CHRISTMAS NUMBER

6d MONTHLY

Television

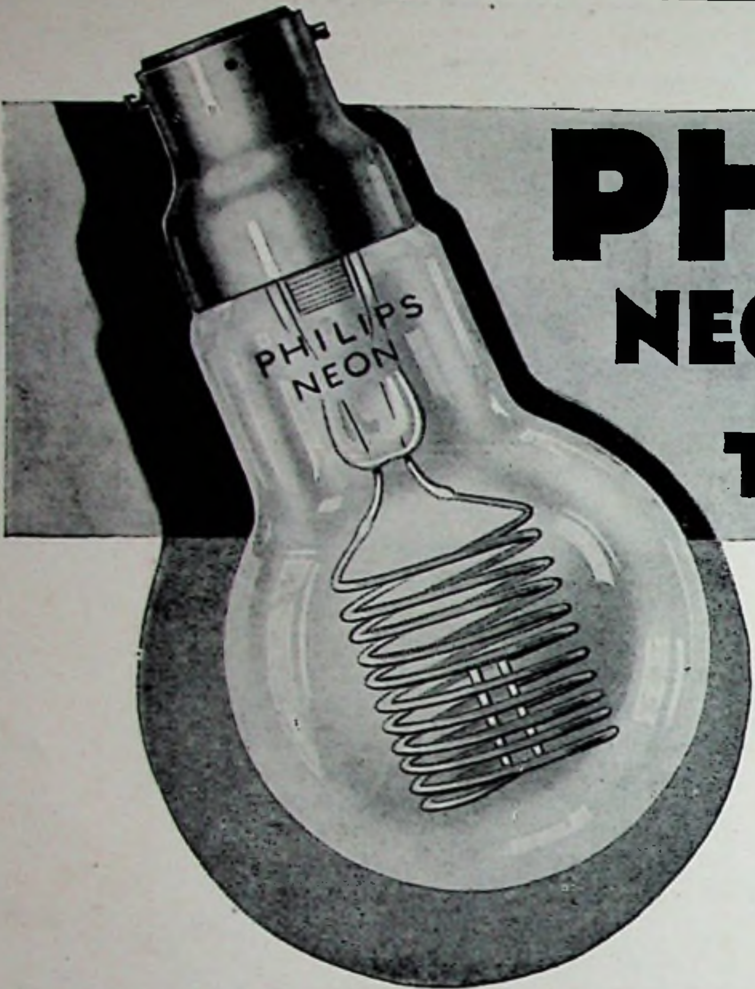
The Official Organ of the Television Society

VOL. 1 DEC. 1928 No. 10

BRITAIN LEADS THE WORLD IN TELEVISION

SUPPORT BRITISH INVENTIONS

THE WORLDS FIRST TELEVISION JOURNAL



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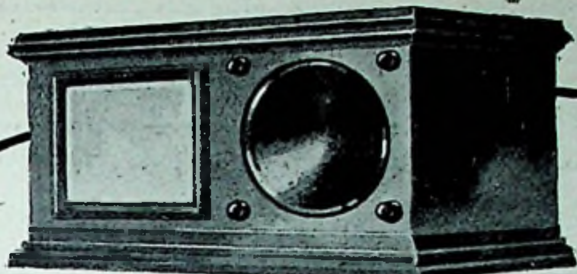

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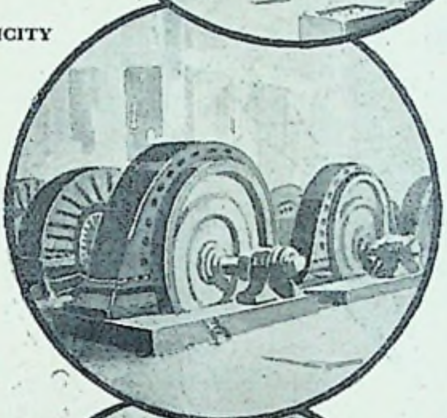

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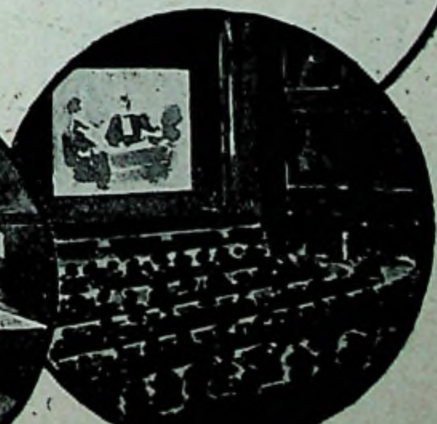

CINEMATOGRAPHY

HAS THE B.B.C. VISION?

Take from my eyes
These shades of doubt.
Of Fulton photos
I will have nowt.
I want to see
Before me spread;
The Empire living—not dead.

"The broadcasting of still pictures will be a hindrance rather than a help to the development of the vastly important subject of Television."

Television

THE WORLD'S FIRST TELEVISION JOURNAL

The Official Organ of The Television Society

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

Consultants: Dr. C. TIERNEY, D.Sc., F.R.M.S.; W. J. JARRARD, B.Sc. (1st Hons. Lond.), A.R.C.S., A.I.C.

Technical Editor: J. C. RENNIE, B.Sc., A.M.I.E.E.

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EDITORIAL

BEFORE proceeding to discuss any other topic, we hasten to take this opportunity, the first we have had since this magazine was founded, of wishing our readers a Right Merry Christmas. At this season of the year it is customary for us to rest upon our oars, perhaps to look back upon the year which is almost ended, survey the events which have happened, and the experiences through which we have passed.

* * *

BUT chiefly it is a season of revelry, and of the various forms of amusement which are open to us wireless broadcasting figures very prominently. We had hoped that this Christmas would have been particularly outstanding in that another amusement would have been added to the list. We refer to "looking-in" combined with "listening-in." How much greater would be the interest attaching to the Christmas revels which we *hear* taking place in the broadcast studios if only we could also *see* them!

* * *

BUT the powers that be have, for the time being, at any rate, decided against the inauguration of this invaluable and inevitable adjunct to broadcasting. We use the word "inevitable" deliberately. We must remember that the B.B.C. have yet to be granted the *right* to broadcast television.

* * *

SUPPORT BRITISH INVENTIONS.

WHICH brings us to a consideration of a most remarkable British trait, which our friends across the Atlantic would call an inferiority complex. Why is it that we, as a nation, refuse to admit and recognise, until too late, that anything good can possibly have its birth and being in this country?

* * *

THERE are those who will immediately protest that our coal is the best in the world, our engineering products are unequalled anywhere,

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and so on. Certainly; our main industries are unexcelled. " British goods are best," says someone else. Certainly; but do *we* buy them?

* * *

HOWEVER, it is not with our established industries that we are concerned here. We are concerned with the attitude of mind which prevents us from recognising, for example, that British opera singers can be as good as their foreign competitors.

* * *

IN our last issue our eminent contributor, Dr. J. A. Fleming, F.R.S., out of his vast fund of experience, gave our readers some instances of the way in which new ideas and inventions are greeted in this country. He related how, when the incandescent electric lamp made its first public appearance at the Crystal Palace in 1882, gas engineers were unanimous in their declaration that it could never by any chance displace gas as a source of domestic light; how the first samples of Bell's speaking telephone were looked upon merely as an " interesting toy."

* * *

ON page 31 of this issue Major Church relates some of the difficulties and obstacles encountered by that great pioneer of electricity, Faraday; how, when he demonstrated experimentally some of the results of his researches, he was asked: " What is the use of it? "

* * *

OTHER more recent examples of pioneers, the value of whose work has gone unrecognised and unrewarded, occur to mind, examples the significance of which is that the exploitation of their work was allowed to fall into foreign hands. There is the case of Prof. W. H. Perkins, of Oxford, whose brilliant research work on dyes was unheeded until the Germans, as a result of it, founded their famous dye industry. There is the case of the Gnome aero engine, the principle of which was invented by two Coventry engineers. This principle was so revolutionary that no British manufacturer would take it up, and it was left to a Frenchman to sell this British invention to British manufacturers.

* * *

THERE is the case of Sir Ronald Ross, whose monumental work led to the discovery of ways and means of exterminating the particular type of mosquito which carries malaria. The only outstanding use made of his discovery was (and is) at Panama, by the Americans. Within the confines of the British Empire there are enormous tracts of land where hundreds of lives are needlessly sacrificed annually, simply because we, as a nation, will not recognise the value of Sir Ronald's work and apply his methods.

* * *

ANOTHER case, which does not apply directly to this country, is that of the cinema industry. The principles of the cinematograph were invented by a Frenchman. France failed to recognise the value of the invention, with the result that America exploited it.

* * *

IN America the boosting of inventions has become a fine art. If the invention in question is not of American origin, that fact is carefully obscured; the main idea is to boost themselves first and then to boost the invention as being of American origin. The distinction between the British and American attitudes is perhaps best typified in the story of the American advertising man who was engaged by a British firm to boost its business. He suggested to the managing director that, as the firm had a commanding site, they should erect on the roof an electric sign measuring thirty feet by one hundred feet, advertising the firm's products. The reply he got was: " But, my dear fellow, don't you think it would be too conspicuous? "

THAT sums up our national attitude. We are afraid of being too conspicuous; which explains to some extent why the fruits of our labours are reaped by foreigners.

* * *

ON other pages in this issue we read what a prominent German scientific journalist thinks of the Baird system of television; also what has already been done in America to put television broadcasting upon a public utility basis with the aid of only *some* of the Baird patents. In certain quarters there is a tendency to laud *any* foreign television inventor who may come along, notwithstanding the value or otherwise of his claims. There is only one television inventor in this country; but does he receive his due measure of recognition in Great Britain? No. We laud every foreigner who follows in his footsteps.

* * *

SIGNS OF THE TIMES.

WE congratulate our contemporary *Amateur Wireless* on its vision in changing its name to *Amateur Wireless and Radiovision*. Another contemporary, *Popular Wireless*, we note, seldom appears without the word " television " on its cover. What does this graceful gesture to the new applied science mean? Just this. **The sale of a television set means the sale of another five-valve wireless receiver.**

* * *

THE best salesman on earth could not persuade you, under existing conditions, to purchase another wireless set in addition to the one you already possess and are satisfied with. British wireless manufacturers and wireless journals are beginning to recognise that the introduction of television broadcasting means the sale of another wireless set to every existing wireless listener. In other words, **television means a new boom to the wireless industry, and the provision of work for some of our unemployed.**

AMOUNT OF THE ETHER REQUIRED BY TELEVISION

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

Last month our contributor devoted his article to an exposition of the principles of image scanning, in the course of which he very thoroughly exploded the "dot theory" of the structure of a television image. Having done that, Dr. Robinson this month has something to say on another bugbear created by misinformed critics, i.e., the width of waveband required to broadcast television. He shows clearly that an ordinary broadcasting station can be used without causing any interference to other stations.

ONE of the most difficult problems in television is in connection with its transmission by wireless. For certain purposes wireless need not be employed, such as, for instance, in the well-advertised case where we expect to use the ordinary telephone and look at the person who is talking at the other end of the telephone line. There are other applications of television which will not involve wireless, but in its most general application it is impossible to dissociate television from wireless.

Everyone thinks at present of the broadcasting of television, and, again, it is desired to have instantaneous views of happenings in other continents, so that we cannot afford to allow television to proceed with the cable and land line as the only means of transmission. Incidentally, the problems of the transmission along cables are not very far removed from those that are present with the wireless transmission.

Ultra-short Wavelengths.

The opponents, or rather, shall we say, critics of television have not failed to indicate the very serious nature of the problems that will arise in wireless as soon as television becomes at all general. It has already been stated by them that for perfect television a single service will absorb so much of the ether that there will be very little space left for other wireless services. Further, it is stated that in consequence of this it will be essential to operate television on the very shortest possible wavelengths, round about ten metres.

Supposing these statements to be correct, television would be restricted very seriously, and the only possible means of wireless communication that would be allowed for such services would be by beams, thus completely eliminating the idea of broadcasting.

In order to investigate these statements it is necessary to have a clear idea of the present-day wireless transmission of a service such as telephony or telegraphy, as regards the amount of ether space taken up. This expression ether space is not a strict definition, but it should convey what is meant.

Wireless communication is effected by wave motion, these waves travelling at the enormous velocity of 30,000,000,000 centimetres or about 186,000 miles per second. The waves can have different wavelengths, ranging from over 20,000 metres or about 11 miles to at present about 10 metres.

We always employ the metric system for these waves in place of the English system of yards and miles.

In place of referring to wavelengths, we may refer to the number of waves that would pass a particular spot in one second, and we have the very simple relation that wavelength × number of waves per second = the velocity of the waves.

Thus a wavelength of 1,000 metres would cause 300,000 waves to pass a certain spot in one second, and we call 300,000 the frequency in this case. Referring to frequencies, the range at present in use is from about 15,000, which corresponds to a wavelength of 20,000 metres, to about 30,000,000, which corresponds to a wavelength of 10 metres. The loose but convenient expression of ether space available means the whole frequency range from 15,000 to 30,000,000.

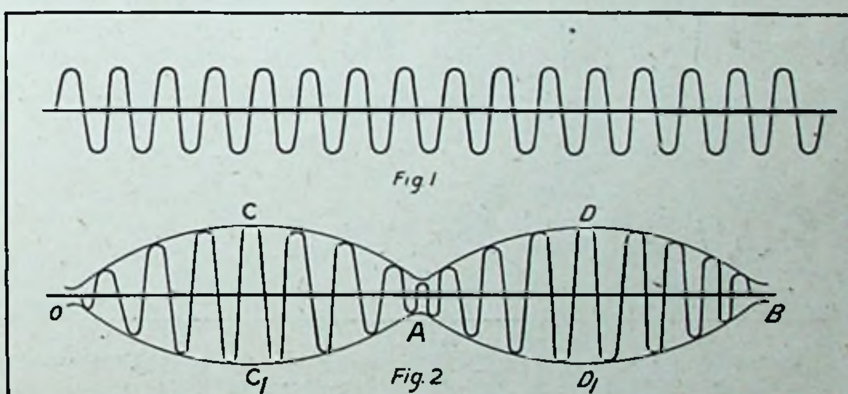


**Fig. 1 indicates a carrier wave, unmodulated, whilst—
Fig. 2 shows the effect of modulation.**

Avoiding Interference.

Obviously we cannot conveniently have two services employing the same frequency unless they are being employed in different parts of the world, for they would interfere with one another, and the term interference is the actual technical term employed in such a case. Thus at present frequencies should be, and in fact are, allocated to various services to avoid as much interference as possible. If it were possible to restrict each service to one definite frequency this problem of allocation would be very simple, but unfortunately as soon as one attempts to use simple waves of this nature in order to convey a signal the simple frequency spreads, and usually does so to both sides.

Thus, instead of simple frequencies we must take into consideration frequency bands. If a simple wave has a frequency of 300,000, as soon as we put a signal, say a Morse signal, on it, there will be other frequencies present, say 300,500 and 299,500, and the number of such frequencies depends on the regularity of the signalling, whilst the range of the frequencies, *i.e.*, the maximum distance in frequency from the original frequency, depends on the speed of signalling.

Modulation.

Other factors enter into this problem, such as the method employed to put the signal on the original wave, which is usually called the carrier wave. The method usually employed in telephony and in television is called an intensity modulation method, where the signal that we wish to convey causes the intensity or amplitude of the carrier wave to change. This whole problem must appear very complex to those who have never before considered it, and in fact it appears almost paradoxical, for all that the signal purports to do is to change the intensity of the carrier wave, there being no deliberate attempt to change the frequency. The frequency changes that are, in fact, produced are, however, unfortunately a necessary accompaniment of this form of signalling, and whenever the intensity of a carrier wave is changed, there is present at least one other frequency in addition to the carrier frequency.

In order to understand how this spread of frequencies arises we shall consider the simplest possible case. Fig. 1 shows a uniform series of waves whose frequency is, say, n per second, and whose amplitude or intensity is constant, these being the carrier waves. Fig. 2 shows these waves modulated, or having the amplitude varied from a maximum at C or D to zero at O, A and B. We shall suppose that the number of times per second that the amplitude goes from a maximum to zero is p. There are many methods of producing a modulation of this type, and all that we have intended to do is to keep the frequency of the carrier waves constant at n, and to vary their amplitude from zero to a maximum p times per second. The result is to produce trains of waves, the first being OCA, the second ADB, and so on.

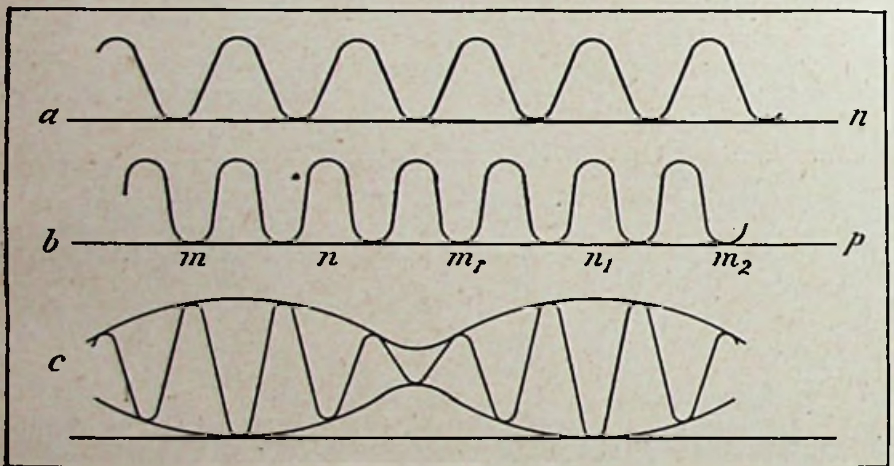


Fig. 3.
Illustrating the heterodyne principle. Two waves (shown at *a* and *b*) of different frequencies combine to form the resultant wave-form shown at *c*.

Wave Relationship.

Looking at Fig. 2 in a different way, it appears as if there are two influences at work, which help each other at C and D, and which are opposing each other at O, A and B. Two such influences are two series of waves which sometimes help each other and sometimes oppose each other.

One way in which we can have two such series of waves to do this is for these series to be of different frequency and each series to have the same and constant amplitude. When we have two such series of waves they will sometimes be in step and sometimes out of step with each other. When they are in step they will help each other, and when out of step oppose each other. Fig. 3 shows two series of waves of frequency n and p at a and b, and the combination at c. They are in step about the points m, m_1, and m_2, and out of step about n, n_1, . . . , giving the maxima and minima of the combined wave at c.

Reference to the mathematical treatment of this subject will explain this principle completely. The waves in Fig. 1 are represented by the curve $y=a \sin nt$. We apply to these waves a regular variation of amplitude of the form $b \sin pt$ where p is a lower frequency than n. Thus the final result is

$$Y=ab \sin pt \sin nt,$$

which can be transformed into

$$Y=\frac{ab}{2}[\cos(p-n)t-\cos(p+n)t].$$

The two frequencies are thus

$(p+n)$ and $(p-n)$,

i.e., our original carrier frequency n which is modulated by a lower frequency p results in the presence of two frequencies

$n+p$ and $n-p$.

Usually the frequency n itself is also present, for the type of modulation given here is a complete modulation, whereas in practice for telephony this is seldom achieved, and we have partial modulation leaving three frequencies present, the original frequency n, with $n+p$ and $n-p$.

Different Frequencies.

This is no mathematical abstraction, but these waves really have an objective existence, and in fact in ordinary wireless telephony all receivers depend on their existence to receive the signals.

The example given here corresponds to the old tuning note of the B.B.C. stations, the transmission by wireless of a single note. If we take this note to have a frequency of 500, and if the carrier waves have a frequency of 800,000, we have present three different frequencies, viz., 799,500, 800,000, and 800,500.

Frequency Band.

Suppose now that many notes of different frequencies are being transmitted simultaneously in the form of speech or music. We shall then have the mean carrier frequency present of 800,000, and a number of frequencies greater than this by the acoustical frequencies present, *i.e.*, if the upper limit of these latter frequencies is 10,000 we shall have this range of frequencies from 800,000 to 810,000. In addition, we shall have a similar range on the lower side of 800,000, *i.e.*, from 790,000 to 800,000. Thus we have a band of frequencies from 790,000 to 810,000 required for ordinary telephony transmission, *i.e.*, a telephony service requires a frequency band of about 20,000 cycles.

This wide range of frequencies required for telephony means that in order to avoid mutual interference the frequencies allocated to the various telephony services should be at least 20,000 cycles apart. In fact, with the receivers in use at present, it is wiser to have stations more than 20,000 cycles apart, as a receiver for telephony should be capable of receiving the whole of the 20,000 cycles frequency range uniformly in order to avoid distortion, and thus present-day receivers are arranged to receive a much wider range of frequencies than 20,000.

When we come to consider television it has been stated by critics that the frequency band required will be of the order of 3,000,000 or 4,000,000, thus requiring a range as great as 150 telephony services. This estimate would naturally make television impossible, and we must examine it in some detail.

Requirements of Television.

Referring back to my article on Scanning, a criticism was reproduced where it was stated that for perfect television it would be necessary to divide a picture of 1 square foot into about 250,000 dots, and to transmit the equivalent electrical effect obtained from the light effect of each dot 16 times per second, thus requiring 4,000,000 signals per second. Then the assumption was made that this signalling speed is equal to one side band of the frequency bands, and that our total frequency bands would thus be

Dr. J. ROBINSON.

8,000,000 on the ordinary method of transmission. However, it was granted that we might employ what is called single side band transmission and thus still require a frequency band of 4,000,000.

In the article referred to I showed that this was far too high an estimate and that we should probably require only something of the order of 160,000 signals per second for satisfactory television even on the "dot" method of considering the subject. However it is essential to examine the assumption made in this criticism that the width of a frequency side band is equal to the number of dots on a picture multiplied by the number of times per second that the picture is scanned, *i.e.*, 16. We shall soon discover the fallacy in this assumption, and in doing so we shall be able to keep our minds on the practical methods of television.

In practice there is in fact no simple relation between these two factors, and the calculation of the width of the frequency band either on the "dot" conception or on the practical strip conception is not easy. Suppose, however, that we could have the picture divided into dots, say 250,000, and that it were possible to employ the jerky motion, equivalent to the gate motion of the cinematograph, where one dot is viewed completely, then the light is extinguished or shaded till the next dot were in view. In such a case, "*if the dots were all of the same intensity*," we should have a signalling speed equivalent to 4,000,000 signals per second, and there would be present two frequencies differing by 4,000,000 from that of the carrier frequency.

In fact, if such a movement were possible at all, it would most probably be irregular, and we should have many more frequencies also present, some of them probably differing by more than 4,000,000 from the carrier frequency. Such movement is, of course, impracticable, and if we transfer the conditions to the real case, instead of having a number of dots of constant intensity, we shall have a number of strips of constant intensity to be scanned by a slit.

Suppose now that the slit were of very small dimensions we should have merely one continuous unchanging effect throughout the whole of one strip, and in fact throughout the whole of a picture. Thus no extra frequency will be introduced at all, and we shall have merely one frequency transmitted. Owing, however, to the fact that the slit must have finite dimensions, we shall have end conditions at the beginning and end of each strip, these conditions depending on the size and shape of the slit. Reference to my earlier article on Scanning will explain this.

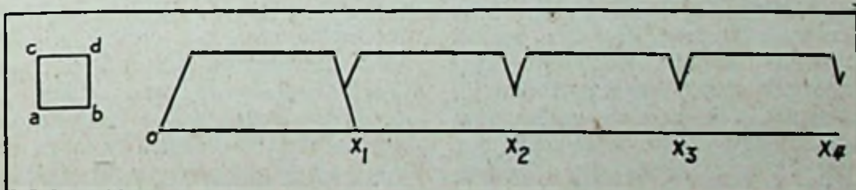


Fig. 4.
Showing the sort of modulation record given by a slit of finite dimensions.

DR. ROBINSON, by means of the hypothetical examples which he works out here, shows clearly that adverse critics of television have been working on false premises when they calculated the figures of the stupendous and impossible frequencies which they alleged would have to be broadcast in order to transmit television by wireless.

In place of a continuous record we shall have a record as shown in Fig. 4, with small dips at the end of each strip. If there are 50 strips we should then have extra frequencies introduced, these being very difficult to calculate, as they depend on the size and shape of the slit. However, we are fairly safe in stating that such frequencies will be of the order of the carrier frequency plus about 50, and minus about 50.

Frequency Band Much Narrower.

Thus in a case of this type the frequency band, or the amount of the ether required, is very much smaller than that calculated on the dot method and assumption referred to above.

Let us examine another case as shown in Fig. 5, where the light is distributed in the original scene along one strip, as shown at $Y_1Y_2Y_3$ . . . *i.e.,* in step formation, the intensity increasing by the same amount after the same distance, this distance being the width of the slit. Without going into detail, we know from my former article on Scanning that the reproduction in this case is in the form of two straight lines OH_5 and H_5Q. Suppose that the time required for the slit to pass across one step Y_2Y_3 is one hundredth thousandth of a second we ought to obtain extra frequencies differing by 100,000 from the carrier frequency, but in fact whilst this ought to happen we have the light effect in our reproduction rising continuously to a maximum. Thus the extra frequencies introduced will not differ by so much as 100,000 from the carrier frequency, and in fact in this case they will be much smaller.

Essential Data.

Further examples could be worked out, although it is impossible to calculate generally what the frequency bands would be. Sufficient examples have, however, been given to show that it is unwise to equate the number of dots multiplied by 16 to the resulting frequency bands. In fact, it is unwise to do so if we assume that a "dot" is equal to the area of the scene viewed by the slit when it is at rest.

In the examples given the actual frequency bands obtained are smaller and, in fact, much smaller than those given by such calculations. We again have the result that the necessity of having slits of finite dimensions tends to introduce a rounding off effect of irregularities and thus to keep down the width of the frequency bands.

