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6d MONTHLY

Television

The Official Organ of the Television Society

VOL. 1. APRIL 1928 No. 2

TELEVISION IN MID-ATLANTIC.

In the early hours of the morning of March 7th, the Baird Television Development Co. conducted a successful transmission of Television to the Cunard liner "Berengaria," then in mid-Atlantic. Mr. S. W. Brown (extreme left, background), chief wireless operator of the "Berengaria," was able to recognise the image of his fiancée. On the right of our illustration, leaning on the Televisor, is Captain Sir Arthur H. Rostron, K.B.E., R.D., R.N.R., commander of the "Berengaria."

THE WORLDS FIRST TELEVISION JOURNAL

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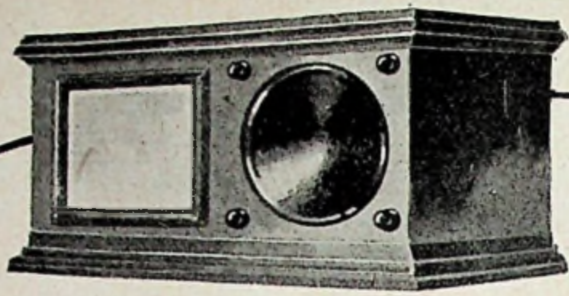
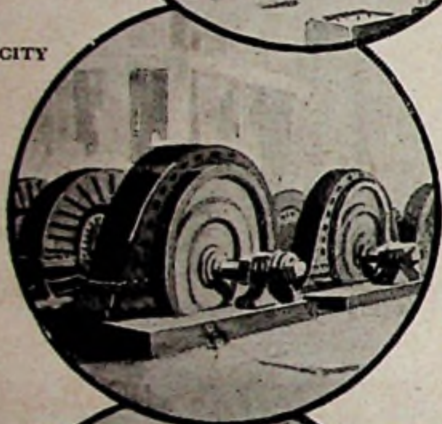


WIRELESS

ELECTRICITY

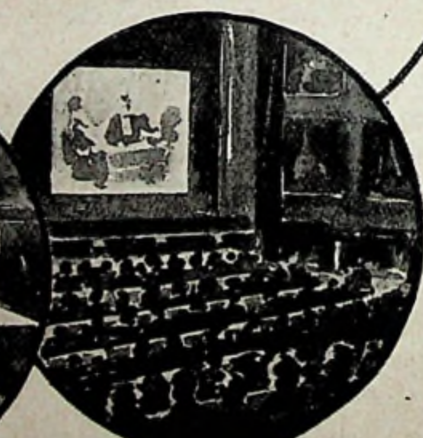


MECHANICS

APRIL 1928

CHEMISTRY

OPTICS



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Television

THE WORLD'S FIRST TELEVISION JOURNAL

The Official Organ of The Television Society

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Vol. 1] APRIL 1928 [No. 2

EDITORIAL

WE are most happy to be able to inform our readers that the first issue of this magazine has met with the most unqualified success. Bookstalls all over the country became sold out with such great rapidity as to give point to the advice given in our advertisements anent the desirability of placing a permanent order with your bookseller.

WE have received from all over the country literally thousands of letters of congratulation on the appearance of this, the world's first television journal. Letters to that effect have come from all over the Continent and even the United States. We wish to take this opportunity to thank the writers for their enthusiastic support.

* * *

IN response to our announcement to the effect that we are in a position to issue television constructor's sub-licences, covering patents held by the Baird Company, we have been literally snowed under with applications. This is most extremely gratifying, and illustrates in the most concrete manner possible the enormous interest which is being taken in the subject by the amateur constructor and experimenter.

OUR only regret is that owing to certain delays in the initial stages of the preparation of the licence forms, and to the very heavy amount of clerical work involved, we have not been able to issue these licences as quickly as we would have liked. It is anticipated, however, that by the time these lines are in print we shall have been able to cope with all applications to date.

* * *

LAST month we advised our readers not to allow themselves to be misled by carping critics of the present state of development of television. We pointed out that the knowledge of these critics is incomplete, and their actual achievements nil.

WE note that one of our wireless contemporaries is now endeavouring to put before its readers the *real* facts about television. The only comment which we would make, in passing, is that whilst the journal in question was endeavouring to cast ridicule on Mr. Baird's proposed trans-Atlantic demonstration, the said demonstration actually took place; and while it was calling upon Mr. Baird to demonstrate television by wireless over a distance of twenty-five yards, the Baird Company forestalled the publication of the challenge by transmitting recognisable images of human faces to the Cunard liner *Berengaria*, then 1,500 miles away in mid-Atlantic. *Verb sap.*

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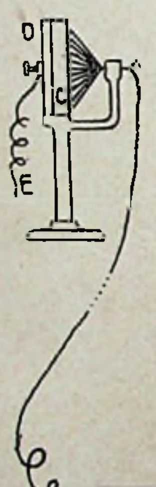
"SEEING BY ELECTRICITY"* IN 1880

This interesting article shows that efforts to achieve a form of television were being made as far back as fifty years ago.

THE art of transmitting images by means of electric currents is now in about the same state of advancement as the art of transmitting speech by telephone had attained in 1876, and it remains to be seen whether it will develop as rapidly and successfully as the art of telephony†. Professor Bell's announcement that he had filed at the Franklin Institute a sealed description of a method of "Seeing by Telegraph" brings to mind an invention for a similar purpose submitted to us some months since by the inventor, Mr. Geo. Carey, of the Surveyors' Office, City Hall, Boston, Mass. By consent of Mr. Carey we present herewith engravings and description of his wonderful instruments.

Figures 1 and 2 are instruments for transmitting and recording at long distances permanently or otherwise by means of electricity the picture of any object that may be projected by the lens of camera (Figure 1) upon its disc P. The operation of this device depends upon the changes in electrical conductivity produced by the action of light in the metalloid selenium. The disc P is drilled through perpendicularly to its face with numerous small holes, each of which is filled partly or entirely with selenium, the selenium forming part of an electrical circuit. The wires from the disc P are insulated and are wound into a cable after leaving binding screw B. These wires pass through disc C (Figure 2) in the receiving instrument at a distant point, and are arranged in the same relative position as in disc P (Figure 1).

FIG. 2.



A chemically-prepared paper is placed between discs C and D for the image of any object projected upon the disc P (Figure 1) to be printed upon.

Figure 3 is a sectional view of Figure 2, showing wires and the chemically-prepared paper.

FIG. 1.

Figure 5 is a sectional view of disc P (Figure 1) showing selenium points and conducting wires.

Figure 6 is a sectional view of another receiving instrument with platinum or carbon points, covered with a glass cap, there being a vacuum between glass cap D and insulating plate or disc C.

These points are rendered incandescent by the passage of electric current, thereby giving a luminous image instead of printing the same. These platinum or carbon points are arranged relatively the same as the selenium points in plate P (Figures 1 and 4); each platinum or carbon point is connected with one of the wires from selenium point in disc P (Figure 1), and forms part of an electric circuit.

FIG. 3.

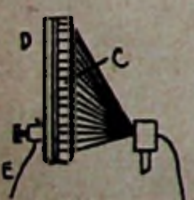


FIG. 5.

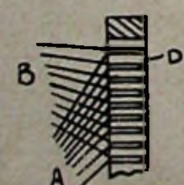


FIG. 4.

FIG. 6.

The operation of the apparatus is as follows: If a white letter, A, upon a black ground, be projected upon disc P (Figure 1) all parts of disc will be *dark* except where the letter A is, when it will be light; and the selenium points in the light will allow the electric current to pass, and if the wires leading from disc P (Figure 1) are arranged in the same relative position when passing through disc C (Figure 2) the electricity will print upon the chemically-prepared paper between C and D (Figure 2) a copy of the letter A, as projected upon the disc P (Figure 1). By this means any object so projected and so transmitted will be reproduced in a manner similar to that by which the letter A was reproduced.

Figures 7 and 8 are instruments for transmitting and recording by means of electricity the picture of any object that may be projected upon the glass plate at TT (Figure 7) by the camera lens. The operation of these instruments depends upon the changes in electrical conductivity produced by

(*Continued on page* 37.)

FIG. 7

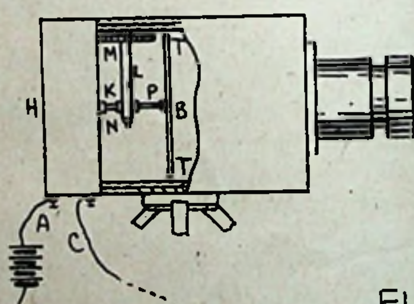


FIG. 8

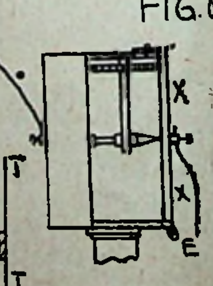
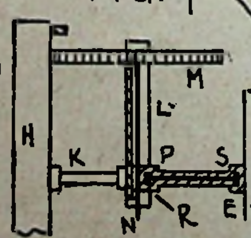


FIG. 9



* *Extract from "The English Mechanic," Vol. XXXI, June 18th, 1880, page 345. Reprinted from "The Scientific American."*

† *This is particularly interesting in view of recent pessimistic utterances on the subject of television.*

Short Waves & Television

By A Correspondent

SOME time ago, in speaking of the beam system, Senatore Marconi expressed the opinion that short waves, in conjunction with the beam system, would prove of great value in television.

The great success which has recently been achieved by the beam in the translation of facsimile messages gives an indication of the value of this system for television purposes, as television is, of course, closely allied to facsimile telegraphy, being, in fact, merely a speeding up of this process. In view of these facts it will not be out of place in this journal for us to give you a brief résumé of the work which is being done and the results which are being achieved at the present time.

Short Waves Best for Distance.

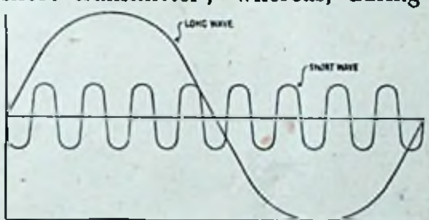
The immense success which has attended the application of short waves is best exemplified by the long-distance transmissions which are now taking place between London and the most remote parts of the Empire, at speeds far exceeding any hitherto considered possible.

Wireless waves, as everyone knows, are exactly similar to waves of light except in regard to their length.

They can be refracted and reflected in a manner exactly similar to light waves, but as these wireless waves are enormously long the reflectors used must be correspondingly larger, so that we get the enormous reflecting systems such as those used at Bodmin, gigantic towers and stupendous aerial networks replacing the parabolic silvered mirrors of the searchlight.

There may seem, at first glance, to be little similarity between the searchlight mirror and the skeleton framework of a beam transmitting station; but this is due to the fortunate fact that, owing to the length of the waves, a solid reflector is unnecessary, a mere skeleton serving the same purpose as a solid metal reflector.

In this article, however, we are not so much concerned with the reflecting system as with the fact that the shorter wave-lengths permit of a much higher speed of signalling to be obtained. This is due partly to the far more rapid rate of oscillation of short waves. During any given interval of time, say, one ten-thousandth of a second, during which the signalling key is kept closed, a number of complete waves will be emitted from the aerial of an ultra-short transmitter; whereas, during the same interval of time, the aerial of a very long wave transmitter will only have time to emit a single wave or part of a wave.



Wave-length and Time.

Let us consider the position in figures.

Ultra-rapid Oscillations.

The frequency of oscillation of a one-metre wave is 300,000,000 per second; while the frequency of the longest wireless wave of 30,000 metres is only 10,000 per second. Thus, during one ten-thousandth of a second a one-metre wave transmitter would emit 30,000 complete waves, or oscillations, whilst a 30,000-metre transmitter would emit but one single wave, or oscillation. The state of affairs is more clearly indicated in the accompanying diagram.

Another difficulty of long wave-lengths is that it is necessary to employ very high power, and this, in turn, necessitates the use of very long aerials. A modern high power long-wave station, in fact, makes use of an aerial the length of which bears a definite relationship to the length of the wave to be radiated. Such aerials are called tuned, or Beverage aerials, after the inventor of the method, and may be ten, fifteen, or even twenty miles in length.

Under such conditions a difficulty which is immediately encountered, when it is desired to signal at high speed, is that the aerial takes an appreciable period of time to charge up to its full extent. It is, in fact, virtually a condenser of considerable capacity. If the signalling current is not kept on long enough the condenser does not have time to become fully charged, with the result that maximum radiation is not secured. This means that, at the receiving station, a signal of too short duration is considerably weakened, or lost altogether.

Baird Success on Short Waves.

With short waves no such enormous aerial systems are required, nor is very high power necessary. Quite low powers and small aerials are adequate to meet the requirements, and low power can be handled at high speed, just as a low capacity aerial can be charged at an enormously rapid rate.

Television requires for its success the signalling of a stupendous number of impulses per second, and with the longer waves, as we have already explained, a limit is reached beyond which signalling becomes ineffective. It is a fact worthy of note that Baird, whose original experimental broadcast transmissions were made on 200 metres, is now using a wave-length of 45 metres for his long-distance television transmissions, and it was this wave-length which was so successfully employed for the recent transatlantic demonstration of television.

Clairvoyant: "Might just as well shut up shop now she has a Televisor."

Invisible Rays—The Infra Red Experiments & Applications

By J. DARBYSHIRE MONTEATH

SINCE the application of the infra-red rays for the purposes of noctovision, where visible radiation, or light, is neither desirable nor available, the search for information regarding the origin and generation of rays kindred to the infra-red end of the solar spectrum has been intensified; and experimentalists generally have had their interest awakened to further possible applications of invisible rays, and to extend research in directions other than that which Mr. Baird has so uniquely made his own.

When speaking of light we refer to rays emitted or reflected from luminous bodies, for space itself is dark. It is the heavenly bodies or particles that shine; so even the very finest particles of matter excite the sense of sight when acted upon by suitably disturbing radiations.

The blue sky appears blue to us because of the scattering of the shorter wave-lengths by the fine particles of rarified air and its contents. The ruddy glow of the sunset is due to the effect of the longest wave-lengths of visible radiations.

Infra-Red Rays Indicated by Thermometer.

It is in the neighbourhood of these latter that we find the infra-red rays. They extend far beyond the red end of the spectrum (the luminous coloured beam which is refracted by a prism when it is placed in sunlight) and were discovered by Sir Wm. Herschel, who explored the spectrum by the aid of thermometers. He found that the maximum energy of these radiations, as indicated by temperature, rose as he moved his thermometer past the red end of the spectrum, where rays of lower refrangibility exist. The wave-length of these rays is too long and they vibrate too slowly to affect our vision; but they are heat producing, and are therefore heat-waves.

Infra-red rays have since been well examined by means of the thermopile and the bolometer, which are extremely sensitive forms of the thermometer. Their wave-lengths have been established and their properties of selective reflection and absorption, for the most part, experimentally determined.

Moving along the spectrum past these radiations we reach the position of the Hertzian waves, the shortest known wave-length of which is about two millimetres. The longest wave-length of the infra-red wave-lengths is just over one-tenth of a millimetre. More precisely the wave-length 0·314 millimetres has been obtained and tested from a quartz mercury vapour lamp.

Photo by courtesy of Prof. R. W. Wood (U.S.A.).

This is *not* a snow scene. It is a view of Monte Pelegrini, near Palermo, Sicily, photographed by infra-red rays.

The Extent of the Spectrum.

The extent of the spectrum may be appreciated when it is stated that the sun's spectrum, which can be represented diagrammatically in octaves according to the method devised by Guillaume in 1899, has one octave visible, two of shorter wave-lengths, invisible, called the ultra-violet rays, and nine or ten octaves on the other side of the visible octave which are the infra-red radiations which add themselves to the energies of the luminous solar beam. The longest heat-rays are only three and a half octaves from the shortest electric waves, whilst these are nine octaves away from the red luminous rays.

These long heat-waves pass through thin black paper and certain other substances almost without any absorption. Rock salt, mica, celluloid, gelatine and thin ebonite are peculiarly transparent, whilst alum, ice, sugar candy, glass and water are absorbers. The penetrative power of infra-red rays is such that they pass through smoke so dense as to be absolutely opaque to light.

A well-known lecture experiment which illustrates the blood-red appearance of the sun during fog owes its success to the fact that a solution of "hypo," into which a trace of hydrochloric acid has been added, will absorb all the light rays of the usual projection lantern, except the red, so that the disc of light seen on the screen will gradually go dim, and pass from yellow to red as the precipitate of fine sulphur particles increases, the longer waves penetrating the solution as in the case of smoke or fog.

Isolating the Rays.

Isolation of the rays may be effected not only by filtration but by reflection.

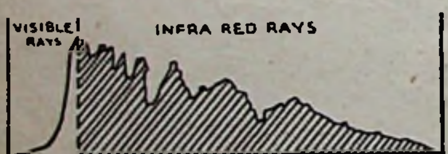
Take a roughened surface and employ it as a mirror, and it will be found that an image may be obtained by using the longer wave-lengths, which will be as sharp as if a polished surface had been used. The shorter waves are scattered by the projecting particles of the mirror.

An interesting result indicating the presence of these rays may be observed on a card painted with luminous paint. Place the card in good sunlight, and while it is phosphorescing allow a spectrum (produced by means of a prism) to fall upon it, and note that the invisible infra-red rays will at first make their presence known by increasing the luminescence at the place of their impact, producing a luminous band brighter than the spectrum itself. This causes a rapid emission of phosphorescence at this portion of the painted card, so that all emission will ultimately cease, and leave the card darkened where the infra-red rays have operated.

Infra-red rays have the usual properties of light, and interesting experiments can be cited for the production of polarisation and diffraction, as well as reflection, absorption, and phosphorescence.

Photographs by Infra-Red Rays.

Utilising screens that will absorb the luminous rays but pass the longer ones, Prof. R. W. Wood obtained many interesting infra-red ray photographs. An ordinary camera may be used for this purpose, but must be fitted with a suitable filter which will pass only the required rays. A good screen recommended by Prof. Wood can be made by using a cobalt glass cell about a quarter of an inch thick, filled with a saturated solution of bichromate of potash. Such a screen

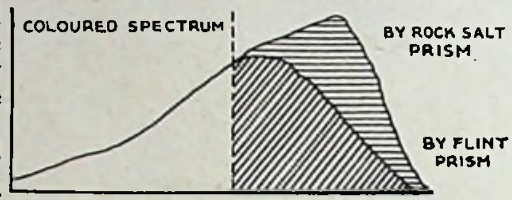


ENERGY CURVE OF THE SUN'S RAYS.

stops all wave-lengths shorter than the just visible extreme red.

