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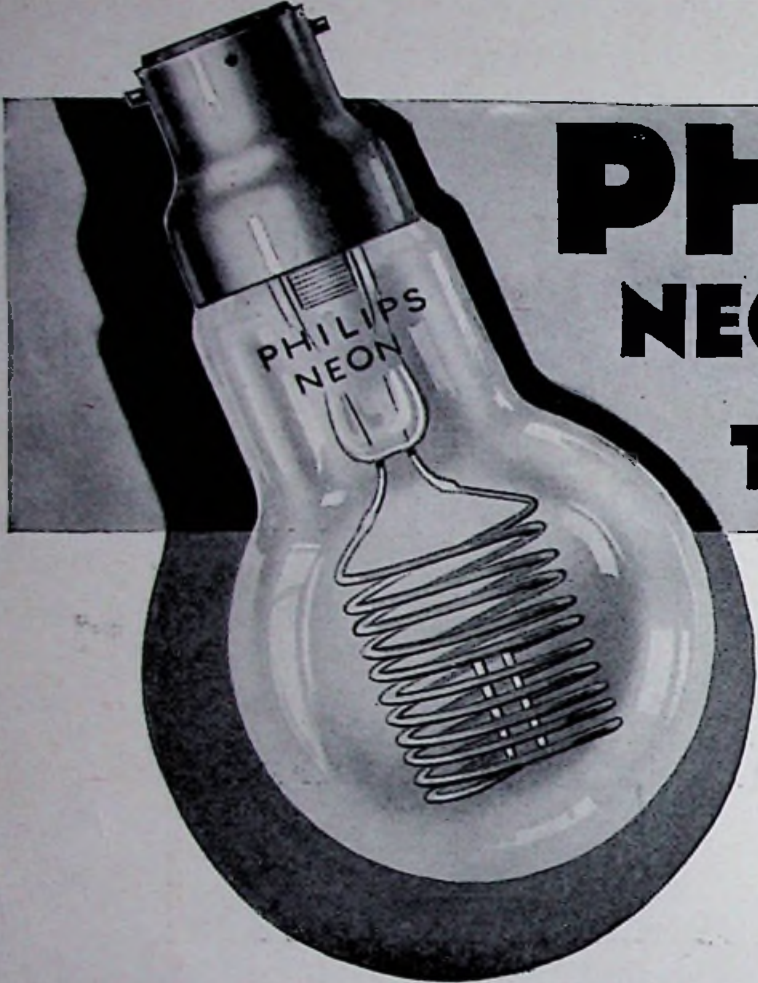
Television

The Official Organ of the Television Society

VOL. 1. OCT. 1928 No. 8

THE WORLDS FIRST TELEVISION JOURNAL



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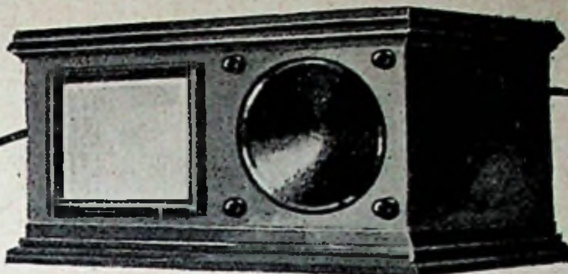

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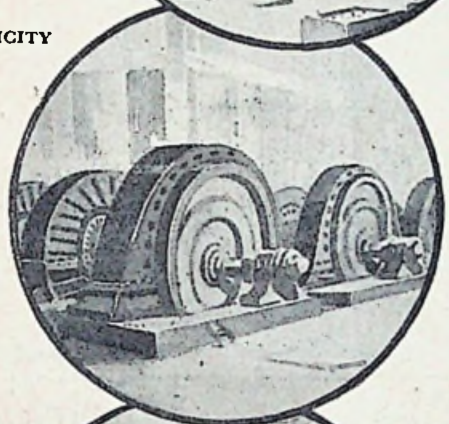

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Television

THE WORLD'S FIRST TELEVISION JOURNAL

The Official Organ of The Television Society

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

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

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

Vol. 1] OCTOBER 1928 [No. 8

EDITORIAL

BY the time these lines appear in print the annual Radio Exhibition will be in full swing at Olympia, and this issue of TELEVISION will be on sale at our stand there, Stand No. 11, Avenue A. We are looking forward with keen anticipation to the pleasure of meeting many of our readers there.

A LARGE number of readers have paid us the compliment of writing to ask us to extend the length and scope of our Editorial, and our sense of appreciation is such that we take the opportunity offered by this, our Radio Exhibition Number, of acceding to these requests

* * *

Television Demonstrations

WITHOUT a doubt the greatest attraction of the exhibition this year will be the Baird Company's exhibit of several commercial types of home televisor. In one form the set is a dual instrument, incorporating a very high-class radio broadcast receiver, together with a moving coil type loud-speaker, and a televisor. The combined instrument is therefore capable of receiving not only the voice but also the image of the broadcasting artist, thus enabling the user not only to hear the artist but also to see him, or her, simultaneously, in perfect synchronism.

THE rules of the Radio Manufacturers' Association, under whose auspices the exhibition is held, do not permit demonstrations of any kind within the precincts of Olympia whilst the exhibition is in progress, but the Baird Company has, we understand, rented premises in the immediate vicinity of Olympia and made arrangements to demonstrate the commercial televisor in actual operation.

THERE will undoubtedly be a tremendous demand for tickets for these demonstrations, and, knowing this, the Baird Company informs us that in order to make the organisation of the demonstrations as perfect as possible they have decided that admittance to the demonstration rooms shall be by ticket only. These tickets can be obtained, free, by anyone applying for them at the Baird Company's Stands Nos. 13 and 14 in Olympia itself.

WE have been asked to state these facts clearly, so that there shall be no misunderstanding on the part of the public, and so that the organisation of the

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demonstrations shall not break down under pressure of uncontrollable numbers.

* * *

The British Association Meeting

SINCE our last issue appeared the annual meeting of the British Association for the Advancement of Science has come and gone. Last year the meeting was held at Leeds. This year it was held within the precincts of the magnificent university building at Glasgow. A more suitable and more majestic *venue* for such a gathering would be hard to find.

LAST year, at Leeds, Mr. Baird demonstrated noctovision to the members there assembled. At Glasgow this year he demonstrated stereoscopic television and television in colours, the two most important scientific achievements which are the results of his past year's labours. The demonstrations proved to be an extremely popular attraction, and were conducted very successfully indeed. Glasgow is Mr. Baird's native city, and her citizens took a very keen interest in the inventor during his brief sojourn in their midst.

* * *

B. B. C. and Picture Broadcasting

THE possibility of the B.B.C. commencing a picture broadcasting service has been under discussion for some time, but we did not seriously think that such a service would ever be instituted. It was with considerable surprise, therefore, that we read recently that experimental still picture broadcasts will be started by the B.B.C. from Daventry, 5XX, in October of this year, and that if there is a sufficient public demand for these transmissions they will be incorporated as part of the ordinary programmes.

IN making this announcement the B.B.C. is careful to point out that such still picture broadcasting is not television. There is already quite enough confusion in the minds of ordinary non-technical members of the public as to the difference between photo-telegraphy (still picture transmission) and television, and it has been one of our endeavours in these pages to make the difference clear.

PHOTO-TELEGRAPHY, by whatsoever system it is accomplished, undoubtedly has many valuable applications, notably in the newspaper world, where it is essential to transmit news pictures over great distances in the minimum space of time.

THERE are many other useful applications for photo-telegraphy, but we must confess ourselves as being completely at a loss to understand why it should be thought desirable to broadcast pictures through B.B.C. stations. What possible use can there be for such pictures? If it be argued that pictures are useful to illustrate a talk, or news item, surely very much better reproductions are to be found, or can be published, in the official B.B.C. publications, or in the daily or evening papers. We have not noticed, so far, that B.B.C. news bulletins are so far up to date that the same news, plus pictures, does not appear in the evening papers.

HOWEVER, it is at least encouraging to know that the B.B.C. are sufficiently alive to the possibilities of the transmission of optical effects to take at least one step in that direction, though we are far from convinced that the step which they have taken is the right one.

IN face of the now perfectly practicable possibility of television broadcasting, we feel sure that any effort to popularise "still" picture broadcasting as a means of entertainment is doomed to be short-lived. Many of our readers no doubt remember the old magic lantern entertainment of pre-cinematograph days. With the development of the cinema, or *moving* picture, the "still" pictures of the magic lantern lost their appeal. The magic lantern is still used, of course, for the purpose of illustrating lectures, but as a means of general entertainment it is entirely dead. So will it be with "still" picture broadcasting, just so soon as the television broadcast service is inaugurated. Another point of importance in connection with the above magic lantern simile is that the lantern flashes a picture on a screen instantaneously. So does television, but the television picture is a moving one. Photo-telegraphy systems, on the other hand, take several minutes to transmit one single still picture.

AN important difference between television broadcasting and "still" picture broadcasting as at present proposed by the B.B.C. is that the former, being on a different waveband, will not interfere in the least with the enjoyment of the listener-in who does not possess a televisor.

* * *

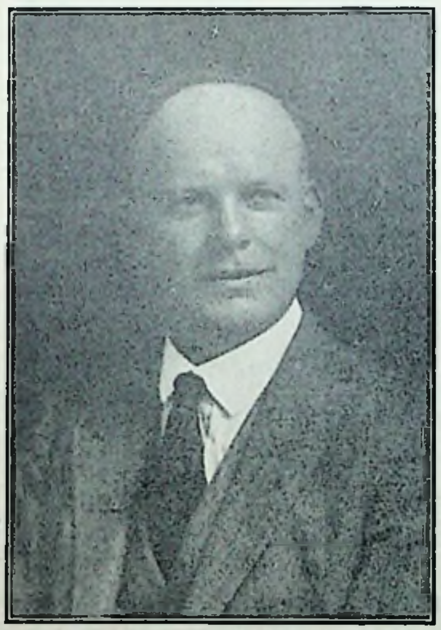
A Contrast

ACCORDING to a recent newspaper announcement we note that the Baird Company has applied for a licence to broadcast television. In contrast to the conditions prevailing in this country, we received with considerable pleasure the information that the Baird Company, when they recently applied to the Dutch Government for permission to broadcast television through one of Holland's most powerful stations, were received with great courtesy, and the necessary licence was dispatched to them *within five days* of their application!

In the following powerful and well-reasoned article Dr. Robinson makes a striking appeal for facilities to broadcast television. As a former member of the Imperial Communications Committee—the ultimate authority on wireless communication in this country—his remarks on the subject will be read with great interest by our readers. Next month Dr. Robinson will explode the erroneous idea, voiced by some critics, that television broadcasting will require a very wide waveband.

TELEVISION—AN APPEAL FOR BROADCASTING FACILITIES

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



Dr. J. ROBINSON.

BROADCASTING is a comparatively new service, and it has become firmly established as a necessity of life. Wireless has performed many wonders so far, and we are by no means near the end of its possibilities. Not the least of its achievements has been the broadcasting of speech and music, and the average man in the street is of the opinion that this is the chief application of wireless.

When a new development takes place in any walk of life there is a tendency to wish to employ the method of broadcasting in connection with it. This is particularly the case when the new development has some association with the press or with the communication services.

We have in the last few months heard many times about wireless being employed to transmit pictures, and in fact our newspapers employ this very rapid method to obtain pictures of events happening at a considerable distance. This new development enables the editors of newspapers to obtain a picture of an event at a distance of five hundred miles in probably less than one hour, whereas the system employed until quite recently—that of taking a photograph and sending it by post—required probably one day. Of course this new method of transmitting still pictures can be accomplished either by wireless or by cable.

Control of Broadcasting.

We have also heard at some length about **television, which consists of the instantaneous transmission of events actually in progress, thus enabling actual vision of motion to be accomplished.**

It is not surprising that our minds should be directed to the facilities of broadcasting for these new services, for wireless, though not essential, is most useful for them. The control of broadcasting of speech and music in this country (though not that of wireless generally) is in the hands of the British Broadcasting Corporation.

The problems introduced by the possibilities of optical broadcasting are so vast that the general public expects that no mistakes will be made by the responsible authorities. I have not heard that the control of optical broadcasting has been given to the B.B.C., and before such a step is taken very careful consideration must be given to the subject by the Government or their advisers on this subject, the Imperial Communications Committee.

Grave Responsibilities.

However, there are rumours that the B.B.C. is attempting to absorb these new functions, and that they are contemplating the transmission of still pictures. Very grave responsibilities rest on them in this connection, and one of the first things to be done before any decision is made to give broadcasting facilities to one system and not to the others is to have a thorough examination of the whole situation. In this country we have several systems for transmitting still pictures and one system of television. Any decision by a body like the B.B.C. will have very far-reaching effects, and it is expected that they will have taken every possible step to seek out information about these systems. It is not sufficient for them to wait for things to be submitted to them. **Their responsibilities to the people of this country demand more than a passive waiting attitude, and they must be actively employed in searching for and investigating any alternatives to any system which may have been submitted to them by any one active personality.**

Fields of Utility.

The two types of optical transmission—that of the still picture when some minutes are required to

THE CASTING VOTE

complete one picture, and that of television which transmits a reproduction of actual events in motion—both have their different forms of utility at the present time. The still picture is now being employed in very excellent manner for newspapers, and further for what is called facsimile transmission by the communication companies, both cable and wireless.

More Scope in Television.

In fact we might say that the still picture has reached a stage where any further developments will be along detailed lines. It is not, however, necessarily the case with television that further developments will be only on minor details, for this is a very much more difficult problem than that of the still picture, it is of much more recent growth, and above all its potentialities are unlimited, particularly in comparison with the still picture. **In fact the position is such that the transmission of still pictures is merely a phase of development, and when television has proceeded somewhat further, still pictures will be completely abandoned, just as the development of the cinematograph caused the abandonment of the magic lantern except for special purposes.** We could write at considerable length on the possibilities of television, of actually looking at happenings and people thousands of miles distant, but I shall leave this to the imagination of the reader.

" A Hindrance."

Whether broadcasting of television will become as general as that of sounds is presumably a matter of opinion at the moment, but it is difficult to understand why there should be any doubt about it. There may be some reasonable difference of opinion as to how long it will take for television to be widely used in the home, but it is absolutely certain that this state of affairs is coming.

Can we look on the broadcasting of still pictures as a step in this direction? This question appears to be troubling the B.B.C., but in my opinion a very emphatic answer can be given. **The broadcasting of still pictures will be a hindrance rather than a help to the development of the vastly important subject of television.**

Insufficient Interest in Still Pictures.

In this connection it must be clearly understood that the word " Broadcasting " is used here, and not " Wireless," for there is no doubt that in the laboratory the methods of the still picture have been of use in the television field. In broadcasting, however, we are bringing the subject right into the homes of the people, and there must be some justification for doing so.

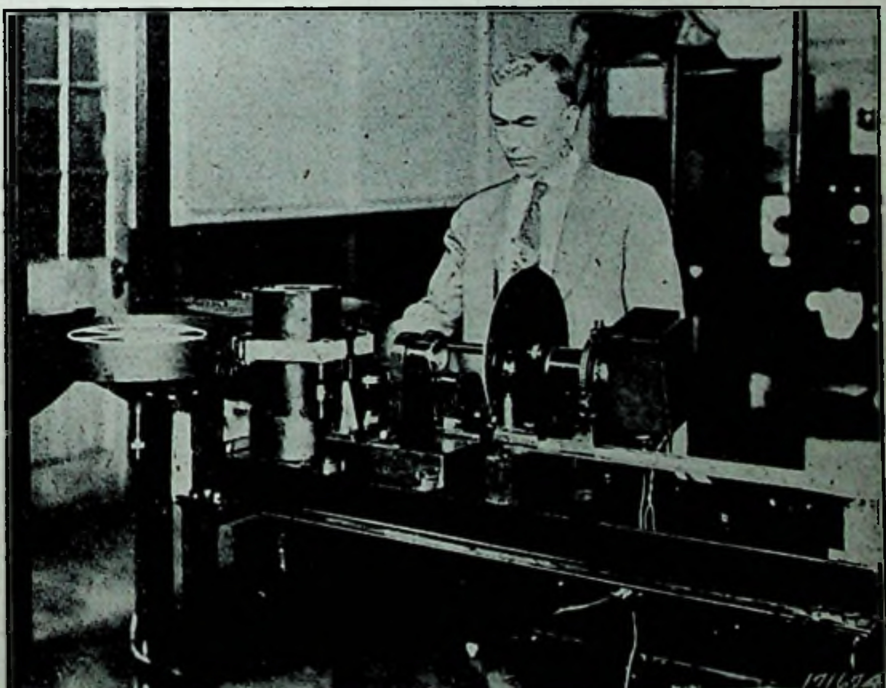
In the present stage of wireless, where there is a congested ether, and when the ether is guarded jealously by those who allocate a new wavelength for a new service, we must be absolutely certain that there are very good reasons for employing the wavelengths and times allocated to broadcasting for a new service. **It is exceedingly difficult to imagine what reasons, if any, can be put forward to justify the employment of broadcasting facilities for still pictures. There cannot be sufficient interest in any form of still pictures to justify broadcasting of this nature.** The B.B.C. will be well advised to leave this subject to be applied in its legitimate fields—that of the newspapers, and that of facsimile transmission for the telegraph companies.

Broadcasting Weather Maps.

There has even been a rumour that it would be useful for the B.B.C. to broadcast weather charts, but it cannot be seriously considered by anyone that the general public will wish to undertake expenditure and spend some minutes every day merely to receive a chart which very few will understand, particularly when they can receive without any trouble the present excellent B.B.C. weather reports. Again, let it be clearly understood that we are here referring to broadcasting as at present widely known, for there is something to be said for the transmission of such weather charts to sailors, but surely this application of wireless is not one for the B.B.C.

Provide Facilities for Broadcasting Television.

Many more aspects of the broadcasting of optical effects could be brought forward, but on each of these already discussed there appears to be only one legitimate course open, for in every case, that of the interest of the public, that of the responsibility in allocating wavelengths and time, that of future potentialities, and that of the putting before the public, or that portion of it which is interested in development work, of



(P. & A. Photo.)

Dr. FRANK CONRAD, Research Engineer of the Westinghouse Electric and Manufacturing Co., and the apparatus he has constructed for transmitting cinema films. Its resemblance to C. Francis Jenkins' apparatus, described in our last issue, will be apparent.

something to work on, the only course to follow is to provide facilities for the broadcasting of television.

This of course involves the question whether television has reached a sufficiently advanced stage. There is one company in this country and one only—the Baird Television Company—which has carried television to a fairly advanced condition. In fact Mr. Baird personally is the real pioneer of this subject, and **those who have already witnessed what he has accomplished are almost invariably enthusiastic about the results.** Naturally, perfection has not yet been achieved, "*but actual television is being carried out.*" It is a subject of tremendous possibilities and also of tremendous difficulties, but what is possible at present is very suitable for broadcasting.

Present Possibilities.

It is possible to give small scenes with very good definition, and scenes of the magnitude which is at present possible can be transmitted by wireless means without an undue absorption of ether space. It is, for instance, possible to transmit a single individual so that no imagination is required to recognise him or her. It is possible in such circumstances to notice the movements made by such an individual.

The question may be asked whether it is worth while broadcasting scenes of such small dimensions even though they can be transmitted and reproduced. There is no doubt that it is useful to commence broadcasting with such material at hand, and one way in which this can be used is to show a picture of an actual performer who is broadcasting for telephony purposes. In this case one would have a combined wireless telephone receiver and television receiver, and, if necessary, both sound and vision can be obtained simultaneously; or again, we might concentrate on the acoustical part and occasionally switch over to look actually at the performer.

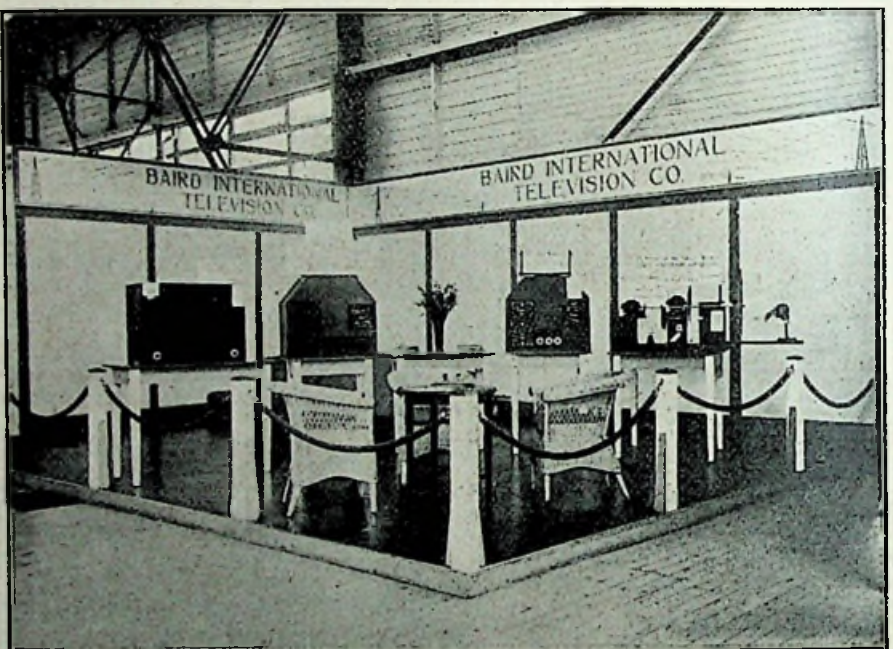
Value to Advertisers.

It is thus possible to give comparatively small scenes with excellent definition, and it merely remains for those skilled in the art of what is suitable matter for broadcasting, to take up the subject. Many subjects could be chosen by such experts which would interest the public, and the public would be interested because they are viewing "action," or something in motion.

Quite apart from this aspect, there are various applications of television, such as its use by advertisers. In some other countries, particularly the United States, advertisers are allowed to use the broadcasting services, and they combine in this way the two functions of advertisement and the provision of amusement and interest for the public. This form of using broadcasting might with advantage be considered by the B.B.C. for sounds, and there is no doubt that for television purposes at present it will be particularly appropriate.

There is one feature of this subject which may form an imaginary stumbling block, and that is that television may absorb a large slice of the ether, or in more academic language a wide frequency band. I shall deal with this subject in a later issue of this journal, but it is very important to have it clearly in our minds that at the present time and in the present stage of development, a single service of television will not absorb as much of the ether as a present-day telephony service.

A very important feature is that television is a new subject, and one with enormous potentialities and, further, with many problems still to be solved or features to be improved. Many people wish to work on the subject, and they are all needed. It is of the highest importance that facilities should be provided for them, and surely one of the best methods for doing so is to provide some transmissions for them to work with. This will immediately remove a large difficulty from the path of such enthusiasts, that of great expenditure. Workers of this type have already proved their value when they performed their excellent work on short-wave communications over vast distances with exceedingly small power. That subject has advanced considerably since they did their remarkable work, and short-wave communication is now a daily occurrence. **Television needs these workers, and it is essential to provide broadcasting facilities for them to work with. In this subject there is plenty of opportunity for their energies and skill, thousands of times more so than in the case of the broadcasting of still pictures.**



The Baird International Television Company's stand at the Radio Exhibition at Rotterdam, where actual demonstrations are now in progress.

"Hope of Better Things."

The time is ripe for some new application of broadcasting, and the possibilities introduced by the broadcasting of vision are making a strong appeal to the imagination of the people. It is essential that any form of vision broadcast shall not produce

(*Continued on page* 10.)