It is very essential to have as much information as possible about this aspect of the subject. At the present moment it is not possible to do more than estimate the width of these frequency bands, but for the case corresponding to about 1,000 strips per second a fair estimate should be 100,000 cycles.

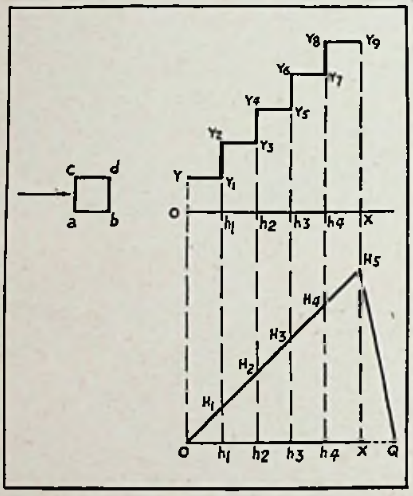


Fig. 5.
Illustrating how the passage of the slit across the image builds up the light intensity in steps.

At the present time it is not proposed to transmit scenes which will demand anything like this magnitude of frequency band. I have not heard of any measurements of this nature of the Baird transmissions, but it is very necessary to have them on record as early as possible. Then there should be some data on which to base calculations, and it cannot be too strongly emphasised that with the present transmission methods in wireless the controlling factor of the advancement of television is the width of frequency band that is required. In fact, whenever a new service of television is allowed, it will be given on the definite understanding that the frequency band allocated must not be exceeded. Thus here we have a field of work which is of the utmost importance, as it bears on the relation of television to other wireless services.

We have discussed here, in fact, the most serious criticism that television has to face, and I think it has been shown that although the magnitude of the frequency bands required for television is fairly large, by keeping our minds to the practical method of considering the subject, we need not contemplate having to require a side band of more than 100,000 cycles for very satisfactory television, and this would allow us to have the whole of a theatrical performance, and scenes of similar magnitude transmitted.

Such a frequency band would be equal to that of five telephony services, and thus the criticism that no room would be left for other services was far too severe in nature.

One other aspect of this subject needs some consideration and that is how the width of these frequency bands influences the actual carrier wave frequency or wavelength. Had we to consider side bands of the order of 3,000,000 it is impossible to conceive however this would be possible for wavelengths longer than 100 metres, for the actual frequency corresponding to a wavelength of 100 metres is 3,000,000 and the frequency bands required in such a case would be from 6,000,000 to zero, *i.e.,* from 50 metres to a wavelength infinitely long. In order to receive such a service we should need a receiver capable of receiving all wavelengths equally from 50 metres upwards to infinity, which is very impracticable.

However, with a frequency band of 100,000 the problem is not so difficult, for if our carrier frequency were 3,000,000 the frequency band would extend from 3,100,000 to 2,900,000, which corresponds to a wavelength range from 96·8 to 103·4 metres, which is quite practicable.

At the present moment television of comparatively small scenes requires a frequency band much smaller than that for telephony, so that any ordinary wavelength that can be used for telephony will suffice for television.

Sydney A. Moseley on the B.B.C. Decision—and after

I BEGAN this article in a highly militant mood; but I prefer to be philosophical. . . . Far better, thinks I, let public opinion speak for itself. For me, let me confess a feeling—temporary, at any rate—of absolute incredibility at the B.B.C. decision. Whatever are they thinking about ? Here is an opportunity to let *the public* support their view that television has "not yet reached a practical stage." Obviously, if you shut down on it in this fashion you are going to create sympathy for the British inventor and suspicion that the B.B.C. has something to hide. **There is no surer way of helping a cause than in giving the impression that it has not had a fair hearing.**

For consider the circumstances. The Post Office send engineers to enquire into this thing called television. They send two of their best men—men who had either never before seen television, and therefore come with an open mind, or, at any rate, *men who have not previously committed themselves by a publicly expressed view* on television. They come to Long Acre, witness a demonstration by land wire, and then ask, and are given, a protracted demonstration of television by wireless at a West End club. On this strictly impartial test they report favourably to the Government through the Post Office. They think television should be encouraged and helped.

Now follow the next step. For what seemed to be purely formal reasons, and because the B.B.C. happen to be in possession of the necessary stations, the Post Office suggest that it would be "reasonable" to give the B.B.C. engineers a test. Now *was* this a reasonable request ? Would the Post Office have considered it so had it been in possession of the publicly expressed views of the Chief Engineer of the B.B.C. on the principle of practical television ?

Captain Eckersley had repeatedly expressed himself in rather cynical terms on this new wireless development. For instance, I wrote an article for *Popular Wireless*, which appeared in the issue of Sept. 22nd of this year, simply giving the layman's account of what television was like. In order to counter this, Captain Eckersley was commissioned to write a full-dress article, which showed how definite and uncompromising his attitude was. Thus he writes :

> "Incidentally we do not feel that our talks will be much enhanced by a few people having a distant peep at the moving lips,"—

and he goes on with what I think is rather cheap wit :

> "As the television science develops, however, we may be given people in instalments ; or the more famous beauties may lease their legs for the modern and scientific Peeping Tom."

Most amusing, no doubt, but unfortunately a hard-working British scientist and many thousands of shareholders may regard it as lacking in dignity from one who holds an official position on a public body that is to sit in impartial judgment on television.

If any further evidence is required of the chief engineer's hostility to a science in which, apparently, he had been left far behind, this could be seen by the quotation he gives at the beginning of his article, which is too long to repeat here. Nevertheless—and here again I am trying to maintain a restrained mood—he permits himself to head the deputation which is sent *officially* from Savoy Hill to decide a matter of vital import. You would think that decency, at any rate, would have suggested to him the advisability of staying away and leaving the matter to less prejudiced minds. **I was myself present at the demonstration, and, knowing one or two of the B.B.C. representatives, televised myself and was recognised. It was a perfectly satisfactory test.**

Let me say here that the *communiqué* of the B.B.C. rather mystified some people and misled others. It spoke of "conditions," and I have been asked what these conditions were. The fact is, however, *that no conditions at all were laid down,* although it was understood that, since this was a private demonstration, no communication to the press should be made unless both sides agreed. This, by the by, was not done, and one wonders even to-day where was the urgent necessity to rush the damaging statement to the press before exercising the usual courtesy of communicating their views to the Baird Company.

I am a man of peace, and my intention has been all through to bring about a peaceful atmosphere and a fair working arrangement between the two parties, but, strive as I will, I cannot get rid of an impression in my mind that the earlier sponsorship of wireless pictures had created a difficult position. The B.B.C. had, wrongly in my opinion, permitted its name to appear in the prospectus of Wireless Pictures, which made an issue to the public early in the year. I should not be surprised that this matter will be gone into ere this appears in print, but surely some explanation must be given why this was permitted, for, obviously, having done so, and having, in fact, given what is tantamount to its beneficent blessing to the public flotation, it was necessary to see the thing through. **Had the B.B.C. accepted television, what would have become of wireless pictures ?**

I am imputing no ulterior motive, but as an official concern the B.B.C. committed itself to a dangerous precedent in permitting its name to be used in a public prospectus.

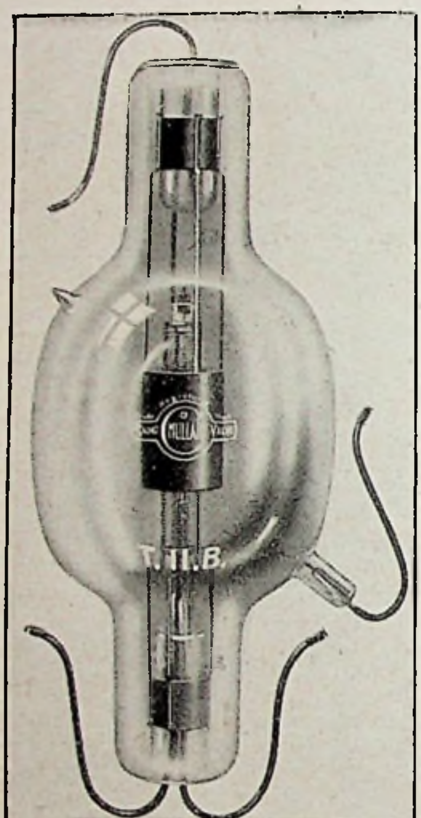
Now why is it that I read of the B.B.C. decision with incredulity ? Simply because everybody I spoke to, inside and outside the B.B.C., agreed that it was only logical and fair that **similar facilities that had been granted to the invention of Mr. Otho Fulton should have been given to the young Scottish inventor, Mr. John Baird,** who had fought to maintain the British lead in this science—single-handed until the last year or so.

If, I repeat, it was the B.B.C.'s sincere view that television was not what it was made out to be, Mr. Baird's pretensions would have been exploded once and for all within a fortnight of the experimental transmissions. There would have been a sufficient number of independent amateurs who would have purchased or made their own sets to have judged this matter on behalf of the public. As it is, by its decision, the B.B.C. has created dismay and mistrust all over the country. Newspapers that had not hitherto been friendly towards Mr. Baird have rallied to his support ; **critics who remained sceptical until they were given demonstrations, are all asking on what grounds the B.B.C. have prevented the world of amateurs from engaging upon this interesting new field.**

As *Amateur Wireless* puts it :

"We say most definitely that the Baird System does justify a broadcast trial."

This technical newspaper, in common with its contemporaries, has



A Mullard 1 kw. modulating valve, referred to on another page.

always adopted a cautious and independent attitude, but it appears to be as flabbergasted as I was at the decision.

"While we quite appreciate that the B.B.C. could see room for improvement in the results which Mr. Baird could show them," says the Editor, "we certainly are of the opinion that they would have done well in the public interest to have made an experimental attempt to broadcast televised images," and he goes on to say : "Nobody is likely to be convinced that the Baird system does not justify broadcast trial. We can go so far as to say definitely that it does justify such trial, and in taking up this attitude we do not pretend the Baird system is perfect. How could it be, with just four or five years of experiment behind it ? But the assistance of the B.B.C. at this juncture would have enormous value in giving it an opportunity of development, and we sincerely hope that the B.B.C. will very shortly change its mind on the matter. We do not ask it to change its opinion as to what Baird has accomplished. All we ask is that it should satisfy itself by a real trial on its own monopoly apparatus, built at public cost, whether there is sufficient in the Baird system to warrant a public broadcast."

That sums up my view, and I maintain that it is a fair exposition of the situation.

This plea is echoed by another important technical newspaper, *Wireless World*, which declares that "Quite a good case has been created for the shareholders of the (Baird) Company to feel that they have a legitimate complaint against the authorities. *Is there not some way in which a compromise could be arranged ?*" Then the editor goes on to suggest an interesting way out through the use of the Marconi House Stand-by Station.

Other newspapers, including the lay press, are similarly sympathetic. To quote them all would take too much space, but I cannot help again referring to the *Morning Post*, which was the first newspaper to publish the news that no objection to broadcasting television had been made by the Postmaster-General ! The *Morning Post* sent not only its Special Representative, but later on its Wireless Expert, Mr. W. James. Says the latter :

> "I feel that the B.B.C. might at least have begun experiments at one of their stations, and might have invited the co-operation of amateurs. Looking back, one remembers, at the beginning of broadcasting, how crude were some of the early transmissions. Yet at that time they were acceptable. There was nothing better to be obtained, and we were satisfied (according to present-day standards) with distorted speech and music. One cannot help wondering whether the B.B.C. have considered the subject of television in a very sympathetic manner."

I think this expresses the views of a good many other experts with whom I have discussed the matter. Let me say here that every newspaper correspondent who was given a demonstration—*Daily Express, Daily Chronicle, Daily Mail*, etc.—wrote of the clear images they had seen. The *Daily Mail* correspondent was able to read the title of his newspaper through the televisor.

Altogether, then, the B.B.C. has created an atmosphere which I very much regret. The Governors cannot have anticipated this, but the effect of broadcasting this adverse decision on the British system has helped the foreign inventors, who certainly until then bore the British Broadcasting Corporation no particular goodwill. Now they are jubilant.

I ought to say when I spoke of the Press as being without exception sympathetic, that there is one exception, and that is *Popular Wireless*, which has been unfriendly to Mr. Baird, for reasons best known to itself, for some considerable time. In my last article I stated that I had hoped to arrange for the Editor to see a demonstration, so that he should be able to know exactly what he was writing about. His somewhat foolish attitude, however, made this concession rather difficult. Obviously you cannot expect one to invite a rude stranger to one's home, so that *Popular Wireless* **remains in the strange position of being the only critic of Mr. Baird, and the only newspaper which actually has not seen a demonstration.** Possibly this is a new form of journalism with which I am not very familiar. Probably, too, that is what Mr. Edwardes would call "modern journalism."

I have maintained all along that the critics of television were those who had not seen its recent developments; and I have already given several instances where technical writers altered their views—and said so in print—after being shown recent developments. I now give the latest striking instance of a critic who passed on adverse comments heard from the other side, but turned round completely after *seeing* television. I refer to my colleague A. G. Walsh, of *Britannia*. Mr. Walsh, in his capacity of City Editor, slashed out rather unmercifully on television, having heard (obviously from a tainted source) that the recent B.B.C. demonstration was a "wash-out."

I wrote rather strongly to Gilbert Frankau about the matter, and after having a chat with him and Mr. Walsh, the latter—as the critic concerned—came along to Long Acre and saw for himself what television really was. It was a pretty thorough demonstration he had—right through lunch-time! And this is what he writes:

"The demonstration took place at the Company's headquarters. The images of various people, including a colleague who accompanied me, were transmitted from one point of the building to another. *The transmission, I frankly admit, was good, the features of the subjects being clearly distinguishable.*"

Pretty frank, and does credit both to him and to *Britannia*. His views about the shares do not concern me. Time will prove the correctness or otherwise of this attitude.

The chief thing is this: Is television practicable? He answers in chorus with all who have seen it—IT IS!

You see, then, that I have written more in sorrow than in anger. No one was more intensely anxious than I for co-operation with the B.B.C., and nobody worked harder for it. Still I am convinced that matters will adjust themselves. Nothing can stop the progress of television, phonovision, and noctovision. Mr. Baird, with whom I have remained in touch, comes out with some fresh development every day. There are indeed sufficient wonders-in-the-making to employ a whole army of technicians! Yet, handicapped as he has been, he has beaten the world in the race for perfect television. Under the eye of zealous and jealous emissaries from abroad, the work to maintain the British lead goes on.

You would have thought, would you not, in a matter of this sort, that the last body in the world to impede him would be *British*?

In the last issue of TELEVISION it was announced that television would be broadcast. Well, it will be—SOON!

TELEVISION HAS DONE ALL THIS—

Points out William J. Brittain

DO the public know—do the hermits, or the blind-man-bluffers, of the B.B.C. know—what television has done already?

Of course they have heard that a face has been flashed by Baird from London to Glasgow, from London to New York, from London to a liner in mid-Atlantic.

They have heard of noctovision, colour television, daylight television—these things are taken for granted.

I suppose they have read of a play being broadcast by television. Not quite so much as it sounds, and a separate transmitting apparatus was necessary before each player, but it points the way to television entertainment.

Did they hear the wireless announcer say that the Graf Zeppelin carried television apparatus? (I wonder, by the way, whether R100, the British airship, will?)

Television to and from the air is usual now. The other day a Ford—a tri-motored aeroplane, not a Tin Lizzie—carried a merrily-working television apparatus 3,000 feet above Chicago.

I'm sorry I was not in at the world's first television wedding, with the couple before a transmitter and the clergyman 25 miles away. I have been looking for a long time for such a bright entrance into married bliss. Now I shall have to remain single a little longer.

You might say that was a pleasant prospect with "Television Queens" now appearing. One of these new branches of royalty was chosen at the end of the Chicago radio show. She is Miss Louise Wallis, and has dark brown hair, a pretty smile, and a clear pleasing voice.

While I am being frivolous can't you see the serious point? *America is choosing television actresses, while we...*

The enterprising proprietor of the new Hotel Carteret, New York, proposes to place a television receiver in every room. He is now in negotiation with the Baird Company.

Doesn't all this show you that television is alive, and doing things?

I am warned that any day now a message will be coming to me: "Please come to see Mr. Baird's latest development."

Then I shall be able to cross one more item from my list, "Television promises," and add one more item to my list, "Television—things done."

IMPRESSIONS AND OPINIONS OF A LAYMAN

By A. W. SANDERS

I'VE seen television; I've not only seen the living picture of a man on the screen of a televisor, but I've realised, with some effort, that this man was sitting about a mile away from me; that between him and myself there were many houses, trees, moving vehicles, etc., etc. This may sound funny, but it isn't; first because it is true, and second because I had to think of these things before I could grasp the meaning of television.

During the demonstration near Olympia I was interested, and naturally concentrated on what I saw on the screen; but unconsciously—I only know it now—I compared the televised image with a cinematographic picture, so that when I left the building I felt curiously dissatisfied and puzzled. In fact I felt quite angry with myself for not having that exhilarating feeling of having witnessed something absolutely marvellous. I looked at the others who had also been privileged to see the demonstration. I heard what they said and they all gave me the same impression. This unconscious comparison between early television and full-grown cinematograph cannot but do a lot of harm.

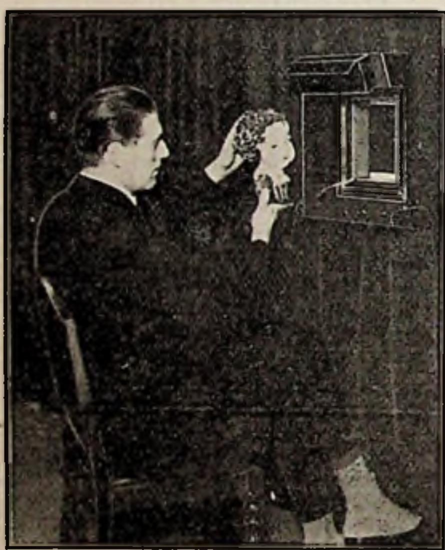
Having once realised all the objects that divided the televised person and myself, having impressed upon my unbelieving mind that my eye could not see him in the ordinary way, that I could not touch him, I began to wonder at it all, and I wanted to know all about it. So I bought a book on the subject and read about the selenium cell, the scanning of the picture, the optical lever, the synchronisation and phasing; and the more I read the more the comparative simplicity of the whole thing struck me.

My interest in television is not that of the experimenter, but solely that of the man in the street who sees in it something that will greatly enhance the joy of life, that will make all sorts of hitherto impossible things possible.

As a result two questions arise:—

1. How does this new invention affect me now?
2. What of the future?

It is clear that broadcasting of television from some station that I can pick up with my set is essential; but if that happened to-morrow I am quite sure that even in this stage of development it would give me distinct enjoyment; to see *and* hear Harry Lauder televised must be very much more fun than only to listen to him. Were it possible to get Chaliapin televised while singing his famous Song of the Flea (see him raise his eyebrows!), nobody who had the opportunity would miss it.



THE EDUCATIONAL VALUE OF TELEVISION.

Our illustration shows Mr. G. Holme, Editor of the "Studio," delivering a broadcast lecture on art pottery. By means of television he is able to illustrate his points in a thoroughly convincing manner.

These are not the only practical uses to which this invention can be put immediately. Dr. J. A. Fleming writes that television, even as it is at present, could give a lesson on lip-reading. A lesson on foreign languages would be of much more educational value televised and sound-broadcast (because the synchronisation is perfect) than broadcast simply as at present.

There are, no doubt, a great many more uses to which television can be put in its present stage, even when leaving the commercial application, such as advertising, wholly alone. When, however, the screen is made appreciably bigger the amusement and commercial application will be limitless.

Now that it is possible to "see in" the question of price becomes important. Compared with the prices asked for the first wireless sets, television sets are cheap; and the one which will be the most sought after will be Model B, priced £40, because it gives both speech and sight, has a moving-coil loud-speaker, and can be attached to two ordinary wireless sets capable of giving good loud-speaker results.

There is one point which, I have no doubt, has irritated prospective buyers of wireless sets as much as it has me. I mean that prices quoted for sets, till recently, never included valves, batteries, royalties, or other essential items, and these were not even priced. At the last exhibition this was corrected by quite a number of firms.

The televisors A and B require a voltage of 350, but the price of the required transformer is not quoted. I quite understand that this price varies considerably according to the supply current, while, I imagine, the full manufacturing problem of the televisors is not yet fixed. This question of all-in price therefore cannot yet be settled, it seems; but when once a bid is made for the greatest possible demand I do hope that the above remarks will be borne in mind.

How long it will be before I can enjoy both speech and vision by wireless I do not know. How long it will be before television will be perfected is equally unknown to me, but one thing I do know: THE SOONER TELEVISION IS BROADCAST THE BETTER.

Neon Lamps and the Last Stage of L.F. Amplification

By W. G. W. MITCHELL, B.Sc., & C. H. WESTCOTT

LOCAL SECRETARIES—KINDLY NOTE:

The following is an account of some experimental investigations with neon lamps, with suggestions for further work along these lines, the apparatus required being simple and the work eminently suitable for local branches of the Television Society.

As is well known, the image seen on the screen of the televisor in the Baird system is reconstituted by successively viewing small areas of a glow discharge lamp of the neon type. At any instant the incoming television signal is made to vary the degree of intensity of the neon glow, and in building up the picture the intensity and the spatial relations have to be in register, so that the correct elemental area and the correct intensity are viewed.

Attempt to reduce High Voltages.

It should be explained that the notes which follow were really part of a wider investigation concerned with an attempt to reduce the high voltages which have been found necessary in television work. The experiments were also carried out some months ago before the new Pentode valves were available.

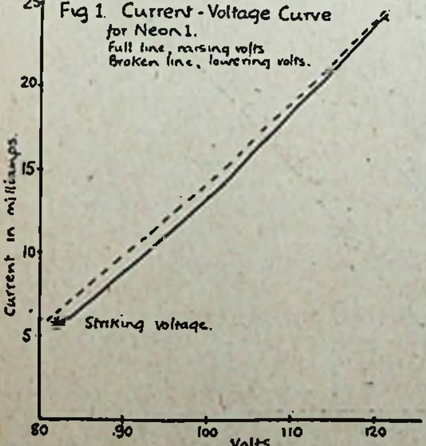
In this survey of the properties of the light source which has to be controlled the following lamps, all of commercial type, were tested :—

(1) A Philips' 110-volt neon with similar electrodes, referred to as Neon 1.

(2) A Philips' 240-volt, frosted glass type similar to (1), and referred to below as Neon 2.

(3) An "Osglim" 240-volt "Beehive" type, referred to as Neon 3.

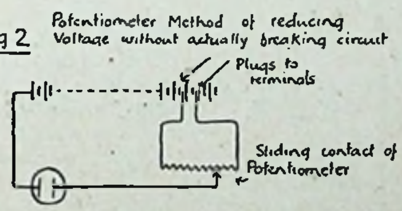
(4) A similar "Osglim" lamp with the series resistance (which will be found inside the cap) removed. This is referred to as Neon 4.



Characteristic Curve.

The current-voltage characteristic of a typical neon lamp (in this case Neon 1) is given in Fig. 1. It will be seen that no current flows until the voltage across the lamp reaches a

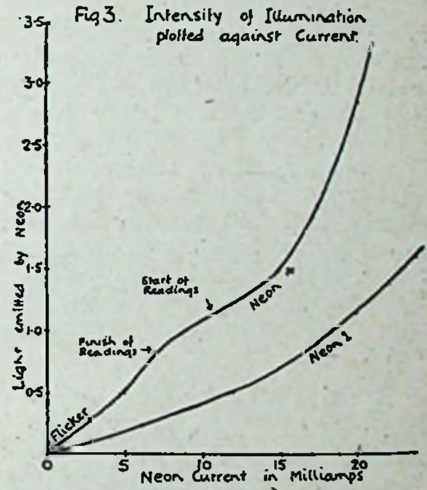
Fig 2



certain critical value (about 82 volts in this case), known as the striking or breakdown voltage. From this point onwards the current increases linearly with respect to the voltage. The current passing through the lamp for any particular voltage in excess of the "striking voltage" depends somewhat upon whether the voltage is being increased or decreased at that point, but the values are sufficiently close to warrant our taking them as single values for our present purpose.

How Curves are Compiled.

The curves of Fig. 1 were compiled by plotting the current in milliamps against potential difference across the terminals of the neon lamp. Wet H.T. batteries of the "sac Leclanché" type were used throughout, but owing to polarisation results cannot be considered as good. Neon 3 was only used off the mains (240 volt D.C.) as a standard, and was not tested. Neon 4 was found unstable in operation. Its striking point current was about 50 milliamps and the volts had to be dropped by the potentiometer method of Fig. 2. No current voltage curve was obtained for Neon 4 but its impedance (i.e., small increase in potential divided by small increase in current) was found by actual experiment to be about 10^3 ohms. Neon 2 had much too high an impedance (about 5×10^3 ohms) and was not used further. The impedance of Neon 1 was approximately 2×10^3 ohms.



Grease Spot Photometer Method.

We next had to consider whether the current passing through the neon lamps truly represented light intensity values. This is shown in Fig. 3, where the light emitted by the neon

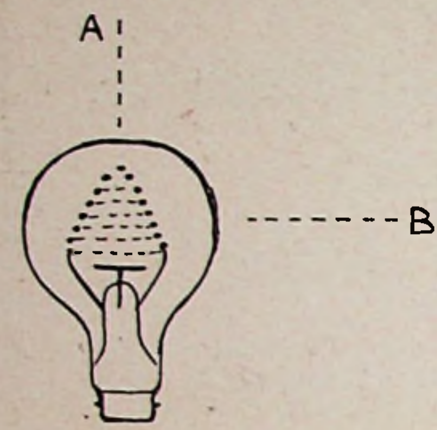


Fig. 4.

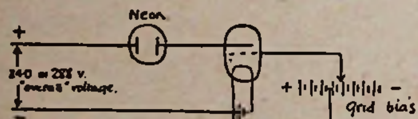
is plotted against current passed in milliamps. Here the simplest plan seemed to be that of using the grease spot photometer method, which is explained in any standard text-book of physics, and to overcome colour difference Neon 3 was used as standard. Even then these measurements are perhaps at the best only rough, but care was taken to see that Neon 3 and Neon 4 were always used with the glow on the grid or meshwork.

