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TELEVISION

TELEVISION AT Schoolboys' Exhibition

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TELEVISION

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TELEVISION

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VOL. III] JANUARY 1931 [No. 35

THIS MONTH'S CAUSERIE

WE have devoted considerable space this month to the important development in the Baird Company's relationship with the B.B.C. There are, however, other matters of importance. For instance, the success that attended the big screen demonstrations in Berlin and Paris has been followed with equally gratifying results in Stockholm. In this connection we would refer readers to the reproduction in facsimile of a telegram received from that centre which is eloquent in itself.

* * * * *

It is apt that an exhibition, which so successfully attracts the schoolboys as that organised annually by the *Daily Mail*, should be supported by the presence of the British system of television. In co-operation with the *Daily Mail*, the Baird Company will exhibit, not only an apparatus, but a working apparatus. That is to say, there will be a receiver and a transmitter, both of which can be inspected by inquisitive Jones minor, who will be able to see Williams one and two televised from the studio on the next floor. Like most interesting exhibitions, however, which are intended primarily for the young, the Schoolboys' Exhibition will attract the grown-ups, and, if previous exhibitions are any criterion, the television display at Olympia will not be the least attractive of the exhibits. We recommend a visit by those who are reading this paragraph and have not yet seen the wonders of this great invention.

* * * * *

We have made another selection this month from the many hundreds of postcards that were received by this magazine some months ago in response to a request to our readers to indicate which features in the magazine they like best. From our long experience of journalism we say that the response to our request was unprecedented in a magazine of this nature. We invite other readers who have been loyal to us to write and tell us what they think of the magazine, and in what way they think it could be improved.

* * * * *

Among the correspondence received at this office are reports of many interesting results obtained by amateurs all over the country, and, in fact, even farther afield, but the most striking was that obtained by a Belgian correspondent who entered the competition run last month by this magazine in conjunction with the Baird Company. This correspondent succeeded in describing in the closest detail no fewer than 25 articles that were transmitted during the week from the Baird Studios through Brookmans Park. The extraordinarily interesting account of this fine achievement appears on page 442.

Quality and the Output Circuit

By *William J. Richardson*

BROADCASTING is now accepted by the public as a standard means of entertainment and as part of the normal scheme of things. Radio being no longer looked upon as a scientific novelty, the mere reception of a noise will not satisfy. Natural reproduction is required, and receivers and speakers are criticised from this point of view rather than on the score of their " distance getting " capabilities.

The Right Combination

A radio receiver built on modern lines and correctly operated in conjunction with a good balanced armature or moving-coil speaker will give reproduction that will satisfy the most critical musician. It sometimes happens, however, that although both receiver and speaker are individually beyond reproach, in combination they give disappointing results. This does not mean that one or the other must be abandoned, for matters can usually be remedied by modifying the method by which the speaker is coupled to the last valve.

In the majority of small receivers, the speaker is connected directly in the anode circuit of the power valve so that the whole of the anode current flows through the speaker.

Now it has been explained on more than one occasion in these columns that the current flowing in the anode circuit of the last or output valve of a receiver is a combination of steady, direct current and a low frequency alternating current which represents the signals received. The direct current component has nothing to do with the actual operation

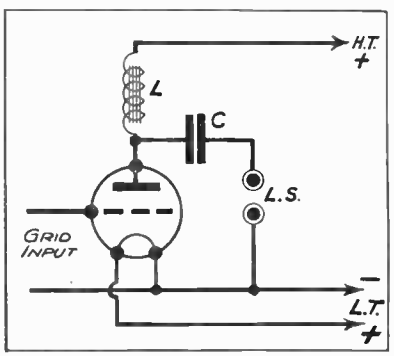


Fig. 1.

Choke filtering the output current from the last valve in a wireless receiver gives several advantages.

of the speaker, and merely acts as a " carrier " for the low-frequency impulses. Because no useful purpose can be served by allowing it to flow through the speaker windings (in fact, more harm than good may be caused thereby), it is desirable to divert the direct current component, and to permit only the audio-frequency current to circulate in the speaker windings.

An Alternative Path

Two methods are available, namely, the choke-filter and the output transformer methods.

In the choke-filter arrangement the anode circuit is split into two alternative paths, one consisting of a low-frequency choke and the other of the speaker in series with a condenser (*see Fig.* 1).

The iron-cored choke (*L*), while permitting the steady direct current to pass through its windings, offers an

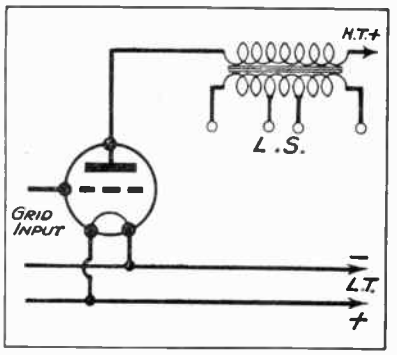


Fig. 2.

In many cases the use of an output transformer is essential if impedance matching is important.

obstacle to the passage of the speech current. The condenser (*C*), on the other hand, will pass the varying current impulses but not the steady direct current.

The advantages of a filter circuit are fourfold. In the first place many speakers are so arranged that if the correct polarity is not observed in connecting up, that is to say, unless the positive terminal of the speaker is connected to LS+ on the receiver, the steady direct current component of the anode current will tend to demagnetise the magnets, thus causing the speaker to lose its sensitivity. A choke filter, by isolating the speaker winding from the direct-current component, avoids this risk.

No Risk of Shock

Again, if the speaker is installed at a considerable distance from the receiver, the long speaker leads cause a drop in voltage, with the result that the valve will not work at its highest efficiency. When high anode voltages are used, a choke filter avoids the risk of shock through touching the speaker terminals and eliminates the chance of damage due to worn or faulty insulation of the speaker leads causing a short circuit.

In order that the maximum amount of audio-frequency power for operating the speaker is obtained from the output valve, the impedance of the external anode circuit should be as nearly as possible equal to the internal impedance of the valve. " Impedance " is the opposition which a circuit or device offers to

variations in current strength. Amongst other things, this opposition depends upon the frequency of the current fluctuations and is greatest when the frequency is greatest.

Although the choke-condenser filter will protect the speaker, it will not make good any wide difference between the speaker impedance and that of the valve. Matched impedance can be obtained by using an output transformer.

Using a Transformer

The primary of the transformer is connected to the loud speaker terminals of the set, *i.e.*, directly in the anode circuit of the output valve. The speaker leads are then joined to the secondary windings (*see Fig. 2*). By choosing a transformer having a primary impedance equal to that of the valve, and a secondary impedance equal to that of the speaker, the desired "matched impedance" is obtained.

Readers will no doubt have noticed that there are several output transformers with tapped secondaries. This is a great advantage, since the best step down ratio can be found on site when one is using a speaker with a very low impedance.

A good example of a tapped secondary output transformer suitable for loud-speaker or television working.

The facts we have stated are reasonably straightforward with ordinary wireless receivers together with speakers for the reception of sound broadcasts, but will the same reasoning apply when we have to deal with quality from the vision standpoint?

Faults near Home

If we consider the frequency question, bearing in mind that it is the higher frequencies which give the wealth of detail to television images, it would seem that, where possible, "iron" should be avoided in coupling the vision apparatus to the wireless receiver. This generally is the case, but when chokes or transformers have to be employed then the component should be chosen from the lists of makers of repute. Anything cheap or shoddy will have a marked deleterious effect on the image, and one is liable to blame the television transmission, whereas the fault is nearer home.

Since this article is concerned only with the output circuit, the current and voltage values mentioned apply to the output valve or vision apparatus, and in assessing the total consumption allowance must be made for the other valves in the wireless receiver. Furthermore, much will depend on the nature of your vision apparatus, that is to say, whether it is automatically synchronised or "hand" controlled, and also whether you are using neons of the flat plate type, such as the special Baird neon lamp, or whether your choice has been confined to beehive or spiral neons.

Series Working

From my own tests, using a Baird "Televisor" made up from a kit of branded components, I have

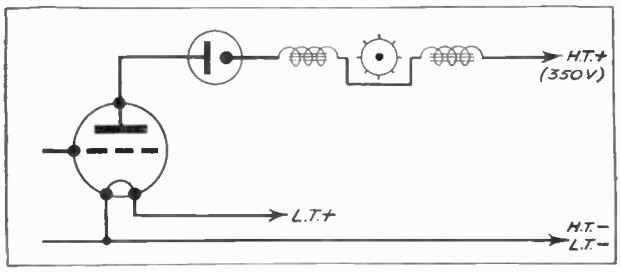


Fig. 3.—Series working the output valve, neon and synchronising coils where a high voltage is available.

been able to make a number of interesting observations dealing with the output circuit and its effects on image quality. Both commercial and home constructed wireless receivers have been used and no difficulty experienced in obtaining a good image. The best results were secured with a voltage of the order of 350 volts and wiring the neon and synchronising coils in series with the plate of the output valve as shown in Fig. 3. With a current of 25 milliamps, or even less, the neon glowed sufficiently to give a bright image, while the synchronising mechanism held the picture particularly well. For those readers who have this H.T. power available I am convinced that this method gives the best results.

In those cases where a voltage of the order mentioned is not available, then recourse has to be made to other methods, and it is here that we find "iron" has to be pressed into service in the form of chokes or transformers. Provided one pays attention to my earlier remarks concerning the incorporation of good quality components, then the "loss of quality" is almost negligible for most purposes. For example,

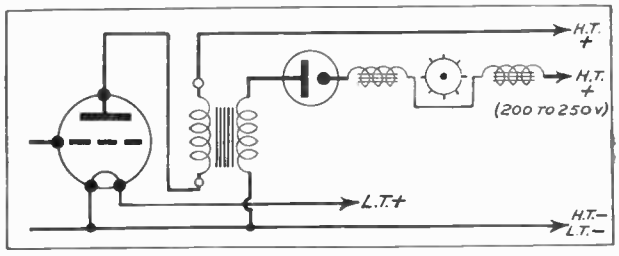


Fig. 4.—By connecting an output transformer in this manner the high tension voltage can be reduced in value.

I found that output transformers listed by Ferranti, Ltd., Varley, Ltd., R. I. Ltd., etc., all retain the quality factor which is so essential and important.

Output Transformers

The reason for requiring these components is made clear by referring to Fig. 4. It is necessary to "feed"

the neon and synchronising coils with the current required for their successful operation and yet allow a voltage drop of the order of 200 volts across them. If this was attempted with low voltage and direct working as shown in Fig. 3, it is obvious that no voltage would be available on the valve plate, and the scheme therefore fails to materialise.

By inserting the transformer in the position shown in Fig. 4 and connecting the primary and secondary windings in the manner indicated, then it is possible

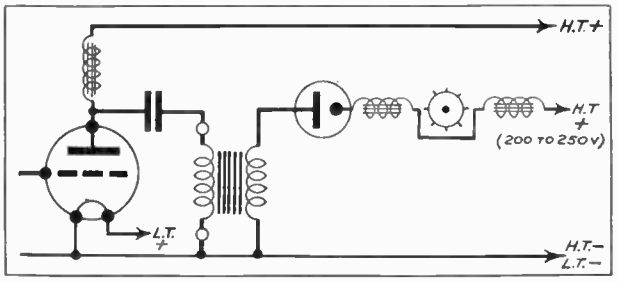


Fig. 5.—A combination of choke and transformer feed for working the vision apparatus from your wireless receiver.

to "feed" the neon and coils from a 200 to 250 voltage source. This will give full brilliancy to the neon and allow the light fluctuations to be controlled by the television signals from the output valve. The same source of H.T. may be used for both receiver and neon provided it is capable of meeting the total current demanded. Failing this, then two distinct sources must be employed, the negative H.T. terminals being made common. I have used two A.C. mains eliminators in this way with admirable results. The transformer should usually be of the 1 to 1 ratio output type, but other ratios may be experimented with in this position to find what effects take place.

Combining Two Output Methods

In those cases where the output valve is already "choke fed" the connections to the vision apparatus can be effected in an identical manner. This is made clear by a reference to Fig. 5. Consideration must be directed towards the use of a first-class choke, however, for it is seen that in this case we are pressing "iron" twice into service and poor quality material will tend to spoil the resultant image.

It can be argued that if the use of iron in the output circuit has a tendency towards frequency distortion then why not operate the synchronising coils separately. This can be done quite easily if one is prepared to add another output valve to the wireless receiver, but frankly, my own tests served to indicate that practically no adverse effects were apparent when the synchronising coils were placed in series with the neon. For those readers who desire to work their apparatus in this manner, however, details of the connections are given in Fig. 6, and they are self-explanatory.

The Pentode Valve

The foregoing remarks should serve to emphasise that quality in the output circuit of vision-receiving apparatus bears a very close resemblance to the quality factor in aural reception.

There is one more aspect which merits mention here and that is in relation to the pentode valve.

In spite of all that has been written both in the technical and the semi-technical Press, there still appears to be some doubt in the minds of many as to the functions of the pentode valve and its value in a modern receiving set.

Most people are aware that the pentode is a power amplifier or "output" valve; that is to say, it is the valve the anode circuit of which supplies the power for operating the speaker. Now, wherein lies the difference between the performance of a pentode and that of a normal three-electrode output valve?

In the first place it must be understood that to "control" a three-electrode valve of the super-power class, that is to say, to permit it to give its full output, it is necessary to apply to its grid a fairly large alternating signal voltage. Because the voltage swing in the anode circuit of the average detector valve available for application to the grid of the following valve is of the order of a volt or so only, it is necessary, if a three-electrode output valve is to be used, to interpose at least one stage of low-frequency amplification between the detector and the output stage.

High Amplification Factor

By means of its special construction, however, the pentode valve will give its full output for a much smaller signal voltage than that required by a three-electrode valve of equivalent output rating. This means that less low-frequency amplification is necessary between the detector and the output valve.

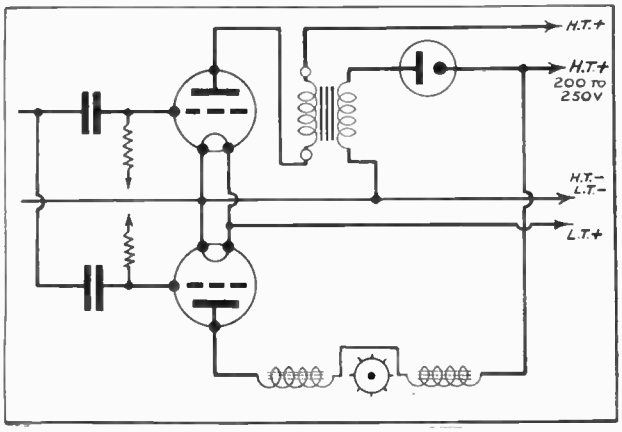


Fig. 6.—When it is desired to work both the neon and synchronising coils from separate valves then the connections should be as this diagram.

At the same time, it must be remembered that a pentode should not be substituted for a super-power valve in receivers which already give full loud-speaker strength, for in such cases the pentode would, undoubtedly, be overloaded.

I explained the method used for connecting up a pentode valve in a straightforward vision receiver in the October 1930 issue of this magazine, and readers are referred to that number for full details.

One More Epoch!

By Sydney A. Moseley

READERS of the TELEVISION Magazine may have read in the newspapers one of those items of intelligence that journalists seem to get hold of somehow. This was to the effect that contrary to rumours that had been spread by either misinformed or malicious persons, the Baird transmissions are to be continued in 1931, and that the relationship between the Baird Company and the B.B.C. was of the friendliest description.

Since, as a matter of fact, I act as liaison between the two concerns, being very interested in both and having a number of friends at Savoy Hill *and* Long Acre, I am able to state with authority that the relationship has never been better.

Showing the interior of the Röda Kvarn Cinema in Stockholm, where the Baird lamp screen was shown for two weeks in December.

Now in one of the friendly wireless monthlies—to whit, *Wireless Magazine*—my friend Mr. Bernard Jones asked the question: "Is television standing still?" It was therefore necessary to prove to him, as well as to certain members of the B.B.C., that television actually was *not* standing still, and that in the laboratories of Long Acre were a number of developments of the highest importance!

You may ask why these things were not made public before, and the answer is the answer I wrote in the *Wireless Magazine*, namely, that the only way to make a fair comparison between the laboratory picture of 1928 and the picture that could be seen to-day, would be to *see* what Mr. Baird has achieved in 1930. I pointed out that the arguments put forward by Mr. Bernard Jones, although friendly, were rather like the motorist who was privileged to visit the workshop of a big motor manufacturer and saw the following year's models; then, having seen the actual model on the road a year or so later, declared that there was "no advance."

I asked Mr. Bernard Jones if he expected to find the laboratories and their contents the same as on his last visit, or if he imagined Mr. Baird has let the grass grow under his feet. Without giving away secrets which are naturally jealously guarded, I hinted at certain developments, i.e., pictures improved not only in quality but transmitted on an improved system; extended vision as an advance on head and shoulder; the new model "Televisor," which is a decided advance on the first commercial set put on the market.

A point which surprised me in Mr. Jones's article was his suggestion that the Coliseum public demonstration was a mistake. He stated that "the public looked at a crude representation which I, from my seat in the stalls, could scarcely recognise." This was undoubtedly due to the fact that Mr. Jones sat too near the screen, and that he probably attended on an afternoon when the screen was not behaving itself. Apart from this, there was the unanimous chorus of praise from critics that the Coliseum demonstration was not only justified, but definitely indicated one more milestone in the progress of television.

I quoted extracts from German newspapers, indicating that the same success attended the Berlin

demonstrations as obtained in London. The Press there used such adjectives as "epoch-making," "wonderful." Here is an example from the *Berliner-Westen:* "It was wonderful, and it will certainly not require thirty years for this invention to be as perfect as the film is to-day." And *Lichtbild Buhne:* "The fact is indisputable. The wonder of television is solved and is no longer a problem."

