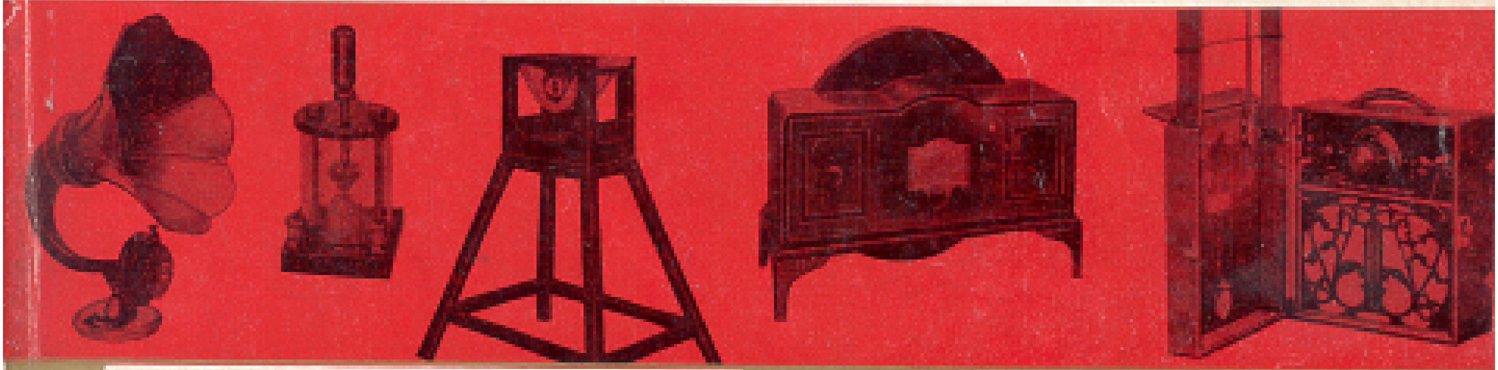
Wireless World

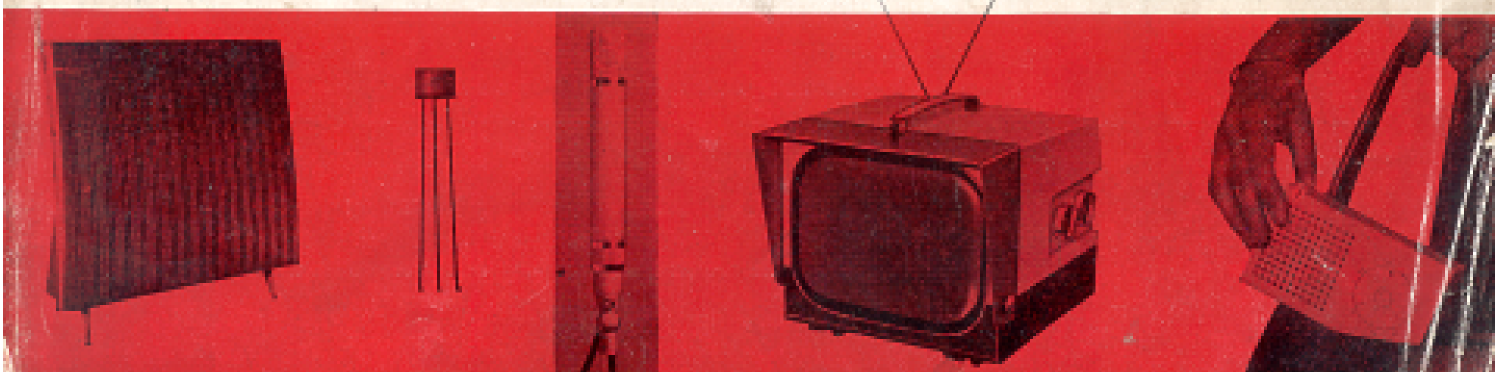
Golden Jubilee Number

APRIL 1961 TWO SHILLINGS

Radio Electronics Television



50 years of progress



Wireless World

VOL 67 NO 4 APRIL 1961

HALF A CENTURY

IN 1911 the business and profession of wireless communication was already established, but as yet it had made little impact on the daily lives of most people. There was a certain novelty in sending a telegram "*via* Marconi" and a few amateurs dabbling with spark coils and crystal and electrolytic detectors made a welcome diversion from lantern lectures and microscopy at the local literary and scientific society. But the seeds of future developments had germinated. Every day more ships were being fitted with wireless, and more amateurs were proudly passing their headphones to admiring friends to listen to the musical morse of Clifden or the growl of Eiffel Tower and Poldhu.

Until then technical information had been scattered in occasional articles in the electrical journals and in one or two papers read before the learned societies. Now it was decided that there was sufficient interest to support a journal "the aim of which will be to acquaint the reader with the latest possibilities of this most marvellous invention." Such was the success of the *Marconigraph* that two years later it was decided to give it a new format and a new title in keeping with its wider circulation. In the first editorial of the new series we said, "The *Wireless World* will still be the medium, as was the *Marconigraph*, for the interchange of ideas concerning the further scientific and commercial development of wireless telegraphy, with its bearing upon national and economic interests. But these long words do not mean that we intend to take up the standpoint of a dry and educational science. Our Magazine is to be popular, and while the information we shall print will compel the attention of the scientist, it will not be beyond the scope of the general public."

If at times we seem to have become more complex it is because we reflect the growth of our subject, which even in its beginnings called for more than a little application to gain mastery. We invite those who doubt this to turn up some of our earliest issues (e.g., the series on aerial capacitance by Professor G. W. O. Howe in 1915). While many of our articles have been addressed exclusively to the professional quite as many have been prepared specially for the beginner who may be at the start of his career as a radio engineer or technician or just interested in the subject as an amateur. The dividing line, if indeed one exists, is hard to draw. Many of our readers who earn their living by research on semiconductors or development on microwaves find relaxation as amateur transmitters or high-quality sound enthusiasts. We welcome them all as readers and take this opportunity of thanking them for their sustained interest, which as our recent questionnaire has shown, more often than not is of long standing.

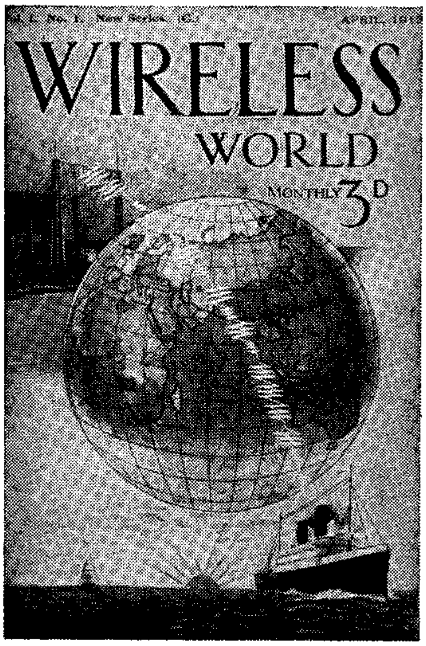
The entity and character of a journal is something which is difficult to define in words. It transcends all outward forms of print and styling; it cannot be detected in the contents of individual articles; it exists as like-minded thought and a community of interests between readers and staff. We are all of different ages, have divergent personal interests and while retaining our independence are prepared to argue, to listen and to learn—all with one object: as far as this journal is concerned to keep the record straight.

Looking back we pay tribute to our predecessors in office, to past members of the staff, to our contributors and to all those whose ability and loyalty have laid the foundations upon which we build. Looking to the future we shall strive to improve our journal as the medium of communication between all whose vocation or interest lies with radio and electronics, to serve as a forum for discussion, as a medium for enlightenment and exposition, and as a bulletin for news of the world of wireless.

"This then is our policy: to be of use and interest to our readers, and through them to be a factor for progress." These words are quoted from Volume 1, No. 1 of *Wireless World* and we can find no reason for altering them today.

SINCE THE 50

Years of Progress As Seen Through Our Pages



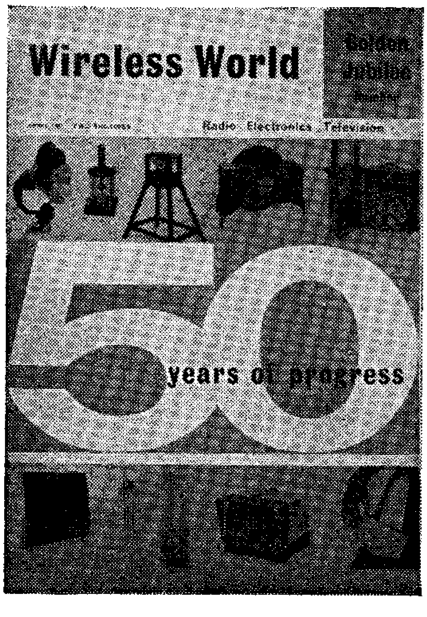
THE STATE OF THE ART IN 1911

THE Edwardian age into which *The Marconigraph* was launched was less prone than is the Neo-Elizabethan to the unquestioning acceptance of scientific marvels. Many people still looked upon wireless telegraphy as "against Nature"; as something akin to a music-hall trick. That attitude of mind was certainly not discouraged by wire telegraphy and submarine cable interests, with whom we were to remain in bitter competition for many years. By way of counter-attack, we made great play of the fact that the so-called "KR factor," which limited the speed of cable transmission, did not apply to us. High-speed wireless transmission—which then meant about 60 words per minute—had already been demonstrated experimentally, but the volume of traffic on offer was generally not great enough to encourage its commercial use.

Whatever the reason may have been, wireless telegraphy had hardly made spectacular progress during the first dozen years of its existence. When we began publication there were, according to official figures published later, a mere 1,740 licensed land and ship stations in the whole world.

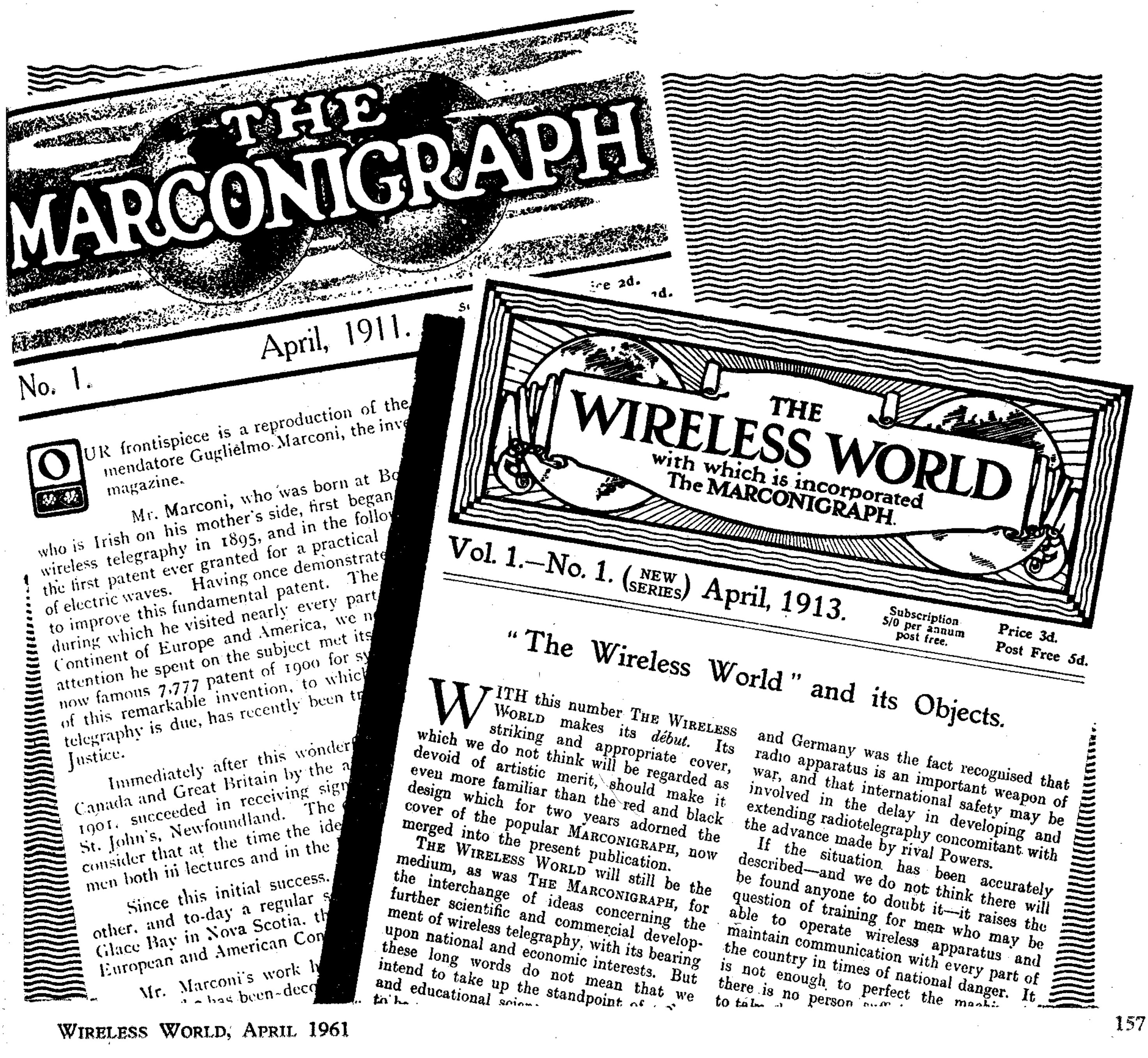
But that understates the position rather seriously. The United States had not ratified the International Convention and had no licensing system; thus the true number of her stations cannot be ascertained. For once, America had made a slow start in taking up a scientific innovation; when the first wireless-equipped ships sailed from Europe to the New World there were no coastal stations in the North American continent with which they could communicate. But America was soon to catch up, and by 1911 probably had a greater number of stations than any other single country. Going by the few figures available and working backwards from the time when licensing came in, it is fairly safe to guess at a round 1,000, or something not far short of it. Thus the world total of stations in 1911 was over 2,500. The total number of people gaining their livelihood in wireless, from Mr. Marconi himself down to the humblest messenger boy, could hardly have exceeded 8,000.

Though the commercial growth of wireless may have been disappointingly slow, technical progress had been quite impressive. An old-timer dating back to 1911 might make out some sort of case for claiming that the effectiveness of the gear of his period had increased as much since 1897 as it has done between 1911 and the present day. Be that as it may, he would be on



Wireless World BEGAN

Wireless World, the first radio journal, appeared in April, 1911, as The Marconigraph. The present title was assumed two years later. We were originally published by the Marconi Company and circulated largely among engineers and operators, though from the start there was a public readership. We became an independent journal 36 years ago. This review traces the significant advances in radio and electronics since we began. Except in the introductory section, the material is taken entirely from our own pages. In the introduction an attempt is made to give the reader a glimpse of " what everybody knew " in 1911.


THE MARCONIGRAPH

April, 1911.

No. 1.

OUR frontispiece is a reproduction of the ... mendatore Guglielmo Marconi, the inv... magazine.