Position of Maximum Light.

We found that most light was obtained by viewing from a point diametrically opposite to the cap (*A*) in Fig 4, and we estimate that about 40 per cent. better light is obtained from this angle of viewing than from *B*. At low current values the light flickers to the eye, but photometrically it is fairly constant and does not give trouble in this respect.

In Fig. 3 the light scale is the vertical axis of the graph. Thus light equals 1, means that the neon under

Fig 5. Circuit diagram for Valve amplification.

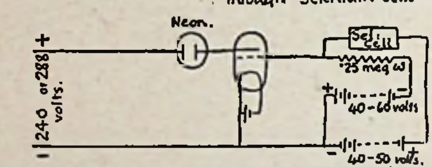


test gave the same amount of light as the standard neon when both were viewed from position *A*. The peculiar behaviour of Neon 4 for values round about 10 milliamps may probably be accounted for by remembering that the readings were started at about this value. Apart from this peculiarity, however, Neon 4 shows much better quantitative light intensity results than Neon 1 over the given range of current.

The neon lamps were then tested in the plate circuit of a "six-sixty" type 610 P valve. The diagram of connections is shown in Fig. 5. The incoming signal was applied to the valve as a grid swing, using positive and negative grid biasing (wet H.T.) batteries. The results are given in Fig. 6, where the independent variable "grid volts" represents input, and output is measured either by milliamps through the neon or, as in Fig. 7, by actual light emitted. Curves for Neons 1 and 4 are shown, and it is clear that additional overall voltage merely displaces the whole curve to the left, and further that Neon 4 needed much greater voltage than Neon 1.

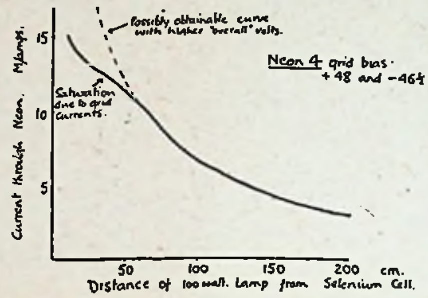
Actually positive grid bias is impossible on account of grid currents, so that much higher overall voltages are necessary. Given these higher

Fig 8. Circuit Diagram. Signal applied through Selenium Cell.



voltages, the slope of Neon 4 curves, particularly the light curve, which is what is really used in television work, is much more satisfactory than those shown for Neon 1, i.e., the curve is steeper and therefore represents a wider light response for a given change of television signal.

Fig. 9



Effect of Impedance.

Used in the plate circuit of a valve, impedance has the effect of reducing the filament-plate difference of potential when the emission and consequently the neon current increases, this decrease in potential tending to reduce the current further. From theoretical considerations of the graphs supplied by the makers, we found that for a valve having voltage amplification factor μ, an impedance R ohms, and an external impedance N due to a neon lamp, the value $\frac{\mu}{R+N}$ should be as large as possible, consistent with a suitable maximum emission. Also, as the filament-anode P.D. varies, this maximum emission must be obtainable with negative or

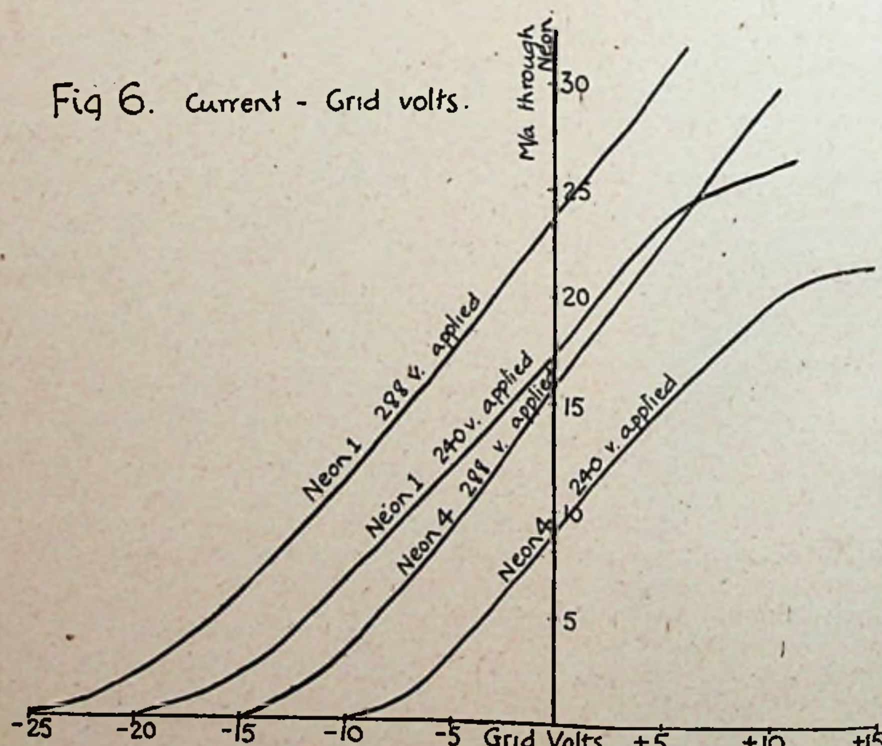
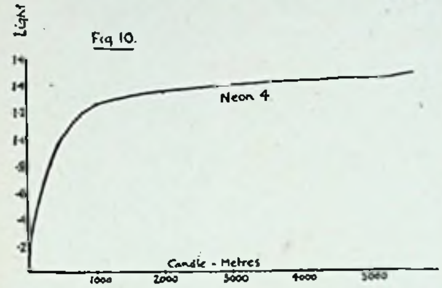


Fig 6. Current - Grid volts.

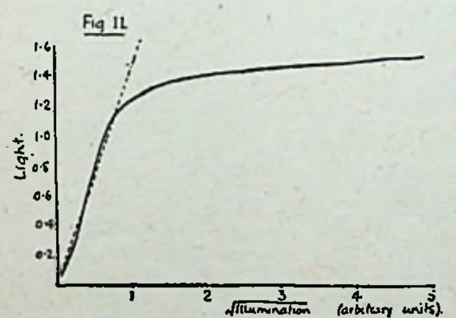
zero grid volts so as not to encounter grid currents, and without unnecessarily exceeding the maximum voltage allowable on the anode of the valve. We chose a "six-sixty" type 610 P valve for these experiments, disregarding the makers' maximum anode voltage of 100 volts, and applied voltages up to 288, of which from 100—150 volts were distributed across the neon lamp. Here $\mu=7{\cdot}2$



and R=6000 ohms. As we have already seen, Neon 4 has the lower impedance and gives a better slope as shown by the formula. In addition, the light slope curve for Neon 4 is better than Neon 1 (Fig. 3), so that Neon 4 gave best results in all respects but one—namely, it required a very high overall plate-neon voltage. Neon 1 required about 50 volts less for similar but less suitable results.

Tests with Selenium Cells.

Further, we then made up the circuit shown in Fig. 8, where the grid swing is produced by the current changes flowing through a selenium cell. Illumination of the cell was



obtained from an ordinary 100-watt gas-filled lamp. In Fig. 9 the distance of the light source in cm. is plotted against neon current in milliamps by first arranging the grid batteries so that the neon lamp nearly went out when the selenium cell was put in the dark.

We then combined several results to produce the curve of Fig. 10, showing intensity of the light source in candle metres falling on the selenium cell, plotted against light emitted by the neon. The curve is that obtained by using Neon 4 with 240 volts overall, the grid biases

W. G. W. Mitchell, B.Sc., the author of this highly interesting article. Mr. Mitchell is a member of the Council of the Television Society, and has just accepted the Joint Hon. Secretaryship of the Society. In this latter capacity Mr. Mitchell will deal with all questions appertaining to lectures.

being +48 and $-46\frac{1}{2}$ volts respectively. Had more overall volts been used the resulting curve would in all probability have gone much further before flattening out.

Fig. 11 shows the light given by Neon 4 plotted against the square root of the illumination on the selenium cell (in arbitrary units) from which a fairly close linear relationship may be established—at least for that part of the curve before saturation sets in.

Effect of Lag.

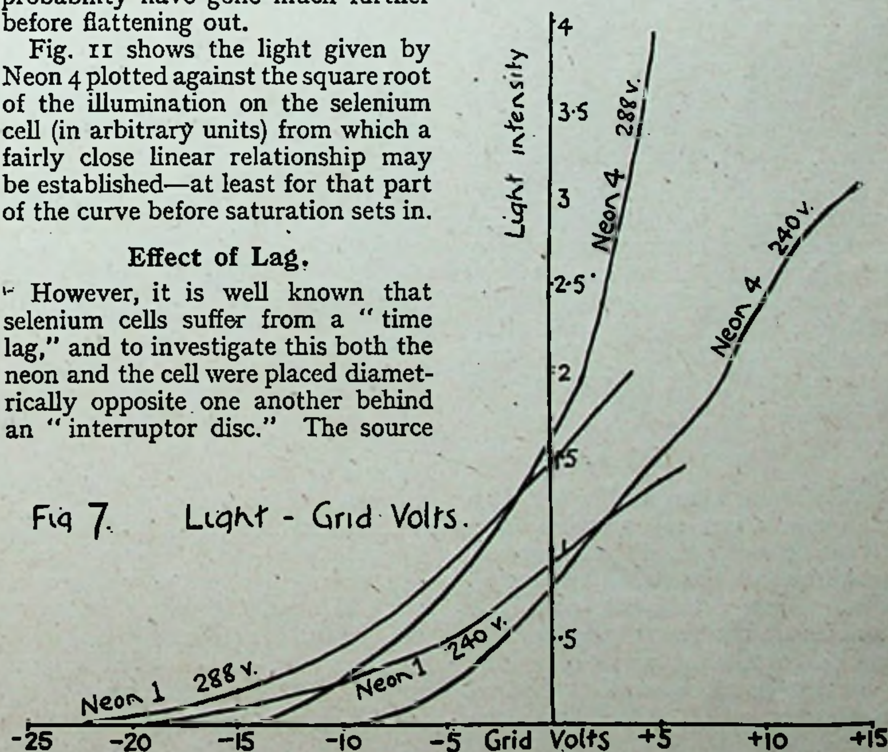
However, it is well known that selenium cells suffer from a "time lag," and to investigate this both the neon and the cell were placed diametrically opposite one another behind an "interruptor disc." The source of illumination for the selenium cell was again a 100-watt gas-filled lamp placed in front of the rotating disc and opposite the cell.

At frequencies of one or two a second (caused by rotating the disc) the neon lamp lit up and went right out every time a slot passed in front of the cell. When frequencies of about 10 per second were reached the eye could not detect the original flickers, but on looking through the disc. dark and light bands were seen across the neon, and were more easily observed when a ground glass screen was interposed. They were not well defined because the neon was still half alight when the selenium was half covered. Other bands were observed, when looking through the disc on to the wall of the laboratory, at a point where the light from the lamp had come through another part of the disc.

Lag Determined.

On speeding up, the bands or lines became less defined and appeared to move slightly in the direction of rotation, until at frequencies approaching 100 they became unnoticeable, although those on the wall were still very clear.

From these observations we deduce that our apparatus is useless for any appreciable frequency greater than 100, owing to the lag in the cell and neon lamp.



What it Feels Like to be Televised*

By MARK LESTER

Mark Lestcr was one of the distinguished artistes who appeared before the televisor during the public demonstrations of television at Selfridges in September last. In the following highly amusing article he tells us what he felt like during the performance.

THERE will be no more of this egg-throwing business at theatres. Television will be the salvation of stale jokes and the ruination of the business in the soft, squelchy things which descend when the "gods" are angry.

I was televised the other day, and people asked me if I felt nervous. Nervous ?—said he, with a chuckle. Of course not. I never felt more safe. Mind you, I've never yet had to dodge a brick.

All the same, it is nice to feel you are perfectly safe. You can sit in front of a televisor in your little home in Pimlico and appear on the stage in the West End, or Basutoland, or Lyme Regis, and there you are—or, rather, there you arn't. It's great.

And it's all so simple. I was pushed well into the limelight in a box affair, little and empty as an Aberdeen collection-can. Everyone was very kind and told me in that "painless extraction" voice of the blighter with the forceps that it wouldn't last long. Then I was told to stand very still and smile and say who I was. I grinned till my gold-stopping ached, and mumbled my name while someone behind kept prodding me, first under one ear, then the other, then under my chin, to make me keep my face in focus. There came giggles from the next room. "They've seen you," said a chap in a double-meaning sort of way. "Tell them something, but don't waggle your face too much."

Elusive Jokes.

I had come along with about fifty gags and seven set speeches from "Blue Eyes," but, do you know, I couldn't think of one ? The box was all white inside, and a little light kept bobbing up and down in a frame in front of me like the larynx of a glow-worm singing Pagliacci. Very fascinating it was, and I was settling down to listen for the top note when the chap behind prodded me again and told me to get a move on and say something.

So I addressed the popping worm in front, and started to tell the story of the Englishman, the Irishman, and the Scotsman. You have heard it, of course. But it seemed so darned silly to waste one's sweetness on the what's-its-name that I switched off.

MARK LESTER, the well-known comedian.

I could not speak properly because I was thirsty, and I told them so. Believe me, I was that dry I would have taken two gills of H_2SO_4. It was the heat that did it.

They handed me in a tumbler. Was it stout—was it beer ? Neither. It was coloured water with cotton wool on top ! "The audience won't tell the difference," said the fiend in human shape. No, but I could. Upon my life, I've never been more upset.

"Hush !" said the fiend, in a shocked voice. "It's after hours," he said. "Just pretend to drink it. There's no need to eat the cotton wool at all." "Oh, thank you, sir !" I said, and pretended. Then by request I lit a cigarette and grinned again and listened to the giggling. I was told from behind that I was really great. I dare say I was, but the next time I televise there has got to be an all-day licence.

Cool Evelyn Laye.

Then I stepped out of the collection-can and mopped the massive brows and said, "Isn't it splendid ?" and went round to the other room to see how Evelyn Laye came through. That girl's a marvel. Cool as a cucumber and nippy as a spring onion. I looked with the other folk into a sort of frame in which bands of light were running sideways. I wondered where Evelyn lay.

Then she pushed through the lights and everyone cried "There she is !"

It was wonderful. She opened her mouth, and everyone said "Ooo !" Then she shut her eyes, and everyone said "Ah !" and then she said "Good afternoon," and everyone simply went hysterical.

Someone with a notebook came up and asked me what I thought the future of television was to be. "Tell the world, boy, it's marvellous — simply marvellous — absolutely wonderful—er—absolutely wonderful. Marvellous—er—got that down ? It's—ah—it opens up great possibilities—I might almost say huge possibilities—especially for comedians. Distance lends enchantment, you know, and I'd like to meet the man who can throw a tomato from Zanzibar to Ulster."

And with that the great voice ceased, and the face that had made the ether wiggle and the many-headed multitude grin faded into a tankard.

* Reproduced by courtesy of the Manchester *Daily Dispatch.*

Lenses: Optical Bench Experiments

Part V

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

This month our contributor devotes his article to the description of experimental methods and apparatus by means of which the various equations he gives can be proved. Instructions are given for finding, in a practical manner, the focal length of different types of lenses.

AT the close of our article in the last issue of TELEVISION we deduced two or three simple equations for finding the position and the size, or magnification, of the image of an object projected by a simple thin lens. Calling the magnification, or ratio of the linear size of the image to that of the object m, and the distances from the lens of the object, image, and principal focal points, u, v, and f, respectively, we found that—

$$m=\frac{v}{u}=\frac{f}{u-f}=\frac{v-f}{f}\ \ldots \quad \text{(A)}$$

and that $(u-f)\,(v-f)=f^2 \ldots$ (B)

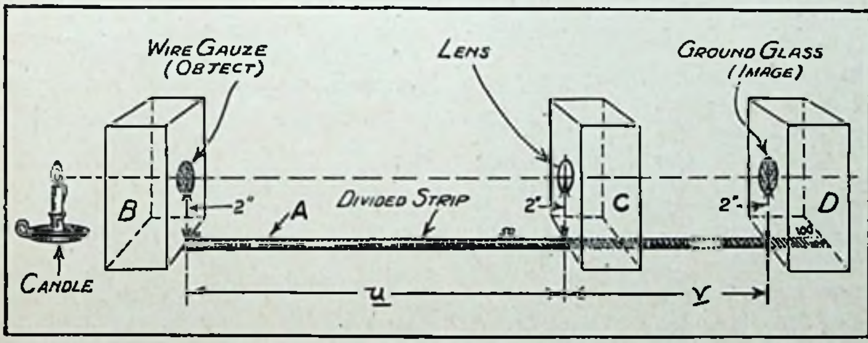


Fig. 1.—Simple form of optical bench.

and $\frac{1}{v}=\frac{1}{f}-\frac{1}{u}$ .... (C)

Armed with these equations, we are in a position to consider with advantage the subject from an experimental point of view, and verify the results at which we have arrived from theoretical considerations. For this purpose we will employ what is known as an *optical bench*. This apparatus takes many forms, in some of which it is very complicated and therefore costly. For our purpose, fortunately, it need not cost, complete, more than a few pence.

Optical Bench, simple form of. In this apparatus a number of cardboard boxes, standing on end or side, and carrying the necessary lenses, screens, etc., are slid along a long paper strip conveniently divided throughout its length into a scale of equal parts. This strip may be as short as a foot, but the longer it is—up to five or six feet—the better.

Each holder consists of a cardboard box with a half-inch hole punched in its bottom, two inches away from one of its edges. Each holder, therefore, can be stood up with its perforated bottom in a vertical plane and with the centre of the hole punched in it two inches above the flat surface on which the box or holder is standing.

Such holders are shown in Fig. 1, at *B*, *C*, and *D*, adapted to be slid backwards and forwards along the divided strip *A*, pasted or fixed down upon a table top or board. Four holders are wanted for our first experiments, one, *B*, with the half-inch hole covered with rather coarse wire gauze, to act as an object; a second, *D*, similarly fitted with a piece of ground-glass to act as a projection screen; a third with its aperture covered with a piece of flat mirror; and a fourth, *C*, before the aperture of which any required lens can be secured temporarily with wax. The four box holders may be of the same size, about 4" × 3" × 2" each, but in some experiments it is very convenient to have holders which will slip into one another, because in this way the distances between the optical elements carried by them can be made very small when adjusted on the bench.

There is nothing better than spectacle lenses, either old or new, for our work. They can often be purchased from a barrow in the street for a few pence a dozen. These lenses need not be circular, neither need their edges be ground. Specimens of the different types of correcting lenses, such as converging, diverging, and astigmatic,* should be obtained of different strengths ranging, say, from 1 to 10 diopters † + and —. We can, thus equipped, proceed to make experimental determinations of u, v, f and m, and thus check the three equations (A), (B), and (C).

The Power of a Lens.

The power of a lens is, as we know, measured by the change of curvature which it impresses upon light-waves passing through it. In the case, then, of plane incident waves, like those

* An astigmatic lens is one with a spherical curve ground on one face and a cylindrical one on the other.

† A five-diopter lens is one with a focal length of $\frac{1}{5}$ meter, or $\frac{40}{5}=8$ inches, but more on this matter later.

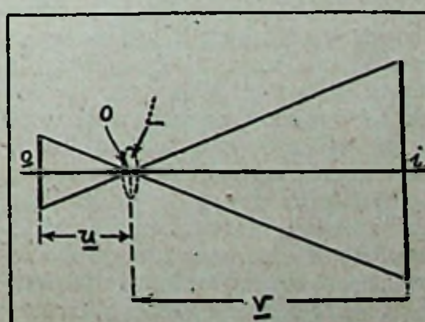


Fig. 2.—Diagram for finding the position of the lens in Experiment 3.

derived from a distant body such as the sun or a star, the final emergent curvature has been impressed solely by the lens, and this is equal to $1/f$, where f is the distance from the lens at which these plane waves (parallel rays) are brought to a focus.

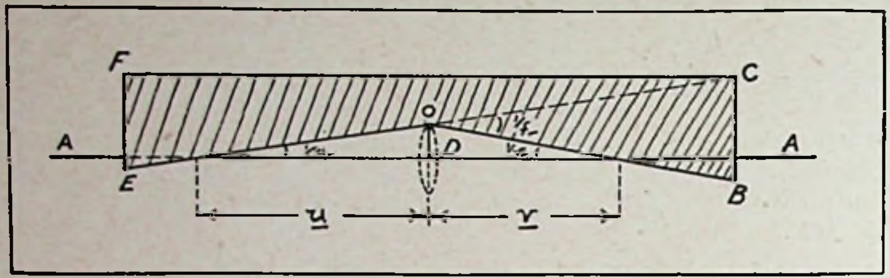


Fig. 3.—The "see-saw" method of solving lens problems.

One of the simplest ways of finding the focal length of a lens is to project an image of the sun upon a wall, or other screen, and then measure the distance away of the lens when the image is in focus. For this reason the focal length is sometimes referred to as the "solar focus."

Experiment 1.—We will now as our first experiment determine the focal length of a given spectacle lens on our optical bench. Fixing the lens conveniently with wax in the holder C, we slide it backwards and forwards along the scale A, until the illuminated wire-gauze, fixed in the holder B, at one end of the scale, is projected in focus on to the ground-glass screen carried by the holder D.

Suppose that when this adjustment has been made the distance u between the gauze and the lens is 12 inches, and that v, the distance between the lens and the ground-glass screen, is 6 inches. Then by equation (C)—

$$\frac{1}{f}=\frac{1}{12}+\frac{1}{6}=\frac{1}{4}$$

So that the required focal length is 4 inches.

Experiment 2.—In the case of a simple thin lens we can, however, find the focal length in a more direct and simple way. We replace the screen D by the holder carrying the flat mirror, and then move up the lens in its holder C, until a sharp image of the gauze carried by B is seen side by side with the gauze itself. The position of the mirror along the scale A does not affect the result, but it should be brought up fairly close to the lens in C. The distance between the lens and the gauze when adjustment has been made is the focal length f.

The theory of this experiment is simple. Rays from the object pass through the lens, and are reflected back again through the lens to a focus by the mirror. When the rays emerging from the lens, and on their way to the mirror, are parallel to one another they are reflected as parallel rays and brought to the principal focus of the lens, which is in the plane of the object itself. The distance between the gauze and the lens is thus the focal length of the lens.

The method just described of adjusting an object in the principal focal plane of a lens is largely used by the optician. Collimators, for example, are adjusted in this way. (A collimator in a simple form consists of a tube with a scale or graticule at one end, mounted in the principal focal plane of a lens mounted at the other end.)

It is obvious that, knowing any two of the quantities u, v, and f, in equation (C), the third can be determined.

Equation (B), known as Newton's equation, from its discoverer, is a very important one, since it is true for both *thick* and *thin* lenses. It tells us that if we measure the distances of the object and its image—not from the lens itself, but from the two principal foci of the lens—then the square of the focal length is equal to the product of these distances. For the present it is sufficient for our purpose to remember that in the case of a thin lens, such as we have considered so far, the distance between the two principal foci of such a lens is always equal to $2f$, whereas in the case of a thick or compound lens, such, for example, as a photographic lens, this distance may be equal to, greater than, or less than $2f$.

Experiment 3.—To find the focal length of a compound photographic lens by Newton's method the positions of the two principal foci are first found with respect to the two end faces of the lens by experiment 2. The lens is then used in the ordinary way to cast an image of the object at B, upon the screen in D, and the distances u_f and v_f, from the principal foci measured. The product of these distances, i.e., $u_f v_f$, is equal to f^2, the square of the focal length.

Example.—A compound projecting lens of the photographic type has its principal foci 3 inches and 1 inch away, respectively, from the first and last lens surfaces. An object 7 inches from the first lens surface gives an image 10 inches away from the last lens surface. What is the focal length of the projecting lens. Here $u-f$, or u_f, $=7-3=4$; and $v-f$, or v_f, $=10-1=9$; so that $f^2=4\times9=36''$, whence $f=6''$.

Experiment 4.—Suppose that in some optical instrument it is required to produce in a plane D, say, a three times magnified image of an object in a plane B, 20 inches away. Here we have to find the power of the required lens and its position between D and B. To find the required position we draw an object o, 20 inches away from the three-times magnified image i, Fig. 2, and connect the opposite ends of the two lines. These lines will intersect in a point O, 15 inches away from i, and 5 inches away from o. It is obvious that the lens required must be placed at O, because this is the only point between o and i for which $m=v/u=\frac{15}{5}=3$ is true.

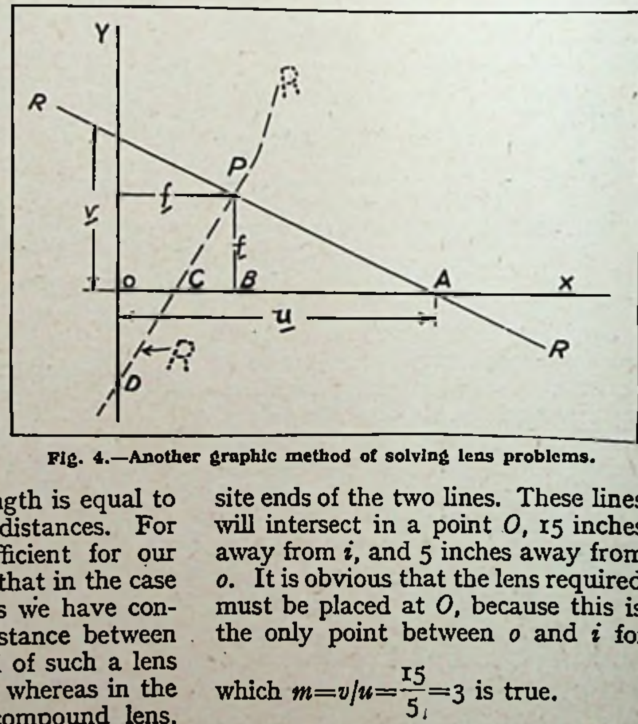


Fig. 4.—Another graphic method of solving lens problems.