Interested photographers will find that landscapes make the best pictures, because the chlorophyl of vegetation acts selectively and reflects the longer wave-lengths. Vegetation thus photographs in strong contrast to the sky, which, owing to the absence of the longer wave-lengths in skylight, leaves no impression on a photographic plate.

The beneficial effects of these rays are very pronounced, for they are rapidly absorbed by a thin layer of water. This means that the waters of the earth are warmed by them on the surface, thus producing evaporation; and then the rainfall or snow is again dispersed by them in the same manner. Further, the water-laden atmosphere affords us protection



ENERGY CURVES RESULTING FROM THE USE OF PRISMS OF DIFFERENT MATERIALS

from extreme heat waves of the sun, for aqueous vapour is a pronounced absorber of infra-red radiations.

Vapours Absorb Rays.

In fact vapours generally are absorbers, for if we compare a quantity of dry air with the same quantity of marsh gas, we find that the latter absorbs four hundred times better than dry air. Ammonia absorbs over one thousand times better than dry air.

Tyndal, who first popularly disclosed experimental facts relating to infra-red ray absorption values, found that perfumes and stinks each had their absorption figure, and that the thermopile responded to the heating effects of the rays as they passed through each distinctive scent. The galvanometer reading for lavender was 32 times that of the air which carried the scent; oil of cloves, 34; otto of roses, 37; lemon, 65; thyme, 68; and aniseed, 372.

The properties of absorption or transparency are known as diathermancy, and tables of diathermanent values for various materials can easily be referred to in works on this branch of physics. Quartz has a high diathermanent value and makes a good lens for focussing the rays, or curved metallic mirrors may be substituted.

Focussed Rays Produce Fire.

The focussed ray will afford amateurs an interesting field for experiments. By means of an arc and a quartz lens secure a parallel beam and introduce into it a thin flask of iodine in carbon disulphide. Cut off the luminous rays by means of a very thin sheet of ebonite. The rays, bent by the refractive solution, will then be brought to a point of focus where gun-cotton will easily explode, or a cigar may be lighted; and other interesting properties of the rays can be investigated.

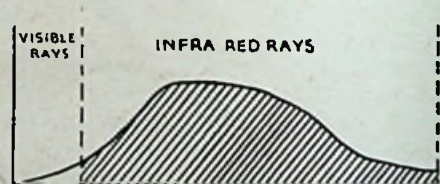
It will be found that a small tray of common salt will simply be warmed, whilst a similar quantity of sugar will be instantly inflamed. Phosphorus will not light up as easily as expected, as it is so transparent to the rays. A card covered with powdered alum will soon get hot, whereas one covered with iodine will remain cool unless comparison is made at a point where the rays are too intense for the test. Similarly, ordinary white paper will be charred, glazed red paper scarcely affected, and sandpaper pierced, whilst a thick dead black paper will be set ablaze.

All rays from the radiant source are heat rays, because when they are absorbed by any material they give rise to heat, and their effects are additive.

Other Experiments.

The thermopile and a low-reading millivoltmeter will assist the beginner in his investigations, and the sputtered tungsten bolometer is available for the more advanced experimeter. With the aid of such instruments sources of this type of radiation may be inspected and the percentage of infra-red rays emitted subjected to measurement.

A Welsbach burner gives off 90 per cent., incandescent platinum



ENERGY CURVE FOR AN ARC LIGHT.

98 per cent., and an alcohol flame 99 per cent. of invisible rays. The hydrogen flame radiates practically only infra-red rays.

In place of the phosphorescent card method of investigating the rays, the Balmains paint may be painted on glass, which, after it has been exposed to the rays and the darkened portion has been produced, may be placed in contact with photographically sensitive paper. This paper, after exposure to light, can be treated with " hypo " in the ordinary way, for the purpose of keeping records of the region, extent, and intensity of the infra-red rays.

The existence of the many wave-lengths of the infra-red rays suggests many fields of interest to research workers, such as the analogy between pitch and colour, the properties of materials in relation to their polarisation, refraction, and diathermanence, according to the wave-lengths employed; their selective action in reflection, and in their selective photo-electric properties, which, as in other parts of the spectrum, is found to be pronounced.

Selective Properties.

Selective properties for diathermanence have been shown by experiment. Smoke so thick that the sun on a bright day could not be seen through it, transmitted 76 per cent. at a wave-length 26, and 91 per cent. at wave-length 108. And paraffin wax, which could transmit 57 per cent. at wave-length 108, was found capable of transmitting 85 per cent. at a wave-length about three times as long, and a test for ebonite gave 39 per cent. transmitted rays in the first case, and 65 per cent. on the longer wave-length.

Photo by courtesy of Prof. R. W. Wood (U.S.A.).

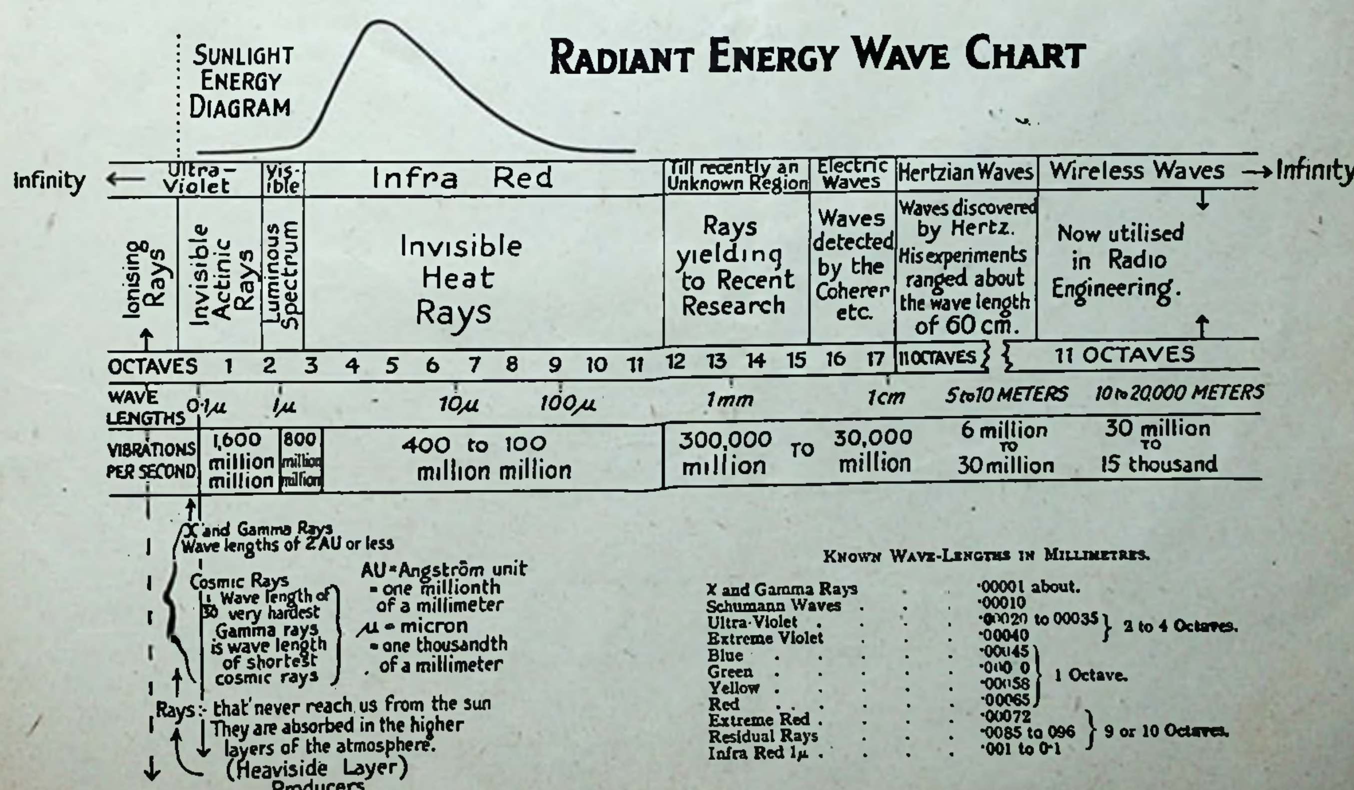
Another photograph which shows in a particularly striking fashion the absence of infra-red reflection from the sky, and the intensity of the reflection from foliage.

To the engineer the study of the infra-red radiation is all-important, for it has only recently been recognised that radiation or loss of heat in internal combustion engines largely depends on whether the explosive mixture is dry or wet, and the importance of considering the absorption values of the mixture is becoming recognised as being a matter for research.

Quite recently figures for combustion engines have been published* showing that when a dried mixture of the gases is used an additive 7 per cent. of the gross amount of heat due to combustion is radiated in excess of that emitted in the presence of 1·9 per cent. water vapour.

The most outstanding application of the rays in recent times is undoubtedly the noctovisor, which is capable of making visible to the eye persons or objects who are in complete visual darkness, but who are flooded with these infra-red rays. The presence of the densest smoke or fog mixed with the atmosphere makes no substantial difference to the image visioned on the distant televisor. It thus becomes imperative that generators of the infra-red type of energy should be evolved, and so enhance the value to our race of Mr. Baird's great invention.

* Phil. Mag., Feb. 1928.



Known Wave-Lengths in Millimetres.

X and Gamma Rays	·00001 about.	
Schumann Waves	·00010	
Ultra-Violet	·00020 to 00035	2 to 4 Octaves.
Extreme Violet	·00040	
Blue	·00045	1 Octave.
Green	·00050	
Yellow	·00058	
Red	·00065	
Extreme Red	·00072	9 or 10 Octaves.
Residual Rays	·0085 to 096	
Infra Red 1μ	·001 to 0·1	

Technical Notes

By the Technical Editor

THE LIGHT-SPOT—(*continued*)

LAST month's article described a method of obtaining a very high intensity of illumination on an object an image of which is to be televised, together with the reasons for requiring such high intensities; but, for reasons of space, it did not include any description of the apparatus. The method is, briefly, that a small spot of light is caused to travel over the object synchronously with, or at the same rate as its exploration.

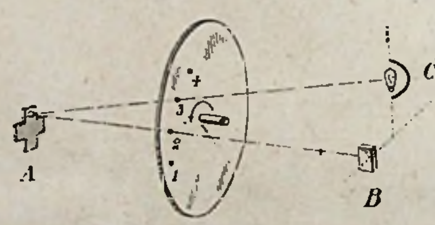
The word exploration is used to denote the examination of the object in a succession of small areas; it is as if one had a large screen in front of the object, with a small hole, say $\frac{1}{8}$ in. square, through which the object is observed. By moving the screen about one would in time have looked at every part of the object and noted the relative light and shade of all the individual bits that were seen.

The Electrical Eye.

This is what happens in television, except that the selenium cell takes the place of your eye, and according to the light or shade of each bit of the object, it changes its resistance so as to permit more or less current to pass to the receiving station.

In order to obtain a visible image it is necessary to explore the object from 10 to 16 times per second and produce a corresponding number of complete images at the receiving station, just as a cinematograph actually shows 16 complete pictures per second.

It is clear that 16 complete explorations per second means a very high rate of working, and it would be very difficult to get an exploring device and a light-spot director to work exactly in synchronism if they were separate mechanisms. This difficulty, however, is avoided in Baird's apparatus, for he uses a single disc—the exploring disc described in the last issue—to effect both the exploration of the object and the traversal of the light-spot over the object.



A beam of light from the source C shines through the lens 3 of the revolving disc on to the object A. Light reflected from A passes through lens 2 of the disc and strikes the light-sensitive cell B.

In the accompanying diagram there is shown an exploring disc, but the spacing of the spiral set of lenses is exaggerated to make the principle more clear. The object which is being explored is shown at A, the selenium cell at B, and a powerful lamp at C. The lenses in the disc are numbered from 1 to 4, and in the position shown the selenium cell can "see" a small portion of the object through the lens 2.

It is a useful assumption in dealing with television apparatus to think of the selenium cell as seeing things in exactly the same way as a human eye sees them. It is not an inaccurate assumption because the eye sees an object by virtue of the light coming from the object, usually reflected from it, and entering the eye. The light produces certain effects on the retina which are translated or understood by the brain. In the same way the light coming from the object falls on the selenium cell and produces an effect which is a change of resistance. Different amounts of light produce different degrees of effect on a selenium cell just as they do on the eye; so that the use of the word "seeing" is justifiable, and I personally have found it a convenient way of thinking of the action of a cell.

Exploration Explained.

As the lens 2 moves downwards by the rotation of the disc the selenium cell will see successively a series of bits of the object which together form a narrow band extending from top to bottom, and it is required that the light-spot shall shine on each of these bits at the same time as the selenium cell sees it. The lamp C is arranged above the selenium cell B and a short distance to one side of it, so that it can project a beam of light through the next lens 3 in the disc.

(*Continued on page* 28.)

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

TELEVISION SOCIETY.

MEMBERSHIP APPLICATION FORM.

April, 1928.

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

Name ....

Address ....

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

Academic Qualifications .... or

Scientific Pursuits ....

THE SECRETARY OF THE TELEVISION SOCIETY,
[Stamp enclosed.] 200, High Holborn, W.C.2.

ORDER FORM.

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

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

Name ....

Address ....

....

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

Announcement

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

* * *

APPLICATION FORM.

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

PLEASE WRITE IN BLOCK CAPITALS.

I ....
(Full Name)

of ....
(Full Postal Address)

....

.... hereby apply
(Occupation)

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

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

THE TELEVISION SOCIETY

REPORT OF FOUNDERS' MEETING.

THE Hon. Secretary reports that all applications for membership are being dealt with as quickly as received, which means that over one thousand application forms have had attention. Many Fellows and Associates are being elected, the Fellowship representing most of the Universities in the kingdom. Research papers are promised by leading specialists, and many University graduates in science have promised help to maintain the standard aimed at by the founders of the Society.

The educational and the social side of the Society's work will be managed by various local committees who will undertake the management of the public lecture work included in the Society's programme.

In this connection the Secretary will welcome communications from members and friends interested in the work of their own district, with a view to the formation of local centres.

Founders' Meeting.

On March 13th, at the Engineers' Club, Coventry Street, W.C.2, a meeting of the founders of the Society was held, for the purpose of ratifying the work of the Executive Committee, elected at the Leeds Foundation Meeting.

Dr. Clarence Tierney, D.Sc., as Chairman of the meeting, referred to certain adverse criticisms as to the desirability of forming the Society, some critics considering that the Society's objects might well be included in the work of an ordinary wireless society, others that there was danger of overlapping with the work of other scientific societies. But men's memories were short, though it should not be difficult to recollect the beginnings of other scientific societies that had entirely justified their individual existence. Referring to other criticisms regarding the subject of Television, Dr. Tierney recalled the famous "S." signal in early Marconi research, and the criticisms of that day, and indicated that similarly to-day much of the adverse criticism presented was due to lack of information of the trend and the results of recent Television research, the critics themselves in most cases obviously not having seen recent results or fully appreciating recent achievements.

Dr. Tierney's Speech.

So far as he was aware, Dr. Tierney said, no society existed solely for the study of Television problems, at the date of the foundation of this Society, and it was essential that the Society should concentrate on this subject. All would be welcome to bring forward their suggestions and so add to the sum total of ideas, it not being the object of the Society to exploit any one system, but to afford a common ground for the scientist and the amateur to meet to discuss research and experimentally to test results and ultimately advance the art of Television.

The Agenda included the Memorandum of Association and the Articles of Association, notice of which had been sent to all Foundation Members. Following the notice, a further reminder was sent by the Secretary (owing to the importance of the meeting) requesting a letter of approval of the synopsis published, in the event of a member's likely absence. Many letters of approval were received from distant members, unable to attend, and members present at the meeting unanimously adopted the recommendations of the Executive Committee, the synopsis referred to being adopted together with confirmation of the election of the Council and officers of the Society.

Mr. Bartlett addressed the meeting on the subject of incorporation, and it was agreed to accept the articles and memorandum of association and to forthwith proceed with the matter.

Mr. A. Dinsdale, A.M.I.R.E., suggested that applicants for the Fellowship who were University lecturers should be invited to co-operate in the lecture work of the Society.

Mr. J. C. Rennie, D.Sc., A.M.I.E.E. said that as the Society proceeded there would be no dearth of technical papers to be read and discussed.

The Chairman, Dr. Tierney, in closing the meeting referred to the granting of licences to amateurs by the Baird Development Co., Ltd., which he had asked should be done. He said the Baird Company had responded splendidly by granting free licences to amateur constructors, and many applications had been received from amateurs for the manufacture of their own apparatus. He asked the Secretary to thank the Company for all they had done in this direction.

Date of Next Meeting.

It was decided that the next meeting should take place on the first Tuesday of next month, the object of the meeting being to welcome new Fellows and Associates, Mr. Mitchell, B.Sc., F.R.Met.S., undertaking fully to state the aims of the Society; Mr. A. Dinsdale to indicate papers required for publication, and Mr. J. Cameron Rennie the subjects for technical meetings. Further particulars of the meeting will be notified to members by the Hon. Secretary.

A Love of Scientific Adventure and where it leads

(A Specially Contributed Article)

By W. C. FOX

Mr. Fox, one of the first men to have his face televised across the Atlantic, tells, for the benefit of readers of "Television," some of the experiences he has had in his search for scientific adventure, and how he felt when before the Televisor.

A LOVE of adventure is supposed to be an essential part of the make-up of the character of natives of these islands. It led us to colonise and go adventuring all over the world in the old days, while to-day, with fewer opportunities, it seems to me, it has played a very considerable part in the development of wireless.

There is an adventure in reaching out invisibly over the continent of Europe and meeting strange stations, strange voices and languages. The spirit of adventure drives the crystal user to one valve because of its increased range of reception, and then to two and more valves.

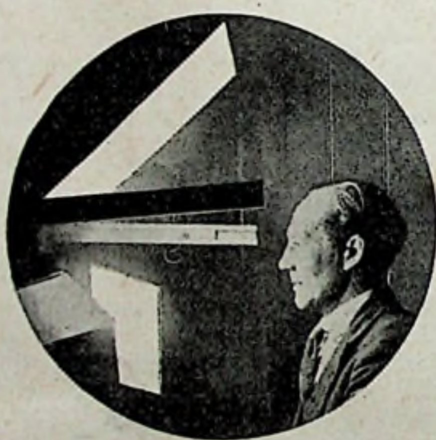
During the war everyone had adventures, often more than he wanted, but when peace came I, for one, was faced with the problem of how to get further adventures and strange experiences; and I decided to turn to my boyhood hobbies of science and engineering. There is always something new being done there, and for the man who can appreciate it there is a decided spice of adventure in this direction.