Mr. Marconi, who was born at Bo... who is Irish on his mother's side, first began ... wireless telegraphy in 1895, and in the follo... the first patent ever granted for a practical ... of electric waves. Having once demonstrate... to improve this fundamental patent. The ... during which he visited nearly every part ... Continent of Europe and America, we n... attention he spent on the subject met its ... now famous 7,777 patent of 1900 for s... of this remarkable invention, to which ... telegraphy is due, has recently been tr... Justice.

Immediately after this wonder... Canada and Great Britain by the a... 1901, succeeded in receiving sign... St. John's, Newfoundland. The ... consider that at the time the ide... men both in lectures and in the ...

Since this initial success... other, and to-day a regular s... Glace Bay in Nova Scotia, th... European and American Con...

Mr. Marconi's work h... has been dec...

THE WIRELESS WORLD with which is incorporated The MARCONIGRAPH.

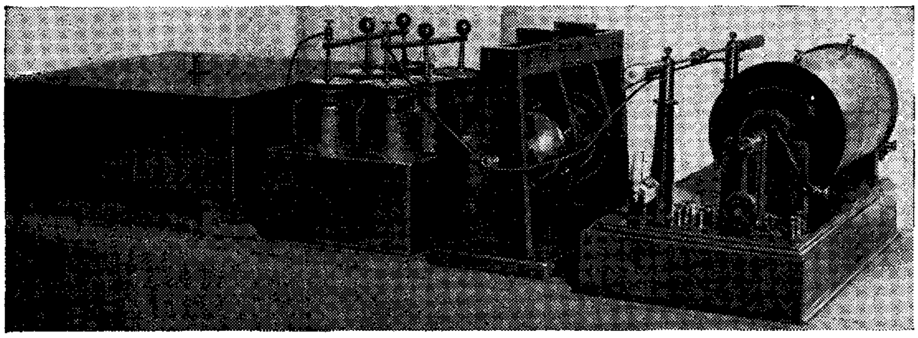
Vol. 1.—No. 1. (NEW SERIES) April, 1913. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

"The Wireless World" and its Objects.

WITH this number THE WIRELESS WORLD makes its *début*. Its striking and appropriate cover, which we do not think will be regarded as devoid of artistic merit, should make it even more familiar than the red and black design which for two years adorned the cover of the popular MARCONIGRAPH, now merged into the present publication. THE WIRELESS WORLD will still be the medium, as was THE MARCONIGRAPH, for the interchange of ideas concerning the further scientific and commercial development of wireless telegraphy, with its bearing upon national and economic interests. But these long words do not mean that we intend to take up the standpoint of ... and educational scien... to b...

and Germany was the fact recognised that radio apparatus is an important weapon of war, and that international safety may be involved in the delay in developing and extending radiotelegraphy concomitant with the advance made by rival Powers.

If the situation has been accurately described—and we do not think there will be found anyone to doubt it—it raises the question of training for men who may be able to operate wireless apparatus and maintain communication with every part of the country in times of national danger. It is not enough to perfect the machi... there is no person ... to tak...



A " coil set "; the kind of transmitter that was going out as we came in. Right to left: induction coil, spark gap, " battery " of Leyden jar condensers, " jigger."

pretty sure grounds in going on to claim that by 1911 the foundations of nearly all modern techniques had been laid and the majority of the great basic inventions had been made. Practitioners of the art certainly did not look on themselves as being in the Dark Ages. They had already seen great technical progress and were full of confidence for the future. To them, it was a kind of Elizabethan age, when everything was bright, new and exciting.

Many of the inventions that had been made were waiting—and some had to wait for many years—for the means to put them usefully into practice. Christian Hülsmeyer's radar pulses, first suggested by him in 1904, had to wait 30 years for the means of generating them and usefully detecting their reflections. Oliver Lodge's moving-coil loudspeaker looks, in the patent specification drawing of 1898, surprisingly like the instrument of today, even if the " hi-fi " enthusiast would hardly approve of his diaphragm or its suspension. But valve amplifiers capable of working moving-coil speakers did not appear until 20 years later.

Fleming's diode, which we used to call, rather confusingly, an oscillation valve, was already ancient history, and was not especially esteemed as a signal rectifier. De Forest had added a grid in 1907, but his triode had made no impact. Probably fewer than five per cent of our early readers had ever heard of it and there was no mention of triodes in our pages for the first two or three years. The triode remained in obscurity until the discovery of regeneration caused many workers to concentrate their efforts on its improvement. Those efforts were probably triggered off by von Lieben's work on the amplifying triode in 1910-11.

" Tele-vision " (generally so printed) was a word that appeared surprisingly early. Nipkow had enunciated the basic principles of scanning in the nineteenth century, but few seemed seriously to expect that " moving pictures by wireless " would be achieved. One of the exceptions was Campbell Swinton, a versatile engineer and wireless enthusiast who had already forecast that, if the difficulties were ever to be overcome, it would be by means of " the weightless cathode rays " of the Braun tube, the forerunner of the c.r. tube of today. Magnetic recording—on wire, not coated tape —was already known and had been used for the recording of high-speed signals.

Transistors? Well, hardly. But oscillating crystal circuits had been devised by Dr. W. H. Eccles, one of the " founder members " of wireless technology whose name recurred constantly in our pages for many years. In another sphere, he was one of the first to accept and interpret Heaviside's theory of a conductive layer in the upper atmosphere as an explanation of observed phenomena in long-distance wave propagation. For a long time to come there was a tendency to ignore or even to scoff at Heaviside's theory; his American co-worker Kennelly had even less recognition on this side of the Atlantic.

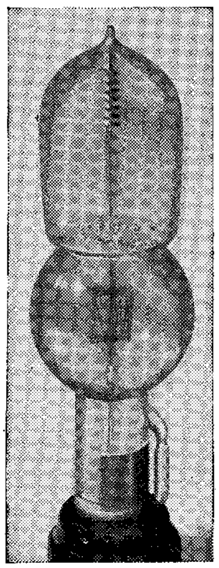


Photo: Deutsches Museum, München.

An historic valve— the Lieben-Reisz triode of 1911.

In Britain the art we practised was always called " wireless." The official international word " radio " had been introduced some years earlier but had had a chilly reception. It did not trip easily off English tongues; worse, to use it was considered " non-U " and aping the foreigner. In fact, though, most nationalities still preferred their own versions of " wireless ": *sans fil, drahtlose, sin hilos.* But in Germany they soon began to show a preference for the word *Funk* (spark) which still survives strongly in *Rundfunk* (broadcasting).

Naturally enough, wireless had already produced its own jargon. Equally naturally, many of the earlier examples have now disappeared, some of them frozen out by changing techniques. One of the queer words was " jigger " (r.f. transformer for coupling the closed circuit, transmitting or receiving, to the open aerial). The derivation of this term is obscure and has apparently been lost in the mists of time. Maurice Child, in a historical lecture in the early 20s, admitted his inability to trace it. " Billi " is easier; it was a small variable condenser reputed to have a capacitance measured in billionths of a farad. Though by international agreement wavelengths were measured in metres, the foot still served occasionally as the unit. It had not been so long ago that only two wavelengths were in use, officially for merchant ship communication, but in fact for other purposes as well: Tune A, 1,000ft and Tune B, 2,000ft—quite near enough to 300 and 600 metres for the order of accuracy then prevailing. Whether chosen by luck or judgment, Tune B, the more popular, was in fact an excellent general-purpose wavelength for the techniques of the times. The foot (length of wire used in winding a coil) sometimes served also as a unit of inductance!

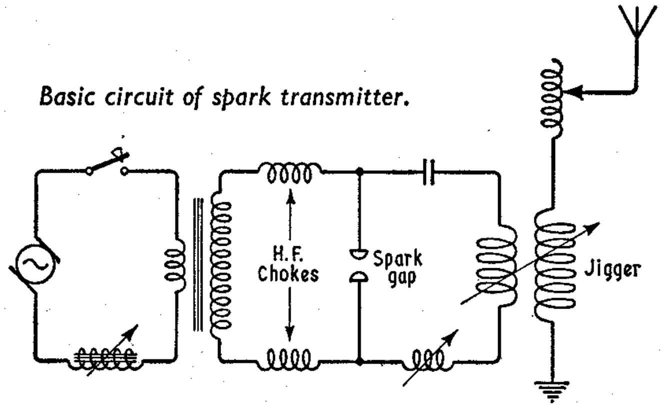
The Postmaster-General's control of all wireless activities in Britain had been firmly established by the Wireless Telegraphy Act of 1904. Even before that date the Post Office had quietly assumed power over us by virtue of the monopoly in telegraphy conferred on it by Disraeli in Victorian times. This control may at times have seemed somewhat heavy-handed; indeed, *Wireless World* has on many occasions throughout its life been at odds with the Post Office over allegedly restrictive practices or other departures from rectitude. But we must remember that the Post Office, as one of its historians has said, "is not just another Department." It functions under a long-established tradition of providing a public service, first in carrying the mails, then in transmitting telegrams and later in running a telephone service. In return, Parliament has granted certain monopolies and privileges, which have always been jealously guarded. Each successive development in wireless must have seemed to the official mind to threaten serious encroachment on these monopolies and it is small wonder there have been occasional bunglings and examples of over-cautiousness. However, it is a pleasant thought that Post Office control has generally been benevolent and beneficent.

Apart from the exercise of his monopolistic powers, it was (and is) the duty of the Postmaster-General to ensure the observance of international regulations. In 1911 we were governed by the Convention of 1906, to which nearly all nations had adhered. The United States was an exception; neither had she ratified the Convention (was that a manifestation of the Monroe Doctrine?) nor had Congress as yet passed any law to regulate or control wireless communication. America was indeed the land of the free. But, according to stories—perhaps exaggerated—filtering across the Atlantic, jungle law prevailed. Deliberate jamming of competing stations was commonplace and powerful stations shouted down the weaker. And there was nothing to protect the secrecy of messages. According to the folklore of the time, submarine cable interests intercepted telegrams sent by the Marconi transatlantic station at Glace Bay, Nova Scotia, and published a selection of them—reputedly the most scandalous—as advertisements in New York newspapers. They are also said to have published intercepted messages relating to interruptions in communication, such as "stand by for three hours; atmospherics too bad," thus hoping further to discourage potential users of the new and then struggling wireless service. This latter kind of interception was eventually circumvented by the use of code words for inter-station messages relating to interruptions and similar matters.

Some support for the truth of these stories comes from the fact that American legislation, when it eventually came, was not particularly onerous in most respects but imposed severe penalties for deliberate jamming and failure to observe secrecy. As things turned out, the American free-for-all had worked remarkably well in the early stages. No doubt most of the stations did in fact establish a tacit *modus vivendi* with their competitors. But control was bound to come sooner or later; in the event, it came sooner than expected, and for a reason that nobody could have foreseen.

Wireless telephony had already been accomplished experimentally when we began publication, but was as yet of no practical significance. Both arc transmitters and rotary r.f. generators capable of producing continuous waves had been developed, but in the absence of valves the problem of modulation was indeed difficult. Water-cooled and liquid jet microphones, inserted directly in the aerial circuit had been used in some of the experiments.

For telegraphy, spark transmitters were almost universal. A big station of the period was an impressive affair; the sight, and still more the sound, of tens of kilowatts being dissipated in a crashing oscillatory discharge was something not easily forgotten. There was even a strong characteristic smell, generally referred to as "ozone". All the so-called "systems" were basically similar; the circuit arrangement,



Basic circuit of spark transmitter.

shown in the accompanying diagram, was simple enough. The a.c. supply, of 50 or 60c/s, was stepped up to 15 or 20kV, an iron-cored choke being inserted in the transformer primary circuit to bring it into resonance with the alternator frequency. The condenser of the closed oscillatory circuit, charged through protective h.f. chokes, discharged itself through a spark gap, the electrodes of which, in all but the most up-to-date sets, were stationary, though adjustable as to distance. The closed circuit was coupled to the open aerial through a double-wound "jigger" or an auto-transformer.

These fixed-gap sets gave a low-pitched, irregular tone distinguishable with difficulty from atmospherics and radiated heavily-damped wave trains, due to interaction between closed and aerial circuits. The "rotary discharger" sets which were just being introduced were a great improvement in both these respects. In the most highly developed form the rotary electrode, mounted on an extension of the alternator shaft, carried a number of projecting studs arranged to give a spark for each half-cycle of the supply frequency; this had now been increased to several hundred cycles per second. Thus a clear high-pitched note was produced, and, as the primary circuit was opened after a very short interval of time, interaction was reduced and there were more persistent oscillations in the aerial circuit.

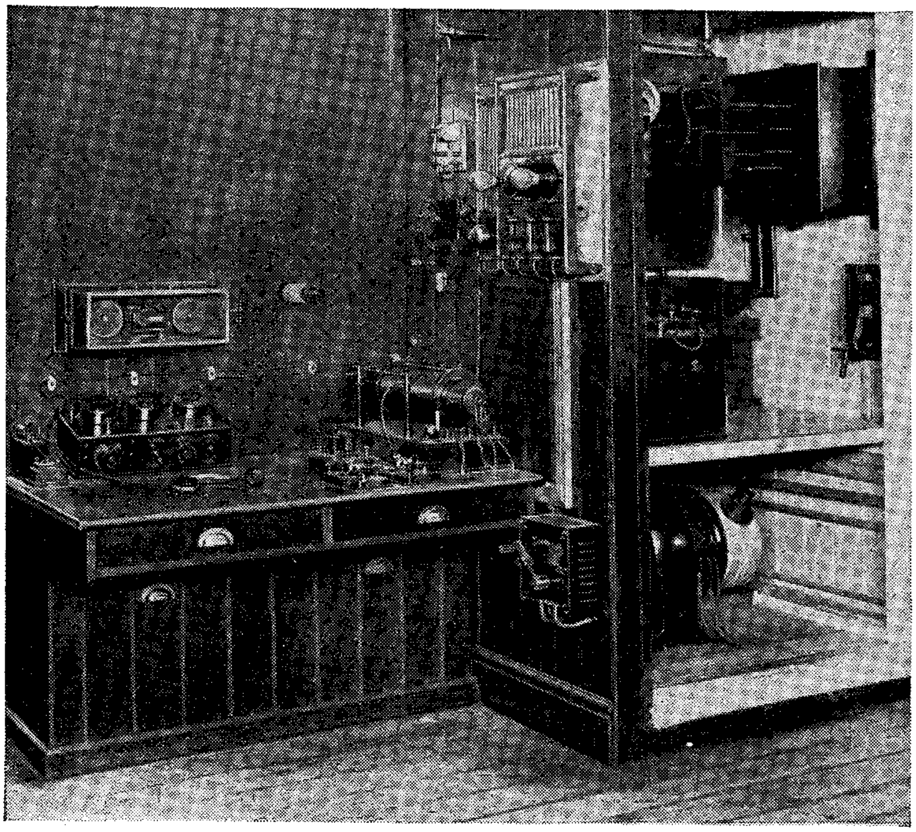
Transmitters fed from alternators were known as "power sets" and were mostly fairly up-to-date. But there were in 1911 many relics of the not-so-distant past with induction coils drawing their supply from accumulators or d.c. mains. These were mostly fitted in merchant ships but the British Post Office station at Malin Head in the remote North-West of Ireland is thought to have had at this time a coil set worked from an accumulator battery charged from banks of primary cells.