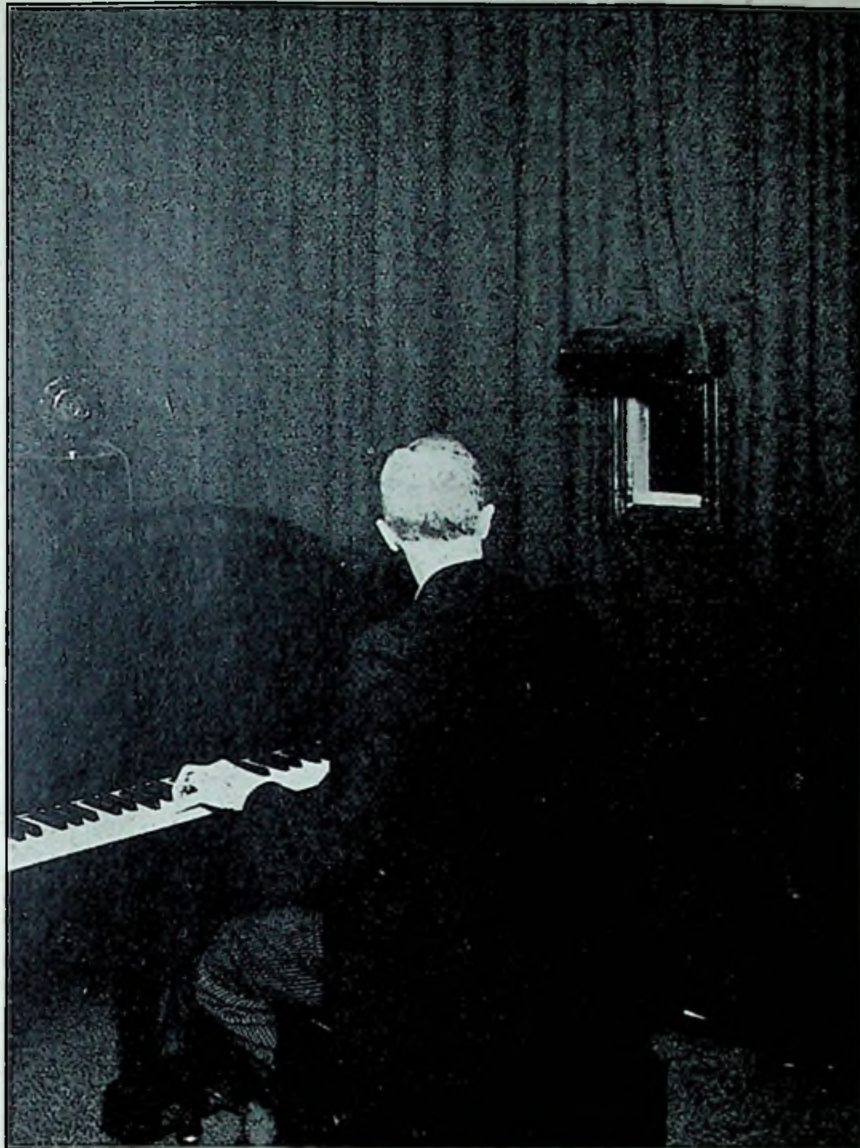
To find the power of the required

lens we have from equation (A)—

$$m=\frac{v-f}{f}$$

i.e., $$f=\frac{v}{m+1}=\frac{15}{3+1}=3\tfrac{3}{4}\text{ in.}$$

To satisfy the conditions imposed we must then place a thin lens with a focal length of $3\frac{3}{4}$ inches, 5 inches away from the object *o* to project into a plane 15 inches away from the lens a three-times magnified image. To measure the magnification in any experiment an object of known length is placed in the holder *B*, and its image measured on the ground-glass screen, when $m=i/o$.



HOW A SELF-ACCOMPANIED SINGER CAN BE SEEN AS WELL AS HEARD.

A recent and exclusive photograph of the new sound-and-sight broadcasting studio which has just been completed by the Baird Company. To the right is the opening through which the travelling light spot emerges to move rapidly across the singer's face. To the left, behind the piano, is the microphone which picks up the voice of the singer and the sounds of the piano.

Graphical Solutions of Lens Problems.

The student should find the graphic solutions given below both interesting and illuminating.

First Method.—Take a long strip of stiff paper or cardboard, *E, F, C, B*, and cut along the lines *EO* and *OB*, making the angle between *EO* produced, and the line *OB*, equal to the angle $1/f$,* where *f* is the focal length of the lens for which the diagram is being made. Now draw a long line, *AA*, upon a sheet of paper, and at unit distance above it insert a pin, *O*. Divide the line *AA* into a number of equal parts, each equal to *DO* in length, and the diagram is complete. Suppose that it is required to find the distance *v*, at which the image of an object, placed at a distance *u*, is projected by a lens with a focal length *f* for which the cardboard, i.e., the angle *EOB*, has been cut. Rock the card on the pin *O* until the line *EO* cuts the scale *AA*. at a point, making the length *u* equal to the given value, then the line *OB* will cut *AA*, at a point giving *v*, equal to the answer, and so for any other pair of conjugate distances. From inspection the exterior angle $1/f$ is equal to the two interior angles $1/u$ and $1/v$, so that equation (C) is satisfied by the diagram.

Second Method.—By this method two graduated lines or scales *OX* and *OY* are drawn at right angles to one another and a pin inserted at *P*, at perpendicular distances from *OX* and *OY*, equal to *f*, the focal length of the lens for which the diagram is made. The distance *u* of the object from the lens is set off along *OX* and the corresponding distance *v* of the image is read off along *OY*. To find *v*, corresponding to a given *u*, occurring on the scale at the point *A*, it is only necessary to lay a straight line or ruler R, through *AP*, to cut the line *OY* at a point giving the value *v* required.

It is interesting to note that as the object moves up along *OX* to the lens the image moves away along *OY*, until, when the object is at *B*, the principal focus, the line *BP* is parallel to *OY*, indicating that the image is at infinity. As the object approaches the lens still more the lines *PC* and *OY* intersect at *D*, below the horizontal, indicating that the image is now to be found on the same side of the lens as the object, and at a distance *OD*.

That the diagram agrees with the equation (B), for example, is shown by the fact that by inspection $\frac{v-f}{f}=\frac{f}{u-f}$ which is Newton's equation.

By setting *P* at different distances from *O*, along the bisector of the right angle *YOX*, the diagram can be used for lenses of different focal lengths.

* It must be remembered that in all simple lens problems the focal length is considered to be so great, when compared with the linear aperture of the lens, that the tangents of the angles concerned may be taken as equal to the angles themselves.

The News Spreads

By Charles Jones

POET RALL, a gardener in these parts, is my best friend. He tends a lord's garden, and lives in the shadow of a former Laureate's house. Perhaps he feels the Laureate's august presence still clinging about the place where he dwells and is influenced by it, for he is the sort of man who gains great respect among his equals. He has even written verses, in fact many verses, and that is why he is called "Poet."

One evening recently, as Poet and I were walking in the village, we heard strange noises coming from the parlour of the "Blue Lion." So we turned in there, and as we entered we noticed that the noises came from a loud-speaker which the landlord, a sailor home from the sea, was tuning clumsily. We had hardly time to remark the exasperation with which he was doing this when George pushed in, the furrow clay still on his heels.

"Hear you'm got a three-valver," he burst out.

"Ay, George," said the landlord. "Here! You take over the wheel. She's answering me back an' I'll——"

"Aw, see here," interrupted George, and he settled down to tune in adroitly.

George—The Expert.

George is an expert. He made nearly all the crystal sets in the village, and when they go wrong, which often happens, he puts them right at journeyman prices. By this means he has earned a great reputation for wisdom in such things. He certainly tuned the "Blue Lion" set very dexterously, and just as Gaffer Randall and others came into the parlour the clamour of oscillations subsided, and a prima donna's voice emerged, clear and sweet.

Gaffer Randall stopped short. Although he is very old and rather deaf, he heard the keen melodious voice, and looked round in bewilderment.

"Wheer be t' lady?" he asked, in his cracked voice.

"That be wireless," said George.

"What! Speakin' right out? Not in they pill-box things?"

"Ay, theer he be, in yon trumpet."

Gaffer gave the loud-speaker one disgusted glance.

"'Tis devil's work," he said, "devil's work a singin' off a wire."

WHAT does the average rustic think of wireless and television? We who live in cities, surrounded by all sorts of distractions, are apt to lose sight of the point of view of the average countryman who never in his life has been "further than Beckett's copse." In this interesting little tale our contributor gives us an intimate glimpse of the rustic in the act of expressing his own ideas in his own way, in his own environment.

"Nay, shall I tell you what?" cried George, eager to mystify the old man. "Thet lady what's singin' is dead."

"What did I tell ye, George? 'Tis devil's work . . . skelingtons a-singin' off a wire."

"You don't understand, Gaffer. 'Tis only a gramophone record playin' in Lunnon. 'Tis science."

The old man glowered fiercely.

"Scy-ince!" he ejaculated, with scorn. "They spoilt the weather, they did. Look at the summers we'm had since they got scy-ince."

George felt his reputation was at stake, and cast round in his mind for some slashing argument that would shatter the ignorance of such an old numskull.

"Science does marvels, Gaffer," he said slowly. "See here, I warrant you an't heerd of the Lunnon professor who fed germs to a onion till t'were as big as my head."

Gaffer Randall, glass in hand, cast him a scathing glance.

"'Twould be a swelled gurt onion, thet," he replied reflectively, and the cause of science dissolved in the heats of laughter.

As the music went on, placid and sweet, Gaffer turned and spoke to Poet, who was sitting silent upon a bench beside me.

"What d'you think of all this wireless, Poet?" he asked. "I says it ought not t' be."

Poet smiled.

"I was just wondering, Gaffer, what you will think when television comes——"

"Tel——what?" enquired George, sharply.

"Television. The power to see far-off things as we hear them now. The chauffeur at the House showed me a paper in which it was told that such things have been done already."

"How d'they do it? Megohms and things?" asked George.

Television Next!

"I do not know. It doesn't matter a lot—to me. What does matter," said Poet, passionately, "what does matter is that, as things are, men like you and me are hobbled to an acre, in a world full of glory. We see no further than Beckett's copse in a twelve-month. I know what you think, George. That there's money in it. That isn't the scientist's spirit, my lad. Scientists aren't florin-fiends, with one eye on the universe and the other on their pass-books.

Thank God they aren't, George. What matters is that another gift is to be given to ordinary men like us. Presently we shall see as well as we can now hear, by wireless. Think of that! There are stranger things to be seen than we dream of in this village."

" I a'nt heerd anything of it," said George, morosely though unabashed. " Wheer d'you get the gadgets ? "

" I don't know, George. In any case, only simple things can be shown as yet. One thing I can tell you—television sets cannot be knocked up like crystal receivers."

Gaffer pondered all this deeply. As his glass was refilled he fixed a thoughtful eye on Poet.

" What sort of things will you be able to see ? " he asked.

" Well," said Poet, " I have often wondered what the Italian singers look like on the coloured stages at the opera, and how the great actors strut through a Shakespeare play. I have often wondered about the places spoken of in books—the dunes of the Sahara ; the atolls of the southern seas. Before I am much older I shall see them, just as I saw a glacier on the pictures at Portnor. I've faith —faith in the work of science——"

" Ay ! Ay ! But can y' see persons at all ? " interrupted Gaffer. " Like you could hear the girl singin' ? "

" Oh, yes ! Faces have been transmitted already. Oh, yes, that is already done."

" Well, I'd like t' see my old missus agen," said Gaffer. " But not with the speakin' part," he added.

What a roar of laughter there was ! Gaffer's wife had been dead these five years, but the simple old fellow thought that if a dead girl could sing his dead wife could certainly reappear, and he said so straitly, giving us to nnderstand that it would be a much more desirable miracle.

Hardly had this outburst subsided than the landlord's voice rang out : " Time, gen'men ! Time, gen'men ! "

The villagers departed, still talking over the news, and some carried strange tales home to their waiting wives.

Poet and I walked homeward together, and he was silent except for the usual quiet " Good-night " as he turned in at his cottage door, in the shade of the Laureate's homestead. I am sure that for him the night was already filled with vagabonding mirages, and all the worldless wonder of the world was in his eye.

Future Horrors

By NOËL SWANNE

TELEVISION is going to alter many things. I had a vivid dream last night, which was but a forecast of what the future will hold for many of us. I saw my own sitting-room, in which Marjorie and I were passing the evening. She was messing about as usual over something or other, and I was working—also as usual.

I am not quite certain what I was doing, but I think I was writing a review of the seventy-third book produced by Edgar Wallace that month. Not writing it exactly, but thinking over the wording. At least I was reading the book.

Suddenly Marjorie stopped and glared at me, and things began in a very homely manner—

" You blithering fool ! " she spat at me.

" My dear ! " I expostulated.

" What in the name of fortune I married you for I cannot imagine. It wasn't your money. It wasn't your beauty. I must have been mad."

" Have been ? " I queried, feeling it was time I got one in somewhere. " When did you change ? "

" There you are ! " she snorted. " Insults ! That is all your feeble mind can run to. Mother always said I was a fool."

" Mothers are always right," I retorted. " But, anyway, what is the matter now ? "

" Look ! " said Marjorie, waving a piece of paper. " Look ! Here is the coal bill. What have you done with the money ? "

" I have many calls to meet," I protested.

" So you spent it on calls and meetings, did you ? It is me that has to face the coal man, not you."

" It is I," I corrected her.

" Never mind my grammar," she snarled. " I had as good an education as you had. I did not get a scholarship over which I've done nothing but swank ever since, and I can speak plain English."

"Plain enough—certainly," I agreed.

" This sort of thing cannot go on. I will not continue to be the object of derision of my friends. Look at my clothes. You are too mean for anything."

" Look at mine," I countered.

" I do," she replied, " and it gives me cold shivers down the back. Despite the fact that in anything you would look a scarecrow, you might at least have the decency to keep your things free from grease and oil."

Somehow I thought that things were becoming more bitter than usual. Of course, in the privacy of the home, a man and his wife may be allowed to work off a little steam. Life is very trying, and when these little do's are over—well, that's that, as it were. Certainly they never are over until I have produced or promised to produce chocolates, theatre-tickets, hats or whatever was the real instigation of the " do."

After all, an Englishman is master in his own home—vote or no vote. He owes the bills. I felt it was time I put my foot down. Slowly I lowered my book and raised my chin and stuck it forward. Marjorie met my glance with a frigid glare, but soon her eyes faltered and she stared over my head and her features underwent a change. A smile spread over her face, and she looked at me with that loving, meek glance so reminiscent of our courting days.

" Darling, I think it was very good," she cooed softly, slowly and very distinctly. " It sounded very good anyhow. It was a ripping idea of yours to practise it in this way. Now, *you* know how it sounds. I should fancy the next act will be very stirring."

Frankly I was surprised. *Sounded* very well ! Next act would be very stirring ! What did the woman mean ? But, she had risen now and, smiling still, walked over to me, playfully ruffling my hair as she passed. Well, woman is a puzzle anyhow. I felt I had better say nothing. Evidently she had seen that I was not to be played with. After all a man is . . . .

There was a click and a swish.

" You blithering idiot," came Marjorie's voice from behind me. " You left both the screen and the receiver on, and now the Jones's will have listened and seen all that, and if we are not the laughing stock of the neighbourhood to-morrow, it will be due to my cleverness in trying to pass it off as a rehearsal of one of your silly plays. You one-eyed——"

Fortunately, I woke up just then, to find that I was not in our sitting-room. I was seated in a comfortable armchair in the corner of the television broadcasting studio, and I had fallen asleep whilst awaiting my turn on the programme.

Bridging Space

(Part VI)

By JOHN WISEMAN

In this, the sixth of our contributor's series of articles in which the fundamental principles of electricity and wireless are being explained, the function of a thermionic valve in an oscillating circuit is fully described. It is shown that the valve is an "impulse timer," which keeps the electrical oscillations steadily and regularly surging to and fro through the circuit.

EVERY one who has been following this series must by now have realised that in order to appreciate exactly what happens when signals are broadcast into space it is essential to study all the intermediate stages. No one can run before he can walk, and on the same lines no recruit to the ranks of television can expect to picture how space is annihilated by wireless signals unless he becomes familiarised with all the contributory factors in this scheme. That is why we have traced our steps slowly but thoroughly to the point where we are in a position to unravel whatever mystery is attached to the functioning of a valve as far as generating oscillations is concerned.

Strictly speaking, the valve itself does not generate oscillations. The oscillations take place in the closed oscillatory circuit, but the valve, in conjunction with its associated apparatus, has the property, provided certain conditions are satisfied, of regulating the energy in the whole circuit, so that the oscillations, once started, are maintained; that is, it acts as an impulse timer.

What Happens.

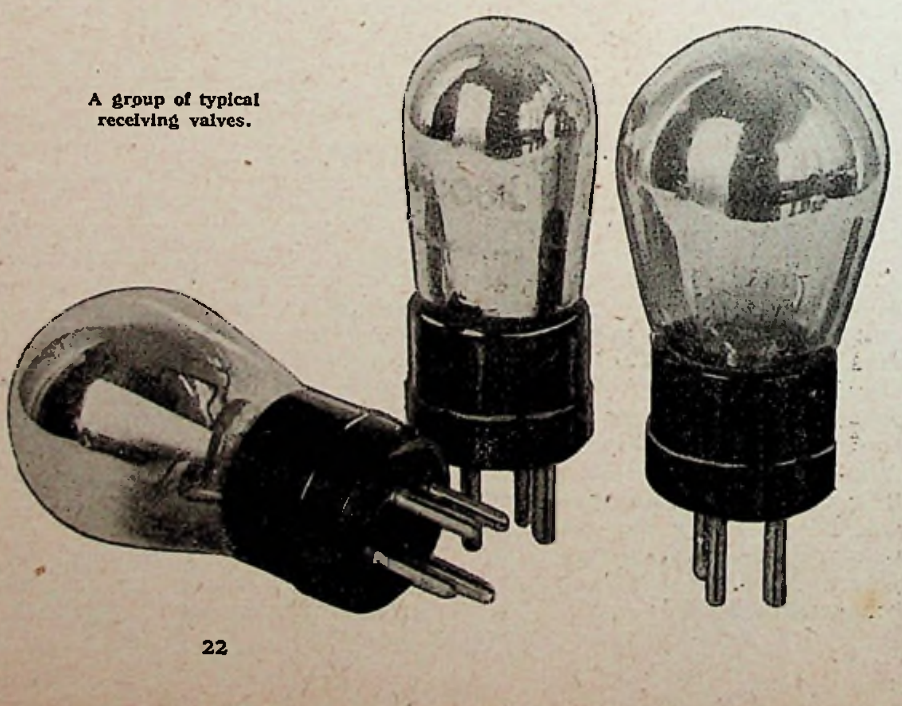
For the purposes of explanation, let the valve be connected up as in Fig. 1, the magnetic coupling between the coil L_1 of the oscillatory circuit situated in the grid lead, and the coil L_2 in the plate lead being variable. Set the L_1C_1 circuit oscillating—switching on the valve is sufficient to do this—and let us examine what happens.

Immediately this varying current starts to flow there is produced across the extremities of the coil L_1 an electromotive force (E.M.F.) or voltage. This is known as a self-induced E.M.F., and is a characteristic produced in any coil which has a varying current flowing through its winding, it being the outcome of electrical inertia, or the tendency of the coil to prevent sudden current changes taking place. Now, as we saw last month, if we have any voltage changes impressed upon the grid of a valve we shall cause a change of current in the plate circuit. The magnitude and exact nature of the change will depend upon the normal working conditions of the valve as determined by the values of the filament, grid and plate voltages.

A Plate Current Change.

Assuming that the valve characteristic of Fig. 2 is drawn for these conditions and O is the initial grid volt point, then the line OP gives the average plate current of the valve. The voltage change for one complete cycle produced on the grid by the self-induced E.M.F. is shown dotted at the bottom, and it will be appreciated that this alteration of grid volts from O to A, A to B, and finally from B to O will produce the plate current change from AC to BD as indicated by the dotted curve on the right-hand side of the diagram.

The original oscillating current in the grid circuit has therefore produced a similar current change in the plate circuit, the actual current change being of the same frequency, but greater in magnitude than that in the grid circuit owing to the amplification of the valve. Of course, this new current change in the plate circuit must flow through the coil L_2, and, as we have seen before, this produces magnetic lines of force in that coil. Now, if we arrange for L_2 to be near L_1 the lines of force from L_2 will link the coil L_1 and, as other articles in this series have proved,



A group of typical receiving valves.

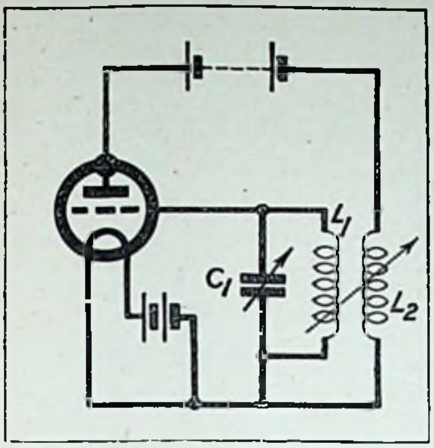


Fig. 1.—A simple form of oscillatory circuit.

this will re-introduce another voltage into the coil L_1.

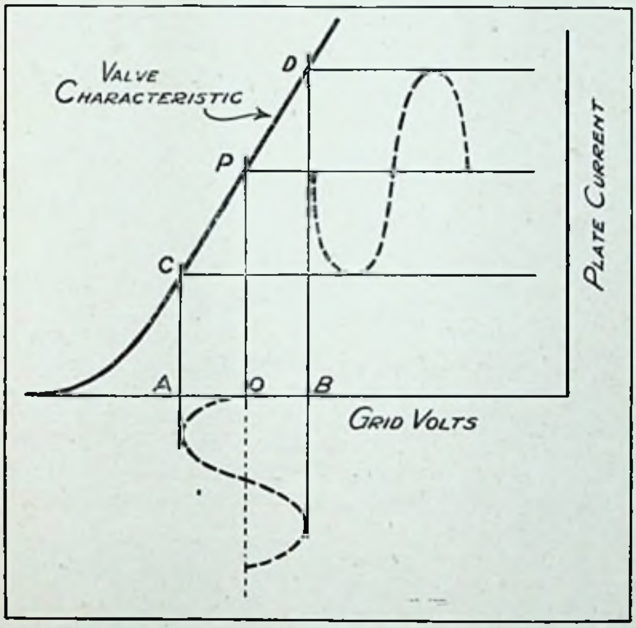


Fig. 2.—A typical valve characteristic curve, showing the relationship between an oscillating grid voltage and the corresponding oscillating plate current.

What We Require.

Provided certain conditions are satisfied, this is just the state of affairs that we require. Left to itself, the L_1C_1 circuit will dissipate all the energy produced by its own oscillations, and these oscillations will die down quite rapidly. This re-introduction of another voltage into the grid coil L_1 has altered matters, however.

Supposing you suspend a weight on a piece of string and set this swinging and then strike the weight with the hand—what happens? A number of haphazard blows will inevitably cause erratic swinging, but properly timed blows can do one of two things. Imparting blows to the weight at the bottom of its swing, but in the opposite direction to the weight's movement, see Fig. 3*A*, will quickly bring it to rest. If the blows are given in the same direction as the weight's movement, however, Fig. 3*B*, then the weight will continue to swing uniformly. The magnitude of the blow will determine the extent of the swing, small blows producing small oscillations, while heavier blows will cause large oscillations.

In the electrical sense this is precisely what can happen with our Fig. 1 valve circuit. The re-introduction of a voltage into the coil of the oscillatory circuit is equivalent to a blow, and by ensuring that the phase of the magnetic coupling between the two coils is in the correct sense, then the energy blow imparted by this re-introduced voltage energy will help to overcome the loss of energy in the oscillating circuit. The magnitude of the voltage imparted to the coil L_1 will depend upon the degree of coupling between L_1 and L_2, that is, the closer the coils are together the larger the magnitude of the induced voltage.

An Energy Reimbursement.

It should be easy to appreciate, therefore, that it is possible to reimburse this oscillatory circuit with energy sufficient to compensate for that lost by the current oscillating. Indeed, with the coupling fairly tight (coils fairly close), more energy can be given back to the coil L_1 than it actually loses, and if this happens the oscillations will increase in magnitude quite apart from being maintained. The timing of these blows is automatically governed by the current itself, for obviously the current changes in the plate circuit are

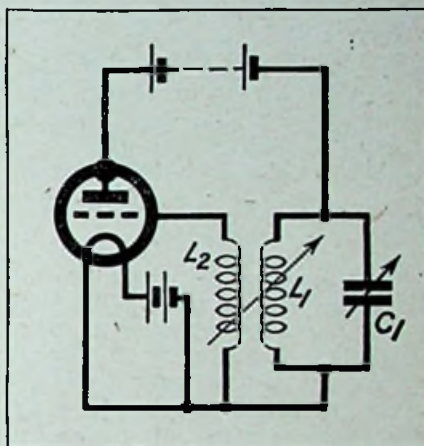


Fig. 4.—The form of oscillating circuit which it is more usual to employ in wireless transmitters.

identical in frequency to those in the grid circuit.