Favoured by fortune during the past eight years, there has not been a twelve-month when some adventure or other has not come my way.

The First Wireless Telephony Experiments.

To begin. In my small town I was among the first to hear Melba broadcast from Chelmsford and to attend Marconi's first demonstration of two-way wireless telephony. Two lorry loads of apparatus were used at each station—about 26 miles apart—and we thought it wonderful. If one used as many valves now as were considered necessary then one would expect to hear Mars at least!

The next adventure in connection with wireless was to hear American telephony, when two big electrical companies combined, about 1922, and treated some 40 scientific and engineering people in London to a reception of speech from New York. There was a decided thrill in hearing an unmistakably American voice say: "Hello, London! This is New York calling you. It gives me the greatest pleasure in the world to be able to call you up."



Mr. W. C. Fox, photographed before the Televisor whilst the image of his face was being transmitted across the Atlantic.

My First Flight.

This adventure was, however, quite mild compared with one in which I took part some months earlier. It was to be the first passenger to be carried from London to Paris in an aeroplane at night and, incidentally, the first pressman to communicate with his office in Fleet Street while in the air.

It was, too, my first flight, and before we landed it was a real adventure.

We left Croydon with Sir Alan Cobham, then plain "Mr.," as pilot, on a beautifully clear January night. London lay beneath us like a heap of glittering gems on a deep dark velvet background, while in the west there was just visible the red glow of the departing day.

As far as the coast conditions were perfect, then when over Lympne fog began to roll up and it was decided we had better land.

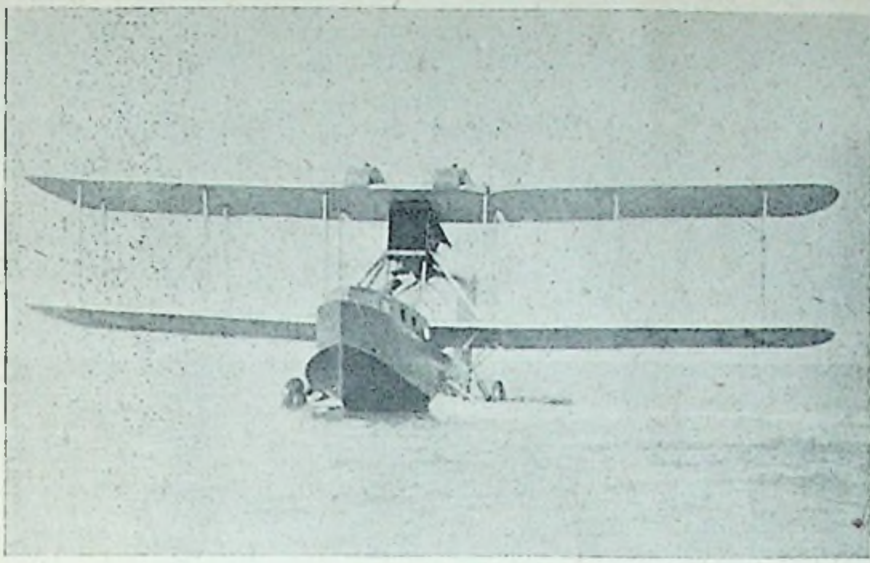
Landing in Fog.

The buildings on Lympne aerodrome were all picked out with red lights to warn us of the high points, while on the ground a big letter T was formed with flare lamps, to give us the direction of the wind.

Before we finally touched the ground I had seen those red lights and that T from every possible position as Cobham rose, fell, twisted and turned in an endeavour to get down when the fog, which was patchy, had cleared for a moment.

We continued in daylight to Paris and tried to fly back to London a night or two later, but fog again spoiled our attempt and we were flying for over an hour above a solid "earth" of fog. I found it interesting, but felt no fear or anxiety as to our safety.

I have since been a passenger in a King's Cup Air Race machine, when we flew all day in fog and lost our way. Eventually, when we attempted to land in a field, we crashed into a wood. It was not nice, and I have never liked a fog since.



Coming ashore after landing on the sea off Blackpool. Another thrill safely ended.

A Forced Landing in the Sea.

Another adventure, also in a King's Cup Air Race, was to land in the sea off Blackpool in a supermarine flying boat, which for the purposes of the race had no wing-tip floats. The machine was being used exclusively over the land and it was not thought they would be necessary.

When we arrived over Blackpool we could not find a field large enough to land in—our machine was a big and heavy one—and as our petrol was nearly all used up we had to land on the sea. Before we had reached the beach our machine, by reason of the engine being placed high up, had a dangerous list, and we were all ready to swim for it if need be.

Other milder adventures were to see a cinema entertainment in an aeroplane flying over Kent and have lunch in a big double-engined passenger liner flying over Croydon. It was a bitter disappointment, too, because although I was enjoying my champagne and lobster salad there were others who were far from happy, and Sir W. Sefton Brancker, who was with the pilot, seeing their condition, ordered an immediate return to land.

Broadcasting from the Air.

In the same machine, too, I accompanied the Savoy Orpheans when they broadcast from the air.

I accompanied them, but gave them no attention. For one thing they were completely drowned by the drone of the engines, and just before we were due to start off an oil pipe on the starboard engine broke and let all the oil out.

It delayed us twenty minutes while it was being repaired. When we eventually took off I was far too interested in the behaviour of that engine and was listening much too keenly to its exhaust note for the slightest sign of failure to give the Savoy Orpheans much attention.

I took part in other milder adventures after this, such as wireless transmission and reception on a train travelling to Newcastle from London, and hearing the first broadcast reception in an aeroplane.

While these adventures were following one another in a pleasant succession I made the acquaintance of a very quiet and unassuming man. It was Mr. J. L. Baird.

How I met Mr. Baird.

He first crossed my path one evening about 1923 when I was hurrying up to get home after a hard day's work. He came in to see the editor, and as the editor had already gone I was sent down to deputise.

After the usual formalities he announced: "I have built a television apparatus," with the same quiet indifference that one would display if one said "I have picked a penny up in the street."

I am afraid I was not thrilled, and, like all pressmen, wanted to know more. One gets so many people coming into a newspaper office who say they have done this, that, or the other thing, that strange announcements have no effect.

A colleague who happened to be with me soon gave it up as hopeless and put Mr. Baird down as "another of those mad inventors." I have since learned that in another office which Mr. Baird visited the editor told his assistant: "There is a madman in there who says he has invented something. Go in and see what he wants and get rid of him, but make sure he has no razors on him!"

"WHERE ARE WE?"

Pilot Lieut.-Col. C. C. Minchin (in centre, white hat), Mechanic (extreme left), Mr. Fox (right) and friend trying to fix their position after getting lost in fog and crashing into some trees.

A Chat in a Teashop.

By great good fortune I did not think that, and to discuss the matter Mr. Baird and I adjourned to a teashop, and over a marble-topped table we discussed his invention. As a wireless enthusiast I wanted to *know*, and Mr. Baird did his best to satisfy my thirst for knowledge.

He succeeded so far that he gave me enough to write a short paragraph drawing attention to what he had done.

At that time he was down at Hastings. I next met him about six months later when he had a laboratory in Frith Street, Soho, and there I first saw his apparatus. It was weird and wonderful, and to see it was in itself an adventure.

Weird Apparatus.

As an amateur mechanic I was amazed at what he had improvised out of the most unpromising material. String, cardboard, and pieces of rough wood with Meccano parts; bits of bicycles, and strange scraps of Government surplus stores all combined to make the television machine which introduced me to television as a visual fact.

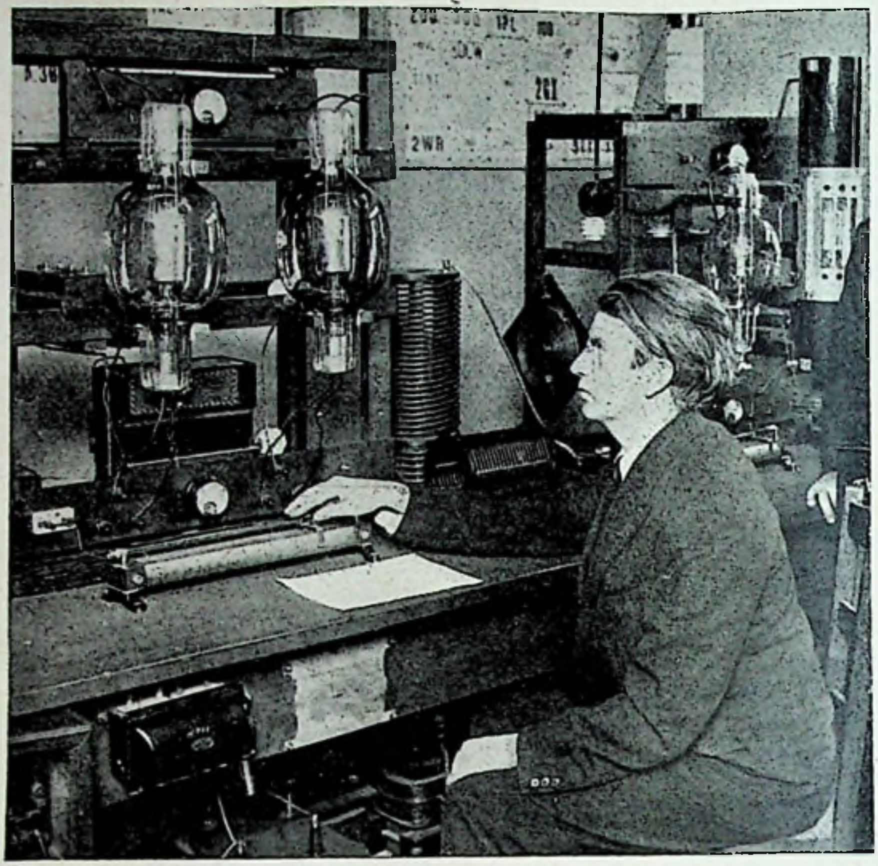
When he started it up I expected to see the whole crazy contraption fly to pieces, or else go up in a flash of blue flame as its wires fused! Nothing happened beyond a grunting and groaning as the various ill-assorted pieces worked together. After adjusting a number of rheostats, some of which were on the other side of the room and controlled by long wriggling pieces of rod, Mr. Baird said: "Now look in there and I will put my head in front."

I watched, and sure enough when he had threaded a perilous way to the other end of his apparatus I saw a pale mask of a face appear floating, as it were, on a whirling black background.

Mr. Baird Demonstrates.

I was genuinely surprised, and in view of the crudeness of the apparatus that had produced such a result, I was convinced that he had the method upon which true television would be built.

A steam engine built on such lines would blow up; a wireless apparatus would not even howl; while a cinematograph, perhaps the most nearly related, would certainly not produce moving pictures.



Mr. J. L. Baird seated before the 2 kw. amateur wireless transmitter which performed such yeoman service in the recent transatlantic experiments. The station is at Coulsdon, Surrey; its call sign is 2 KZ, and its wave-length is 45 metres. Television transmissions may sometimes be heard from this station after midnight.

The next time I visited Baird he took me into a nearby room and introduced me to a small box, in one corner of which the image appeared. This was only connected by cable with the transmitting apparatus, and it proved the soundness of his method of synchronisation. When the two pieces of apparatus had settled down to their job the image was steady. There was no "hunting" for it by varying the speed of the receiver in an endeavour to keep pace with the transmitter. They followed each other as faithfully as a man's shadow.

On that crude apparatus I saw the first wink and other facial movements transmitted by television.

It was in Frith Street that Mr. Baird subsequently gave his now historic demonstration of television to forty members of the Royal Institution on January 27th, 1926, images of the faces of members being sent from one room to another.

The small party he had expected turned out to be about six times the size of the available accommodation, and while he demonstrated and explained inside I tried to entertain the overflow on the stairs. There was nowhere else he could put them.

"A Matter of £ s. d."

While the demonstration was on we were afraid all the time someone would get caught up in the "machinery" or get a nasty shock, but nothing happened, and for the first time I heard the remark, made by the late Mr. Sanger Shepherd: "He has got it. Development is now purely a matter of £ s. d." That gave me a real thrill, for this was the birth of a new branch of science, and I was present.

In Frith Street Mr. Baird spent his time, it seemed to me, between giving demonstrations to doubting Thomases (some of them could not see wood for trees, and, it seems to me, would if they dared question the truth of broadcasting) and keeping his accumulators up to standard. They were the worry of his life, for, having little capital, he could not afford expensive apparatus and had to "make do" in a number of ways.

Watching Progress.

All the same he contrived to do a little development work, and when the time came to move to Motograph House, St. Martin's Lane, it was marked by a decided improvement in the image obtained, both as regards size and by the first appearance of true detail. There he gave further and more convincing demonstrations. People recognised one another when they were transmitted, and the receiver and transmitter were separated by a greater distance than had been possible at Frith Street.

Motograph House saw the birth of noctovision, and to me it savoured of "black magic" and the supernatural to sit in a room in which one could not see one's hand before one's face and yet be told of every movement of one's head and face. It was even more remarkable to have the room filled with a dense impenetrable chemical fog and yet see through it by the apparatus as though it were broad sunlight on a clear summer day.

Motograph House saw, too, the successful transmission to Glasgow.

Serious long-distance wireless tests, too, were started here. I, as an outsider, was content to watch developments and offer to the press, when circumstances seemed to warrant it, a short story of what had occurred or was happening.

I never realised whither the road was leading or that the culminating adventure was, as far as I was concerned, to have my face sent over the Atlantic to be recognised in New York. That it proved such an adventure was, for me, but another kindly turn of fortune's wheel.

Televised Across the Atlantic.

It is strange, too, that the next move of the growing company—to Long Acre—should be marked by another step forward. What will follow?

I went to Long Acre to "see the fun" in the same cheerful spirit in which from time to time I have always "dropped in" on television. A pleasant chat with some congenial spirits on wireless or television problems, the inspection of some new pieces of apparatus or half-completed experiments was all I expected. In fact I was engaged in this very pleasant way of passing the time when Mr. Baird approached me and asked me if I would care to be a subject.

I assented with somewhat the same feelings as one responds to a dentist's attendant when asked to "Step this way, please." I was not afraid. I was prepared to make some sacrifices; but was not prepared for the sensations which I experienced. One could be excused for thinking I was hardened, blasé, and bored, but television made me feel more uncomfortable than any of my other adventures.

Television Fright.

When I sat down my lips felt like stable doors badly hung on rust-bound hinges. My eyelids felt like cellar flaps, and my ears seemed to have grown enormously and to be flapping about like an elephant's; while every movement seemed to go jerkily and not at all in the smooth way which one expects. It was a clear case of television fright.

I think Mr. Baird must have realised this, for he began to address me in the broadest Scotch and made such queer noises that I had to laugh. After that laugh all went well, and I was at home again. The half-hour transmission passed like five minutes. I could not realise that through that shimmering little window into which I had been looking my face was being sent to America. It did not seem possible. Even later on in the day, when I learned I had been recognised in New York, a sense of unreality still hung over it.

All the same, television has given me a thrill which nothing else yet has.

Seated on the left: Mrs. Howe, wife of an American journalist, the first woman to have her image televised across the Atlantic. This photograph was taken whilst the transmission was actually taking place.

THE CONTENTS OF THE
MAY NUMBER
will include constructional details of a Simple Televisor divided into
TWO SEPARATE MACHINES
(a Transmitter and a Receiver)
together with details on
METHODS OF SYNCHRONISM

How to Make a Simple Televisor

Concluded from our March issue.

ADJUSTMENTS AND EXPERIMENTS.

By Our Technical Staff.

IT is proposed in this issue to give hints on the operation of the "Televisor" described in last month's issue, but before doing so certain improvements, mainly in the optical system, will be described and explained. In another article in this issue a specially developed amplifier is described which enables the H.T. voltage required to be reduced to 250.

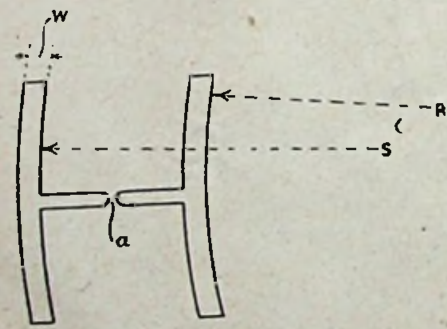
As originally designed, the optical system consisted simply of a concave mirror placed behind a 400 watt projector lamp at such a distance that an image of its filament was reflected on to the selenium cell.

Now the main disadvantage of this method is that the ordinary cheap concave mirror is not perfect, and consequently the image of the filament formed by those rays which pass through a given aperture in the spiral disc is not in the same position as the image formed by rays passing through any of the other apertures. Hence if the spiral disc be slowly rotated the image of the filament will be seen to wander within quite wide limits across the face of the cell, and, in addition, there will be noticed a fleeting and less brilliant image whose motion is in a vertical direction. This latter is formed in the same way as the image produced by a pinhole camera, the "pinhole" in this case being one or other of the square apertures in the spiral disc.

New Optical System.

This difficulty may be largely overcome by using a pair of exactly similar converging lenses, either plano- or bi-convex. One of these is placed between the projector lamp and spiral disc so that the filament is at its principal focus, while the other is placed behind the spiral disc so as to focus the image of the filament on to the cell. The arrangement is shown diagrammatically in Figure 1, and it will be found to be very much better than a concave mirror. The lenses should be four to five inches in diameter and should have a focal length of about seven inches.

Another point which will require attention is the provision of some suitable screening for the projector lamp, as the light is very brilliant,



How the stencil is prepared. The radii S and R start from a common centre.

and in addition to being very trying to the eyes, it will mask the dim light of the neon tube. Any simple contrivance of box form made from sheet tin or cardboard is suitable, but if the latter is used plenty of space must be allowed, because a great deal of heat is radiated from the lamp. In any case some ventilation is advisable as a protection to the lens.

An additional refinement would be to substitute for the stencil holder (the holder for the object whose shadow is to be transmitted) described in last month's issue a "Bulldog" paper clip screwed by one arm to a wooden upright. This enables the stencil to be adjusted in position so that the best results may be obtained.

This concludes the suggested improvements to the original design, so that a few practical hints on operation may now be given.

Cutting the Stencils.

When considering objects the shadows of which are to be transmitted, simple stencils which the amateur can cut himself out of thin cardboard are perhaps the best with which to commence experiments. A very useful and instructive one is the letter H, and the cutting of such a stencil will be described in some detail.