TELEVISION IN AMERICA

Many Experimental Transmissions in Progress

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

From time to time we have described television developments in America. In the following concisely worded article Mr. Tiltman gives us a résumé of what has been taking place recently on the other side of the Atlantic, and the impression he leaves us with is that, owing to the fact that broadcasting in the States is unrestricted, progress with television is going ahead with characteristic American rapidity.

TELEVISION has become a very prominent subject in America in the past months, for both professional and amateur experimenters have taken up the subject with great enthusiasm.

Several of the leading U.S. radio stations are broadcasting television regularly, many more stations have applied for licences and are planning radio vision tests, and there are thousands of keen experimenters constructing simple receivers. It is said that to-day there are over two thousand amateurs in New York alone equipped with experimental receiving apparatus. In addition, the syndicate which acquired the American rights of the British (Baird) system will very shortly commence broadcasting from a chain of radio stations in the U.S.A., Canada, and Mexico, and commercial receiving sets will be available.

Britain Still Ahead.

Although, of course, television was demonstrated in this country about fifteen months earlier than the first American demonstration, and Britain is still ahead in actual reception results, experimental work in America is now able to go forward at full speed, for broadcasting there is run by private enterprise and development is not hampered by a broadcast monopoly as appears to be the case in this country.

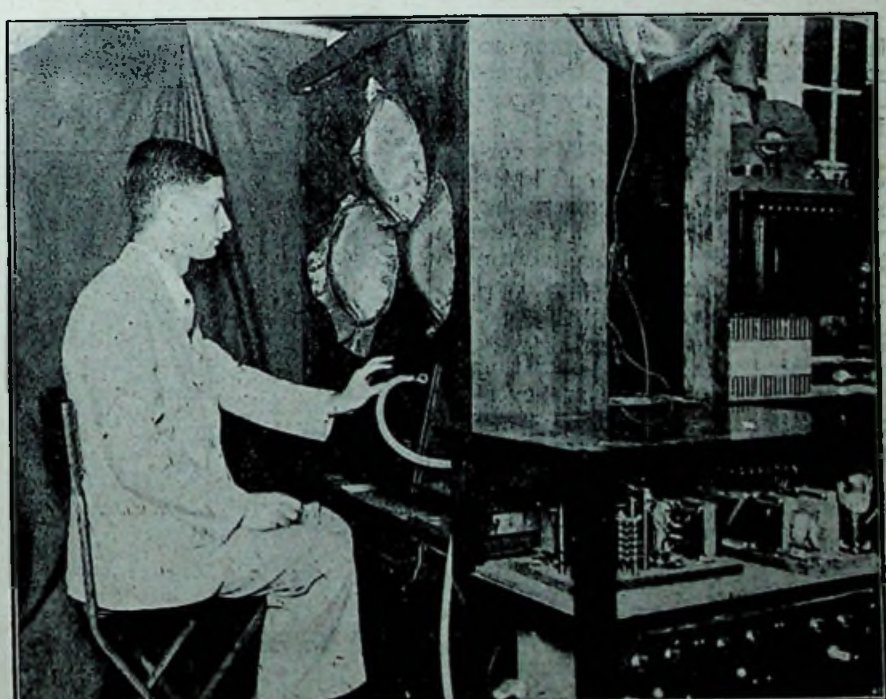
Television transmitting and receiving apparatus was one of the main attractions at the Radio World's Fair, which opened at Madison Square Garden, New York, on September 17th. It was at first rumoured that displays of television would be barred owing to the objections of certain radio manufacturers, but later plans were completed for a television transmitter to be installed, while a number of receiving sets were placed at various points in the exhibition to show images approximately five inches square to the spectators.

Numerous Applications for Television Wavelengths.

Some weeks ago the Federal Radio Commission was dealing with nearly a dozen applications for the allocation of wave-bands for experimental television work. The Radio Corporation made three applications, making a total of twenty bands, two applications were from the Jenkins laboratories, the Westinghouse Company asked for nine bands, and other applicants included W. J. Allen, H. E. Smith, and R. B. Parrish. It was said that more applications for licences were pending.

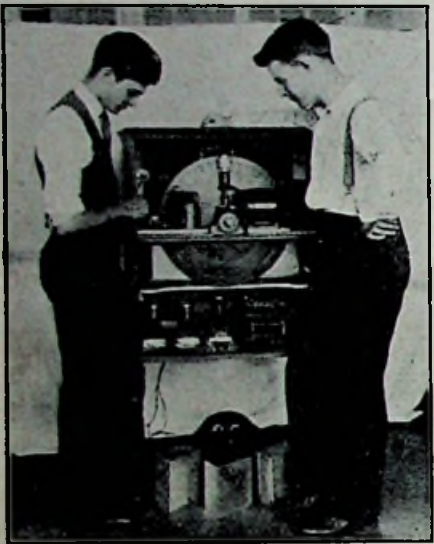
First Regular Broadcasts.

The first regular experimental television broadcasts in New York



The television transmitter in use at WRNY. Readers will recognise the great resemblance to the Baird transmitter.

started at station WRNY on August 13th last. This station is owned by the journal *Radio News*, and it was stated that thousands of letters had been received asking for the broadcasts. The tests were also sent out



A simple form of television receiver devised for the reception of images broadcast by WRNY. It is a skeleton form of Baird televisor, without any provision for synchronism except a hand-controlled motor rheostat. Images 1½ in. square are produced, according to reports.

by WRNY's associated short-wave station 2XAL, which operates on 30·91 metres. The first tests were received on apparatus installed in the home of H. Gernsback, president of the station, and, according to report, "The images were not perfect, but they were readily recognisable."

From August 27th WRNY incorporated television as a regular nightly feature, the impulses being sent out every hour, on the hour, while the station is working. Despite the opinion of some engineers that television signals in regular programme channels would be apt to cause interference with those operating on adjacent wavelengths, no "overlapping" was reported from these transmissions!

Station WGY, Schenectady, has been maintaining a regular series of television transmissions for several months. The programmes last from fifteen to thirty minutes and are intended for engineers and experimenters. In the middle of August this station claimed to have handled the image of Governor A. E. Smith delivering his speech of acceptance of the Democratic Presidential nomination. Engineers of the General Electric Company focused their transmitting apparatus on the Governor and broadcast the image from the Schenectady station. No detailed reports of the quality of reception have come to my notice.

On July 22nd last the American Continent was spanned by television, and people in Los Angeles reported viewing the image of a man transmitted from Schenectady, about 3,000 miles away. This long-distance reception was carried out by G. Lee and K. G. Ormiston. Special long-distance transmission and reception experiments are now being conducted by these experimenters.

A Play Broadcast.

On September 11th, according to the New York correspondent of the *Evening Standard*, a one-act play was broadcast and televised from Schenectady, and receiving televisors within a range of four miles tuned in both sight and sound. The experiment was said to be "a great success."

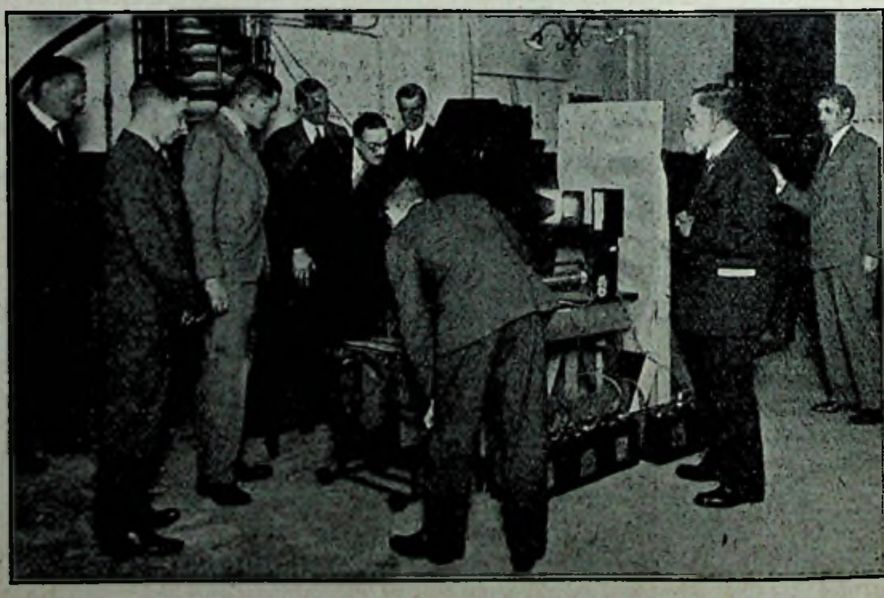
Station WOR recently broadcast images of puppets in motion with accompanying sound and music, and television tests have also been carried out by WLEX near Boston, and WCFL at Chicago. Television in sunlight was demonstrated by engineers at the Bell Laboratories, in New York, a short time after the British inventor, J. L. Baird, demonstrated television in diffused daylight in London.

Although eye-witnesses' reports which are to hand do not indicate that the actual reception results in U.S.A. are comparable with the remarkably clear images I have personally witnessed in the Baird Laboratories, London, America has taken up this new branch of science very seriously and very thoroughly, and night after night the ether is filled with "sights" as well as sounds.

(*Concluded from page* 8.)

a feeling of disappointment, and the worst form that such can take is where it is not accompanied by hope of better things. **It is impossible to believe that the broadcasting of still pictures will produce anything but the bitterest form of disappointment,** whereas with the really live subject of television very many people will be highly satisfied with results right from the start, and all will retain their interest in watching or in taking part in the march of progress.

The subject is of such national importance that we are looking hopefully towards the Imperial Communications Committee to give due consideration to the problem, and to provide means for the broadcasting of television in the immediate future, and one method for doing so would be to form a new corporation to control the broadcasting of television with powers similar to those of the B.B.C.



Members of the British Association examining Mr. Baird's stereoscopic television transmitter at Glasgow.

Light: The Essential of Television

Part II.

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

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

SINCE white light consists of a combination of colours, it may be said that a beam of white light is composed of light rays of different frequencies. The velocity of light is the velocity of any kind of light, that is, light of any spectral character, from which it follows that waves of high frequency have a shorter wavelength than low frequency waves. The waves may be compared with sine waves, so that they have definite values from zero to zero, or from crest to crest. The relative values of red, green and blue are illustrated in Fig. 1.

These wavelengths are measurable, the unit of measurement being the Angström unit (ten-millionths of millimetres). The number of Angström units in the visible spectrum is about three thousand. Of this the blue-violet is between 4,000 and 5,000, green between 5,000 and 6,000, and the red between 6,000 and 7,000. The units below 4,000 are associated with the ultra-violet rays, sometimes termed the actinic rays; the units above 7,000 are associated with the infra-red rays, sometimes termed the dark heat rays.

Although normal daylight is generally accepted as white light it may be said that it varies in colour quality. A most conspicuous example of this is the colour change which the sun appears to undergo in passing from zenith to horizon. The reason for this may be said to be due to the composition of the "body colour" of the atmosphere. That is, the colour which is possessed by an object by virtue of its selective action in absorbing, refracting, and transmitting the rays of various wavelengths in such a manner that certain rays are reflected or transmitted more than others.

In the normal atmosphere the selective effects are produced by particles of dust of various colours, minute drops of water (these are the cause of refraction) and the molecules of the air. When the sun's rays pass through the atmosphere the selective effects of the media referred to results in the scattering of light rays of all wavelengths, but more so those of the short wave lengths, the blue. The colour of the sun, to us, appears to be more red. We know that outside the layer of atmosphere it is not so, but to us it appears to be so. Since the light which has been scattered, or refracted, is blue, the scattering medium is also blue. It is in this way that we appreciate the colour of the sky as being blue. In other words, the atmosphere acts as a screen through which light from the sun passes to the earth. The quality of the light we receive depends upon the position of the sun in the sky; it is for this reason that the colour quality varies between white at noon and red at sunset.

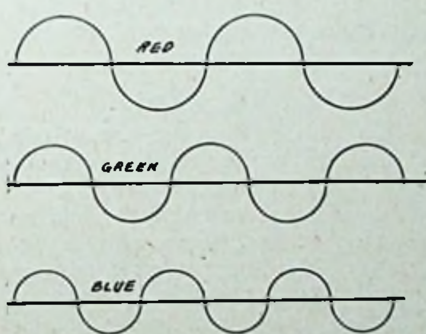


Fig. 1.
The relative values of red, green, and blue.

We can only appreciate the colour of objects in their true colours when they are viewed under normal or natural daylight. I have already pointed out that, in television, many scenes will be broadcast under artificial light; and it is very safe to say that no method of producing artificial light is constant, even with the so-called daylight lamps. This means that the colour, and even the shape of objects, cannot be appreciated under artificial light, unless means are taken to correct for colour quality. We will consider the production of coloured light and its effect upon coloured objects.

The general conception of colour is somewhat loose; I have referred to blue—sky blue—but this varies in colour quality. Violet, blue and green-blue when combined form blue, but the quality of this blue will depend upon the mixture of these colours. Blue-green, green and yellow-green when combined will produce green; and green-yellow, yellow and orange gives us amber. Here, again, the quality of amber depends upon the quality of the colours used to produce it. Let us consider the factors which affect the variation in the production of artificial coloured light.

Artificial light, or electric light, since this is the only kind of artificial light which can be produced in high intensities, depends upon the passage of electric current through some form of conducting medium. In the modern gas-filled lamp the conducting medium, the lamp filament, is tungsten steel. This, with an exhausted globe refilled with an inert gas (argon), permits the filament to be run at a high temperature, thus producing as white a light as is possible. The quality of this light, however, is inferior to normal daylight.

The difference in this quality of artificial light and normal daylight is that the former contains an excess of yellow and red rays. We can correct for this by filtering the excess rays out, by fitting a colour screen of blue which will absorb the rays which are not required. The colour quality of the screen, however, is constant, and the factors which produce the artificial light are variable; the quality of the artificial light will therefore vary, although a colour filter may be used.

Variable Factors of Artificial Light.

The variable quantities are:—(*a*) The possibility, in fact probability, of voltage variation due to increased or decreased loads on the lighting service. The effect of this is to increase or decrease the voltage applied to the lamp terminals; this results in a variation of filament current and temperature, and therefore in the colour quality of the light. (*b*) Decrease in initial efficiency according to the length of life of the lamp. All electric lamps are made to a specification which demands a definite efficiency (subject to small tolerances) at the commencement of the lamp's life. After the first 100 hours the efficiency falls very rapidly; that is, the light output is decreased and the colour quality of the illumination is altered.

We know that the effect of normal daylight falling upon coloured objects is to enable them to be seen in their true colour quality. They appear coloured because they pick out certain rays from the light and reflect these back to the eye, absorbing the whole of the other rays in the spectrum. Now what is the effect of coloured light upon coloured objects?

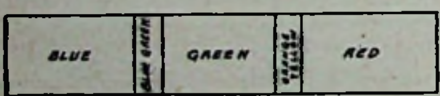


Fig. 2.
The three primary colours (light).

A pure red light falling upon a red object will enable the latter to be seen in its richest quality. If we project red light upon a green object the whole of the red rays will be absorbed and the object, since no rays remain to be reflected, will appear to be black. If the red light is projected upon a yellow object, the latter can be identified as red, because yellow reflects red, among other colours. The primary colours (and these refer to light and not to pigments) are red, green and blue, the intermediate colours are illustrated in Fig. 2. Mixtures of two, or even the three, primary colours in varying proportions will give all the intermediate colours. Red and green will produce yellow; blue and

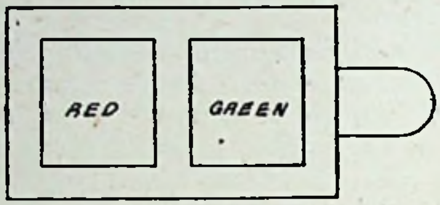


Fig. 3.
A double colour filter.

green, blue green; blue and red, purple; red and green, with more red than green, orange, and so on.

A white object will reflect all colours, and thus its apparent colour depends upon the colour of the light projected upon it. In this way if a red object on a white background is illuminated with red light, the background and the object will both reflect red light at its full value; and the object will be invisible. The same effect is obtained if green light is projected upon a green object on a white background.

Startling Effects.

This phenomenon in colour can be used to produce some very interesting and startling effects. A simple effect is to paint the outline of an egg in green on a white background. Then, near it, paint an egg in red with the top broken, with a chicken's head and wing poking through the top. A double colour filter should then be made with two windows as illustrated in Fig. 3; it may be made of wood with a small handle with a slide, so that red or green light can easily be projected upon the background and sketches.

The light source should be an ordinary flash lamp, the demonstration being carried out in a dark room. When red light is projected upon the sketches the red sketch becomes invisible and the full egg can be seen. When green light is projected upon the sketches the full egg becomes invisible and the chicken coming out of the egg can be seen. If the colour filters are moved quickly in the slide the effect is an animated picture of a chicken coming out of an egg and, not liking the look of the world, going back into the egg again.

(*To be continued.*)

Sydney A. Moseley airs his views on Television

AND so to television. When I was asked to be present at and test the claims of wireless telephony umpteen years ago I remember I smiled one of those sad, cynical smiles of the vastly superior person. Wireless telephony.

Said I to the Editor: "Hadn't this crafty commercial crowd better use the advertising column?"

"Shssh," he replied. "This is a new era in science. Think yourself lucky that you're privileged to be present at the birth of," etc., etc.

* * *

When I saw the huge clumsy apparatus I thought: "The birth of a new science? A cumbersome birth!"

Then I looked for what I thought was the inevitable catch—hidden wires, secret codes, and so on. Finally the inventor shouted through the apparatus and got purple in the face trying to get through *to the next room*. Why, you could have heard him in the next street!

Apparently he was ultimately successful, for he shouted in glee: "Good. Good. Come and hear." I went over to the instrument and listened. All I heard was a syllable here and there of a voice that sounded from the depths.

I wished the anxious inventor success. I thought he surely deserved it.

The Good Old Days.

Came the next phase. "Let me build you a wireless set," said a friend of mine some years ago. "Marvellous things are happening."

"Let 'em," said I, and being quite an original fellow, I added: "There is nothing new under the sun; nothing new happens; nothing new has ever happened."

But I permitted him to do his worst, and he built the set, a ramshackle sort of affair which tickled my humorous fancy.

IN this highly interesting and amusing article our contributor, who is a well-known writer on divers subjects, recalls the scepticism of other days when wireless first started, and draws a comparison between the early doubters of wireless and the modern doubters of television. Mr. Moseley ranges himself stoutly on the side of television.

"Stick it. Perseverance wins. More haste, less results," said I cheerfully when, after twiddling divers knobs, nothing happened—not even Morse.

But why go on? You who pride yourself on being among the pioneers who listened to the howling and screeching of the early broadcasts, yet lifted up your hearts and went on—do you, I beg, recall the scepticism and incredulity of those far-off early days?

Had British broadcasting been up against the wilful, incomprehensible opposition and disbelief that television is receiving now, where would broadcasting have been to-day?

* * *

Granted that broadcasting has made in a comparatively short space of time progress of magnitude and magnificence. I am proud of British broadcasting and I am equally glad that such help as I have been able to give it has been recognised by those in authority.

During the darker days when a mass of ill-informed criticism was directed against those whose efforts really deserved eulogy I did my little bit in standing between broadcasting and its critics.

* * *

"They Took a Risk."

I propose to do the same thing with television. **Some weeks ago John Logie Baird and his**

co-managing director, Captain Hutchinson, invited me to witness a demonstration in the laboratory in Long Acre. They took a risk, and knew it. If television had turned out to be the trivial affair I had heard it to be, I should have used every influence I could have brought to bear to expose it.

* * *

I had actually heard two versions of the "miracle" which television was alleged to have accomplished: one, that we were on the verge of seeing Ascot, the Derby, and the football final; the other, that all I should see would be a turnip, with blobs for eyes, nose, and mouth.

* * *

But the main thing I wished to satisfy myself on was whether it were indeed possible to transmit over space a *living* image—however crude it might appear at first. Frankly, a dead, immovable picture would have left me cold. You can get that in the newspaper; you could *not* get, as far as I knew then, a first-hand living miniature by any other known means. I can get a picture of my brother in America by various media, but if I could see him, and know that I was actually looking at him himself and not at a reproduction—how different that would be!

Why, you could recognise his peculiar facial expressions. You could watch him smile. The picture would become more intimate by the way he placed a cigarette in his mouth. It would be a natural, living, speaking image, as if you were looking at him from the wrong end of a telescope. I say in the circumstances that it would be sheer nonsense to compare this with wireless pictures and what not.

* * *

But had television achieved this? I confess that on my way to Long Acre I felt somewhat incredulous.

* * *

What I saw fascinated me as much as the first discordant note I heard through the cumbersome wireless cabinet. The snowstorm, twirling iridescence, and then suddenly the building up of a face, not too clear in outline, but manifestly human, rolling its eyes, smoking a cigarette.

Televising Advertisers' Goods.

I saw colour television—flowers, fruits of every hue. And the inventor gazing rapturously through the screen behind me. Colour television fascinates him. So it will be with those who have an eye for beauty. When perfection comes, as it must, it will add to the artistic joys of life. And —to be commercial for a moment—these living pictures will oust the pictorial hoardings. No advertiser will fail to televise his goods. Personally I should like to see Mr. Drage greeting Mr. and Mrs. Everybody! We could then judge whether the second-hand advertised smile is as good as the original!

Mr. Wills taking one of his own cigarettes out of a case, lighting and smoking it, would be a sight for the gods. But speculation along these lines is endless.

* * *

If visitors to the Olympia Exhibition who crowd to see the first real public demonstration of television expect to see another movie innovation, they will be disappointed. If it is a *still* photograph or a moving picture that they want to see why should any of them trouble to go to the television stall at Olympia? But if they have imagination, if they can be brought to the frame of mind which is expectant, sympathetic to Great Beginnings, if they will realize that they witness the work of a young Scottish inventor who has striven hard for years against extraordinary obstacles, then they will be filled with gratitude and wonderment.

* * *

Britain First.

Science and Art should have no boundaries. Yet in these competitive, commercial days, especially when Britain is trying to find her industrial legs after a long depression, **I think it is the duty of every Britisher to give encouragement and help to the British side of this invention.**

* * *

I may have a little more to say on this in a future article, when I shall ask my friends of the wireless press what is in their minds when they accept unquestioningly claims from every foreign source and are so ungracious in dealing with the claims of John Baird.

What I mean is this. The American magazines are full of television—always boosting, of course, the purely American side of the business. Quite right too! The Americans are brought up to cry and sell their own wares. That is why they put it over on us again and again. Look how they handled the moving picture business. Polite and modest France, having done the work, had to take a back seat in the business. You would think that Hollywood was the first and last home of the movies.

And that is what is likely to happen with regard to television if we are mugs enough to permit it. Catch an American ever mentioning the name of some blessed foreigner in the same sentence as one of his own countrymen. But they will *have* to mention the name of John Baird.

Wherefore I am puzzled to find strange-sounding names with stranger sounding claims in the columns of British newspapers. We are a soft-hearted race, I know. But why be soft headed?

* * *

Perhaps there is a reason for this persistent belittling and crabbing which I am at present unable to fathom. I can only deal with the matter as every fair-minded visitor to the Exhibition must see it. Here is the initial achievement of an invention, the possibilities of which are boundless. Accept it as such. Watch it develop. Take part in its development. Give credit to a one-time penniless Scot who fought through and won against an army of detractors.

Who knows, the day may be at hand when we shall be able to see in our homes the facial features of the inimitable George Robey, eyes and eyebrows complete, while listening at the same time to his injunction to "Shurrup!"

TELEVISION AS "BOOSTER"

The Coming Revolution in Advertising

GIVE WIRELESS A CHANCE!