Input power of the typical and more modern transmitters of the period for ships and coastal stations was generally between one and three kilowatts; anything more was considered high power. A fair number of point-to-point and special-service stations used as much as 30kW; anything more was quite exceptional. The lower-powered stations seldom achieved a daylight range of much over 300 miles, depending on their aerial height.

The most common type of receiver used the Marconi magnetic detector, a rugged and reliable but relatively rather insensitive device. It depended for its action on hysteresis changes in an endless soft-iron-wire band moved by clockwork through a coil carrying the received signal current. A magnetic field was provided by a pair of permanent magnets and a secondary winding, concentric with the r.f. coil, was connected to a pair of telephones. Unlike other detectors, the magnetic was a current-operated device and the associated three-circuit tuner had circuits with a low L/C ratio.

The only other kind of detector in widespread use was the crystal rectifier, the combinations most favoured being carborundum-steel, zincite-bornite and silicon-gold. Crystals were almost always used with two-circuit tuners having variable coupling between primary and secondary. A few stations had Fleming diodes.

Work on rotary r.f. generators had been going on for some years, but they had barely reached the stage of commercial use. The fact that an electric arc, shunted by a tuned circuit, could produce continuous oscillations had been known for some time. This had been turned to practical use by enclosing the arc in a chamber filled with hydrogen or alcohol vapour and subjecting it to a strong magnetic field. A small number of arc stations were in operation, mostly in America, but efficiency was low and continuous waves had little advantage until heterodyne reception became possible. The mechanical interrupters ("tickers") used in early c.w. receivers did not allow aural discrimination between signals and atmospherics.



Typical Marconi ship's wireless installation of the period showing (left) receiving tuner with magnetic detector on bulkhead above it; (centre) emergency spark-coil transmitter and (right) 1½ kW rotary converter and spark gap of the main transmitter with (above) boxed coils of "jigger" and aerial tuning inductances.

Constructionally, the gear of the period tended to follow contemporary scientific instrument practice, with lacquered brasswork much in evidence, especially in Britain. Nickel-plated finish was more popular on the Continent and in the U.S.A., where ceramic insulants tended to be more widely used. Ebonite was, however, the most favoured material; plastic mouldings were virtually unknown. The concept of a "packaged" station had not arrived; the majority of transmitters and receivers consisted of a collection of units mounted where convenient and then wired together. But complete single-unit receivers were fairly common.

Some of the older stations used tinfoil-coated Leyden jars as transmitter condensers (the "jar" still did occasional duty as a unit of capacitance, but not in our pages). There were more modern tubular versions with sputtered or electrically deposited metal coatings on superior glass. Oil-filled condensers with metal plates and sheet-glass dielectric were perhaps the most common. Receiving variable condensers often had ebonite dielectric.

By far the most important application of wireless was for marine use,

Log cabin station typical of those used by North American miners, trappers and fishermen to keep in touch with civilization.

both in merchant ships and the navies of the world. Next came coastal stations for working with the ships. These were often sited on prominent headlands; a relic of the days when ranges were even shorter than in 1911. A few strategic naval and military stations, mostly of relatively high power, had been erected.

With the exception of the transatlantic service (of which more later), wireless had so far made little progress in its competition with landline and cable for point-to-point work. There were, however, a certain number of stations providing a telegraph service for isolated communities in cases where a wire connection was uneconomic. In particular, the so-called log-cabin stations on the North American continent allowed local miners, trappers or fishermen to keep in touch with the outside world. A few of the early point-to-point stations, working at distances well beyond normal daylight range, provided a rather erratic service by taking advantage of night-time propagation conditions. Indeed, what might be called the "Heaviside bonus" was extremely valuable in the early days, particularly to ships. With its help, extraordinary ranges were attained with some consistency, especially outside the equatorial atmospherics belt. Atmospherics, or X's, were the great enemy. X-stoppers, optimistically so-called, had already appeared, but no real solution was in sight. About the best that could be done was to use pairs of crystal detectors working in opposition as limiters.

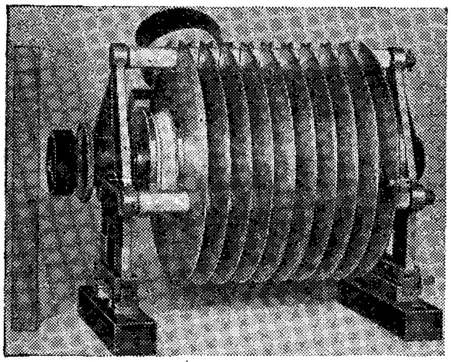
Special-purpose equipment for military and similar uses was already being designed and wireless had managed to stagger into the air in both lighter- and heavier-than-air machines.

Prominent among the handful of famous stations of the time was Poldhu, in Cornwall, whose main task, together with its counterpart Cape Cod, U.S.A., was to provide a Press Service for the big liners which already printed daily newspapers on board. Poldhu was the first a.c.-operated "power set," as distinct from an instrument-maker's job powered from an induction coil. It had been used by Marconi just after the turn of the century for the first transatlantic experiments. Dr. J. A. (afterwards Sir Ambrose) Fleming had been called in to do the original engineering design. Fleming is mainly remembered for his invention of the diode, but he has an equal—perhaps even greater—claim to fame as the first of the wireless engineers. Incidentally, he was the author of the first severely technical article (on r.f. resistance measurement) ever to be published in *The Marconigraph*.

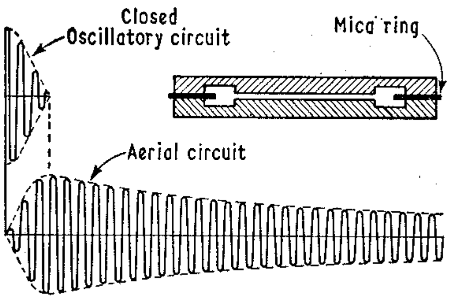
The French military station on the Eiffel Tower, with its fixed spark gap and 25-c/s a.c. supply ("one spark for a dot and three for a dash") was known throughout Europe for its time-signal service. Thanks to the exceptional height of aerial, very long ranges were achieved, though the signals were often quite difficult to read through X's. The German stations of Nauen and Norddeich were also well known. Most of the high-power transmitters worked on wavelengths around 2,000 metres but the transatlantic station Clifden and Glace Bay were on about 6,000m.

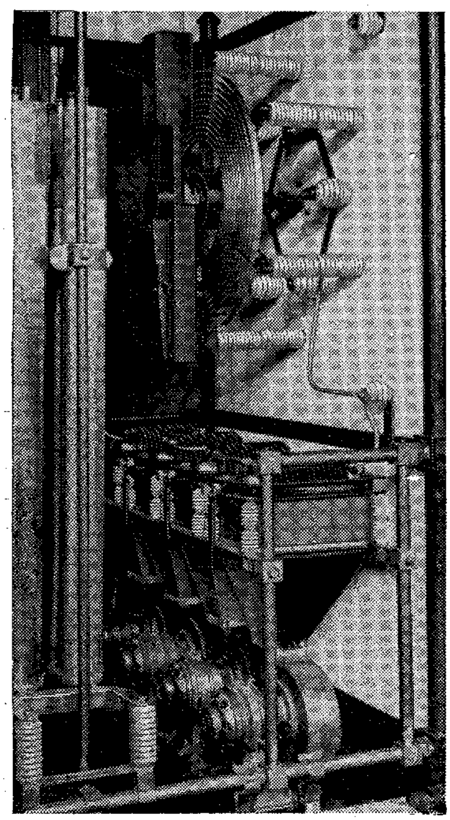
Commercially, the Marconi Company and its associates throughout the world were in a dominant position, if only by virtue of the patent position. In our very first issue we reported a successful action for patent infringement against the British Radio Telegraph and Telephone Company which did much to consolidate that position. Marconi's personal claims as the originator of wireless telegraphy had been hotly challenged for a dozen years or more. But, now the smoke has cleared away, it is not difficult to see that those claims were fully justified. He may not have contributed any great fundamental invention but, put in the simplest possible way, he had "made it work." The last word in the controversy had in reality been said as long ago as 1897, when the Editor of the *Electrical Review*, in answer to the rhetorical question "What did Marconi invent?" said, quite simply, "the elevated electrode." A prolonged subsequent correspondence in the pages of the journal failed to establish any valid claim to the anticipation of Marconi's invention of the aerial. It is clear enough now that an elevated aerial, plus an earth connection, was all that was basically necessary to turn Hertz's transmitting oscillator and Branly's receiving coherer at one step into a communication system with a useful beyond-the-horizon range. Subsequent detail improvements were not so difficult, but especial credit should be given to Lodge, whose "syntonic jars" experiment of 1889 had paved the way for syntony or tuning, without which wireless could never have got very far.

The race for priority had been close run and several rivals were breathing hard down Marconi's neck for the golden prize. And golden it turned out to be. When the young Marconi, in his early 20's, formed his company in 1897 he received £15,000—in golden sover-



Construction and electrical characteristics of the Telefunken quenched spark gap (based on Figs. 8, 10, 11, page 155 of Telefunken Zeitung, *Vol. 26, No. 100*





Air-blast cooling of multiple quenched spark gaps in a Telefunken high-powered transmitter.

eigns, not depreciated paper pounds —and £60,000 in shares, which gave him a controlling interest. He was no guinea-pig director; at the time we began he was playing a dominant part in technical development.

At that time Marconi had no significant competition in England but his American company had to struggle against the United Wireless Company which controlled some 500 stations. But, in a year's time United Wireless was to be absorbed after admitting the validity of the Marconi patents. The real and most serious competitor, both commercially and technically, was the Telefunken Company in Germany, an amalgamation of several German wireless interests.

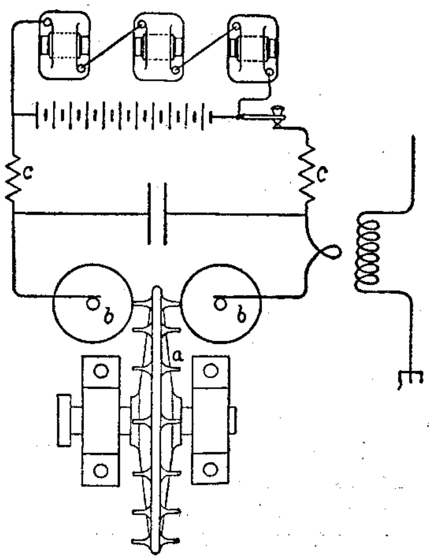
Telefunken had produced a distinctive and extremely effective spark transmitter of which the main feature was a multiple spark gap made up of a number of silver-faced copper discs with deep cooling flanges separated by thin mica rings. In the standard 2½kW set there were eight series-connected gaps. Thanks to the rapid dissipation of heat, excellent quenching of the primary circuit oscillations was secured, with wave-trains of high persistence in the aerial circuit. An alternator frequency of 500c/s gave a spark frequency of 1,000; the high-pitched note of Telefunken transmitters was quite distinctive. Efficiency was high; probably over 60%.

The Telefunken receiver had a tuned aerial circuit variably coupled to a semi-aperiodic secondary shunted by a crystal detector and headphones. An alternative type of set, giving higher selectivity, had an intermediate tuned circuit. Clip-in interchangeable coils were used. The detector, a sealed cartridge usually with a silicon-gold combination, was interesting as a kind of forerunner of the modern crystal diode.

Germany's contribution to wireless development had been acknowledged when Ferdinand Braun shared with Marconi the Nobel Prize for physics in 1909.

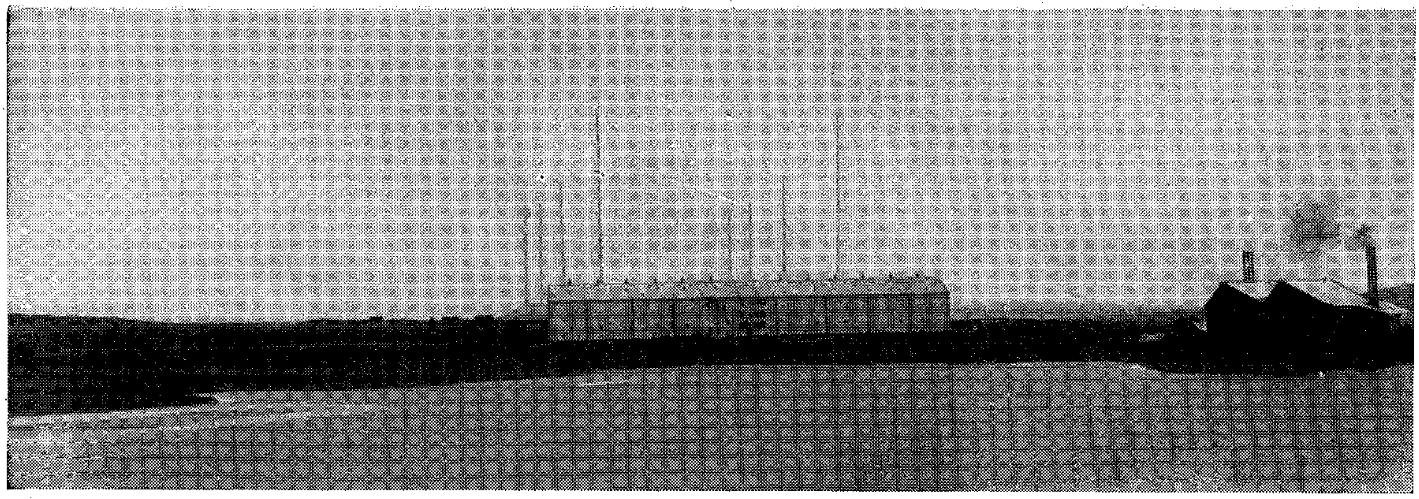
In the early days the transatlantic station at Clifden, in the wilds of Connemara, was the wonder of the world of wireless. And rightly so; there was nothing remotely approaching it, either in technology or performance, except its communicating station at Glace Bay, Nova Scotia, which, being more remote, was less in the limelight. Marconi himself gave a detailed description of Clifden, which had recently been rebuilt, in a lecture to the Royal Institution, reported in our first volume. This fantastic station was unique in being powered by d.c., drawing 300kW from a 6,000-cell accumulator battery, "the largest of its kind in existence," which, when fully charged, gave a voltage of 15,000. Charging of the battery was by three series-connected high-voltage generators, the prime mover being a steam engine. The six boilers were fired with peat, brought by a light railway from the adjacent bog. Still more fantastic was the closed circuit air-dielectric condenser; the metal plates were spaced a foot apart and this component—the first to which the term "low-loss" was applied—needed an enormous shed to house it. The rotary spark gap was run at a speed giving a sparking rate of 500 p.s. As the rate was independent of load, the note was exceptionally pure.