As each of the square apertures in the spiral disc moves on a circular path, the limbs of the H will be curved in corresponding arcs, so the stencil must be cut accordingly (see Figure 2). Thin card or copper foil is suitable, and the material can be cut with a sharp penknife. It should preferably be coated with dead black celluloid paint after cutting. It is desirable to leave a small strengthening web in the centre of the horizontal crossbar of the H, as shown at *a*, Figure 2.

Correcting Image Reversal.

While on the subject of stencils, it should be mentioned that the image formed by this simple televisor may be described as a "focussing screen" image. That is to say, like the image seen on a camera focussing screen, it is upside down. Now, in the transmission of the shadow of the H stencil this defect will obviously not be very apparent; but the amateur should bear this fact in mind when constructing on the same principle stencils for the letters T, E, F, G, etc. The experimenter may perhaps care to try the effect of focussing the received image on to a ground-glass screen by means of a converging lens. The resulting image will then be erect, but brilliance will be lost.

Working Adjustments.

Having made the stencil, it should now be adjusted in its holder, the projector lamp being switched on so that the shadow is thrown on to the spiral disc. The latter is then slowly rotated by hand and the passage of the square apertures over the shadow observed; the outermost aperture should trace exactly the outer vertical limb of the H, and the stencil should be adjusted until this is the case. When this has been achieved the innermost aperture should trace over the inner vertical limb, while the remaining light apertures should pass over the horizontal limb one by one, if the stencil has been cut accurately and the light beam is truly parallel.

The interruptor disc should then be started, and about 30–50 volts switched on in series with the selenium cell. The filaments of the amplifier should then be switched on. Switch off the projector lamp and adjust the filament rheostats so that the amplifier does not oscillate. Oscillation is indicated by the neon tube, which will suddenly light up very brilliantly. Should this occur the last valve should be switched off, or it may be seriously damaged. The other filaments must be reduced in brilliancy before again switching on the last valve.

Focussing the Projector Lamp.

Having stabilised the amplifier, the description of which appears elsewhere in this issue, switch on the projector lamp and see that the image of the filament remains on the cell during the whole time of illumination of both the vertical limbs. While this is the case the neon tube should light up, but should remain dark when no light is falling on the cell. Once this condition is attained the motor driving the spiral disc should be switched on, and the speed adjusted by the rheostat until the image of the H is formed clearly and distinctly when the neon tube is looked at through the spiral disc.

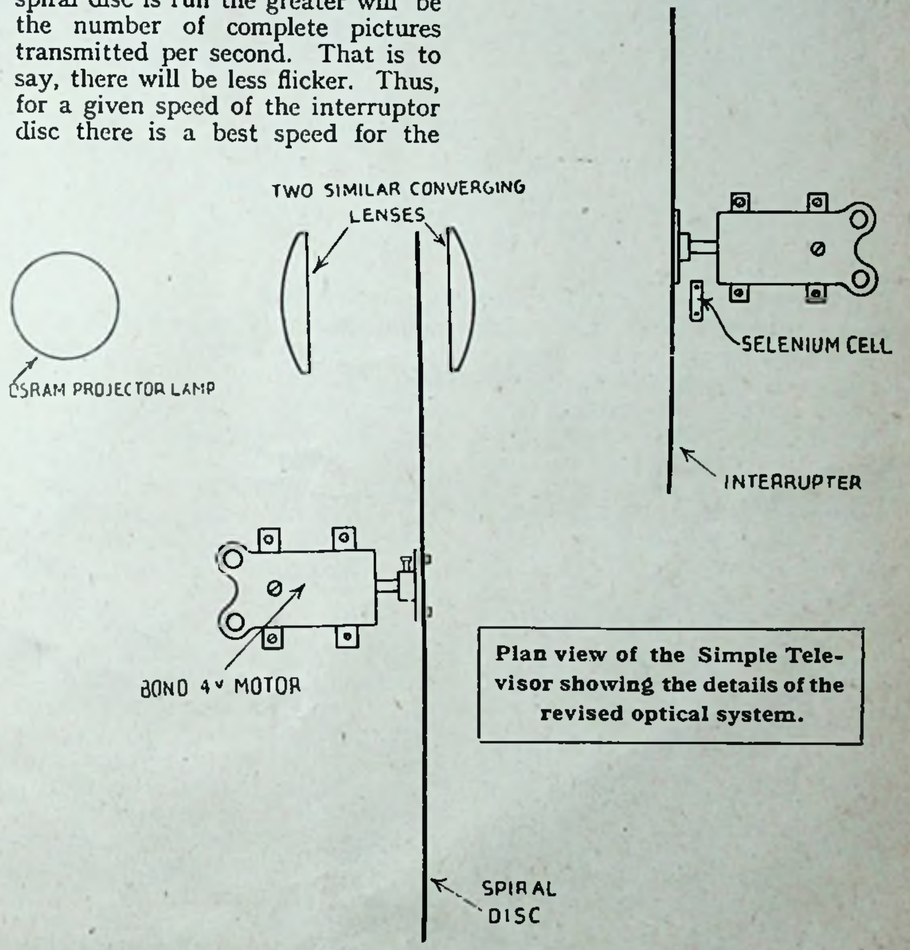
It is necessary for the interruptor disc to be run very fast so that the picture has as fine a "grain" as possible. This will be more readily grasped if the stencil is removed and the appearance of the bright field of view at the receiving end is examined while the spiral disc is being speeded up. The faster the latter is run in relation to the speed of the interruptor the more will the field of view resemble a chessboard arrangement, and this can only be counteracted (i.e., so that the field is uniformly bright) by increasing the speed of the interruptor.

On the other hand, the faster the spiral disc is run the greater will be the number of complete pictures transmitted per second. That is to say, there will be less flicker. Thus, for a given speed of the interruptor disc there is a best speed for the spiral disc. This best speed is a compromise between the two extreme conditions—a fine grain and a complete absence of flicker.

There is also a further consideration which limits the speed of both the spiral disc and the interruptor, and that is the lag of the selenium cell. This can be easily demonstrated. Keeping the frequency of interruption constant, speed up the spiral disc and watch the horizontal limb of the image of the letter H. It will be observed to shift in the direction of rotation of the spiral disc to quite a noticeable extent, often as much as half an inch, while at the same time it broadens out.

In addition it will be noticed that whereas, at slow speeds, the upper and lower edges of the horizontal limb were sharp and well defined they now shade off gradually, while the whole broadens out considerably to perhaps more than twice its original width.

It is impossible in a single article to deal with all the possibilities of this little machine, or with all the experiments that can be performed with it. Enough has been said, however, to show the enormous scope there is for the amateur experimenter to modify or to improve the apparatus in accordance with the indications resulting from his own research.



Plan view of the Simple Televisor showing the details of the revised optical system.

WHERE L.F. AMPLIFICATION COMES INTO TELEVISION

By JAMES B. ELMORE

We describe below an amplifier suitable for use in conjunction with the Simple Televisor described in our last issue. This has been tested by our technical staff. Since the publication of our last issue, further development has made possible a considerable reduction in the value of the H.T. voltage required to operate the neon tube.

IT probably came as a happy surprise to many of our readers that the very familiar low-frequency amplifier figures in the apparatus necessary for television. At first sight, however, the actual part it played must certainly have been rather a matter for conjecture. Everyone would be quite at home when associating a low-frequency amplifier with a wireless receiver, but in connection with the new science of seeing electrically there was good ground for being puzzled.

Nearly every possessor of a wireless receiver, at least those who have had to visit their local dealer to purchase replacement valves, knows that a wireless set usually embodies high-frequency stages, a detector stage, and one or more low-frequency stages. It is with this last part of the wireless set that we are now concerned. As the description implies, these stages deal with the lower frequencies; or, in other words, those impulses which are within the limit of audibility. This means to say that if one placed a pair of telephones in the plate circuit of the valve we should be able to hear sounds either in the form of music or speech according to the type of sound which was being passed through the amplifier.

Outside the Limit of Hearing.

Sound as translated into wireless impulses is transmitted through the ether outside of the limits of audibility. The feeble oscillations which are collected by the aerial pulsate very much more rapidly. For example these pulsations, in the case of 2LO, are 830,000 per second. This high speed frequency is known as high-frequency; such rapid vibrations are outside the limit of human hearing.

Speaking in the general way, the human ear responds to a frequency band between 25 and 14,000 vibrations per second. These audible sound vibrations are interpreted by our sense of hearing as familiar sounds of musical instruments and human voices.

In the case of the well-known pianoforte, its frequency band extends from 32 to 4,096 vibrations per second. So far as our wireless set is concerned the low-frequency side deals with vibrations from about 30 to 10,000. Over this band are located the sounds we hear emanate from our loud-speakers. Therefore, in writing of low-frequency amplification we do not refer to something intangible, but rather to a very commonplace matter with which we can all feel at home.

A Frequency of 600 per Second.

It has often been heard that some possessors of wireless sets have expressed the wish for stronger signals at their loud-speakers. It is not quite clear with everyone that the desired increased amplification is only obtainable by the addition of a further stage or stages of L.F. amplification. Radio, or high-frequency amplification adds range; L.F. adds volume.

When we come to television we again deal only with low-frequency amplification. The actual vibration or more accurately the frequency at which we amplify is 600. On the piano scale this would be roughly D♯—the second black key above the C one octave higher than middle C.

When referring to our wireless set we saw that the low-frequency side dealt with a very wide frequency band; from 34, perhaps a little below, up to 10,000 vibrations per second. In television low-frequency amplification is confined within very narrow limits. So far as this goes we are able to sacrifice certain points in the design which, were the amplifier destined for a wireless set, we could not well afford to do. But it must not be understood that because the amplification is within a narrow and prescribed limit we shall be able to play fast and loose with the design of an amplifier for such apparatus as the Simple Televisor described in this and our previous issue. Just as in wireless, we must beware of incorporating in the amplifier poor components. Therefore exercise similar care in the choice of the low-frequency transformers for your televisor amplifier as you would if about to build an amplifier for adding to a crystal or one-valve set.

The Importance of the L.F. Amplifier.

As you have experienced with some types of transformers, there is a peculiar tendency for certain notes to be brought out more prominently than any other. Mark you, such a resonant peak must be very strongly marked or it is only apparent to the highly-trained musical ear and to very delicate testing instruments. It is said that the human ear is not capable of detecting anything less than a 10 per cent. variation in sound intensity. While the ear may be unresponsive to this degree, may the same lack of sensitivity be equally true of the eye?

Should you see a letter distorted, or what would be a more accurate word, twisted, would the average eye detect or spot such divergence from the original?

Is it to be decided that the eye is more trained than the ear or that the eye is less sensitive than the ear? We think that present readers will all agree that the eye is far more difficult to deceive. On this account, therefore, it is clearly very important that the low-frequency side of our Simple Televisor is not to be overlooked as being of little consequence.

The true state of affairs is rather to the contrary. Extremely sharp resonant peaks may perform all manner of tricks with the image seen in your Simple Televisor. It is desirable to employ a group of low-frequency transformers which have flat amplification curves. We use the word group, for indeed we have to use more low-frequency amplification in television apparatus than we do in our wireless set. This, if not for any other reason, calls for great care in the selection of the individual components in a television amplifier.

Three Stages Necessary.

In the early days of broadcasting many of us wishing to run a battery of loud-speakers resorted to three stages of transformer-coupled L.F. with very little success. The absence of suitable valves, to mention only one point, brought many complications our way which were not easy of solution. It was found that immediately upon switching on only a tremendous and unceasing howl rewarded our labour. This was all too disappointing. Most of us wisely gave up the endeavour to obtain satisfactory results from the arrangement and lived in hopes of some improvement taking place which would enable us to enjoy without tears all the amplification we required.

Consider then, that our Simple Televisor calls for three or four stages of L.F. amplification which must function without howling, whistling, or distortion.

It is not required to solve the problems which we encountered in those early days. Valves have improved beyond recognition. L.F. transformers which are available today bear no resemblance to those types which we were compelled to employ two or three years ago. The builder of the Simple Televisor will be able to succeed here where in the past he was certain of being ill-favoured with failure

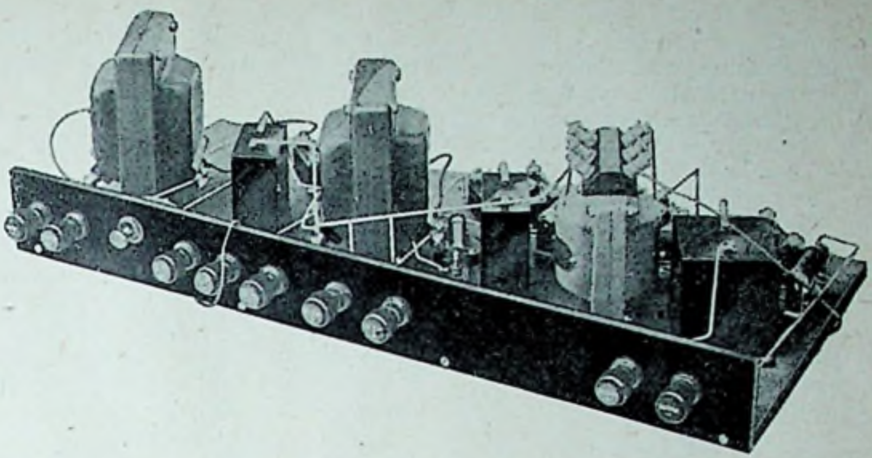
With these preliminary remarks in mind, any one of you will be able to tackle the construction of an amplifier suitable for use in conjunction with his television apparatus. Such an amplifier we now propose to describe.

Whereas in the case of our wireless set the low-frequency amplifier passes on impulses which the loud-speaker translates into music and speech, in your Simple Televisor the impulses passing through the amplifier are fed into a neon tube with the intention of providing the light. For this purpose we must set out to design an amplifier which gives maximum amplification without any difficulties which may upset the perfect functioning of the final portion of the apparatus.

Avoiding L.F. Oscillation.

As you will gather by a little thought, inefficient design would not result in a consistently good performance. By way of illustration we may refer to the presence of L.F. oscillation which is caused by battery-coupling and stage interaction. This causes the neon tube to light up steadily and brilliantly.

The avoidance of oscillation is most important. It is probably more important to steer clear of it than to set out to achieve that for which we aim in the design of an amplifier for addition to a detector stage. Therefore, one's first consideration is to choose a group of L.F. transformers which will work together without L.F. oscillation. Trouble of this kind is readily distinguished. Interminable howling and whistling on test is a sure sign that your amplifier suffers from L.F. oscillation, the cause of which is most likely due to the fact that the transformers you



Another view of the amplifier showing more clearly the angle at which the L.F. transformers are set.

The layout of the amplifier is clearly shown by this illustration. It will be noted that large by-pass condensers are arranged across the high-tension tappings.

have chosen to employ do not work in harness.

Before aiming for maximum amplification strive for stability. When you have obtained this, then you will be able to satisfy your main object—that of securing the highest degree of amplification from the least number of valves and transformers.

Many of you are wondering what the duty of a L.F. amplifier is in television apparatus. Very briefly it amplifies the converted light impulses so that we are able to use the characteristic glow-discharge of the neon tube.

Neon Tube in Place of Speaker.

After the image, or letter, as it happens to be in this instance, has been explored by one aperture in the "exploring" disc the reflected light is directed on to the selenium cell which has the property of converting the light rays converging upon it into electrical vibrations. These vibrations have the same characteristic as a note of the piano before it is translated into sound by our loud-speaker. Such vibrations or impulses the amplifier can deal with very efficiently, as you know. Remember, it is this simplicity of operation and simpleness of essential apparatus which, on the one hand, is your assurance of success, and, on the other, the great fascination of the Baird system of television.

After the converted light impulses have passed through the numerous stages of the amplifier until finally reaching the anode circuit of the last valve, nothing takes place which in any way is any more mysterious than in your wireless set. At this point of television apparatus, however, in place of the loud-speaker or head-phones, we have a neon tube.

The Simplest L.F. System.

Is it not all very fascinating? With such equipment who among you could not be assured of certain success?

The more experienced experimenters to be counted among our many thousands of readers will be able to proceed with the construction of a suitable amplifier without further assistance. They will know by past efforts what is required. We ask them to follow the design they fancy best. For example, resistance capacity coupling may make its appeal to them or, alternatively, a combination of transformer and R.C.C. These systems call for more care in construction and design than the arrangement described in this article. More than two stages of R.C.C. call for very special arrangements which we feel would be better dealt with on a future occasion.

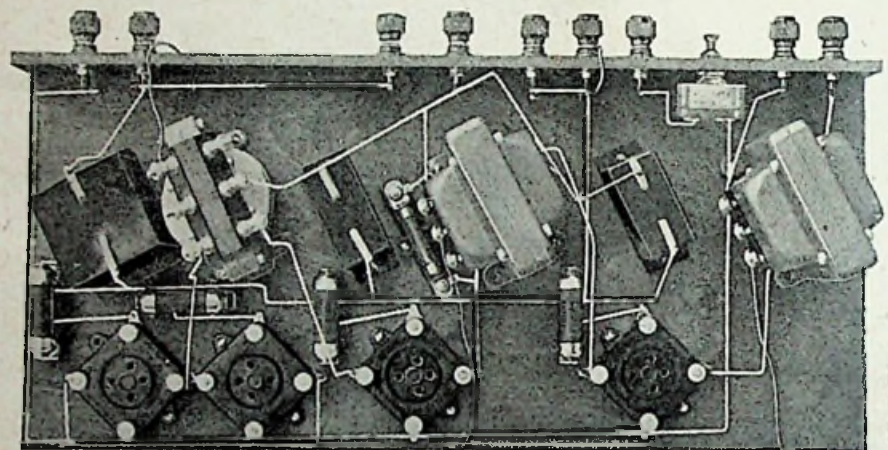
Immediate Success Assured.

Our object in choosing the amplifier published in this issue was to ensure immediate success. We believe that every one of our readers would, by far, prefer to turn his attention to experimenting with the actual television side of it rather than to devote time and energy to getting the amplifier to work, while the remaining part of the Simple Televisor lay idle on the bench.

recommended by the plan views given in the illustrations. Otherwise, you will be faced with curing L.F. oscillation, which is not an easy affair. Place the transformers exactly as they are shown in the photographs and screw them down on the baseboard at the angles prescribed.

For the sake of convenience one may use a wire such as "Glazite," which is sold covered with insulation, or employ "Junit."

Our injunctions on the question of mounting the transformers also apply just as much to the wiring itself. Back-coupling, besides taking place because of magnetic fields linking up, is very often traceable to interaction between adjacent wiring. As far as possible follow the course of each wire



A plan aspect showing the baseboard layout. It is important to follow this closely as any modification may result in instability. Across the centre L.F. transformer is connected the 100,000 ohm resistance.