By SHAW DESMOND

In his usual inimitable style Mr. Shaw Desmond points out this month how useful a television broadcasting service could be to national advertisers. Mr. Desmond is very familiar with sound broadcasting conditions in America, and has observed how American advertisers have been quick to make the best use of this valuable new medium. In the following article he suggests how, similarly, television broadcasting might be made an even more valuable advertising medium, without, at the same time, impairing its entertainment value or causing offence to "lookers-in."

THE Upside-Down Man is known to each one of us. He is always standing on his head. He sees everything down side up. And when, by accident, he does stand the right way up and he sees things as they are, he says, triumphantly, "I told you so!"

It is from that man that television advertising is suffering. He is the man who says: "It can't be done. It won't be anything, if it does come." **He is the very identical gentleman who visits the Baird laboratories, sees things with his naked eye, admits he has seen them, and then goes out to tell the world he hasn't seen them at all!**

He is first cousin to those hoary old friends of mine who still parrot: "It can't be done. It won't be done. It isn't yet brass tacks." And then, that variation: "I believe a radical discovery is necessary before television is practicable."

Then there is our dear old friend, the B.B.C., with whom I will deal later, as with broadcasting. But, just for the sake of those "brass tacks," I want everyone concerned to sit up and take note of the following facts:

What are Brass Tacks ?

First, that television advertising is so much brass tacks that to my knowledge at least two great newspapers have recently had it under consideration. Secondly, that chiefs of great stores are already weighing up its possibilities. Thirdly, that in the United States (always, unfortunately, first to seize upon new business ideas) radio-advertising has formed the natural bridge to that "television boosting" now being organised across the Atlantic. Lastly, for good weight, I may say that more than one politician is considering its potentialities for election advertising work. And, as super-weight, still holding to our sheet anchor of facts, Mr. Don E. Gilman, manager of the N.B.C. Pacific Coast Network, has recently visited the New York offices of the National Broadcasting Company for one single purpose—that of completing national plans for radio broadcasting, plans which will, I know, in due course lead to National Television Advertising.

The Rip Van Winkle Act.

Let a plain statement suffice, as Kipling would say. I will not burden the already overburdened brain of the B.B.C., or the brains of those who are doing their best to "knock" television publicity, by piling on the agony. But I could fill this page with similar facts.

Do these "candid friends" realise that stereoscopic television, with the figures, so to speak, "coming out of the screen," is an accomplished fact? Do they realise that daylight television is no longer just "a vision" or that the genius of Mr. Baird has made television in colours no longer a pipe-dream? Heaven knows I don't want to wake anybody out of *their* pipe-dreams; but I sometimes wonder, I who have not a halfpenny in television or anything to gain by the statement, whether some of our friends have not been doing the Rip Van Winkle act rather too effectively.

Ridiculous Objections.

Television *is* fact. Television in colours *is* fact. Daylight television *is* fact. Noctovision, or seeing in the dark at a distance, *is* fact.

I have discussed television publicity recently with various public men. Here are their objections taken in order of importance:

(1) That it is "still in the air" and that it'll be time enough to consider it when it comes down to solid earth; (2) that it is "only play acting anyhow"; and lastly, the objection made by those depending for their incomes largely upon the printed advertisement, that "it will kill advertisement by the printed word." (N.B.—This last is often adduced by intelligent men who have just told me that "it can't possibly compete with print.")

The reply to No. 1 is to be found in what has gone before. No. 2 is merely ludicrous and needs no answer. The reply to the last may be put in the words of the biggest

Pacific Coast publicity man: "On the contrary, successful radio (television, etc.) development will create more advertising for all other advertising media than it can possibly take for itself."

Before going farther, I want to get the B.B.C. off my chest (how many others have wished the same thing!).

Concerning the B.B.C.

I am wrongly supposed, if my mailbag does not lie, to be a sort of implacable critic of Savoy Hill. I am nothing of the sort. I have in print and otherwise repeatedly stated that the British Broadcasting Corporation have a most difficult task (under their present Charter an impossible task), that parts of that task they often carry out surprisingly well, and that the better-class items on their programmes are often unimpeachable.

But I don't believe in semi-State-run enterprises. I, being a believer in those "brass tacks," believe also that competition is essential to high standard so long as men are humans and not angels (of the angelic ancestry of the ladies and gentlemen behind the B.B.C. I have little doubt—they are so extra-terrestrial). And **I want wireless run by private enterprise upon ordinary commercial lines.**

If there be any other part of the moon for which I am crying, it is that the B.B.C. or its successors, as the commercial world generally, may recognise that television is going, and pretty quickly at that, to revolutionise the world of broadcasting as well as that of advertising, as I said in a recent TELEVISION article.

How could it be otherwise?

Pictures Oust Print.

My lords, ladies, and gentlemen: for the love of Mike, as my American friends say, how *could* it be otherwise? Pause, my brethren, pause! Consider, not the lilies, but the flowers that grow in the human garden—the flower of the human mind and its method of evolution.

Don't you see all about you how the picture is ousting print? Can't you guess why the cinemas, rotten though many of them be, are packed to the doors? Won't you shake the sleep out of your eyes and ask why is it that the greatest dailies are adding page after page of pictures to replace the printed word?

This may be good. It may be bad. But it is FACT.

People are getting used to thinking in pictures—not words. That is the outstanding fact of our day and generation.

Then what about television advertising now? Isn't it practical politics?

Is there any Rip Van Winkle of them all who can deny it?

The writer, Mr. SHAW DESMOND.

ON this page Mr. Shaw Desmond says: "I want wireless run by private enterprise upon ordinary commercial lines."

". . . the picture is ousting print."

". . . the greatest dailies are adding page after page of pictures to replace the printed word."

"The daily newspaper that first has the courage to take a lease on the ether . . . will outdistance its competitors."

Some time ago I addressed the New York advertisers assembled in conference upon "Advertising and Art." I told them that the day of the picture advertisement, the "living" picture advertisement, was coming. I proved to them, by asking questions of my auditors, that the "dynamic" as opposed to the "static" advertisement was the stuff that would bring the bacon home. And they tacitly admitted that I was right, though I do not pose as an advertising specialist.

"Taking a Lease on the Ether."

The courageous advertisers who first "take a lease on the ether," as I have christened the new publicity, will have an enormous "pull" over the laggards. The daily newspaper that first has the courage to take this lease, when the law permits and the B.B.C., for instance, has undergone a spring cleaning, will outdistance its competitors, "leaving them standing."

In this, as in everything in life, it is the first step that counts.

If I were Mr. Selfridge or Sir Thomas Beecham (now looking for new advertising mediums for his opera scheme), or Lord Melchet, formerly Sir Alfred Mond, I would get to work right away. I would move heaven (that is, the Chancellor of the Exchequer) and earth (that is the politicians) to adopt my favourite scheme of metamorphosing the B.B.C. by turning it from a "peddler of licences" to a "transmitter of wireless."

Convert the B.B.C.

Let the big national advertisers of Britain compete for "time on the air" for the purpose of broadcasting their wares, first by ordinary wireless perhaps, later by that television publicity which is already in sight.

Let the big dailies run their own concert programmes, using, in the beginning, the ordinary broadcasting of to-day, and, later, especially now that television broadcasting is about to commence this autumn, the television screen. For, let there be no mistake about it, the television screen in the private home will soon be as common an object as the loud speaker itself.

Again, we are not dealing with fancies, but facts. Accomplished facts.

And the method?

First, the conversion of the B.B.C., as I have said, from a programme-maker to a programme-sender. Let the B.B.C. of that not distant day—be sure, a corporation of definitely different charter and concept—have charge of the transmitting stations.

And let the expert provide the programme — whether expert educator or entertainer. (And I would say that where education ceases to be entertaining it often ceases to be education !)

Secondly, the gradual reduction and final abolition of the licence fee paid by the public.

Wipe Out the Broadcasting Licence.

"Can't be done," you say? Well, it *is* done. America has done it. There they have one radio receiver to each five or six of her 110,000,000 population, and not a licence fee in the lot! There the revenue comes from advertising, etc. Let England do the same.

And don't forget one other thing, you people who say "it can't be done." In the Land of the Wooden Nutmeg, whatever its faults, there is no *Radio Times* or other programme monopoly publication. Any newspaper can publish the weekly programme of the wireless lists. And any newspaper does.

The third point in the method would be what I may call "the tuning picture," to match the present "tuning note" now broadcast to help listeners to adjust their receivers.

With television as an intrinsic part of wireless advertising a picture, the same as the curtain in a theatre, might be broadcast showing the names of the national advertisers who are to provide the different hours of entertainment during the evening.

Or an attractive little sketch might be presented, showing the actors using advertisers' goods. Properly done, such sketches could be made very interesting, and compel the attention of the television audience.

How to Save the Railways !

So much for the *method*, following my replies to the usual objections as to why "it can't be done." Now for a few major fields in which television advertising can be used with effect.

The British railways are losing a million a month we have just heard. One of the reasons, apart from freight, is that British people don't use their railways enough. Men and women in Tooting or Finsbury Park, in Bradford or Birmingham, Liverpool or Lower Mudcombe-on-Mud—these men and women will do anything possible to avoid travelling farther than fifty miles to their summer holiday resort.

If you could throw upon the television screen, either in the cinema or the home, in the theatre or music hall, a living picture "actually happening" of a railway journey through delightful surroundings, with the train climbing between mountains or skirting great sea-swept bays, with the passenger seated in well-appointed carriages in which cheap, tasty, clean food was served—don't you think our Tooting and Liverpool friends might be induced to travel further afield to find freshness and fresh air?

But perhaps railway directordom won't think that brass tacks.

POINTS on this page: Mr. Desmond describes how the present broadcast licence fee can be wiped out, making listening-in free for all. The expenses in connection with broadcasting will be met, under his scheme, by national advertisers who want to "buy time on the ether." He also suggests how, under this arrangement, the Chancellor of the Exchequer can be assured of a greater income from broadcasting.

Yet it is these very directors who have been using widely the immensely less effective poster advertisement to get people to travel to "Breezy Bexhill" or "Sunny Skegness." **The "pull" of the television picture is, I should say, three or four to one as opposed to the "static" poster.**

Or you have a fashionable stores. You sell dresses—or you want to sell them.

To-day you buy a page in a society paper on which you print those often ghastly doll-like imitations of the female form divine, and underneath the price of the dress. To-morrow, the living *mannequin* will live and move and have her being before you upon the television screen.

Chic you say? What's the use of *chic* in a dress if you can't show it on the *living* figure?

Before this old earth has circled the sun half a dozen times more, and long æons before the Rip Van Winkles who, unfortunately, infest not only Government but other offices, have awakened to the fact that television is here, we shall be selling by television everything from soap to scent and from that golden powder now being used by the *Parisienne* as the *dernier cri* in complexion preparations, to puffs and pomatum. **For, again don't forget it, colour television (another of the Baird *tours de force*) is fact.** You will be able to *see* the mellow tinge of that soap, the fascinatingly dinted flask of that scent, and some day—who knows?—Baird or some other may find a way to send a scent over the wireless!

Possibilities for the Government.

In all this, it might not be a bad idea for Mr. Churchill, who is usually a trifle more wideawake than some of his dearly-beloved brother Rip Van Winkles, **to consider the possibilities of television for what I will call Government advertising. Also, let him get down to those brass tacks beloved of Chancellors and let him gently probe the possibilities of increased revenue from the same source.**

As regards the latter, all he has to do is to transform broadcasting as suggested above (and I defy any man who thinks to find it impracticable) and charge a fixed percentage upon all national wireless advertising, whether television or otherwise. It would be a thousand times easier, and more effective, to tax broadcasting at its source, than the present ludicrous and ineffective method of trying to tax millions of individual listeners. **Apply taxation to the bottle-neck, to those national advertisers who want to "buy time on the ether."**

Use the Television Screen for Emigration !

As regards the former, if he wants a solution to the overcrowding of England and the prevention of "forced emigration," now being put forward, let him look to the television screen.

If we could show in the overcrowded districts of this little island free life as it is lived *at the moment of living* in the Australian bush, on the Canadian farm, the South African karoo, or anywhere in Britain's wide-flung Empire, the Government

(*Continued on page* 20.)

The Late Lord Haldane

First President of the Television Society

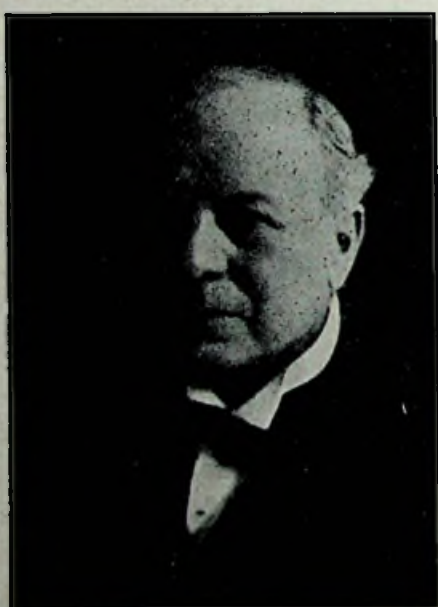
By Major A. G. CHURCH, D.S.O., M.C., B.Sc.

THE death of Lord Haldane deprives the country of the services of one of its greatest men and truest patriots. His departure from our midst leaves the Mother of Parliaments poorer in council, and the supreme judicial court of the Empire without its foremost figure. It robs the civic universities and other higher educational institutions of their doughtiest champion, philosophy of a great exponent, science in general of a devoted adherent, and, in particular, the members of the infant Television Society of their first president. His acceptance of this office was indicative of his attitude towards all progressive undertakings. There are few such extant which do not owe much to his inspiration and support.

Few men have owed so little to the external advantages of rank and fortune. Lord Haldane's rise to fame was due to his natural intellectual gifts to which he added prodigious industry. He was educated at Edinburgh and Göttingen Universities. From the former he graduated with first-class honours in philosophy. At the latter his Hegelian tendencies were strengthened under the influence of Lotze, while his studies and associations aroused sympathies which were subsequently so interpreted as to cast a shadow over some of the best years of his life, partly, though inadequately, compensated by the ever-increasing respect he enjoyed during his last years.

He was called to the Bar at the age of 23, and within a few years acquired a large junior practice in the Privy Council. In 1885 he won Haddingtonshire from the Conservatives by a small majority, and during the next 25 years established it as a safe Liberal seat. In 1889 he took silk to enable him to devote his energies more fully to his Parliamentary duties. During the years which followed he devoted no small amount of his time to the promotion of our educational institutions, particularly the creation of new universities and university colleges, through whose agency he believed not only the whole cultural level of the nation would be raised, but that they would create that knowledge and those qualities of mind which were the greatest safeguards of the country against complacency and decay on the one hand, and revolution and disruption on the other.

There is little doubt that Lord Haldane would have made a great Minister of Education, or that had he been made Lord President of the Council he would have striven to create the administrative machinery for the encouragement of scientific and medical research which had to be improvised in later years. His apprenticeship in the Cabinet, however, was served as War Minister under the late Sir Henry Campbell-Bannerman, and it is not among the least of his triumphs that he earned for himself the title of the greatest War Minister.



A recent portrait of the late Lord Haldane, whose recent death at the age of 72 has deprived the nation of a valued counsellor, and the Television Society of its first President.

The fact that it is now generally recognised that his most obvious claim upon the gratitude of posterity is the invaluable organisation which he created between 1906 and 1912 for the expansion of the army to meet any contingency is the finest vindication of his memory against his war-time calumniators. That he did not fully appreciate the growing menace of German aggression sufficiently to warn the nation publicly before the catastrophe of 1914 must be attributed to his almost passionate belief in the sanity of peoples.

Lord Haldane was twice Lord Chancellor, first from 1912–15 as a Liberal, and secondly in the Labour Government of 1924. The Labour Party gained enormously in prestige by his adherence to its cause, and its hold on the affections of the electorate might have been strengthened considerably had he been given more support from his new colleagues. Unfortunately, they lacked his experience, his sagacity, and his vision; they differed from him temperamentally; and one at least of the schemes he devised for the furtherance of the interests of the community was shelved until adopted by the present Government.

The remaining years of his life after leaving the Woolsack for the second time were devoted by Lord Haldane to the consideration of the new problems, legal and constitutional, which were created by the new status of the nations comprising

(*Continued on page* 20.)

A TELEVISION SCOOP

By Derek Ironside.

MR. VAN STEEG, head of a vast organisation controlling a multiple chain of entertainment halls throughout Britain—an imposing figure as he sat at his roll-top desk—knocked the ash off his cigar and glared at the unfortunate representative of "Televisual News, Ltd."

"I've tried to give you a fair chance," he roared. "You say you had trouble with your photo-electric cells and that the hitch can't possibly occur again. Well, I don't know anything about photo-electric cells. My business is entertainment, and our announcing a special demonstration of current news by television at the Silver Screen Theatre and then turning away about three thousand people doesn't do my corporation any good. If a thing like that were to happen again the shareholders would start clamouring for a new managing director, and our stock would slump. I believe in progress, but not in risky progress, and I've a thundering good mind to cancel the contract we entered into with you."

An Unfortunate Mishap.

"I quite agree that it was very unfortunate for everybody, especially myself," said young Dick Merton, who was the managing director, chief shareholder and one-third of the working staff of the newly-founded Televisual News, Ltd. "You saw the previous trials yourself and you know that they were perfectly satisfactory. There's no question of risk. Unluckily, as I've explained, our car had a slight collision on the way down to Hendon and some of the selenium cells must have got damaged. This made it quite impossible for us to transmit. Otherwise, you'd have had perfect pictures of the air pageant."

"Well, I'm ready to give you another chance, Mr. Merton, but if you let me down this time you can regard the contract as cancelled, and I shall give the commissionaire instructions to kick you down the steps if you show your face in this building again. I don't propose to advertise the feature specially, but shall just announce that we hope to show televised news during the usual cinematograph entertainment at the Silver Screen Theatre when suitable opportunities offer. You can have a week in which to justify the continuance of the contract. *Good* morning."

Hunting for News.

Merton rejoined his anxious partner who was waiting for him in Shaftesbury Avenue with their transmitting car.

"I've succeeded in calming old Steeg," he explained as they drove off. "He was fearfully wild at first; threatened to cancel the contract, start legal proceedings, and generally make trouble. He's given us a week in which to supply the goods. Well, we must make absolutely sure that no hitch occurs this time."

"We want something good," remarked Peter Vallance. There was a thoughtful look on his usually unruffled countenance. "Something big—something that will make a splash."

"The bother is," said Merton, "if you go hunting for news you rarely find any. Anyway, let's have lunch and forget our troubles in an orgy at Frascati's. Then we'll ring Bill up at the Silver Screen to make sure he's got the receiver in O.K. order."

* * *

At three o'clock in the afternoon, the car was heading slowly westwards through Hounslow, with Merton at the wheel. He had a vague idea of "shooting" some scenes of the field operations which, according to report, were scheduled for that day by the London Command, in the neighbourhood of Virginia Water. They had not quite cleared the town, however, when there was a sudden affray on the pavement just ahead, revolver shots rang out, and a number of men, hotly pursued by a little crowd, leapt into a waiting car and rapidly made off, leaving several prostrate figures on the pavement. A policeman appeared, apparently from nowhere.

"In the King's name, I command you to follow that car," he ordered breathlessly. "Those men have robbed the Hounslow branch of the Southland Bank." He leapt aboard the television car, which quickly accelerated.

"This is a wireless car, constable. Perhaps you would like to speak to Scotland Yard," said Peter quietly, as their car gathered speed. "I think I can manage their wave-length."

The constable grunted his surprise, but was soon conversing with the Yard. "They're going to warn all police stations ahead," he remarked, when he had laid the microphone and headphones down. "Meanwhile, my instructions are to keep the bandits in sight."

Televising a Bandit Chase.

The fugitive car was about two hundred yards ahead and both pursuers and pursued were doing a cool fifty-five miles to the hour, to the amazement of pedestrians and the occasional traffic which they passed at that comparatively quiet time of day. Now and then a revolver bullet sighed overhead. Peter switched off Scotland Yard and tuned in to the Silver Screen Theatre.

"Hullo, is that you Bill? Ask the manager to tell Mr. Van Steeg that armed motor bandits have just robbed the Southland Bank at Hounslow, and that if he likes I can flash him pictures of the police chase. Your receiver's ready, I suppose."

"Quite O.K., sir. Just hold on."

Peter held on. Another bullet sang past. Bill's voice came over. "Mr. Steeg says he's clearing the screen in the middle of the star film, *Birds of Prey*. All clear, sir; will you transmit."

The televisor, with its unblinking eye focussed dead on the flying bandits, began to fling pictures across the ether, to where in a huge hall in the centre of London two thousand people, seated in comfortable chairs, watched with unrestrained excitement the beginning of an epic chase, which was destined to become famous both in police and television circles, as its details were instantaneously portrayed upon the silver screen. Van Steeg himself roared out a running commentary through a huge loud-speaker.

Near Egham a formidable barrier blocking the road became visible, behind which armed police could be seen. Three hundred yards from the barrier the bandits stopped their car dead, and, in too much haste to fire, raced across ploughed fields to where an empty brick-built bungalow stood. Peter secured some splendid close-ups through his telephoto lens. Police rifles began to speak. One of the bandits whirled round and collapsed before he reached the shelter of the bungalow. The others attained their objective and the rapid bark of their automatic pistols testified that they were not disposed to surrender easily. Dick adroitly ran the car up to within a hundred yards of the bungalow, using a stout brick wall as cover, round the corner of which he thrust the all-seeing lens of the televisor.

While lines of police encircled the bungalow, advancing in sectional rushes to the accompaniment of staccato revolver and rifle shots, Dick had a word with Van Steeg through the ether.

"I hope it's satisfactory, sir?" he enquired over the wireless 'phone.

"My dear boy, it's great. I've seen nothing like it before. The audience is simply mad with excitement. You ought to see us duck when the bandits shoot. The sound effects are coming in extremely well. You seem frightfully close to the firing, though."

"About a hundred yards, but I'm using a special telephoto lens and amplifier. By the way, I think the police are retiring. Probably waiting for the miltary from Hounslow. I think we shall have machine guns and trench mortars up if the bandits don't hang out the white flag. Yes, there's a company coming up the road now."

"Ah, there's the whole show going up in fragments. Poor devils!"

A police inspector went forward to parley, carrying a white flag. Dick was told afterwards that his "shots" of this were particularly good. The inspector came back quickly under a gust of fire from the bandits. Clearly they refused to surrender.

"The trench mortars are going to start firing," warned Dick over the 'phone. "This is the grand finale. The shells are bursting all round the bungalow. They'll hit it in a minute. Ah, there's the whole show going up in fragments. Poor devils! . . . By the way, sir, am I to cancel that contract. I rather fancy I could get better terms from the Associated Picture House Corporation."

Dick heard Van Steeg chuckle." I'm cancelling nothing. But come round to-night and we'll have a little chat about increasing the capital of Televisual News, Ltd., to a million sterling."

(*Concluded from page* 18.)

the British Empire, and to the furtherance of education and scientific research. His contributions over this varied field are difficult to over-estimate.

The esteem in which he was held by those who have been privileged to know him well has been expressed by my friend, Professor T. Percy Nunn, thus:

"In prolonged conversations in recent years, during which the great statesman, student, and man of affairs talked freely about many phases of his wonderful experience, he never uttered a word of bitterness, and one caught glimpses of a faith, a courage, and a spiritual nobility that could not but evoke reverential esteem."

The nation has good cause to mourn his loss.