Now, what did Mr. Noel Ashbridge, Chief Engineer of the B.B.C., Mr. Gladstone Murray, and Mr. Bernard Jones see in the laboratories when the first, and on another occasion the latter, came to Long Acre?

Without giving away too many secrets they saw a complete scene composed of a number of persons going through a small stage play, the whole thing being shown on a small screen—12"×8"—and which could easily have been seen from any part of a large room. Up till now television screens have only shown one or two people simultaneously, so that this in itself marks a very big advance on anything hitherto attempted.

They also saw on the small commercial "Televisor" an interesting film showing a boxing match. Both combatants and referee were clearly visible.

At the time of writing I have not had Mr. Ashbridge's official comment on what he had seen. For myself, I should think the most interesting of immediate developments was the portable transmitter, which is a remarkably simple apparatus, and can be carried over the shoulder to any outside studio or scene where it might be required, and the ground glass screen which showed a very fine and enlarged image.

Mr. Ashbridge and others may have their own preferences, but, speaking as a layman, these two things interested me most of all.

So now, in 1931, despite the pessimists, transmissions are continuing; the engineers at Savoy Hill are in closer touch with the engineers at Long Acre; ways and means are being found where some practical help can be given by the great and powerful B.B.C. to the smaller and struggling Television Company.

Am I too optimistic in forecasting that in this new year there will be developments of such a final character as will make a permanent place for television in the scientific history of this country?

In Favour of the English Audience

By *Sydney A. Moseley.*

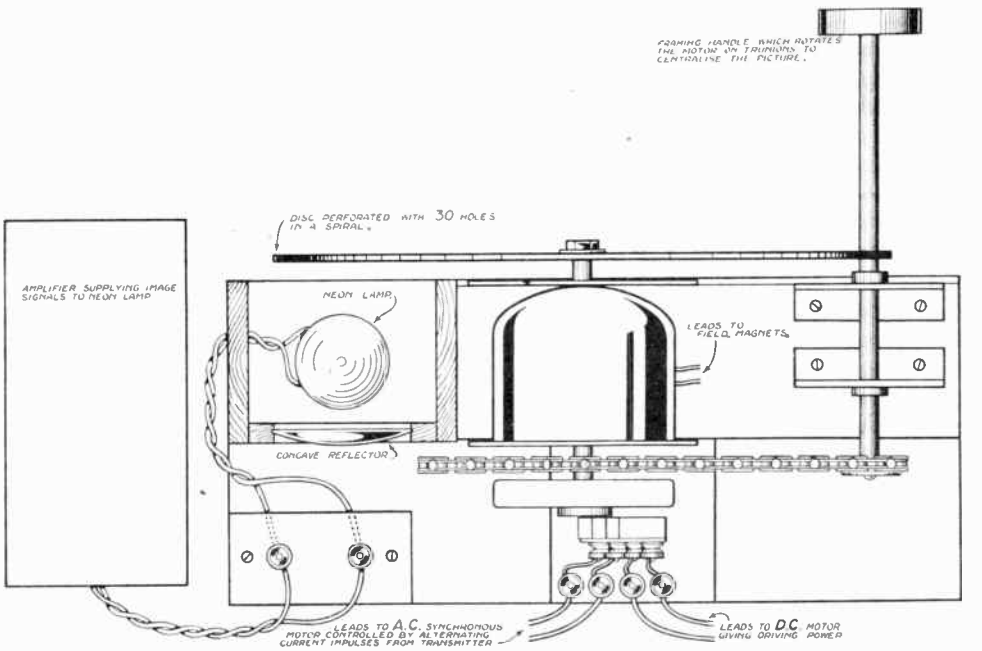
IF there is any legitimate grumbling against the B.B.C. to be done, I am the fellow to do it. But when a critic writes in an important national paper that the audience at the B.B.C. Symphony Concert required "disciplining," I am moved to protest.

In so far as he would exclude late-comers from a concert until the end of a piece that is being played, I am with him. People are able to catch trains and to shop before closing time, and they should be able to accustom themselves to be in their seats at the opera or concert before the performance begins.

In the case of opera, they must be left outside until the act or scene is over. In the case of a concert, no matter how long an item is likely to take, they should be made to remain outside the hall until the applause signifies that the piece is at an end.

Yet the audience at the Queen's Hall, which called forth the rebuke from a leading music critic, was, in my view, an exemplary one, and I did not hesitate to say so in his own newspaper!

Now, why did I think that? Because from the time Mr. Adrian Boult raised his bâton until some two hours later, when the concert was over, the audience



Last month we included illustrations of Mr. Baird's early apparatus used when demonstrating to members of the Royal Institution in January, 1926. Here we see a diagrammatic plan-view of the same receiving equipment. This apparatus will shortly be on view at the Science Museum, South Kensington.

listened with rapt attention, and there was hardly a murmur save that of applause and excited whisperings between the pieces throughout the whole evening.

How does this compare with the audiences I have seen in the supposedly more musical countries of Germany and France?

In Paris a week or two ago I saw *Samson and Delilah* again, and in order to try to capture the atmosphere as far as possible I engaged a seat in the front row. Not the best possible position perhaps from the point of view of volume, but one at any rate which shuts out the rows of heads which obstruct a clear view of the stage. What happened?

First of all, many members of the audience entirely disregarded the overture as part of the opera. To them the opera did not begin until there was something to be *seen*. Then, to my intense irritation, there was the inevitable wiseacre trying to explain to his neighbour who was who, and what was what. I was seated next to a woman who had a little boy with her; his attire was above reproach; not so his manners. He was a precocious lad, duly encouraged by an adoring mother who was insensitive to the feelings of those who had come to listen to the opera. A man on my left, wearing the Legion d'Honneur, evidently possessing a knowledge of music, criticised the performers in the midst of their singing.

But what appalled me was the astonishing indiscretion of members of the orchestra in the Paris Opera House. *They laughed and chatted during the whole course of the opera.*

So that on my arrival in London I returned joyfully to my wireless set. Here, at any rate, I thought, one could sit back quietly and listen without interference from so-called music lovers. Wireless transmission might not be quite so real as the actual thing; but in view of my experiences perhaps this is just as well. If only one could cut out the applause, particularly that from the studio, we could approach the ideal.

Nevertheless, to return to the theme that inspired this article: Were all audiences as well behaved as that which assembled in full muster at the first new B.B.C. Symphony Concert at the Queen's Hall, then perhaps the advantages of a wireless concert would be minimised. Unfortunately, they are all too rare.

[Reproduced from the *Radio Times*, December 12th, 1930, by courtesy of the Editor.]

OF INTEREST TO ALL READERS.

Bound Volumes of "Television" to be Won.

Copies of "Television To-day and To-morrow" Given Away.

THAT you yourself are interested in television and its future development is proved by the fact that you are a reader of this—the world's first television journal. Probably you are an enthusiast in the cause of television, in which case you will welcome an opportunity to arouse similar enthusiasm in some of your friends. This you can do by introducing to them the interesting and informative articles published month by month in the TELEVISION Magazine.

By so doing you will be helping to increase the ever-growing circle of subscribers to TELEVISION, as well as doing a good turn to your friends. At the same time you can also reap some little benefit yourself, because the proprietors of TELEVISION have decided to express their thanks in a tangible form to all who join in this effort to obtain new readers.

Simple Conditions

Bound volumes of TELEVISION, and autographed copies of "Television To-day and To-morrow," by Sydney A. Moseley and H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E., will be presented on the following conditions:—

1. To every reader who obtains by February 10th, 1931, six or more new subscribers to TELEVISION, a 7/6 copy of "Television To-day and To-morrow," signed by the authors.

2. To the three readers who obtain by February 10th, 1931, the greatest number of new subscribers, a bound copy of Volume 2 of TELEVISION.

3. Consolation prizes will be sent to every reader who obtains more than one and less than six new subscribers.

4. The names and addresses of the new subscribers, as well as the name and address of the reader by whom they are introduced, should be sent to:—

"New Readers,"
TELEVISION,
505, Cecil Chambers,
Strand, London, W.C.2.

Cheque or postal order to cover the amount of the annual subscription (7s. 6d.) should accompany each order.

Remarkable Results in Latest Competition

Belgian sends in a Wonderful Report

By The Managing Editor.

SOME remarkable results have been obtained in the recent Television Competition.

You will recollect that in our December issue it was announced that during each morning of the Baird transmission, commencing on Monday, December 8th, five or six different objects would be placed before the transmitter, the basis of the competition being to note these objects each day, and then, at the end of the week, to send in the complete list of the articles as seen on the "Televisor."

Since there were no fewer than twenty-five objects which had to be recognised by "televiewers" (do you like this word by the way ?), it was felt that if 50 per cent. of the objects were correctly named this would be a fine achievement.

But the first and second prize winners have done very much more than that. They have fully described practically every one of the twenty-five objects. Not only that, but each of these two competitors has gone to the trouble of describing objects in detail, such as with a gramophone record, the label, which was not really intended to be part of the competition, was mentioned in detail. The time on a clock was correctly given. Again, a pair of headphones were not only recognised, but even the maker's name is given by a Chelmsford competitor.

But what is most remarkable about this competition is a detailed and comprehensive report from Antwerp. Mr. George Verdun, of 9 Rue du Moulin, Antwerp, has gone to such pains that we have no hesitation in awarding him first prize.

Mr. Verdun sets out the objects in their order, draws each object (and very well drawn they are), reports on the reception of each, such as "very clear, sharp contour," "clear, but weaker because of background," "very clear and sharp," "dull, due to interference," and so on.

He makes one amusing error when he refers to a lampshade as "a bowl as used for Christmas pudding." The hat he describes as "soft light felt hat, Prince of Wales' model, flat brim, without ribbon border, groove on top, border slightly down in front. Was turned around to show the interior, which was in silk—finger pointing to the interior (probably the maker)."

The telephone apparatus, he says, was taken away too quickly for him to be able to see further detail.

The second object on the second day, Mr. Verdun says, was "horn-rimmed spectacles, such as worn by Mr. Sydney A. Moseley (they might be his !)."

Apparently, on four out of the five days, reception was exceedingly good, but on the last day, Friday, it was not quite up to standard.

That Mr. Verdun was able to discern so accurately all these objects from that distance is probably due to his enthusiasm and the care with which he looks after his set.

On the other hand, Mr. Douglas C. Clark, of 25, Rainsford Lane, Chelmsford, has done equally well, and, although he has not gone to the same length as our Belgian reader, he has succeeded in naming most of the objects accurately, and Mr. Clark wins the second prize.

Congratulations to both winners, whose names will certainly go down in the history of "successful amateur experimenters."

The objects shown were :—

Monday, December 8th.—Bottle of milk, dog (toy), drawing (a heart pierced with an arrow), hammer, headphones.

Tuesday, December 9th.—Gramophone record, doll, lamp shade, numbers 0–14, revolver.

Wednesday, December 10th.—Clock, attaché case, umbrella, playing cards, letters EV–NOS.

Thursday, December 11th.—Broom, camera, hat, shoe, telephone.

Friday, December 12th.—Teapot, purse, glove, spectacles, screwdriver.

Cosmic Radiation

Or, Wireless Signals coming to us from the Confines of the Universe

PART III.

By *Sir Ambrose Fleming*, D.Sc., F.R.S.

THIS radiation is now called the Cosmic radiation. It comes to our earth on all sides, and is not in any way due to the sun. It is recognised by its power of making air or other gases conductive for electricity, and its penetrating power is far greater than that of the Gamma rays of radium, for the Cosmic rays can pass through 18 feet of lead or 200 feet of water.

To explain the source of it, it will be necessary to consider a few facts connected with the weights of atoms and the upbuilding of heavy atoms out of lighter ones. We have already seen that all atoms are made up of protons or units of positive electricity and electrons or units of negative electricity.

It is a curious and unexplained fact that a proton weighs 1,840 times as much as an electron, although the electric charge of both of them has the same magnitude—that is, one proton can exactly neutralise or destroy one electron, electrically speaking.

A Tough Object

Now the simplest chemical atom, viz., hydrogen, is made up of one electron revolving round one proton, like the moon round the earth. The next simplest atom is that of helium, the nucleus of which consists of four protons held together by two electrons, and then two planetary electrons revolve round this nucleus.

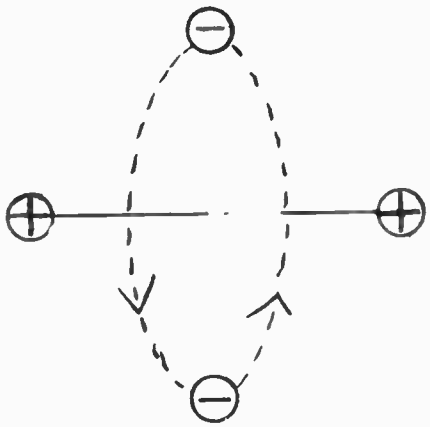
This helium nucleus is one of the toughest objects in nature, and is otherwise called an *alpha* particle, whilst an electron itself is called a *beta* particle. These two kinds of particles are projected from radium and radio-active substances together with the non-material Gamma rays already mentioned.

The helium atom may then be considered as made up of four hydrogen atoms, and in the same way the oxygen atom is built up of sixteen hydrogen atoms.

Nevertheless, the helium atom weighs rather less than four hydrogen atoms. In other words, there is a loss of mass when four hydrogen atoms are welded together into one helium atom.

This loss amounts to 0.032 gram when building up four grams of helium. In the same manner there is a larger loss of mass when sixteen hydrogen atoms are built up into one oxygen atom.

We have already mentioned that matter can be converted into radiant energy or radiation. Hence, if we find this penetrating short-wave radiation



Illustrating a molecule of hydrogen with two negative electrons rotating round two positive protons.

coming to our earth from all directions, it is not unreasonable to assume that it is an indication that somewhere in the Universe matter is being converted into radiation.

Nature's Laboratory

The researches of Drs. Millikan and Cameron in the United States have shown that this Cosmic radiation comes to us in three definite wave frequencies, which have respectively 12, 50, and 100 times the energy or penetrating power of the strongest Gamma ray from radium. The wavelength of these Cosmic rays extends over three octaves, from 1/2,000th to 1/5,000th of an Angström unit. This last unit is a length of one hundred millionth of a centimetre.

The most powerful of these Cosmic rays can penetrate through 18 feet of lead or 200 feet of water, as already mentioned. Now Millikan suggests that

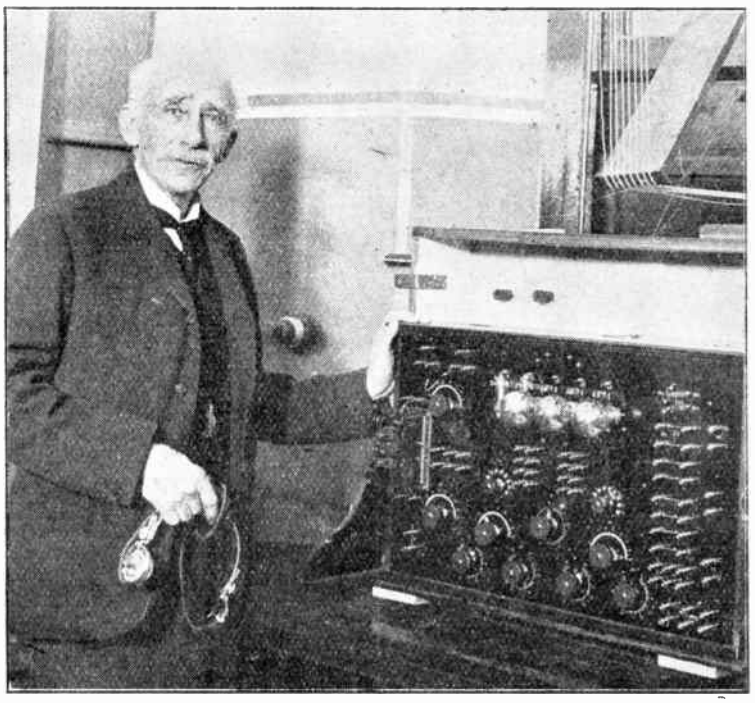
these radiations are the indications that somewhere in the Universe hydrogen gas is being built up or transformed into helium, oxygen, silicon, and iron, which are the most abundant elements in nature.

There must, therefore, be some laboratory in which this transformation is taking place.

It cannot be in the interior of stars, because these places are at enormously high temperatures, and are regions where some form of radio-active matter of high atomic weight is being broken down into radiation.

Finding the Source

The suggestion has been made that these Cosmic rays come to us from the great extra galactic nebulæ which lie far outside the system of stars visible to us with the naked eye or with telescopes of moderate power.



Some of our readers may not know that Sir Ambrose Fleming, D.Sc., F.R.S., is the possessor of the Faraday Medal presented annually by the Institution of Electrical Engineers to scientists of outstanding merit.

All these stars, of which there may be some 30,000 million, are arranged in space in a form roughly like that of a bun or double convex lens or magnifying glass; that is, circular in form but thicker in the middle than at the edges.

Astronomers measure the vast distances of space in terms of a unit called a *light-year*, that is the distance light travels in one year. It is nearly equal to six million million miles.

The dimensions of this great galaxy or collection of stars has been estimated to be about 4,000 light-years in thickness and 300,000 light-years in diameter.

It is, therefore, a very flat biscuit-shaped arrangement of stars. It is called "our galaxy," because our sun is a member of it. The streak of misty light we see across the sky on clear nights, called the "Milky Way," is the outer edge of this disk where the stars, by reason of distance and perspective, appear very close together.

What the Telescopes Reveal

The great telescopes of the world, such as the 100-inch reflector at Mount Wilson in California, reveal to us a vast multitude of masses of gas partly condensed, and having generally a flat spiral form, indicating that they are in rotation in their own planes or round an axis perpendicular to that plane.