In the Simple Televisor Amplifier we have three transformer-coupled stages of low-frequency, arranged so that it is connected direct to the selenium cell on the input side and to the neon tube at the output end. Terminals are provided where battery leads are necessary; their disposition should be that which is laid down in our illustrations. The same remark applies most emphatically to the placing of the transformers and the direction taken by the wiring.

Our previous references to L.F. oscillation now begin to have their bearing. Great care in layout is not essential when up to a pair of transformers is being used. Interaction is not often encountered; three stages, however, demand different treatment. Unless you have had previous experience with multi-staged L.F., adhere very conscientiously to the layout extremely carefully so that your amplifier becomes a duplicate of the original and published design. By so doing you are certain of avoiding any difficulties.

Choice of Valves.

Our choice of transformers has been made with consideration of the fact that the more wealthy will make use of a large power valve output such as the 040, where many will by force of circumstances rely upon a power valve of the L.S.5 or D.F.A. class. Under our heading of suitable valves will be found the necessary terminal modifications for which different valves will call in order to gain maximum overall efficiency.

The value of high-tension current and grid-bias required are also fully covered under the appropriate headings.

There is a very important reason for the use of power valves of the types enumerated in our list of recommended valves. Referring once again to the familiar wireless set, it is usual to employ a general purpose valve for the first L.F. stage and follow it up with either a small power valve or a super-power valve. In most cases such an arrangement will supply all the power the average listener requires, but more signal energy than this is required for the successful operation of the Simple Televisor.

Therefore, we make use of power valves with a larger grid base; these valves are capable of handling greater signal voltage without overloading. Do not attempt to operate your Simple Televisor with valves other than those which we have specified. Otherwise you are certain to meet trouble in the form of overloading with consequent distortion.

Two Last Valves in Parallel.

So important is it to avoid overloading that the Simple Televisor amplifier incorporates two valves in parallel at the output. By this means it is possible to feed almost double the energy into this last stage without any fear of overloading. As the diagram shows, the anodes and grids of V.3 and V.4 are connected.

There are very few points in the construction of this amplifier which will present any difficulties to readers. Reference to the theoretical diagram shows that a resistance to the value of 100,000 ohms is connected across the secondary of the second transformer. This is included to ensure stability in all circumstances. Such a resistance, complete with holder, is marketed by Dubilier and is obtainable from any wireless dealer.

It will also be noted that a fixed resistor is connected in series with the negative filament of each valve. The correct values are to be found in the list of valves. Those used in the original amplifier are marketed by S. S. Bird & Co., Ltd., under the trade name of "Heavy Duty Resistors," and are also to be obtained from your usual dealer.

Valve-holders may be of the standard type, but do not be tempted to incorporate makes other than well-known products sold under brand names. Benjamin were chosen for the published design; Lotus or Pye would be just as suitable.

Details of Layout.

The photographs show the disposition of the respective components and readers should be able to proceed without any hesitation. Our photographs do not show any cabinet, but, while at the point of going to press, we understand that one suitable for the purpose is in production by Camco. Whether or no a cabinet is necessary each should decide for himself. Of course, once the amplifier has passed a preliminary test, a cabinet would keep dust from settling on it and protect the apparatus from accidental damage.

It is not important to solder; you will find that the components in the published design allow the wires to be connected either by soldering or by the use of terminals. The theoretical diagram shows the exact terminals on the L.F. transformers to which connections are made. For the information of our readers the makes used in the original amplifier are manufactured by R. I.-Varley—the first two being of the Straight Line type, while the third is a standard Multi-ratio.

Valve Combination for Six-Volt Accumulator.

V.1.—P.M.6 (Resistor 4 ohms) or D.E.5 (Resistor 4 ohms).

V.2.—P.M.256 or D.E.5A (Resistor 2 ohms).

V.3.—D.F.A.7 or L.S.5A (Resistor 1 ohm).

V.4.—D.F.A.7 or L.S.5A (Resistor 1 ohm).

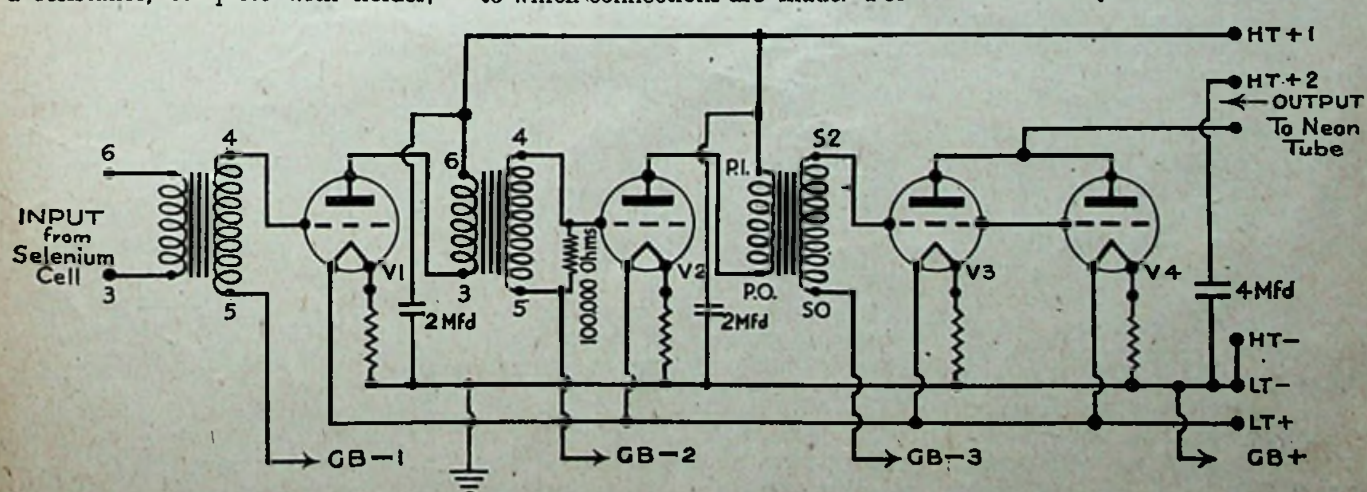
Should you refer to the valve makers' characteristic curves for the above valves it will be noted that more than the normal 120 volts H.T. is required. In point of fact all the H.T. above 200 volts will give improved results. The values given in the following table are as recommended by the valve makers and should be adhered to as closely as possible.

High Tension Values.

H.T.+ tapping No. 1 feeding V.1 and V.2, 125–150 volts.

H.T.+ tapping No. 2 feeding V.3 and V.4, 200–300 volts.

As a rather high value of high-tension current is used in television, more than usual care should be exercised when attaching or changing battery leads. With this in mind, builders of this amplifier are advised to use the Belling-Lee insulated type of terminal. Lisenin wander plugs were employed for the grid-bias and H.T. leads.



The complete theoretical diagram of the amplifier showing exact connections

Grid Bias Valves.

G.B.1.—7 to 9 volts.

G.B.2.—18–24 volts.

G.B.3.—From 100–300 volts, according to the value of high tension used. We recommend the value of 250 volts H.T. when the grid-bias value should be approximately 100.

An Important Note.

One little point which occurs to us is the temptation to experiment with grid-bias values. Most of us make adjustments while our sets are in operation. While this is not a good practice, the comparatively low H.T. voltages applied to a receiving set, result in scarcely no harm being done to the valves. The same does not apply to television amplifiers, however, *and if it is thought necessary to make any adjustments to the grid-bias, switch off the filament current by means of the L.T. switch.* That this should be made a regular habit cannot be stressed too greatly. To remove the bias on the grids with a high value H.T. on the anodes will seriously damage the valves. The switch in question is made by Igranics.

Testing the Amplifier.

The long-forgotten crystal set will provide a useful means of testing this amplifier for stability should it be necessary. If you have followed the published design such a test need not be made. For all that, it is quite within reason that many readers will prefer to put the amplifier through a preliminary test. All that it would be necessary to do in this event would be to link it up with the crystal set in the ordinary way. Do not connect a small loud-speaker to the output terminals; it would probably suffer some damage from the tremendous signal voltage which this amplifier will deliver.

Remember, it is not easy to obtain absolute stability with more than two stages of transformer-coupled L.F. Therefore, adhere to the published design, which, by the way, has been connected to a simple crystal set to confirm its stability of operation. The crystal set test is extremely appropriate, as the output from the selenium cell is approximately crystal strength. If stability is obtained in these circumstances, one is certain that it will function equally efficiently in your Simple Televisor.

The Constructor and the Experimenter

By "Ruminator."

THERE are two essentially different types of amateur. The first, and perhaps the most general type, comes under the heading of the constructor. It is the constructor who provides the backbone of the present amateur wireless industry. For him the chief joy in wireless is the building up of a set. He delights in the handling and gradual building up from indiscriminate parts and crude shapes of ebonite, the beautiful finished set, resplendent with brass terminals, highly-polished panels, and glittering dials. The actual working of the set is a secondary consideration. He forms a direct contrast to the experimenter.

The apparatus of the true experimenter is invariably the very reverse of a thing of beauty. Globules of sealing-wax, nightmare cobwebs of tangled wire, indiscriminate slabs of raw unfinished woodwork, usually comprise his workshop. No sooner has he assembled one of his contraptions and obtained from it a few results than it is pulled down to give place to another erection.

For him the results are the primary object. On the other hand, he often, in his eagerness to achieve immediate results, defeats his own end. His ideas may be thoroughly sound, but they become invalidated by the crudity and makeshift nature of his apparatus.

Somewhere between the two, between the whole-hearted constructor and the whole-hearted experimenter, lies the desirable *via media* along which success is to be achieved.

The man who concentrates his whole attention upon producing a beautiful article is only too apt to forget that his apparatus is, after all, only a means to an end.

He who, on the other hand, concentrates entirely upon results, forgets that results are impossible without adequate and efficient apparatus.

Technical Notes

(*continued from page 14*).

By carefully choosing the position of the lamp the spot of light coming through the lens 3 can be arranged to fall on the same bit of the object as the cell is seeing through lens No. 2. Lens No. 3 moves downwards at exactly the same rate as lens No. 2, so that the spot of light will move downwards at the same rate as the exploration takes place.

Determining Correct Positions.

The positions of the object, selenium cell, and the lamp could be explained in terms of solid geometry, but a simpler way of defining them would be to place your eye in the position of some particular bit of the object and look through the lens 2. The selenium cell is placed in some position so that you can see it through the lens No. 2, and then without moving your eye you look through lens No. 3 and place the lamp in some position in which you can see it. As your eye takes the place of only a very small portion of the object this one test is not enough. The eye should be moved downwards, say, to the bottom of the object, and the disc moved until the selenium cell is visible through the lens 2. In this position it is necessary that the lamp also should be again visible through the lens 3, and it will be clear from the geometry of the system that this result can only be achieved if the lamp and the selenium cell are both at the same distance from the object.

Dividing up the Image.

The lenses in the disc are arranged spirally so that the selenium cell sees one particular strip of the object through lens No. 2 and sees another strip through lens No. 3, the second strip lying closely against the first strip, and it is this lateral displacement of each lens with respect to the one ahead of it that requires the lamp C to be placed somewhat to one side of the selenium cell.

In this scheme the lamp remains stationary, and the movement of the light-spot is caused by the movement of the lens 3 which lets a beam of light through it. It follows, therefore, that the beam of light projected by the lamp must be big enough to cover the whole object, so that a part of the disc itself is strongly illuminated. As this part of the disc is facing the selenium cell, it must be painted dull black, so that no light is reflected from it on to the selenium cell.

LIGHT UPON THE RECEIVING END

By WILLIAM A. FERGUSON

This article gives some interesting information about neon tubes and their function in Television apparatus.

DOUBTLESS many readers of our last issue came across for the first time a printed reference to a "neon tube." It is quite possible, however, that a majority had heard of neon tubes before it was informed that such a device is needed for televisors. Most of you who have visited London will have marvelled at the wonderfully brilliant signs which are to be seen in all the main thoroughfares.

Have you not stood in the centre of Piccadilly Circus and remained spellbound before such a wonderful sight as is to be seen there every evening after the sun has gone down? Signs radiating in all colours of the rainbow, above your head and on every side. In the main these picturesque signs are made possible by the neon tube. There you see them made in endless designs, illustrating this, that, or the other product.

A Very Familiar Device.

Prior to reading about a neon tube in our description of "How to Make a Simple Televisor," in our last issue, you would have had no idea that such a familiar means of producing light featured very prominently in television. As you know now, it is a very important piece of the apparatus and for the moment, at any rate, it enables us to see clearly and distinctly the object being televised.

Advanced experimenters with radio apparatus will, of course, be more familiar with the neon tube. They will recall that it may be made up into a very useful testing instrument for measuring very high resistances and large capacities. One or two manufacturers of variable grid-leaks have used the neon tube at exhibitions to demonstrate the fact that their variable grid-leaks were really variable over the full movement of the plunger and that such variation was gradual and not spasmodic or jerky.

Present readers will therefore realise that in the neon tube we have a very familiar device after all.

CONGRATULATIONS FROM A PROMINENT ENGINEER.

"I am pleased to hear of the proposed publication of a monthly magazine on 'Television.' It is easy to wish it success wholeheartedly because such success would at the same time connote the success and progress of this striking new development of electrical science.

"The extent to which it has recently been possible to interest the general public in such developments is shown by the wide support afforded to special magazines which consist largely of technical matter, and is a gratifying feature of the days in which we live."

COLONEL T. F. PURVES, M.I.E.E.,
Engineer-in-Chief, General Post Office.

Although almost commonplace, its function in a televisor is not to be under-estimated. In point of fact the work that it does in the Simple Televisor which many of you are in the process of building is extremely important. Were it not for the properties of this lamp it would not be possible for you to commence experiments with television.

The lamp will enable you to see a demonstration of television in your own home. That is something which more than a month ago you would have considered as nothing more or less than utterly ridiculous; and yet to-day you are in the wonderful position of being able to show your family and friends the initial steps towards that degree of success which Mr. John L. Baird reached in his recent achievement of bridging the Atlantic with his television apparatus.

This sounds almost too magical; for all that, it is a definite fact. The neon lamp gives the light at the receiving side, if one may use that expression in the case of the Simple Televisor which the technical staff of this journal has built and described for the benefit of its readers.

The Value of Threshold Voltage.

Elsewhere in this issue the constructional details of this televisor are completed, and the technical staff have prepared interesting information on its operation. So far as this article is concerned we propose to deal with the neon tube or lamp.

It consists of two electrodes in a glass bulb which is exhausted of air and then filled to a low pressure with neon gas. When a voltage of about 160 is applied across the two electrodes an electrical discharge takes place, which produces a pink glow within the tube. This discharge will continue, once it has been struck, until the voltage falls to about 140, when it will cease.

Thus we see that at a given voltage applied across the electrodes of a neon tube we see light. In the Simple Televisor, which many of you are now building, the voltage is supplied by the high-tension battery, a positive lead from which is connected to one of the electrodes of the neon.

It will be noted that the position

of the neon tube in the circuit is in the anode lead of the last valve of the amplifier. Briefly, it interprets in terms of light the current variations in the anode circuit of the last valve. On the transmitting side of our Simple Televisor we have a selenium cell which has converted light vibrations into electrical impulses which are passed through the valve-amplifier in due course to impress the grid of the last valve.

In the Anode Circuit of Last Valve.

The electrical impulses in the anode circuit of the last valve are applied across the electrodes of the neon tube. This enables us to see in the form of a shadowgraph the outline of the letter which we are in the process of televising.

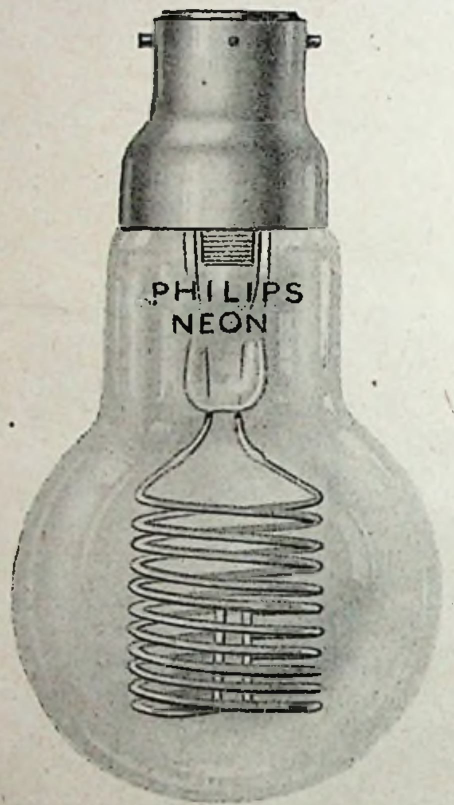
We have previously stated that as the voltage rises the pink discharge becomes stronger, and as the voltage falls the discharge weakens until it ceases altogether. In the case of the television apparatus at present before us the constant voltage obtained from the H.T. supply must be high enough to strike and maintain the discharge. The current varies, however, at the same frequency as the light is interrupted at the selenium cell. Looking at the neon tube in operation it appears to give a steadily fluctuating glow. Should a continuous bright light be observed, trouble in the L.F. amplifier is indicated.

Those fortunate readers who have arrived at the stage of seeing a letter televised by television apparatus of their own construction may well feel proud of themselves. Such we know to be many, many thousands. Speaking for ourselves, we visualise a vast army of enthusiastic experimenters treading along a very definite road. As we advance so we shall describe in simple language the apparatus used.

The Electronic Theory.

When speaking of radio-receiving valves reference is often made to electronic emission. We know that when the temperature of the filament is raised to a certain figure by passing a specified voltage across it, electrons are emitted. These electrons carry charges of negative electricity which surround a small nucleus. This nucleus bears a much greater positive charge than the negative charge of one of the negative electrons surrounding it. But the negative electrons are proportionately more numerous, with the result that the negative charges exactly balance, or neutralise, the positive charge; and the group of one positive nucleus, together with its several attendant negative electrons, becomes electrically neutral. With neon there are ten negative electrons surrounding one positive nucleus.

The process of detaching an electron from an atom which is made up of the nucleus and its attendant negative



A typical form of neon tube suitable for use with The Simple Televisor.

electrons is called ionisation, and an atom which has lost one of the electrons normally surrounding the nucleus is said to be ionised. Ionisation may take place in many ways. For example, an external electron may move with considerable speed towards an atom to be repelled by an atomic electron since each would be negatively charged. This repulsion may be so strong that an electron may be ejected from the swarm surrounding the nucleus. Meanwhile, the external electron will proceed, though diverted from its original course, through and away from the atom.