(*Concluded from page* 17.)

would not have to use the whip to get men to emigrate. They would eagerly go themselves. *It is chiefly their fear of the unknown that hinders them to-day.*

"Live" versus "Dead" News.

But it is the showing of events *at the actual moment of occurrence* that is the supreme pull in advertising. The modern dummy film, made up of dummy men and women acting for the purpose, has a dummy, sometimes a dumbfounding, effect. Even the record of "natural" happenings, when they are past, loses its savour, as does what Fleet Street knows as "news." The value of news is in inverse ratio to its age.

The television advertising screen, recording things happening at the moment, will overcome all this. And the day is not too far distant when every section of our national human life, from a Westminster politician to a Westinghouse brake (so often having the same effect), from a department of emigration to a department of agriculture, and from a pound of sugar to a pound of soap, will find its place on the television advertising screen.

Did I hear somebody murmur again: "Can't be done?" If I did, it must have been Whitehall murmuring in its sleep. For no man who will take the trouble to re-read this statement of fact, no man who is a business man with imagination, will say it can't be done.

It is being done—and that's that!

Optical Reflectors

PART III

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

Our Contributor resumes this month his popular series of articles on optical subjects likely to be of special interest to those of our readers interested in the working of known types of television apparatus and the designing of new ones. These articles will also deal with the construction and application of optical elements made available by optical science in recent years.

Critical Angle of Refraction.

By Snell's law, referred to on p. 36 of the April issue of TELEVISION, we know that if a ray *BO*, Fig. 1, strikes the surface separating two transparent media, such as air and glass, at any angle of incidence α, it will be refracted at an angle β such that sine α/sine β is constant for all angles of incidence.

This constant, known as the refractive index, is equal in the case of air and light crown-glass to $3/2=1{\cdot}5$. Drawing a circle about *O*, with a radius *BO*, equal to unity, and dropping perpendiculars *BA* and *CD* on to the normal *AO*, we have, therefore, $BA/CD = n = 1{\cdot}5$, and, further, if the length *BA* represents the distance through which light-waves travel in the first medium, air, say, in a given time, then the length of the line *CD* will be the corresponding distance through which light-waves will travel in the second medium, glass, say, in the same time. An elegant method of tracing a ray across the bounding surface of two media is based upon this fact.

Let *S*, Fig. 2, represent a glass surface in air, upon a point *O* in which a ray of light *RO* strikes at an angle of incidence α. It is required to trace the ray into the glass, it being given that the refractive index n of the glass is equal to $1{\cdot}5=3/2$.

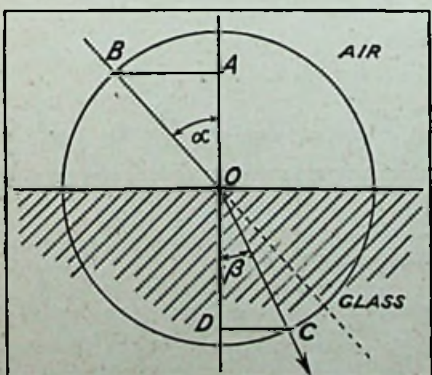


Fig. 1.
Illustrating the refraction of light as it passes from air to glass.

Now we know that while the light travels through three units of length in air it will travel through two similar units in glass. From the point *O*, therefore, the distances *OC* and *OD* are set off equal to 3 and 2, respectively, on any scale. Raise the perpendicular *CE* to cut the incident ray *RO* at *E*, and with a radius *OE* draw a circle. Drop a perpendicular *DF* upon this circle and join *OF*. *OF* is the refracted ray required.

Proof:—Draw the semi-chords *EA* and *FB*. Then sine $\alpha=EA/_{OE}$ and sine $\beta=FB/_{OE}$ so that

$$\text{sine } \alpha/\text{sine } \beta=\frac{EA}{FB}=1{\cdot}5$$

by construction.

An interesting case arises when a ray passes from air to glass at an angle of incidence of 90°. The ray strikes the point *O* at glancing incidence, Fig. 3, so that setting off *OC* and *OD* as in Fig. 2 the circle is drawn with a radius *OC* equal to 3. The refracted ray *OF* is formed as in Fig. 2.

We have now sine $\alpha=1$, and sine $\beta=\frac{2}{3}$, so that, as required, sine α/sine $\beta=1/\frac{2}{3}=1{\cdot}5$, and a reference to a book of mathematical tables will show that the angle (β) which has a sine of 2/3 is one of 42° nearly.

Thus, when light passes from air to glass, no matter how great the angle of incidence may be,—it cannot exceed 90°, however,—the corresponding angle of refraction can never exceed 42°; and conversely, if light passes from glass to air, an angle of incidence of 42° cannot be exceeded. What then happens if a ray in glass strikes an air surface at an angle greater than 42°?

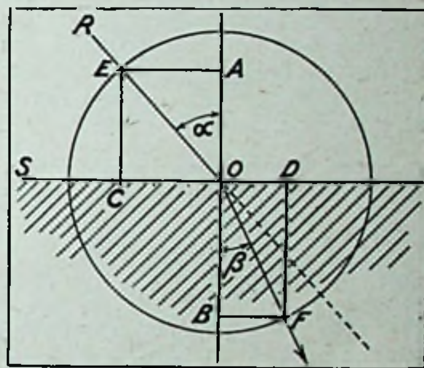


Fig. 2.
Construction for refracted ray.

The answer is that it does not pass into the air, but is totally reflected, as shown by the dotted line, Fig. 3, in accordance with the law of reflexion. *In fact, for all angles of incidence greater than this critical angle of 42° a glass-air surface acts as a perfect reflector.*

The magnitude of this critical angle depends, as has been shown, upon the refractive index of the glass: for dense flint, for example, with an n-value of 1·75 it is equal to 35° roughly. Obviously this critical angle only occurs when light passes from an optically denser to an optically rarer medium—from water or glass to air, for example, but not from air to water or glass.

An empty test-tube immersed in a tumbler of water and looked at in an inclined direction from above looks like a solid rod of burnished silver: fill the tube with water and the illusion vanishes.

By virtue of the total internal reflection which occurs when the critical angle is exceeded solid rods of glass and water jets can be employed to transmit light around corners. A rod of glass is used for this purpose in a well-known microscope lamp, and fountains in play at night illustrate the use of water jets.

Optical Squares.—Let a ray *CD*, Fig. 4, fall upon the lower plate *B* of two parallel reflecting plates *A* and *B*, at an angle α. After two reflections it is evident that since the angle *EOD* is equal to the angle *CDO* the ray *OE* is parallel to the ray *CD*. The ray *OE* has been displaced laterally during reflection, but it has not been angularly deflected.

Now, imagine the upper plate *A* to be rotated about the point *O*, in a counter-clockwise direction, through an angle β into the position A^1, shown in broken lines. The two mirrors will now be inclined to one another at this angle.

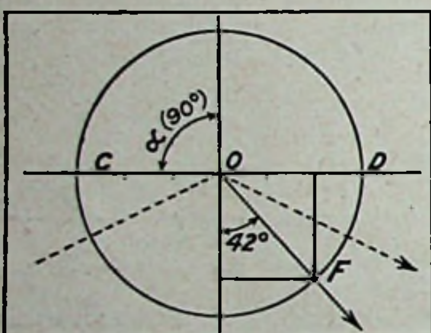


Fig. 3.
Critical angle for glass-air surface.

As has been shown on p. 21 of the August issue of TELEVISION, the effect of tilting the plate *A* through an angle β is to tilt the reflected ray *OE* through twice that angle, namely 2β, into the direction *OF*. But *CD* is parallel to *OE*, and the angle *DLF*, therefore, which is the angle through which the ray *CD* has been deflected by successive reflections by the plates *A* and *B*, is equal to the angle *EOF*—i.e. to 2β.

This result, it should be noted, is independent of the angle of incidence α. By making the angle β equal to 45°, we should make the angle of divergence *DLF* equal to a right-angle, and thus construct an "optical square," so much employed by surveyors and others for setting off two lines of sight at right angles to one another.

Prismatic Reflectors.—In modern optical instruments the plane silvered reflector is, for technical reasons, avoided as much as possible, especially in combinations such as those required in the prismatic field-glass. Its place is taken by the prismatic reflector, which consists of a prism of glass, variously shaped, of which one or more faces are used as reflectors. These operative faces may, or may not, be silvered.

In Fig. 5 a number of the more simple forms are shown. No. 1 shows the right-angle prism. A ray from an object at *A* passes through the face *D*, strikes the hypotenusal face *C* at an angle of 45°, approximately, and is reflected at right-angles through the face *E*. This prism used in this way gives an inverted image—i.e. *P* at *A* appears as *d* at *B*. It should be noted that this prism is not an optical square because the angle of deviation depends upon the angle of incidence on the face *C*. If this angle is less than the critical angle of 42° the face *C* should be silvered.

No. 2 is a right-angle prism as used for inverting optical images. Placed in front of a projecting lens in a lantern it corrects the inversion produced by the lens. Thus "*P*" at *A* is seen as "*d*" at *A*.

No. 3 shows the prism system used in prismatic binoculars for inverting and reversing, side for side, the image produced by the object-glass. Two right-angle prisms, I and IV, are mounted so that the two hypotenusal faces are parallel to one another, but crossed lengthways. In general they are also separated in the direction of the incident ray to reduce the length of the telescope.

The incident ray entering normally the hypotenusal face of the first prism I strikes the face *B* at an angle of approximately 45°, i.e. without the critical angle, and is reflected

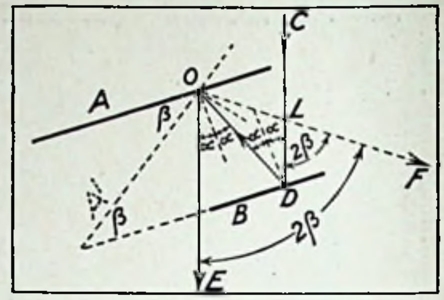


Fig. 4.
Reflection by two inclined plates.

downwards at right-angles to strike the face *C*, which reflects it back again parallel to the incident ray in a vertical plane. The second prism IV acts in a similar way to the first prism, but in a horizontal plane. The result is that the emergent ray is displaced laterally with respect to the incident ray, but is parallel to it. A "*P*" is seen through it as "*d*." The object-glass of a telescope projects "*P*" as "*d*," so that the prism combination takes up the image of the object-glass and reinverts and reinverses it so that "*P*" finally is seen as "*P*." The prism acting in this way performs the function of the lenticular erecting system in a terrestrial telescope.

No. 4 is an example of a roof-prism—the *bête noire* of the optician. The long face of the prism is made up of two inclined faces meeting in a median ridge at an angle of 90°. A ray from the object at *A* enters the lower face of the prism and, striking one of the inclined faces *C*, is reflected by it on to the other, from which in turn it is reflected out through the vertical face. "*P*" at

(*Continued on page 27.*)

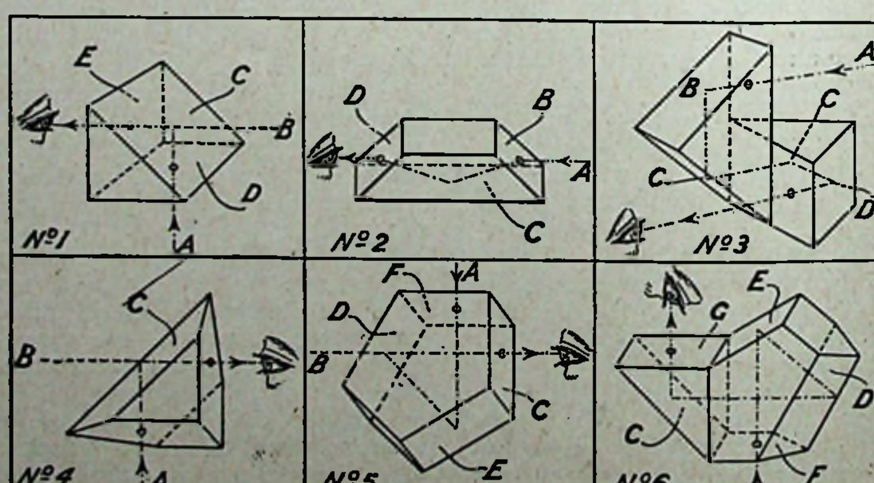


Fig. 5.
Simple forms and combinations of prismatic reflectors.

The Story of Chemistry

Part I

The Chemist's Picture of Matter

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

Following up our policy of giving our readers information on all the various branches of science which make television possible, we are commencing this month a new series of articles on Chemistry. Month by month Mr. Shearcroft will revive long-forgotten memories of elementary facts about Chemistry which most of us have never had occasion to remember since our schooldays.

YEAR by year life becomes more and more complex. Many of us can remember when the most complicated thing we were called upon to do was to tighten up the cones on a push-bike. The motor made us familiar with such things as gears, pistons and internal combustion. The aeroplane enlarged our vocabulary, and when wireless sets began to find a place in our homes, we settled down to learn a new land of wonders.

Now television is entering into our lives, and it seems more complicated than all the rest put together. Not only have we all the technique of wireless, but added to this is a continual reference to chemical processes and substances of which we have heard very little. The pages of TELEVISION are freely sprinkled with chemical names and formulæ, and we may easily sigh for a fresh education which would make us more familiar with these things which are entering, and bid fair to have an important influence on our lives, than with the history of ancient Romans.

Learning the Inside of a Hobby.

It is the experience of those who cater for a public interested in these matters that people are willing to devote time and trouble to learning the inside of their hobbies. We all have an instinct of curiosity, which must be satisfied somehow. We all know that the time has passed when any man can be an expert on all subjects, or even on one complete subject. No scientist would dare to claim to know all that is known of chemistry, for example.

He knows his own branch from A to Z, and of the rest he has to be content with a general knowledge. It is the same for the average person. Of the many scientific subjects which enter into daily life and into his particular hobbies only an outline can be attained, but that outline is sufficient to make interest, in what is being done, intelligent. It will enable the reader of technical articles to read without leaving gaps.

Composition of Matter.

It is the object of this series of articles to provide that outline for the subject of Chemistry. You cannot be a chemist, of course, unless you pursue a lengthy course of study, but it is possible to understand what the chemist is talking about, without devoting more time than you can easily spare to a consideration of the subject.

The main object of the chemist is to find out of what things are made. This is a problem to which centuries of work have been devoted. Sometimes progress has been slow, and at others rapid. The history of chemistry is a fascinating story which cannot, however, be told here. The chemist deals with a material world in which he finds innumerable substances. These substances differ from one another in a recognisable degree.

Glass, for example, is quite distinct from soap. The chemist says that glass possesses different *properties* from soap. He can write a list of these properties for glass and, as far as possible, he will measure the properties, so as to make them precise. When he has written a complete list of the properties of any substance he has *described* it in such a way that other workers can recognise it.

Such a task would seem to be endless; in fact, it did seem endless to early workers. If you will look round the room in which you are sitting and mentally note all the different substances around you, you will be surprised at the number you can list. Extend your enquiry to the rest of the house, to the garden, and to the whole world, and you will have a list that staggers imagination.

But it is common knowledge that many of these substances can be made from others. Glass is made from sand and soda. So we glimpse another list still more staggering. In this we would have our first list to which would be added the information of what each substance was made, and much study of this would most certainly land us in a home for the insane.

Chemist's Picture of the World.

Surely in this world in which we live there is some order, some simple underlying principle which will make it comprehensible from the point of view of the finite human intelligence? This underlying principle has come from the work of thinkers of the past centuries, and for an understanding of chemistry the picture of the world which the chemist has painted is the first thing to grasp. It may have apparently very little direct connection with television or with anything else, but actually it is fundamental to all things.

With the gradual building up of this picture, and with the mistakes that were made, we cannot deal here. All we can do is to give the prominent features of the finished product—yet the word "finished" should not be used, for modern work is still adding details.

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It so happens that I am writing this as I sit on a sandhill, some 30 or 40 feet high. It is a solid affair on which bushes grow and holiday-makers have built bungalows. The waves of the sea batter against it with a thunderous roar, and yet it stands firm. Still, I can take portions of it up in my hands, and it trickles through my fingers like water. My own eyes give me the explanation. The sandhill is made of tiny grains of sand, packed tightly together. I can separate grain from grain with my fingers. The solidity of the sandhill is an appearance only.

It is a picture similar to this that the chemist has of all substances. He does not imagine that the piece of glass is just glass all through, any more than you and I imagine that the sandhill is just sand all through—there are gaps between the grains. So the chemist pictures gaps in the piece of glass. They are not gaps such as we get in a sponge or a piece of pumice-stone, with sponge and pumice-stone continuous around them, but gaps due to the packing of tiny particles.

Dr. TIERNEY (extreme left), Dr. EDERIDGE GREEN (next to Dr. Tierney), and other members of the British Association witnessing a demonstration of colour television in Glasgow at the recent B.A. meeting.

An Apt Simile.

There is much evidence in favour of this view. We may consider one point only. A small child in front of me is shovelling dry sand into a pail. The pail is full to the brim, and yet when given a tap or two the level sinks appreciably below the top. We do not imagine that the tapping has lessened the quantity of sand, but that the grains have settled down more closely together. All substances can be compressed by tapping or squeezing, and there is no believable explanation other than the idea of particles being pressed nearer together.

These tiny particles, of which the chemist believes all forms of matter to be composed, are called *molecules*. All the molecules of any one substance are alike, but they differ from the molecules of any other substance. They are the smallest particles of any substances which can have a separate existence. They are far too small to be seen either with the naked eye or by the aid of any apparatus which will increase the powers of vision.

A piece of glass is then a "sandhill" of glass molecules. It could, in imagination, be cut in half—cutting being only the division of one lot of molecules from another lot. The cutting process could be continued until a limit was reached, and two molecules existed side by side. Then one more cut only would be possible, and we should have the smallest portion of glass possible—a single glass molecule.

"A Sandhill" World.

We live, then, in a "sandhill" world, a world of molecules, which stick together in masses which we call specimens of matter. What the cohesive forces are which keep the molecules together we do not know. In some substances the molecules cling on to each other very tightly, as is the case in most solids.

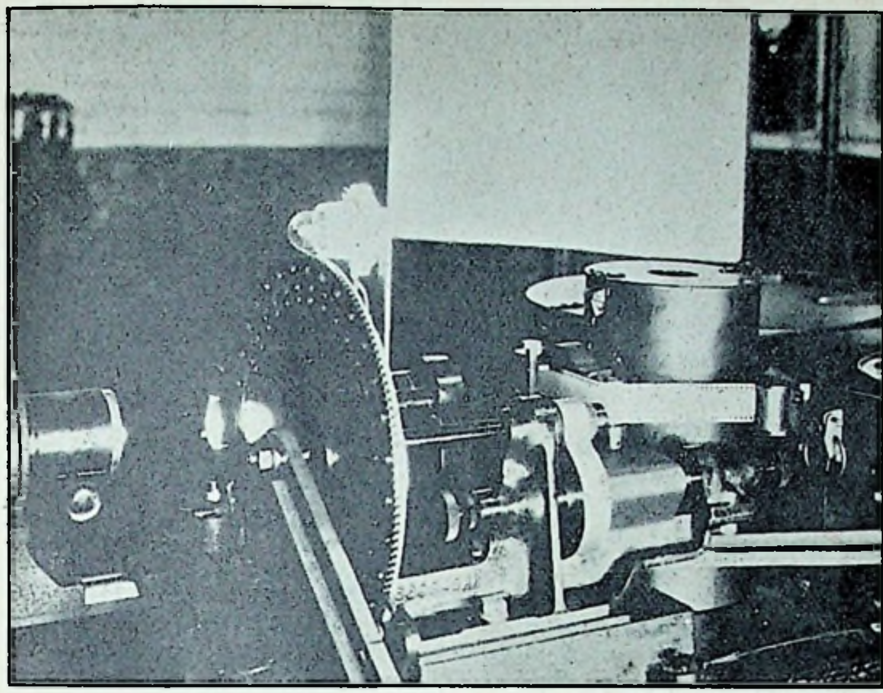
In liquids we imagine a much more loose arrangement with molecules easily slipping over one another. In gases we are forced to suppose that the molecules are widely apart. In all cases we imagine that the molecules are in continual motion, a mere vibration in solids and a wild rush in gases, each rush ending in a collision with either another molecule or the sides of the vessel containing the gas.

Atoms.

The picture, however, is not yet complete. These molecules cannot be simple things. Take water as an example. We can get from any sample of water another substance, a gas called hydrogen. We can also get another gas, oxygen, from water. And taking these two substances only, we can make water with them. Water must therefore consist of hydrogen and oxygen. Hence a water molecule must contain both hydrogen and oxygen; for any sample of water is but a mass of water molecules all alike.

This suggests another order of particles smaller than the molecules. These smaller particles are called *atoms*. The work of the chemist is mainly to discover what kind of atoms make up any molecule. Whereas there seems to be an unlimited number of different kinds of molecules, only a very few different kinds of atoms have been discovered. In fact, we have reason to believe that there are only 92 different atoms in all the various kinds of matter in the world.

This gives us a picture of the material world which does offer a possibility of grasping its details. All the many kinds of substances which we meet are made up of the tiny molecules. They exist as masses of molecules clinging together. These



(P. & A. Photo.)

The machine devised by Dr. FRANK CONRAD, of the Westinghouse Electric and Manufacturing Co., for transmitting cinema films by wireless.

molecules in their turn are made up of different groupings of a comparatively few different kinds of smaller particles, the atoms. Fundamentally, then, the world consists of 92 different substances, which have never been split up into other substances, and are called *elementary substances*, or *elements*.

Some of these elements we find existing as such. For example, gold is an element. Gold, as found in the crust of the earth, consists of masses of gold molecules, made up of gold atoms. The molecules of all elements are made up of one kind of atom only. Oxygen and nitrogen which occur in the air are other examples of elements. Some elements, however, are never found in the *free* state. Chlorine, for example, the horrible green gas which was used in the early days of the war as a poison gas, never exists in a free state. All the atoms of chlorine in the world are locked up in molecules of *compounds*, that is, substances which have more than one kind of atom in their molecules.

Here, then, we have divided all matter into two classes—*elements*, the atoms in the molecules of which are all alike, and *compounds*, with molecules containing at least two kinds of atoms.

Compounds are made from the elements, their molecules being formed by the unions of a small number of atoms of one element with a small number of atoms of one or more other elements. Thus, for example, atoms of the element sodium, a soft metal, and chlorine can *combine* together to give a molecule made up of one atom of sodium and one atom of chlorine. This molecule is a molecule of common table-salt.

This example will serve to illustrate another very important point. Common salt contains both sodium and chlorine, but look at it as closely as you may, you will see no sign of a green gas or a soft metal in it. When atoms join up to form molecules they lose their own individuality in that of the molecule. It is not just a case of mixing them together—the process we call chemical combination has to occur, a wonderful process which robs the atom of its individuality. Yet it is not destroyed. Out of common salt we can still get the chlorine and the sodium, but again only by processes which we call chemical.

This, then, completes our initial and essential picture—the world a mass of molecules, made by the chemical union of atoms of the elements.

(*Concluded from page 22.*)

A is reflected as *d* at *B*, so that the prism is sometimes used above the eyepiece of an ordinary microscope to correct the orientation of the usual image, and thus permit of the microscope being used for dissecting purposes. Unfortunately, the two faces of the roof have to meet very accurately at an angle of 90°, otherwise two overlapping images are seen.

No. 5 shows the most valuable of all prismatic prisms for use in optical constructions. It has been known since the war as a "pentagonal" prism, although the adjective "tetragonal" would more exactly indicate the essential form of the prism.