For the year to April, 1911, it was proudly claimed that 812,200 words of paid traffic had been pumped across the Atlantic. That would sound pitifully small to the manager of a modern communication circuit, but



DISC DISCHARGER
CONTINUOUS CURRENT

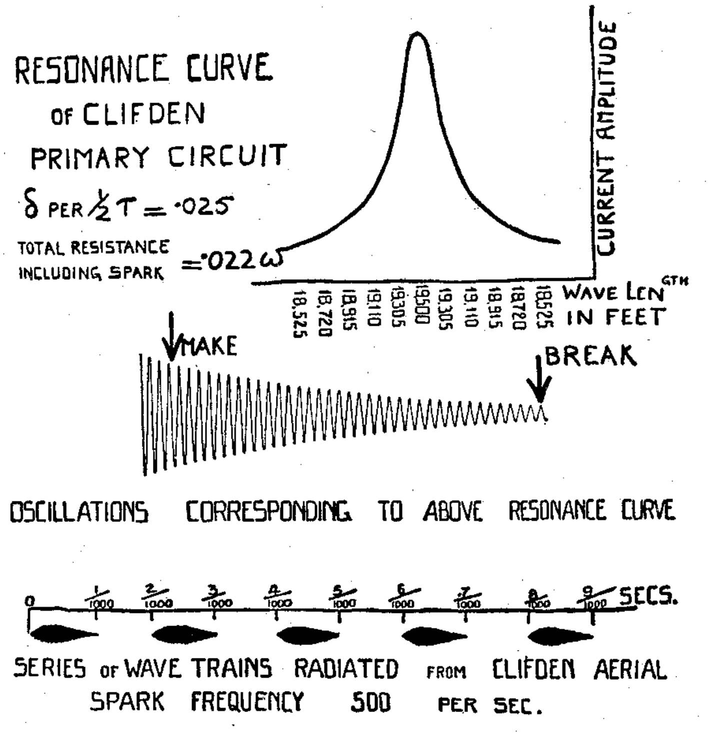
Circuit diagram of the Clifden "d.c." transmitter.



General view of the transatlantic high-power spark station at Clifden, Connemara. On the right is the peat-burning power house.

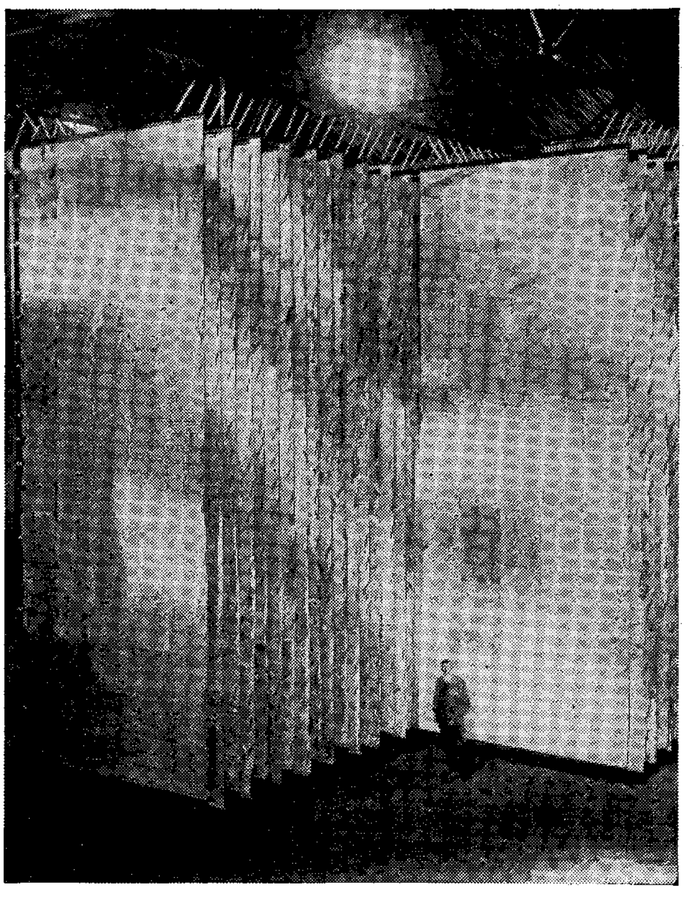
was probably a great improvement over that achieved with earlier apparatus. Detailed records are lacking, but in the Marconi archives there are some figures relating to the period beginning October, 1907, when a limited public service had been opened. Traffic was then running at the rate of a mere 300,000 words a year and average delays ranged from 2½ hours at best to over 14 hours. And—supreme humiliation to wireless men—well over 7,000 words had to be handed over for transmission by cable. Apart from the humiliation, that involved a dead financial loss of 4d a word: the "*via* Marconi" service was cut-price.

We do not know what were the delays and "cablings," as they were called, in 1910/11, but it seems certain that the new apparatus just described had brought about a great improvement in communication. Independent testimony given a year or two later suggested that average delays did not exceed those of the cable. But highly detailed signal-strength curves shown in Marconi's 1911 lecture make it appear that communication was liable to fail for a few hours nightly at times when X's were prevalent. Still, it is fair to



Characteristics of the Clifden transmitter. (From Marconi's Royal Institution Lecture, June 2nd, 1911.)

Air-dielectric condenser of the closed circuit at Clifden.



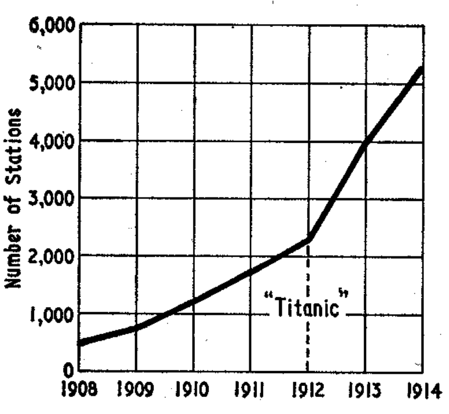
say the Atlantic had been conquered at last after many failures and disappointments. The epic struggle to get consistent signals across had started from the Canadian end* eight years earlier, at a time when nothing was known about long-distance propagation; the engineers did not even know on what wavelength they were transmitting! Countless changes in circuitry, power and aerial arrangement had been made. Glace Bay station had even been shifted to a different site.

Clifden came to a sad end in "The Troubles" of 1922, when the station buildings were burned to the ground. Still, it had nearly served its time and a radically new long-distance technique was soon to emerge. The station has no memorial, though, by a strange coincidence, near the site is a commemoration stone to the flyers Alcock and Brown, who crash-landed there after conquering the Atlantic through a different medium.

* The Canadian government had subsidized the Glace Bay station to the extent of $80,000.

1912

A CATASTROPHE which stirred the minds of men—and still does so—was the sinking of the *Titanic.* That great liner, believed to be unsinkable, struck an iceberg on her maiden voyage and sank in a few hours. Over 1,500 lives were lost, but some 700 were saved by ships summoned by wireless.



Increase in the number of the world's licensed stations between 1903 and 1914. (Based on data from the International Radiotelegraphic Bureau, Berne.)

That "epic tragedy of the sea," as we called it, was to have far-reaching effects. In earlier shipwrecks lives had been saved by wireless, but the part it had played in the *Titanic* disaster fired the public imagination; no longer did anyone doubt its value. America quickly passed a law to regulate wireless communication and, at long last, ratified the International Convention. Wireless men had become benefactors of humanity and, if our pages can be taken as reflecting their attitude, felt they "had never had it so good." Indeed, over-confidence began to creep in.

A grandiose, and what now seems over-optimistic, "Imperial Wireless Scheme" for linking the units of the British Empire was planned and a contract between the Postmaster-General and the Marconi Company was signed in July. A few extracts from the specification will give some idea of the giant spark stations proposed: "Capable of transmitting to the distant station at any time of day or night. . . . Wavelengths as great as possible within the limits of 17,000 and 50 000ft. . . . Aerials over 3,000ft to 8,000ft long, supported by tubular masts 300ft high. . . . Prime mover to be a steam turbine of between 1,300 and 2,500 h.p."

A name that has constantly recurred in our pages since the beginning—and happily still recurs—is that of H. J. Round, one of Marconi's engineers. In an article on the strength of atmospherics in relation to signals, Round described the use of a Fleming diode as a valve voltmeter to measure voltages set up by the X's—certainly our first mention of what we would now call electronics. Round has played a prominent part in many important developments.

High-speed automatic telegraphy was discussed. The transmitter was keyed by a Wheatstone machine and, for reception, there was the choice of photographic or phonographic methods. The phonograph, which allowed better discrimination between signals and X's, seems to have won the day; before long, speeds of 100 words per minute were demonstrated.

Heaviside's theory of wave propagation, enunciated some ten years earlier and now expanded and championed by Eccles, became the subject of quite violent controversy. It is pleasing to record that we came down editorially on the right side—but very cautiously: "at the moment there is a disposition to accept the hypothesis put forward by Dr. W. H. Eccles as yielding the best explanation of the observed phenomena."

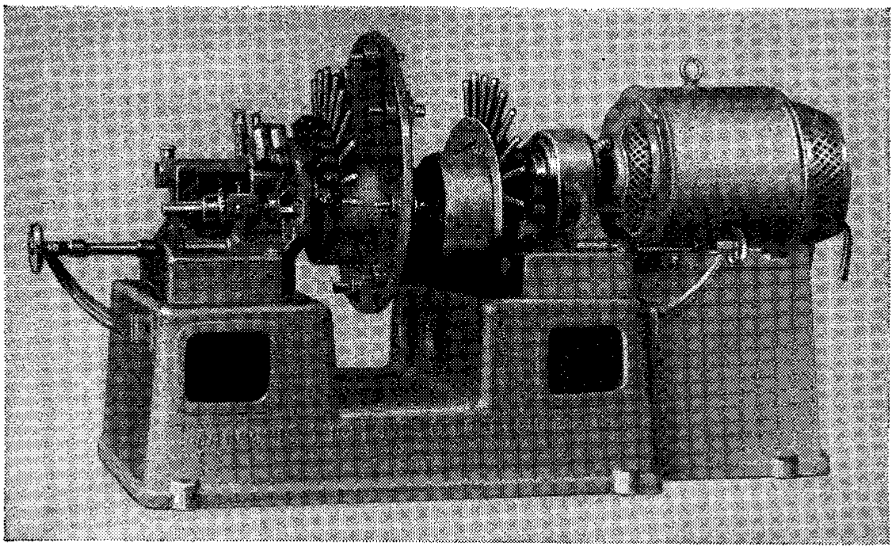
Direction finding, a brand-new application of wireless, now appeared. Thanks to the large size of the pair of fixed loops used in the original d.f. gear, sufficient signal pick-up was obtained to give fairly useful ranges without amplifying valves.

Throughout the early period wireless was bedevilled by patent litigation. During this year some sort of agreement seems to have been reached between Marconi's and their rivals Telefunken; actions and counter-actions with Siemens, who exploited the German system in Britain, were called off.

1913

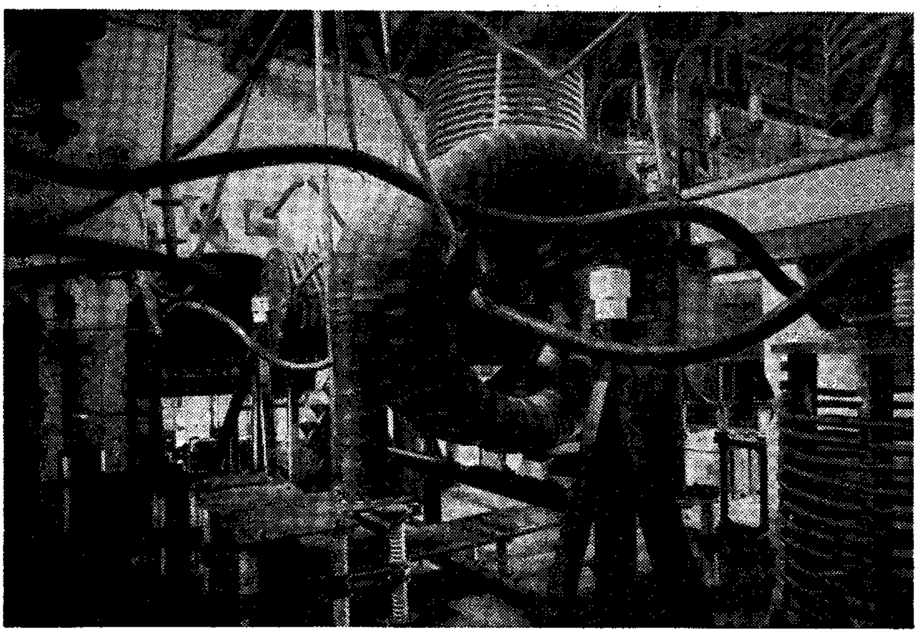
EVER since the Imperial wireless scheme had been announced the Government had been constantly under criticism, mainly on the grounds that the contract had not been thrown open to tender. A technical committee was now appointed "to report on the merits of the existing systems of long-distance wireless telegraphy." The distinguished members, all Fellows of the Royal Society, included the Director of the N.P.L. and the President of the I.E.E. They obviously did a conscientious job and produced a report providing a valuable and unbiased commentary on the state of the art in 1913. The systems examined were Marconi and Telefunken (spark), Poulsen (arc) and Goldschmidt (alternator), which used a rotary r.f. generator with contra-rotating field and armature, frequency multiplication being obtained by feedback. Those responsible for these systems were invited to give practical demonstrations "if possible over distances of 2,000 miles and upwards."

According to the committee's report "Except in the case of the Marconi system we did not, however, obtain any demonstrations over a distance of even 1,000 miles". Of Telefunken, it was said that experiments were being made between Nauen and Togoland (4,000 miles) and that communication seemed possible at night. Results of the Poulsen arc system working between San Francisco and Honolulu (2,100 miles) "do not appear to have been very satisfactory". The Goldschmidt machine being set up at Hannover "was ad-



Disc discharger for the 75kW Marconi spark installation.

The huge primary winding of one of the "jiggers" (aerial coupling transformers) for the 300kW synchronous spark transmitter at Caernarvon.



mirable both in design and workmanship" and expected to be capable of communicating across the Atlantic.

The Clifden transatlantic station was visited by the committee members, to whom high-speed and duplex working were successfully demonstrated. Of the general performance, it was said "Communication is practically continuous, though there are, no doubt, periods when the signals become very weak and even occasional periods when no signals can get through". But a note of warning was wisely sounded about the possibilities of atmospheric interference in the tropics.