The atom will contain one less electron than usual, and since it is usually neutral it will now be positively charged. At the same time there will be the ejected electron bearing a negative charge at some little distance from it. These opposite charges will attract each other with the result that the ejected electron will once more fall back into the atom and restore the initial condition. This process is called ionisation followed by recombination. When this occurs the atom concerned emits light.

Continuous Ionisation.

The light from a neon tube comes from atoms ionised by this process. Every reader will know that if two electrodes, separated by air or other gas at the usual pressure, when connected to a source of electric supply and the voltage gradually raised, a spark will ultimately pass. The discharge in a neon tube is only a spark in a gas at a low pressure.

There are always free electrons in any gas, and when one of these comes into the electric field between the two electrodes it begins to travel towards the positive terminal, gaining speed as it goes on. It soon encounters an atom and if it has gathered sufficient speed it will penetrate into the swarm and ionise the atom. The ejected electron also begins to move towards the positive terminal, gather speed, and ionise atoms on its own account. The electrons it ejects will ionise in their turn and so the process goes on, each ionised atom being the cause of ionising others.

The Design of a Neon Tube.

Discharge will only commence when the strength of the electric field and the distances between atoms are so related that an electron in the interval between two encounters has time to get up the speed required to ionise. This relationship is governed by the distance between the electrodes and the pressure. The field for a given voltage is greater the less the distance between the electrodes, and the distance between atoms is greater the less the gas pressure. Thus the voltage at which the discharge will start is reduced by bringing the electrodes close together and by using a low pressure. The use of neon gas enables discharge to commence at a comparatively low voltage where formerly it was necessary to use as much as 2,000 volts.

It will be seen that the electric lamp manufacturer has played his part in making possible "Television in the Home."

The General Electric Company's Recent Television Experiments in America

A Special Article

By Dr. E. F. W. ALEXANDERSON,
Chief Consulting Engineer to the G.E.C.

NOTE.—*As promised in our Editorial in the last issue of this journal, we publish below a special article describing the recent American experiments.*

The General Electric Company are following along the lines laid down originally in this country by Mr. Baird in the now classic experiments which he carried out in January, 1926. They use shutters for image-exploring and a glow discharge lamp as the light source at the receiver, just as used both by Mr. Baird and by the American Telephone and Telegraph Company in their previous demonstrations of television.

This is particularly interesting, because the original system described by Dr. Alexanderson proposed the use of mirrors as the image-exploring device, and an arc lamp in conjunction with a magnetically-controlled shutter as the varying light source.

This system has apparently been found impracticable by the General Electric Company, who have reverted to the use of apparatus which has already demonstrated its ability to do the work required.

The article indicates the immense interest and activity shown in television by the great American corporations, who have been spending vast sums of money upon research into the subject. It will be doubly encouraging to the British reader to know that in the field of television British enterprise and inventive genius was first, and still maintains an indisputable lead.—EDITOR.

BEFORE we could think seriously of television broadcasting we had to convince ourselves that a television receiver could be simplified to the point where it could be made available in the home of the average man. In order to test out the practicability of a television receiver for the home we constructed a model receiver of the greatest possible simplicity and distributed several duplicates of it in some homes in Schenectady.

Television receivers may be worked out in a variety of ways according to well-known principles. The first choice to be made was to select the source of light. This choice was soon narrowed down to two alternatives. The light control developed by Professor Karolus of Leipsig and the Neon lamp developed by D. McFarlan Moore of the Edison Lamp Works of the General Electric Company.

Tests of these two sources of light for television soon convinced us that each has its own distinct field of usefulness. When a large volume of light is needed for projection on a screen the Karolus system is preferable. The work on television which I described in a paper last year was built around the idea of using the Karolus light control for projecting television images on a large screen.

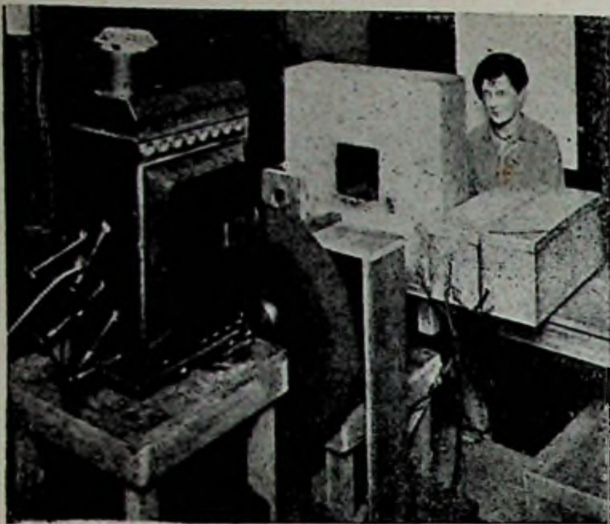
The other light source available for television was the lamp invented by Mr. Moore, who proposed this lamp for television in a paper as early as 1906, but it was not until 1913 that he received a quantity of neon from Sir William Ramsey which enabled him to construct a practical lamp. While the Neon lamp does not compare with the Karolus light in brilliancy it is more sensitive and easier to operate. The distinct fields of usefulness of these two systems thus become evident: The Karolus light for the large television projector and the Moore light for the home receiver.

The Neon Tube.

Most experimenters with television in Europe, as well as America, have used the Moore lamp. Mr. Moore has developed one television lamp which gives a uniform glow over a flat plate and another which gives a concentrated light in a cavity in the electrode. An enlarged and improved lamp of the first type was one of the important elements used in the demonstration of television by Dr. Ives of the Bell Laboratories last April. The tubular lamp with 2,500 electrodes was also based on the Moore invention.

One of the features of the demonstration by the Bell Laboratories at that time appears to be a valuable contribution to the art of television—the arrangement of large photo-electric cells for intercepting the reflection from a moving spot of light. This system saves the eyes of the subject from the glaring light

Dr. Alexanderson (leaning on back of chair) "looking in," while an assistant tunes in the television receiver. Note hand control of receiver driving motor in assistant's right hand.



The projector lamp and revolving disc. The beam of light shines through the square opening on to the figure to be transmitted. Behind the opening, and round it, are grouped three photo-electric cells. (See "Technical Notes," page 12.)

to which he would otherwise be exposed. The Bell Laboratories photo-electric system has been adopted in our equipment for broadcasting television and will probably prove to be one of the factors in the development of practical television.

Returning to the design of the television receiver, we had the choice between three well-known systems—the mirror drum, the disc with lenses, and the disc with holes. Our conclusion was that, while the mirror drum and the lens disc may have certain advantages for television production on a larger scale, we decided that from the point of view of television in the home a hole is more economical than a lens and 48 holes are more so than 48 lenses.

The Question of Synchronism.

Whenever television has been discussed in the past there has always been some pessimist who has wound up the discussion by asking how are you going to synchronise? The answer has always been that we will have a synchronous motor and transmit a special synchronising wave or synchronise to the picture frequency or to a tuning fork. But all these devices mean higher cost, special amplifiers, and more things that may get out of order. We therefore simply decided to leave out all this complication. We took a standard motor made for household use and manipulated its speed by an electric hand control. With a little practice and co-ordination between the eye and the hand it is possible to hold the picture in the field of vision as easily as one steers his car on the middle of the road. In special cases when the transmitting and receiving systems are on the same power net-work, the machines may be operated by 60-cycle synchronous motors.

Experimental Transmissions to Continue.

Experimental television programs will continue to be broadcast from a laboratory transmitter on a wave-length of 37.8 meters with the accompanying voice transmission on the regular 379.5 meters of WGY. As soon as it is found that the range can be extended the television transmitter will be transferred to the high power short wave experimental station at South Schenectady. A new transmitter is being built for this purpose, so that the voice and the television can be radiated simultaneously by two transmitters.

We feel that the inauguration of this new development will be the starting point of practical and popular television. The transmission is the expensive part of such an undertaking and we feel that it is our privilege to provide it. The television transmitter is nearly completed at our South Schenectady plant.

A Projector Aerial.

A part of this equipment is a new type of projector antenna which is now being tested with music and voice modulation, and favourable results have already been observed in San Francisco and Europe. We have called this a projector antenna because it does not pretend to be a beam. The radiation that would be wasted backward and sidewise is saved and projected in the general direction where it is desired. After trying several types of projector system we have arrived at a type which we call the checkerboard antenna for reasons which are apparent from its appearance. It is built in a checkerboard pattern; the sides of each square being a wire half a wave-length long. All these half-wave antennas are connected in such a way that they oscillate in phase and require no tuning or adjustment.

A duplicate of this transmitter is being installed in the San Francisco broadcast station of the General Electric Company. This plan was decided on in order to provide means for systematically studying the physical phenomena of wave propagation over long distances.

Television aids Examination of Wireless Phenomena.

Television will here serve as a means to an end, but in the determination of wave phenomena one thing is certain, that the eye is infinitely superior to the ear for ascertaining facts and for critical analysis and comparisons. This has already been proven by our television tests in Schenectady. Occasionally, when we "look-in" on television at our homes uptown, we observe a visual echo of the wave from the ionised layer of the upper atmosphere. The evidence of the echo is that two images appear side by side instead of one. The echo image is usually displaced a distance corresponding to one fifteen hundredth of a second, showing thereby that the echo wave had travelled

(*Continued on page* 37.)

The receiving equipment as viewed from the back. On the bottom shelf can be seen the L.F. amplifier, above which are the batteries. The pointing finger indicates the motor which drives the disc. The motor control is in the left hand of the erect figure. Immediately above the motor is the neon tube.

BOOK REVIEW.

Practical Television.*

The book before us, *Practical Television*, is true in its title and the author, E. T. Larner, A.M.I.E.E., of the Engineering Dept. of the G.P.O., is to be complimented on his lucid style and the faculty of sensing the demands of his generation of readers.

A foreword by Mr. J. L. Baird indicates the universal intuition of mankind for the attainment of unity through worship, happiness or the pursuit of truth, in which the true devotee to scientific research finds a beatitude.

In *Practical Television*, the introduction summarises the fundamentals of modern data relating to vision subjective and objective, light, wave-lengths and persistence of vision, and compares the practical methods of sound and sight transmission.

The author rightly realises that "the object of a book should be to inspire or excite action" and presents the pioneers of his subject in entertaining text. Early experiments with selenium cells are well illustrated, and such accessory apparatus as the string galvanometer, the point-o-lite lamp and the mechanism for photo-telegraphic transmission lead up to well-defined "prints sent by radio."

The increasing number of users of selenium and photo-electric cells will undoubtedly use the volume, as the latest types have carefully been selected for treatment, and circuit diagrams and graphs, with illustrations of cells, supply a much required chapter.

The suggestions and researches of Continental workers on television could not be omitted, and the application of the cathode rays is thoroughly described.

The physics of the subject is sufficiently covered for popular reading, where light, lenses, shadows and images are discussed, but the reader is left with the inspiration which "the fine black shadow" makes, to wish for more on the subject of diffraction.

That we hark back to Newton for a qualified corpuscular theory is suggested by the phenomena in connection with photo-electrics, though the author is cautious in seeking safety in the wave-theory as a working hypothesis. Such geometrical optics as are included are helpful for the purposes of the book, and do not enslave the reader unduly.

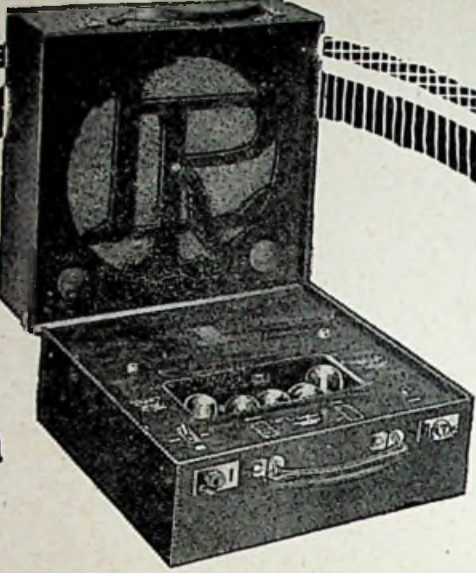
It is on the chapters on the Televisor and its developments that readers of this journal will focus. The steady progress of the Baird system is well stated and fairly comprehensive.

A discussion of noctovision and phonovision complete an unusually practical and readable odd volume.

The appendix is a meritorious effort to keep up with advance and describes the trans-Atlantic transmission, but fails to keep pace with the mid-Atlantic reception of the Long Acre transmitter.

Practical Television is a welcome contribution to the literature of television. At the moment it is a text-book and provides an unbiassed and scientific review and is a presentment of the principles of all known theorists and experimentalists in this virgin field of research, and justly apportions its climax to the advances made by Mr. Baird in the development of his system. J.M.D.

* Practical Television, published by Ernest Benn, Ltd. (175 pages, 97 illustrations. Appendix, two tables, and Index). Price 10s. 6d.



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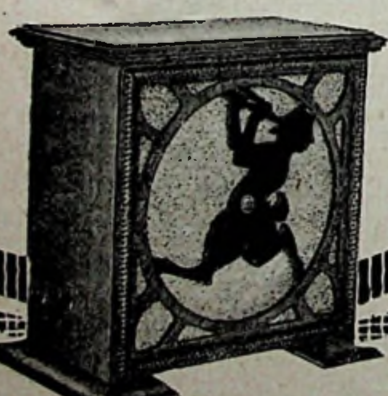


Mention of "Television" when replying to advertisements will ensure prompt attention.

Ray Tracing: Optical Designing and Computing

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

PRIMITIVE man must have known that when a straight stick is thrust obliquely into a pool the stick appears to be broken or bent where it enters the water. A charming experiment, which must have delighted generations of children, depends upon this fact. It was first described nearly 2,000 years ago by Cleomedes, the Greek astronomer. It is shown in Figure 1. A penny or other small heavy object (A) is placed at the bottom of an empty bowl. The young experimenter then moves away until the penny is quite hidden from view by the edge of the bowl. In this position, of course, any ray AC, passing from the coin over the edge of the bowl must pass above the eye. Let someone now, whilst the experimenter stands perfectly still, fill up the bowl from a jug of water. As the water level rises the penny will be seen rising into view from behind the edge of the bowl until, when the bowl is full, the penny will be seen an inch or more above its original position along the line OB.

How a Wave is Refracted.

The phenomena of refraction had to wait for explanation until Huygens advanced his wave-theory of the propagation of light, at the end of the seventeenth century. The explanation then given was so beautiful and simple, and of such a fundamental character in the science of optics, that it is deserving of the closest study. Figure 2, which is taken from Huygens' "Traité de la Lumière," published in 1690, shows how a wave is refracted or bent in passing from one transparent medium to another across a common plane bounding surface. Let us suppose that in the figure the line AB, is the trace of the plane surface of a block of glass, into which light is passing from the air above.

The wave AC, moving in the direction DG, then falls upon the flat surface AB obliquely, so that when the lower end A of the wave considered is just about to enter the glass, the end C has still a distance CB to travel before it reaches the glass.

Let us further assume that whilst the waves are passing over this distance CB in air, the wave produced at A *in glass* has travelled at a lower velocity, through a shorter distance, therefore, AN, the direction of which we do not at present know. All that we do know is that at the instant the light-wave reaches B, the disturbance produced at A in glass, as the light-wave was passing through C, must be somewhere on the circle struck from A with a radius AN.

The Path of the Ray.

By similar reasoning, it will be seen that when the wave AC has reached the position K_1L_1, the distance away of the wave starting from K_1, in glass will, when the element of the wave at L_1, reaches B, be such that it bears the same ratio, to the length L_1B, that the distance AN does to the length CB, and so on for all the wavelets which may be looked up as originating at all points between A and B; and, since the line BN is a common tangent to these wavelets, it is the trace of the wave into which the wave AC passes on refraction.

Further, since a ray is a normal to a wave-front, we may say that the ray DA, in air, incident upon the glass surface at A, is bent or refracted into the direction AN in glass. This construction of Huygens' is so important that we will draw the rays DA, AN, and the normal EAF, on another diagram, Figure 3, in which about the point A a circle is drawn.

Diagrammatic Explanation of Refraction.

With a radius equal to unity, perpendiculars DB, and NC, are dropped on to the normal. Let the angle between the incident ray DA, and the normal be α, and that between the refracted ray AN and the normal be β. Assuming with Huygens that the velocity of the waves in air bears a constant ratio to the velocity of these waves in glass, no matter in what direction they pass (which is equivalent to assuming that the media are homogeneous), it will be found upon consideration of the two diagrams, Figures 2 and 3, that it follows that for any value of α the ratio between the lengths of the two lines DB, and CN, is constant, and is equal to the

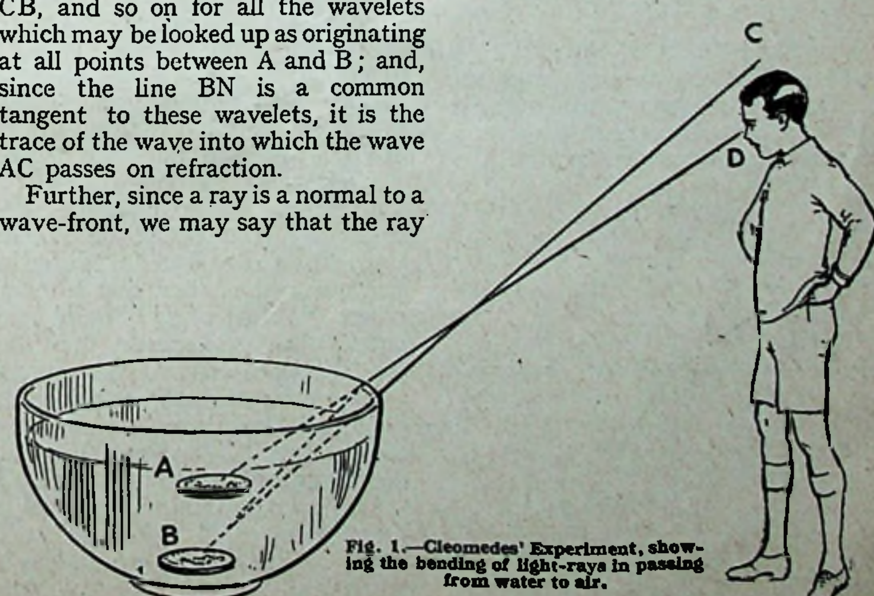


Fig. 1.—Cleomedes' Experiment, showing the bending of light-rays in passing from water to air.

ratio between the lengths of the two lines CB and AN, which, by construction, is equal to the ratio of the velocity of the waves in the first

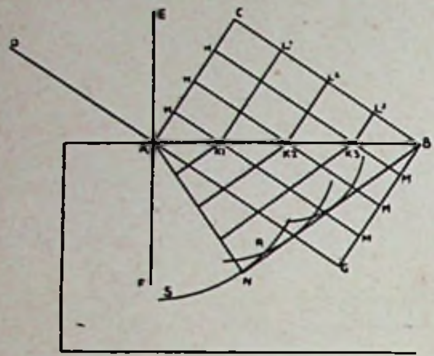


Fig. 2.—Huygens' explanation of refraction by his wave-theory.

medium to that of the velocity in the second one.