It is said that there are more than 100 million of such extra galactic nebulæ at distances from us of 100 to 150 million light-years.

These are sometimes spoken of as "island Universes," because they are probably vast clusters of stars, so to speak, in process of manufacture.

Now the spectroscope shows us in these and other similar nebulæ abundant presence of hydrogen and helium, and the last suggestion on this subject is that these far-off nebulæ are the laboratories in which some of the commoner elements, such as helium, oxygen, silicon, and iron, are being formed out of hydrogen gas.

A Strange Story

We have little or no knowledge of the temperatures or pressures in the interior of these nebulæ, or of the circumstances and conditions under which this up-building of matter takes place in these nebulæ laboratories. These Cosmic rays are, however, the wireless signals being sent out from these distant laboratories, informing us of the process of manufacture of common material elements out of the simple hydrogen atoms, each consisting of a single proton and electron revolving round each other.

It is a strange story that we have thus been able to trace so far, and we have not probably come to the end of it or been able to discover any utility in nature in these Cosmic rays.

Every step forward in astronomical research only reveals fresh mysteries and still more unsolved problems. There is a natural tendency in the human mind to cling to the idea that in some way or other the material Universe is purposive, and not a mere fortuitous concourse of atoms.

The study of this material side of the Universe alone may, however, not be able to lead us to any satisfying conclusions on this point. There is a psychic or spiritual aspect of it which must be taken into account if we are not to be put to confusion. The material side may be only, as it were, a cypher message which has to be decoded in terms of the fundamental truths of the spiritual world, if we are to find anything but oppressive and apparently insolvable riddles in the results of modern physical research.

From My Notebook

By *H. J. Barton Chapple*,
Wh.Sch., B.Sc.(Hons.), A.C.G.I.,
D.I.C., A.M.I.E.E.

The Schoolboys' Exhibition

I SEE that the Baird Company are showing again at the "Schoolboys' Exhibition," a function at which youth and age combine to make a very happy gathering. Last year this Exhibition was held at the Horticultural Hall and thousands of people availed themselves of the opportunity to see the results of Baird television for the first time, demonstrations being run continuously from 10 a.m. to 9 p.m.

I had occasion to be at this Exhibition on several days, and some of the questions that were asked and remarks passed were full of unconscious humour. It was necessary to prove that the transmissions which took place were nothing in the nature of a conjuring trick or illusion, and, in the course of conversation with one of the engineers, one dear old lady vowed it was spiritualism.

On another occasion a party of youths passed through with the queue and took their look into the Baird "Televisor." As this party was leaving, one of the young men was asked what he thought of the results and replied somewhat on these lines:—

"It is no good, mister, you cannot kid me. That is the face of a real man you have got there, I saw his boots poking out under the table!"

Although it was very carefully pointed out to him that the boots he saw belonged to an assistant who was making adjustments at the rear of the apparatus the youth still retained his scepticism. Nothing daunted, those in charge asked him to accept a ticket which would enable him to pay a visit to the transmitting apparatus and actually be televised himself. It was emphasised that his friends could then see whether they recognised him at the receiving end. The youth paused for a few moments while thinking over this offer, and then, much to the amazement of everyone concerned, replied: "No, thank you, you have fooled me once, so I am not going to give you a second chance to do the same thing."

Resurrecting the Dot Theory

I notice that one or two writers of late have taken it into their heads to resurrect the "dot theory" of television. Assuming, for example, that sharp definition requires 10,000 elementary areas in each square inch, the culprits go on to point out that the sideband width necessary for this type of transmission amounts to 75 kilocycles, assuming that there are fifteen complete explorations of the subject transmitted in one second. The calculations are quite correct, but, unfortunately (or perhaps it would be better to say fortunately), the theory is quite wrong.

In the early days, writers, when dealing with this most fascinating subject of television, went to great pains in order to prove *conclusively* that a sideband width, sufficient to accommodate anything up to ten normal broadcast programmes, was *absolutely essential* before television signals could be transmitted through the ether with any hope of success. The deductions are absolutely fallacious, however, for reproduced photographs, such as appear in this journal as half-tone blocks of certain *screen*, bear no resemblance in their method of reproduction to the television images which we see in a "Televisor."

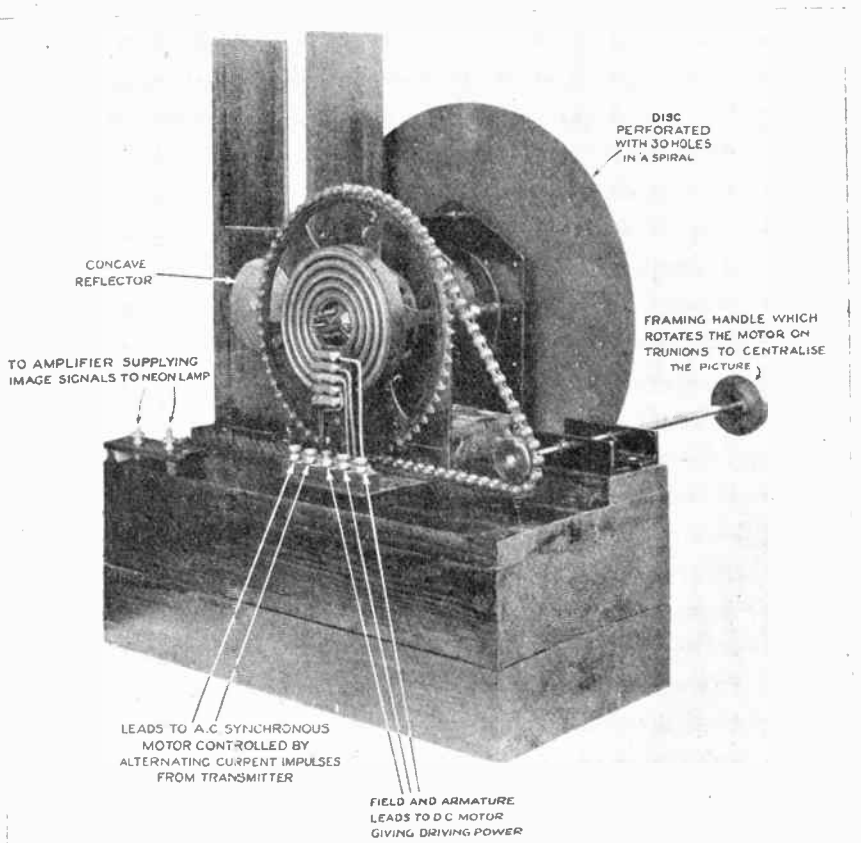
Where the Theorists Fail

With magazine illustrations it is, of course, quite correct to say that the finer the screen, that is, the more elemental areas to the square inch, the better the reproduction. In a television image we find the state of affairs quite different from this. To save further argument on this point let me try and indicate where these dot theorists fail. It is in their assumption that the picture or object at the transmitting end needs to be split up in the manner suggested. They have right on their side if they state that a wider sideband allocation would increase the scope of the subjects that could be televised, since the extent of the scenes shown would be larger and details more pronounced, but that is all. The light and shade, which together go to make up a televised image, are distributed throughout the picture in the form of a wash drawing or a continuous surface. Instead of assuming the draught board design of alternate black and white squares which they do in order to arrive at their wonderful figures, what should be remembered is that, during any one period of movement, the light spot may be exploring or scanning an area of white on an object.

In this case we shall then have a comparatively

large current response from the photo-electric cells during that period. It is quite possible that this will be followed by another period when no light is reflected back to the photo-electric cells owing to the light spot then passing over a black portion of the object. The actual wave form of the resulting current from the cells is, therefore, very complicated, and, in addition to a fundamental frequency, a plethora of harmonics is present. It has been pointed out more than once in these columns that the lower the cut off of the higher frequencies the greater will be the rounding off and smoothing over of any sharp contours, so that *small* details are apt to be lost.

Anyone can testify, however, after having seen the reception of Baird television by wireless, that even within the normal sideband allocation now in existence, namely, 9 kilocycles, the received television images possess considerable detail. We are introduced, therefore, to a case where practice disproves theory and points out very convincingly the error of assuming anything in the nature of dot formation, like magazine illustrations, for television images, and it is to be hoped that other writers will not fall into the same mistake.



This original apparatus, used by Mr. Baird in January, 1926, will be displayed at the Schoolboys' Exhibition at Olympia from 1st to 10th January.

A "Poet's Licence"

No doubt you are all familiar with the term "poet's licence" and understand that it indicates the latitude that is employed by writers of verse when they give expression to their thoughts. Unfortunately a similar looseness of expression often exists when we find the newspaper press preparing copy concerning news of a technical character. In many cases the true facts or important details are either omitted or only have a passing reference, while in others the efforts to interpret technical phraseology results in an entirely different complexion being placed on the points at issue. This inevitably leads the non-technical reader to believe something that does not really exist, while frequently the professional engineer is somewhat nonplussed by his efforts to learn what exactly is meant.

This state of affairs often happens when paragraphs dealing with television appear in the press. I can call to mind a case where a writer abroad during the course of his dissertation included the following statement: "The serious difficulty with television to-day is that at least on a single broadcast channel we cannot have sound and vision at the same time. The stations that broadcast television have trouble even to switch from aural to vision programmes. Less than a fraction of a second now interferes during the switching, but this is not the final solution. It is possible to do it on two or more wavelengths, but then again at the receiving end apparatus is needed to tune into the different wavelengths, and that is evidently very difficult to incorporate into a single set although not impossible."

It will be seen that this quotation is very involved and is liable to be misinterpreted by the average individual. Readers of this journal know that visual and aural transmissions do take place simultaneously, perfect synchronisation being secured automatically. While two separate wavelengths are employed at present, it will be remembered that a few months ago I described in an article contributed to this magazine a possible scheme whereby one wavelength could be used for the dual broadcasting. The reception of the two wavelengths with the two separate sets feeding individually the loudspeaker and "Televisor" presents no difficulty, and only one aerial is necessary.

This Month's Book Reviews

Testing Radio Sets. By J. H. REYNER, B.Sc., A.M.I.E.E. Published by Chapman & Hall at 10s. 6d.

THE testing of radio sets has now become a very important item in modern radio technique, and it is necessary for the dealer, set user and home constructor to be in a position to locate faults if the greatest benefit is to be derived from radio reception, whether for television purposes or normal sound broadcasting.

The first part of Mr. Reyner's book deals with the location of faults in existing receivers, whether home-constructed or factory built. Systematic methods of elimination are dealt with so that the defective area can be properly located. While generally it is not advisable for the home user to tamper with factory-built sets, it is, nevertheless, of great assistance to be in a position to employ simple tests in order to rectify faults if they are of an elementary character. To advanced experimenters, however, or in the case of home-constructed sets, the diagnosing of faults is an important item.

The second part of the book deals with the laboratory testing of receivers during the stages of design and production in the works. In this case the use of scientific instruments is advocated and, of course, this limits the application of the tests mainly to those who are engaged in this form of practice as their daily task.

The book is well illustrated with clear line drawings and a few half-tone blocks and for those readers who are interested in this class of work, the book should undoubtedly make a great appeal.

Easy Lessons in Television. By R. W. HUTCHINSON, M.Sc. Published by the University Tutorial Press, Ltd., at 1s. 9d.

The aim of the author of this book has been to write a volume essentially for the beginner so as to form a companion volume to "Easy Lessons in Wireless," by the same writer. Non-technical language is used throughout and mathematics introduced only where absolutely necersary. Mr. Hutchinson has adopted the policy of assuming that his reader knows little or nothing of the subject and, in consequence, has covered a very wide field in his book.

A few necessary items concerning electricity and light are dealt with, while the atom and electron are clearly expounded. Most of the apparatus used in television, that is photo-electric cells, motors, scanning discs, neon tubes are explained in a very lucid manner. The transmission and reception of television images by the Baird system are thoroughly dealt with together with detailed instructions for the successful operation of the Baird "Televisor" itself.

The theory of the thermionic valve forms a fitting introduction to the section of the book dealing with the design and operation of wireless receivers and amplifiers which may be used for the successful reception and application of the broadcast television signals. Brief explanations of tele-talkies, telephotography, and the application of the big screen to theatre working show that this book is quite up to date.

Some of the material has been obtained by making use of contributions appearing in the columns of TELEVISION. Due acknowledgment has been given.

As a book for beginners, we feel sure that Mr. Hutchinson's work will be appreciated by the novitiate.

The Wireless Trader Year Book and Diary for 1931. Published by the Trader Publishing Co., Ltd., at 3s. 6d., post free to subscribers to Trader journals, and 5s. 6d., post free, to non-subscribers.

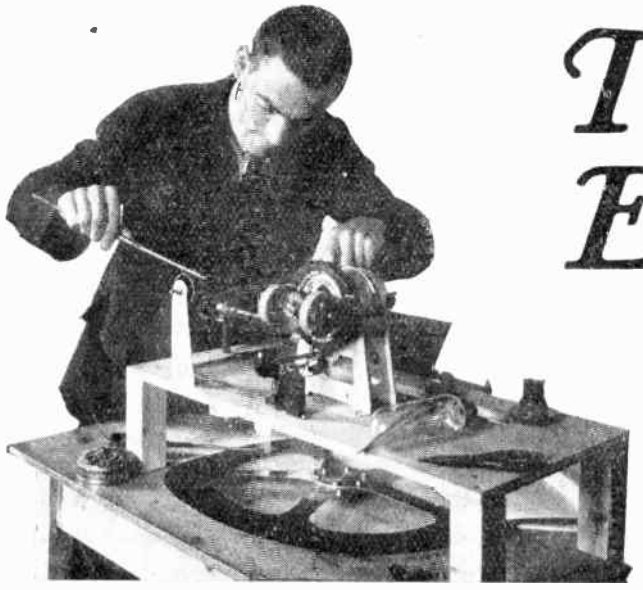
The 1931 edition of this Year Book and Diary should prove of valuable assistance to manufacturers and retailers of wireless and gramophone goods every day throughout the year. A new sixteen-page feature dealing with practical service methods has been included and deals with the broad principles involved in the service work the dealer is normally called upon to perform. It covers the most economical and up-to-date methods dealing with repair, service and constructional jobs in installations, accessories and receivers. For ease of reference the Trade Directory portions are printed on various tinted papers and include lists of manufacturers, manufacturers' agents, and wholesale factors, proprietory names of wireless and gramophone goods and their makers and a buyer's guide.

The book is thoroughly up to date and will undoubtedly prove very handy to both manufacturers and retailers.

Daily Mail Year Book for 1931. Published by Associated Newspapers, Ltd., at 1s.

As a handy book of reference and quite up to date in character, the thirty-first edition of the Daily Mail Year Book is an excellent investment. Amongst other things it contains between sixty and seventy special articles by experts on various topics and we were pleased to see that Mr. J. L. Baird had described the progress of television up to the date of writing. He gives a short explanation of the television process and emphasises that sound and vision are daily sent from the Baird Television Studio at Long Acre through to the B.B.C. stations at Brookman's Park.

The book fulfils most of the uses of a bijou work of reference, while the political situation is reviewed and special attention devoted to unemployment. There are 1,000 brief biographies of leading men and women of the day.



The Enthusiast Sees it Through

THE birth of a New Year heralds the making of resolutions. Many of them subsequently are broken, but for the *enthusiast* there is one which all can make and keep for the whole twelve months, Determine to make 1931 a year in which your interest in television in all its aspects will be doubled. You are doing pioneer work and supporting a cause which we all have at heart, and your efforts will meet with a just reward. Make a point of keeping the Editorial Department of this magazine well informed as to your progress, either individually or collectively. In this way we shall maintain the intimate contact with our readers which has inspired this series, a feature which is proving very popular since it encourages others to start experimenting. Furnish us with details of your apparatus, diagrams, photographs, etc., and, of course, intimate the results obtained.

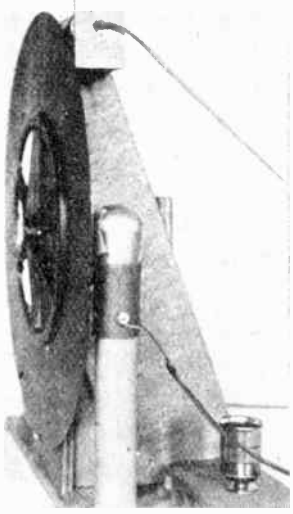
Receiving Television Images 375 Miles Away

We have often reiterated in these columns that distance proves no obstacle in television working, and the comments of Mr. Richard Theile, of Marburg. Lahn, Ortenbergstrasse 8, Germany, bear further testimony to this. Although situated 375 miles from London he can watch and hear all that is happening before the transmitter in the Baird Company's studio. Just read his own story and this will show you how he brings about this excellent result, an achievement for which Mr. Theile receives our heartiest congratulations.

"I am extremely pleased with the reception of the experimental television transmissions of the Baird Television Company. The place of reception, Marburg/Lahn, lies at a distance of approximately 375 miles from London. To receive the images I use an ordinary 4-valve set, which works as follows :—

"The first stage is connected as a high-frequency amplifier, the following operates as detector, and to this is connected two resistance-coupled low-frequency stages with the neon lamp connected directly in the anode circuit of the last valve. The sound accompanying the television is received on my home-constructed 6-valve superheterodyne receiver.

"The real television receiver is also home-constructed. The Nipkow disc has two series of holes for the two different standards, and the size of the pictures is 35 mm. by 15 mm., since the diameter of the apertures is $\frac{1}{2}$ mm. Synchronising is effected by means of variable resistances, which lie in the circuit of the driving motor. I am, however, shortly going



Showing the neon lamp and disc used in the home-made vision apparatus employed by Richard Theile of Germany.