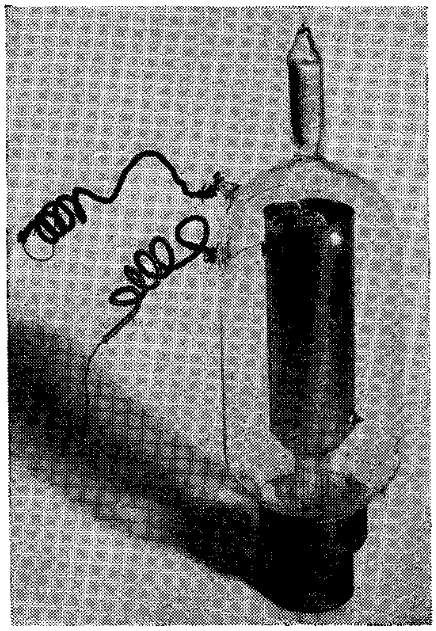
In spite of this favourable report, the Imperial wireless scheme was not to have a smooth passage. Criticism of the Government continued and a political scandal had developed. To cut a long story short, although the contract was eventually ratified by Parliament, the scheme never came to fruition. It ended with the conferring of the G.C.V.O. on Marconi and the award to his company, many years later, of £590,000 damages against the Postmaster-General for breach of contract.

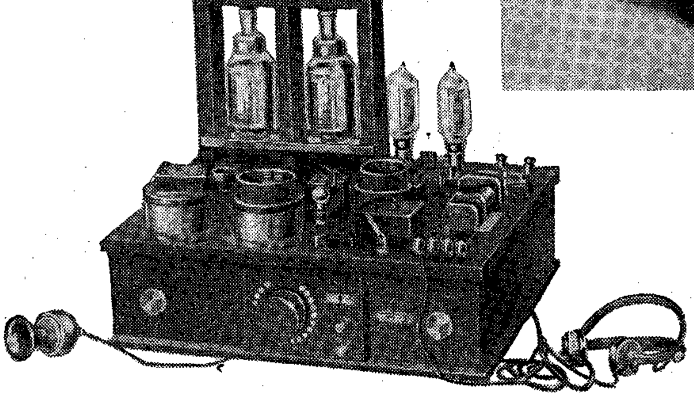
Thanks to the attention focused on wireless by the *Titanic* disaster the amateur movement had begun, and we were already publishing instructional articles for the benefit of amateur readers. We showed them it was quite easy to make a start: "An old motor-cycle ignition coil will do for the transmitter and a simple crystal set for the receiver". American amateurs were now controlled, being restricted to wavelengths below 200m and input powers of not more than 1kW.

1914

THIS year was marked by the most momentous advance so far described in our pages—the practical introduction of the triode, which had got off to a false start in 1907. This

The Round-Marconi triode, one of the early practical amplifying valves. ▶

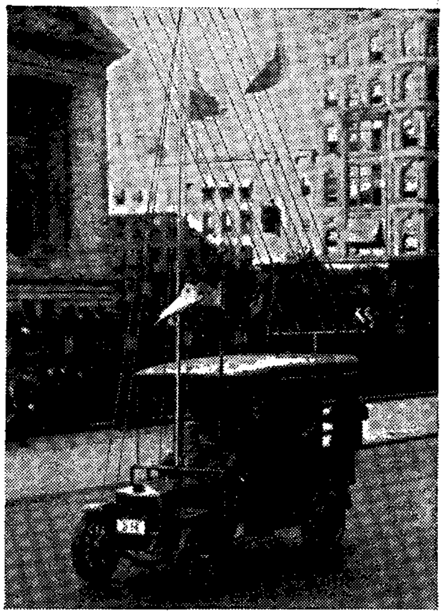




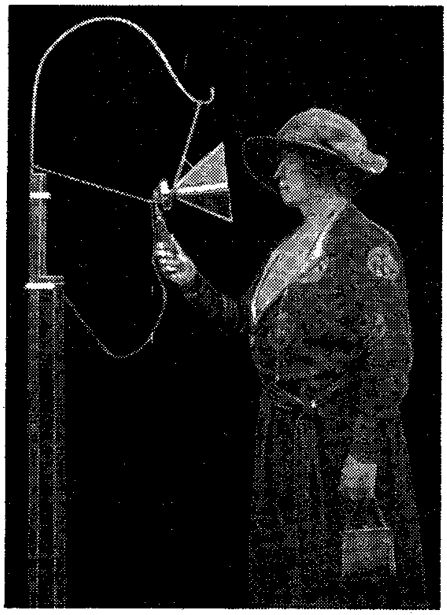
◀ *Marconi combined transmitter and receiver for wireless telephony (1914).*

was used in "a practical standard set for wireless telephony" developed by Marconi. This transmitter took 10-12mA from a 500-V dry battery and was stated to have a range up to 45 miles. Hardly any details were given.

The Marconi transatlantic station at Caernarvon was opened, working on the "timed spark" system in which more-or-less continuous waves were produced by overlapping spark discharges in appropriate phase. The "tone wheel", a mechanical beat-frequency generator for c.w. reception was introduced in Germany.



Police wireless car in New York (1918).



Dame Nellie Melba giving her famous broadcast concert from Chelmsford long-wave station on June 15th, 1920.

1915-18 THE FIRST WORLD WAR

DURING the war our activities were severely circumscribed by what we called "the heavy hand of censorship" and, in particular, we were prevented from writing anything about the rapidly increasing use of valves for war purposes. In fact, the only "safe" technical news was that coming from neutral America. David Sarnoff, then in Marconi's W.T. Co. of America, and later to become President of the Radio Corporation of America, was for a time our New York correspondent.

Without any doubt, the most important news coming from the U.S.A. concerned the development of the triode: in particular "the simultaneous use of a single bulb as rectifier, amplifier and oscillator has already produced startling results". That may raise a smile nowadays but, at the time, it was difficult to believe that anything more sensitive and selective than a good single-valve regenerative receiver would ever be devised. The importance of heterodyne reception was fully realized, thus giving continuous wave systems a new lease of life.

Towards the end of the war there was some relaxation by the censor and theoretical articles on valves were printed. Among the authors of these were two distinguished founder-members of Phase II of wireless technology: Dr. R. L. Smith-Rose and E. V. (later Sir Edward) Appleton. Smith-Rose wrote a long series of articles, starting with elementary thermionics, while Appleton's contribution gave our first mathematical treatment of valve characteristics. Valve manufacture was advancing rapidly and as early as 1916 transatlantic wireless telephone tests were made, using 300 receiving-type valves in parallel in the transmitter.

In the early days most wireless stations were designed empirically but by 1917 it was thought possible to design a complete station of specified performance by applying accepted formulæ; to "fly 'em straight off the drawing board", as they say in aviation circles. A theoretical exercise of this kind was now offered to readers in a series of articles.

The end of the spark transmitter era was now drawing nearer, thanks to improvements in continuous-wave gear and still more to heterodyne valve reception. The last of the great spark stations were those built for spanning the Pacific in two hops; from San Francisco to Honolulu (2,100 miles) and from Honolulu to Funabashi, Japan (3,350 miles).

British amateur activities had been entirely suspended since the outbreak of war but in the U.S.A. the movement steadily gained strength until America's entry into the war in 1917; by that time the supply of amateur equipment had become big business.

Television; a contributor's prophesy that went wrong: "The idea of wireless television is . . . absurdly improbable. . . . To construct wireless apparatus capable of receiving 40,000 signals in one-tenth of a second and arranging them in their correct order [would be beyond] the limit of human ingenuity."

1919

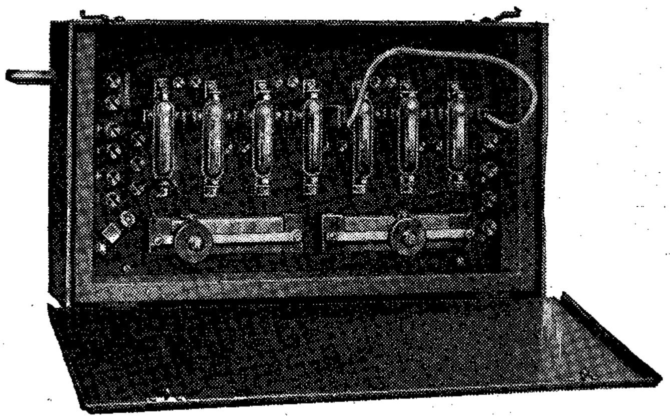
WITH the end of the war, articles of the "it-can-now-be-revealed" type were printed. One of the developments disclosed was the multi-stage r.f. amplifier with semi-aperiodic couplings.

Valves were now being produced by improved processes and the "soft" kind was fast disappearing. The generation of oscillations (by van der Pol) on a wavelength as short as 3.65m was considered a notable advance. Eccles suggested the modern valve nomenclature; diode, triode, tetrode and pentode. We were not quite at our best in editorially stigmatizing these now-universal terms as "too academic and refined to become familiar." High-power transmitting valves were now being made, allowing Marconi to span the Atlantic by telephony in daylight.

Amateur transmitting licences were not restored by the Post Office until a year after the war had ended; this delay caused much complaint.

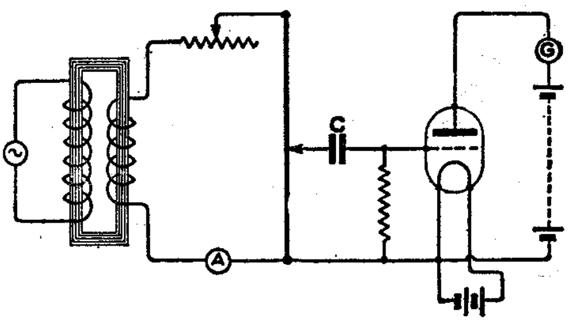
1920

THIS was the heyday or the great long-wave stations with arcs or r.f. machine generators, operating on



A famous r.f. amplifier-detector—the Marconi 55A with V24 type valves.

A group of passengers about to embark for Paris on the first commercial machine (Handley Page) to be equipped with radiotelephony (1920).



Circuit diagram of the Moullin valve voltmeter (1922) showing method of calibration.

wavelengths most conveniently measured in miles; the longest (Bordeaux) was 14 miles. Powers were up to 1,000kW or even more. In spite of improvements, the arcs radiated a rich assortment of harmonics and "arc hash."

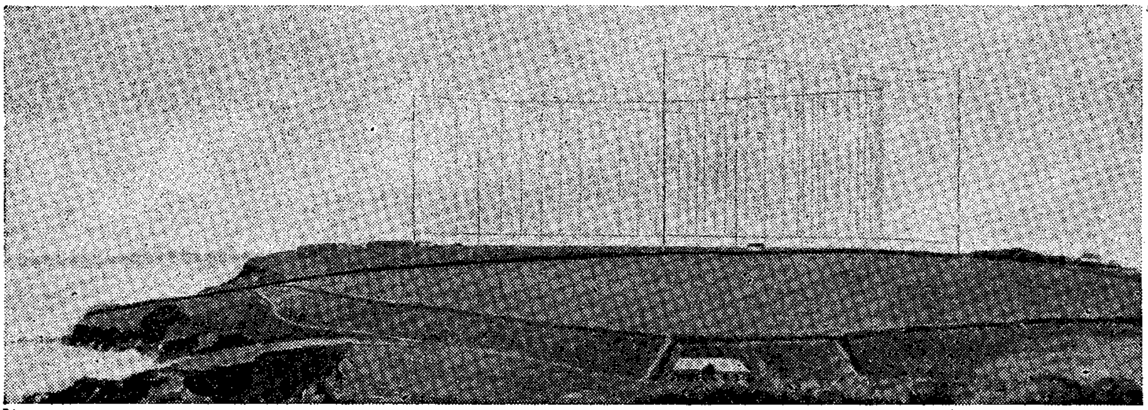
Continuous-wave sets for ships, wireless gear (including telephony) for the new airlines and commercially available direction finders were new developments.

The Wireless Society of London, suspended during the war, had now resumed full activity. Though by constitution an amateur body, this unique institution did in fact represent a happy mingling of amateurism and professionalism. Many of the most "eminent wireless telegraphists," as we used to call them in our earliest days, lectured before the Society. The first five Presidents—Campbell Swinton, Erskine Murray, Admiral of the Fleet Sir Henry Jackson, Eccles and Sir Oliver Lodge—had all from before the turn of the century played distinguished parts in wireless development. The Society changed its name to Radio Society of Great Britain in 1922.

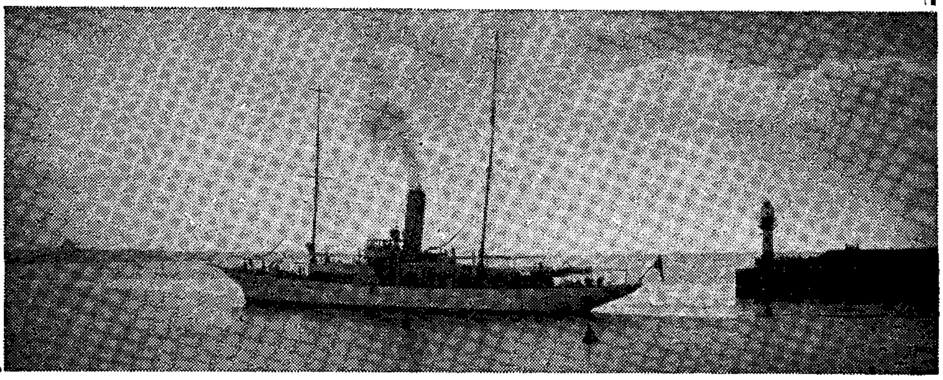
1921

THERE had by now been several casual mentions in our pages of what is now called "electronics"; Appleton, in a tailpiece to a book review, referred to the valve as "an invaluable laboratory instrument" to the general physicist. The use of amplifying valves in conjunction with photoelectric cells for measuring light intensities had also been mentioned. Now came our first full-dress electronics article in a report of a paper read before the Wireless Society of London by Prof. R. Whiddington on the measurement of physical quantities. He described the measurement of short distances by capacitance variation using the beat-note method with two oscillating valves. Sensitivity claimed was 50 to 100 times greater than that of the optical interferometer.

Broadcasting in America was already under way and regular "Dutch concerts" from The Hague were started. The Marconi Company's transmissions from Writtle were licensed by the Post Office early next year. With increased interest in telephony loudspeakers became important. Most of them consisted essentially of a telephone earpiece with a horn, but the American Mag-



Above: The parabolic aerial reflector at Poldhu used in early short-wave beam experiments.



Right: A floating laboratory—Marconi's yacht Elettra.

navox moving coil and the Western Electric balanced-armature types had appeared.