Let us designate this constant, which is known as the "index of refraction" of the medium into which the light passes, by the letter n. Then—

$$n = \frac{DB}{NC} = \frac{\text{Sine } \alpha}{\text{Sine } \beta}$$

Also—

$$n = \frac{CB}{AN} = \frac{\text{Velo. in air.}}{\text{Velo. in glass.}}$$

Thus the index of refraction has two meanings—one geometrical and the other physical. When the index of refraction for a light crown glass is said to be 1·50, this means that if a ray of light passes into it at any angle of incidence equal to α, it will upon refraction make an angle β with the normal such that—

$$\text{Sine } \beta = \frac{\text{Sine } \alpha}{1{\cdot}5}$$

As we shall see later, this constant n depends upon the wave-length of the light employed. Red light, for example, travels in glass with a greater velocity than does blue light.

Fig. 3.—Diagram illustrating Snell's law of refraction.

The following analogy will probably assist students to a clear understanding of Huygens' construction. A rank of soldiers on the march advances in step and along a direction at right angles to its front, so that marching in these respects is analogous to the propagation of wave-motion.

Let us see if we can push the analogy further. Suppose in Figure 2 that that part of the diagram above the line AB, represents a parade ground separated along the line AB, from a field of stubble occupying the lower part of the diagram. Now let a line of soldiers AC, advancing in the direction DA, strike obliquely the

" I consider that the most fertile fields of radio for the amateur experimenter and young engineer just out of college are short waves, directive transmission, and television. I believe television is finally emerging from the laboratory. It will be seen in homes throughout the land, but I do not know how soon."— SENATORE G. MARCONI.

separating line AB, and further let the rate at which a soldier can march in the stubble be only two-thirds of that which he can do on the parade ground.

When, therefore, the first man at A enters the stubble, which of course he does sometime before the last man at C does so, he has an interesting problem to solve, and that is to find a new direction of march AN, such that when all the men, one after another, have entered the stubble, and marched off in the same direction, they will find themselves arranged along a line BN, and marching in a direction at right angles to their front.

This sergeant-major's problem is therefore solved by Huygens' construction and also by Snell's law of refraction.

The discovery of this famous sine-law has a curious history. Ptolemy, who lived in the second century of our era, determined experimentally the

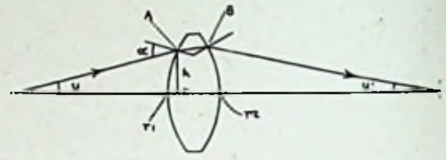


Fig. 4.—Illustrating trigonometrical ray-tracing.

angles of refraction corresponding to given angles of incidence varying from 0° to 80°, for air and water, air and glass, and water and glass; and yet, although the greatest trigonometer of his time—one of the founders, in fact, of the science, and one who had himself constructed with great geometrical skill a complete table of sines of angles increasing by half degrees of arc—he failed to discover the simple relation existing between the sines of the angles of incidence and the corresponding angles of refraction for any given pair of media.

Early Investigations.

The subject of refraction was subsequently investigated by Alhazen and Vitellius with great care, but the law eluded their grasp. Then, at the beginning of the seventeenth century, Kepler attacked the problem, but although, by assuming a constant ratio for the angles of incidence and corresponding refraction when small, he was enabled to give the first correct explanation of the optical action of a telescope, he met with little more success than his predecessors.

Finally, about 1620, that is 15 centuries after Ptolemy, Snell, a professor of mathematics at Leyden, discovered the law which in England is known by his name. Snell died soon after this, and his manuscripts were unfortunately not published, with the result that the law of refraction was first given to the world by Descartes, as a discovery of his own in the year 1637.

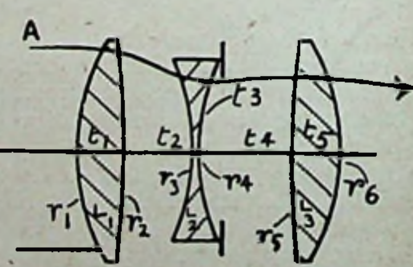


Fig. 5.—The Cooke photographic lens.

In the early days of optical manufacture lens systems, such as those required for microscopy and photography, were almost entirely produced by workshop trial-and-error methods, which often led by long and expensive experiments to useless results.

By the modern method of designing, however, which is based upon the trigonometrical tracing of rays, workshop trial-and-error work is rendered unnecessary—trial-and-error work is still required, but it is done on paper only.

The Design of Optical Systems.

Figure 4 illustrates diagrammatically the way in which the path of a ray is traced through a single lens of axial thickness t, and with radii of curvature r_1 and r_2, and having a known index of refraction n. Suppose that the incident ray makes an angle u with the axis and falls upon the first surface of the lens at a known height h above the axis. From these data the angle of incidence α can be determined, and with the known value of n the path of the ray through the glass. Similarly, upon emergence through the point B the final emergent ray can be traced and the angle u_1, at which it crosses the axis, and the position of this point found.

Figure 5 is a diagram of the optical system of the famous Cooke lens, invented by H. Dennis Taylor in 1893. The constructional data required for any optical lens system are:—

(1) The kinds of glass employed for the various lenses of the system, preferably by reference to the glass-maker's catalogue.

(2) The radii of curvature of the various lens surfaces.

(3) The axial thicknesses of the lenses, and their separations in air.

In the example shown the first and last lenses are made of the same glass with an n value of 1·511, whilst the n value of the glass of which the middle lens is made is 1·604. The successive radii of curvature r_1 to r_6, together with the thicknesses and separations t_1 to t_5, are also given numerically. With these data any number of rays falling upon the first lens can be traced through the system and thus the necessary information obtained for the determination of the optical qualities of the system.

"Seeing by Electricity" in 1880—

(*concluded from page* 8).

the action of light on the metalloid selenium.

The clockwork revolves a shaft K, forcing the arm L and wheel M to describe a circle of revolution. The screen N, being fastened firmly to the wheel M, turns as wheel M revolves on its axis, thus turning the sliding piece P, and selenium pointed disc, or ring B, towards the wheel M (see Figure 9). These two motions cause the point, disc, or ring B, to describe a spiral line upon the glass TT, thus passing over every portion of the picture projected upon glass TT.

The selenium point, disc, or ring, will allow the electrical current to flow through it in proportion to the intensity of the lights and shades of the picture projected upon the glass plate TT. The electric currents enter camera at A and pass directly to the selenium point, disc, or ring B; thence through the sliding piece P and shaft K by an insulated wire to binding screw C (Figure 7); from this screw by wire to binding screw D (Figure 8) through shaft K and sliding piece P to point E (Figure 8); then through the chemically-prepared paper placed against the inner surface of the metallic plate XX by wire F to the ground, thus completing the circuit and leaving upon the abovementioned chemically-prepared paper an image or permanent impression of any object projected upon the glass plate TT by the camera lens.

Figure 8 is the receiving instrument, which has a clock movement similar to that of Figure 7, with the exception of the metallic point E, in place of the selenium point, disc or ring (Figure 7) at B. Figure 9 is an enlarged view of clockwork and machinery shown in Figures 1 and 2.

G.E.C. Experiments in America—

(*concluded from page* 32).

about 200 kilometres; and yet the echo image is occasionally as strong as the direct image which has travelled only a few kilometres. Such phenomena obviously cannot be observed by the ear.

What we may learn about wave propagation by systematic study of television across the continent is something we can only vaguely imagine, but we do feel without any doubt that television is the new tool by means of which we are going to explore the secrets of space.

Announcement

THE proprietors of this periodical, Messrs. Television Press, Ltd., have the pleasure to announce that they have made arrangements with the owners of the World Patent Rights in the well-known Baird System of Television whereby they are able to empower their readers to become sub-licensees under such patents as affect their country of residence, for the limited purpose of the construction of one set of apparatus for television, if erected and operated by the sub-licensee purely as an amateur.

In order to avail themselves of this offer our readers need only fill in and cut out the application form, which will be found on page 16 of this issue, and address it to the Editor, "Television," 26, Charing Cross Road, W.C. 2.

The conditions relating to the grant of these sub-licences are as follows:—

1. This sub-licence is strictly personal and incapable of assignment.

2. The licence herein contained extends only to the manufacture of apparatus as described and illustrated in the issues of TELEVISION, numbered 1 and 2, or any other apparatus which may hereafter be specifically included herein by public announcement in that periodical during the period of this sub-licence.

3. The sub-licensee shall not permit any other person to make use of the apparatus constructed hereunder nor shall he sell, hire, lend, or give the same to any other person during his lifetime.

4. In the event of the death of the sub-licensee while in possession of apparatus made hereunder, the person or persons entitled to same by operation of law in case of intestacy, or by any testamentary disposition, shall be entitled to continue to use the same, subject to the conditions herein contained.

5. Any breach of any of the above conditions renders this sub-licence immediately void and, thereafter, the construction or use of the said apparatus is no longer permitted by virtue of this sub-licence.

6. This sub-licence may be determined or limited as to period, place, nature of apparatus, or otherwise, by notice published in TELEVISION or elsewhere, and publication of such notice in TELEVISION, or the posting thereof by ordinary letter posted to the address of the sub-licensee, appearing upon this sub-licence, shall be conclusive evidence of express notice to the sub-licensee, provided that such determination or limitation shall not affect the right to use the set of Television apparatus licensed hereunder in the place where it is at the date of such notice, if the same shall, prior to such date, already have been constructed and completed.

Transatlantic Television.

(It is regrettable that so many people in this country should find it necessary to rush into print either to " damn with faint praise " or adversely to criticise and belittle the pioneer work of Mr. J. L. Baird. It is refreshing, therefore, to read the whole-hearted admiration of the American Press, some extracts from which we reproduce below. Truly, " A prophet hath no honour in his own country."—ED.]

The *New York Times*, Feb. 11th (Editorial): " Baird was the first to achieve television at all, over any distance. Now he must be credited with having been the first to disembody the human form optically and electrically, flash it piecemeal at incredible speed across the ocean, and then reassemble it for American eyes.

" His success deserves to rank with Marconi's sending of the letter " S " across the Atlantic—the first intelligible signal ever transmitted from shore to shore in the development of trans-oceanic radio telegraphy. As a communication Marconi's " S " was negligible; as a milestone on the onward sweep of radio, of epochal importance. And so it is with Mr. Baird's first successful effort in transatlantic television. His images were crude; they were scarcely recognisable; they faded and reappeared, as the atmospheric conditions varied; but they were the beginnings of a new branch of engineering. . . .

" All the more remarkable is Baird's achievement because . . . he matches his inventive wits against the pooled ability and the vast resources of the great corporation physicists and engineers, thus far with dramatic success. Whatever may be the future of television, to Baird belongs the success of having been a leader in its early development."

The *New York Herald-Tribune*, Feb. 12th: " Baird has been experimenting a long time with television, and it has been his ambition to be the first across the ocean, in the well-known Lindberghian manner. He has succeeded, for, if the images that were received on the televisor in New York were crude, they were pictures, nevertheless. . . . If it be appreciated also that Baird is an experimenter of the most classic type, and that he has been struggling along for years with the crudest of equipment, built in the skimpiest shop, his recent stunt is nothing short of marvellous . . .

" When engineers in New York successfully demonstrated television on a telephone line about 200 miles long, between New York and Washington, Baird showed he could do the same thing by screening pictures in Glasgow of persons in London, a distance of 438 miles. It is said that probably one thousand engineers and laboratory men were involved in the American tests. Only a dozen worked with Baird."

The *Sun Telegraph* (Pittsburgh), Feb. 9th, referring to the received images, says: " They were comparable to the visions brought in at the A.T. and T. demonstration by air, from no farther away than New Jersey. The vision of the dummy, in fact, was clearer than those, but the moving faces were not so strong."

Television in mid-Atlantic.

A Passenger's Story.

By A. J. DENNIS.

WITH the normal wireless work of the ship going on in the usual way, a notable television triumph was accomplished on the Cunard liner *Berengaria* in mid-Atlantic a few weeks ago.

A little group of people (of whom I was privileged to be one) crowded together in a small reception room amid a maze of wires, batteries and tubes, and saw, projected on a screen in front of us, images of people sitting at the time in front of a transmitter in the laboratory of the Baird Television Development Company in Long Acre, W.C.

True, the images we saw were sharply defined only momentarily, and at times it was impossible to obtain any results at all, as, for instance, when a morse station got to work on the wave-length being used. But one image was sufficiently clear for Mr. Stanley Brown, Chief Wireless Operator of the *Berengaria*, to recognise his fiancée, Miss D. Selvey. All of us could pick out the face of a girl; we could see the way in which her hair was done; we could see her head turning slowly from side to side.

Previously we had seen the image of the head of a bald man with deep-set eyes clearly and sharply defined, resembling a photographic negative held up to the light, with only the outline of the chin a little indistinct.

This was a dummy which was used when the possibilities of transatlantic television were being investigated a short time ago.

It was not so much the result of the experiment—decided upon only the day before the ship sailed and performed under obvious and exceptional difficulties—that impressed those who, like myself, know nothing of the technical mysteries and intricacies of television. Rather it was the potentialities of the discovery which were driven home.

It did not seem difficult to imagine that in a few years' time passengers on liners like the *Berengaria* might sit at their ease capturing all the excitement of, say, the F.A. Cup final on the television screen in front of them as the match was being played at Wembley.

We could visualise the possibilities, and a little thought showed us that television will bring people in the most out-of-the-way regions into close and constant touch with scenes and events which they now see perhaps only once or twice in a lifetime.

Mr. S. W. Brown's Story.

In a special interview with a representative of TELEVISION, Mr. S. W. Brown, Chief Wireless Operator of the *Berengaria*, stated that when the image of Miss Dora Selvey, his fiancée, appeared on the screen, he had no difficulty at all in recognising her, first by her characteristic style of hairdressing, and later by her profile. " It was a wonderful experience," said Mr. Brown, " to be able to see Miss Selvey like that in mid-Atlantic, and the achievement clearly demonstrates the enormous progress which has been made in television."

THE BEST LETTERS OF THE MONTH

To the Editor of TELEVISION.

DEAR SIR,

I enclose form duly filled in and shall be glad to have a constructor's sub-licence.

Your first number of TELEVISION makes fascinating reading and conjures up still another scientific "thrill" for experimenters, some of whom have become quite blasé—after exploiting the wonderful and ever-increasing possibilities of W/T.

Best of luck for the organ's success.

Yours sincerely,

ARTHUR R. JEWELL.

"TRIORKY," BOSTON RD.,
HANWELL, W. 7.
February 27th, 1928.

To the Editor of TELEVISION.

DEAR SIR,

I was delighted to "discover" TELEVISION on sale to-day, and, as an early plodder in the realms of this wonderful science, your paper fulfils a hope that one did not expect to come true so soon. I send my most hearty greetings, and wish you every success. Please find application forms enclosed.

Yours faithfully,

A. V. KELLER.

"ELLESMERE," FANE ROAD,
THUNDERSLEY, ESSEX.
February 20th, 1928.

To the Editor of TELEVISION.

DEAR SIR,

The announcement by Television Press, Ltd., that they will allow amateur constructors to exercise a right which they already possess was probably greeted all over the country with the same tolerant smile which was accorded to the Marconi Co. on a similar occasion.

All serious experimenters know that: "Any patented article can be made as a bona fide experiment to see whether it can be improved upon, and so long as there is no intention of selling or using it for a profit. Patent rights were never granted to prevent persons of ingenuity exercising their talents in a fair way."—*Vide* Sir George Jessel in "Frearson *v.* Lee."

The making of apparatus described in TELEVISION does not of itself constitute an infringement. A constructor's sub-licence, therefore, confers nothing. On the contrary, it definitely seeks by its provisions to take something away. A signatory of the sub-licence undertakes to give up his pre-existing legal right to construct after the lapse of two years.

A sub-licensee continuing to construct after two years would still be immune from prosecution for infringement, but by reason of his folly in signing the sub-licence an action might lie for breach of agreement.

In view of the above, it would appear that a suitable legend for inscription at the head of the sub-licence would be: "Will you walk into my parlour, said the spider to the fly."

The foregoing is a summary of the thoughts which your sub-licence project aroused in my mind. I should be glad to have your comment either privately or through the medium of TELEVISION, on the publication of which I offer my congratulations, with best wishes for its future development.

Yours faithfully,

P. L. HOLDSWORTH.

9, UPPER GROSVENOR RD.,
TUNBRIDGE WELLS.
Feb. 26th, 1928.

To TELEVISION PRESS, LTD.,
26, CHARING CROSS RD., W.C.2.
March 13th, 1928.

DEAR SIRS,

You have put before us a letter addressed by Mr. P. L. Holdsworth to Television Press, Ltd.

We have referred Mr. Holdsworth's letter to our patent agents, who state that the belief expressed in Mr. Holdsworth's letter that "an amateur" can construct and use a patented article without infringing the patent, is a view which is quite commonly held, but it is an entire fallacy.

It is a fact that when a patent is infringed the patentee generally avoids bringing an action against a man of straw, and selects as the defendant a responsible company or individual, and therefore probably there never has been a patent action against a college student or pure amateur researcher.

The rights given by a British patent are that the "patentee by himself, his agents, or licensees, and no others may . . . make, use, exercise and vend the said invention." There is not the slightest shadow of doubt that if the owner of a patent found that someone without licence or authority made or used, or made and used the patented invention, the patentee could succeed in obtaining an injunction against such unauthorised construction or use. If the use had, on the one hand, not been for purposes of profit and, on the other hand, had been to a very small extent, merely an experimental extent, it is quite possible that the amount of the damages awarded by the Court would be correspondingly small, but it is quite common in patent actions for the damages to be negligible while the effect of the injunction is of the greatest importance to both parties.

Mr. Holdsworth has quoted the case of Frearson *v.* Lee, and indeed, this case has often been referred to as though it lent colour to the view that an amateur can use a patented invention without paying a royalty, but it is important that one should appreciate precisely what was decided in that case. Frearson had two patents relating to screws, and the nick in the screwhead was shorter than the diameter of the head. At the trial, the defendant relied on the prior patent of Newton, which disclosed a central hole in the head of the screw (instead of the nick formerly used), to receive a screw-driver in the form of a plug. Newton's specification stated that the lower part of the screw-driver could be made square or any other shape.