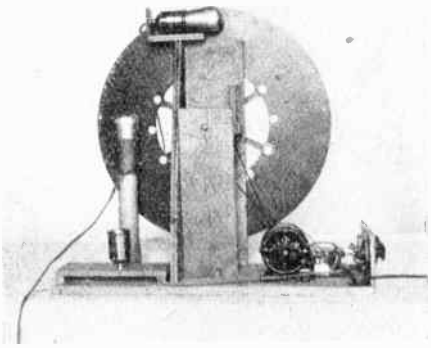
to build an automatic synchronising device. An ordinary double-spiral lamp serves as a glow lamp. In spite of the relatively small size of the images, details can easily be distinguished, so far, of course, as the fineness of the screen permits. All the movements of the artists during their performances can be followed without any trouble. Besides the usual

songs, I liked the violin recitals which were given some time ago, and particularly the appearance of an artist whose sketches were also remarkably clear in the television receiver. The headlines which generally announce the appearance of an artist at one of the following transmissions are also very legible.

"The accompanying photographs show the complete apparatus and separate parts and, as already mentioned, I am very pleased with the reception and follow the transmissions with great interest."

Results Nearer Home

Coming much nearer home, we find Mr. G. E. G. Graham, of 73, Reynolds' Buildings, Westminster, London, S.W. 1, a student member of the Television Society, one of the "old brigade," inasmuch as he has been a supporter of our magazine since the first issue. With a total high tension consumption of only 7 milliamperes he has succeeded in obtaining very



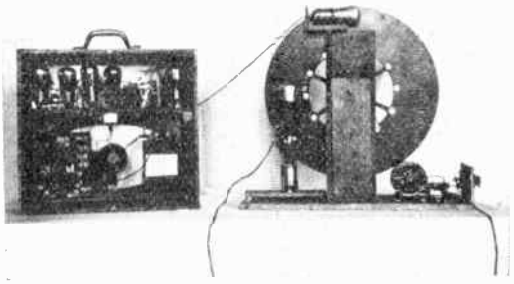
A view of the back of the television receiver used in Marburg/Lahn.

good images, and this surely is a very successful performance. We include a photograph of his apparatus, and are intrigued with his synchronising methods. In the course of the letter he sent us a few days ago the following remarks appear:—

"I have been a reader of TELEVISION since its first issue, and I think it may interest your readers to know that I have received very good images with a total high tension consumption of 7 milliamps. My vision receiver consists of a grid leak detector, with R.C. and transformer-coupled L.F. stages. The voltage employed for the power valve (Triotron ZD2) is 120 volts, and the neon, which is joined directly in series with this valve, is a Philips 'neon indicator lamp' (110 volts, ½ watt), arranged with its plate at the focus of a 4-inch condensing lens which renders the light parallel before it reaches the disc.

"The motor is 4 volts and controlled by a single wire resistance in series, a fine control being obtained by a 60-ohm rheostat in parallel with the single wire. Synchronism is maintained by varying the tension on a string tied to a staple and looped over the motor shaft.

"The disc, which is of 26-gauge aluminium, was constructed by the use of a jig as described in the January, 1930, issue of TELEVISION, and leaves little to be desired as far as accuracy is concerned, but is rather heavy for the motor. I may say that the



The wireless set for receiving the sound together with the vision apparatus made by Mr. Thiele.

image is very bright in spite of the low current consumption, although it suffers from some lack of half tones, due, no doubt, to the inferior transformer employed.

"It is to be deplored that more convenient and extensive times of broadcasts cannot be arranged. I hope that more details of the new 50-metre transmitter will be forthcoming shortly."

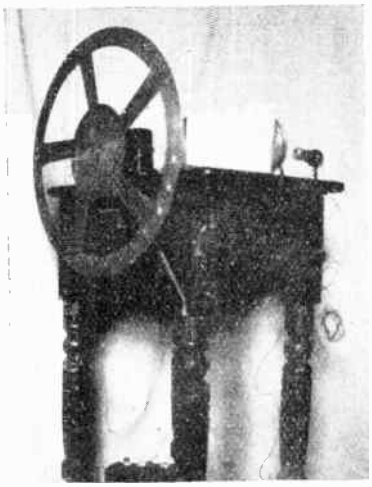
Holland Continues to Record Progress

We heartily endorse the hope expressed by Mr. W. A. J. Moerdijk, of 's-Gravenhage, Adelheidstraat 97, Holland, namely, that Holland in the future will be as good a television country as it is a radio country

* * *

Mr. Graham uses a very ingenious method for maintaining "synchronism" with his apparatus. Varying string tension is the medium employed.

* * *



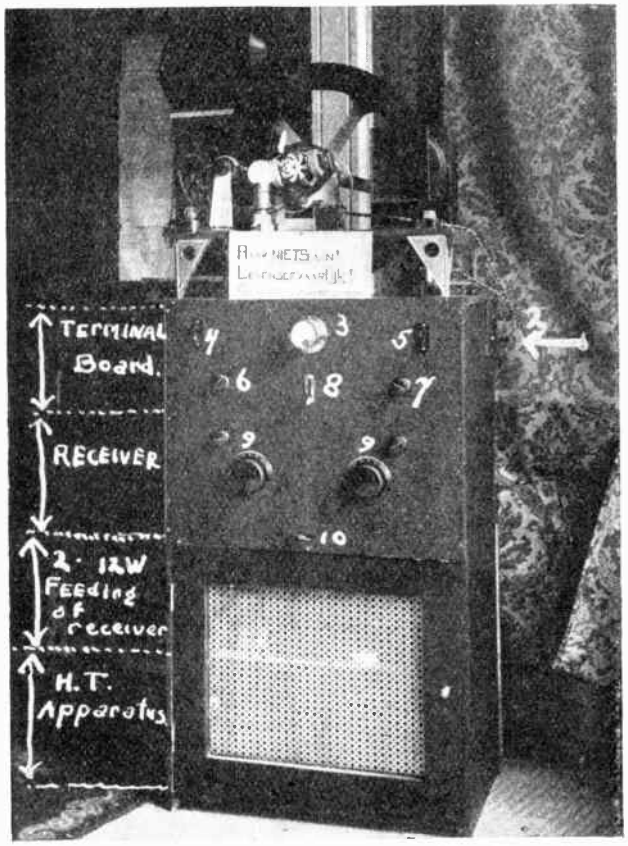
now. His enthusiastic letter is reproduced below, and he points out how difficulties are only in existence to be overcome. This spirit is excellent when dealing with television.

"It is a pleasure for me to send you a photograph of the model of my apparatus that I am using in Holland. The numbers on the photograph correspond with those on the detailed list at the end of the letter. This is my own experimental apparatus, the amplifier being of my own construction and the results are really splendid.

"I have several inventions dealing with wireless and loudspeakers to my credit, and hope that the same will happen with television. Of course, in Holland there are a number of difficulties to be overcome, but they are only there to be overcome.

"The worst trouble is fading on the night transmissions. The second difficulty with which we have to contend is the interference of German stations and the weakness of the signals on 261 metres.

"My apparatus is a complete all-mains drive including the grid bias, two 12-watt output valves being used, one for the neon and one for separate synchronising. Naturally, we need a greater degree of amplification here in Holland than is necessary in

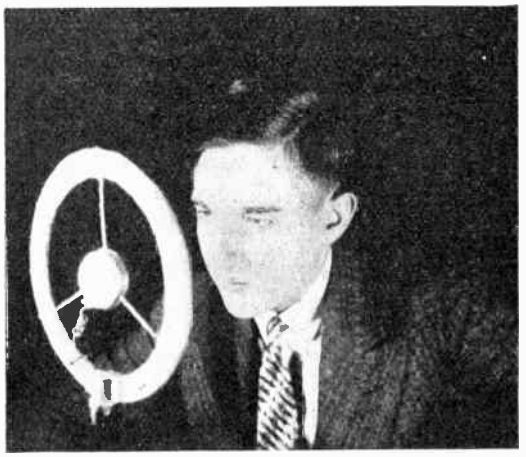


The elaborate apparatus constructed by Mr. Moerdijk of Holland for receiving the Baird television transmissions.

England to get the same quality image, but even so it works remarkably well.

"Some time ago I placed in the 'B.O.R.N.,' that is the paper of organised radio men in Holland, about 5,000 in all, an advertisement inviting everyone to come and see my television results. This caused considerable interest, and I suppose that Holland, in the future, will become as good a television country as it is a radio country now.

"I am reading your magazine with the greatest of interest as there are a number of outstanding subjects dealt with, as for example, 'Cosmic Radiation,' by



Mr. R. Theile, whose successful television reception is recorded in these columns.

Sir Ambrose Fleming. I am sure that this last named will prove a splendid series.

"Reverting to the photograph, the following reference should make matters clear:—

1. Motor with stroboscope and small neon for stroboscope.
2. Terminals with amplifier to 'Televisor.'
3. Millianieter giving total consumption of the apparatus—all-mains receiver and amplifier.
4. Switch for discharging condensers of the high tension apparatus (about 2,000 volts).
5. Switch for releasing synchronisation if required.
6. Resistance for controlling loudspeaker volume.
7. Resistance to regulate image clarity (output of the 12-watt valve that feeds the neon).
8. Switch for turning a negative image into a positive image.
9. Primary and secondary controls of the 3-valve screened grid all-mains receiver.
10. Long and short wave switch.

"The inside of the apparatus resembles a biscuit tin somewhat, there being an all-metal lining for screening the various parts. The receiver has proved very selective, and this is a necessity in Holland for cutting out some of the German stations.

"There is another small receiver for the reception of sound. The output valve of the receiver is connected by means of two transformers, so that the amplification for synchronising and operating the neon can work separately."

The Reflection and Refraction of Wireless Waves

By *L. P. Dudley*, Grad. I.E.E.

NOWADAYS we are so accustomed to the reception of wireless signals from stations situated hundreds, or even thousands, of miles away that we seldom pause to wonder at the ability of an electro-magnetic wave to follow the curvature of the earth. It is, nevertheless, a fact that the cause of this phenomenon is not, even to-day, fully understood.

There is a fundamental law in physics which states that the propagation of light takes place in straight lines. Without this law, the study known as optics would be non-existent, and we should not "see" anything at all. Our eyes would be able to appreciate brightness or darkness, but no object would appear to have a definite shape. In this respect the sense of vision would be akin to that of hearing. "How, then," we may well ask, "can we explain the fact that radio waves which, like light waves, are electro-magnetic disturbances, are able to travel round the world?" It is with the object of outlining some of the theories which have been advanced as possible answers to this question that the present article has been written. In most of these theories it is assumed that the waves suffer the effect known in optics as *refraction*. Hence, some explanation of the nature of this effect will not be amiss.

Refraction may be defined as the bending of electro-magnetic waves as they pass from one medium to another. The phenomenon is easily noticeable in the case of the visible or light rays when they pass, for example, from air to glass. It is well illustrated by the apparent distortion of a regular metal rod when dipped into a glass of water. The bent appearance is due to the displacement of the rays from the submerged portion of the rod, causing them to arrive at the eye at an angle different to the angle of arrival (or "incidence," as it is termed) of the rays from the dry portion. If the water be replaced by glycerine it will be observed that the distortion is greater, this being due to the greater density of the latter medium.

Atmospheric Refraction

The density of air, like that of other gases, varies considerably with change in temperature and pressure. Hence, on ascending from the surface of the earth, refraction due to the atmosphere becomes less owing to the decrease in density. Thus the light from a star undergoes refraction on passing through the earth's atmosphere somewhat as shown in the accompanying diagram. (The illustration has been greatly exaggerated for the sake of clarity.)

To an observer situated at O, light from a star S appears to have traversed the path $S'O$, this being the line along which a telescope must be directed in order to view the body. For this reason a heavenly body always appears to be higher in the heavens than is actually the case (unless the star is in the zenith Z, when there is no refraction). In astronomy the observed altitude must always be corrected in order to obtain the true altitude. It is very difficult to calculate this correction with any degree of exactness owing to the irregular and gradual change in the density of the atmosphere. Barometer height and temperature have also to be taken into account. With stars in the neighbourhood of the horizon, variation of refraction with altitude is so rapid that no accurate correction can be made.

That the above digression from the subject of radio waves to that of light waves is fully justified will be appreciated when it is recalled that, in their very earliest experiments in wireless telegraphy, Hertz, and later Marconi, used extremely short waves concentrated by means of reflectors.

The First Suggestion

In the year 1896 Marconi demonstrated to the British Post Office the transmission of signals over a distance of more than 3,000 yards using these very short reflected waves. A little later, however, he made great strides in transmission by the use of much longer waves, and experiments with the short waves were abandoned for a considerable time.

With the accomplishment of these long-distance transmissions the question naturally arose as to why the waves travel over the surface of the earth when, according to theory, they should leave the earth tangentially.

Foucault showed experimentally in 1850 that the velocity of light is a maximum in vacuo, an increase in the density of the medium through which the waves are travelling resulting in a decrease in the rate of propagation. It was thought, therefore, that since the top of a radio wave must travel more rapidly than the bottom, Marconi's long-distance transmissions could be thus explained. But calculation showed that the *bending forward* caused by this normal refraction effect was very small and could not be a complete explanation of the ability of the waves to

follow the curvature of the earth. However, no further solution to the problem was forthcoming until the year 1900 when Heaviside put forward an extremely interesting theory.

The Heaviside Layer

Heaviside suggested that, at a height of about 50 to 100 miles above the surface of the earth, there may be a permanently conducting layer of gas. Such a layer would reflect radio waves in much the same way as a huge mirror would reflect light waves. It becomes, therefore, much easier to comprehend how signals are heard over great distances if, completely surrounding the earth, there is a gigantic reflecting layer which returns the waves to a lower altitude, compelling them to follow a path more or less round the world.

The process by which a fluid is rendered conductive is known as *ionization*, this phenomenon being due to the formation of positive and negative *ions*. The positive ions consist of atoms from which one or more electrons have been removed. The negative

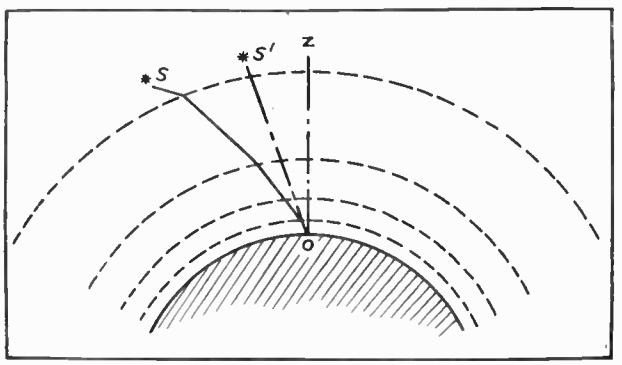


Diagram illustrating atmospheric refraction (see accompanying text).

ions seem, at low atmospheric pressures, to be merely free electrons, but at normal pressures they are evidently atoms to which one or more electrons have been added. The degree of conductivity of the liquid or gas is determined by the number of ions present.

The ionization of the atmosphere and the effects of the process upon wireless reception are discussed in detail in Sir Ambrose Fleming's "Introduction to Wireless Telegraphy and Telephony." In this work Sir Ambrose draws attention to the probable existence at a high level, in the earth's atmosphere, of sufficient free electrons and positive ions to impart to the rarified air a considerable electrical conductivity. The Heaviside layer theory is further supported by the fact, ascertained by direct experiment, that the conductivity of the atmosphere, small at low altitudes, increases as we ascend to greater heights.

The formation of the ions from which the upper air derives its conductivity can be explained by another established fact, namely, that molecules of oxygen, nitrogen and other gases become ionized under the influence of ultra-violet light. Thus, sunlight, which is rich in ultra-violet rays, may cause ionization of the upper air, the ions re-combining to some extent after nightfall.

This theory of the Heaviside layer is upheld by, in addition to Sir Ambrose Fleming, many other eminent scientists, including Sir Oliver Lodge and Dr. W. H. Eccles. It has been attacked by an equal number.

Ionic Refraction

In 1912 Dr. Eccles suggested another cause for refraction. He demonstrated that when an electro-magnetic wave passes through an ionized gas the velocity of the wave-front increases. Due to the action of sunlight, the ionization of the atmosphere is more even during the daytime than it is at night, the coming of darkness causing a high ionized layer to be more sharply defined. Hence, when the sun's rays have been withdrawn, the upper part of a radio-wave travels more rapidly than the lower portion, with the result that the wave-front is bent forward. This ionic refraction, as it is termed, causes the strain energy to follow the curvature of the earth.

There is reason to believe that the sun exerts a further ionizing influence by virtue of the continuous agitation of its incandescent atmosphere. This agitation creates enormous quantities of electrified dust and, as Fleming points out, should the earth, on its journey through space, chance to pass through a cloud of such dust the upper layers of our atmosphere would become ionized.

From the foregoing, it is apparent that very many of the freaks met with in radio communication may be traced to ionic refraction. To summarise, we can see—

(*a*) that atmospherics, which are caused largely by lightning flashes, are due primarily to ionization;

(*b*) that reception becomes poor when thunder is in the air since, on account of the highly ionized condition of the whole atmosphere, the ionic refraction is less noticeable;

(*c*) why atmospherics are, as a rule, more severe by night than by day;

(*d*) why, during and after a cloudy day, when the lower regions of the atmosphere are not ionized and the ionic layer is well defined, reception is almost invariably better than during a day of brilliant sunshine;

(*e*) why, with a given transmitter and receiver, communication is generally possible over greater distances at night-time than during the day.

The Gliding Theory

According to an alternative theory put forward by Elihu Thomson, the propagation of radio waves does not take place along the lines of true Hertzian waves. In this theory, the name of which forms the title to the present paragraph, it is suggested that, on account of the proximity of the transmitting aerial to the ground, the waves are only half Hertzian waves, these being actually attached to and guided by the surface of the earth.

The attempted proofs of the above theories involve too great a knowledge of mathematics for them to be included in this article. However, none of them are without flaws, and it remains for the future to provide a perfect explanation of the way in which radio waves are carried round the earth.