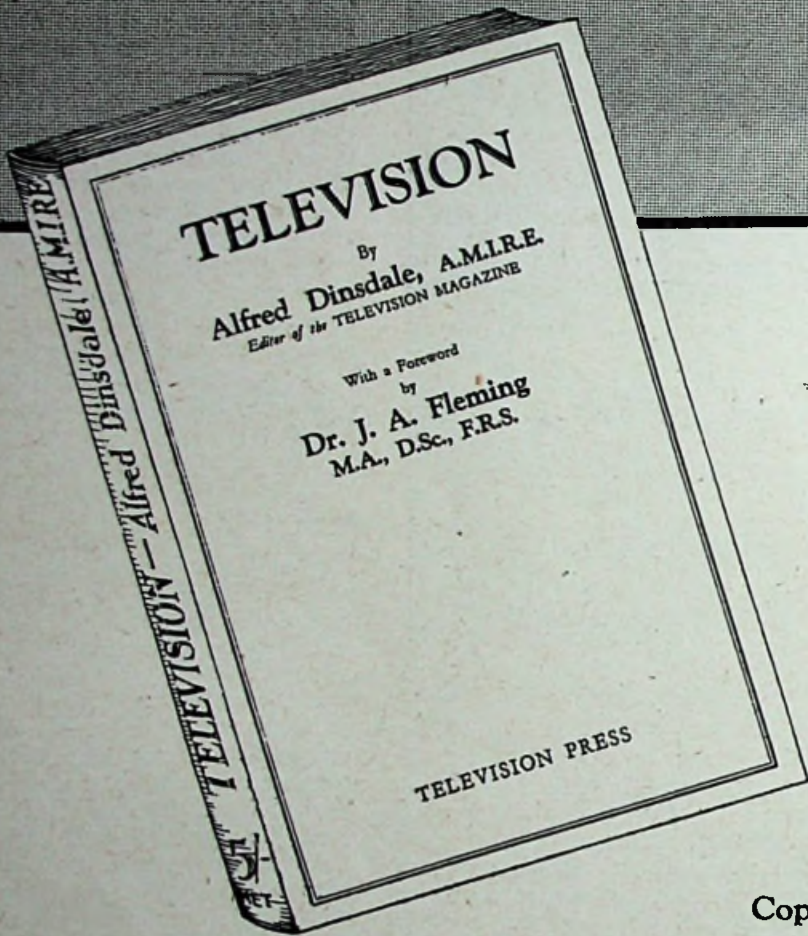
This prism is an optical square in which the two operative reflecting faces *D* and *E* are inclined to one another at 45°. A light ray entering normally the face *F* strikes and is reflected by the face *E* on to the face *D*, from which it is reflected horizontally, through the face *C* to the eye.

If the faces *C* and *F* are accurately at right-angles then any deviation by refraction at the first face *C* is corrected by an equal and opposite deviation at the second face *F*, so that the prism may be rotated through an angle in its own plane without altering the rectangularity of the initial and emergent rays. A "*P*" at *A* is seen as "*P*" at *B*. The prism is largely used in range-finders of moderate size. In the larger types plane reflectors are often employed because of the quantity of optical glass required for large prisms.

Since the angle of incidence on the face *E*, and also on the face *D*, is 22½° only, it is necessary to silver these two faces.

No. 6 shows a prism, employed in a well-known type of prismatic binocular, in which a pentagonal prism with a roof-face at *D* is cemented to a right-angle prism. The ray entering by the face *F* is reflected in succession by the faces *E* and *D* on to the inclined face *C* and thence through the face *G*.* This prism is the optical equivalent of the two right-angle prisms shown at No. 3, Fig. 5, but it has two air-glass surfaces less, and thus the loss of light by reflection is less.

* Anyone interested in prismatic reflectors could not do better than visit the Patent Office Library and look up a few modern patent specifications dealing with range-finders.


TELEVISION
By
Alfred Dinsdale, A.M.I.R.E.
Editor of the TELEVISION MAGAZINE
With a Foreword
by
Dr. J. A. Fleming
M.A., D.Sc., F.R.S.
TELEVISION PRESS
TELEVISION—Alfred Dinsdale, A.M.I.R.E.

DISCUSSION ON THE AIMS AND DEVELOPMENTS IN BROADCASTING

British Association Meeting, Glasgow, September 11th, 1928, in the Section devoted to the Study of Education.

The Impact of Personality upon Personality.

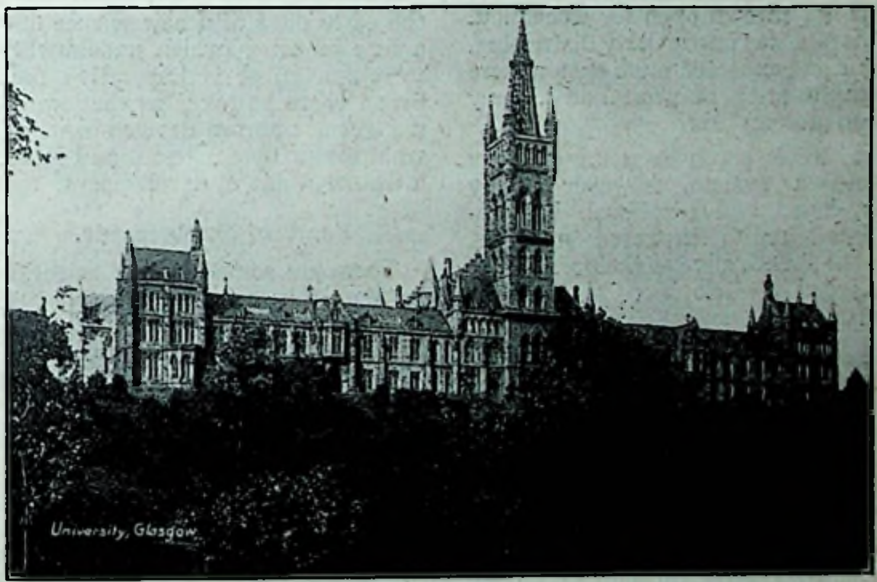
IT is not so many years ago that the B.B.C. acknowledged a difficulty in finding artists suitable for broadcast work. Famous stars, popular behind footlights, fell flat when their "turns" were broadcast. Why? Because we could not *see* them, and they could not convey their personality over the microphone by voice alone. It is strange, therefore, to find that at this year's meeting of the British Association the B.B.C. was at pains to try to convince members that personality *can* be conveyed over the microphone.

DURING the week spent at Glasgow, members of the British Association were invited to consider a problem which I venture to think is of considerable interest to every reader of this Journal. The problem may be stated in this way: "How far, or to what extent, is it possible for a speaker to project his personality upon an unseen audience, through the medium of the present broadcasting system?"

To assist members, the B.B.C. had arranged a model studio in one of the meeting rooms at the University of Glasgow. Visitors were invited to put their friends through a personal test. In an adjoining classroom, they would hear their friend's speaking-voice and gauge the success or otherwise of this experiment in projecting personality.

That the B.B.C. is alive to the importance and magnitude of the problem is indeed a hopeful sign, for it is evident that the broadcasting of vision in addition to the spoken word would greatly assist to make up for the defects of the present system. The time is surely not far away in the dim future, when, by television, we shall be able to project nearly 100 per cent. personality. Then the unseen audience will be able to see on the screen of the televisor, in their own homes, the facial expression of the speaker as his lips move in unison with the spoken word.

Accordingly, a whole galaxy of talent was brought together for the purpose of discussing the aims and developments in broadcasting. Mr. J. C. Stobart, M.A., Director of Education for the B.B.C., led the way with a paper on "Wireless in the Service of Education." He reminded his audience that in 1926, at the Oxford meeting, the problems of broadcasting as an aid to education were broadly discussed; at first wireless was treated as a toy or a hobby for the few. It was then only vaguely realised, except by a very small minority, that broadcasting would ever play a part in the education of the people, either through the schools or in the home. Those few with vision began to explore the long view, to find out the possibilities, remembering all through that individual tastes differ. What was one man's education was another's entertainment, it was impossible to draw a hard-and-fast line between entertainment and education. Mr. Stobart contended that the public taste had advanced so much since the advent of broadcasting that tastes which would have been denounced as highbrow two years ago, were now taken as a matter of course. "Group" listening had been encouraged through



Glasgow University, this year's meeting place of the British Association for the advancement of science.

such organisations as the co-operative movements and the adult education societies, as well as in the primary and secondary schools of the country. Some 3,000 to 5,000 schools were known to be making use of the educational broadcasts.

Sir William Bragg, K.B.E., F.R.S., President of the British Association, also spoke in praise of what had already been achieved by the B.B.C. scheme. Sir Oliver Lodge qualified his remarks with the statement "that the programmes were sometimes good, and the saving clause was that the apparatus could be shut off at the will of the listener."

Mr. Watson Davis (United States) compared the American system with that developed by the B.B.C., and almost gave the palm to the latter. But although the papers attracted a very large audience, many of whom, including the Chairman of the Council of the Television Society, could not gain admission, the meeting was not thrown open for discussion. This fact was particularly distressing, for I had expected more than a mere recapitulation of what had already been accomplished.

There is surely something wrong when a system, however highly developed and successful, has unstinted praise showered upon it. Is the B.B.C. alive to the possibilities afforded by television in the near future?

W. G. W. MITCHELL.

LOOKING AHEAD

By The Technical Editor

In the following article the Technical Editor points out how rapidly flying developed under the impetus of war-time necessity, and endeavours to discover ways and means whereby, without the urge of another war, we may develop television with equal rapidity.

POSSIBLY my readers expect—and legitimately expect—purely technical articles from the pen of the Technical Editor, but unfortunately we do not live in Utopia; in fact some people would say that we do not live in a land fit for inventors to live in. So I make no apology for dealing again with the broad aspects of technology that I mentioned last month, because in the early days of a new science and a new industry (which undoubtedly television is) it is imperative that broad views be taken so that we do not get a cramped development, or, what is equally dangerous and futile, a distorted line of development.

Scale of Experiment.

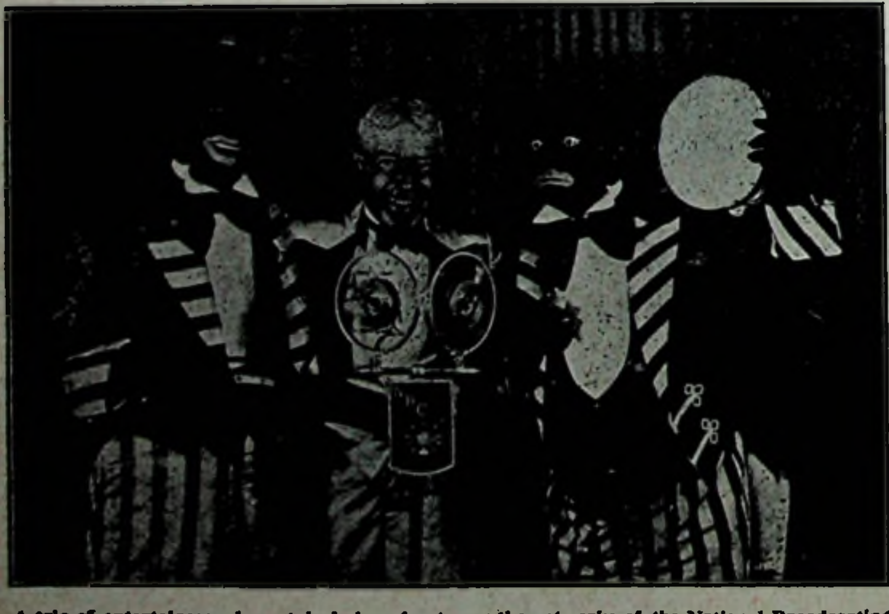
There are some kinds of scientific research that can be effectively and completely carried out within the limited precincts of a laboratory, but, equally, there are others which it pays to work on a large scale, and still others in which experiment is no good unless it is on a large scale.

Now consider for a moment this new science of television in which we are technically interested. We have sufficient evidence already to show that it is something more than a mere scientific curiosity; in fact many of us believe implicitly that it has a commercial future, although we may not be prepared to say exactly how or when. A commercial future does not mean merely that some people will make money out of it, it means rather that it is something that the world wants—*and will have*—sooner or later. Wherein then does the value of television lie? In this—it is a *new means of communication*, and it is therefore one of the foundation-stones of civilisation.

Our creed then is that television is coming, and is coming for the good of the world, and as true disciples we want it quickly, but properly. Therefore, I ask you to consider briefly how we can accelerate the coming of television into daily life.

The Impetus of War.

In 1914 there were some aeroplanes (flying machines we called them) in existence and in use, but does anyone imagine that the present stage of development would have been reached unless they had been used in active war service? The imperative demand for improvement was quickly answered in the special conditions of war, but conditions are different in peace. The rate of development of a science and an industry, of theory and practice, is largely dependent on two factors—experience and imagination. War-usage provided the intensive experience for the aeroplane, but we cannot get—thanks to Mr. Kellogg



A trio of entertainers who regularly broadcast over the networks of the National Broadcasting Company (U.S.A.). Their appearance must be SEEN before the audience can hope to enjoy their "turn" to the fullest.

—the same opportunities for television, and we must find a substitute.

The formation of the Television Society was the first step in this direction, for it has given us a place where we can learn what others are doing. Experience is a purely personal matter for each of us, and time alone is the consideration that limits one's experience, so that by learning what others have done and have failed to do, we can add, in effect, to our own experience. The Television Society provides for this interchange of experience, but, after all, only on a comparatively small scale and amongst enthusiasts, whereas what we want is a nation-wide experience, including those who only look for results, and are critical if they don't get perfection.

Value of Criticism.

You and I are not worried particularly by, say, a slight blurring of the image, or by a momentary loss of synchronism, for we know the technical difficulties that have been already overcome, and are inclined to be lenient, whereas we need reminding by the acid criticism of the subscriber to television broadcasting that perfection such as he expects to get is still somewhere in the future.

Clearly, therefore, we must have broadcasting of television started as soon as possible, but the strange thing is that we have not got it now. We have been told that it started two months ago in America, and we know that responsible people are ready to start it here, and this brings me to my justification for not writing a purely technical article about light-spots or lenses or selenium or exploring.

Progress Impeded.

The technical development of television—this new science in which we are interested—is being held up for some reason, and as scientists, pure and simple, we want to know why. A very large number of us, myself included, have no financial interest in any television company, but we believe in television, and our self-respect in a national sense impels us to wonder why we should be left behind in the race. Each one of us would be proud to make some contribution, some discovery, large or small, in this new field which has been opened up for

(*Continued in column* 3.)

The Television Demonstrations given by Mr. J. L. BAIRD before the BRITISH ASSOCIATION at Glasgow

At last year's British Association meeting at Leeds the most popular demonstrations were unquestionably those of noctovision given by Mr. Baird, when members of the British Association seated in total darkness in one room were seen by their friends in another room on a little screen. This year Mr. Baird showed two further developments—television in colours and stereoscopic television. The demonstrations created intense interest. Hundreds of members, including many of the world's most eminent physicists, availed themselves of the opportunity of seeing these unique demonstrations. Colour television and stereoscopic television are still, of course, in a purely experimental stage. Principles, technical details and accounts of demonstrations have already been described in this journal, but a brief résumé of the principles involved may interest new readers.

Colour Television.

Colour television is similar in nature to the original process of colour cinematography. The result is achieved by a very simple apparatus. The transmitter is simply a rotating disc with three spiral sets of holes arranged around its periphery, each set of holes being covered with a different light filter, one set passing red rays, the second passing blue, and a third green. This disc rotates in front of a powerful lamp, so that pencils of red, green, and blue light sweep across the object being transmitted. These rays of light are reflected back from the object on to a photo-electric cell.

The cell sends out electrical impulses which are transmitted to the receiving station, where they control the light of two glow-discharge lamps, one of which gives blue and green light and the other red. In front of the lamps a disc identical with the disc at the transmitting station revolves exactly in step with it, and the observer watching this revolving disc has presented to his eye first a red image, then a green image, and then a blue image, with such rapidity that the persistence of vision makes the three images blend into a single coloured image. From the three primary colours every colour can be produced, so that the process is capable of reproducing any colouration.

Stereoscopic Effect.

The other section of the demonstration was less spectacular, but represented also a decided advance. It exhibited a method of transmitting, by television, images in stereoscopic relief. The principle consists of sending two images in succession, first image as seen by the right eye, and then an image as seen by the left eye. These images appear in rapid succession side by side on a receiving screen, where they are viewed through a prismatic viewing device which combines them into one, and on the well-known stereoscopic principle show a single image, standing out in relief, with the appearance not of a flat picture, but of an actual solid object.

"Looking Ahead" (concluded).

us, but it seems as if this little personal pleasure for you and me is to be reserved for people like us in America.

Necessity of Experience.

The second factor that helps in the development of science is imagination, and this again is a purely personal ability that varies in different people, but it is rather different from experience. Experiences can be added together and the total is a plain addition, but two imaginations brought together react on one another and increase individually as well as collectively. It is a kind of multiplication rather than addition, and is sometimes extraordinarily productive of results. It is not an entirely foolish thing sometimes to discard may be an accepted principle, and say, for example, "Can't I get a television image without using a neon lamp or any other kind of lamp?" "Why must I explore the object for transmitting an image?" I have no answers ready, but promise myself an interesting day-dream on these two questions. Quite probably I shall arrive at quite negative results, but I fully expect to get something useful, even if it is only a new point of view. Try it.

Photo-Electric Fatigue

By H. WOLFSON

The photo-electric effect, first discovered by Hertz, has a bearing on television which is of such vital importance that the study of it warrants the serious attention of all experimenters. Mechanical engineers are now becoming familiar with the principles underlying the fatigue of metals in a mechanical sense. This month our well-known contributor devotes this article to an exposition of the phenomenon of fatigue, in an electrical sense, as applied to metals which exhibit photo-electric characteristics.

ONE of the most important problems in the designing of photo-electric cells is the elimination of what is known as the "fatigue" to which all early types of photo-electric cells were subject.

Photo-electric fatigue manifests itself by a falling-off in the current generated by the cell after it has been in use for a short period. The phenomenon of fatigue is one which has engaged the attentions of a large number of investigators, and we can now consider ourselves in a position to make definite statements as to its nature and cure.

Since the fatigue effect is a cumulative one, it becomes at once apparent that any cell suffering from this defect will become useless in course of time, this time depending on the type of cell and the conditions obtaining in each particular case. This would, of course, make it impossible to employ the cell in a television transmitter with any degree of success, so that in this article I shall endeavour to explain to the readers of TELEVISION the underlying principles of photo-electric fatigue in a manner as simple as the subject will allow.

The first observation of the fatigue effect was due to Hertz, who found that while the photo-electric effect was shown by the freshly polished brass terminals of his spark coil, the effect was either considerably diminished, or entirely absent, when the terminals were tarnished.

This result was confirmed by Hallwachs in his first paper on photo-electricity, which appeared only one year after the discovery by Hertz of the existence of currents generated by the action of light. In this paper he states that the "ageing" of the surface is accelerated by the influence of the illumination, while later work showed that old metallic surfaces no longer show that activity which they exhibited when freshly polished. He states quite definitely that this decrease in activity or fatigue is not due, in the case of copper at any rate, to either the oxidation of the surface or to the presence of water vapour.

Cause of Fatigue.

Since the foregoing results have been amply substantiated by numerous other workers in the field, I shall, after a brief description of the apparatus employed, discuss the problem in the light of the following four questions :—

(*a*) Is light the primary cause of the fatigue?

(*b*) Is the rate of fatigue influenced by the electrical condition of the cell?

(*c*) Does the fatigue take place in gases other than air or in a vacuum?

(*d*) Has the size of the containing vessel any influence on the effect?

The vessel in which a large number of experiments were carried out by H. S. Allen is illustrated in Fig. 1. It consists essentially of a cylindrical brass box with brass end-plates screwed on. One end is provided with a window of clear quartz, marked Q in the figure, in contact with which is placed a piece of metal gauze, which makes an electric connection with the brass case.

Through an insulating bush of ebonite (E) in the opposite end passes the central electrode (A), to which we can attach a plate of any desired metal which we have under review. The apparatus is completed by mercury cups attached to the case and the central electrode, marked D_1 and D_2 in the figure. A lever serves to connect or disconnect these two cups, thus making it possible to have electrical connection at will between the central electrode, the case, and the gauze screen.

Let us now place on the central electrode a plate of freshly-polished zinc, and illuminate it by light from a mercury vapour lamp, which enters the vessel through the quartz window. In passing, I might mention that the purpose of the quartz is to allow to pass through into the vessel light of all frequencies, from ultra-violet to infra-red, inclusive.

On receiving the light energy the zinc will acquire a positive potential due to the emission of particles of negative electricity, which we call photo-electric electrons, and it is a simple matter to measure this potential on an electroscope or quadrant electrometer. Since it is not essential that we know the actual value of the current in micro-amperes, it will suffice to obtain a comparative value only from the scale reading of the electroscope, assuming, of course, that our instrument has an even scale, that is, a deflection of one millimetre at any part of the scale always corresponds to the same increase in value of the current.

The procedure now is to measure the relative value of the photo-electric current at regular intervals of time; these intervals can conveniently be minutes, as it will be found that the fatigue proceeds with sufficient rapidity to cut down the value of the current to about one-third its original value in 16 minutes.

Discussing first the influence of light on the rate of fatigue, it is important to note that Allen has shown quite definitely that the rate at which the current falls off is exactly the same whether X-rays are present in the exciting light or not.

Buisson Experiments.

Experiments made by Buisson led him to the conclusion that the surface of the metal was in some way modified under the influence of the light. He states that the rapidity of diminution of the photo-electric current depends on the richness of the light in ultra-violet rays. He is also of the opinion that the decrease is sensitiveness is not essentially due to an alteration by oxidation, which might be produced by the air, but he thinks that it is light alone which is the active agent. In the work of Schweidler, also, the fatigue was thought to be due to ultra-violet light.

The first worker to question the correctness of the supposition that light was the primary cause of the fatigue was Hallwachs, who pointed out that it was necessary to keep the size of the testing vessel constant if comparable results were to be obtained. Experiments carried out with two similar zinc plates in sunlight and complete darkness showed no difference in the rate of fatigue.

In sunlight (% fatigue)	40	78	88	93
In darkness (% fatigue)	44	81	88	94
Time in minutes ..	6	24	52	135

Hallwachs was also unable to find a recovery of activity which other workers had claimed to be brought about by keeping the plate in darkness. Ultra-violet light, while not the direct cause of the fatigue, may be a secondary cause, since under certain conditions ozone may be formed by its agency, and it has been found that ozone is capable of reducing photo-electric activity.

The results of Hallwachs were, however, disputed by a number of other workers, and it is to the English worker, H. S. Allen, that we are indebted for the thorough investigation which settled the controversy. The following experiment gives a general idea of the nature of the work which was carried out.

A zinc plate was polished with emery and rouge and then exposed

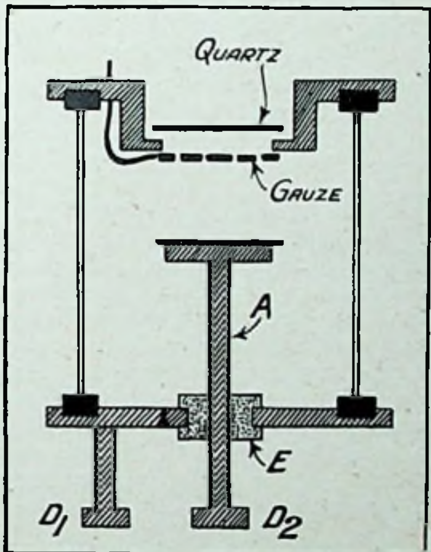


Fig. 1.
Apparatus designed by Allen for conducting experiments on photo-electric fatigue.

to ultra-violet light for a period of 16 minutes, and the fall in activity noted. On repolishing, the plate was again exposed to ultra-violet light, this time for only a small part of the total time of 16 minutes. For the remainder of this period the plate was allowed to stand in total darkness. The decrease in activity was again measured.