1922

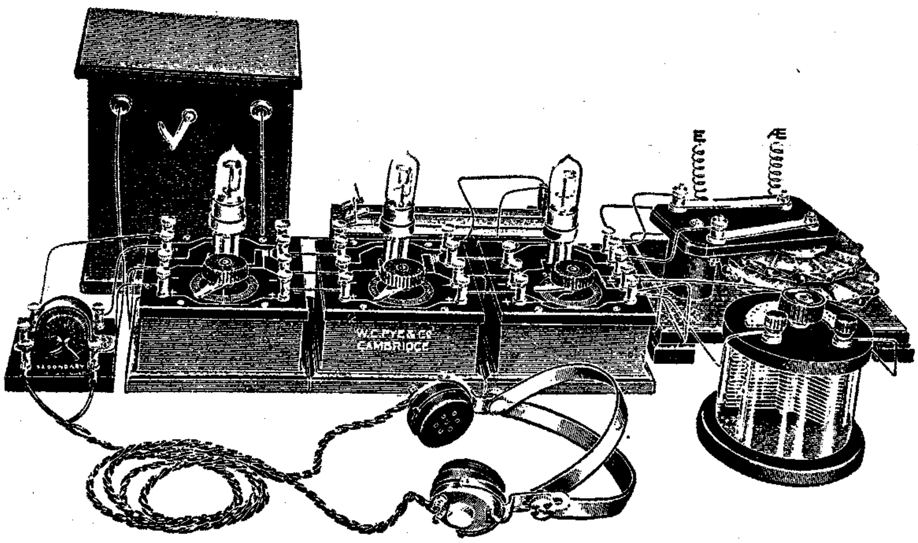
AMATEUR transatlantic tests were successfully carried out on 200 metres, *Wireless World* organizing the arrangements on this side. Moullin described his valve voltmeter, the first widely used electronic device. Dull-emitter valves with a filament wattage about 1/15th that of earlier types were introduced and news of Armstrong's super-regenerative receiver came from America.

C. S. Franklin of Marconi's described an important development—the use of highly directional aerial arrays on wavelengths below 20m. But so far there was no suggestion that such waves were usable over very great distances.

Towards the end of the year the British Broadcasting Company, forerunner of the Corporation, began official transmissions. *Wireless World* started weekly publication.

1923

WITH broadcasting in full swing, the biggest do-it-yourself boom of all time got under way; a high proportion of receivers were home-assembled The typical valve set of the period had a regenerative de-



"Messrs. W. G. Pye & Co. (Makers of Physical and Electrical Apparatus) beg to announce that they have opened a Wireless Dept. at their works" (Advertisement from W.W. May 27th, 1922).

The unit receiver was popular in the early broadcasting era.

tector with two transformer-coupled a.f. stages and sometimes a rather ineffective r.f. stage, stabilized by aerial loading or positive grid bias. Neutralizing of anode-grid capacitance was already known, but its use did not become widespread for several years. Cost of valve receivers was high, so many listeners used crystal sets with headphones.

The superheterodyne principle of reception was first described; this was one of the great basic inventions which got off to a slow start.

"Electromagnetic Screening," the subject of an article by R. A. (later Sir Robert) Watson Watt, seems a far cry from the author's future work in radar. More in character was his R.S.G.B. lecture "Observations on Atmospherics" (using recording gear and direction-finding) reported later in the year. "The greatest unsolved problem in radiotelegraphy is interference by X's."

1924

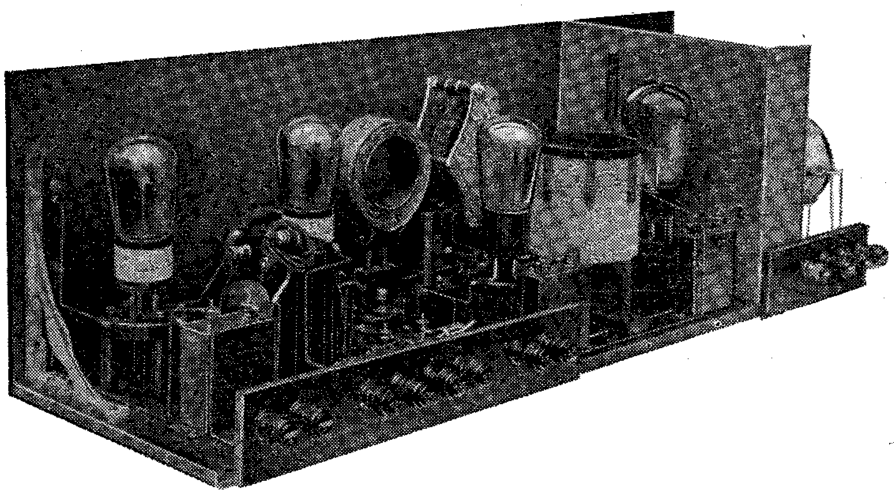
THIS was the year of the "wavelength revolution," a distinct landmark of the half-century. Marconi exploded his "beam wireless bombshell" by disclosing how, in the spring of 1923, he had conducted short-wave receiving tests on 93m while cruising in his yacht *Elettra* in the S. Atlantic. The transmitting station was at Poldhu, where Franklin had erected a parabolic reflector array. The British Government hastily revised their scheme of expensive mile-wavelength stations for Imperial communications and the Marconi Company undertook a contract to erect beam transmitters on a strict "no play, no pay" basis. That was probably one of the boldest commercial enterprises ever undertaken; nothing was known about short-wave propagation theory and the phased multiple "grid" aerials which were to replace the parabolic reflector system existed only on the drawing board. But fortune had favoured the brave; we now know 1923 was a sunspot minimum year; the frequencies chosen for the early experiments, though on the low side, were not so low as to be unworkable; on the other hand, they were not so nearly correct for prevailing conditions as to give an over-optimistic impression of the potentialities of short waves.

Short-wave working had by now become widespread, particularly among amateurs, and s.w. broadcasting had started in America. Other highlights of the year: Campbell Swinton's detailed pronouncement on the possibilities of cathode-ray television and Baird's first article on his mechanical system.

1925

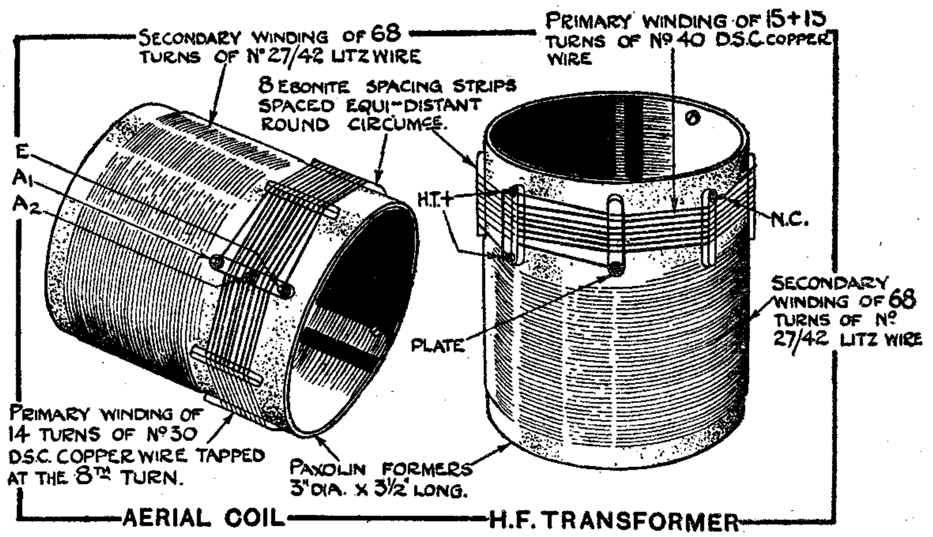
SOMETHING approaching the modern theory of short-wave propagation was now put forward by Appleton; Round wrote our first article on second-channel interference and other troubles to which the superheterodyne, now becoming of practical significance, is prone. Baird wrote on television by reflected light (as opposed to shadowgraphs) and that versatile genius, A. D. Blumlein, in collaboration with N. V. Kipping, discussed valve theory. Electrical recording and reproduction of gramophone records was introduced and the quartz oscillator and piezoelectric effect were described.

The amateurs' position had, we considered, been steadily undermined by the Post Office and, feeling diplomatic methods would no longer suffice, we publicly offered £500 towards the cost of fighting a test case against the Postmaster-General. It so happened the Marconi Company (then our publisher) was at the time engaged in delicate negotiations with the Post Office: an embarrassing situation seemed likely to arise, so the obvious course was to get rid of *Wireless World* as quickly as possible. Thus the transfer to our present publishers came about. That, needless to say, is a story which did *not* appear in *Wireless World*.



Wireless World "*Everyman 4*" *receiver (1926) set a new standard in range and selectivity for broadcast receivers.*

Details of the low-loss tuning coils used in the "Everyman 4."



1926

SO far as we were concerned, the event of the year was the introduction of the "Everyman Four," a receiver design of outstanding performance produced by us for home constructors. The feature of the set, which survived for many years in various modifications, was a high-gain neutralized r.f. stage with coils of exceptional "goodness," based on the classical work of Butterworth and on tests of coils submitted by readers.

The first mains-operated broadcast set (Gambrell) made its appearance. The series-connected 60-mA valve filaments were heated with rectified current from the h.t. supply source. Battery eliminators were now commonplace.

1927

AT last, Heaviside's theory of a conductive layer in the upper atmosphere was experimentally verified. Amplifying work done in the previous year, Appleton wrote an article showing how, by a method of distinguishing between waves travelling horizontally and those arriving in a downward direction, he had concluded the height of the layer of ionized air at night was 80-100km.

The first public transatlantic telephone service was opened and we conducted a campaign for Empire broadcasting on short waves.

1928

A MORE scientific approach to many problems, particularly to the details of receiver design, now becomes evident. It had already been shown (by M. G. Scroggie) that even a very low value of impedance common to several anode circuits could completely spoil the performance of an a.f. amplifier. This trouble was overcome by "decoupling" individual circuits, a method originated by Ferranti. The isolation of circuits by "scientific wiring" was also described.

By now, the neutralized triode was being replaced by the screened tetrode for r.f. amplification. Output pentodes, fed directly from the detector, helped to simplify and cheapen broadcast receivers: the three-valve set was becoming the most popular.

Detection of signal echoes "from the depth of space," with a time delay of 15 sec, gave a foretaste of extra-terrestrial communication.

1929

BAIRD'S 30-line mechanical television system, with flying spot scanning, was now sufficiently developed for the B.B.C. to give experimental transmissions of it for half-an-hour a day; these were continued until 1935. The broadcasting of "still" pictures by the Fultograph system by the B.B.C. and many European countries enjoyed a short-lived vogue.

Spark transmission for ships and coast stations was slowly giving way to i.c.w. (interrupted continuous wave); for long-distance point-to-point communication short waves had almost entirely replaced long-waves except on the N. Atlantic circuit.

Broadcast receivers were now built more or less in the modern manner, with metal chassis and, quite often, built-in speakers. Mains sets with the recently introduced indirectly-heated valves were commonplace. But there were still few sets with ganged tuning. Efforts were being made to provide greater selectivity in preparation for the "Regional" broadcasting plan, which was to offer listeners a choice of two programmes. The architect of the scheme, of which many traces remain in the present B.B.C. distribution system, was P. P. Eckersley, then chief engineer, who for many years has projected his ebullient personality and original thoughts through occasional *Wireless World* articles.

1930

A LIVELY controversy arose over the so-called "Stenode" receiving system, in which sidebands lost by extremely sharp tuning were restored by tone correction. The crucial question: "was interference put back equally with the sidebands?" A related controversy concerned the physical reality of sidebands; there were several notable "heretics."

The susceptibility to cross-modulation of screen-grid valves brought about a wave of interest in bandpass filters; as a corollary, ganged single knob tuning was widely adopted for broadcast and other receivers. Permanent-magnet moving coil loudspeakers were now in general use.

Our funny man "Free Grid," shrugging off an Editorial footnote threatening imminent "earthing" soon after starting his whimsical writings in September, 1930, has carried on ever since with his task of preventing us all from taking ourselves too seriously. One of his outstanding contributions (in our issue of March 10th, 1933) contained a remarkable anticipation by 16 years of Orwell's "1984." "Free Grid" went one better than Orwell in giving his Big Brother an electronic "thoughtcrime" detector.

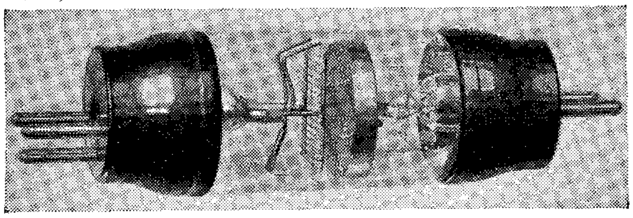
1931

PAVING the way for a better understanding of short-wave propagation, Appleton showed for the first time in our pages that there was more than one reflecting layer in the upper atmosphere. He had earlier sought the help of our readers in reporting distortion of the Baird 30-line television picture brought about by multipath propagation and reproduced a reader's sketch of a picture which clearly showed the effect.

Short-wave telegraph and telephone services had by now linked many, if not most, of the more advanced countries of the world and lack of secrecy, a handicap of wireless since the earliest days, was overcome by "scrambling."

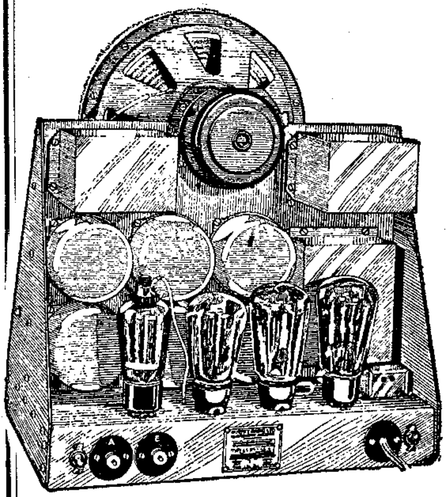
The N.P.L. was taking steps to develop a standardized form of test for the sensitivity, selectivity and fidelity of receivers. The decibel scale began to come into general use in place of such expressions as "times amplification," etc.

So far as receivers were concerned, the introduction of the variable-mu valve with linear characteristics largely overcoming the difficulties of cross-modulation, was an important development. "Straight *versus* superhet" became a burning issue, but the outcome was not in much doubt. Realizing that ganged tuning with "potted" coils would soon become universal, we commissioned a special investigation of the characteristics of coils. Moving-coil speakers, now generally built into the receiver, were almost universal: during this and the preceding year the finer points of their design were discussed in a long series of important articles by Dr. N. W. McLachlan.