Artistes participating in the Baird Television Broadcasts

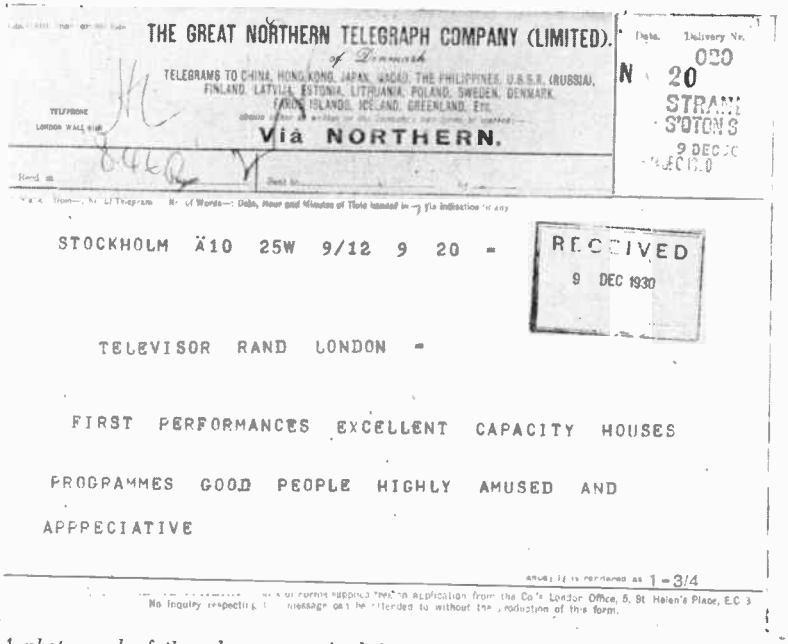
1. *Mr. IAN HASSALL, whose amusing cartoons have recently been televised, is a son of John Hassall, the famous poster artist.*
2. *Miss DORIS PALMER, comedienne, is as comic as her make-up indicates, and provides excellent entertainment for lookers and listeners.*
3. *Mr. HERBERT DE LEON has a baritone voice of fine quality, and appreciates the value of television as a new medium for his art.*
4. *Miss FLORENCE HAFES, soprano, possesses a charm of style and personality—two valuable television assets.*
5. *Miss WINIFRED FAIRLIE, a versatile character artiste, who played the parts of "Grannie" and "Mdm. Duval" in "Great Expectations."*
6. *Mr. JEAN MICHAUD, solo violinist, who, with his trio (violin, 'cello, and piano), appears successfully through the medium of television.*
7. *Mr. WALTER TODD is an entertainer who has already given several television broadcasts. Can more be said.*
8. *Mr. ROBERT EASTON, the first exponent of a new and interesting television feature, namely, silhouette portraits.*

What Readers Want

IN his last article the Managing Editor expressed a hope to find space for a number of the postcards he has received from time to time from helpful readers. Since they indicate both the taste and wishes of television enthusiasts in general, he thinks it will interest readers to know of the many suggestions that have been put forward and the instances in which they have been carried into effect.

Most of these cards have been in his possession for some months and have been held over in order to prove that the ideas of the TELEVISION public are duly considered and, where feasible, put into practice.

The consensus of opinion seems to be in favour of constructional articles, and this is comprehensible, since readers of a journal of this character are naturally experimenters—television still being largely in the advanced experimental stage. Allied with this technical interest, however, is the desire for details concerning less specialised topics. Certainly, if TELEVISION is to be universally indispensable, it must cater for the non-technically-minded, as well as the wireless enthusiast, and this aim has recently been much before the eyes of the Editorial Department.


THE GREAT NORTHERN TELEGRAPH COMPANY (LIMITED).
of Denmark
TELEGRAMS TO CHINA, HONG-KONG, JAPAN, MACAO, THE PHILIPPINES, U.S.S.R. (RUSSIA), FINLAND, LATVIA, ESTONIA, LITHUANIA, POLAND, SWEDEN, DENMARK, FAROE ISLANDS, ICELAND, GREENLAND, Etc.
Via NORTHERN.
STOCKHOLM Ä10 25W 9/12 9 20 =
TELEVISOR RAND LONDON =
FIRST PERFORMANCES EXCELLENT CAPACITY HOUSES
PROGRAMMES GOOD PEOPLE HIGHLY AMUSED AND
APPPECIATIVE
RECEIVED 9 DEC 1930

A photograph of the elegram received from Stockholm by the Baird Company, indicating the success attending the demonstrations of the big screen.

The information published a few months ago about the Berlin Radio Exhibition, and the more recent details of demonstrations of the Big Screen in various important capitals, should meet the request of Mander Barnett, of 28, Aughton Road, Birkdale, Southport, who wishes for both "Reports of foreign activities, which are hard to obtain elsewhere, and more articles in a lighter vein." The articles on the Big Screen should satisfy both these demands, and, incidentally, appeal to anyone possessed of progressive instincts. In the same way TELEVISION is able to satisfy the desires of Edward J. Walton, c/o Royal Air Force, Filton, Nr. Bristol, who, though stating that "the variety of articles makes choice unnecessary" asks for "a little 'light relief' from the severely technical."

W. R. Wheeler, of 2, Electrical Staff Quarters, Bulford Camp, Wilts., and S. J. Vincent, of Alcombe, Minehead, will undoubtedly feel gratified by the inauguration of "Trade Notes and Apparatus Tested."

It was John Salter, of 13, Featherstone Buildings, W.C. 1, who wrote "I like two columns instead of three. The paper is easier to read, and the printing appears better." This is good news, as approbation is always encouraging. Mr. Salter also asks for "the institution of a prize competition for apparatus." If he has read the November and December issues of the magazine he will see his wishes have come true, and it is to be hoped that some day soon he will be the successful competitor in a competition of a similar nature. E. C. Mulgrin, of 54, Campbell Road, Southsea, endorses the opinion of Mr. Salter and expresses his appreciation of "the bold title headings." This reader also suggests "a competition of some kind" and a prize offer of a television receiving set. A competition with a "televisor" as a prize was held in October, 1930, the winner being Mr. H. R. Jeakings, of Mill Street, Bedford.

Miss Marian Bell, of 36, Wellesley Road, Croydon, gives a most complimentary verdict. These are her words: "I like the clear type, the paper, the two-column instead of three arrangement, the clearness of the headings, the readableness of the articles. The book, in its present form, is inviting and appealing and crisp." It would be interesting to hear Miss Bell's views on the subject of the present cover of the magazine, since her former suggestion was "the cover should be of modern design, that it should be dynamic and suggestive of progress rather than of static enjoyment." The question of "advertisements to be included in order to lessen the expense of production" seems to have been answered in the pages of the last few issues.

The suggestion of L. Kenneth Rourke, of 14, Heathbank Road, Cheadle Hulme, nr. Stockport,

to "maintain the present high standard and keep to the subject, i.e., television," has been adequately dealt with, since the pages of the magazine are devoted to matters appertaining to television construction, apparatus, and development.

H. H. Edmondson, of 144, Richmond Row, Liverpool, once deplored the lack of balance in the contents and wrote, "I should like more even balance between the technical and non-technical. Previously uninteresting except to advanced technicians." Has Mr. Edmondson since read the series "For the Beginner"? He also advocated the inclusion of a television story "to capture the imagination of the family."

S. Seakins, of 20, Peverley Road, Catford, will certainly be interested to read about the Stockholm demonstration, as it falls in with his suggestion "Why not try the Scandinavian Countries?"

For generosity and wholeheartedness, however, the prize must be given to Fred. C. Harris, of Rhodes Building, Capetown, who seems genuinely delighted with TELEVISION and writes: "The several features are so varied that they cannot be compared with each other. I like them all. May I take this opportunity of congratulating you on your magazine. I have taken TELEVISION since the first number, and have *always* found it *most* interesting. Every article seems to be put in such a way that it is all interesting and intelligible. I always try to read TELEVISION from cover to cover, and whenever I fail so to do it is merely through lack of time. I have no suggestions for improvement at present, but should I have any later, I will write you."

The tastes of Delbert L. Gilbert, of 681, N. Harrison Avenue, Kankakee, Illinois, U.S.A., have recently, unconsciously, been consulted. He asks for "articles on the latest developments in television." During the past months development has been the most outstanding topic, since there have been so many encouraging advances to report in this direction.

"Moseley's fighting articles," "Articles by Sydney A. Moseley," "Moseley's 'scrapping,'" "Sydney Moseley and the B.B.C.," and similar requests are made by A. C. Harrington, (Llandinam), H. L. Malcolm-Oxley (E. 14), C. M. Pranderd (Watford), F. W. Hildyard (Bath), R. V. Powditch (Gateshead-on-Tyne), A. V. Lamb (Bradford), H. Brown Lindsay (Glasgow), W. Maxwell (W. 1), and others.

The opinions that have just been quoted will probably interest readers and initiate further correspondence of a similar character. This is what the Editorial Department is seeking—an opportunity to take the temperature of public opinion on the subject of Television, and, where possible, fall in with the wishes expressed. Readers are encouraged to voice their suggestions regarding "proposed new features" and they may rest assured that their views will be given careful consideration.

Unfortunately, there is no space at the moment to expatiate further on readers' preferences and criticisms, but the Managing Editor would like to express his gratification at the constructive and intelligent interest shown to date. R.M.

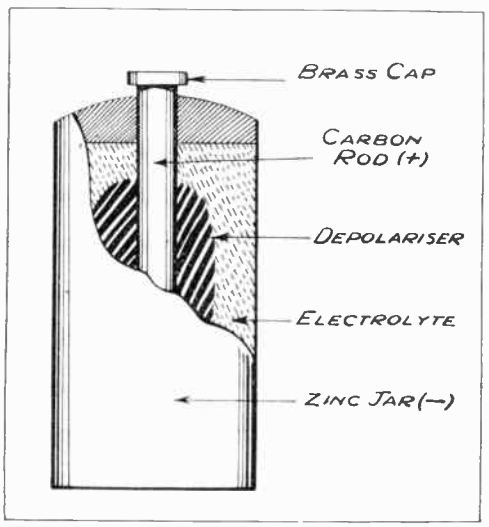
Attention to the High Tension

PART I.

By *H. J. Barton Chapple*,
Wh. Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

WHILE it is realised that for the efficient reception of the vision wireless signals care and attention must be directed to the set employed, frequently it happens that the important items associated with the supply of power to the valves and vision apparatus are overlooked. In this series of articles it is my intention to consider carefully each possible source of high tension supply, and by placing these facts before the reader he can form a better conclusion as to which meets his requirements —financially and otherwise.

There are many points which need to be studied, for it must not be thought that all the advantages lie with any one H.T. system. There is a law of



Showing in simple diagrammatic form the construction of a single dry cell.

nature which says that whenever an advantage is gained a disadvantage crops up and this has a bearing on our H.T. problems. For example, it may so happen that where the cost meets our pocket the source of current is unsuitable for our needs, and so on, but that is inevitable.

Voltage and Current Requirements

First of all, what are our voltage and current requirements? This will be governed by the distance from the station transmitting the vision signals, for on this depends the number of valve stages in our receiving set. Again, is the same H.T. source going to supply both vision and sound receivers, or do you prefer to isolate the sets and work them separately? It is quite satisfactory to use the same H.T. system to feed both receivers. In the course of my own tests I have used dry batteries, accumulators, and mains eliminators as the single source, and in every case experienced no difficulty, provided simple and elementary precautions were taken, especially from the point of view of de-coupling.

If you purpose working, say, a Baird "Televisor," then this alone requires approximately 200 to 250 volts with a current output of 25 milliamperes. If this apparatus is choke- or transformer-fed then the same voltage will suffice, but in order to meet the needs of the vision wireless receiver a further 15 to 20 milliamperes is a possible requirement, say, roughly, a total of 40 milliamperes at 250 volts.

Not Binding

The figure is in no way binding, for I have had exceedingly good images with a total consumption of only 30 milliamperes, and there have been many cases recorded in these columns where amateurs using home-made television apparatus have testified to their wonderful results with current consumptions less than my quoted figures. This is particularly so when low voltage or beehive neons have been used instead of the flat plate type and also where automatic synchronising is not being employed but some other form of control.

There is another factor which should not be overlooked. At present the weekly total of the television service, unfortunately, is only a few hours. Thus, although the wireless set which serves as a medium to delight the ear can be working (and in consequence consuming current from the H.T. source) for several hours a day (not per week), the vision set is only required for a comparatively short period.

Possible H.T. Sources

Naturally we are all looking forward to the time when this state of affairs will be changed *materially*, but in assessing the value of your H.T. source just bear this "time element" in mind, for it affects considerably the estimated useful life which can be assigned to the H.T. side.

So much, then, for generalities. Let us now deal in turn with each of the possible sources of high tension current. We have :—

(1) Dry H.T. batteries.

(2) Wet H.T. batteries (including accumulators).

(3) Electric mains (including battery eliminators, rotary converters, rectifiers, etc.).

The last named of these covers a very wide ground, and I shall attempt to deal with the most important and include also wiring diagrams and full constructional details, so that readers can build up their own eliminators.

The Dry Battery

There is no doubt that the dry battery has enjoyed a wonderful run of popularity and is still in demand. Several reasons combine in making this state of affairs possible. We can point to such advantages as cleanliness, a fair measure of safety, reasonably silent working if good quality batteries are in use, cheap initial cost, can be used anywhere whether an electric power supply is available or not, etc.

Be sure and choose your battery of sufficiently high capacity to make it meet the current demands of the receiver.

Even with these points in its favour the dry battery is very much misunderstood, and through bad handling suffers a premature death.

A dry high tension battery consists of a number of cells joined together in series, and the life of the battery is dependent upon the quality, quantity, and proportions of zinc and chemicals available in each cell. What do we mean when we talk of the voltage and the capacity of a battery ?

An Analogy

Broadly speaking, capacity refers to the current available while voltage is the pressure behind it. The idea can perhaps be explained best by referring to a simple analogy, say, that of steam. If we had two boilers—one as large as that employed in a railway locomotive and the other quite a small affair—just satisfactory for driving model engines, it would be possible to raise the steam pressure in each to, say, 40 lbs. to the square inch. Electrically, voltage is the equivalent of pressure in steam. The smallest dry cell and its larger counterpart each provide a pressure of 1½ volts, just as the small and large boilers can furnish the steam pressure we quoted.

But the small boiler can supply only a limited amount of steam, and if it was connected to a fairly

large engine the pressure would fall rapidly to almost zero. Our large boiler, on the other hand, would function satisfactorily in conjunction with the engine with no or only little diminution of pressure.

The Individual Cell

The same thing happens with the individual dry cells employed in making up dry batteries, but the larger cell can do much more work than the smaller one since its greater capacity enables it to supply a far larger amount of current or alternatively to furnish the same amount of current for a much longer period.

The ordinary dry cell contains four main parts—the zinc pot, which forms the negative electrode; the electrolyte, consisting in the main of sal-ammoniac and water in paste form; the depolariser, made up of manganese dioxide; and the central carbon rod, which is the positive electrode. Current is produced by consuming zinc, and during this chemical process hydrogen gas is formed and this must be got rid of as rapidly as it appears or the voltage of the cell will show a heavy fall and it is here that the depolariser plays its part.

Careful Balance

In practice the depolariser always falls short of the ideal, namely, that of dealing with the hydrogen as fast as it is formed. In consequence, as long as current is flowing there is a small but steady increase in the amount of hydrogen that accumulates, the internal cell resistance thus gradually increases and the potential of the cell falls.

From these remarks it is quite obvious that the cell construction demands very minute attention, for the "useful life" depends on a careful balance between the component parts. This can be demonstrated very clearly between a bad battery and a good one.

When choosing your dry battery see that it is chosen with a view to "fit" the set. The greater the H.T. current consumption the larger the capacity of the battery must be. Either by using the published valve charts or by measuring the quantity with a milliammeter ascertain the current required by your set and choose a battery whose recommended discharge rate most nearly corresponds with this figure.

"Life" Charts

There are on the market dry batteries of four different capacities, and in some cases the manufacturers give the rated discharge of these batteries, and this figure should not be exceeded except for short periods at a stretch. I can call to mind one firm, Messrs. Ripaults, Ltd., who actually publish an approximate "useful life" table. Dealing with each of their models from the standard to the quadruple type, they give three possible discharge rates in turn, and then specify the approximate life in hours and months for two separate monthly aggregates.

This chart is of inestimable value to prospective dry battery purchasers, and the policy is recommended to the attention of all other manufacturers. While the initial cost of the larger capacity models is higher than the standard models, it becomes a money-saving plan when spread over a twelve month's upkeep and you possess a high-powered set.

Economical Working

When considering the use of batteries for television purposes it must be admitted that at first sight it would appear that the cost is on the high side. Bear in mind, however, that you are only likely to use your vision set for half an hour daily at the moment, and this will serve to bring down your annual costs. Another way of economising is to use a separate battery of large capacity for serving the output valve only, and then a smaller capacity battery will suffice for the other valves.

In this connection let me emphasise a point of importance, and this is "attend to the grid bias of your low frequency stages." Too often the grid battery, built into the set, is regarded as a permanent fitting of the same kind as the valves, the condensers, and so on. It receives no attention, and is left for considerable periods without renewal.

Test the voltage every now and then for as the grid bias voltage falls off the H.T. current increases, and it is quite possible that an excessive current may inadvertently be drawn from the high-tension battery with a consequent rapid reduction in useful life. It is advisable to change your grid bias battery every six months, and regard this item as the cheapest form of insurance against big high-tension costs.

From the whole of the foregoing remarks it should be concluded that dry batteries, if properly chosen and used judiciously, are quite satisfactory for television purposes. They are capable of giving excellent results, and are very convenient, especially where no electric light service is available.

Warlingham Wireless Memorial Society.