Ultra Violet Ray Cause Refuted.

Both experiments were repeated a number of times, and the average of each set of results was taken as the correct value. In each case the activity was found to have decreased from 100 per cent. to 45 per cent. This result then completely refutes the idea that ultra-violet light is instrumental in bringing about fatigue, and we must therefore look elsewhere for an explanation of the phenomenon.

The second question is more easily disposed of, for by a series of simple experiments incontrovertible results have been obtained which prove that the electric condition of the plate has no influence on the rate of diminution of photo-electric activity. A general idea of the type of experiments can be conveyed in a few words.

If we carry out measurements of the activity of the plate in the apparatus shown in Fig. 1, and charge the gauze screen first positively and then negatively, no difference in the rate of fatigue can be detected. Similarly, it is immaterial whether the plate under observation is surrounded by a brass case, or whether it is unshielded by a metal case, being simply enclosed in a glass vessel containing air.

Whenever one obtains a series of results in the form of a table of figures, and it has been impossible to decide the true conditions under which the experiments have been carried out, there inevitably arises a doubt as to the correct manner in which the results are to be interpreted. Other factors are constantly cropping up of which the worker is totally unaware, which falsify his conclusions, and it may be some considerable time before the mistake is discovered, often more by accident than by design, by further experiments along similar lines.

Discordant Theories.

So with the subject of photo-electricity we find many discordant theories, and carefully reasoned conclusions have often to be abandoned in the face of more recent research. Thus the need for a careful sifting of the results relevant to the third question on our list is important.

Early workers wrongly ascribed fatigue to oxidation effects produced by the oxygen of the air. Though certain people found no fatigue in the presence of hydrogen, Hallwachs, Ullmann, and Allen have all shown that fatigue does take place under these conditions. In the experiments of Hallwachs it was found that while the fatigue of copper was less rapid in hydrogen than in air, that of platinum was slightly more rapid in hydrogen.

In the experiments performed by Allen, with the metals aluminium, copper and zinc, the metal plate was first polished with emery and rouge paper and at once placed in the testing vessel. The air was displaced

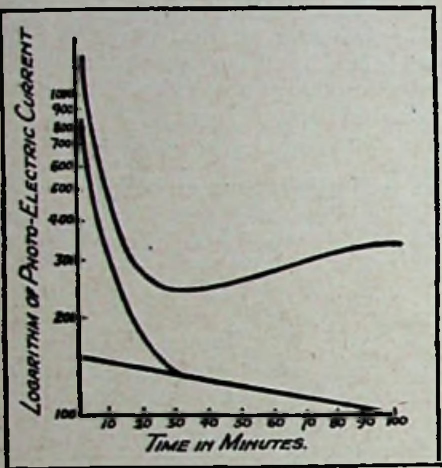


Fig. 2.
Showing rate of decrease in sensitivity for different metals.

by a current of hydrogen, and measurements of the activity taken a few minutes after polishing. No difference from the results in air was detected, though it is improbable that the gas was entirely free from water-vapour, or that the air film on the surface of the plate was immediately replaced by a layer of hydrogen.

Chlorine and ozone, in the presence of water vapour, had a marked effect on the rate of fatigue. With moist ozone the value of the photo-electric current fell to half its value in one minute, whereas in dry ozone the time required for this decrease was 15 minutes. This has been thought to be due to the formation on the metal surface of hydrogen peroxide, synthesized by means of a photo-chemical reaction from ozone and water under the action of ultra-violet light, since it has been shown that hydrogen peroxide has an enormous absorption for ultra-violet light, and thus a very thin surface film would suffice to reduce very considerably the intensity of the exciting light.

Air *v.* Vacuum.

Having so far discussed possible explanations which have proved to be only blind alleys, we are in a position to consider the effect of the size of the vessel on the photo-electric effect. While working with a silver plate Allen found that the activity remained unaltered even after two hours' exposure to ultra-violet light. This result was obtained with air in the vessel as well as when the vessel was evacuated. The same plate when tested later in the air of the room showed a fatigue, the activity falling by 50 per cent. in two hours. The explanation of this disparity of results is due apparently to the effect of the size of the containing vessel.

Highly-polished copper plates were placed in a cell and their activity determined in the usual manner. They were then removed from the vessel and placed in receptacles of various sizes, from which they were taken periodically and their activities determined by transferring them to the vessel shown in Fig. 1.

Loss in Open Air.

Plates lying in the open air lost 50 per cent. of their initial activity in one and a half hours, while those in the laboratory required three hours for the same percentage loss. When the plate in a vessel of half a cubic metre was tested it was found that its half value period was 22 hours, while for the plate in a one-litre flask a period of from 8 to 20 days was required before the activity suffered a 50 per cent. decrease.

In Ullmann's experiments vessels of capacity one litre, 600 litres, and a room of volume 9,400 litres were employed. If we assume the original activity to be 100 per cent., then the percentage fatigue noted for these three vessels, tested over the same period of time, amounted to 27·4 per cent., 32·8 per cent., and 40·5 per cent., respectively.

Size of Containing Vessel.

Thus we see now quite clearly an instance of a factor, hitherto unknown, which has been the cause of so many varied results in earlier experiments. Exactly why the size of the vessel should be the ruling factor in causing photo-electric fatigue I shall discuss a little later, after I have treated the subject of fatigue in a vacuum, which I purposely omitted to deal with when answering question (*c*), since most modern photo-electric cells are either highly evacuated or else filled with a gas such as helium.

In recent years the technique of obtaining a high vacuum has attained a high order of perfection, and many doubtful results dealing with fatigue in a high vacuum have been completely revised.

Lenard was responsible for a series of exact measurements of fatigue in a very high vacuum. He placed a freshly cleaned and polished aluminium plate in the apparatus to be evacuated, and commenced observations of the activity about one hour after the plate had been polished. For the first 45 minutes of his observations bubbles of gas were still being removed from the apparatus, and there was a steady diminution in the value of the photo-electric current over this period. A vacuum as nearly complete as possible having now been attained (i.e., without having recourse to methods other than pumping), it was found that the activity did not change further over a period of ten days.

Experiments with Lampblack.

Some interesting results were obtained with a freshly-deposited surface of lampblack. There was first a rapid decay of activity during the first day, which gradually became very slow, and extended over a

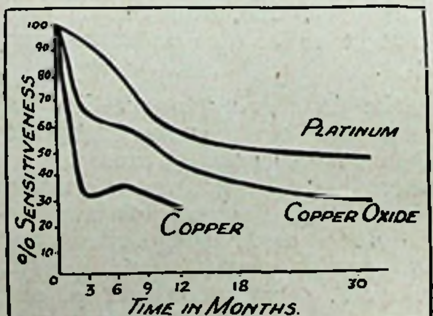


Fig. 3.
The rate of decrease in sensitivity of various metals over a period of months.

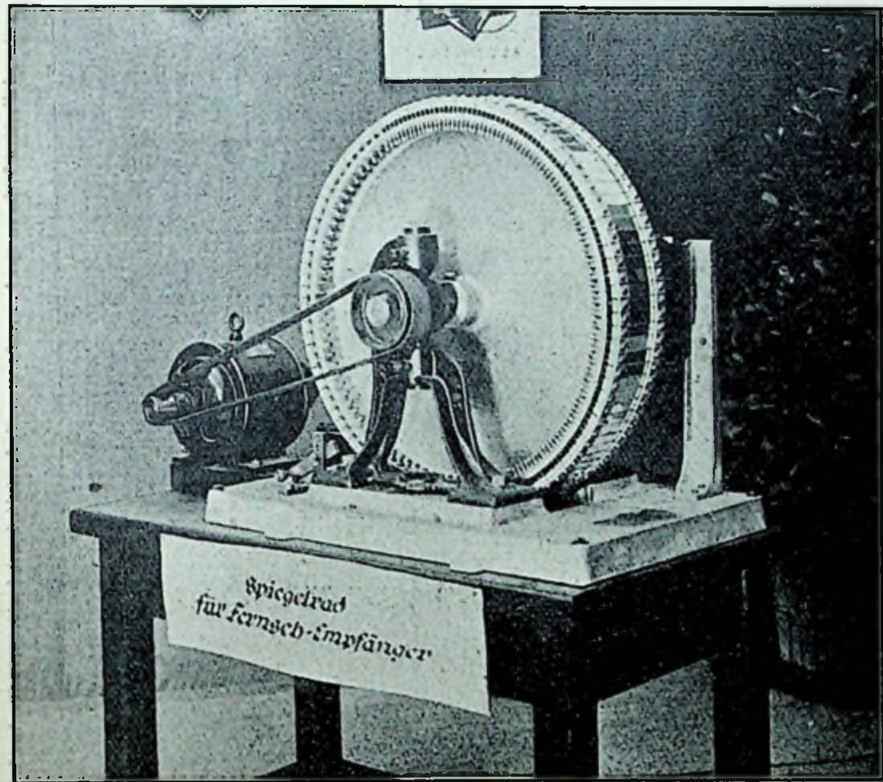
period of many months, when the activity had fallen to one-seventh of its initial value. On admitting air and then re-exhausting the original activity returned. When the lampblack surface was finally examined an image of the gauze appeared on its

(*Continued on page 37.*)

The Karolus System of Television

By DR. ALBERT NEUBERGER

Last month we described the latest advance made by the American television experimenter, C. Francis Jenkins. This month we have great pleasure in introducing to our readers Dr. Albert Neuberger, the well-known German scientific writer, who describes in detail, exclusively for "Television," the latest television apparatus—the product of Prof. Karolus of Leipzig and the Telefunken Wireless Co.—which was exhibited at the Berlin Wireless Exhibition recently.



The Weiller Polyhedral Mirror Projection Drum used by Karolus.

AT the Wireless Exhibition now being held in Berlin the televisor developed by Dr. Karolus, Professor at Leipzig University, in connection with the Telefunken Wireless Telegraph Company, is exciting no common attention. This is the outcome of Dr. Karolus's picture telegraph system, and uses a number of technical details which the operation of that apparatus is based upon. In fact, this televisor may be said to be the ultimate stage in the development of picture telegraphy.

That television would be an accomplished fact when a scheme had been evolved for scanning as rapidly as possible the various luminous shadings of a picture and, after transmitting them to a distance, recombining them in such a way as to produce for the eye a continuous impression, has, of course, been suggested in many previous cases. This, however, would be the case whenever, in accordance with present theories, a minimum of ten luminous stimulations per second would strike the retina of the eye. According to other researches, even eight per second would be sufficient. Nay, it has lately been found that a continuous impression would still be produced if only five stimulations per second were striking the retina, the inertia of the eye merging them even then into one continuous total impression.

At the Radio Show, where the Karolus televisor for the first time is being placed before the public eye, there are separate exhibits of the transmitter and receiver respectively. Moreover, provision has been made for the picture to appear in a separate darkened cabin, comprising on the wall a screen of 75 square centimetres. The picture, enlarged by optical means, appears there with a satisfactory luminous intensity. The enlargement can, however, be driven even further, being increased to an area of one square metre and even more. This is how pictures can be made accessible to a certain number of persons at a time, though, of course, the receiver may as well be designed for the direct observation of a smaller non-enlarged picture on a plate of frosted glass or a screen.

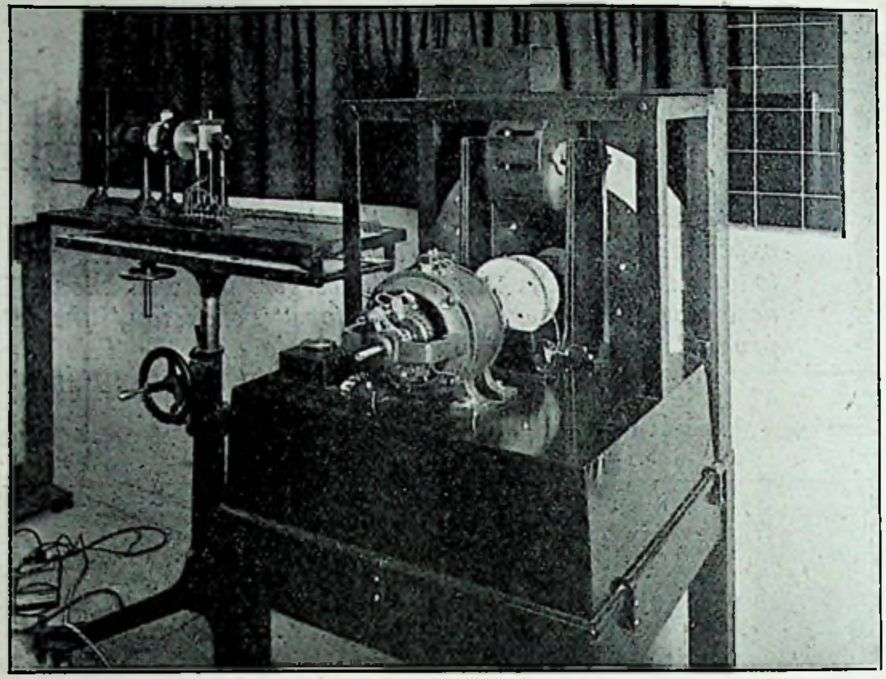
Maximum Picture Elements.

The main thing in connection with any long-distance transmission of moving scenes or pictures is that as many picture elements as possible should be transmitted per second. A maximum of, say, 2,500 picture elements has already been obtained in previous cases, particularly by the use of neon glow lamps, which, however, on account of the coarse subdivision, may be said to be insufficient, especially in connection with enlarged reproductions. The Karolus process enables a picture to be decomposed into as many as 10,000 elements and allows even this figure to be exceeded.

If a transmission is made at a

sufficient rate of speed—pictures can be scanned ten times per second or even more by means of a beam of light—the resulting reproduction will show a wealth of details and embrace a sufficient field of view, enabling, for instance, whole faces to be transmitted. An additional advantage is that pictures can be reproduced on the frosted glass in fairly large dimensions. In fact, in the case of the Karolus-Telefunken system, their size is 10 by 10 centimetres, while admitting, in accordance with the above, of an enlargement to 75 by 75 centimetres, without having too coarse a subdivision.

What is being shown at the Radio Exhibition are mainly diapositives, *i.e.*, translucid photographs. The Karolus apparatus is as well suited for the transmission of cinema pictures, thus realising the idea of a "tele-cinema." When a film is to be transmitted by the Karolus televisor, it is sent continually through the apparatus, in the place of intermittent projection, according to the general practice in connection with cinema films.



The complete Karolus Receiver.

Decomposing the Picture.

The various pictures of a cinema film—or, in fact, any other pictures—are scanned by a long and narrow beam of light, the width of which has been so designed as to correspond to one-hundredth of the width of the picture. The beam of light is produced by a strong lamp combined with a suitable optical system, thus decomposing each picture into a hundred parallel bands. A further subdivision is effected by means of a rotating disc decomposing the band into picture points. The speed at which the scanning beam

One of Prof. Karolus's early Television outfits, showing the transmitter at the left and the receiver at the right. The Nipkow discs are in this case mounted on the same shaft for the sake of simplicity.

is sweeping the picture bears a certain ratio to the number of revolutions of the disc. The disc, however, is not designed according to the Nipkow scheme, with spiral perforations, but comprises at its circumference a number of radial slots. This combination of disc and scanning beam produces the various picture elements.

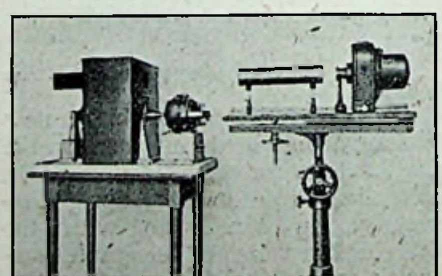
The beam of light is produced by first concentrating the light of a sufficiently intense lamp in a single parallel band. The various parallel beams then pass through a cylindrical lens, by which they are compressed into wedges, passing through a diaphragm by which they are given their proper width. The picture passes by a beam of light at a certain rate of speed, and while it is advancing one-hundredth of its width, the disc will rotate at a speed corresponding to the width of two of its radial slots.

This is how the various picture elements are produced. The shadings of these picture elements are converted into electric current impulses by a special photo-electric cell developed by Karolus. This is so designed as to work without any inertia.

Transmission of Signals.

Luminous shadings having now been converted into current fluctuations, these can be transmitted to a distance either through lines of conductors or by wireless. In the latter case, the waves emitted from a transmitter are modulated in proportion, short waves being, in the opinion of wireless experts, particularly suited for the purpose of television.

The receiver, according to the Karolus-Telefunken system, is based on the use of a Kerr cell properly modified by Karolus. This has given excellent results in connection with picture telegraphy, and has also been found suitable for the television receiver. In the latter case it should be combined with a device by means of which the shadings reproduced by the Kerr cell can be recombined to a continuous picture. In fact, the following sequence of operations will be obtained at the receiving end: Arrival of modulated electric vibrations, audion effect, *i.e.*, conversion of these vibrations



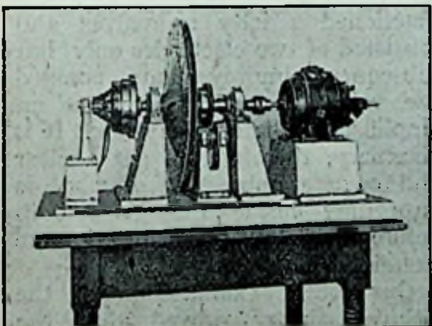
Prof. Karolus's Television Apparatus: The receiving apparatus with the scanner, arc lamp and Kerr cell.

into low-frequency electric currents, and, finally, reconversion of these vibrations, corresponding to the luminous shadings of the original, into fluctuations of light, which are eventually recombined to form a picture.

Nothing need be said of the actual reception and audion effect. The low-frequency vibrations produced by the apparatus will, after proper amplification, be allowed to act upon the Kerr cell. The latter is based on what is termed the Kerr effect. When causing a beam of light to pass through two Nicol prisms arranged in a given situation with regard to one another, it will be extinguished completely. Now, the Kerr cell, which is inserted between these two prisms, is nothing else but an electric condenser, *i.e.*, a device absorbing electric charges. Like any other such condenser, it is made up of two conductors of electricity, separated by a non-conductor.

The Kerr Cell.

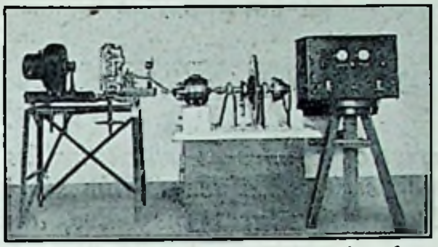
The two conductors are metal plates, while the non-conductor is a liquid. The cell used by Karolus is a narrow glass vessel filled with liquid nitro-benzol, into which one metal plate is inserted from above and one from underneath. As electric tensions are applied to the metal plates, the beam of light which, in accordance with the above, has been darkened by the mutual position of the prisms, will be lighted according to these tensions. The currents coming from the receiver have only to be supplied to the condenser in order to have the beam of light brightened more or less, according to the variable tensions. The higher the electric tension between the two condenser plates, the brighter is the light beam bound to become. In fact, its luminous intensity will adapt itself most readily to any change of condenser tension, the whole cell working with practically no inertia.



Professor Karolus's Television Apparatus, comprising the scanning disc with radial slots of identical design for the transmitter and receiver respectively, with driving motor and synchronising motor.

Current fluctuations have now been converted into fluctuations of light and, what is the main thing, without any inertia or lag. An arc lamp serves to generate the beam of light, which by a system of lenses gives it its proper shape.

The next task will be to recombine the luminous impressions at the same speed as used in connection with the scanning device. A Weiller mirror wheel is used to this effect. This resembles a narrow drum, the edge of which is fitted with mirrors. As many as a hundred mirrors have been arranged on the edge of the wheel, in a proper position corresponding to accurate mathematical calculations, thus combining the reflected luminous impressions into bands, placed closely beside one another, though being slightly inclined. A disc resembling the one used in the transmitter can as well be used. When using this, the same type of picture decomposer is employed in the transmitter and receiver respectively.



Professor Karolus's Tele-Cinema Outfit at the transmitting end. This is merely a combination of the Televisor with a film projector. The picture shows from left to right: Arc Lamp, Film Feeder, Synchronised Scanner and Amplifier (fitted into a protective casing).

A uniformly luminous surface, free from any *striæ*, is produced on the frosted glass or, in the case of an optical enlargement, on the projection screen. The mirror wheel should, of course, be properly synchronised with the disc used at the transmitting end. This is obtained by a special method in a perfectly satisfactory manner. Moreover, the mirror wheel, in order to insure a uniformly lighted surface, should rotate at a given rate of speed. If it should be rotating more slowly, there would be parallel *striæ* on the surface. These positive connections are unavoidable and must be dealt with both by mathematical calculation and in actual practice.

The inventor has succeeded in solving this task in a splendid manner. As objects of any kind, either diapositives or compact objects, are introduced into the transmitter, they can be seen with their actual movements on the projection screen.

(*Continued from page* 34.)

surface. This suggests some alteration in the chemical or physical nature of the carbon itself.

Elster and Geitel found no fatigue in cells of potassium and sodium containing either hydrogen at very low pressure or else a high vacuum. Other workers on the whole confirm the absence of fatigue in the case of the alkali metals, though Dember found a slight fatigue in cells containing hydrogen, which might be attributed to a change of gas pressure within the cell, since as mentioned in a previous article there is an optimum pressure, called the critical pressure, at which the photo-electric current is a maximum. Cells containing a colloidal modification of potassium show a remarkable constancy, though cells made on the gas-free principle are claimed to be free from either fatigue or time lag.

Before drawing my article to a close, a short mention of the time of photo-electric fatigue from a mathematical point of view may prove of interest to my readers.

Rate of Fatigue.

H. S. Allen found in the case of zinc and aluminium that the rate of fatigue at any time after polishing the plate could be found by applying an equation containing two exponential terms, as follows:—

$I=K_1e^{-\lambda_1 t}+K_2e^{-\lambda_2 t}$, where K_1 and K_2 are of the same order of magnitude, and λ_1 is about ten times λ_2.

These two terms can be explained if we assume that a freshly-polished plate of metal X gives out negative ions under the influence of ultra-violet light and changes to a form represented by Y. Under the same conditions this also gives rise to negative ions, and changes to a form Z, which is supposed to be inactive. The change may, of course, be either physical or chemical. Thus in the equation the first term is represented by Y and the second by Z.

The chief conclusions drawn are five in number, the first supposing the fatigue to be due to oxidation, which I have already shown to be untenable. Since the fatigue depends on the size of the vessel, but is not directly due to light, we can definitely dispose of the next two theories,

(*Continued on page* 40.)

Bridging Space
(Part IV)

By JOHN WISEMAN

This is the fourth of a series of articles in which the fundamental principles of electricity and wireless are being explained in the simplest possible language. This month our contributor introduces the valve, and explains briefly and in simple language just what it is and how it works.

SO far in this series we have progressed to the stage where a clear mental picture can be drawn of electro-magnetic waves being propagated into space from a transmitting aerial, the resultant transference of energy from this aerial to an unlimited number of receiving stations being effected without any tangible connecting medium.