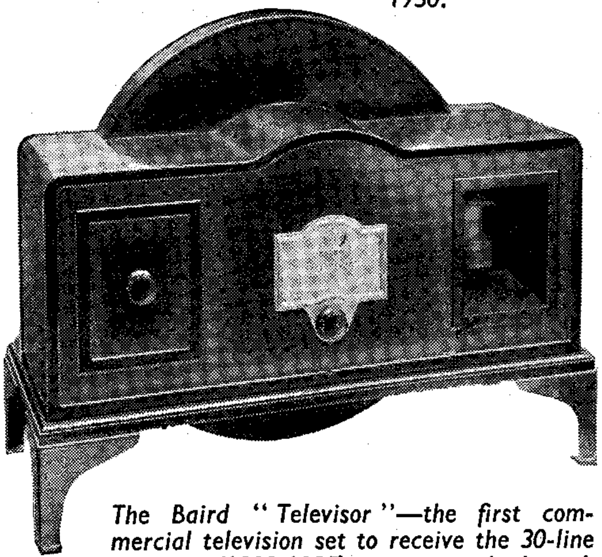


The introduction of the screened-grid valve in 1927 enabled higher r.f. gains to be achieved with stability. ▲

▲ *A. A. Campbell Swinton, F.R.S., the prophet of television as we know it today, who died in 1930.*

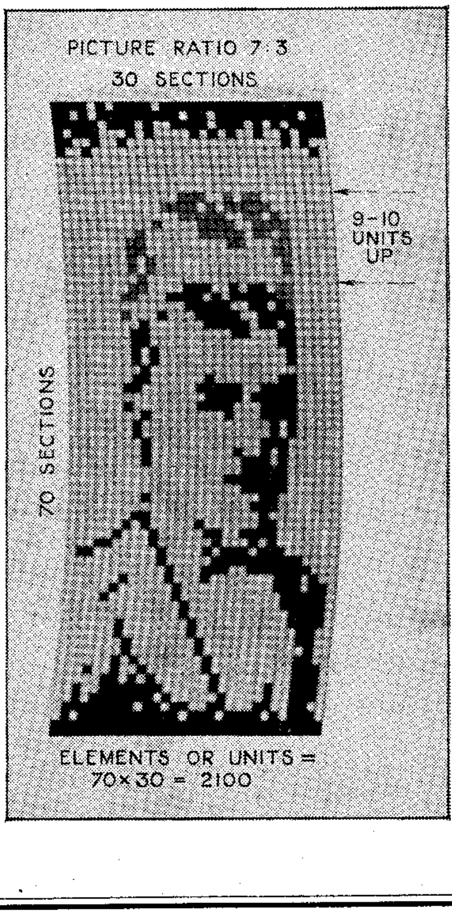


◀ *A highly-developed broadcast receiver of the late "straight-set" period: the Murphy A3 (1931).*



▲ *The Baird "Televisor"—the first commercial television set to receive the 30-line pictures (1929-1935) transmitted through the B.B.C.*

Sketch by a reader (W. B. Weber) showing observed effect of multipath propagation on a 30-line television picture (1931). ▼



▶ *A turn of this kind, giving wide contrasts of light and shade, was thought to provide "genuine entertainment value" on 30-line television.*

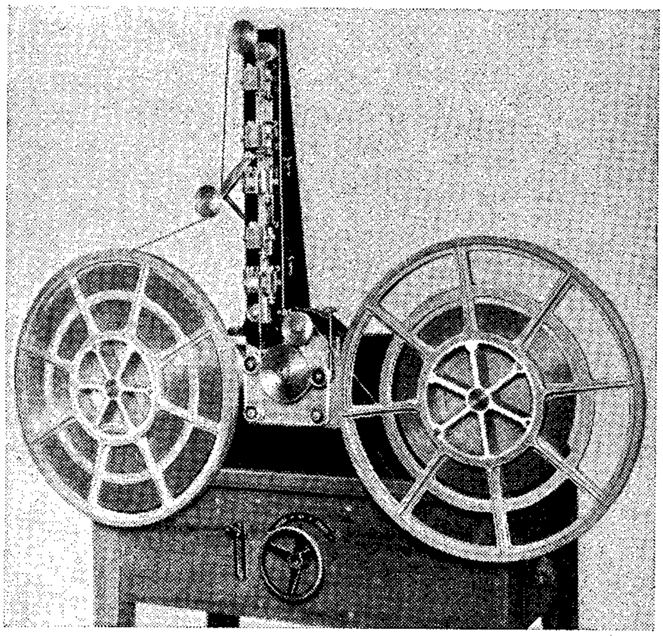
1932

THOUGH many ships still had spark transmitters, marine wireless had by now made considerable progress. Short-wave equipment for telegraphy was commonplace and some 15 transatlantic liners provided a radio-telephone service for passengers. The G.P.O.'s long-distance station for working to ships had been much improved and now had a rotating beam array with an electrically-interconnected receiving beam turning in unison at the remote controlling station.

The cathode-ray tube had by now become a regular article of commerce and its applications were no longer restricted to research work; it was being used for routine factory testing.

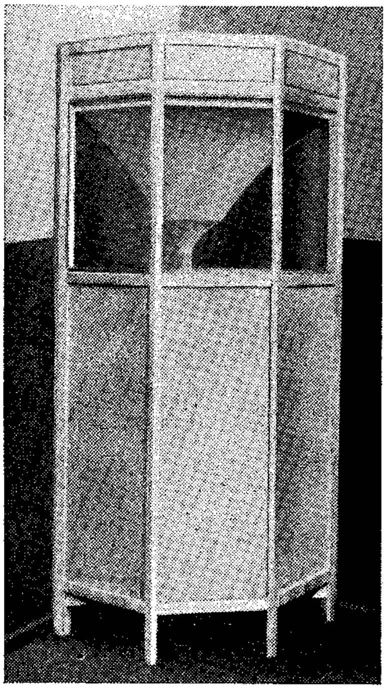
A stir was caused by the introduction (from Germany) of coils with powder-iron cores; inductors of this type were soon to be widely used in receivers in place of bulky air-cored windings.

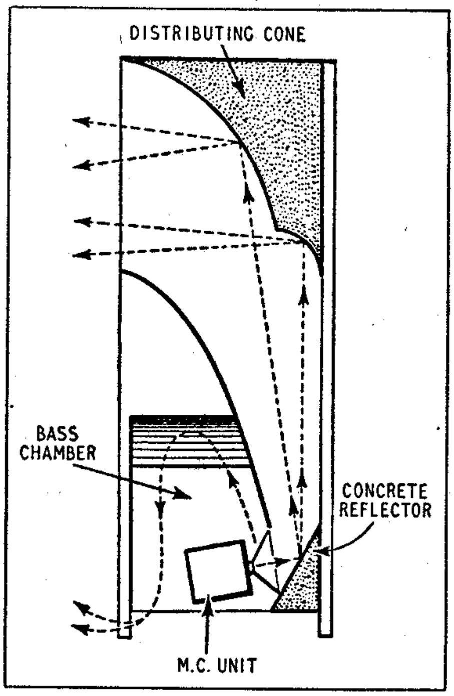
A B.B.C. service of official "Empire" broadcasting, for which we had campaigned for some six years, was at last started. Wire and wireless were linked by a five-metre Post Office telephone link across the Bristol channel.



Marconi-Stille steel tape recorder.

An historic high-quality loudspeaker: the Voigt domestic corner horn in its original form (1934).





1933

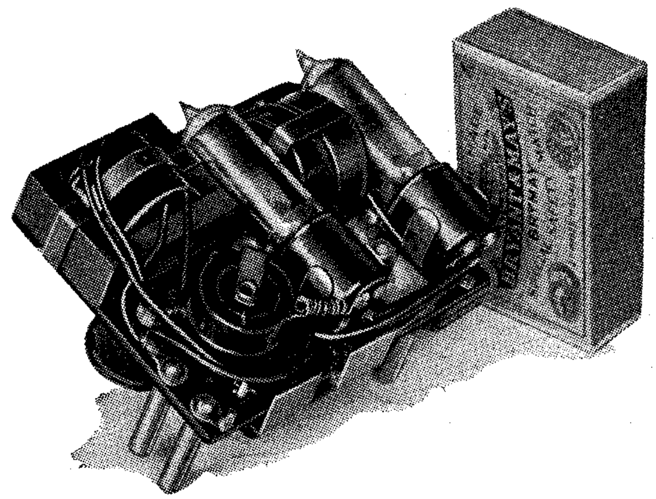
WITH the increase in sensitivity of receivers and the growing electrification of the country, man-made interference had become a serious problem. Following suggestions made in *Wireless World* the I.E.E. had set up a committee to consider the possibility of legislation and interference complaint questionnaire forms could be had from post offices. This service is still available to the public.

The "small superheterodyne" was soon to become Britain's standard broadcast receiver: early versions had bandpass input, single-valve frequency-changer, one i.f. stage and a second detector feeding a pentode output valve. R.F. pentodes were by now widely used and the electron-coupled frequency-changer had appeared. Refinements like automatic gain control, noise-suppression switches and, occasionally, "quiet" a.g.c., were coming in. For battery sets, economy circuits with push-pull output valves biased to cut-off were being used. Built-in car sets had arrived, so we described methods of suppressing ignition interference.

S.T.C. put up for the Air Ministry a decimetre-wave (17.5 cm) link working across the English Channel.

1934

SEVERAL high-definition television systems were now being described and Zworykin's "Iconoscope" camera tube was announced. Apparently the audience of the Baird 30-line broadcasts was greater than we had thought; publication of a proposal to suspend the transmissions brought,



Forerunner of the (transistor) pocket portable: chassis of a super - regenerative valve set (1935).

within the week, protests from a large number of readers. No doubt the transmissions on this system, crude as it was, did a great deal to stimulate work on television; some correspondents were now using cathode-ray receivers.

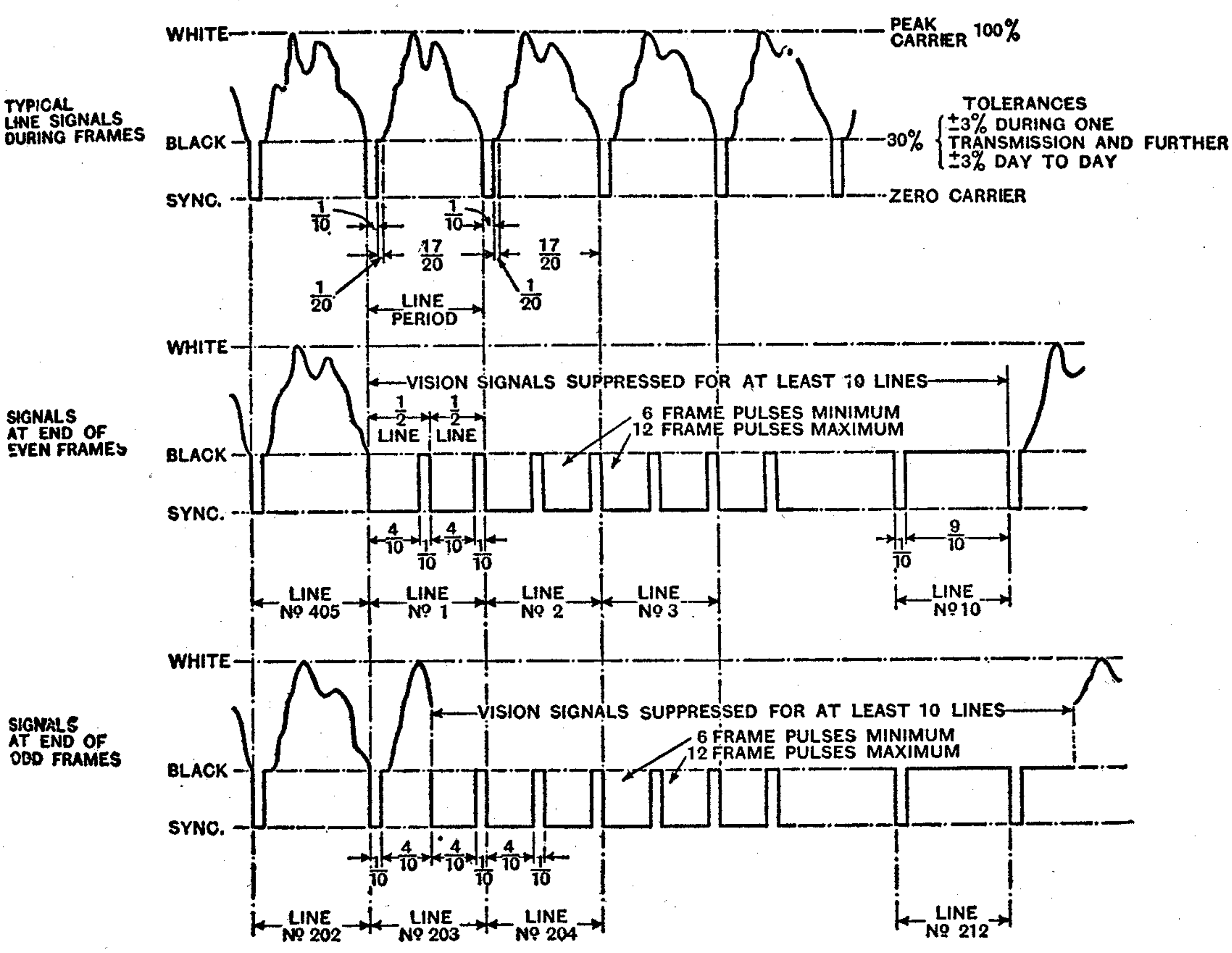
The introduction of suitable valves now made practicable the "universal" a.c./d.c. receiver, without a transformer.

Our contributor "Cathode Ray" started his inimitable series of expository articles in 1934. Apart from his services as a talented and sympathetic expositor of the trickier aspects of technology he has been a doughty fighter against the many irrational and confusing technical terms which make life so difficult for the student and beginner. And "Cathode Ray" has won many of his battles: few of us now dare to speak of "non-linear distortion" unless we really mean it is the distortion which is non-linear!

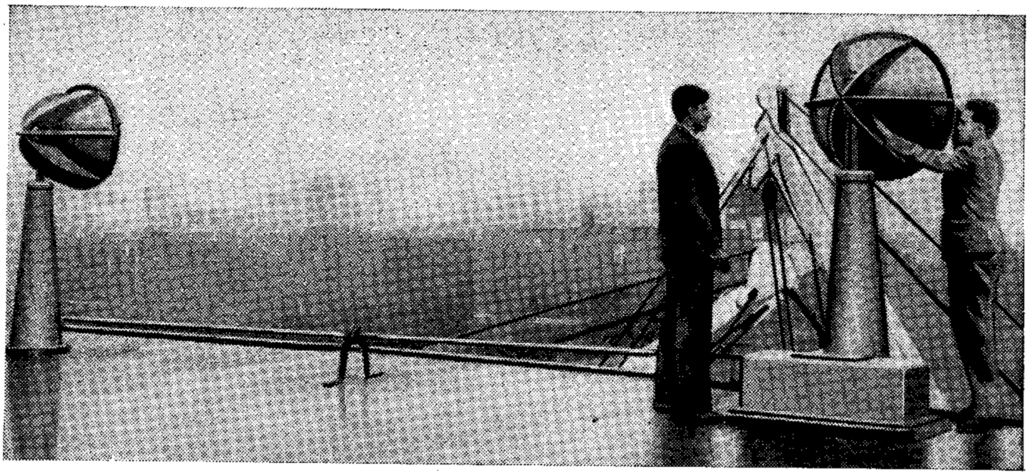
Other innovations of the year: investigations of the effect of sunspots on h.f. propagation: the Marconi-Stille magnetic wire recorder: high-note speakers (tweeters): the *Wireless World* Quality Amplifier, with resistance-coupled push-pull, which set a standard for high-quality reproduction for many years: the Voigt domestic corner horn loudspeaker.