We understand that a Society has been formed for erecting a wireless and television experimental station in honour of the wireless experimenters who fell in the war. According to a leaflet which has come into our hands the aims and objects are set out as follows :—

(1) That the Society shall be formed for the purpose of experimenting on wireless and television.

(2) That a Memorial Rest Home be provided where members can enjoy the summer programmes of long-distance stations.

(3) Weekly and monthly lectures to be organised in places arranged by the committee.

(4) The business of raising funds necessary for experimental work to be vested in the committee.

(5) Founder members to become life members; the subscription for members 5s., honorary members 2s. 6d., per annum.

At the beginning of December a concert was held to augment the funds of this Society, and we understand that a dance will take place in January for the same purpose. Full particulars can be obtained from the Honorary Secretary, Mr. A. E. White, 25, Godstone Road, Kenley, Surrey, and the Honorary Treasurer, Mr. P. W. Stillwell, 248, Galpins Road, Thornton Heath.

A use for the Stroboscopic Effect in Television

By *D. R. Campbell*

WHEN wishing to receive a sound broadcast we just tune in the radio receiver to the required station, having made sure the loud-speaker is connected to the output terminals, then recline at ease and enjoy the fare provided. For television the same operation is repeated, although frequently it is found advantageous slightly to de-tune the receiver. In addition, it is necessary to adjust the speed of the disc motor so as to bring it into synchronism and phase with that of the transmitting station.

Until synchronism is nearly obtained between the two discs—transmitter and receiver—it is hardly possible to recognise any resemblance to a picture in the resulting effect, and to judge from this weird pattern formed whether the disc motor is running either too fast or too slow, requires a certain amount of experience. Twelve and a half revolutions per second is the correct speed, but even half a revolution above or below this speed can be most misleading to the novitiate.

Not so Simple

For fortunate readers who possess a Baird commercial "Televisor" it is quite simple to bring the

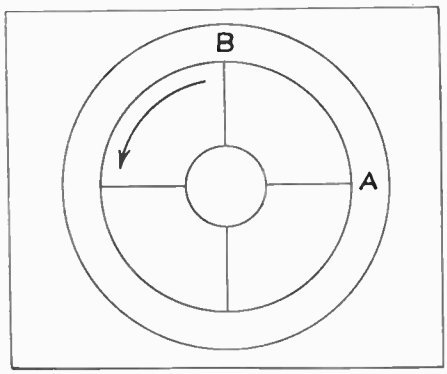


Fig. 1.—Illustrating how wheels sometimes appear stationary on the screen although revolving normally.

motor up to the correct speed. Merely join the supply leads to the proper terminals at the back of the machine and, starting with the speed knob turned as far as it will go in an anti-clockwise direction, slowly rotate it clockwise, and before one revolution with the knob has been made the disc will have run up to its correct speed.

To the enterprising amateur, however, who has rigged up the first motor that could be secured, controlling it by a resistance that may not be the correct value, the operation is not quite so simple. In many cases it is not even known if the motor will approach the required speed. I know of more than one case where whole transmissions have been missed

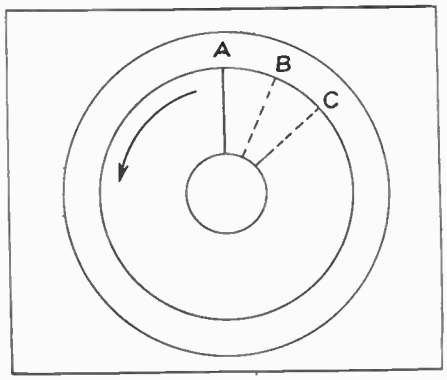


Fig. 2.—Cases arise when the spokes of a wheel have an apparent backward motion as explained in this article.

by being unable to find the correct setting for the motor. Wishing to ascertain the constancy and speed at which various motors would run, the writer, having no tachometer, decided to make use of the stroboscopic effect as a speed indicator. Before going into details this phenomenon should be explained.

Defining the Effect

The stroboscope, according to a well-known dictionary, is "an apparatus for observing periodic motion by throwing a light at intervals on the rotating body." In everyday life one rarely comes across the stroboscopic effect except at a cinema theatre. Patrons of the cinema at various times must have noticed how wheels on the screen often appear to be either stationary or, in some cases, going backwards. To explain this rather curious effect, which somewhat spoils the reality of the pictures, will explain the stroboscopic principle.

"Moving pictures" do not really move, but are a series of photographs of moving objects, taken in rapid succession, at definite intervals, nowadays generally twenty-one per second. It is this regular succession of photos which makes it so easy to produce the curious effect, causing the wheels to appear at a

standstill or turning backwards, although when photographed they were really revolving in a forward direction.

"Stationary Wheels"

In Fig. 1 is shown a four-spoked wheel rotating at such a speed that spoke "A" moves round to the

A tachometer is a very useful device for determining motor speed, but care must be exercised to impose no extra load on the driving mechanism.

position of spoke "B" during the interval between two successive exposures. Then, if the spokes are alike, it is evident that if the cine-camera and wheel keep turning at constant speeds, the picture of the wheel will, when projected on to the screen, appear to be standing perfectly still. Again, when a cine-picture of a fast-moving wheel is taken, it appears to go backwards, because the spoke "A" (Fig. 2) is revolving so fast, compared with the taking of the different pictures, that in the interval between one exposure and the next it will have revolved round to "B," and during the next exposure to "C," and so on.

Now this optical illusion, though it may rather spoil a cinema picture, can be put to many practical uses. Three quantities are necessary to produce the phenomenon. First a periodic light, second a certain number of "spokes," and third a definite speed of wheel rotation. Given any two the third can be determined.

Number of Wheel Spokes

For the purpose of knowing when a television disc is revolving at the correct speed, the light periods and number of spokes are fixed in relation to the speed required. Taking the light source first, the most common form of interrupted light is that from A.C. mains—in this country generally 50 cycles, giving light interrupted 100 times per second, that is, one interruption for each half-wave. Now consider the method adopted to calculate the number of spokes. The speed of the television disc being 12·5 revolutions per second, this equals an angular velocity of $360 \times 12{\cdot}5$—that is, 4,500 degrees per second. If the interrupted light source is from 50 cycle A.C. electric mains, divide 4,500 degrees by 100, giving 45.

Using the Device

This is the number of degrees the receiving disc must rotate in one hundredth of a second. Hence an eight-spoke wheel, such as shown in Fig. 3, will be required. Make a copy or a tracing of this figure on paper or card, and suitably attach to the disc concentric with the shaft. Looking at the stroboscopic pattern under a 50-cycle light, start the motor under test. The eight spokes will first produce a blur until the speed reaches certain fractions of 12·5 revolutions per second, when they will appear stationary as some whole multiple of eight. Increasing the motor speed, the eight spokes will appear first slowly going backwards, coming to a standstill when the speed of rotation is exactly 12·5 revolutions per second. On further acceleration the spokes will dissolve again into a blur. On running the motor

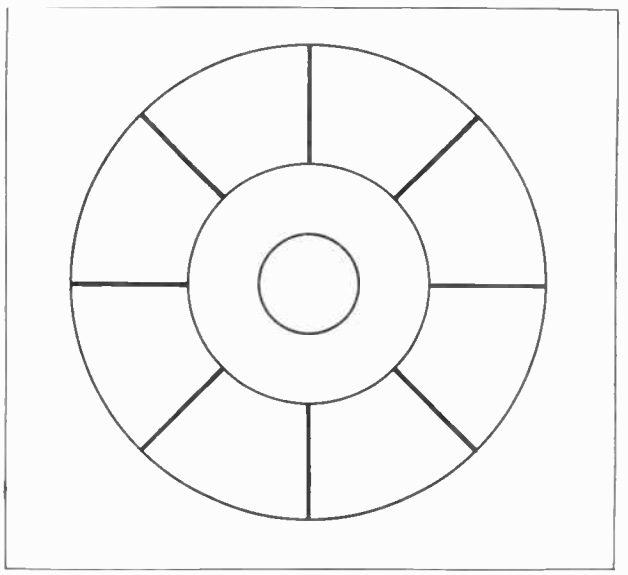


Fig. 3.—An eight-spoke wheel drawn on a card is suitable for finding the correct disc speed for Baird television broadcasts.

up to double or treble the speed the spokes will reappear eight in number, so it must not be forgotten that the first time they came to a standstill and were eight in number the motor was running at the correct speed.

A Special Case

As an interrupted light source a neon lamp is

(*Continued on page 467*)

The Television Society

BEFORE a well-attended and representative meeting of the Society, held at University College, London, W.C., on December 10th, at 7 p.m., Mr. T. Thorne Baker, F.Inst.P., A.M.I.E.E., lectured on "Television in Natural Colours, and the Fundamental Problems Involved."

The summary of the lecture was as follows: the nature of the problem; the principles of colour-vision as they apply to television; similarity of the physical problem to that of natural colour photography; early and recent attempts at colour television; selective colour-sensitivity and the modern photo-electric cell.

The lecture was well illustrated by techni-colour lantern slides and diagrams.

Indicating the present transition phase in kinematography, "when silent pictures are giving place to talking pictures, and black and white pictures are being superseded by films in natural colours," the lecturer suggested that it was "only natural to assume that, as this new science develops, the image in its natural colours in television will be made to materialise as it has done in the motion picture."

Discussing the principles of three-colour printing, the lecturer said the problem of colour television in many ways coincides with that of three-colour reproduction.

Considering wavelengths and spectrum values, it was shown that the shortest visible radiations were of wavelengths 388 $\mu\mu$ giving rise to the sensation of extreme violet, and the longest about 760 $\mu\mu$, which give rise to the sensation of deep red, and half-way between these are the greenish-yellow rays; the three primary colours in the spectrum being approximately red, green, and blue, and by the mixture of these primaries in different proportions we can form white, or any pure or intermediate colour.

Curves of luminosity were shown to indicate the enormous variations in respect to wavelengths. The subtractive and additive processes utilised in colour photography were referred to, also colour kinematography, as these must be regarded in some measure as the forerunners of colour television.

The two-colour process as used in "techni-colour" was dealt with, Mr. Baker stating that in his opinion, if the two colours were substituted for three colours in colour television, the television in natural colours could be put in performance to-day with little more effort than is being required for monochromatic transmission.

Dealing with practical colour television the lecturer said: "It is clear that we must analyse the colours of the subject at the scanning end into their primary constituents. Each primary constituent must be transmitted individually, either simultaneously—employing a separate radio channel for each—or one after the other; in the latter case we must transmit three (or two) sets of signals, one for each image instead of one, and provided the persistence of vision is the same as for monochromatic work, this sets a new limit upon the amount of possible definition we can get into the image."

Having reviewed the work of Ruhmer, Belin, and Anderson, who experimented with a view to securing colour television, Mr. Baker then referred to the actual demonstration of colour television by Mr. Baird in July 1928.

Describing Mr. Baird's method, the lecturer pointed out an interesting claim in connection with the apparatus, inasmuch that it was found unnecessary to increase the speed of revolution of the scanning disc three times, owing to parts being common in the three-coloured images.

In considering Dr. Ives' later process of colour television, it was pointed out that Ives used Argon lamps for blue and green primaries, but these had to be run at high current densities in order to get sufficient brilliance, and were constructed with water-cooled cathodes, which made a considerable complication.

The interesting experiments of Mr. H. Marryat on helium tubes, which by adjusting the gas pressure and the e.m.f. could be made to give light varying from white to straw colour, and even to bright scarlet, would probably give rise to some form of lamp which may eventually be employed for colour television.

Specially designed light-sensitive cells as regards colour sensitising would be of great importance. The colour sensitising of the metals of which the active surface is made has also been closely investigated, and more recently attempts have been made to sensitise by colour in the same way as already discovered for the photographic plate.

The lecturer closed a most interesting lecture by prophesying "that soon after television has become an everyday matter it will be adapted to natural colours and will be used on a far wider scale for commercial work, and that modern business will make it necessary to transmit designs, whether of the dressmaker or architect, the engineer or the banker, in their natural colours."

A verbatim report of the lecture will be issued in the "Proceedings of the Society," available to Fellows and Associates, and purchasable by non-members on application to the Hon. Secs., Television Society, 4, Duke Street, Adelphi, W.C.2.

Particulars of the next meeting (January) and conditions of membership can be had on application to the headquarters of the Society at the address above-mentioned.

J. J. DENTON, A.M.I.E.E.,
Hon. Secretary (*Members*).

Studio Topics

By *Harold Bradly*

Miss Joan Dare knocking at "the wrong door," in the television sketch of that name.

THE exploitation of the extended scene or greater depth of vision which has been apparent in the Baird Co.'s recent transmissions is yet another step in the right direction. This practice enables the company to present a wider range of subjects, and will further stimulate a desire to see as well as hear in those who only listen-in. In an endeavour to incorporate and establish this development in the broadcasts, various experiments have been made in the studio, and much time and thought given to exploring every avenue of the technique as applied to television.

The successful presentation of a sketch or play in a form suitable for vision transmission can only be attained by experiment after experiment, and, apart from the measure of success attained in this direction, the experience has proved very profitable.

Parenthetically it might be stated that the most simple subjects require careful preparation. The lecture showing the Baird "Televisor" components, given a short time ago at a morning session, needed much rehearsing before it was passed for broadcasting. The demonstration of ballet dancing transmitted in November embraced the extended scene, and entailed a great deal of attention to detail in its production. In this a small platform was erected with a slight slope in the direction of the transmitting apparatus. A pair of curtains fixed to a rod across the studio, and well above the beam, screened the stage from view—the rod also serving the purpose of a hand-rail and acting as a support for the artiste during her performance. Miss Ailsa Bridgewater actually performed the dancing, and an illustration in the December issue of this Magazine showed how the experiment was effected.

There was also a photograph of one scene from *The Wrong Door*, the first television sketch, produced on Wednesday, November 19th, with the following cast :—

Mrs. Talent (a voluble lady) ..... Joan Dare.
Mr. Malines (of the Early Worm Insurance Co.) ..... John Rorke.

In the transmission two characters appeared together in the office scene, and a natural effect was secured by placing the desk at such an angle that both profile and full face of each artiste could be distinguished throughout. This gave a good perspective effect, and was unlike previous efforts to transmit the images of two people appearing together.

Of quite a different type to *The Wrong Door* was the sketch by Ruth Maschwitz, called *Great Expectations*, given in six short scenes on Tuesday morning, November 25th, with the following cast in the order of their appearance :—

Juliet (a modern girl) ..... Ursula Hughes.
Her mother ..... Ruth Maschwitz.
Grannie ..... Winifred Fairlie.
Mme. Duval (French dressmaker) .. Winifred Fairlie.
Archie (Juliet's pseudo-fiancé) ..... Harold Bradly.

Only a slightly extended vision was needed here, as no two characters appeared together, but there is no doubt that the value of these sketches was enhanced by seeing the characters and incidents through the medium of television.

These forms of entertainment have brought into being the new art of fading. *The Wrong Door* was the first subject chosen for a trial, and the results proved so effective that it was again used in *Great Expectations*, and should be of inestimable service in the future.

In place of the customary form of ingress and egress before the transmitter, or changing over from one scene to another in a sketch or play, in full view of lookers-in, a neat change of scene or of artistes takes place during a momentary fading out of vision with this new scheme.

In this way it is possible to preserve the continuity of an item that is being broadcast, particularly where the subject requires it.

With fading now in operation, additional systems of signalling between studio and control room have naturally come into use.

And so we progress.

Aberdeen Experiments in Television

THE experiments in television reception of an Aberdeen amateur and two Stonehaven companions have been brought into vivid limelight owing to the remarkable results which are being achieved with rough-and-ready equipment.

Since March of this year Mr. W. S. Mowat, 8, Tullos Circle, Torry, has been endeavouring to pick up pure pictures of the entertainments which are being broadcast at intervals from London by Baird, the famous Scots television inventor.

Baffled time and again by small faults, Mr. Mowat and his companions have persevered until now they are able to receive vividly clear motion pictures through a small lens, behind which there revolves a disc, in which are innumerable little holes.

Mr. W. S. Mowat and his collaborator giving a demonstration on their home-made television receiving set.

At first, pictures would be seen in halves, or negatives would be seen instead of positives, but the flaws were detected, and now Mr. Mowat can any night tune into the London broadcasts of television and receive wonderfully clear pictures which are for all the world like cinema pictures projected upon a miniature screen. Not only so, but television which is being broadcast from the Witzleben station is also being received with wonderfully good results, to the amazement of the experts in the South, who were of the opinion that such a thing was almost impossible at the present stage.

The Set

In an interview I had this week with Mr. Mowat, he informed me that he was merely working an ordinary valve set, to which he had attached a special neon lamp, an ordinary magnifying glass, a disc of thin aluminium, in which small holes are perforated, an old lighting motor from a car, and a series of three electric batteries.

"The disc with the holes is mounted upon a stand, and it is revolved on its axle by the old motor. At first the row kicked up by this was terrific, until the insertion of a condenser in the circuit removed the trouble. The magnifying glass is placed against the disc, with the neon lamp behind, and in complete darkness, except for the flickering of the neon lamp, we sit around the 'screen' and watch the moving pictures."