The thoughtful reader will at once be inclined to ask the question: "How can these waves which are sent out from one position be instrumental in serving any number of receiving stations?" The answer is simple if it is borne in mind that our waves move out like travelling circles with the transmitting station as the centre, in just the same way as you can see ripples in a pond spreading out from the point where a stone has been thrown in.

This is where the type of transmission just described differs from the so-called "beam wireless," where efforts are made to concentrate the waves in a narrow beam, and enable them to be focussed on one definite receiving station and not run in every direction. To attempt anything of a beam nature with television transmissions would mean that only a few people, relatively speaking, could then "see in" to the broadcast television service, and in consequence this method is not adopted.

Introducing the Valve.

The next detail that calls for explanation is the system adopted for feeding energy into the transmitting aerial so that it can be transferred into waves in space, and here we make our formal acquaintance with the thermionic valve. The advent of the valve many years ago altered the whole aspect of wireless transmission and reception, and even now we are unable to appreciate the full significance of this epoch-making discovery, due in the first instance to the foresight and genius of Dr. J. A. Fleming.

Before proceeding further, therefore, it is essential to master the *modus operandi* of this wonderful, yet after all extremely simple, piece of apparatus, for its principles and applications manifest themselves in directions other than television and wireless. For this reason alone the valve is of fundamental importance and deserves the fullest attention of all who come in personal contact with its benefits.

From the point of view of appearance the present-day valve gives little indication of its functions. As one of the accompanying photographs shows, we have a shaped glass bulb at one end of which is a cap of insulating material holding four metal pins.

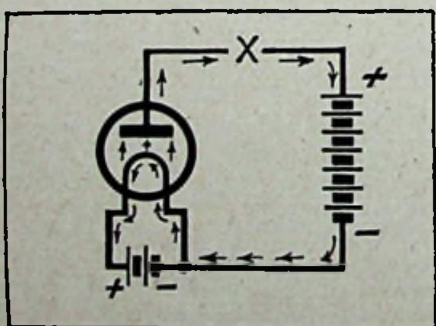


Fig. 1.
A simple diagrammatic explanation of how electrons flow in a Fleming valve circuit.

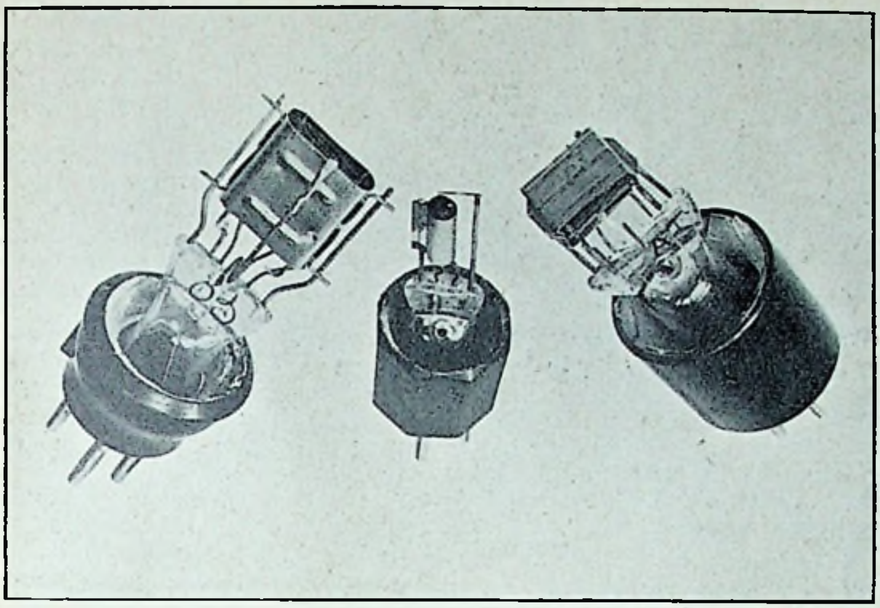
Owing to a certain process in manufacture, as we shall learn later, the inside of the bulb presents a silvered appearance and this, as a rule, hides the internal construction. Another of the accompanying illustrations is therefore of interest, since it shows exactly the formation of the "electrodes" with different types of valves, the glass bulbs having been removed.

A Possible Misunderstanding.

Now we know that the term "valve" is applied in other directions as being simply a cover to an aperture which opens in one direction and not in the other, and consequently people are sometimes led astray by the use of this word for the piece of apparatus under discussion. The first valves functioned strictly as valves and consisted of two electrodes only, but subsequent improvements enabled the valve to be employed as an amplifier, oscillator, relay, etc. It is necessary, therefore, to get a clear and concise impression of what is happening inside the glass bulb before any details of construction are examined.

Our recent examination of the electron theory proved that the electron is the indivisible unit of electricity and is negative in character. Consequently, if an atom of matter contains an excess of electrons it is negatively charged, while a deficit constitutes a state of positive charge.

In Part I of this series we saw that in any conducting material, such as a length of wire, there occurs a constant interchange of electrons between neighbouring atoms, and hence we have numerous relatively unattached



Illustrating typical variations in the form and arrangement of the internal electrodes of modern valves.

electrons moving to and fro in all directions within the body. Owing to their electrical character we can, of course, realise that these so-called "free electrons" will be guided in their paths when placed under the influence of an electric field. Thus a flow of current, that is, a steady drift of electrons, is brought about when a difference of potential is maintained across the ends of a conducting body.

Evaporating Electrons.

Under normal circumstances, either when a current is flowing or not, none of these energetic free electrons escape across the bounding surface between the conductor and its surrounding medium—say, the atmosphere or a vacuum. The situation is changed, however, when the temperature of the body is raised. The heat produces a more violent electron movement, and with a progressive rise in temperature the electrons near the surface acquire such a high velocity that they overcome their internal atomic attractions and leave the surface of the body. This is analagous to the evaporation of water exposed to the air.

If we can by any means capture these "boiled off" electrons we are then able to cause a current flow actually distinct from that flowing *in* a wire. The method adopted for imparting the heat is really immaterial, but for convenience we take advantage of the resultant heat developed in a filament when a current of electricity is forced through it. Here then we have the nucleus of our valve. If we take a filament together with a metal "plate" and seal them inside an evacuated glass bulb, then by means of an external battery we can heat this filament and cause the electrons to be boiled off from the surface.

A Thermionic Current.

Now, to capture these electrons it is necessary to impart a positive potential to the plate, and owing to their negative character the electrons will be attracted to this plate; and provided there is a complete electrical circuit between plate and filament these electrons will flow back from the plate to the filament.

The simplest way to make the plate positive is to use an ordinary battery, and with this arrangement we have the circuit represented in schematic form by Fig. 1. If the plate is kept at a higher potential than the filament a flow of current, as indicated by the arrow heads, will take place and can actually be measured with a suitable instrument placed at the point *X*.

On the other hand, if the plate is given a potential which is negative with respect to the filament, the evaporated electrons will be repelled and no current flow will take place. Naturally, the greater the difference of potential between plate and filament the greater the current flowing in this circuit, and if we plot a curve between plate current and plate voltage it will resemble that of Fig. 2, and this, for fairly obvious reasons, is known as the ***characteristic curve*** of the valve.

"A Traffic Controller."

Our simple valve then acts by allowing electric currents through when they are travelling one way (plate to filament, *outside* valve), but stops them when they want to go back. In this form the plate can be looked upon as acting in the same manner as a policeman traffic controller. When his arm is out (negative plate potential) no traffic can get past (no current flow), but as soon as "the arm of the law" is lowered (positive plate potential) traffic passes on in the usual manner (electron current flow). This unilateral conductivity between hot and cold electrodes was applied in the early days of wireless to enable wireless signals to be rectified or detected, and as a detector the valve was a marked improvement over the rectifiers in use prior to the date of its introduction.

Although the wire filament is brought out at both ends to enable the heating current to be applied, so far as the thermionic current is concerned the whole filament acts as one electrode, technically called the *cathode*, the metal plate constituting the second electrode, which

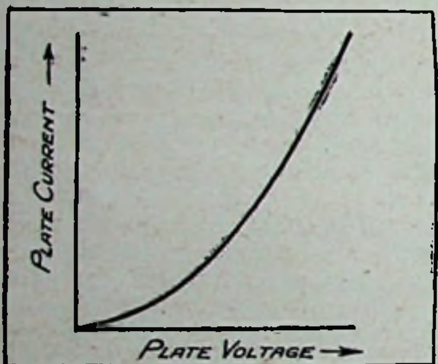


Fig. 2.
A typical characteristic curve of a valve.

in turn is known technically as the *anode*.

The introduction of a third electrode (the *grid*) by Lee de Forest marked a radical change in the applications of the valve. The grid become the control or regulating electrode, and the valve's normal function of rectifying became more efficient in character; but perhaps more important still, it was discovered that under certain conditions the valve was capable of amplifying, and could also be instrumental in producing or maintaining a continuous electrical oscillation.

The Space Charge.

Let us see how this is brought about. We have found that the electrons emitted from the filament surface can be urged across the vacuum to the plate by the existence of an electric field in the direction plate-to-filament. In the absence of this attraction the emitted electrons congregate in a cloud formation close to the filament. The space around the filament, in consequence, acquires a charge of negative electricity, and this forces back into the filament the electrons subsequently evaporated from the surface. It is only when this space charge is removed that the stream of electrons leaving the filament can continue to exceed the return stream of electrons thrust back by the space charge.

We have an analagous case when we consider that on a windy day the pools of water in a road dry up very quickly. This is simply because the water vapour given off by the pool is swept away by the wind as fast as it makes its appearance, whereas under calmer conditions the vapour merely remains on the surface of the liquid and prevents further evaporation.

In our valve, therefore, the actual thermionic current depends really upon the vigour with which the electrons are swept away from the filament. A stage is reached, however, where the electrons are removed as fast as they are evaporated, and this is called the *saturation current*. Further increases in anode potential will not cause a rise in the value of the plate current.

A Controlling Effect.

Having noted the effect of the space charge, in what way does the addition of a grid positioned between plate and filament bring about a change? According to the mesh size of the grid and its relative distance from the filament as compared to the anode, so we shall have different influences. In any case, since the grid is always closer to the filament than the plate, the application of a given positive potential to this electrode will influence the stream of electrons to a greater extent than if the same potential were applied to the plate. Furthermore, by giving this grid a high negative potential it is possible to completely overcome the attraction of the positive potential on the plate.

Thinking in this way, it is easy to picture how the grid with its applied voltage provides an excellent control over the thermionic current and becomes a really potent force. Next month we shall be able to examine the grid influence in so far as it enables the valve and its associated apparatus to act as a generator of continuous oscillations.

(*Concluded from page* 37.)

which assume photo-electric fatigue to be the result of a physical change in the surface, such as roughening, or, in the theory of Ramsay and Spencer, a disintegration of the metal due to exposure to light. Lenard thought he could explain fatigue on the assumption of an electric double layer, but experiment has shown this view to be erroneous.

Occluded Gas.

The explanation of photo-electric fatigue which is most in agreement with experimental facts is due to Hallwachs, who states that the main cause of photo-electric fatigue is to be found in the condition of the gaseous layer at the surface of the metal plate or film. I have already mentioned that ozone produces a rapid fatigue, and we observed that there was a probable formation of hydrogen peroxide, which has the power of absorbing ultra-violet light to a very great extent, and the presence of a very thin film is sufficient to cause a very rapid decrease in activity, or fatigue.

This last view is also supported by the following experiments. If we observe the photo-sensitiveness of platinum at room temperature, after it has been heated for some time to red heat, we find a value greater than normal, while after cooling the value of the current is less than normal. On Hallwachs' theory, in the first case heat removes part or all of the occluded gas, and the current is greater than the equilibrium value, while cooling causes the surface to adsorb more gas, thus lowering the activity, as we have seen to be the case.

Further Research Required.

Although there has been a vast amount of work performed on the subject of photo-electric fatigue, its nature is still somewhat obscure, since we have no direct evidence as to the way in which the various factors (such as the variations in quantity, and kinds, of adsorbed or occluded gases and vapours) act.

When, therefore, chemical research has explained thoroughly the adsorption of gases by metals, we shall be in a position to explain more concerning the emission and absorption of photo-electric electrons.

THE TELEVISION SOCIETY

Lecture arranged by the Council of the Television Society in conjunction with the Glasgow Educational Authority.

ADVANTAGE was taken by the Council of having Mr. J. L. Baird's apparatus in Glasgow, and through the kindness of Professor J. Gordon Gray, who kindly placed a large lecture room at our disposal, the opportunity was afforded of inviting some 250 senior scholars from the secondary schools of Glasgow to a lecture and demonstration. At 3 p.m. on Wednesday, September 12th, the scholars, accompanied by their masters, assembled in the large lecture theatre of the Natural Philosophy Department of the University. They were indeed a mighty throng of Scotch stalwarts, varying in age from 16–18 or more. There were also in the audience several of His Majesty's inspectors of schools and the Assistant Director of Education for Glasgow.

The proceedings were opened by Professor Gray, chairman, who introduced the lecturer, Mr. W. G. W. Mitchell, B.Sc., member of the Council of the Television Society.

Professor Gray told two amusing stories which had the effect of putting the youthful audience in good form for the lecture, a brief report of which follows:

The Problems of Television.

In television the aim is to extend the range of vision beyond human limits. By whatever means this may be accomplished there must be utilised an electric link to bridge the space between transmitter and receiver. The connecting link may be a wire channel or a modulated carrier wave, but an essentially important part of the system will be the electric eye, which transforms the light impulses into electrical impulses. We already have a kind of electric eye which we know as the photo-electric cell. It is not a complete eye in the sense that it could replace the human optical system, for at its best it can only replace one of the millions of tiny cells or light sensitive spots which acting together and simultaneously under the stimulus of light send nerve impulses from the retina to the brain, there to be registered in correct space relationship. In order to reach the brain, messages are flashed through each separate nerve fibre to the visual centres of the brain. This communication channel we call the optic nerve.

Mr. W. G. W. MITCHELL, B.Sc., Member of the Council of the Television Society.

A theoretically possible television system might be made by copying the human eye and adding an extensible optic nerve. The number of wires or other communication channels necessary in such a system, however, would be impracticably large. As an alternative we might take the two-dimensional view, break it down into individual elements of light and shade in the form of a definitely limited number of parallel strips, then spread these strips out in their proper sequence for transmission into a long ribbon of varying light, and finally recombine the strips side by side at the receiver. Such an arrangement necessitates but a single or, at the most, a definitely limited number of transmission channels. It is, in fact, the only known solution to this particular aspect of the subject, and is one of the reasons why television must always be much more difficult of achievement than the sister art of telephony.

Persistence of Vision.

The same artifice is used in sending pictures over a wire. Instead of attempting to transmit all the elementary light impressions simultaneously, we run over the elements of the picture in sequence. Such a process is technically known as "scanning" or "exploring," and it can conveniently be done by directing an intensely brilliant and rapidly moving spot of light to run over the view in a series of parallel strips.

But assuming that vision can be sent in this way, the final link in the whole scheme is the human eye itself, and fortunately for the success of television, the human eye has a time "lag." By this is meant that although the tiny cells are acting continuously and simultaneously in sending messages to the brain, a complete sensation of continuity of vision is obtained from otherwise discontinuous signals, provided these are flashed to the brain rapidly enough.

In the cinema we see a number of individual pictures projected on to the screen at the rate of about sixteen per second without any sensation of discontinuity in the moving scenes they portray, and due as we have seen to the particular arrangement of the optical system, which we call "persistence of vision." But the transmission of sixteen photographs per second would not give television. Even if it were possible to speed up the rate of sending photographs to this extent so as to utilise the time lag of the eye, we should have a cumbersome and costly cinematograph film record at both transmitter and receiver whose only usefulness would be that of a permanent record. Vision only lasts as long as the stimulus that produces it, and the same applies to television. It cannot have a permanent form.

We therefore arrive at the conclusion that, as a first step in the problems before us, we must translate the space variations in brightness of the view into time variations in electric current that can be sent over a single wire or channel, and that this method, or some slight modification of it, is the only practical one to adopt.

Converting Light Impulses into Electrical Impulses.

In the next stage we have to consider the conversion of the light impulses into electrical energy, and in this connection it is well to remember that the device we employ must be capable of handling *reflected* light, which is likely to be many thousand times less than that of the scanning beam itself. Suppose that the view being sent is divided by the exploring beam into fifty parallel strips. Then each strip throughout its length is divided into not more than fifty changes of brightness, giving 2,500 picture elements for transmission in one-sixteenth of a second, or 40,000 signals per second.

The time factor enters into all television problems. Here it demands that in the process of converting individual light impulses into electrical energy, there shall be a time lag not exceeding 1/40,000 second, in other words that the translation shall be practically instantaneous. The modern gas-filled photo-electric cell can meet this demand upon it by releasing a practically inertia-free beam of electrons from its photo-sensitive coating. The quantity of electrons released is also strictly proportional to the total quantity of light falling upon the cell.

These first two requirements, namely, proportionality of response and quickness of reaction, having been met, the electric eye must be sufficiently sensitive to be capable of delivering a signal response of manageable size. This latter requirement is one that is not easily obtained, and it may be considered one of the main difficulties of television.

Unlike the human eye, whose light-sensitive layer of visual purple is being continuously regenerated, the electrons released from the photo-active layer of a cell, even when a strong light is shone directly upon it, do not give an output current of more than 10^{-8} amps or round about 1/100 micro-amp. Remembering that the quantity of light falling on the cell is many thousand times less than a direct beam, it will be realised that amplification factors of the order 10^{12} to 10^{15} must be applied to the picture signal current before it can reach an energy level of, say, 4 milliamps, suitable for delivery to the transmission medium.

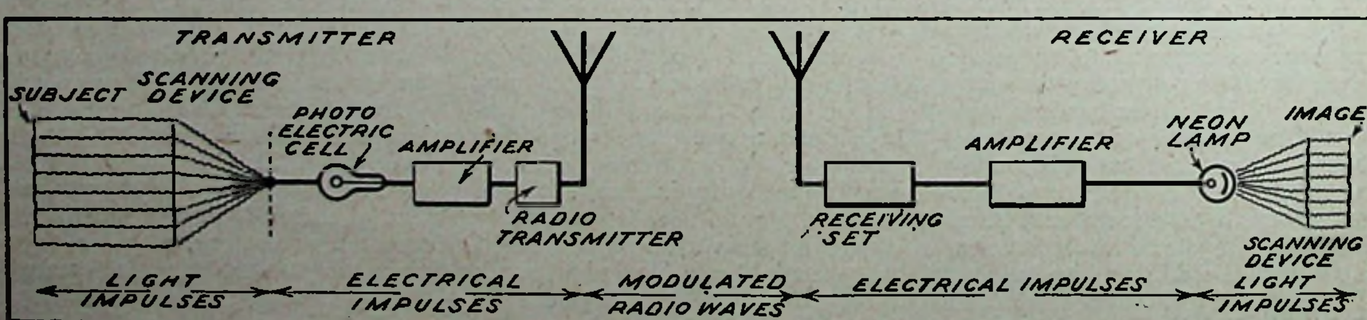
Amplification Problems.

When valve amplifiers are employed for this purpose to secure large amplification factors, the intrusion of parasitic noises, due to battery irregularities and the extraneous currents which are always present in metallic conductors, are among the causes operating to set a practical limit to the amplification obtainable. It is obvious that the initial energy level of the signal current must be considerable greater than the noises introduced by irregular emission of the valve filaments. Seeing that the current delivered by a photo-electric cell is strictly proportional to the incident light, two or more such cells can be arranged in parallel to collect this reflected light, but such an arrangement (involving as it does metallic leads) does not make the problem of amplification easier, in fact it rather adds to the difficulties.

Picture Elements.

Assuming that means can be developed for producing an electrical signal proportional to the reflecting power of the subject, sufficiently free from inertia to follow these rapid variations at the high speeds of signalling to be used, and of sufficient strength above extraneous noises as delivered from an amplifier, then the next problem is that of its transmission over an electrical communication channel.

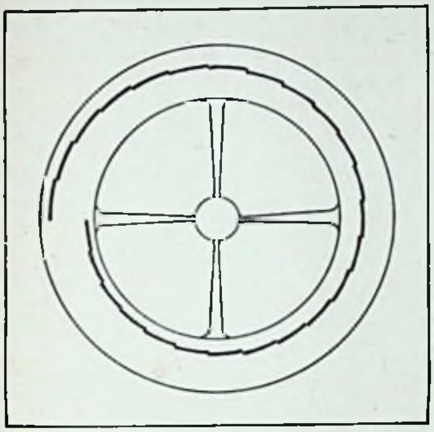
We have taken as standard a value of 2,500 picture elements to be sent over this channel in one-sixteenth of a second, or 40,000 elements per second. The frequency range necessary to transmit this number of signals without attenuation over the whole range cannot be calculated with confidence in advance, but from experience a band of approximately 20,000 cycles would appear adequate. Any attempt to increase the picture detail would entail a spreading out of the side bands when these are applied to a modulator. Wire circuits are not ordinarily designed for frequencies of this order, and, with radio systems, uniform transmission over wide signal bands becomes a matter of increasing difficulty. So in any case a practical limit is set up. The time factor being constant and the number of picture elements variable, we reach the conclusion that either a limit must be put on the picture detail or several



Pictorial representation of the various stages through which the transmission and reception of Television is effected.

channels must be used in the transmission.

Provided we have succeeded in securing a high quality undistorted signal at the receiver, we are now in



Form of disc used to cause spots of lights to trace out strips on the image.

the position to attempt the reconstruction of the image. This process involves the translation of the electrical signal back into a varying light signal, working synchronously with the changes occurring at the sending station. The conversion may be regarded as the converse problem of the photo-electric cell. The fifty strips forming the long ribbon of light has to be spread out over one square inch of surface, for which purpose a distributor conforming to the general design of the scanning device at the transmitter, and working synchronously with it, will be required. After amplification of the received picture current signal, a further reduction in brightness is bound to occur if it is attempted to spread this out over the whole screen in the same way as the object is scanned.

Essential Problems.

This loss can be largely eliminated by directly viewing a light source, such as a neon glow-discharge lamp, whose brightness is controlled by the picture current. The received image can then be built up by interposing between the light source and the eye of the observer a small aperture moving in synchronism with the scanning spot at the transmitter. The brightness of the discharge lamp being proportional to the current flowing through it, the observer (owing to the persistence of vision) thus experiences a sensation of brightness at any instant in correct register with that at the sending station.

In conclusion we may group the essentially main problems of television as outlined above under these headings :—

1. That of collecting light impressions from an extended object and of converting these signals into a continuous ribbon of electrical energy.

2. That of transmitting these electrical impulses to a distance either through a single channel or a very limited number of channels.

3. That of converting these electrical impulses back into light signals and spreading them out in their right sequence so as to recreate a living scene.