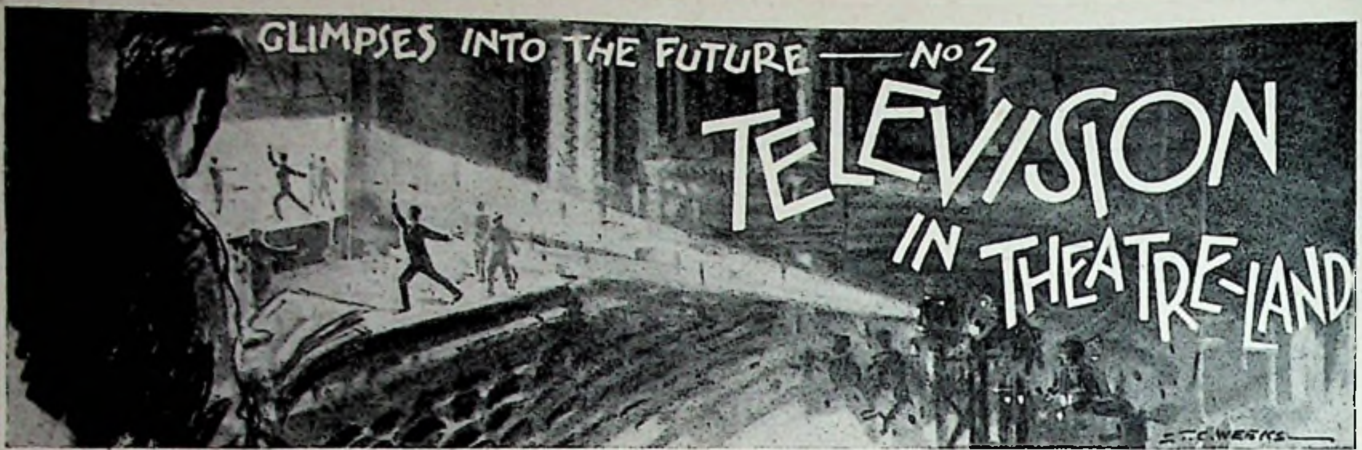
The defendant had not actually used the invention or sold any of the alleged infringing articles, but he claimed the right to use the screws complained of. The Master of the Rolls granted an injunction with costs, and ordered delivery up of the infringing articles.

The *obiter dictum* in the judgment to which Mr. Holdsworth is apparently referring began in the following terms: "No doubt if a man makes things merely by way of *bona fide* experiments and not with the intention of selling and making use of the things so made for the purpose for which a patent has been granted . . ." It will be seen that the Master of the Rolls had one very definite thing in mind, namely, that the experimenter was not going to make use of the thing made for the purpose for which the patent had been granted. The dictum, therefore, would have no bearing whatsoever on the very proper offer of free licences to amateurs which has been embodied in the announcement in TELEVISION for March, 1928, on page 42, because it is quite obvious from that offer that the licensees are to be free to make use of the apparatus which they construct, for the purpose for which the patents have been granted.

Yours faithfully,

BAIRD TELEVISION DEVELOPMENT CO., LTD.

133, LONG ACRE, W.C. 2.



By R. HEATH BRADLEY

As the curtain fell on the final act the audience rose to its feet with one accord, cheering, clapping, waving programmes, shouting for the author and for Bobby Mackey, the principal actor. And not the least enthusiastic amongst that vast audience was Sir Alfred Rouse, the best-known producer in London's theatre-land.

Even as he cheered he inwardly gibed at himself for being so demonstrative; he who had seen so many plays and been so long in the theatrical profession that even the best of new plays had to be superlatively good to arouse in him more than a passing flicker of interest. Yet this new American play was different . . . and superbly acted. It was obviously written expressly for New York's idol, Bobby Mackey, in such a way as to make the most of his varied abilities and the wonderful possibilities of skilfully managed "effects."

A Difficult Rôle.

Sir Alfred decided, there and then, that London should see that play, and see it soon. His determination was strengthened by the fact that he, and probably he alone, knew of an English actor capable of filling the difficult leading rôle. The part demanded that the actor should be an athlete—almost an acrobat—of no mean order; a singer with a voice well above that usually expected of an actor; a pianist and a violinist and, above all, a remarkably good actor who could play the parts of tragedian, comedian and lover.

A tall order, yet Sir Alfred was convinced that Jack Sheldon could play the part. Jack Sheldon, whose name was probably not known to one in a thousand London theatre-goers. It was only a chance meeting, miles from theatre-land, that had given Sheldon the opportunity of making known to Sir Alfred his varied abilities.

Twenty-four hours later Sir Alfred had the contract signed and packed in his trunk with the book of the play. Another twelve and he was at sea, on his way back to London.

Jack Sheldon was enthusiastic about the part offered him in the new play and very grateful for the chance it would give him of emerging from obscurity. He and the rest of the company which Sir Alfred gathered together entered whole-heartedly into rehearsals; the theatre was booked and press agents whetted the public appetite by extracts from the American papers.

The Search for an Understudy.

Preparations went ahead without a hitch, but all the while there was one thought which troubled Sir Alfred. He knew of no understudy for Sheldon, and an understudy was very necessary. There were risks attending such a play. Sheldon's energetic part might easily mean a sprained ankle or twisted wrist—or worse still, a complete physical breakdown, so greatly would it tax even the hardiest of actors. But the actors who could undertake such a part were rare and difficult to find. And until one was found the play stood or fell by Sheldon. If he failed it collapsed like a pricked balloon.

The first night arrived. The publicity had reached its crest and queues exceeding the normal seating capacity of the theatre had assembled a good twelve hours before the curtain was due to rise. And still there was no understudy . . . or at least one who had attended rehearsals. Sir Alfred certainly had, that very day, been given the name of an actor who could possibly fill the rôle, but he was on tour up North and even when his whereabouts had been discovered and arrangements made for his release from his present part, if such arrangements were possible, he could not hope to reach London before the first performance. Sir Alfred had to content himself by praying to his particular gods that nothing would happen to Sheldon, at least until the understudy had had a chance of finding his feet.

Enthusiasm—and Disaster.

The first night arrived, and passed. Never in living memory had a London play been received so enthusiastically. Never had the morning papers been so unanimous and whole-hearted in their praise. And never had a producer been so worried. For, whilst the great general public was reading the laudatory notices over its many breakfast tables, Sir Alfred was sending out urgent messages to his entire company for a rehearsal at an hour when most actors and actresses were usually in bed.

Tragedy had come only too soon. Sheldon, over-exuberant at having scored such a success, had joined in a riotous supper party, followed by a mad motor ride which had ended in a smash. Nothing serious, fortunately, but the little God of Luck had smiled wickedly and presented Jack Sheldon with a broken collar-bone.

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

The Understudy Arrives.

Eleven o'clock in the morning found Sir Alfred pacing the stage in despair. The understudy, Franklyn, had arrived and had done his best. He had worked hard and knew his part fairly well. He possessed the abilities necessary for the part, too, with but one exception . . . he could not create his part. He lacked the divine spark of originality necessary to lift him from the rank of imitator into that of actor. Had he been able to watch Sheldon he would have been satisfactory; as it was he was, frankly, hopeless.

At twelve o'clock Sir Alfred called a halt. The company was tired and hungry; Franklyn was apologetic but was not progressing; Sir Alfred was beginning to think that there was no alternative but to stop the production until Sheldon could return.

The Reporter's Scheme.

With some idea of breaking the news to the crowd of reporters who had been clamouring to interview him, he consented to see them. As he told them the facts they listened in silence, some scribbling notes mechanically, others gazing in sympathy at the anguished face of the producer. Then, when he had finished, questions and suggestions came thick and fast. To all of them Sir Alfred had to shake his head. He had thought of this, of that, of the other . . . but Franklyn *could not create his part*. One man only had remained silent, standing a little apart, obviously lost in thought. Then he came forward: " Why not try television ? " he asked.

" Television; how can that help me ? " Sir Alfred replied.

Macintyre, the reporter, enlarged upon his idea. " If Franklyn cannot create a part, but can only imitate, let him imitate. Let him *see* the play acted, by the American company. Let him copy Bobby Mackey, step by step, action by action. It can be done, with television."

A Televised Rehearsal.

Then he went on to explain how he imagined the scheme would work. The management of the New York production would be asked to give a special performance. Facing the stage would be a televisor and, near by, a microphone and broadcasting plant. In the London theatre there would be a television set and a broadcast receiver, with loud speakers. The two theatres would be in constant communication by telephone.

When all was ready the two companies, one in New York, the other in London, would give their performances and Franklyn, the understudy, would be able to see Bobby Mackey and to copy his actions. He would also be able to hear his voice by means of the wireless set and loud speakers. Thus Franklyn would, in effect, be attending an actual performance of the play with

A TELEVISION ROMANCE.
Miss Dora Selvey, whose image was recently televised from London by the Baird Television Development Co. The image was picked up in mid-Atlantic on board the Cunard R.M.S. Berengaria, upon which ship Miss Selvey's fiancé, Mr. S. W. Brown, is serving as Chief Wireless Operator. Mr. Brown recognised his fiancée beyond all question by her style of hairdressing, and particularly when she turned profile.
Miss Selvey is an employee of the Western Union Cable Co., so that this latest achievement might well be described as a romance of wireless, cable, and television communication.

Bobby Mackey in the principal part. " Why, actually he will have an advantage over Sheldon," Macintyre concluded, " and if he can't put up a good show after seeing Mackey act, then you will really have to shut up shop, Sir Alfred."

Television—the Only Hope.

" Is this possible ? " asked Sir Alfred. " It sounds a bit too wonderful to be practical."

" It would be a big undertaking, but it seems to be your only chance, Sir Alfred. Why not try it ? " Macintyre said.

" By James, I will," shouted Sir Alfred. " How long do you think it will take to get everything fixed up ?"

" Well, you ought to allow three hours, I should think," Macintyre replied. " You'll have to get on the phone to New York right away and tell them the scheme."

" Sir Alfred turned to his company. " Clear off, all of you, and get all the rest you can. Be back here at three sharp. We'll pull through if we can."

" And now," he said, turning to the reporters, " If there are any of you gentlemen willing to help me, I shall be eternally grateful—and shan't forget to show my gratitude in a practical manner. Any volunteers ? "

Several of the reporters, genuinely eager to help and, incidentally, thinking of the wonderful story they would have to tell their readers, offered their help. Thereafter matters moved quickly. Sir Alfred telephoned to New York, asked that a performance should be given, explained his scheme and found the management of the American production eager to participate in what promised to be a wonderful publicity " stunt."

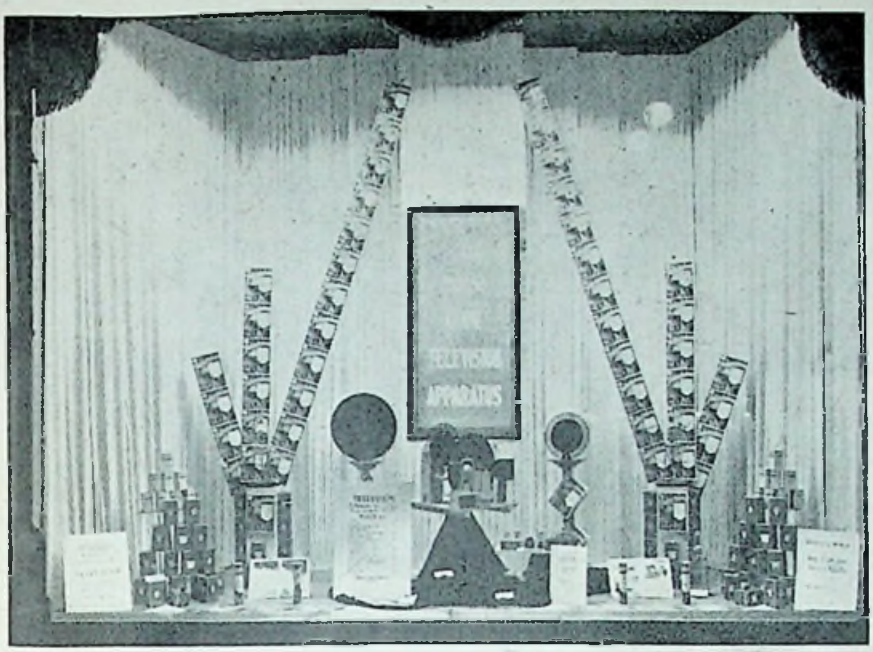
A 3000-Mile Link.

An aerial was erected on the London theatre, a television set installed and the services of a firm specialising in cinema apparatus enlisted to throw an enlarged image of the television picture on to a screen erected in front of the stage. A wireless set and loud speakers were also installed so that the actual words of the New York performance could be heard when necessary. A telephone at the corner of the stage was in constant connection with one at the New York theatre.

Three o'clock found the company assembled, eager to take part in an unique experience. Skilled operators bent over the television and wireless sets, making final adjustments. Reporters and camera-men filled the boxes at either side of the stage so that they could see both stage and screen.

The Dual Rehearsal.

Sir Alfred, his coat off, his hair ruffled, his face strained with weariness, was at the phone. He looked up: " Stand by, everybody," he called, " they're ready to start."



The world's first window display of television at Messrs. Selfridge's recently. The Simple Televisor described in our first issue has a prominent place.

Simultaneously the loud speakers woke to life. "Hello, folks. New York calling. Hope you're getting us alright." The television screen showed a flickering succession of streaks which gradually began to take shape as the operators made their final adjustments. The cinema operators focussed the enlarged image on the big screen and presently there became visible the stage of a theatre, with three actors assembled in the same positions as those on the London stage.

Again the loud speakers spoke, "Are you ready . . . then off we go, and the best of luck."

Those on the London stage saw that the actors were moving and they, knowing their parts, moved in unison. Franklyn stood in the wings, awaiting his cue.

Sir Alfred spoke suddenly, as another figure appeared on the screen. "That's Mackey . . . on you go, Franklyn."

The Understudy takes the Stage.

Step by step, gesture by gesture, the two performances were carried through. Franklyn, with the actual example of Bobby Mackey's superlative acting taking place a few feet from his eyes, at last caught the spirit of his exacting part and, thanks to his ability to imitate, gave a very creditable performance. Perhaps a dozen times Sir Alfred called for a repetition of a difficult situation and it was seven o'clock before the tired performers reached the final curtain.

An hour later the curtain went up again. The television apparatus, the screen, the wireless set and the loud speakers had been cleared away. The vast audience craned eagerly forward, ready to see a play which, if the newspapers were to be believed, promised the greatest of thrills, of laughter-making situations, of sentiment. The notices outside the theatre announcing that Frank Franklyn would appear instead of Jack Sheldon had meant nothing to them. Both actors were practically unknown to them and one would, no doubt, give as good a performance as the other.

The Triumph of Television.

The curtain was up, the play was proceeding and Franklyn was giving a wonderfully good performance. Had the audience been particularly observant it might have noticed that the performers looked unusually tired. And those in the boxes and circles at one side of the theatre may have glimpsed Sir Alfred, standing in the wings, looking unutterably weary and white-faced. And they may have wondered why, towards the end of the performance, he should droop lower and lower, his tired body sagging, until he fell limply into a chair, fast asleep, dead to the thunderous applause which shook the theatre when the tired actors and actresses made their final bows. They may have wondered then ; in the morning the whole country was able to read the romantic story of what had happened in that theatre and how television had made possible the performance they had seen.

This illustration shows the crowds which attended the first public demonstration of the Simple Televisor at Selfridge's. It was at Selfridge's that Mr. Baird gave the first public demonstration of wireless silhouette that the world has ever seen.

PRODUCTS of QUALITY (MH) AND DISTINCTION

THE (MH) 5-VALVE PORTABLE RECEIVER

IN HANDSOME LEATHER CASE COMPLETE READY FOR OPERATING, GIVING THE CHOICE OF A NUMBER OF STATIONS.

PRICE, INCLUDING ALL ROYALTIES

30 GUINEAS.

Read the following copy of a letter sent to us.

Four Gables, Boston Spa.
October, 1927.

DEAR SIRS,

It may interest you to know that the last few weeks I have been touring Scotland and had with me one of your McMichael Portable Sets. For the whole of the trip I was able to hear Daventry quite distinctly and at John O'Groats, which is the farthest north I could get, it came in quite loudly and distinctly.

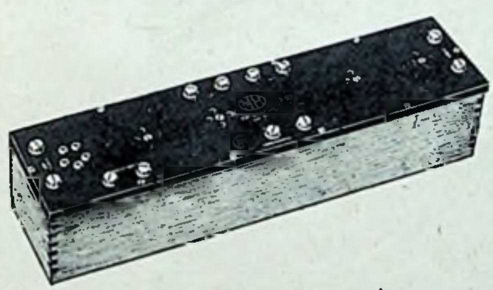
I think this is rather a wonderful performance considering the great distance from Daventry.

I am enclosing a photo or two which may interest you.

Yours faithfully,

(*Signed*) ARTHUR PROCTER.

The (MH) SUPERSONIC BLOCK UNIT



The (MH) 5-Valve Supersonic Block Unit is the "Heart of a Super-Het," and was designed especially to facilitate the assembly of a Super-Het Receiver—and more particularly for those enthusiasts not having the confidence in their ability to make up a receiver of a somewhat delicate nature. Purchasers of this Block Unit can listen in within an hour of reaching home with their purchase.

Price (including 5-Point Oscillator), 300-600 metres, £6 6s.

This unit forms the nucleus of the 6-Valve Receiver used by Mr. Allen, A.M.I.R.E., for the direct reception of the three Empire Broadcast Programmes transmitted by 2FC, Sydney, Australia, a distance of 13,000 miles.

THE (MH) 6-VALVE SUPERSONIC RECEIVER

A simple arrangement of (MH) components for a 6-Valve Supersonic Receiver giving loudspeaker results capable of reception over a waveband of 10 metres to 2,000 metres.

The total cost of parts to build this Receiver as illustrated amounts to approximately £13. Full detailed list, prices and diagrams on application. If desired, the complete receiver, constructed in our works, as illustrated, may be purchased with short-wave coils and auto-oscillator (for B.B.C. stations) for £17 17s. Royalties extra £5. Cabinet extra £2 2s.

The outstanding problem in short-wave reception is to combine amplification and ease of control. The (MH) Supersonic system gives the maximum of amplification and an ease of control which is a revelation.

Telephone:
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