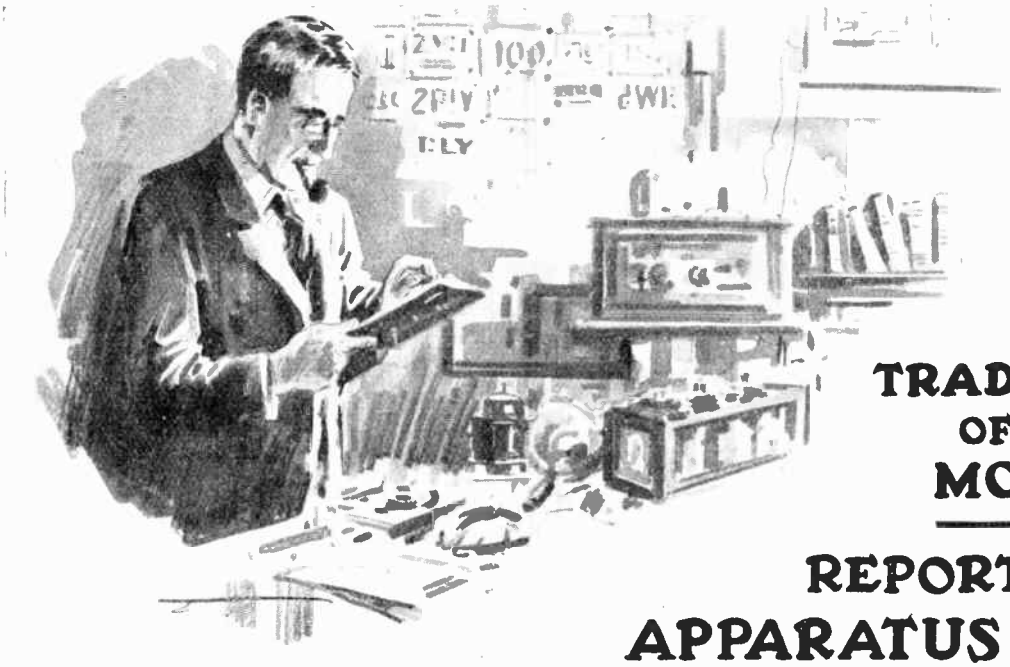
Amazingly enough, even the quickest movement on the part of the broadcasting artistes can be seen, details of their faces are quite clear, but most clearly of all come the printed messages which Mr. Baird periodically transmits. The wording is perfectly received, although, of course, all the television reception is subject to the usual "fading," which all types of broadcasting is subject to.

An idea of the impression one first gains of Mr. Mowat's experiments is given by a north-east gentleman who was invited to 8, Tullos Circle, and was there introduced to Mr. Mowat's collaborators, Messrs. J. MacDonald, The Neuk, Stonehaven, and A. Thow, Cromdale, Stonehaven. "I was keyed up to that pitch of pleasurable anticipation that precedes the unveiling of mysteries," he said. "I was conscious, however, of a slight chill of disappointment as I gazed at what seemed to me unprepossessing and inadequate apparatus.

"Is that all of it?" I inquired. 'That's all!' I was informed—'that coupled to the ordinary four-valve set in the corner.'

"However, the motor was started, the disc spun round, and at midnight we sat peering at the magnifying glass and watched a dull red stream of lights rush past. I watched and marvelled as blobs like bubbles of molten lava appeared in the rushing

(*Continued on page* 467.)



TRADE NOTES OF THE MONTH

REPORTS ON APPARATUS TESTED

Benjamin Valveholders and Switches

THE valveholders and switches made by The Benjamin Electric, Ltd., have been on the market for some time, especially in the case of the former. Since both of these components are used in vision wireless apparatus, it is as well for constructors to have details available, so that they are in a position to judge these products for themselves.

There are three types of valveholders made by this Company, and the one we tested is known as the Clearer Tone. Each valve pin socket consists of a spiral of metal strip carried out integrally to a tinned soldering lug. The entire platform supporting the valve floats in a spring suspension formed by the four spirals. It is this important feature which the Company claims will damp out vibration, and thereby not only lengthen the life of the valve filament but also eliminate the microphonic "ring" which so completely upsets vision reception.

In the Clearer Tone valveholder the entire platform floats on a spring suspension formed by the spiral springs.

On test we found this valveholder a first-class product, a most marked advantage being noticed when compared with an unsprung valveholder. Since microphonic effects can completely upset a television image, it will be seen that a valveholder which almost eliminates this has a decided advantage.

Coming to the switch, there is a double pole rotary switch of the double throw type and a single pole

An ingenious double pole double throw rotary switch giving a particularly positive contact in every position.

rotary switch of the double throw type. In the case of the former, the switch consisted of eight heavy gauge contact strips, disposed rather like the staves of a barrel, around two sturdy bakelite discs separated by distance columns. The spindle carrying the pointer knob terminated in a bakelite T-piece of square section, cups in the ends of the T-arms carrying phosphor-bronze balls loaded with springs. As the pointer knob is rotated the balls ride over the contact strips and click securely into gaps between them, thereby creating a positive and low resistance connection between neighbouring strips.

We were particularly impressed with the "snap" action of these switches and also with the reliability of the contact secured. Particularly robust in character, these switches, which have a multitude of uses,

can be confidently recommended to readers of TELEVISION.

Labels for Battery Leads

Messrs. Money Hicks, Ltd., now have on the market what are known as Cortabs de Luxe. Actually, they consist of neat little ivorine labels slotted at each end so that the label can be clipped along the battery lead feeding the wireless receiver. With this de Luxe pattern, provision is made for the voltages to be marked on the label in pen or pencil. In view of the relatively high voltages used in television working, it is a distinct advantage to have each battery lead properly labelled, so as to avoid any risks of damage to valves or apparatus inside the receiver. A packet of these labels, therefore, is a wise investment and an insurance against possible damage.

A Special Detector Valve

Every user of wireless receivers employing one or more valves will have experienced at one time or another the annoying trouble known as microphonic

The Cortabs de Luxe can be clipped quite readily on the battery lead and the voltage marked as shown.

howl. Messrs. A. C. Cossor, Ltd., claim to have overcome this defect in a new valve by evolving a method of gripping the valve filament in seven places by means of a spiral spring and minute porcelain covering hooks. The accompanying illustration shows quite clearly how this has been brought about, it being embodied in a special detector valve distinguished by the name "Cossor 210 Det." It is hoped to give readers a test report on this valve in our next issue.

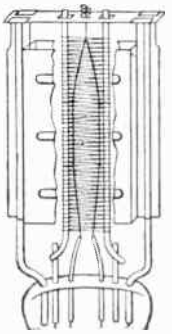
Westinghouse All-Metal Rectifiers

The question of using alternating current mains for supplying power both to the wireless receiver and the vision apparatus is particularly important. It is natural, therefore, that those readers having mains installed in their household should seek information as to how they may use this potential power source. We therefore welcomed the opportunity of being able to test out Westinghouse Metal Rectifier Units in order to see whether they were capable of supplying adequate voltage and current for this purpose.

The makers claim that their metal rectifier does not deteriorate with normal use and has a high efficiency coupled with a low voltage drop. In the units we examined all the internal connections are brought out to marked terminals and in this way the rectifier can be readily joined into circuit.

According to the type of apparatus used by the television enthusiast so his voltage and current requirements will vary.

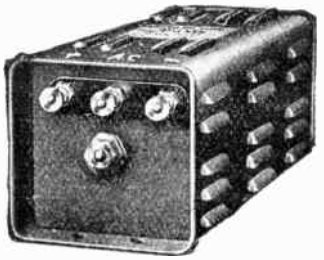
In testing the two metal rectifiers, styled the H.T. 6 and H.T. 7, we found that in the case of the former it gave an output of 25 milliamps at 175 volts,



This illustration shews very clearly how Messrs. A. C. Cossor, Ltd., grip the special detector valve filament in seven places by means of a spiral spring and minute porcelain hooks.

while in the case of the latter 28 milliamps were obtained at a voltage of 200. Where readers' requirements are covered by these figures the units are excellent in every way, and by incorporating suitable smoothing arrangements, that is chokes and condensers, a smooth D.C. output is available which can be pressed into service for television working.

In many cases, however, especially those where it is desired to use the neon and synchronising coils in series with the plate of the output valve, a higher voltage is required. This is met quite readily by using two units together in what is known as the voltage doubler circuit. The connections are quite straightforward and on our tests we found that it



Readers desiring to follow "The All-Metal Way" should make a point of using the H.T.7 type rectifier shown here.

was an easy matter to obtain an output of 30 milliamps at a voltage of 350.

Since these metal rectifiers are quite reasonable in price, 17s. 6d. in the case of H.T. 6 type and 21s. in the case of the H.T. 7 type, readers will welcome this apparatus for use in television working. They are quite safe to use and, with normal handling, should have a particularly long life.

The makers give full details of the auxiliary apparatus to be used with their units, and we would suggest that readers write to them for the brochure called "The All-Metal Way," and mention TELEVISION. The address is The Westinghouse Brake and Saxby Signal Company, Ltd., 82, York Road, King's Cross, N. 1.

The McMichael Mains Three Receiver

Since the transmissions that take place from the Brookman's Park Station are simultaneous sound and vision during the course of the Baird television transmissions, it is necessary to accompany your vision receiver with a first-class sound receiver. Of course, in addition, the sound receiver will serve the family, day in and day out, during those times when the vision transmissions are not on the air.

We have had an opportunity of thoroughly testing the McMichael Mains Three Receiver. The makers state that in producing this design it has been recognised that the essential quality required is a dignified and handsome appearance, combined with compact-

Dignified, and handsome in appearance, the McMichael Mains Three Receiver gives exceedingly good results.

ness, simplicity, and permanence of operation, and perfect tonal quality capable of being graded to all requirements of volume.

These aims of the manufacturer have, in our opinion, been adequately fulfilled in this receiver. An idea of the appearance of the set can be gained from the accompanying illustration, and the additional equipment required consists solely of a loud-speaker, the sensitivity of the set being such that even without an aerial a number of stations are available. By connecting an aerial and earth to this set, however, the range and volume is increased enormously.

Messrs. L. McMichael, Limited, have been manufacturers of wireless apparatus for the past ten years, and they take a pride in producing designs which are simple to operate and give an all-round efficiency.

Instead of the more usual condenser scale marked in degrees, in the centre of the set and near the top is an illuminated scale calibrated in wavelengths, and a pointer operated by a single tuning control is the only tuning required. The selection of long and short waves and the introduction of the gramophone pick-up together with volume control is a matter of rotating one control knob only, namely, that on the bottom left-hand side. The reaction control we found normally may be left untouched, but where extreme range is called for this is brought into play with marked effect.

To our minds it is useless to give a list of the stations which have been tuned in on this set. So much depends upon environment and also atmospheric conditions. Suffice it to say, however, that once the set had been connected up by plugging into the mains socket and joining the loud-speaker to the plug and flex provided, we were able to tune in a dozen or more stations with absolute ease merely by operating the single tuning control and leaving the reaction knob untouched. There was only a slight trace of mains hum, and since quality of reproduction depends largely upon the selection of a loud-speaker with an impedance suited to the last valve, there is an output choke on the top of which are two sockets, one engraved "H" and the other "L." The plug should be inserted into the socket which gives the best quality with the loud-speaker chosen.

The selectivity is adequate for normal situations but may be still further increased by slightly reducing the volume upon the left-hand control. It was then found that the tuning became so sharp that a critical adjustment of the pointer on the wavelength scale was necessary.

This is truly a mains driven set in every sense of the word, suitable for any standard alternating current system, and we unhesitatingly recommend this product to the attention of any readers who desire a first-class receiver at a moderate price, namely, 20 guineas inclusive.

Mullard A.C. Mains S. G. Valves

When the Mullard range of indirectly heated A.C. mains valves was introduced, the screened grid valve of the series, type S.4V, with its amplification factor of 1,000, gave exceedingly good results. Later the same Company introduced a further A.C. screen grid valve type S.4VA, not to supersede but to supplement the original type. The new valve, with a somewhat lower impedance, as can be seen from the table below, has the really excellent mutual conductance of 3.5 milliamperes per volt. This valve gave very high stage gains when used in a suitably designed wireless receiver.

Now comes the news of a further addition to this range, namely, the S.4VB. This valve has an impedance still lower than the S.4VA, the actual published figure being 257,000 ohms. The full characteristics of these three valves are appended below, and the introduction of this new valve should enable readers to experience no difficulty in selecting the one most suitable for use with any standard type of coil and H.F. transformer.

It should be borne in mind that set design frequently centres around existing components, and it is therefore of great value to be able to select a valve to suit a particular method of coupling. Owing to the high

efficiency of these valves, our own tests showed that it was necessary to take every precaution to secure stability, including complete screening and decoupling the H.T. feed circuits. In the case of the S.4V and the S.4VA valves, it is advisable to apply approximately 0.75 volts negative bias to the control grid. This can be obtained conveniently by connecting a wire-wound resistance of 300 ohms, shunted by a 0.01 mfd. condenser, in series with a cathode lead.

In the case of the S.4VB valve, approximately 1 volt negative bias is desirable, and in this case the same fixed condenser can be employed, but the resistance should be 200 ohms instead of 300 ohms.

These valves, when tested out on wireless receivers, gave extremely good results, and we have every confidence in bringing these Mullard products to the attention of all readers seeking efficient A.C. mains screened grid valves.

	S.4V	S.4VA	S.4VB
Maximum Heater Voltage .. (volts)	4.0	4.0	4.0
Heater Current (amperes)	1.0	1.0	1.0
Maximum Anode Voltage .. (volts)	200.	200	200
Positive Screen Voltage .. (volts)	75–100	75–100	75–100
Anode Impedance (ohms)	909,000*	430,000*	257,000†
Amplification Factor..	1,000*	1,500*	900†
Mutual Conductance (mA/volt)	1.1*	3.5*	3.5†

* At anode volts, 100; screen volts, 75; grid volts, zero.
† At anode volts, 100; screen volts, 75; grid volts, —1.

A use for the Stroboscopic Effect in Television

(*Concluded from page 460.*)

considerably better than the ordinary filament lamp. If, however, the Baird special flat plate neon is used, it must be remembered that, owing to the special construction causing it to give practically no light on one-half of the cycle, the angular velocity must be divided by the number of cycles instead of twice that amount, as in the case of the ordinary beehive neon or filament lamp.

In conclusion, any readers who are experimenting with home-made television apparatus will quickly realise how useful the stroboscopic effect can be. Besides giving a means of checking up the disc motor speed, one has also a means of testing out the practicability of various disc motor experiments.

Aberdeen Experiments in Television

(*Concluded from page 463.*)

stream, and, as the subject came into focus, gave voice to my wonder when the animated likeness of a lady, who appeared to be singing appeared. There followed a stout gentleman, full of humour, then another who sang, then a notice in print of the next broadcast, and some wonderful portraits of the announcer.

A New Experiment

"The likenesses were so clear that I am sure I shall recognise any of these people if I ever meet them in the flesh. Then Mr. Mowat explained to me that at the transmitting station there was a disc similar to that which he used, rotating at the same speed, about 700 to 750 revolutions per minute, and through which a light passed on to the subject."

Mr. Mowat is shortly to begin a new experiment. He is to make a gramophone record of the television broadcast so that he will be able at any time to throw the "bottled" picture on his screen. He has also been intercepting television broadcasts from Germany, the subject-matter being principally cinema films.

In Helensburgh, when Mr. Mowat was quite young, he and Mr. Baird, who is very much older, were next-door neighbours.

[*Reprinted from "The People's Journal" November 29th, 1930*]

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for the opinions of his correspondents. Correspondence should be addressed to the Editor, TELEVISION, 505, Cecil Chambers, Strand, W.C.2, and must be accompanied by the writer's name and address.

A SHORT-WAVE SET QUERY.

To the Editor of TELEVISION.

DEAR SIR,—We have constructed a short-wave set as per the instructions of your contributor, B. Marshall, but do not obtain satisfactory results when the 'phones are connected as shown in the theoretical diagram. When, however, the 'phones are connected in the usual manner, that is between H.T.+ and choke, the results are all that could be desired. We have received Pittsburgh East at loudspeaker strength for two hours; also Rome, Prague, and a new station at Lisbon, PCIAA. The set is perfectly stable, and seems ideal for short-wave work.

We are demonstrating the Baird system of television and it is causing great interest over a wide area. Our television results are excellent and we find no difficulty in holding the image. Wishing your journal every success, we are

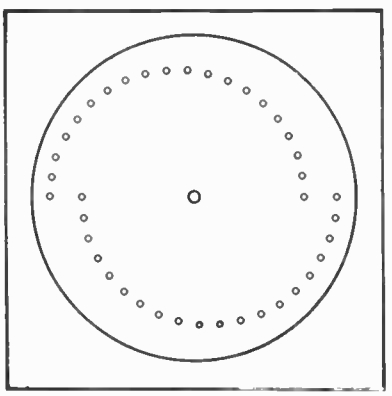
Yours faithfully,

Bagshot, Surrey. LINDFIELDS.
November 25th, 1930.

MR. MARSHALL REPLIES.

To the Editor of TELEVISION.

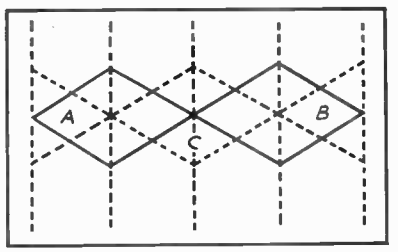
DEAR SIR,—The short-wave circuit will, of course, work as shown by reason of the high-frequency by-passing effect of the condensers shunting the telephones and high-tension supply. It would certainly be better, however, if the 'phones were connected in



The double spiral disc made up by Mr. Carmichael and to which he refers in his letter.

series with the high-frequency choke, and the circuit should be so arranged. In the circuit shown with my article the high-tension positive 3 should be applied not to the terminal shown but to the lower of the two terminals marked "to L.F." It will be seen that in this way the 'phones are connected directly in the high-tension supply.

The successful "bag" of long-distance short-wave stations mentioned by your correspondent is extremely gratifying, and is yet one more proof of the popularity which awaits television transmissions below 100 metres. It is so easy to get good results at



The diamond shaped holes overlap each other in the manner indicated in the sketch.

these high frequencies provided an efficient receiver is used, and the natural sharp tuning of short-wave receivers is conducive to good television reception without undue space being taken up in the ether frequency band.