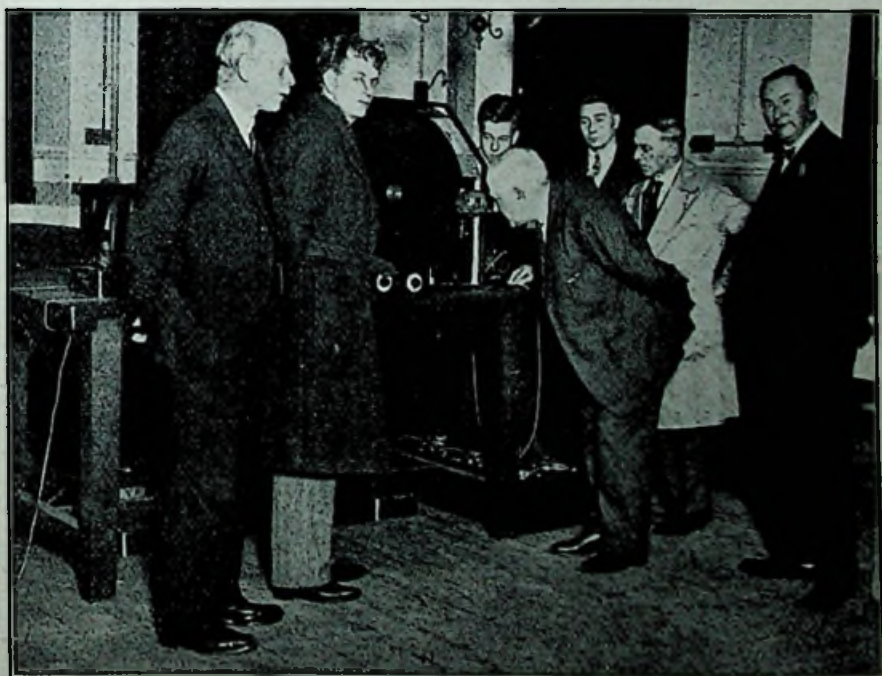
4. That of securing and maintaining synchronism between the transmitting and receiving mechanisms, i.e., they must at all times operate exactly in step with each other.

The main principles are easily understood and to some extent have already been solved ; it now becomes a matter of developing each to the requisite degree of accuracy, of speed and of sensitiveness, so that living scenes can be recreated at a distance with all their natural colour and without appreciable loss of detail.

A vote of thanks to Professor Gordon Gray for the use of the lecture room and to Mr. W. G. W. Mitchell for his lecture was proposed by the Assistant Director of Education for Glasgow, Mr. James Allardyce.

Professor Gray briefly responded, saying he hoped later to welcome some of those present as students, and this would therefore be their first introduction to the University lecture rooms.

Mr. Mitchell, who was loudly cheered (in Scottish fashion), thanked his audience for the wrapt attention they had given him, and remarked that this was a unique occasion. In all, perhaps 3,000 people had actually seen Mr. Baird's apparatus in one form or another, and of that 3,000 they were the first group of boys from schools to be privileged in that way. He also pointed out that what they were to see was far from perfect in its present stage, but progress was being made rapidly and now new workers were wanted. He looked to the youth of the country and especially those present to help in one way or another. They might join the Glasgow centre of the Television Society (which was about to be formed) in the Students' Section, and thus help to help themselves.



Professor J. Gordon Gray, of Glasgow University, witnessing a demonstration of Stereoscopic Television, given by Mr. J. L. Baird before the British Association for the Advancement of Science at Glasgow.

The 250 scholars then proceeded to examine in detail Mr. Baird's apparatus for transmitting and receiving stereoscopic television and television in colours.

The future Development of the Television Society.

These notes are being written at Glasgow in the few odd moments which can be snatched from the wealth of interesting discussions, lectures, and personal contacts with the master minds of science, which the newspaper headlines proclaim as "The British Association for the Advancement of Science."

But my memory goes back to a similar meeting at Leeds last year when I had the opportunity of taking some part in the formation of our Society. That is just a year ago. In twelve months we have certainly done much in the way of preliminary organisation. But finality of view in the way of management or in the methods of development is not to be expected yet; it would be distinctly undesirable. We have a policy, and this has been embodied in our rules and Articles of Association, but much still remains to be done in development work, and what we need, it seems to me, is a "fluid" organisation so plastic that it can be modelled to a rapidly changing outlook on the general questions involved. We want vision for the future in every sense; we must organise twelve months ahead to be successful.

Believing as I do that there are great possibilities and important problems not far ahead that will have to be faced and thrashed out, I am venturing to put on paper a few suggestions. I hope they may lead to discussion and constructive criticism in the columns of this magazine. But I would emphasise that they are my own views and not necessarily those of my colleagues on the Council of the Society.

It may not be long before those in a position of authority come to realise the vast potential value of television as an adjunct to broadcasting. At present they are on a high pedestal, and we, as a Society, can speak with a voice not greater than a whisper.

The strength and endurance of our building will depend on our foundations. We have tried to build sound and sure, but a live and increasing membership will enable us to speak with a voice that commands respect. And we shall need that voice, that powerful organisation with all it means in present-day politics, if television is ever to be utilised as a public service for the betterment of our broadcasting programmes.

I am convinced that television will enable us to "project personality upon personality," and to bring broadcast humour and its naturally corollary facial expression, into the home. Surely that is what the home televisor stands for, above everything else. Its commercial uses are not unknown, but they are subsidiary. I cannot, for example, see much value in the televisor as an adjunct to the telephone, but I do foresee that radiovision will enrich the lighter side of life. This assumes that television will be used in conjunction with radio, as it undoubtedly will; we must therefore organise along these lines, working in close co-operation with local radio societies.

Here is an opportunity. In our large industrial towns I am told that "radio" is almost dead at present. Is not the answer to be found in the fact that the B.B.C. represents a monopoly of entertainment? Can you conceive what our theatres, our amusements would be if they were all controlled by a single corporation?

Television is a wider, more embracing subject than radio. It requires a knowledge of optics, of photo-active substances, of synchronising, of motors. We must give service to our members along these lines.

What services can be rendered? For one moment just try and recall what part the amateur played in popularising wireless. And only this week the "hall mark" of approval, as it were, has been stamped upon broadcasting by a British Association discussion at the Glasgow meeting, in which many well-known men took part.

"Pure science and applied science are not separate things, they just melt into one another," said Sir William Bragg in his presidential address to the British Association.

Lesson from America.

Our Society must arrange for practical demonstrations and simple explanatory lectures to "popularise" television. I hate the word popularise, but it expresses just what I want to say. Let us give the amateur the lead he wants to put him in the way of experiment and of progress. For without progress no organisation such as ours can hope to exist.

Take your lesson from America, and see what they have done on the other side of the Atlantic. They have their Institute of Radio Engineers, with a membership of many thousands. The transmitters have a strong and powerful organisation known as the American Radio Relay League. Both organisations meet a need.

The opening meeting of the London centre of the Television Society will be held on October 2nd, at 8 p.m., at the Engineers' Club, Coventry Street, W.1. Further details will be posted to members.

Mr. Baird explaining his colour Television transmitter to Dr. Edridge Green (extreme left) of Glasgow University, the eminent authority on vision, and Dr. Tierney (facing Mr. Baird) at the British Association meeting at Glasgow.

Navigation by Invisible Rays

By Lt.-Col. CHETWODE CRAWLEY, M.I.E.E.
(Deputy Inspector of Wireless Telegraphy, G.P.O.)

The writer of this highly interesting article describes how the navigation of shipping in fog has been robbed of many of its terrors by the development and perfection of the wireless direction finder. But what of icebergs or other obstructions not fitted with wireless? Shall we, one day, be able by means of invisible rays actually to *see* them through fog just as plainly as if the weather were clear?

THE development of noctovision is being closely watched by all who are interested in one way or another in the practice of navigation, as well as by those who are more specially interested in scientific advance of television and allied subjects.

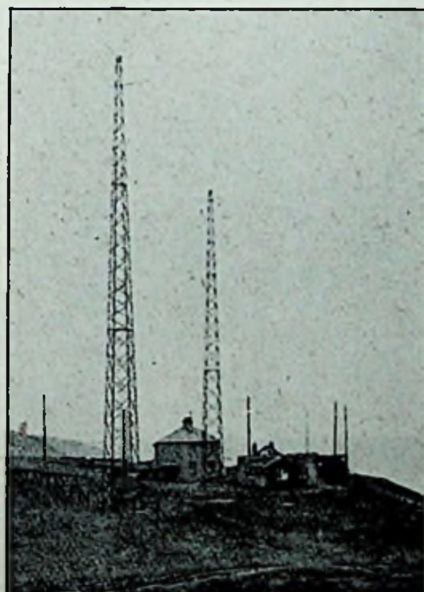
Infra-Red Rays.

The first definite step towards noctovision was made in 1902 when Ruhmer demonstrated in Germany that infra-red rays could be used by their effect on a selenium cell for practical signalling purposes. Herschel had previously discovered the presence of these rays in sunlight by a rise in temperature when a thermometer was placed just beyond the red part of the spectrum; that is to say, he demonstrated the presence of invisible rays of greater wavelength than the longest red rays, which are about 0·0008 of a millimetre in length.

These rays, like wireless rays, are of course invisible so far as the eye is concerned, but otherwise they have properties exactly the same as light rays; that is to say, they can be reflected and refracted in a similar manner to light rays. These infra-red rays can penetrate fog about sixteen times farther than light rays, so that if they can be used for navigational purposes the gain is obvious. The fact that rays at the red end of the spectrum are better for penetrating fog than those at the violet end is well known, and neon tubes transmitting red rays have been in use at many aerodromes for a considerable time.

Noctovision.

Mr. Baird in his early experiments with television experienced much difficulty from the effect of powerful flood lighting on the person who was being televised, and it was this which turned his attention to the possibility of using infra-red rays in place of visible light rays.



One of our coastal wireless direction finding stations, showing short masts used to support the corners of the double loop aerials.

It is obvious that if the navigator of a ship were able to see objects through fog and darkness his greatest troubles would be things of the past, and it is hoped that the use of infra-red rays will lead towards this goal. The ship would direct a beam of infra-red rays, just as a searchlight would be directed, but instead of seeing the object with the eye as in the case of the searchlight, he would have it shown on a screen by his noctovision receiver.

Mr. Baird's first important demonstration of noctovision was given to members of the Royal Institution in December, 1926, and it is understood that developments since then have advanced far on the road towards practical application.

Short Wireless Waves.

Meanwhile great strides have been taking place in the practical application of the longer rays used for wireless communication to the needs of navigation, and it may be of interest to consider briefly the developments in this direction, as an understanding of these developments is essential for an intelligent anticipation of the future of noctovision as applied to navigation.

In the earliest days of wireless Mr. Marconi transmitted the waves in the form of a beam by means of a reflector, just as a beam of light waves is transmitted from a lighthouse. The only difference between the wireless waves used by Mr. Marconi and light waves was that the former were very much longer, 10 to 100 metres compared with less than 1/1,000th of a millimetre.

It was necessary with the reflectors then available to use these short wireless waves of the order of 10 metres, and as such short waves were not then suitable for communication over long distances the whole idea of using reflectors was dropped and arrangements developed for using all-round transmission with waves hundreds of metres in length.

Rotating Beacons.

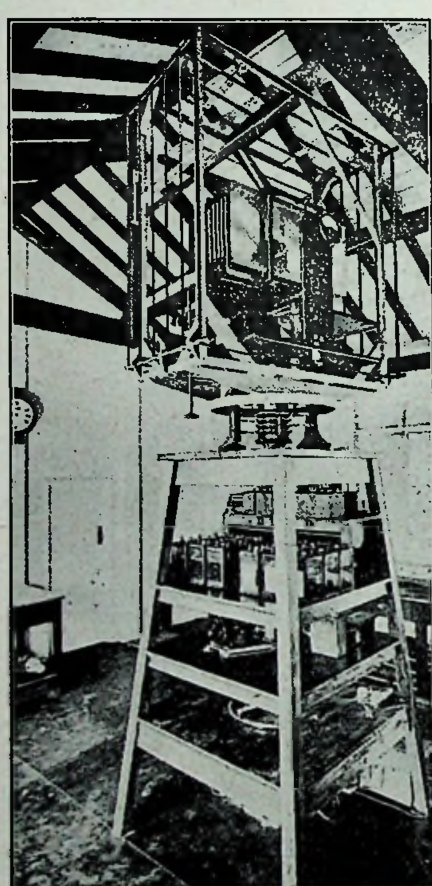
Soon after the war, however, Mr. Marconi returned to his old idea of using short waves with reflectors, and a wireless revolving beacon using short waves was erected experimentally in the Firth of Forth as an aid to the navigation of ships. Later on, of course, with the aid of Mr. Franklin and other engineers of the Marconi Company, he revolutionised the whole outlook of wireless communication over great distances by the use of short waves and reflectors in what is known as the Beam System; but that is another story.

A similar wireless beacon has since been erected at the South Foreland in Kent, but this particular system has not come into more extensive use as it is only practicable for very short waves of about 6 metres in length, which means having a special receiver in the ship in addition to its usual receiving apparatus. This beacon sends out distinctive signals for the various points of the compass, and when the ships hears the signal strongest it knows that it is on the bearing from the beacon represented by that particular signal.

Recently the Royal Air Force and the Radio Research Board have developed a rotating wireless beacon which transmits waves that can be received on a ship's ordinary apparatus up to ranges of about 50 miles. In this beacon the aerial consists of a vertical closed loop which is made to rotate at a uniform speed of one revolution a minute and emits a signal of constant radiation except when the emission takes place in a north-south or east-west line, when characteristic signals are emitted. The bearing is calculated by the ship with the aid of a stop-watch, the watch being started when one of the characteristic signals is received and stopped when the emission is heard weakest. The Government is trying out this beacon experimentally but is meanwhile continuing to erect all-round wireless beacons, which are simpler and much less expensive.

All-round Beacons.

These beacons, which emit waves in all directions, are, of course, only of use to ships fitted with directional receivers by means of which they can obtain the bearing from which the waves are received. All our large passenger ships are now fitted with these receivers, but the percentage of all ships so fitted is still quite small, in fact only about 13 per cent. of the total number of our ships equipped with wireless apparatus. However, as the number of wireless beacons available increases so will the number of ships which find it worth while to fit directional receivers increase, and it is to be hoped that in a few years' time all except the smallest ships fitted with wireless will be equipped with directional receivers so that full use may be made of the beacon stations being established round our coasts.



A directional wireless receiver of the rotating frame aerial type.

Five of these beacons are already in operation at Spurn Head in the Humber, Liverpool, Lundy Island, The Casquets and The Scillies. They broadcast their call signals on 1,000-metre interrupted continuous wave, and ships fitted with directional receivers can obtain their bearings from the beacons up to ranges of between 50 and 100 miles.

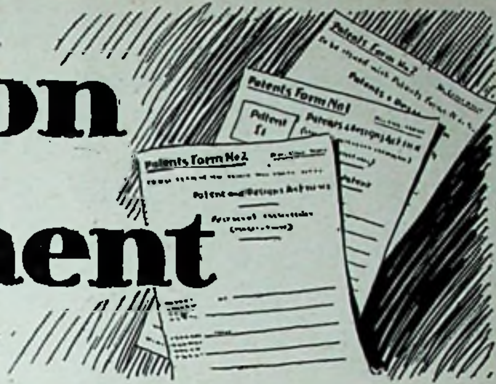
The Spurn Head Beacon sends out also a submarine sound signal which, in conjunction with the wireless signal, enables a ship to obtain its distance, as well as its bearing, from the beacon. It is intended to erect at least another seven wireless beacons at various points round our coasts.

D.F. Stations.

These all-round beacons, as already mentioned, are only of use to ships equipped with directional receivers, but other ships are catered for to a certain extent by the coast stations which are used for the ordinary wireless communications of ships. Those of our coast stations which are conveniently placed are equipped with directional receivers so that any ship can obtain bearings from them up to ranges of 100 miles or even more, and it is interesting to note that during last year the number of bearings so given by our coast stations was over 9,000.

By means of wireless direction-finding apparatus, therefore, it is now possible for ships to navigate in dangerous waters, or approach a port, in the densest fog, secure in an exact knowledge of their positions at any given moment. The remaining risk, that of collision with another vessel or with an iceberg, may yet be overcome by means of an adaptation of noctovision.

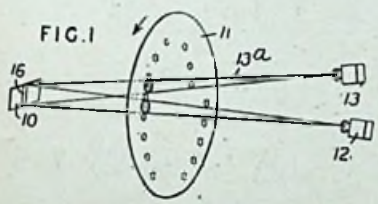
Invention and Development



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

ONE objection which could be foreseen in the structure of the television image as it appeared on the receiving screen is that the picture is gradually built up of strips. One side of the picture is reproduced one-sixteenth of a second later than the forward end. This would appear to introduce a stroboscopic effect in the case of moving objects; in other words, the effect would be to make the wheels of a moving car appear a foot or so ahead of the body. Some method must therefore be devised for fixing an instantaneous image, and in *Patent No.* 291121 J. L. Baird seeks to do this by securing persistence of the image and at the same time obliterating the individual elemental parts thereof before each new picture signal is screened.

FIG. 1



A screen (10) (Fig. 1), having on its surface a fluorescent material such as calcium sulphide, may be activated by a beam of light from a source (12) which traverses an exploring device such as a rotating disc (11) carrying a spiral of lenses. Immediately before the small elemental area (16) of the picture is traversed by the activating pencil of light from the source (12) it is traversed by another beam of different wave-length from a source (13), which has the effect of obliterating the previous fluorescence. Various modifications of putting into effect the same idea are given in the complete specification.

Patent No. 291786. (Convention date, June 10th, 1927.)—The Telefunken Company (Berlin) seek patent rights for a type of scanning disc to be used in building up a television image in a receiver. The disc (Fig. 2) has a number of spirally arranged apertures, in each of which is fixed a small glow discharge lamp (shown as I, II, III, etc.), weighing from 5 to 10 grams. The detailed structure of the lamp is illustrated in Fig. 3, where 25 is the metal casing into which the lamp fits, and 9 is the cylindrical glass bulb having a cemented plane glass window (10). The cathode, in the form of a cylinder, is shown by 11 together with a co-axial anode (12), the latter being connected to the body of the scanning disc by a wire connection (14). The special anode construction, it is claimed, allows only a very fine pencil of light to pass out through the window (10).

FIG. 3

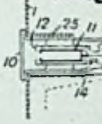
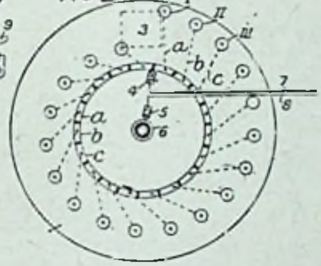


FIG 2



A picture is built up by the television signals being applied through conductors 7 and 8 to brushes 4 and 5. Brush 5 is connected through a slip ring (6) with the metal body of the scanning disc (1) and so with the anodes of all the lamps in turn, while brush 4 is connected through the commutator segments *a*, *b*, *c*, etc., to the cathodes of the lamps in succession. By these means the signals are applied at the right moment to the lamp which is traversing the picture area (3).

In a revolving disc of this structure, centrifugal displacement is bound to take place, and is allowed for by having the lamps adjustably centred.

As far back as 1923 Denès von Mihaly was using small vibrating mirrors for the purpose of exploring an image. A somewhat similar system, in which oscillographs carrying small mirrors and operated by tuned oscillating circuits fulfil the same purpose, is the subject of *Patent No.* 292659, granted to F. M. Robb (Canada) recently. In Fig. 4 the oscillograph (10) consists of a double wire (11) set between the poles of an electro-magnet and the vibrating mirror is shown by 16. A similar oscillograph (17) is set up at right angles to the first with vibrating mirror 18. The first mirror is caused to vibrate at a high frequency by an oscillator (19) and tuned circuit control (20); the other oscillograph being vibrated at low frequency by an oscillator (21) tuned by the control (22). A spot of light is reflected by the mirrors to an object (23) and thence to a lens (25), which focusses the light spot on to a photo-electric cell (26). At the receiver a beam of light from a source (35) is modulated by an opaque disc (29) controlled by an oscillograph (28), which in turn is connected to the photo-electric circuit of the transmitter. This disc (29) is placed in the path of the light beam to exploring mirrors 31 and 33, which are operated similarly to those at the transmitter; 27 is an amplifier introduced in the transmitting line.

FIG 4.

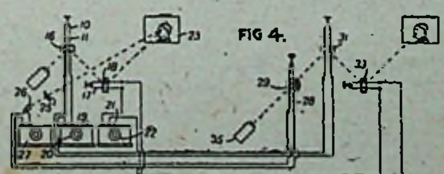


FIG. 5

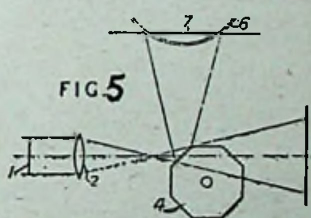


FIG. 6

Patent No. 291365. (Convention date, May 30th, 1927.)—L. Thurm and Etablissements Ariane.—A feature of the television system described in this patent is the construction of the photo-electric "retina" illustrated in Fig. 6. This "retina" is composed of a mosaic of photo-electric cells (7*a*), so disposed that there is no longitudinal break in the continuity of sensitive surface. The photo-electric "retina" (7) (Fig. 5) explores the surface of an illuminated object (1) behind a lens (2) by means of a moving shutter (6) and a set of rotating mirrors (4). The shutter has perforations to correspond with the cells and so arranged that each half of each cell is alternately exposed. By this means continuous modulation of the current in each cell is obtained. At the receiving end the image is reproduced by a similar apparatus in which modulated beams of light take the place of the elements of the cell.

THE BEST LETTERS OF THE MONTH

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

48, RECTORY ROAD,
STOKE NEWINGTON,
N. 16.
August 20th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Many thanks for publishing my letter in last month's TELEVISION, and I take this opportunity to say, or rather write, a few words to Mr. E. P. Adcock about his letter published in the current issue.

If I misinterpreted his first letter, I think it must have been due to the misprints and mistakes he points out in his letter in the July number.

I admit that his letter was purely theoretical, but, from my experience with theory and practice, especially in radio work, the anticipated results on paper have been totally different from the results on test. Therefore, until somebody detects an electric effect produced by electro-magnetic waves of the frequencies of light, *and* utilises them, even in the manner suggested by him, I shall not modify my previous statements.

Yes, Sir! results and figures are the things we require. Mr. "Angström" was kind enough to go into it with a little mathematics, and I must thank him for doing so.

I hope that Mr. Adcock will be able to show us some results and let us know any conclusions he may draw from them.

Anxiously awaiting the results.

Yours faithfully,
S. GOLDSTEIN.

"TWO GATES," MAIDENHEAD COURT,
MAIDENHEAD, BERKS.
September 7th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Please find enclosed application form for constructor's sub-licence. Allow me to congratulate you on your pioneer enterprise—TELEVISION. I have read with interest the opinions of your correspondent, E. P. Adcock. I, too, am convinced that a solution is to be found apart from the mechanical and synchronising systems: in the electro-magnetic property of light. Even as light has an electro-magnetic property, conversely, as Mr. Euclid says, light may be made to produce currents of electr city.

I have commenced experiments with a simple televisor, with which I hope to convince the sceptical family that Baird's invention is a reality, not a dream.

Best wishes for the success of your journal.

Yours faithfully,
COLIN P. GARSIDE.

7, RIVERSIDE,
SUDBURY-ON-THAMES,
MIDDLESEX.
September 11th, 1928.

THE EDITOR,
"TELEVISION."

DEAR SIR,

Just before reading your account (TELEVISION, *September*, p. 42) of Mr. Baird's patent for varying illumination by letting the light pass through two ruled gratings with their planes parallel, and their lines slightly inclined, I had been noticing, with curiosity, bands precisely similar to those shown in Fig. 5 of the article, but on a gigantic scale, formed by an ordinary reed sun-blind flung over a balcony rail, so that the light of the sky was seen through a double layer of the material. The width of the bands was altered by twitching the blind, and thereby changing the relative slant of the two layers. The spaces between the reeds were about half the width of a reed. Probably hundreds of other people also have idly observed the same thing, merely as a curious scientific phenomenon, before a genius came along and at once saw the practical application.

Yours faithfully,
ALICE EVERETT
(M.A., F.Telev.S.).

Mention of "Television" when replying to advertisements will ensure prompt attention.

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