Thus we see how close is the analogy between this electrical circuit and the previously quoted mechanical analogies—the actual timing of the impulses is accomplished by the moving current itself. At first sight one would imagine that surely we have here the nucleus of the scientist's age-long dream—perpetual motion in the

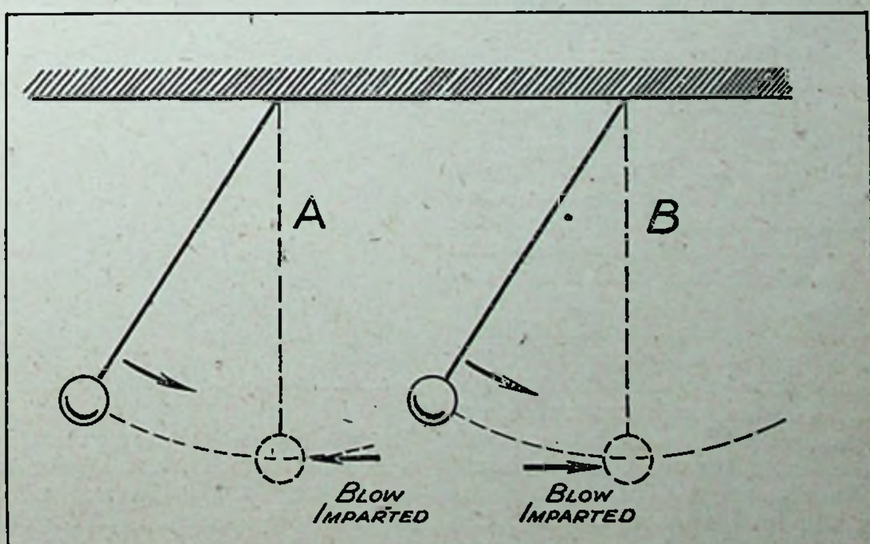


Fig. 3.—A simple analogy of the "impulse-timing" action of a valve.

electrical sense. This is not the case, however, for although energy is certainly given to the oscillating circuit, it is derived actually from the source of power in the plate circuit, namely, H.T. batteries or D.C. generator, as the case may be.

Notice the resemblance between our

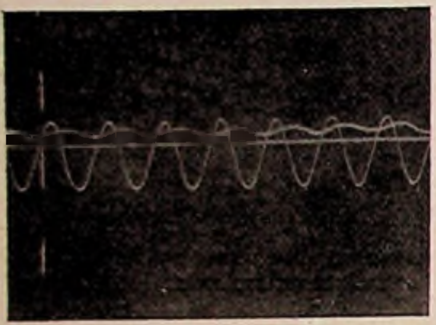


Fig. 5.—Oscillograph record of plate current and oscillatory circuit current when valve is just oscillating.

violin analogy whereby the muscles of the arm are a source of continuous power in exactly the same way as our battery is a source of continuous power. It is the reactions in the circuit itself that virtually change the continuous supply of energy to properly timed impulses of energy.

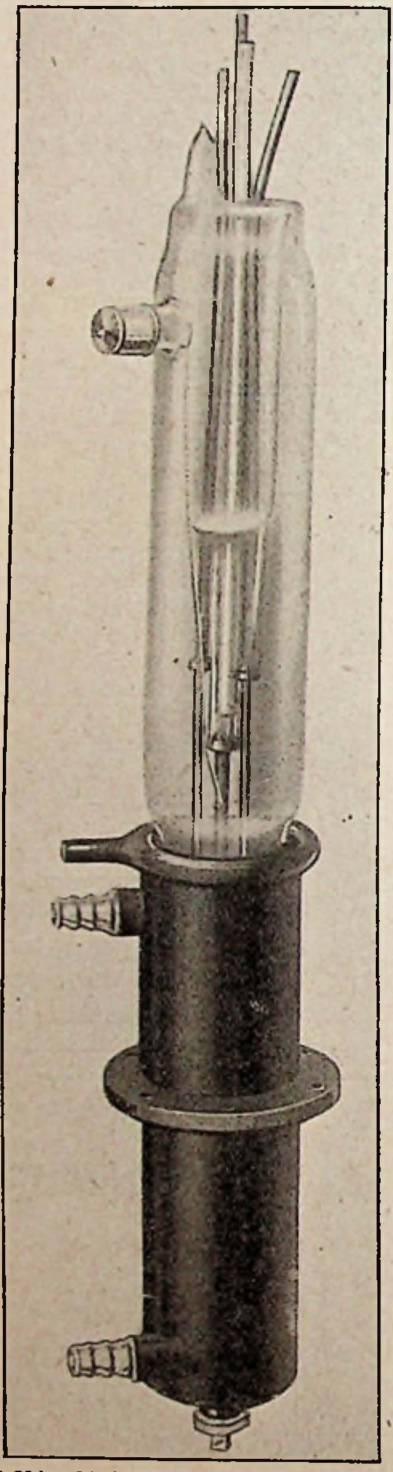
Handling the Power.

There are, of course, other considerations which enter into the question of an oscillating valve, but the facts just enunciated in simple language constitute the foundation of the "modus operandi." The actual amount of power generated in the circuit shown in Fig. 1 is obviously quite small, and in the majority of the valve transmitters the oscillating circuit is situated in the plate circuit of the valve as indicated diagrammatically in Fig. 4. The action, however, is very similar to that just described.

Another important fact governing the power generated is the amount of power that can be handled by the valve itself. Obviously the small valves illustrated in the group shown in one of the accompanying illustrations will deal only with fractions of a watt (unit of power). The design of the valve has to be altered radically as can be seen by comparing this photograph with those illustrating a Mullard water-cooled valve which has an output rating of 20 kilowatts and a modulating valve with 1-kilowatt plate dissipation. The working principles remain the same in spite of the large powers handled; and, after all, it is principles that matter most to us in a series of articles of this nature.

Seeing is Believing.

To understand exactly what is



A 20 kw. Mullard water-cooled transmitting valve.

happening when we are generating oscillations which are maintained at a constant amplitude, and whose frequency is a function of the electrical constants of the coil and condenser in the oscillatory circuit, readers have had to draw a mental picture, this being made easier by the citing of everyday mechanical analogies which can be *seen*. If we could only see the currents oscillating in both the L_1C_1 circuit and in the plate circuit of the valve, it is certain that the impression made on the mind would be more lasting. There are instruments which enable this to be effected, and these are known as oscillographs. They enable the current and voltage variations in a circuit to be observed on a screen, or, alternatively, a photographic record may be secured. This, of course, is provided that the frequency of the current and voltage variations is within the capabilities of the instrument.

Those oscillographs, based on galvanometer principles, have a frequency limit of about 300 cycles per second, but the cathode ray models operate at almost any frequency. The two photographs of curves shown in Figs. 5 and 6 were obtained with a specially designed low-frequency oscillator and are of great interest in view of our study of the oscillating valve.

Photographic Records.

Examining the first of these two photographs (Fig. 5), we have two oscillating currents of constant amplitude and identical frequencies. The larger amplitude curve is the actual current in the oscillatory circuit when the connections are as Fig. 4, while the smaller amplitude curve illustrates the plate current variations.

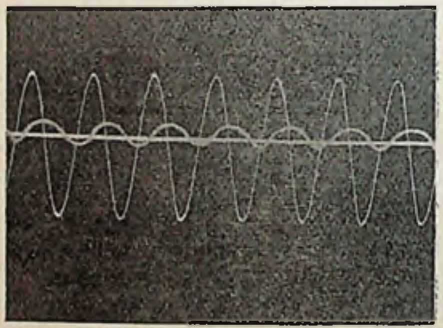


Fig. 6.—Oscillograph record of plate current and oscillatory circuit current when coupling is tight.

It will be remembered that the greater the coupling between the coils L_1 and L_2 the greater was the magnitude of the oscillatory current, and this is borne out in the second photograph (Fig. 6). The increased amplitude of the oscillatory current curve was brought about entirely by the tighter magnetic coupling between the two coils.

NOW, THIS IS TELEVISION!

By Dr. ALFRED GRADENWITZ

In our last issue we published an article by Dr. Frank Warschauer, describing television demonstrations given at the Berlin Radio Exhibition by Mihaly and Dr. Karolus. Dr. Gradenwitz has also seen demonstrations of the Mihaly and Karolus apparatus, and in the following article he compares the results of these two systems with what he has seen demonstrated in London by Baird. Dr. Gradenwitz is very well known in this country, in many European countries and in the United States as a writer on scientific subjects. It is of interest to note also that the earliest trace we can find of the use of the word Television is in an article of his published in France as far back as 1904. Ever since that date Dr. Gradenwitz has followed television developments with a very keen interest. Considerable importance and interest, therefore, attaches to the following article.

WHEN, about a year ago, I came to London on a short visit, mainly with a view to studying at first hand the Baird system of television, I occasionally amused myself by asking people with whom I came in contact whether they had ever heard of television. In most cases I received negative replies, which gave me a welcome chance to deliver an impromptu speech on the subject.

I am now in London again on the same errand, and whenever I ask similar questions people seem to have become much wiser and know what I am talking about, and require no lengthy explanation to understand. In fact, television seems to have become a household word.

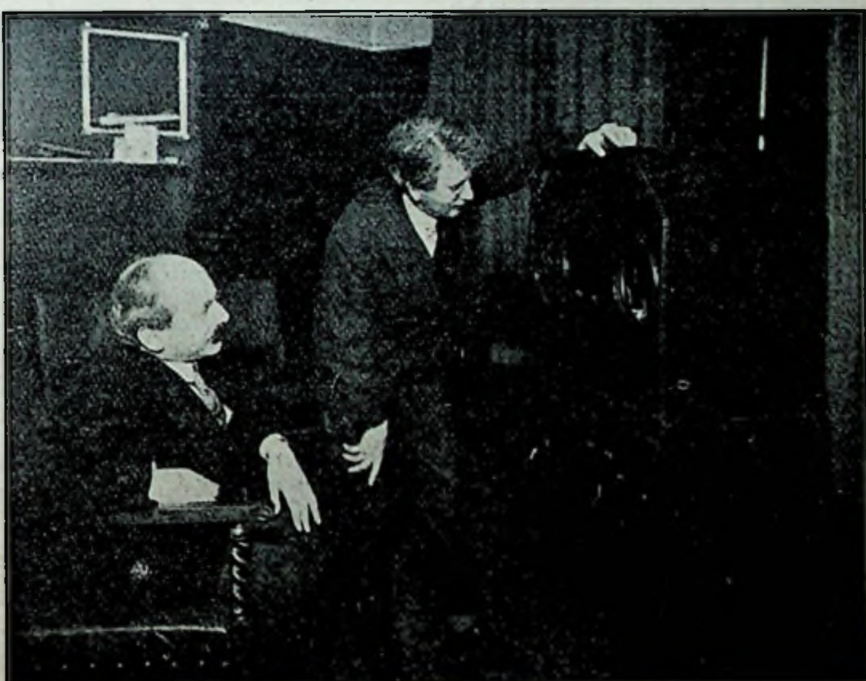
What is Television?

However, did I myself know what television actually was? Of course, I have always been familiar with what it was supposed to be, and what it was supposed to become, **but I never before met the real thing in such complete and perfect detail.** Many a time I have thought it was actually television that I was being shown. For instance, what Mr. Baird demonstrated last year well deserved that name, and in spite of unavoidable imperfections, it not only held promises for the future, but had already achieved something tangible and valuable.

At the recent Radio Exhibition in Berlin this year I was given the opportunity to examine very closely the apparatus demonstrated by Mihaly and by Dr. Karolus of the Telefunken Company—the great German wireless concern of which much has been heard. **Both Mihaly and Karolus merely transmitted lantern slides, and Mihaly sometimes sent the shadow of a pair of scissors; these transmissions were only shadowgraphs.** Mr. Baird has given me an equal opportunity of examining his system of television, and as a result of my examination I say that **now for the first time I have witnessed true television. I have seen the image of a living face with detail, both by wire and by wireless. Unquestionably the Baird system is immensely in advance of any system on the Continent.**

I had, of course, expected to find television greatly improved since I was here last year; I expected better definition and more detail, but I was not prepared to see the progress that has actually been made. The same persons with whom I had been conversing a few minutes earlier, one after the other appeared on the screen with an amazing truth to life, a remarkable clearness, and an astounding wealth of detail enabling, for instance, an outline of finger-nails, the smoke of their cigarettes, and even the lines on their faces to be seen distinctly.

The most wonderful effect of all, however, was an unexpected plastic effect endowing the figure on the



Mr. Baird demonstrating television by wireless to Dr. Gradenwitz (seated).

screen with an almost uncannily life-like appearance. **The image was almost stereoscopic,** although not deliberately designed to be so in the case of the apparatus I was examining. Last, but not least, I was greatly impressed by the perfect combination of sight and sound which was bound to enhance the illusion.

I think the simultaneous reproduction of voice and vision mutually assist each other. While one looks at the image the loud speaker seems more perfect. When listening to the loud speaker the visual effects of television are even better appreciated.

Nor should the fact be overlooked that only a commercial apparatus was being demonstrated this time. **Everything had definitely outgrown the experimental stage and was in a form which could safely be put in the hands of the wireless amateur or the man in the street.** In Germany every encouragement is being given to research workers in television. In fact, one reason for my visit to London is because **the German Post Office is at present negotiating for the purchase of the German rights in the Mihaly system** with a view to incorporating television broadcasting with the existing sound broadcasting service.

Dr. Gradenwitz seated before the televisor in the new Baird studios. Standing behind Dr. Gradenwitz is Lord Angus Kennedy, Vice-President of the Television Society.

"I am amazed."

In view of this fact I am amazed at the attitude of the British Broadcasting Corporation. I have learned with interest that steps are being taken to transmit English sound and sight programmes from the Continent. This, of course, can be done very readily from existing stations without in any way interfering with the present wavelength arrangements, but **it seems to me extraordinary that a British invention should be unable to obtain facilities for its development in the country of its birth.** However, I feel sure that this state of affairs will only be transitory, because the British authorities are certain very soon to appreciate the value of television.

There is no language in sight. Television broadcasting, unlike speech broadcasting, is truly international because a face is just as thoroughly recognisable to a German whether it be an English face, a French face or a Dutch face. And that, I think, is one of the greatest powers that television possesses, being capable as it is of bridging frontiers and bringing the nations of the world closer together than ever before. **Those who in the near future will be wont to see men and women of all nations appearing on the television screen will not be inclined to nourish unfriendly feelings against foreigners ;** and there will be a sounder basis than ever before in the past for mutual understanding and goodwill.

Incidentally, I may point out that here is one reason why the " Talkies," as you call them over here, will never supersede the silent film. Silent films are international, whereas the " Talkies " are limited to the country in whose language they speak.

But I am not here to criticise the latest film invention. I am here to investigate the Baird system of television, the importance of which does not appear to be recognised, and I am truly *amazed* at what I have seen. There is an immense future for this invention. At the same time television will prove an invaluable adjunct to wireless broadcasting by adding visual perception to sound received by the ear. An educational lecture delivered by a person visible on the screen and accompanying his or her words with appropriate gestures and effects will impress far more, and produce a far more lasting effect than broadcasting which appeals to the ear alone. Such a combination will, in fact, be an almost perfect substitute for the actual presence of the lecturer or orator. **A singer, actor, or comedian, seen as well as heard, will impress a radio audience much more profoundly than the same person perceived only by the sense of hearing. This is particularly so in the case of broadcast humour.**

Mankind has ever been intent on freeing itself of the fetters of space and time. In fact, much of the progress of human civilisation is the direct or indirect outcome of those endeavours. I believe television to be the crowning step of the efforts of humanity to annihilate space and time.

Light: The Essential of Television
Part IV.

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 students of television. 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 is elaborating them month by month.

It is an established fact that all objects are seen by virtue of the light which is reflected from them. In ordinary television, therefore (not colour television), every object which goes to make up a scene, stationary or moving, may be considered as a light source. A scene to be broadcast, therefore, may be said to consist of a number of light sources, a number of luminous bodies from which emanates reflected light, light obtained either from the sun in normal daylight or from *some form* of gas-filled lamp in artificial light. I am using a broad term when I say some form of gas-filled lamp. A mercury vapour lamp is a gas-filled lamp; it gives better results, for some purposes, than incandescent lamps with tungsten filaments, or the so-called artificial daylight lamps.

I pointed out in my last article (November issue) that materials of different colours have different reflection factors. All objects in a scene are coloured so that, although all receive light of the same intensity, the intensity of the reflected light depends upon the reflection factor of the material. This holds good for stationary objects only since, with moving objects of a flexible character, the reflection factor of a piece of material may vary, but only because the light incident upon it varies, and this with a constant light source.

Effect of Light on Coloured Materials.

To make this quite clear let us consider for a moment the effect of various intensities of light upon various coloured materials. I am including black as a colour, although it is seen only in contradistinction with other colours. In a garden, under natural daylight of fairly high intensity, every colour of flowers and foliage can be identified. Even

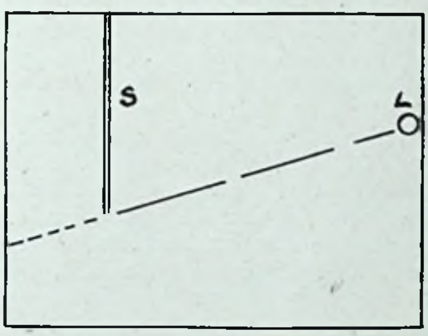


Fig. 1.—How the edge of a screen acts as an angle of cut-off for light rays.

various shades of green can be determined. When daylight commences to fade, however, one colour after another appears to change. Red appears black when very little difference is detected in light green; when green disappears light browns and yellows can be seen and, when these become black, white can generally be identified as something of a light character.

In normal daylight a person wearing a dress of some coloured material, in moving about, causes the material to form into intermittent folds. The folds are distinctly seen by their variation in colour, by the effect of light and shade: The colour varies in shade from the brightness of the material under the highest intensity of light to the lower intensities of light which produce the shade. This is due to a combination of direct and reflected light.

If a light source, *L* (Fig. 1), were located in a room the interior of which was painted dead black, and a screen, *S*, were placed across a portion of the room, the edge of the screen would act as an angle of cut-off for the light rays; and the space indicated by the dotted lines would be in complete darkness. The shadow would vary in size according to the position of *L*. That is, if the light source were moved to the position indicated in Fig. 2 the shadow area would be less, although, as before, the density would be the same.

Effect of Dead Black.

If it were possible to obtain a pure dead black with zero reflection factor, the shadow could not be identified as being apart from the walls of the room, that is, by looking into the shadow. A piece of white paper on the light source side of the screen would, in conjunction with black, represent the extreme contrasts in reflection factors, yet the paper when taken behind the screen would disappear; this because the light rays from the screen are intercepted and the whole of the light upon the walls is absorbed.

In the case of the dress of coloured material that I have quoted the folds

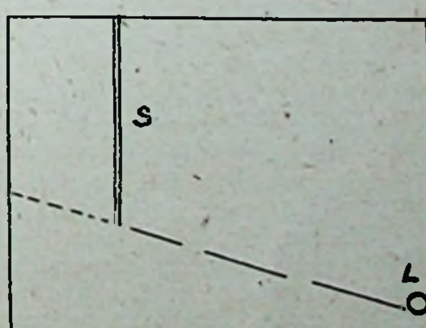


Fig. 2.—Altering area of shadow by moving light source, L.

are seen, first, by virtue of the fact that a certain amount of direct light is intercepted, and because a certain amount of reflected light tends to lighten what would otherwise be dense shadows. Let us consider Fig. 3 for a moment.

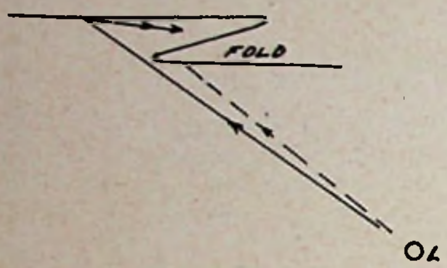


Fig. 3.—Effect of a fold in material.

Here we have a fold of material (say red) upon which light rays from the source *L* are projected. The rays represented by the dotted lines are intercepted by the folds. The rays, indicated by the full lines, strike the material at points beyond the fold, so that some of them are reflected into what would be darkness. It is this reflected light which gives a gradual effect of light and shade. The brightest red is seen at the points where the direct light meets the material; this is because the whole of the other colours in the spectrum are absorbed. The darker shade of red is seen because reflected light (and this is very important) loses some of its *qualities* and *intensity* through reflection.

With simple reflection, such as would be obtained when a light ray strikes a polished surface (not a mirrored surface), the quantity of light reflected would be about 90 per cent. of the quantity striking the surface. The rays from a surface like polished silver would not be distorted or refracted; it is in refraction that most of the intensity is lost.

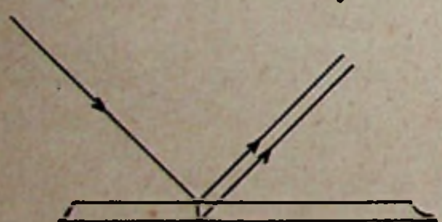


Fig. 4.—Ray of light striking a polished surface.

This brings us to the fact that light rays behave differently when reflected from different kinds of surfaces.

I have above made distinction between a polished surface and a mirrored surface. The difference can be seen upon consideration of Fig. 4. Here a light ray is illustrated following the direction of the arrows. The ray strikes the surface and it immediately becomes split up into two or more parts. Assuming two parts, one ray would be reflected from the surface of the glass, and the other would pass through the glass and, striking the silver at the back of the glass, be reflected through the glass into space again. The direction of the ray is constant through the air, but, after being split, the direction of the ray through the glass is altered; in other words it is *refracted*. The two rays, however, after reflection and refraction, follow different paths, but the paths are parallel.

Splitting up Light.

The intensity of the second ray cannot be equal to that of the ray which is reflected from the surface of the glass. This is because the effect of refraction is to split up the rays into the various colours which go to make up the spectrum of the original light ray. The amount of refraction depends upon the thickness of the glass and its shape.

Refraction, in the form of producing the spectrum, can be readily demonstrated by several simple methods. The most simple form is, perhaps, that adopted by a boy when, with an ordinary glass mirror, he re-directs light from the sun into any comparatively dark space. The light rays from the mirror are projected in the form of a beam; the beam will, as a whole, be divergent so that if the mirror is some distance from the object upon which the beam is projected the latter will be much larger in area than the mirror surface. If the disc of light from the beam is examined it will be found that, round the edge, the colours of the spectrum from red to violet can be seen.

Obtaining a Spectrum.

Another method, and one which is demonstrated in almost every room in which is fitted a mirror with bevelled edges, is shown in Fig. 5. A light ray strikes the back of the mirror near the edge and passes through the edge into space. The bevelled edge is in a different plane to the surface of the mirror proper; the effect is therefore more like that produced when obtaining the spectrum colours through the medium of a prism. (This has been dealt with by another writer in this journal.) In mirrors which have a deep bevel the spectrum can be seen upon the wall, or, better still, upon a sheet of white paper placed in such a position as to intercept it.

It has been shown that light rays from polished or mirrored surfaces are reflected in the form of a beam. This is not the case with matt reflecting surfaces. In one case the reflection is known as direct reflection; in the

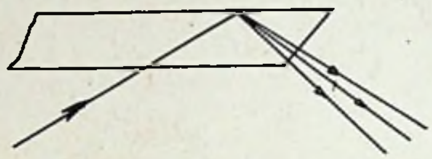


Fig. 5.—Effect of ray of light passing through the bevel of a mirror.

other it is termed spread reflection. Fig. 6 will illustrate the latter.

The *surface*, which for our purpose may be compared with a piece of white blotting paper, is comparatively rough, so that many reflecting surfaces are presented to the light rays. It has been shown that the angle of incidence is equal to the angle of reflection, so that, since the reflecting surfaces are not in the same plane, the reflected rays will radiate in all directions from the point of contact on the reflecting surface.

A clear understanding of this, in television, is important since the reflected light is *diffused* light. Light of a well-diffused character, especially when it is derived from artificial light sources, has the effect of destroying shadows. And shadows of the right quality are essential to produce that effect of light and shade which enables objects, and beings, to be seen in their three dimensions. In television many settings will be broadcast under artificial light, so that, in the production of perfect pictures, where the settings are of a high reflection factor, it may be necessary to instal directional lighting at certain points

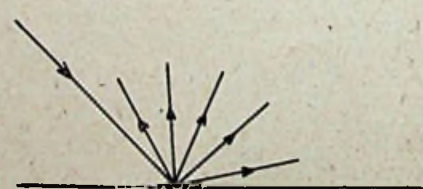


Fig. 6.—Form of reflection from a matt surface.

in order that soft shadows may be emphasised. In scenes and settings broadcast under normal daylight, where refraction has been too great, it may also be necessary to *correct* for the loss of colour in the normal spectrum.

(*To be continued.*)

The Television Society

Report of Opening Meeting, 1928-29 Session

THE first meeting of the winter session of the Television Society was held on Tuesday, November 6th, at the Engineers' Club, Leicester Square.

DR. CLARENCE TIERNEY presided, and the lecturer was Major Church, M.C., B.Sc., who spoke on "Science and Social Progress."

Dr. Tierney, opening the meeting, said that since they had last met they had had to record the loss of their President, the late Lord Haldane. No one realised as well as the Executive what that loss really meant to the Society and to the advancement of science. Lord Haldane had always supported those who engaged themselves on scientific research simply for the love of the work.

In Memoriam.

The condolence of the Society with Lord Haldane's relatives had already been expressed, and graciously acknowledged.

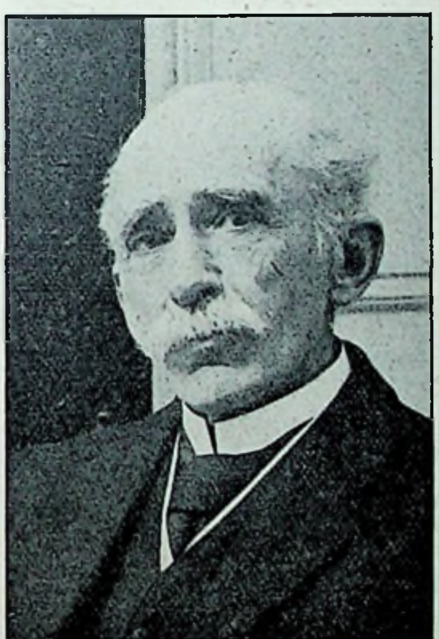
The Society also had suffered another loss in the death of Sir James Percy, their Vice-President, who died very suddenly about a week ago. He was keenly interested in the development of the Society and all that it stood for.