Yours faithfully,

Essex. B. MARSHALL.
December 1st, 1930.

A QUESTION FOR READERS.

To the Editor of TELEVISION.

DEAR SIR,—I have constructed, for experiment, a thirty-hole scanning disc rather different from the standard type. There are two spirals of fifteen holes, so arranged that, if the scanned strips were numbered, the holes of the one spiral would scan the odd, and those of the other the even ones. The holes are diamond-shaped and marked out so that the one, in scanning, overlaps the other next it—*i.e.*, next it in scanning, not in time—by half its width. Thus the strips scanned by two consecutive holes on one spiral would just touch each other.

I have only been able to test it roughly, on a sound broadcast, of course, for flicker effects which did not seem specially apparent, although the speed chosen was about half the standard speed, *i.e.*, 375 r.p.m.

I should be interested to know what results are or have been obtained with this type of disc, and whether the effects differ much from those of the standard arrangement.

Yours faithfully,

P. F. CARMICHAEL.

Claddoch, Gartocharn, Dumbartonshire.
December 9th, 1930.

[We shall welcome any communications from readers bearing on the disc construction suggested by Mr. Carmichael, especially if this scheme has already been tried out by them.—ED.]

TELEVISION IN ABERDEEN.

To the Editor of TELEVISION.

DEAR SIR,—I have pleasure in sending you further details of our experiments with television. During the past few months more than fifty people have "looked into" our set, and expressed their astonishment at the results; none better than the press photographer, who exclaimed in his excitement: "That's got photo-telegraphy knocked sick."

The Baird reception has been as clockwork with us during the past three or four months; we have even been able to get fairly good results from morning receptions, and we look forward to the films from Witzleben on Friday evenings. One evening we enjoyed seeing ballroom dancing—steps of the tango and waltz were demonstrated—also ballroom scene and gymnastic lessons. The print comes in the wrong way, but with the aid of a mirror we can rectify this.

I am of the opinion that for long-distance work grid-leak rectification is better than anode bend. We could not get half-tones from our local station transmission with music, but if we tune-in to any of the foreign stations we get good half-tone effects, using very little reaction.

As previously mentioned, our set is screened grid, detector, R.C. power, transformer super-power (P240).

Yours faithfully,

W. S. MOWAT.

8, Tullos Circle, Balnagask, Aberdeen.

December 10th, 1930.

[Readers are referred to page 463 for further details of the television results in Aberdeen.—ED.]

SUGGESTIONS FROM MR. BURGESS.

To the Editor of TELEVISION.

DEAR SIR,—I have been a regular reader of TELEVISION since No. 1, and this is my first letter to you. Seeing my request for a full-page photograph mentioned in the December issue, I am writing in answer to it, and also to give a few suggestions for making the magazine better.

The kind of illustrations I had in mind were photographs of men who are connected with television, *e.g.*, Mr. Baird (of course), Sir Ambrose Fleming, and other scientists. Also views of things of interest, such as views of the transmitting apparatus now in use, view of the short-wave transmitter (when it is completed). The photographs of the various scientists should be accompanied by a short description of their main work or inventions.

I notice that a Dutch reader asks for more advertisements in this month's issue, and I also notice that you have attended to this.

There is every kind of article in the magazine so that it is hard to say which is best. Those that I like best are the constructional articles, "Cosmic Radiation" (I hope to see more of these and also on cathode rays, infra-red rays, etc.). "The Enthusiast Sees it Through," "Light," "Trade Notes." I am glad to see that you are arranging for articles on optics, chemistry, and the ether, etc.

I have been unable to experiment in television at the moment, and the largest set I have at present is a three-valve, and this does not give London without it fading. I hope when the Northern twin transmitter is working it will relay London and thus give northerners a chance to see as well as hear.

I hope you will forgive me for this long letter, and will consider the suggestion given above. I will close by wishing British television and your excellent magazine the best of luck and hope they will forge ahead of others.

Yours faithfully,

F. BURGESS.

3, Cog Square, Burnley.

December 9th, 1930.

DO YOU ENDORSE THESE REMARKS?

To the Editor of TELEVISION.

DEAR SIR,—As the first acting Editor of TELEVISION—in fact the first pressman engaged to produce the world's first television journal—I should like to congratulate the present editorial staff on the many improvements effected during past months. The present style of general lay-out is most attractive, while the contents are a skilful blend of sound technical articles and interesting popular features which must surely suit the varied types of readers.

Wishing the TELEVISION magazine the success it deserves.

Yours faithfully,

RONALD F. TILTMAN

(*General Secretary, Radio Association*).

17, Stucley Road, Lampton,
Hounslow, Middlesex.

December 3rd, 1930.

LECTURES FOR JANUARY.

The following lectures will be given by Mr. J. J. Denton, A.M.I.E.E.:—

Jan. 15th.—"Television (Principles and Methods)," at the Borough Polytechnic, London, S.E., at 8 p.m. This is the first of a series of six lectures, to be continued on the following Thursday evenings of January and other arranged dates. Particulars can be had from The Principal, Borough Polytechnic, S.E.

Jan. 20th.—"Television and Noctovision," 7.30 p.m. The Association of Engineering and Shipbuilding Draughtsmen, Stafford.

Jan. 21st.—"Radio Vision," at 8 p.m. The Rugby Engineering Society, Benn Buildings, Rugby.

Cards of admission can be had from Mr. J. J. Denton, the Television Society, 4, Duke Street, Adelphi, W.C. 2.

The Crystallization of Selenium

PART II.—A FEW SUGGESTIONS

(Concluded from the October issue.)

By *James Scott*

Fellow of the Television Society ; Member of the American Chemical Society

"THE continued study of the formation of crystals, it is thought, may throw further light upon electrons, and their connection with the structure of the atom."

This is a quotation from page 514, "The Outline of Science," Vol. 2, published by the Waverley Book Company.

Here we have a hint of the special lines of investigation along which the modern research workers are travelling. For the moment, it will suffice for our purpose to note the theory that the bondage of crystals is assumed to be electrical in character. What is referred to as the crystalline lattice indicates the fine net-like lines of junction, or boundaries, between those crystal aggregates.

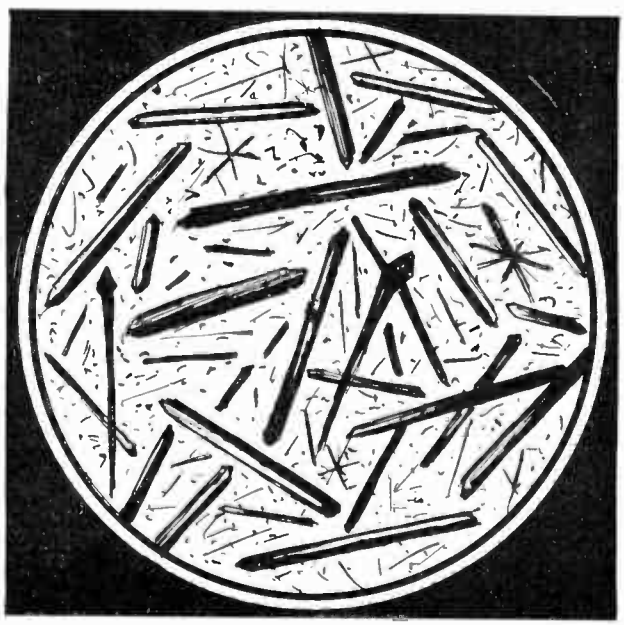


Fig. 1.—Selenium dust crystals after distillation, or rather sublimation. The crystals are then prismatic with tetrahedral and polyhedral ends.

Taking our analogy with "bricks" as a guide, this powerful cohesive, apparently electronic, force is comparable with the binding mortar of a wall, except in so far that it is not materialistic in the sense that the latter is, but is composed of negative and positive electrons, according to circumstances, and so is a kind of energy. Electrolyis releases this power, according to circumstances.

Playing Hide-and-Seek

At a meeting of the Royal Society of Arts, in the session 1928–1929, Mr. G. G. Blake displayed, among many other particulars of electrical phenomena with experiments, lantern slides of clusters of negative, and of positive, electrons. The fact was clearly proved that negative electrons are straight, while positive electrons are wavy. Here we have a suggestion of the underlying importance of discovering just how, and why, electrons play hide-and-seek with one another, being arranged, and disarranged, as it were, according as the selenium affected by them has a ray of visible or invisible light (e.g., U.V.L.) focused upon it. Some fascinating studies should be expected to follow enquiries.

Coming to the actual results of my own experiments and microscopical observations, I will explain some phases of the crystallization of selenium. I took some of this element in its powdered form, quite refined and pure. Under the microscope its particles were seen to consist of the finest possible dust. A few pinches of this powder were distilled—or, rather, sublimed—by means of heat. Upon the receiving glass plate were eventually deposited clusters of crystals of the kind shown in Fig. 1. Many of them were very perfect, while most were brilliant, and almost black, and reflected the light so strongly that the illuminated planes appeared white.

It is here that the refraction of light rays sent through a film of the element disposed of in a selenium cell is of such great significance. We must not overlook that when crystals (of any kind) are forming freely, and their planes and angles have no impediments presented to them, they can follow the law which is inherent in them, and so become correctly symmetrical. In this case the atoms of vaporized selenium are suspended in a medium which does *not*

oppose their internal and external arrangements; therefore they settle or sublime upon the receiving glass fully expanded, so to speak.

Further Experiments

But they are of no use, as such, in the preparation of a selenium cell, because they are scattered. They need to be collected and fused together to comprise a thin film, and it is just here where so much difficulty is experienced, because then the crystallization tends to become modified, though relative.

I heated some of the same selenium dust on a strip of glass, and, as it softened, its particles fused together to produce polygonal crystals, evidently having a tendency to become truly hexagonal. Fig. 2 discloses this modification. Further heating vaporized them.

I would remind readers that when selenium is heated so as to assume the " metallic " form, when its colour and lustre looks " steely," its surface generally exhibits a minute pattern on hexagonal lines, showing plainly that a number of microscopic hexagons are lying side by side.

A remelting, however, at a slightly different temperature will cause this selenium to change from the metallic to the waxen or porcelain appearance, when no, or hardly any, configuration is observable. Probably it is still crystalline, but the crystals may have so intimately fused together at their boundaries that the normal lattice due to such is obliterated, and the selenium tends to become " glassy " in character.

Physical Property Change

We must not forget that selenium may gradually change from one condition to another; and though it may be perfectly and symmetrically light-sensitive in some circumstances, or at certain periods, it is still liable to some peculiar changes of physical properties, and thus its electrical functions become modified accordingly.

Seeing that the metallic form of selenium is hexagonal, minutely, it will be appropriate to consider Fig. 3. Suppose that the element has cooled down and discloses this pattern. It is possible that during the setting process some crystals in a small area are of either slightly higher or lower degrees than the remainder. Consequently they are liable to modification. Their units or atoms will arrange their crystalline planes differently, although their angles may be just the same, viz., 60 degrees. In the middle of the figure we see how such a change can resolve hexagons into rhombic forms. Still, however, there is regularity of disposition, and negative and positive electrons would respond in proper order to the action of a focused ray of light.

This kind of change, known as hemihedrism, is quite common among small (and, of course, large) crystals of elements.

Crystalline Functions

In the case of transparent substances polarised light, used in conjunction with microscopical observations, yield some valuable information to investigators with regard to the internal arrangement of planes and angles; but as selenium is opaque our efforts in this direction are frustrated. A diamond,

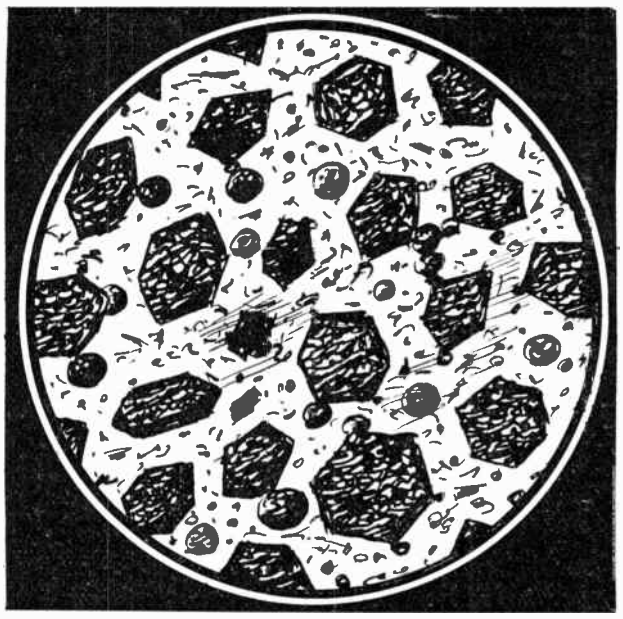


Fig. 2.—Notice how selenium dust, when melted on glass, has a tendency to become hexagonal granules. When vaporised they sublime differently.

for instance, may be rough and shapeless externally, but examination of a section of it reveals a beautiful internal symmetry, and we can realise how the refraction of the light is responsible for the radiant colours—or fire—so brilliantly projected therefrom. Although cane-sugar is so distinct from selenium, its examination will afford us some enlightenment on crystalline formations. The large sugar grains, or crystals, that we buy for household purposes are monoclinic. We can dissolve them into a syrup with water, and later so heat this syrup as to obtain films, cakes, or slabs of amorphous (i.e., non-crystalline) sugar, or we can so treat the syrup, by suspending it on, cords, that quite large crystals of barley sugar result. Again, contrarily, we can deal with the cooling syrup, keeping it agitated by means of a spatula, flattening and kneading it so that when it is cold it becomes creamy, i.e., fondant. Apparently it is then a mass of mere shapeless particles, but under the microscope we find that it is entirely composed of cubic and square crystals of exceptionally minute sizes.

Watch sugar, and salt, grains being dissolved in water (meantime magnified) and you will see little symmetrical pits forming as the crystalline units are dissolved away.

Tungsten

Coming to a more appropriate substance, we learn that the tungsten filament of a wireless valve consists, notwithstanding its hair-like fineness, of a multitude

of crystals, which, when they become disorientated during use of the wire, are responsible for most of its faults and fractures. Research workers have found it possible, by means of special annealing processes, to produce a tungsten filament which is practically composed of a single elongated crystal.

As the particles or units of an ordinary tungsten filament become affected by current, reduced vacuum, and other agencies, the binding or electronic force (the electrons) situated in the boundary lattices is interfered with, and while some crystals get loosened and spoilt, giving rise to minute cracks, others fuse more intimately together to form larger crystals. It was undoubtedly this fact which led to the possibility of making a tungsten filament so homogeneous that actually it could be regarded as a single crystal.

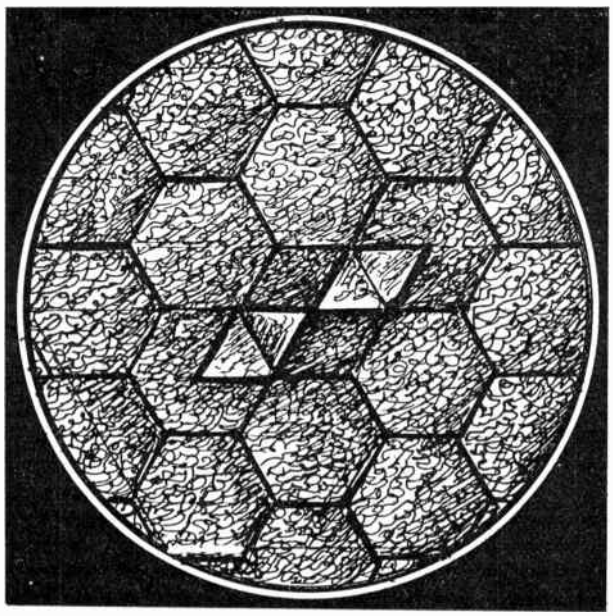


Fig. 3.—An enormously magnified view of fused selenium in its metallic, steely, film form (hexagonal), showing how its particles may become rhombic under various influences.

It would appear, however, that the fact really is that so closely united together do the tungsten crystals become that all traces of boundaries, or lattice, are annihilated. But the atoms themselves must have " spaces " (no other word will do) between them—too ultra-minute to be disclosable to us by any known means!

Schoolboys' Exhibition —Olympia

January 1st to 10th, 1931

WHAT THE BOYS WILL SEE

TELEVISION demonstrations and television equipment will be on view at the Schoolboys' Exhibition, to be held at the Empire Hall, Olympia, from January 1st to 10th, at stands Nos. 11 on the ground floor and 44A on the first floor. A part of the ground-floor stand will be devoted to the reception of continuous transmissions of television by the Baird process during the hours that the Exhibition is open to the public, the remaining space being occupied by a display of the equipment which is at present being marketed, combined with what should be a very interesting exhibit, namely, some of the original equipment as used by Mr. Baird in his earliest experiments.

Technical personnel will be available on the stand to provide information to all who are interested in this new science, and in view of the fact that the youths of to-day will, in the not distant future, come to regard television as a normal part of their education and amusement, it is anticipated that large numbers will take this opportunity of gaining some insight into the Baird Company's equipment and the principles upon which they are working.

Stand No. 44A will be occupied by the transmitter, which will be similar in principle to that which is used in the daily broadcasts from the Baird Studio, and arrangements have been made for this stand to be fitted with a glass frontage in order that a complete view of this equipment shall be available for visitors to the Exhibition.

Wireless " Panel "

At the invitation of Colonel C. L'Estrange Malone, M.P., representatives of the National and Technical Press lunched at the House of Commons on Thursday, December 11th.

The object of this lunch was to explain to the Press the aims and objects of the Radio Association, although one member of the Council, Mr. R. R. Pecorini, with sublime faith in the childlike innocence of the Press, assured the gathering that the idea of obtaining free publicity was furthest from their thoughts when the lunch was arranged.

The advantages of membership of this Association were fully explained in the September, 1930, issue of TELEVISION.

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