The secretaries had already communicated with Sir James's relatives informing them on behalf of the Society of the members' sincere sympathy and regret.

To succeed Lord Haldane as President, Professor J. A. Fleming, M.A., D.Sc., F.R.S., had been nominated—a selection which he felt sure would be very acceptable to all of them. His name in connection with wireless was too well known to need any further recommendation. Professor Fleming was very keenly interested in the Society and the possibilities of the practical application of television.

Two of the first words Professor Fleming had used recently when they were together discussing television were that he was "quite satisfied."

When a man with considerable and sound judgment—and they must not forget that Professor Fleming was identified with wireless from the earliest days—when such a man said he was quite satisfied, they could take courage and go on with their experiments and not attach too much importance to any little hindrances that might be put in the way by "authorities" or others.



Dr. J. A. Fleming, F.R.S., who succeeds the late Lord Haldane as President of the Television Society.

He was sure they would all enthusiastically welcome Professor Fleming's acceptance of the Presidency.

For the Vice-Presidency he had pleasure in announcing that Lord Angus Kennedy had consented to fill the position.

There was another matter which he was sure would give them satisfaction.

One had heard a lot about television, and some of them knew something about it, but at the same time there were many members who had not had an opportunity of seeing these things.

Accordingly, in order that there might be an opportunity afforded to members of seeing a practical demonstration of the present development of the art—and he could assure them it was very far advanced—the secretaries had been in communication with the Baird Television Development Company with a view to getting them to place a receiver at the disposal of the Society for the reception, by wireless, of a television transmission.

Television Demonstrations for Members.

A very cordial reply had been received from the Company granting the loan of a receiver, and, if need be, the services of the Company's engineers at the transmitting station.

It was hoped that a receiver would be installed at the Engineers' Club, so that a demonstration could be given at the conclusion of the next meeting of the Society on Dec. 4th.

Their best thanks as a Society were due to the Baird Company for the way in which they had responded to the request for a loan of a receiver.

There was one other matter. Membership badges were now available and could be purchased from the secretaries by those who had paid their subscriptions. Admission to the next meeting of the Society would be by badge, and members would not have to sign, as they had had to do that night.

Introducing Major Church, Dr. Tierney said that the subject of science and social progress was so closely linked with our everyday life that no one needed any assurance that they were very intimately related. Conditions of civilisation to-day were such that without science civilisation could not possibly exist.

Major Church was intimately associated not only with science, but also with social conditions. There could be no more competent exponent of the subject than he.

Non-Political.

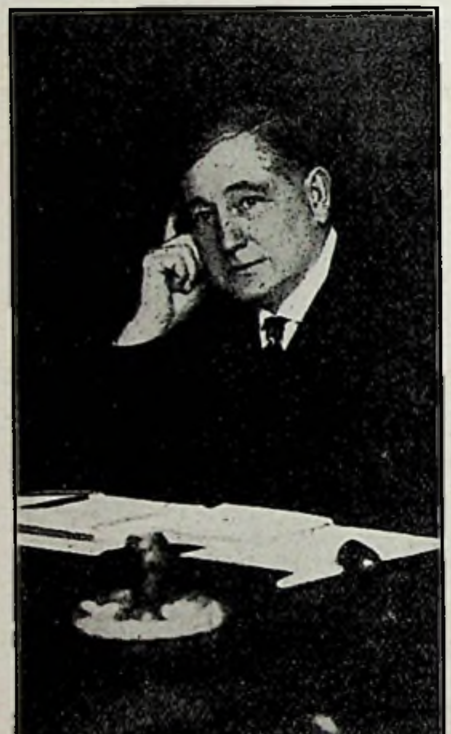
MAJOR CHURCH, in the course of his introductory remarks, said he had not called his lecture "The Science of Social Progress" because he thought some of them might think he was going to deal with the progress of the Labour Party based on the progress of science; but he did not think the Labour Party had any greater leanings towards science than any of the other political parties. Its attitude towards science was the same as that of other parties. He explained this because they might imagine that because he was a scientific worker he was in the Labour Party. One's political feeling was not based normally on one's profession or activities. It was not his intention to deal specifically with social progress.

He regarded progress as something which came from the mind rather than something which was determined by material things, and so he suggested that the progress of civilisation was not a uniform drift towards better things. We could none of us look back on the last twenty years and say that science had been used to foster the greatest amount of progress. If science had been used it had not been used to the best advantage. On the other hand we could not attribute to science many of the difficulties with which the world was confronted at present.

Jeremiahs and Pessimists.

There were Jeremiahs and pessimists in our midst who regarded each new scientific discovery with dismay—it complicated still further an already complicated existence—the task of acquiring an understanding of the environment of man in so-called civilised communities called for too great a mental effort. The alternative to complete understanding was unthinking acceptance—or an attempt to understand a part. We were not yet near a great synthesis of knowledge—with consequent simplification. We were not within measurable distance of applying the scientific attitude of mind to the solution of the economic, social and political problems confronting us. Familiarity with the triumphs of science had not yet brought statesmen and rulers to consider its possible applications to statecraft.

The true scientist believed that the habit of thought inculcated by a study of science made for progress. But he did not regard progress necessarily as merely mastery over nature, the harnessing of natural forces, the substitution of an age of plenty for an age of scarcity, the raising of the material standard of living. Neither did he believe that science was the essential precursor of the age of reason. For science was unreasonable—it refused to regard anything as fixed for all time—it was the apostle of change.



The late Sir James Percy, D.L., J.P., whose recent sudden death deprived the Society of its Vice-President.

Progress had been defined in J. B. M. Haldane's "Dædalus" as "Man's gradual conquest, first of space and time, then of matter as such, then of his own body and those of other living beings, and finally the subjugation of the dark and evil elements in his own soul." Science built on its past but refused to be chained to historical determinism. It refused to be chained to any doctrine, to any particular code of ethics. It visualised life dynamically, not statically. It proved the infinitesimally small and the infinitely great, the atom and the stellar universe. It strove to find harmony in all things organic and inorganic.

The one categorical imperative which it recognised was the urge towards greater knowledge, the freeing of man's energies for the development of his imagination. It was the environment of men's minds with which science should be mainly concerned. The utilisation of the discoveries of science by the multitude without any understanding of the work upon which they were based was fatal to real progress. Acceptance without wonder tended inevitably towards the decay of the principal function of man—the exercise of his creative instincts.

"Conscious Beginnings of Science."

Time would not permit of a reference to the conscious beginnings of science. To deal with our own generation—the greatest of modern scientists was undoubtedly Michael Faraday, the son of a blacksmith and a farmer's daughter, born in a London slum and apprenticed to a bookbinder, before the urge of science took him to Humphry Davy as a humble supplicant for the most humble post that could be offered him in Davy's laboratory in the Royal Institution.

Faraday was the greatest experimental philosopher the world had ever seen. Synthetic dyes were based on his discovery of benzol. The chemical and metallurgical industry owed an incalulable debt to his work on electro-chemical equivalents—while electro-magnetism and all that that meant was based on his labours. His demonstration of electro-magnetic induction inspired Clerk Maxwell's brilliant mathematical work, which in turn opened up the field of research with which we were now so familiar, and upon which most of the work of J. L. B. Haldane was based.

Jealousy and Discouragement.

Faraday did this in the face of every kind of discouragement, the jealousy of the less-favoured intellectuals of his time, even of his patron Humphry Davy, who prevented his receiving the F.R.S. for years.

He mentioned Faraday because that brought his survey up to the present day, and because there was a similarity between the fight Faraday had in his day for recognition for his work and the fight that was going on at the present time.

At present we had men not undistinguished in science definitely doing their utmost to discourage what they considered was a mere spark of progress. We had, too, the example of leading statesmen who were indifferent to the possibilities of a marvellous invention.

"What is the Use of it ?"

Mr. Gladstone, when he visited the Royal Institution, was shown Faraday's first experiments—his early ones with the iron ring and the coil—and was shown a spark, is said to have remarked: "What is the use of it ?"

Faraday's reply was: "You will be able to tax it some day."

A distinguished lady of the time also visited Faraday, looked at his various "toys" as she thought them, and said: "Yes, but, Mr. Faraday, what is the use of it ?"

Faraday retorted: "Madam, what is the use of a new-born babe ?"

It was not merely the attitude of statesmen that we had to deplore. We had also to deplore the attitude of the Royal Institution and the acknowledged great men of the time towards science. For, just as in Faraday's day they did their best in this country to extinguish the transcendent genius of their time, so today we found, although to a lesser degree, the same forces at work trying to prevent the necessary facilities being given for experiment which might have incalculable social and industrial results. At least, that was what many of them felt, and he thought the way in which the journal "Nature" dealt with the attitude of the B.B.C. towards television recently was fully justified.

Those of them who had seen the progress made in the last year and had seen what had been done were fully convinced that the time had arrived when this newest discovery should be made available in the homes of those who wished to share in the experiments that were going on.

One could say that broadcasting of the voice was still in an experimental stage. They felt that broadcasting of living objects was just as far advanced as the broadcasting of the voice or other sounds was when it was first put into the hands of the people in this country. Instruments then were very crude; but they gradually became better because people became familiar with them and created a demand that they should improve; with the result that manufacturers and scientists realised the necessity of improvement and concentrated on it. It was only when an invention of this kind became familiar to hundreds of thousands of people that one got scientific research focused on the essential need of improvement and progress.

Lord Angus Kennedy, who succeeds the late Sir James Percy as Vice-President of the Television Society.

That was just the line which the editor of "Nature" had taken, and he had said that he saw no reason why facilities should not have been given by the B.B.C. for the transmission of images by means of television. That, he thought, was a view which would be shared by every member of that Society.

"Unprogressive Attitude of the B.B.C."

They wanted progress, and more and more minds brought to bear on this, because the cost of experiment borne by a few was enormous; but the cost of experimental work when based on the researches of a large number of people who had become interested in a subject was much less, for those interested people created a demand, which in its turn made the necessary experiment and progress worth while. It was for that reason that **some of them deplored the somewhat curious and unprogressive attitude of the B.B.C., which, as they knew, enjoyed an extraordinary freedom from Parliamentary criticism. He hoped it would not enjoy that freedom for too long a period.** One disadvantage of the present House of Commons was that it was very difficult to get a matter of that kind raised by anyone who was sufficiently interested in the progress of science or scientific discovery.

There was a chance, said Major Church, for any budding Parliamentarian in the House of Commons to bait Parliament to enforce upon the B.B.C. the acceptance of the firm attitude of the Post Office engineers.

One had there this curious conflict of opinion. The Post Office engineers who saw the experiments thought that they were sufficiently far forward for them to be given a trial. The B.B.C., which was the only body in existence in this country which could give definite facilities and provide the necessary time and wave-lengths for the experiments, on a fairly large scale, had said "No," not only to the Baird Company, but to the Post Office engineers as well. He had a sincere admiration for the Post Office engineers and their opinion. It must be clear to them, particularly if they read the TELEVISION journal, that the social implications of television were enormous.

Indifference.

The great objection to television which had been given to him by a certain distinguished scientist was that it was "... merely adding another inconvenience to an already inconvenient life."

As a nation we could not stop going forward with our scientific ideas; and he hoped shortly that we should be able, as well as listening to the curious comments of all kinds on the football field, to look through a televisor and see what was happening, rather than have it somewhat

Major Archibald Church, D.S.O., B.Sc., whose lecture is reported in these pages.

imperfectly described. **He thought the time was near when the whole of the people of the country could go to a central hall and watch the opening of Parliament, which in itself would be an immense boon to people who previously had only been able to read about it.**

When describing other events at a distance, too, there would be the possibility of seeing people thousands of miles away in their own environment, which would be a great help towards giving us a true understanding of other nations; for an Englishman in a foreign country was entirely different from the Englishman at home.

Such things, he thought, would do more than anything else for the peace of the world.

Everybody knew how science was used in the last war, and many of them had some definite ideas as to how it would be used in the next; that was, if the world decided to have another such holocaust.

On the other hand, there were many enlightened scientific people who said that the function of science was to permit social progress and to bring people together and rationalise the world as a whole. Few of us were insular in our attitude; we might be imperial, but that in a sense was largely a form of internationalism.

Use Science to Prevent Wars.

We had reached a stage when we must, to prevent any further conflicts, rationalise the world as a whole, and science had to help in that work. We must make up our minds what was the total potential consumption of the world's stores by the present population. That was a scientific calculation of some magnitude, and we had to determine the system under which the needs of the world, and some of the potential needs, were to be satisfied, and where science would come in.

There was at the present time no need for a good deal of the waste that was going on, for the discoveries of science had not been used in the way that they might be. He was a firm believer in developing those parts of the world where we could transport a large proportion of the people in this country; for either we had to satisfy their needs here in an uneconomic and wasteful way, or we could satisfy them in those other lands in a self-respecting way, which would, in its turn, be of use to the rest of the world.

Social System Outgrown.

That was already possible, for we had the capacity lying in this country to-day in the form of new discoveries of science which had not been utilised. Science had actually outgrown our present political and social systems, and it had gone far beyond them. The Bishop of Ripon was perfectly right in saying that the world had not yet caught up to the discoveries of science. We could use science extraordinarily well for the purposes of destruction, but we had yet to appreciate that it could be used equally well for the purposes of constructing an entirely new world.

Major Church concluded his lecture by showing a series of lantern slides dealing with recent developments in the art of television at the Long Acre laboratories of the Baird Company.

Commenting on these, Major Church said that the members of the Society could do a tremendous amount of work to help on television by urging their members of Parliament to take an interest in the work. It was not enough for a letter to appear in a prominent newspaper. They, as members of the Television Society, must be prepared at all times, in season and out, to explain what television really was, and why it should be given a fair trial in connection with broadcasting. They must not lose sight of the fact that television demonstrations and experiments carried out in other countries were very much behind those carried out here. Members should use every means possible to shake the complacency of the B.B.C. on the one hand and the Members of Parliament of the country on the other, for television was something that was going to bring a tremendous amount of joy to a large number of people.

DR. TIERNEY, thanking Major Church for his very interesting lecture, referred to the achievements of science, particularly with regard to television, and said that as members of the Television Society it was their business to see that they left a record of any discoveries that had been made, and, further, to see to it that those discoveries had a practical application and that the community was permitted to enjoy the facilities that the practical application of ascertained knowledge would give, in spite of all the difficulties that might be put in the way by people who did not appreciate what had been done.

They could take encouragement from the fact, too, that practically every scientist who had made any discovery that was worth while had had the same experience.

Take the case of wireless alone. It was perfectly true that one name loomed large in connection with it, but they should always remember that there was such a person as Hertz,

Full-size reproduction of the new Television Society Badge, which is now available to accredited members, price 1s.

who had had no recognition in his day. Or, to come down to modern times, where would wireless be without the Lodge condenser, or the Fleming valve? Clearly one man did not do it all.

It was the function of a society such as theirs to see that experimenters had facilities and opportunities of getting together and comparing results. That was fundamental to

(*Continued on page* 35.)

The Story of Chemistry

Part III

Inside a Molecule

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

IT would probably be wise, for the sake of my own reputation, to preface this article with the statement that Sir William Bragg and those who follow him have expressed great doubts as to the existence of such things as molecules. This suggestion has been reached after the study of the structure of crystals by means of X rays. Now the chemist prefers to think of crystals as being very regular "buildings" made up of molecular "bricks," and does not greet with any great favour a suggestion that such bricks are like unto those which build castles in the air. Still, none of us like to be very dogmatic about anything in these days, and so we dismiss all doubts by saying that, molecules or no molecules, the easiest way to understand more-or-less elementary chemistry is to think in molecules.

"Our Sand-hill World."

Therefore, let us get closer to our "sand-hill" world, and enquire how these molecules are made and how they behave. We have already said that the molecules of all the thousands of different substances of the world—and probably of the universe—are made up of just ninety-two different atoms. Those of us who have tried short cuts to fortune via football coupons know that a mere twenty-four matches present a number of possibilities which run into millions. Somebody has calculated that it would absorb the national debt to buy sufficient coupons to make certain that we did get the correct result among our entries. The possibilities, therefore, when we deal with ninety-two atoms joining up in all and every kind of way present a problem the solution of which would land the best of us in the nearest lunatic asylum!

Fortunately this path need not be trodden, because, with all these possibilities, only a few are ever taken. The molecules are made of atoms, and the atoms are as full of likes and dislikes as an annual conference of a united political party. The atoms are extremely sensitive—and now, of course, we are talking of the complete atom, with central nucleus and its full complement of planetary electrons. For example, the atom is extremely sensitive to temperature. Given a very hot atmosphere the atom becomes as exclusive as a profiteer's wife who has wandered by mistake into the district in which she was born. On the sun it is thought that the atoms just remain as solitary atoms, some of them, as it were, feeling the heat so badly that they strip off their coats, that is, shed some of their planetary electrons, others going so far as to wander about as nuclei alone—stark naked, to continue the metaphor.

THIS is the third of our contributor's articles on the story of chemistry, written in simple everyday language. Last month he told us some of the wonders of the atom. This month he takes us inside a molecule—i.e., two or more atoms which, combined, form a unit having characteristics totally different from those of the atoms which compose it.

Under cooler conditions, however, they consent to huddle together, but again their likes and dislikes come prominently into play. It is not a case that just anything will do. This huddling together the chemist calls combining, and he recognises that in general an atom will not combine with all other atoms, but only with certain other atoms. If forced by circumstances to effect a partnership which is not "pleasant," then the first opportunity is taken of breaking up such association. The chemist has a name for this phenomenon; he talks of the *affinities* of the atoms. Such and such an atom has a great affinity for some other atoms, or it has little affinity, or none at all. Quite what he means by this word he cannot say, but it is convenient to have such a word, and so avoid the language of metaphor.

"This Affinity."

This affinity varies considerably. It varies with the nature of the atoms and the conditions under which they meet. Thus hydrogen atoms have a great affinity for oxygen atoms, under certain conditions. You can hit the right conditions if you set out with a lighted match to look for a leak of long standing in the gas pipe. Part at least of the excitement which follows your successful finding of the leak is due to the eager combining of hydrogen and oxygen atoms. But you can fill a jar with hydrogen and oxygen, and keep it on the table beside you, and both substances behave as if they had never been introduced. The match flame serves as the introduction.

Quite roughly we can divide the atoms into two groups—metals and non-metals—and in general the metals have an affinity for the non-metals. It is a matter, however, of degree, and not in any sense absolute. There are, however, a group of very superior atoms which will have nothing whatever to do with any other kind of atom under any known circumstances. These are the rare gases of the atmosphere, or, as they are often called, the inert gases. We have reasons for believing that these atoms have reached a state of complete satisfaction—a kind of chemical Nirvanah. There is nothing in the world which can attract them.

Most of us know that the atmosphere consists mainly of a mixture of four parts of nitrogen with one part of oxygen, with varying quantities of

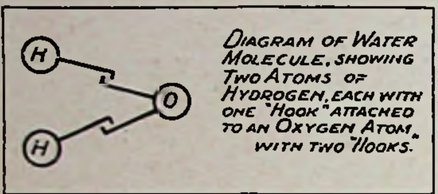


Fig. 1.

water vapour and a very little carbon dioxide. In 1894 the late Prof. Ramsay isolated from the atmosphere another gas, to which the name Argon was given. His specimen was proved to be impure, and from it a number of gases were separated. These were alike in two respects. They were elements which in their physical properties had a resemblance to nitrogen. Chemical properties they did not possess. They combine with no other element, and are affected by none of the most energetic of our chemical reagents. In fact they are quite content to remain as they are.

Stability.

Actually it appears that the planetary electrons which surround the nucleus can take up various arrangements, a few of which are so stable as to make the atom contented with itself. Most atoms either desire more electrons to complete their complement required for stability or they have too many, and do their best to get rid of the extra ones, both processes resulting in chemical combinations.

These inert gases have been found to be of great service. They consist of individual gases, which have been

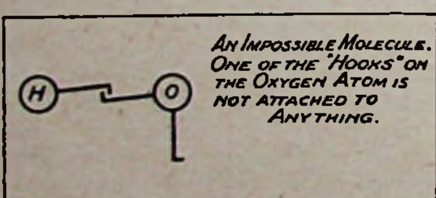


Fig. 2.

named argon, helium, neon, krypton, and zenon. Argon and neon particularly have been utilised to form the inert atmosphere in gas-filled lamps. The neon-tube contains neon under reduced pressure, and when an electric discharge is passed through it an orange-red light is emitted.

The affinity of the atoms, then, sets one limit to the possible number of combinations. A further limit is set by what the chemist calls the *valency* of the atoms. When a molecule is formed then certain atoms become associated together. Some force, of which we know very little, holds the atoms together, but it is a very definite force and it has its limitations. It will help us if we form a mental picture—which most certainly is not true to nature—and suppose that atoms are supplied with *hooks* by which they cling to other atoms. The "clinging" is not just a hanging on anywhere, but is effected by the hooks of one atom linking on to the hooks of another.

Atomic "Hooks."

Thus, for example, it is known that the oxygen atom has two "hooks," while the hydrogen atom has only one. In a chemical combination none of these hooks may remain waving about, as it were, unattached, and so when oxygen atoms and hydrogen atoms unite to form a molecule the simplest possible formation is as shown in Fig. 1. Any such arrangement as shown in Fig. 2 is impossible. Similarly we cannot have three hydrogen atoms attached to one oxygen atom, or two oxygen atoms attached to one hydrogen atom. Possibly we shall be speaking more scientifically if we say we "do not have" these things, instead of we "cannot have them." The number of "hooks" on an atom is called its valency. Thus hydrogen has a valency of one, or it is *univalent*; oxygen has a valency of two, or is *bivalent*.

Thus valency sets another limit to the possible number of molecules. There are other limiting factors, which we need not consider for the moment, but enough has been said to show that the study of molecules is not going to be the terribly complex affair that at first sight would appear to be the case. Even with these two limitations of affinity and valency there would seem to be more than enough for the human mind; but fortunately a further simplification comes to our aid.

With a cartload of bricks one could build many different kinds of structures, but mankind has settled down to a few plans on which houses are constructed. There may be minor variations from house to house and from district to district, but in the main a few constructional plans are common to all buildings.

The atoms have, in the same way, some favourite groupings; but before we attempt to consider these it will be as well to introduce the method by

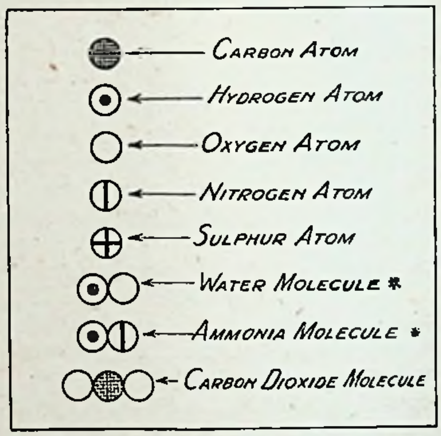


Fig. 3.—Typical examples of symbols used by Dalton.
* Dalton was wrong in the constitution of these molecules.

which the chemist is able to represent the plans of molecules in a very short and convenient fashion. He might quite well have represented molecules by little pictures as in Fig. 1. Dalton in fact did try some such method as this, some typical examples of which are shown in Fig. 3.

From Atoms to Molecules.

It is easy to see that this system is rather clumsy, and most confusing once we get beyond a very small

SYMBOLS OF THE COMMONER ELEMENTS.

Aluminium	Al	Carbon	C	Krypton	Kr	Palladium	Pd	Sulphur	S
Antimony	Sb	Chlorine	Cl	Lead	Pb	Phosphorus	P	Tantalum	Ta
Argon	A	Chromium	Cr	Lithium	Li	Platinum	Pt	Tellurium	Te
Arsenic	As	Cobalt	Co	Magnesium	Mg	Potassium	K	Thorium	Th
Barium	Ba	Copper	Cu	Manganese	Mn	Radium	Ra	Tin	Sn
Bismuth	Bi	Fluorine	F	Mercury	Hg	Rubidium	Rb	Titanium	Ti
Boron	B	Gold	Au	Neon	Ne	Selenium	Se	Tungsten	W
Bromine	Br	Helium	He	Nickel	Ni	Silicon	Si	Uranium	U
Cadmium	Cd	Hydrogen	H	Nitrogen	N	Silver	Ag	Vanadium	V
Caesium	Cs	Iodine	Ir	Osmium	Os	Sodium	Na	Xenon	Xe
Calcium	Ca	Iron	Fe	Oxygen	O	Strontium	Sr	Zinc	Zn

number of atoms. The great Swedish chemist Berzelius, recognising the value of these symbols, suggested that Dalton's geometrical figures should be replaced by letters of the alphabet, a suggestion that was at once taken up and with minor modifications it is used to-day.

Representative Symbols.

Thus we now represent an atom of hydrogen by the letter H, oxygen is represented by O, sulphur by S, carbon by C, and so on. When necessary the first two letters of the name are used, the second one being a small letter; thus the letter C being taken up by carbon, copper is represented by Cu—the two first letters of the Latin name of the element (*cuprum*). Silver (*argentum*) has the symbol Ag.

It is absolutely essential to stress the point here that these symbols represent the *atoms* of the elements. It is incorrect to use them to represent any known substance. If we are speaking of copper as a substance, then we must not represent it by the symbol Cu. Any specimen of copper, as we know it, consists of molecules of copper, and a molecule of copper contains a definite number of atoms.

A list of the symbols of the more important elements is given in the table reproduced on the preceding page.

Now, from the atoms let us pass to the molecules. These we represent by placing the symbols side by side. Thus on these wintry evenings we sit and watch a flickering blue flame playing on the top of a grate full of glowing coal. This blue flame is formed by the burning of a poisonous gas called carbon monoxide. The molecules of this gas contain one atom of carbon and one atom of oxygen, and it would be represented thus: CO. Water molecules contain two atoms of hydrogen and one of oxygen, and would be represented thus: H_2O. If for any reason we need to write about two or three molecules of water then these would be represented thus: $2H_2O$, $3H_2O$.

Such representations of molecules are called formulæ, and again it is necessary to stress the fact that they stand for molecules and not for specimens of matter which are aggregates of millions of molecules. H_2O means *one* molecule of water.

Unknown Compositions.

We know the composition of most of the molecules with which we deal, but there are still a number which we do not know. Copper has already been given as one of these unknown examples. Most of the elements have molecules, the composition of which we do not know. We know what kind of atoms are in them—all atoms of one kind—but how many we have not found out. We might write a copper molecule thus Cu_x, where "x" stood for any number. This would lead to endless confusion, and therefore it is an accepted convention to write just the symbol for those elements whose molecular composition is unknown, and remember our ignorance.

We know the molecular composition of most of those elements which are gases at the ordinary temperature of the air. Thus, for example, the molecule of hydrogen contains two atoms and its formula is H_2; that for oxygen is O_2; for nitrogen N_2. Where we have definite information we use it.

Some Examples.

It will possibly be useful if we give a few examples here, to make certain of these formula. Sulphuric acid is a well-known compound. We use dilute solutions of it to fill up our low-tension batteries, when these are of the type known as secondary cells or accumulators. Sulphuric acid is a compound containing sulphur, oxygen, and hydrogen. Each molecule of it contains two atoms of hydrogen, one of sulphur, and four of oxygen, and its formula will be H_2SO_4. This represents one molecule of sulphuric acid, and the oily liquid in the bottle of acid is just a mass of particles, these molecules made up of these seven atoms clinging together.

We might, of course, write the formula in another way, like this, for example: O_4SH_2 or H_2O_4S; but we shall see later that there is a very good reason for using the first form; for in the molecular world there are rules of architecture which molecules follow, and the formulæ are written so that he who reads may see plainly the rule which has been followed, and knowing the rule deduce much information as to the nature of the molecule.

Television Society

(*concluded from page* 32).

advancement and was the main object of the Society.

Dr. Tierney hoped it would not be very long before those of them who had receivers would be able to pick up transmissions of television and show their neighbours that there was no adequate reason why they should be denied it.

LORD ANGUS KENNEDY seconded the vote of thanks to the lecturer, which was proposed by Dr. Tierney.

At the close of the lecture DR. TIERNEY announced that the lecturer at the next meeting to be held in December would be Professor Cheshire, who was going to speak on tuning-forks.

SOCIETY ANNOUNCEMENTS.

All members of the Society will be glad to hear that Dr. J. A. Fleming, M.A., D.Sc., F.R.S., has accepted the office of President in succession to the late Lord Haldane.

Lord Angus Kennedy has also consented to serve as Vice-President in place of the late Sir James Percy, D.L., J.P.

ANNOUNCEMENT OF MEETING.

On December 4th Prof. Cheshire, C.B.E., A.R.C.S., F.I.P., will lecture on:—

"TUNING FORKS: How they Talk and What they Say."

Being a simple experimental introduction to the study of wave motion.

Before and after the lecture demonstrations of television will be given, and members wearing badges may claim admission to the demonstration room.

The badge is now available and can be had on application to the secretaries at a charge of one shilling, to cover cost. This is issued to accredited members only.

Members will shortly receive a circular regarding exhibition of members' work, which it is proposed shall take place in May.

The secretariat wish to thank the many members and correspondents who have kindly written making suggestions, and to convey cordial Christmas greetings to all members at home and abroad.

J. DENTON,
W. G. W. MITCHELL,
Joint Hon. Secretaries.

The Triumph of the Noctovisor

By Derek Ironside

JUST as the clock indicated 10.5 a.m. the Managing Director of the Anglo-Imperial Engineering Corporation rang for his secretary.

"I want you to get Mr. Vincent over at once from the works," he instructed his secretary when that gentleman had duly appeared. Presently there was a knock on the door and Mr. Vincent, Assistant Chief Engineer, entered. He was a pleasant, keen-looking young man.

"Sit down, Mr. Vincent. I've something interesting to tell you. Here is a letter which has come in this morning from the War Office. It is marked 'Secret':

"I am directed to inform you that the results of the recent trial of the Vincent pneumatic machine-gun, fitted with noctovisual sighting apparatus, are regarded as extremely satisfactory. Further action is under consideration, of which you will be advised verbally to-morrow"—('That's to-day, of course,' interjected the Director)—"by Major R. Reval, R.E., of the Army Inventions Board, who is being instructed to call on you at 10.15 a.m."

The Director glanced at his watch as his secretary re-entered with a visiting card. "Major Reval has arrived, I observe. Show him in, Austin. Mr. Vincent, please stay here."

Major Reval was a fine type of the modern scientific soldier. Vincent took to him at once, as the Director suitably introduced him. Reval came to the point quickly.

"Well, gentlemen, our trials of the Vincent machine-gun have been very satisfactory. The outstandingly favourable points of the gun are its extreme lightness, due to the exclusive use of magnesium alloys in its construction, its silence owing to the perfected pneumatic method of discharging, its rapid rate of fire, and lastly, but not least, the ability it gives to the gunner to sight the weapon direct on to the target in the deepest darkness by means of the noctovisual sights without assistance from Verey lights or searchlights. The compact and sturdy character of the noctovisual apparatus attached to the gun has also met with approval."

The Major paused. Then his tone became lower and still more confidential. "The present Secretary of State for War is, as you probably know, one of the liveliest of the live wires in the Government. He is quick to adopt new ideas and he is really very enthusiastic over this gun. Now, I must tell you that serious trouble is brewing on the Indian North-West Frontier. The Afridi and neighbouring hill tribes are restless. Our repressive air policy appears to have failed. Aircraft have lost their novelty on the frontier, and the bombing of villages seems to be losing its moral effect. In addition, such action invariably results in awkward questions being raised in Parliament.

"Now, the Secretary of State for War sees in this new weapon a distinct possibility of re-imposing a healthy respect on the part of the tribes for the British forces. He has personally deputed me to go out to India at once with one of the new guns, and to put it to the test if the threatened trouble comes to a head. I am further authorised to request that you loan me one of your engineers who is conversant with the gun. He will be granted a temporary commissioned rank for the purpose."

"Serious trouble is brewing on the Indian North-West Frontier."

The Major ceased his discourse and smiled at his listeners.

"Well, Vincent, you can have the first refusal of the job," said the Managing Director, without hesitation. "That's only fair, as the gun was worked out by you in its entirety."

"That's settled, then," exclaimed the Major in his quick way. "You must get into uniform at once, *Captain* Vincent, and report to me at the War Office at 10 a.m. to-morrow."

After the Major had departed the Managing Director had a final word with Vincent.

"I trust you will pull this thing off satisfactorily. If we can convince the authorities of the vital value of this gun of yours, it is going to mean a great deal to this firm and to you. I am looking forward to getting contracts for thousands of them. Now get away—and the best of luck."

To India by Air.

At noon next day a fast R.A.F. 'plane took off from Biggin Hill aerodrome, carrying the Major and Temp.-Captain Vincent, accompanied by two military servants and a complete specimen of the Vincent pneumatic noctovisual machine-gun. With the barest stops for refuelling, the machine headed purposefully for India. Malta, Cairo, Bagdad, and Karachi followed each other swiftly as day succeeded day. Then on to Peshawar over the rolling plains of the Punjab! At Peshawar instructions were waiting that the machine was to proceed to Meranigar, one of the most advanced posts.

Flying over the frontier districts it was clear that serious trouble was brewing. An atmosphere of tension hung over Peshawar; and when they headed towards the grim hills of the frontier their fears became more tangible. As they dropped out of the evening sky into Meranigar a searchlight was nervously probing the foothills with its long quivering beams.

A Testy Commandant.

While Vincent was supervising the unloading of his precious gun the Major hastily greeted the hard-bitten frontier officers, who were crowding round, and enquired for the Commandant. He was informed that that personage was shortly arriving. His informants considerately forbore to mention that when the 'plane had been sighted from the mess-room window in the act of landing on the parade ground the Commandant had almost had an attack of apoplexy. Presently the great man arrived, and his welcome was not in the least effusive.

"Well, what do you want? Your 'plane's made a fine mess of my parade ground."

Major Reval saluted. "In accordance with War Office instructions, I have joined you with Captain Vincent on special duty. I understand you have been informed by headquarters to expect us."

"The Commandant stood impassively, very close to the blazing electric white . . . . . searchlight."

"I've had no instructions whatever. What's this queer contraption you've brought with you?"

"This is the new pneumatic noctovisual machine-gun, sir."

"And what in blazes is that in plain English?" ejaculated the Commandant testily.

"It's a machine-gun operating silently on compressed air, sir, and can be sighted on to its target in the deepest darkness," explained the Major eagerly. "These sights are the latest development in noctovision. This tube just above the gun barrel throws out a beam of infra-red rays, which although invisible to the human eye are reflected back from the target and are picked up by this compact little receiver also attached to the gun. A synchronising apparatus enables one to direct the gun on to the target as revealed in the noctovisual sights. So you see, sir," he concluded enthusiastically, "it's a combined searchlight and machine-gun, but possessing obvious advantages. It looks a trifle bulky, but it's constructed of forged magnesium-alloy—the lightest commercial metal—and is easily portable."

The Commandant snorted incredulously and intolerantly.

"Sounds like a fairy tale. Anyhow, I can hold this post till the crack of doom with my searchlight and Lewis guns. You can take your toy away. When I receive instructions about you from headquarters I will look into the matter. The frontier will be aflame to-night if I read the signs aright, and I've no time to waste now over this footling contraption." The Commandant turned furiously on his heel.

"I thought that type died out during the Great War," said Vincent disgustedly.

"Apparently not," remarked the Major. "Anyhow, I'm afraid we'll have to wait until the instructions come through."

* * *

That night the little garrison of Merinagar stood to arms. All along the frontier the ether trembled with wireless messages reporting the massing of fierce Afridis armed with modern rifles. Over Merinagar the searchlight continued to stab the darkness, and distant shots echoing round the hills soon announced that the clash of the outposts with the enemy was beginning. Presently the outposts were driven in and a silence supervened.

In the intense darkness of the night the silence was uncanny. The Commandant stood impassively, very close to the blazing electric white disc of the searchlight-projector as it swung hither and thither in an effort to locate the enemy. Somewhere in the darkness beyond the tribesmen were doubtless massing for their onslaught. The Major whispered hurriedly to Vincent:

"I don't like this at all. We will get our gun up ready in case it's wanted."

Together they trundled the machine-gun into a corner of the defences, well away from the searchlight. Vincent peered into the noctovisor, but no enemy could be seen; doubtless they were in close hiding.

Suddenly there was a roar of Afridi rifle fire from out of the darkness and a hail of bullets spattered around the searchlight. Just as the beam died out to the accompaniment of smashing glass and ripping metal the Commandant collapsed. The Lewis gunners and riflemen began to reply to the Afridi fire, aiming at the flashes, but the results could not have been very effective, and gradually the firing died down and a deep ominous hush ruled once more.

Vincent leapt to his weapon and feverishly scanned the ground ahead through the sighting apparatus. With a thrill he discerned a vast confused cluster of moving men—he saw them as dark blue figures clearly silhouetted against a paler blue background—just below a rise four hundred yards distant and gradually approaching. At a sign from him the Major, crouching at his side, fed in a belt of bullets. Vincent took careful aim, and with a feeling half of terror, half of exhilaration, pressed the trigger.

A Curious Sensation.

It was a curious, nightmare-like sensation. There were no sudden, barking reports as from the old-type machine guns, and very little recoil The gun merely quivered slightly as it poured out its rain of projectiles, which in their flight made a faint swishing sound in the air. The little blue figures on the screen of the noctovisor seemed to melt away as belt after belt of bullets was fed into the deadly gun and quickly discharged. From out of the darkness a strange uproar as of sudden pandemonium fell upon the ears of the British soldiery as they lay clutching their silent rifles. Presently Vincent ceased to fire.

Throughout the remainder of the night the troops stood to arms, but there was no further sound, for hostilities had definitely ceased. The dawn revealed a frightful hecatomb of dead Afridis barely four hundred yards away.

The Afridi chief was one of the few fortunate survivors of that frightful ordeal. His early tactics—the driving-in of the British outposts and the extinguishing of the searchlight—had been crowned with success. It had only remained to rush the British post, when superior numbers, the darkness, and close hand-to-hand fighting, would have robbed his enemies of their advantage in better discipline and technical training. Then, without warning, his force had melted away under some uncanny annihilating power. At one moment it was moving silently and orderly on its objective—the next he had found himself in a nightmare of falling bodies and amidst the curses and cries of dying men. With a remnant of his host he fled back in panic into the hills. As quickly as by the telegraph, the grim tidings of the disaster swept along the frontier. The taking of Merinagar was to have been the signal for war throughout the region, but instead the tribes slunk back into their fastnesses and peace was assured.

* * *

The story of the success of the new machine-gun reached Peshawar, whence an enterprising newspaper correspondent telegraphed a sensational account to the Press at home. Vincent and the Major became temporary national heroes, but Vincent's chief gratification was provided by a cable from the works stating that the War Office had placed a preliminary order for a thousand of the new noctovisual guns.

AN UP-TO-DATE STUDIO.

This is a photograph, taken in the Baird Laboratories, which shows what the studio of the future must look like. Besides the familiar microphone, the studio is equipped with a television transmitter, before which (right) is seated Mr. A. F. Birch, whose photograph we published last month. Singing to a piano accompaniment, Mr. Birch can not only be heard, but seen at a distance, by wireless. This studio has been prepared by the Baird Television Development Company in readiness for experimental broadcasts of sound and sight.

ANOTHER TELEVISION CRITIC EXPOSED

By

Sydney A. Moseley

I OBSERVE that Mr. Norman J. Edwardes in *Popular Wireless* " replies " to my recent criticism of that journal's attitude towards television—or rather *British* television. Let me clear this modern young man's mind of a few misapprehensions, and to offer a few old-fashioned ideas of what is fair criticism and what is not.

Firstly, in regard to " Mr. Moseley only having made himself known to the Editor within the last month," these are the facts :

In the course of a conversation with a mutual friend I happened to mention that *Popular Wireless* was the only technical journal that was not giving Mr. Baird fair treatment, and I said to this friend : " Besides, your friend Edwardes is barking up the wrong tree. He is certainly not getting the *latest* news about television, and that is bad journalism."

* * *

The sequel was a telephone call to me from Mr. Edwardes, and we arranged to meet at the Strand Palace. I found waiting for me in the vestibule quite a young man, which explains—perhaps excuses—a certain impetuosity and immaturity.

" How can you attack Baird television," I said to him, " if you have never been in the Baird Laboratories ? Obviously you don't know what is going on, and you have no idea of new developments."

" Well, I am quite ready to see a demonstration," he replied, " and I wish you could disabuse Mr. Baird's mind of a sense of my being hostile to him."

I told Mr. Edwardes that I thought he was too dogmatic. and (Mr. Edwardes will forgive me for repeating) he admitted I was a journalist of long experience and he was not. I have myself been one of the most severe critics in my time, but I don't believe in unfair criticism.

However, I told him I would ask the Baird Company if they would extend to him the same privilege they had accorded to *Amateur Wireless* and other journals. This would enable him better to give reasonable and convincing criticism, rather than make bald and bitter attacks.

Please note that Mr. Edwardes did not say, even then, that he had seen a demonstration at Olympia, nor do I accept his rather tardy statement that he did. I personally accompanied one of his chiefs—a man on whose sense of fairness I could rely—and he was unhesitatingly given a demonstration and found it interesting and worthy of encouragement. It was due to this director, by the way, that the only article describing television as it really is to-day, that has ever appeared in *Popular Wireless* from my pen, came to be written, but Mr. Edwardes nullified this *statement of fact* by getting Captain Eckersley to deliver one of his well-known attacks—founded on threadbare theory, before he personally saw television—and, in fact, my article was held back for some time until this damaging counter-effort could be obtained.

As we have seen, *the B.B.C. engineer was in the same position as the Editor of " Popular Wireless," as neither had been to the Baird Laboratories in Long Acre to see first what they afterwards proposed to criticise.*

Now why is it that Mr. Edwardes has not been invited to see what television really is ? I could answer this by quoting *in extenso* from this young man's persistent attacks, but readers are probably aware of them. Despite that, he has the temerity to state that " more than once we have congratulated Mr. Baird on this achievement," and " no technical expert who has written for this journal has deliberately scorned this experimental work."

The fact is that on no occasion has *Popular Wireless*, under the present directorship, given Mr. Baird encouragement on what he has achieved in the face of difficulties. It is perfectly true that the venom of these attacks has been lacking since Mr. Edwardes' chief went to Olympia and saw for himself the actual position of television to-day. But the Editor is doing his best !

Mr. Edwardes thinks that it is a temerity on my part to criticise scientists, whereas I am only a layman. Where I am in the strong position is that *I have seen television, and his armchair critics have not.* I challenge Mr. Edwardes to give us the name of one prominent scientist who has seen television and is still a critic, whereas I can produce a dozen or more of the most eminent names of scientists who have seen television both by land wire and by wireless, and who are strong adherents.

Besides, it is the duty of a technical British journal to be constructive in its criticism, and it should encourage rather than jeer at a British scientific achievement. *Popular Wireless* has been just the reverse of helpful, and by this time many hundreds of its readers who have seen for themselves must realise that the views contained in that journal on television are to be discredited.

THE NEON LAMP IN THEORY AND IN PRACTICE

By H. WOLFSON

Our contributor has devoted several articles to a study of the photo-electric effect and to the design, construction, operation, and characteristics of photo-electric cells. Having thus dealt with the heart of a television transmitter, he proceeds this month to deal with the heart of the receiver—the neon tube—which is the light source. Read in conjunction with another article on the subject which appears elsewhere in this issue, the following article is of vital importance and interest.

IN my previous articles I have endeavoured to give readers of TELEVISION some idea of the problems underlying the transformation of light into electricity by the agency of the photo-electric cell, and by way of a change I am proposing to devote this article to the consideration of the device which is employed to affect the reverse process—i.e., the conversion of electricity into light.

The name of this device is, as we all know, the neon lamp. However, before we commence our consideration of this, we must of necessity be fully conversant with the theory of the discharge of electricity through gases, as well as with the practical problems to be encountered when dealing with this subject.

Apparatus Required.

The apparatus employed consists of a glass tube about 30 inches long and two inches in diameter, with metal electrodes sealed in at the ends. A small side tube serves to connect the tube with a vacuum pump. The tube, which is shown diagrammatically in Fig. 1, is then gradually exhausted of air while its terminals are connected to an induction coil, the spark-gap of which is about ten centimetres long.

The purpose of the gap is to provide an alternative path for the discharge, and at first the whole of the discharge passes across this path of least resistance. On the air in the tube becoming partially rarified, however, luminous lines appear in the tube, and the flow of sparks across the gap ceases.

A most interesting series of changes now commences to become apparent.

The first phenomenon to be noticed is that the tube is filled with a luminous crimson column, usually extending the full length of the tube, and called the *positive column*. At this stage the gas is a very good conductor, as shown by the fact that the spark-gap can be reduced in length to less than one millimetre without any spark passing.

After some little time the colour disappears, and luminous discs known as *striæ* are formed. In a few seconds it will be noticed that there is a dark space, called *Faraday's dark space*, adjacent to the luminous cathode. Further changes take place as the rarification proceeds, for the striæ become wider, and the dark space becomes less marked, while the luminous glow leaves the cathode, and thus gives rise to a second dark space in the neighbourhood of the cathode, which is called *Crooke's dark space*, after its discoverer.

Crooke's Dark Space.

At this stage the conductivity of the gas begins to decrease, and the Crooke's dark space extends till it fills the whole of the tube. When this state of affairs is reached the walls of the tube are covered with a phosphorescent light, whose colour depends on the chemical composition of the glass. More often it is bright green, due to the presence of soda in the glass,

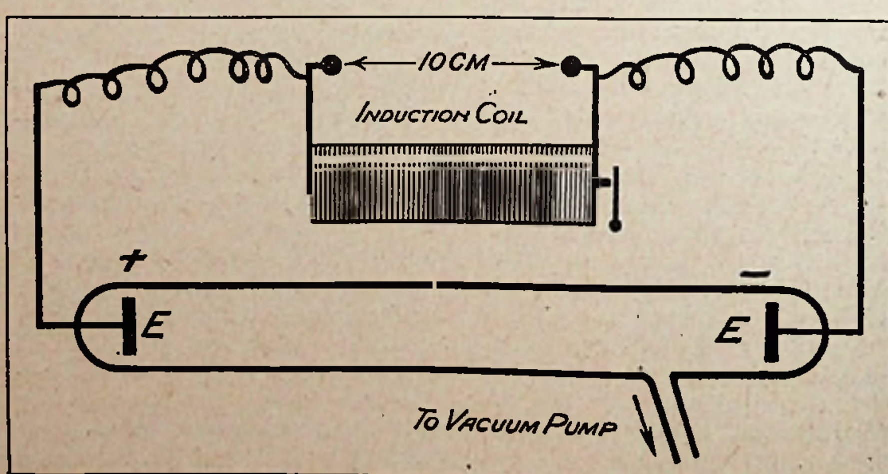


Fig. 1.—Simple apparatus required to demonstrate the conductivity of gases at varying pressures. EE=Electrodes.

while a lead glass gives a blue colour. The pressure now is of the order of *one-millionth of an atmosphere*, and the resistance is so high that it is

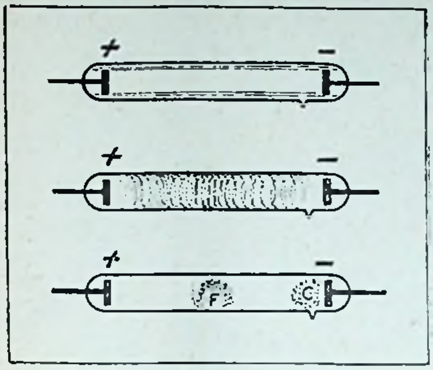


Fig. 2.—An attempt to illustrate the forms which an electrical discharge takes when forced through gases at varying pressures. These discharges are so vivid and beautiful that it is impossible adequately to describe them in a line drawing. C—Crooke's dark space. F—Faraday dark space.

extremely difficult to make the discharge pass through the tube.

I have endeavoured to illustrate these various stages in Fig. 2, but since an actual demonstration is necessary to show the extreme beauty and wonderful variation of the many phenomena, the drawings are of necessity but poor representations of the phenomena associated with the discharge.

The presence of various gases in the discharge tube has a marked influence on the colour and other characteristics of the discharge, and while the tube is in the early stages of exhaustion, it is possible to identify the gas present by the colour produced. For instance, coal-gas produces green, air or nitrogen pink, with a violet cathode glow, while carbon dioxide gives white, and hydrogen blue or crimson, depending on the width of the tube. The case of neon, however, is the most interesting from our point of view, and the warm reddish-orange glow is familiar to most of my readers who have seen the Osglim lamp or those numerous electric signs, consisting of glass tubes twisted to form words which are filled with a flickering orange glow.

What is Neon ?

At this point I feel that there are no doubt a number of my readers who are wondering about the gas neon, which plays such an important part in television. What is it, and how is it obtained? I feel, therefore, that I shall be pardoned if I digress for a few minutes in order to explain this matter fairly completely, in a manner as simple as possible.

During the course of a series of experiments to determine very accurately the density of nitrogen, Lord Rayleigh found certain discrepancies between the results obtained with chemically prepared nitrogen and that obtained from the atmosphere. This should not be so, for nitrogen is a chemical element, and thus has characteristic and unchangeable properties, both chemical and physical; hence suggestions were invited as to the possible cause of the greater density of atmospheric nitrogen.

Untenable Theories.

A number of theories which proved to be untenable were put forward, but Ramsay, a famous scientist, suggested

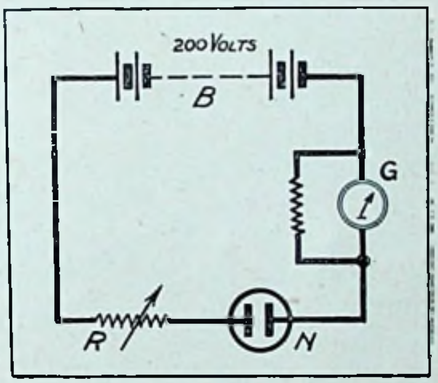


Fig. 3.—Circuit for determining the characteristic curve of a neon tube. N=Neon lamp. G=Shunted galvanometer. R=Variable resistance. B=Battery.

that the nitrogen from the air was contaminated with some gas or gases hitherto unknown, and after working on the problem for some little time he was able to announce in 1894 the discovery of a new gas, which he called *argon*.

After a short time, research on argon showed that this gas, too, was not a simple or elementary substance, but that it consisted of a mixture of five gases, all having a marked resemblance to one another in their extreme inactivity towards other chemical substances.

Helium, neon, argon, krypton and xenon were the names given to these gases, their names being derived from Greek words meaning respectively "The sun," "new," "idle," "hidden," and "stranger," all of which are singularly appropriate.

How Neon is Obtained.

Neon is now obtained exclusively from the atmosphere, though it is present to a very small extent in the gases from certain minerals and mineral springs. The air is liquefied, and the liquid air is then fractionally distilled, and, since the boiling points of the various component gases in the air are all different, this enables a partial separation to be effected. By a repetition of this process several times with the crude fraction of the inert gases, it is possible to separate a mixture of neon and helium from the other contaminating gases. If, now, the mixture of liquid helium and neon is placed in a vessel surrounded with liquid hydrogen, the neon freezes to a white solid, and can thus be separated from the helium by the simple expedient of pumping away the helium with an air pump, which has no effect on solid neon.

This brief summary, though it will suffice to explain the process to those of my readers who have not made a detailed study of chemistry, gives only a very rough idea of the difficulties to be encountered in actual practice, in order to obtain the neon as pure as possible.

Minimum Voltage Required.

Returning now to the consideration of the neon lamp from the point of view of physics, we find ourselves confronted with a difficult but, nevertheless, interesting problem. The glow discharge of the neon lamp is exactly the same as those which we have previously considered at the beginning of this article, though it differs in the one respect that the

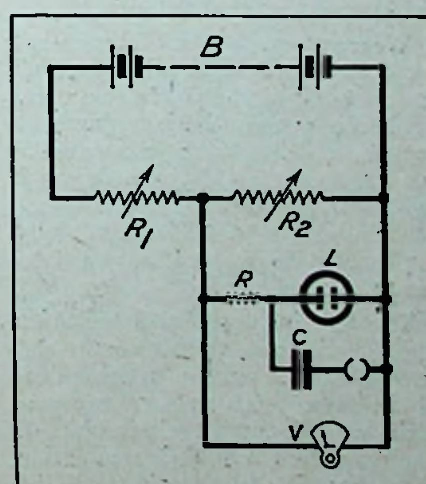


Fig. 4.—The circuit evolved by Pearson and Anson for determining the minimum sparking voltage of neon tubes.

voltage necessary to start the discharge is very much lower—about 164 volts, to be exact.

In order to explain the coloured glow we must realise that the lamp is filled with neon at very low pressure, or, in other words, the number of atoms of neon present is *relatively* small. Those who have done so much work to develop the neon lamp have found it to be very important to make certain that this pressure has a certain exact value in each lamp, in order that it shall function correctly.

When the lamp is switched on, an electric current at a voltage of 164–170 is forced through the tube, and as a result of this the neon atoms become heated, and glow with the colour characteristic of the neon spectrum.

Two points of great importance to television should be noted at this point. First, the neon tube possesses no appreciable time-lag or inertia, and thus responds instantaneously to the passage of an electric current. This fact becomes all the more remarkable when we realise that it has been shown possible to light or extinguish the lamp at the enormous rate of one million times per second. The second point, is that the intensity of the glow is directly proportional to the current strength.

Light Source Requirements.

The importance of these points lies in the fact that it is essential that we should employ a device at the receiver which can respond instantaneously and exactly to the received and amplified impulses, which correspond to those variations in light and shade of the transmitted object.

We come now to the most important part of this article, in which we shall consider fairly fully the electrical properties of the neon lamp, and the factors which govern the rate of flashing, for it is only by a thorough understanding of these matters that we shall be in a position to fully appreciate its application to television.

The first important determination in connection with the neon lamp, and one which has received a great deal of attention from various workers, is the voltage-current relationship, or characteristic curve, a determination analogous to the finding of the characteristic of the ordinary wireless valve.

A new photograph of Mr. J. L. Baird, taken in the new sound-and-sight broadcasting studio which the Baird Company has just built. Mr. Baird's position exemplifies that which would be taken up by a broadcast-speaker who desired to be seen by his audience as well as heard.

Apparatus Required.

The apparatus, the theoretical circuit of which is shown in Fig. 3, consists of a lamp in series with a high tension accumulator of some 200 volts, a shunted suspended coil galvanometer which is calibrated to read as a milliammeter, and an adjustable resistance, which serves to vary the current through the lamp. The voltage is best determined by an electrostatic voltmeter, because this type of instrument takes no current from the circuit, since it works on the condenser principle.

It has been noticed by a number of workers that the current and voltage only settle gradually to their final values, so that it is necessary to wait about fifteen minutes after varying the resistance, before taking the readings on volt and ampere meters.

The next important figure to be determined is the sparking potential, which is the minimum voltage necessary to start a discharge. The method employed is to increase the voltage slowly until a discharge occurs, and to measure this voltage directly.

An alternative method, slightly more complicated, was evolved by Pearson and Anson, and I mention it here as it gives an insight into the practical principles involved in the flashing of the neon lamp, a property which has made the lamp of such great practical utility to television.

Determining Minimum Sparking Voltage.

The circuit of the apparatus is illustrated in Fig. 4. B is a high tension battery, across which are connected resistances R_1 and R_2. The neon lamp, L, has a condenser placed across its ends, while R is a ballast resistance. The voltage is measured by a voltmeter V. The values of R_1 and R_2 are such that the lamp glows when R is at zero, and it is then possible to set the lamp flashing by increasing R to a high enough value. The sparking potential is found by adjusting the apparatus as just described, and then, leaving R at the flashing value, decrease R_2 till the lamp just ceases to flash. Under these conditions the voltage across R_2 is a measure of the sparking potential. The value is independent of the value of R and C, except when C is zero.

If we now summarise these various results in the form of a graph, such as is illustrated in Fig. 5, we shall have at our disposal the complete characteristic curve, which it is possible to interpret as follows.

Interpreting Characteristic.

The point marked B represents the last point at which the glow completely covers the cathode, the slope of the graph decreasing at this point, remaining straight, however, until the point C is reached. That part of the graph included between the points C and D shows the minimum value of the voltage, which remains constant for some time while the current drops gradually through half a milliamp. The last portion of the curve is that between D and E, where there is a rapid increase of voltage, to the fixed value (for the particular lamp) which we call the sparking potential.

The last region of the graph is of especial interest, because in this part the characteristic is definitely negative, since an *increase* in potential is accompanied by a *decrease* in the current. This region of so-called negative resistance gives us the exact conditions necessary for the lamp to act as a rectifier of alternating currents, and it is not therefore surprising to note that the lamp can be used to receive wireless signals in much the same way that one uses an ordinary rectifier valve.

Final Survey.

A careful survey of this article brings to light a number of important facts, which are important to those experimenting with a neon lamp as a generator of light in the receiving televisor.

We see that the lamp will not light until the applied voltage from the output terminals of our radio set has a value at least equal to the sparking potential. On reference to the characteristic shown in Fig. 5 we see this value, at the point E, to be in the region of 160 volts. This value, though invariable for any one lamp, varies in different lamps between 150 volts and 165 volts, though lamps of more modern manufacture are fairly constant at about 164 volts. These differing sparking potentials are due to the variable amounts of impurities present in the neon with which the lamp is filled.

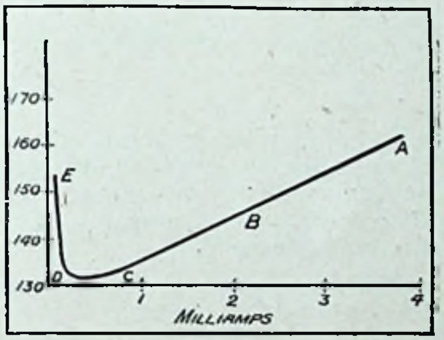


Fig. 5.—Characteristic curve of a neon lamp.

Furthermore, we must not forget that certain lamps are supplied with a ballast resistance in their base, so that in this case the applied voltage will have to be even greater, in order to overcome the resistance without falling below the sparking potential.

Once lighted, the lamp can be run on a voltage less than this value, but before the minimum voltage of 133 volts is reached (CD, Fig. 5), the condition of the lamp becomes unstable, and, as I have mentioned, the glow ceases to cover the whole of the cathode after the point B (142 volts) has been reached. The moral of this is to see that your high tension supply is invariable, besides being high enough at the beginning. Given these two essentials, the television experimenter should have little difficulty in working his receiving televisor, and in obtaining satisfactory results.

AMERICAN TELEVISION DEVELOPMENTS

By Our New York Correspondent

A grave responsibility rests upon an editor's shoulders at all times. When he is pioneering a new science the responsibilities are even greater. In the following article our New York Correspondent gives some illuminating information. It is obvious that under the American system of broadcasting, which is commercially controlled, television is developing by leaps and bounds. Despite the lack of B.B.C. recognition here, the Baird system of television still holds the lead. On another page it will be seen that in Germany also the British television system is recognised as providing the only commercial solution.

AMERICA is no place for sceptics of the new science of television, and the enthusiastic amateurs hold no brief for such scepticism as we find in the parent home of television—England. Here, on this side of the "herring pond," television is the order of the day, and novices, amateurs, experts, manufacturers, radio authorities, and station directors, all are surging around the banner of television and are urging it towards its destined place in every broadcasting station and in every private home. As it was once the ambition of all radio amateurs to "pound the brass" or check modulation, so is it now their ambition to "synchronise" and "stabilise."

The attitude in America towards television is totally different from that in England; better facilities obtain, more licence and scope are granted, full public and official support is accorded, and the proper spirit in the radio world prevails. With these encouragements American television is developing rapidly, has long since emerged from the laboratories, and is now a definite public service. Fourteen television stations are already on the air in the higher frequency band with definite schedules, while several others have more or less definite test schedules incorporated as part of their nightly programmes. Yet England has none.

This not only challenges our English policy but condemns it, inasmuch as it has hampered television development in England by confining television to the laboratory while America utilises it as a public service. As every American amateur is a potential explorer in the television field, it means that we are not only depending on Mr. Baird to maintain television supremacy against the finest expert minds of America, but we are also depending on him to maintain it against the great American amateur world in general. **And to combat the amateur, as English officialdom knows, is a bad and dangerous policy.**

While we plead for television facilities, Dr. E. F. W. Alexanderson televises plays; Mr. C. F. Jenkins televises radio "movies"; the Bell Telephone Company televises outdoor scenes in daylight, and the amateurs press hard to the fore. Yet the American television transmitters are identical with Mr. Baird's earlier designs, and the receivers generally differ only in that they make no provision for automatic synchronism—a vital weakness. The British amateur to-day is seriously handicapped by the fact that his nearest television broadcasting station is 3,500 miles away.

Radio-movies, wherein cinema films are televised, is also developing rapidly. Mr. Jenkins' system, which necessitates heavy silhouette films and a special form of receiver known as the Jenkins quartz-rod drum receiver, is among the latest developments, and transmissions on this system are already being broadcast from the Jenkins Laboratories and elsewhere. Other systems employing the conventional Baird receiver are also being tested out regularly and several short-wave stations, including KDKA, are contemplating definite schedules.

In the outdoor daylight television tests carried out by the Bell Telephone Laboratories a golfer, A. L. Johnsrud, was televised in action about 20 feet away from the camera, and his actions were reproduced with remarkable success at the receiving end. This has aroused great expectations over here, and seems to herald an era of new possibilities.

The commercial receivers as

marketed here are basically identical with Mr. Baird's televisor, but are generally without any synchronising means beyond the rheostat in the motor field winding. In some receivers synchronism is crudely obtained by hand adjustment of the rheostat, while in others a portion of the field resistance is short-circuited by a push button, thus "kicking" the motor to a greater speed. This method is also necessarily crude, since it necessitates skill and judgment in estimating the amount of kick required. These commercial receivers retail from £7 upwards and are obtainable, completely assembled or in kits, **for what they are worth—but that worth is to the American amateur what the crystal set was to the early wireless amateur.**

Mr. Baird's methods of synchronism are highly lauded out here and are considered as the logical means to practical television, but they are not as yet incorporated in any of the commercial sets I have seen in the States.

To receive certain stations 24-, 36-, 48-aperture discs are required, while the speed of disc rotation varies from 600–1000 r.p.m. Thus, to receive WGY 24-hole discs at 900 r.p.m. are required; for WRNY 36-hole discs at 600 r.p.m., and for WLEX 48-hole discs at 1080 r.p.m. The 24-, 36-, 48-aperture discs are more or less standardised in amateur equipment and the motors are designed to be continuously variable in speed up to 1500 r.p.m.

Attention is being devoted to the enlargement of the received image, and images from 6 in. by 6 in. to nearly 12 in. square have been obtained by optical magnification and by projection. A new "high-glow" neon tube has made this possible, and brilliant enlargements have been obtained.

AMERICAN SHORT-WAVE TELEVISION STATIONS.

	Metres.		Metres.
4XA	125–200	WCFL	60–61
2XBV	65–66	3XK	60–61
6XC	65–66	3XK	46·72
2XBS	63–65	2XAL	30·91
8XAV	62–63	2XAD	21·96
2XBU	61–62	2XBW	19·8
1XAY	61–63	2XAV	19·7–8

Television at Home—When ?

By WILFRED ANDERSON

What does the man in the street think of television? Our contributor classes himself as such, and gives our readers his views on the subject in a very interesting manner.

ANYONE with a little foresight can estimate the great possibilities of television when it has reached the stage of practicability. By this I mean when the necessary facilities have been granted for "putting" over a programme.

I was fortunate enough to be one of the many persons who took advantage of the offer of the Baird Television Company to witness a demonstration at the recent Wireless Exhibition at Olympia. To say in cold print that I was delighted and fascinated with what I saw, does not adequately convey the extreme pleasure I experienced in witnessing even a short programme.

When I entered the studio a lady was singing and being televised. I was amazed to see so clearly the singer's portrait recorded on the televisor. The features were wonderfully clear, and the facial expressions of the singer were registered and synchronised perfectly with the words of the song being broadcast. The next item was a gentleman singing, and here again synchronisation was perfect.

I left the studio with a self-satisfied smile to think I had at last actually seen a demonstration of television, my heart was brimful of thanks towards the wonderful genius who had perfected such a vital art.

One confession I must make, viz., when reaching home after the show my loud speaker was at work and Winnie Melville was broadcasting, and I immediately looked for the singer; it was, to say the least, distressing to hear only the song when I knew it was possible by the use of the televisor to have been able to see the artiste in question. Here it was definitely brought home to me that "radio" as we understand it was giving us only 50 per cent.—*sound*. The other 50 per cent.—*vision*, was missing. For how long, I ask, are we to remain at 50 per cent.?

I feel convinced that if every listener could have five minutes before the televisor—at a demonstration, of course—then a universal demand would be made for television, and *at once*.

One reads of a few notable people, such as Mr. Lloyd George, having their own private cinema for the entertainment of their guests. The question presents itself of inquiring why we cannot all have our own miniature cinemas at home by simply making use of this latest science called television.

We do not expect to see the setting of, say, a Drury Lane stage as a first kick-off, but even a single artiste "putting across" humour is more to be desired than mere sound. Humour alone is just what we are at present lacking—George Robey, for instance, being televised when broadcasting, and being picked up on our televisors at home for even a few minutes' show would be worth a whole evening's talkie, talkie. Or, again, one of the three political leaders delivering his final electioneering address would be just splendid, and would complete the 100 per cent. standard which we are at present lacking in our evening's fireside entertainment.

I have only touched in the merest outline of the great possibilities of television—just the fireside one. What about the position when it is developed internationally, and we are able to see the Prime Ministers of the great Dominions delivering their speeches, etc.?

Science must go forward, and we must press for television *and get* television—the sooner the better.

Invention and Development

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

IN *Patent No.* 297147, recently granted to G. Valensi, several features of novel interest appear. The specification provides for a complete system of television based in principle on mechanical exploring methods, but dispensing altogether with the usual image-forming neon lamp; an image of the source of light at the receiving station being formed in the pupil of the observer's eye or in the plane of the diaphragm of a camera. Scanning is effected by means of *two* slotted discs (1 and 2) in Fig. 1, which are rotated in opposite directions at slightly different speeds. Thus each of the intersections of the pairs of slots scans a square in which a picture may be located. It is claimed that stereoscopic or three-colour vision may be signalled by sending two or more views of the object simultaneously.

Fig 1

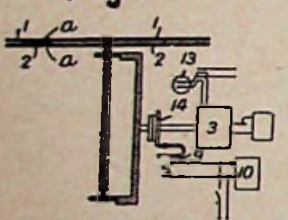
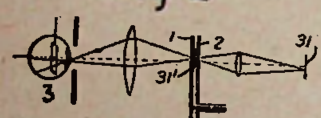


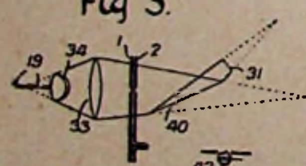
Fig. 2



The arrangements at the transmitter are shown in Fig. 2. A real image (31') of the object (31) is formed in the plane *between* the scanning discs (1 and 2) and the transmitted light pencil falls on a photo-electric cell (3).

An alternative arrangement is that shown in Fig. 3, where a light source (19) and a system of lenses (34, 33) throws a concentrated beam through the moving aperture of the scanning discs (1 and 2) on to a mirror (40), and thence by reflection to the object (31). An image of the object (31) is projected on to a photo-electric cell (42).

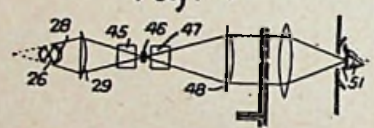
Fig 3.



At the receiver the vision signal currents are applied to the electrodes of a Kerr cell (46), Fig. 4, 45 and 47 representing the associated polariser and analyser. A constant source of light (26), such as that given from a straight filament type of lamp, is provided, an image of this filament being formed by means of lenses (28 and 29) in the dielectric of the cell (46).

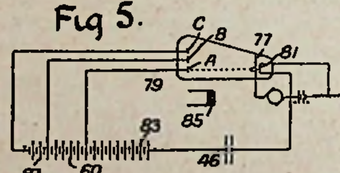
Two different methods of amplification are given in the Patent specification with circuit diagrams. The arrangement shown in Fig. 5 is interesting. Here a cathode stream derived from the filament (81) and passing through a small aperture in the positive screen (77) falls normally on a plate (*A*) so as to bring the battery (83) into circuit with the photo-electric cell (46). The current to be amplified is passed through the coil (85) and by doing so deflects the cathode stream on to another plate (*B* or *C*), thus bringing into circuit further batteries, such as 60 (or 87).

Fig. 4



Synchronising is effected stroboscopically by a tuning fork (9), Fig. 1, electrically maintained in motion by a source of current (10). A neon lamp (13) is connected to the motor (3), and this lamp intermittently illuminates the fork. The speed of the motor is adjusted until the vibrating fork appears to be motionless; the motor then being put under the direct control of the fork.

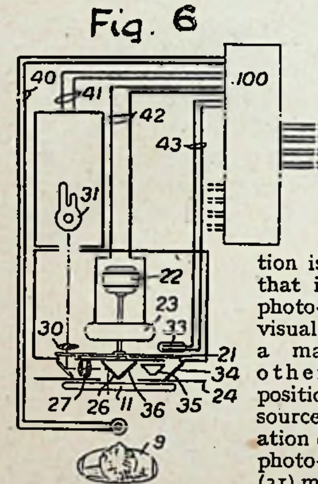
Fig 5.



A method of viewing an object by invisible rays is the subject of *Patent No.* 297014, granted to J. L. Baird and Television, Ltd. Very short wireless waves adjacent to the infra-red part of the spectrum are used. A screen or surface made up of separated and insulated conducting particles, such as metal powder, forms the detector. The resulting spark discharge may be viewed directly on the screen or may be made to influence a selenium cell. The diameter of the metal particles is about twice that of the wavelength employed.

A combined two-way telephone and television system utilising carrier current (wired wireless) transmission channels is described in *Patent No.* 297152, granted to W. E. Beatty (Bell Telephone Laboratories, Inc.). The same exploring disc (21), Fig. 6, is used for transmitting and receiving at each station. The system is designed to operate through a telephone exchange (100), the subscriber (9) being illuminated by a mercury vapour lamp (11). An image of the person being transmitted is carried by the lens system (26, 27, 30) to the photo-electric cell (31), being broken up into strips on the way by the action of the scanning disc (21). To prevent the subject being dazzled the source of mercury-vapour illumination is chosen so that its ratio of photo-electric to visual efficiency is a maximum or otherwise the positions of the source of illumination (11) and the photo-electric cell (31) may be interchanged so that in effect his features are traversed by a moving light spot.

Fig. 6



Incoming vision signals are applied to the lamp (33) and thence through the lens (34), reversing prism (35) and mirror (36).

Normally four channels are used in transmission. Channel 40 being reserved for two-way telephony, channel 41 for outgoing television signals, channel 42 is the synchronising channel, while 43 is for incoming television signals. The four channels may, however, be superimposed, the synchronising channel providing direct transmission, while the other three channels employ carrier current. In a modification of the arrangement it is claimed that all four channels may be carrier channels, or alternatively the television channels may be wireless and the telephone and synchronising channels may be wired.

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.*

ASTLEY HOUSE,
WEST PARADE,
RHYL, N. WALES.

THE EDITOR,
"TELEVISION."

DEAR SIR,

As a regular reader of your journal, and a staunch supporter from No. 1, may I take this opportunity of thanking you for the way in which you have set an example in the television world. For some time past we have felt the want of a good journal to keep us in touch with current topics and new departures in the advancement of television.

May I also apply to you for membership papers for the Television Society?

Wishing your paper every success,

Yours faithfully,
T. R. LITTLE.

J. B. SHREWSBURY'S ARTICLE.

50, HALL AVENUE,
LEEK, STAFFS.
November 16th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Mr. J. B. Shrewsbury, in his article in your November issue, proposed flooding the object to be televised with rapid oscillatory discharges so that electromagnetic waves are reflected, the rays then being focussed by a lens suitable for the particular kind of waves used on to apparatus capable of amplifying the picture without the use of rotating discs, etc., and then transmitted in a parallel beam, each ray in its respective position. Since light waves are rapid electromagnetic waves (rapid oscillatory discharges) he was merely repeating the action of the ordinary camera up to the point when he spoke of amplifying the rays. But in another part of the article he talks of these discharges as though he means waves above the visible spectrum, such as Hertz used in the experiment referred to in the article, and which need reflecting in a different manner to light waves. He seems to have overlooked the fact that waves above the visible spectrum would be reflected in entirely different proportions from the object than would light waves, and the true tone and colour effect would vanish. For instance, Mr. Baird has proved that smoke and other things reflect no infra-red rays, while foliage reflects a large proportion of them. This state of affairs would be worse with waves such as Hertz used in his experiment. Then he says that this system would bring television into every home. I am utterly at a loss to see how he could imagine that, as the resultant parallel beam would have to be directed straight to the receiver, only enabling one person to receive it. As regards amplifying the detail of the picture without rotating discs or vibrating mirrors, this seems to be a neglected line of research. Perhaps it could be accomplished by finding some substance that would vary in its reflection powers or transparency to certain rays while under the influence of light. This method of amplification, if made practicable, would completely abolish the necessity to flood the object with a very powerful light to cause reasonable current fluctuations in the light-sensitive cell. As you said in last month's TELEVISION, there is a great need for more discussion in your correspondence columns. We want more letters like Mr. Adcock's, which lead to interesting discussions. Otherwise I find TELEVISION thoroughly enjoyable and educating.

Yours faithfully,
W. H. JOHNSON.

5, JORDAN'S YARD,
CAMBRIDGE.
October 30th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Mr. Shrewsbury seems to have hit upon a very happy idea in his article on "the travelling light-spot," and I shall be only too pleased to hear of any research work carried out along those lines. However, I do not consider that he will translate satisfactorily his electro-magnetic waves into light waves by means of either calorescence or fluorescence. To produce an image by calorescence would require too much energy to render the method satisfactory, for many other radiations other than the visible radiations would be produced.

Fluorescence is generally excited by ultra-violet light, and I do not quite see how Mr. Shrewsbury proposes to make use of electro-magnetic waves without converting them into ultra-violet light. In any case he would have to use short wave-length radiation, since the wave-length of the exciting light in order to produce fluorescence has generally to be shorter than the wave-length of the luminescent light (Stokes's law). But destructive criticism is never very helpful, and so I will venture to make a suggestion that might prove of some value.

Sources of light can be divided into two groups—temperature radiation and luminescence. In the case of temperature radiation, light is given out purely as a result of the body being heated, the electrons which give out the light waves being caused to vibrate as a result of the motion of the molecules. Whereas in the case of luminescence electric or chemical energy is changed directly into the energy of the light waves without passing through the intermediate stage of heat; the electrons are set vibrating without kinetic energy being given to the molecules as a whole.

It will be seen that this is much the more efficient way of producing light; hence given a suitable luminescent substance there will be no need to convert the electro-magnetic waves into any other type of radiation. Hence if these electro-magnetic waves be focussed on to a suitable luminescent screen, they would excite it in proportion to the amount they were reflected, and so an image would be produced on the screen.

Luminescence is of comparatively recent growth, and there seems to be very little available information on the subject. However, it is possible that luminescence may be of great importance in television, and so I should welcome an article in your periodical on the subject.

Yours faithfully,
C. M. ADCOCK.

BEACH COTTAGE,
BOTLEY ROAD, HEDGE END,
BOTLEY, HANTS.
October 29th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Re Mr. John B. Shrewsbury's article one would be interested to know how he proposes to pick up the electro-magnetic vibrations emitted by the object to be transmitted. These emissions would be very small indeed, and from some parts of the object almost nil. Moreover, metal objects near the path of emission from object to transmitter would be bound to cause distortion.

Yours faithfully,
W. H. HEBDIGE (*Assoc. R.S.G.B.*).

(*Continued overleaf.*)

PICTURE BROADCASTING.*

LONDON, N. 3.
October 20th, 1928.

The Editor, *Wireless World*.

Sir,—It is surprising to me that the B.B.C. should decide for or against any form of picture broadcast without consulting the public which finds their funds.

I suggest a referendum on the following lines :—

"Do you, as a subscriber to wireless services, desire the B.B.C. to include broadcast of :—

(1) Still pictures ?

(2) Television ?

Personally I think it is wasting our money to transmit pictures, however perfect, the like of which can be bought in evening papers at one penny per dozen.

Television may have imperfections at present, but is obviously the eventual home requirement, and the B.B.C. should remember that amateurs have taught them many a lesson—why not let them have a chance at improving television reception ?

E. J. CRAMPTON.

*Reproduced by courtesy of the *Wireless World*.

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To TELEVISION PRESS, LTD.,

26, Charing Cross Road, London, W.C.2.

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

Name..

Address..

....

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

TELEVISION SOCIETY.

MEMBERSHIP APPLICATION FORM.

DECEMBER, 1928.

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

Name..

Address..

I desire to enrol as...(Fellow, Associate or Student Member) and submit qualifications :—

Academic Qualifications ....or

Scientific Pursuits ....

THE SECRETARY OF THE TELEVISION SOCIETY,
95, Belgrave Square,
Westminster, S.W.1.

[Stamp enclosed.]

Arks

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