1935

THE scene was now set for the start of a regular British television service



Characteristics of the Marconi-E.M.I. television system as first issued in 1935.



Radar: S.F.R. "obstacle detector" fitted in the liner Normandie *(1936).*

next year and it was decided that alternative test transmissions should be made on the Marconi-E.M.I. system (405 lines interlaced; characteristics basically as at present) and a new Baird system (240 lines with sequential scanning; 25 frames per second). One of the television systems much discussed was the "intermediate film," with a time delay of about half a minute; it was easier to scan the film image than the direct scene.

Our "Diallist" now started his non-stop radiations of his random and highly individualistic commentary on the happenings of the times.

Some developments of the year: Armstrong's frequency modulation in America: the electron multiplier: "all-wave" tuning and refinements like contrast expansion and automatic selectivity control in broadcast receivers: public address became important.

1936

THIS year marks the end of our first quarter-century and it is time for a backward glance. And a very appropriate time, as it happens: technical development was moving rapidly into Phase III, the era of high-definition television, industrial electronics, microwaves, radar and pulse techniques. Phase I had been the evolution of spark telegraphy on medium and long waves. Phase II, coming to an end in 1936, had began with the practical development of the amplifying and oscillating valve in 1911-1913, followed by radio-telephony, broadcasting, the full exploitation of the multi-mile wavelengths and then of those rich bonanzas the h.f. and v.h.f. frequency bands; also the start of electronics for scientific purposes. Most of this progress had been made possible by valve improvements; our contributor, "Cathode Ray," produced detailed support for the assertion that 92 valves of the 1921 type would be needed to provide the performance of the typical five-valve broadcast receiver of 1936. And a resourceful designer, well primed with the accumulated knowledge of 1936, would have been needed to achieve that performance.

A quick glance through our 1936 volume shows how fast radio technology was then moving into modern times: The B.B.C.'s London television station started the world's first regular high-definition service; the French S.F.R. company introduced the "obstacle detector," a non-pulse radar device; "plumbing" was coming in and waveguide theory was treated; there was a number of articles on electronics; an editorial plea was made for the abolition of spark transmission.

A quarter-century's progress in wireless telegraphy; the *Queen Mary* on her maiden voyage handled as many words of traffic in the few days of the crossing as the great transatlantic station Clifden had averaged in two months in 1910/1911.

1937

NOW that regular transmissions had started, television became the centre of interest and was much discussed both in theory and practice. The first 405-line commercial receiver to be reviewed was an H.M.V. model giving a picture 10in by 8in viewed indirectly in an inclined mirror. The vision unit had a "straight" six-stage r.f. amplifier, the sound receiver being a superheterodyne. Deflection was magnetic and the set, complete with aerial, cost 95gns. After a few weeks' trial the Baird 240-line transmissions were discontinued, leaving the 405-line system, basically as it is today, as the British standard. One of the first television outside broadcasts was that of the coronation procession of King George VI.

Designs for the home construction of ordinary broadcast receivers were now seldom offered in our pages; the readership was undergoing a change, as was shown by a questionnaire. About half our readers were now professionally concerned with radio.

The "all-wave" broadcast receiver, often with three short-wave bands, was now firmly established and the complicated switching required had made the wafer switch almost universal.

Guglielmo Marconi who died in July 1937, aged 63.

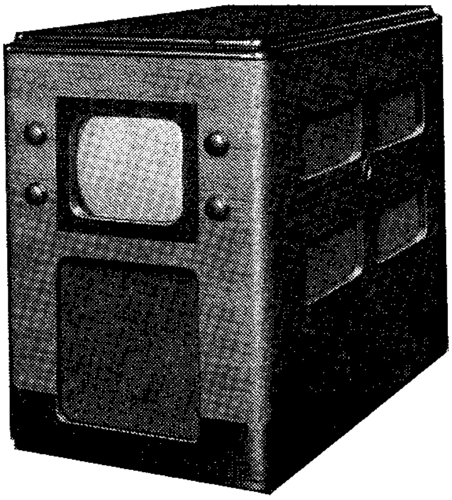
1938

THE days were long past when the vagaries of short-wave propagation had been stoically accepted as something to be endured, like the weather. Diversity reception was now well established; a description of the B.B.C.'s highly developed receiving station at Tatsfield was published. And the minor deficiencies of equipment generally were less readily tolerated. Now came a determined effort to overcome tuning drift by more basic and cheaper means than automatic frequency control; much attention was given to temperature-compensated components.

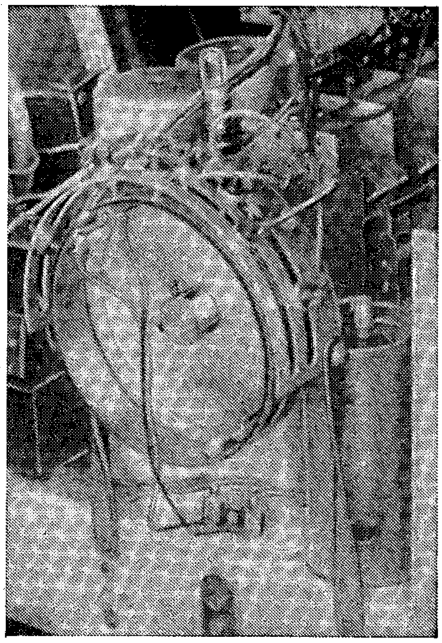
The public demand for television receivers had so far been disappointing. Now, in an attempt to attract buyers, cheap sets with small 5-in, 6-in or 7-in tubes were introduced. One example, costing 29gns, had a 5-in tube giving a picture 4¾in by 4in.

Push-button tuning became the vogue in sound broadcast receivers. There were three main methods: mechanical location of the condenser; motor drive of the condenser; separate pre-tuned circuits for each station.

In brief: electronic techniques used for neurological research and Grey Walter's electro-encephalograph produced; improved electron microscope announced; "wobbulator" and Cossor double-beam oscilloscope introduced.



Cossor Model 54 with 6-in tube (1938).



Drum-type commutator of the H.M.V. motor-driven tuning mechanism (1938).

1939

EVER-INCREASING interest in sound reproduction was further stimulated by B.B.C. experimental transmissions of high quality on 45Mc/s; this was Britain's first taste of v.h.f. broadcasting, though f.m. had already started in America.

The Western Electric "radio altimeter" for aircraft, an f.m. device working on frequency differences between the emitted wave and reflections received from the ground, was described.

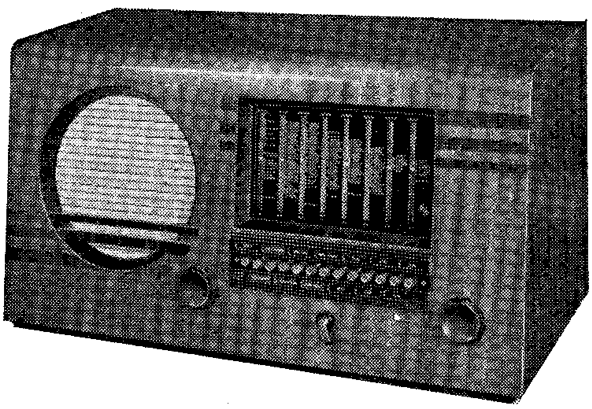
In television, the public had not taken kindly to the small "peephole" sets introduced last year and there was a reversion to larger tubes, the 12-in size being most favoured. Ignition interference was being discussed and voluntary suppression was suggested.

Some new introductions: the cathode follower; "all-glass" valves with short, well-spaced internal leads; forced air cooling for high-power transmitting valves; short-wave therapy.

With the threat of imminent war, *Wireless World* had, with official approval and collaboration, instituted early in the year a "National Wireless Register" through which readers were able, without any liability, to have a record of their technical qualifications made available to the appropriate authorities. The Register was later to prove a valuable source of technical man-power for war-time radar as well as for communications.

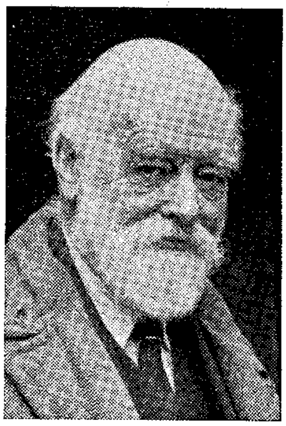
1940-44 THE SECOND WORLD WAR

AMONG the immediate results of the outbreak of war in September 1939 was the closing down of the television service and of amateur transmission; car radio was banned later. B.B.C. headquarters "moved into the country" and a single-programme service was transmitted from syncnronized stations to avoid giving direction-finding help to the enemy. There was a short-lived boom in receivers, especially in the recently-introduced "semi-communications" models, which offered an exceptionally good performance on short waves. This was mainly wanted for the reception of news bulletins from overseas, and especially from neutral sources. Information on short-wave receiving conditions was also wanted; for some time we published ionosphere forecasts provided by Cable and Wireless, but these were eventually stopped by the censor. However, no objection was raised against "do-it-yourself" forecasting and general articles on propagation by T. W. Bennington were continued.



One of the popular "semi-communications" receivers of the early days of the war: the Pye "International" with band-spreading on six short-wave ranges.

So far as *Wireless World* was concerned, the war brought an abrupt change from weekly to monthly publication and, with a depleted staff, we did our best to meet the changing needs of readers, especially in producing instructional articles on new subjects: morse telegraphy was now important. And a rather unexpected demand arose for the treatment of topics bearing no relation to the grim realities of the times—for maintaining the journal, as a correspondent put it, as "one of the few remaining links with normality." Escapism also manifested itself in lively discussions by contributors and correspondents of the changes in radio and electronics they hoped to see in the brave new post-war world. The phrase "after the war" recurred constantly.



Sir Oliver Lodge, the pioneer of "syntony" (tuning), died in August 1940, aged 89.

Maintenance of interest in high-quality sound reproduction was probably another manifestation of escapism. In this sphere an important war-time article was "The Acoustics of Small Rooms," by J. Moir. The kind of acoustics discussed by Moir had hitherto been studied mainly in relation to halls and large rooms.

In spite of restrictions, readers were kept fairly well-informed on the underlying reasons why valves were working better and better on ever-higher frequencies by a series of articles by Dr. Martin Johnson.

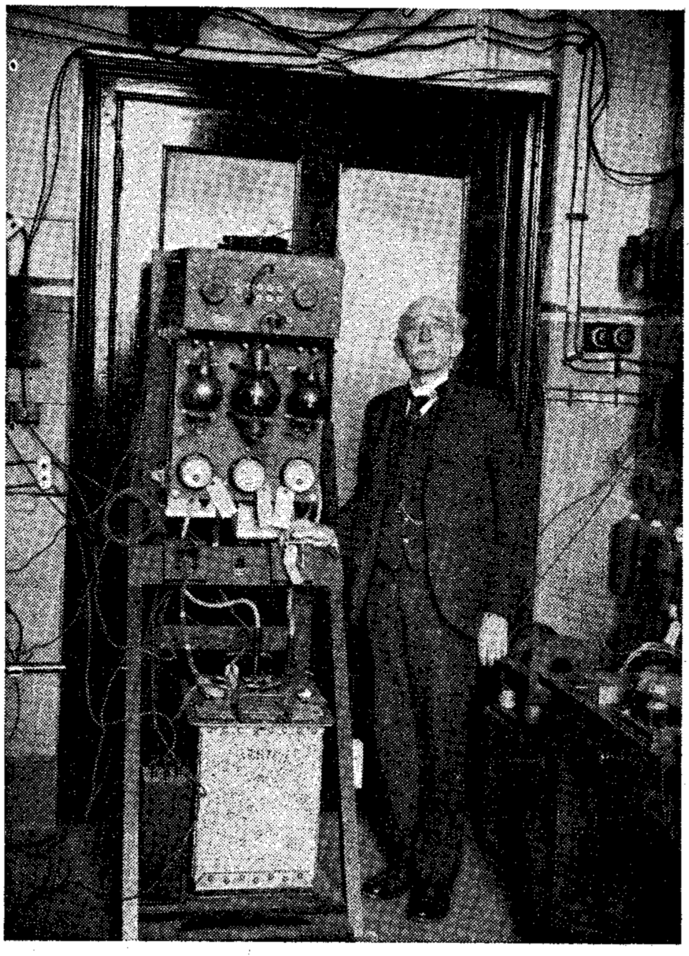
Though censorship was quite different from that prevailing in World War I, it did in fact bear quite heavily on the contents of the journal, as most of the developments now emerging were being applied to purposes of war. Radar and everything connected with it, especially pulse techniques, were completely banned. The authorities had taken us into their confidence about radar before the outbreak of war, so we knew what to avoid. There was a transient lifting of the veil of radar secrecy in 1941, mainly as an aid to the recruitment of civilian technicians, especially from America, but we were allowed to print only a few dozen words of basic description. One of the few electronics developments which could be treated at length was radio-frequency heating.

The fusion of the Institute of Wireless Technology with the British Institute of Radio Engineers and the deaths of Sir Oliver Lodge, of the German pioneer von Arco, and of Nipkow, the originator of television scanning were reported.

John Logie Baird, the pioneer of practical television, who died in 1946, aged 57.

1945

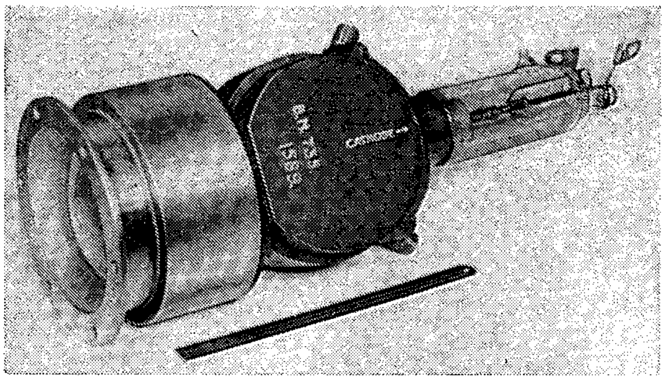
WITH the end of the war in sight, we were able to publish the first full article on the fundamental principles of radar. Appropriately enough, the author was Smith-Rose, who, towards the end of World War I, had given our first detailed exposition of the amplifying valve. Pulse modulation, an offshoot of radar, was described later, as was the proximity fuse, "a radio station in a shell



Sir Ambrose Fleming, who died in 1945, aged 95.

nose-cap," which made use of the Doppler effect. The fuse marked the start of the trend towards miniaturization of components, one of the features of the coming decade.

What may well turn out to be a strikingly accurate forecast of things to come was given in Arthur Clarke's article "Extra-Terrestrial Relays." Clarke contended that artificial earth satellites would provide the most effective and economical means for inter-continental telegraph and telephone communications and for distributing world-wide television. His proposals were described in considerable detail; their essential practicability has not been controverted.



"The greatest invention of the war": cavity magnetron with a peak output of 2,500kW, photograph alongside a 6-in rule.

1946

MUCH new information on radar was now published, but *Wireless World* considered it had come too late. Many of the devices, including some of essentially British origin, had already been described in American journals, and subsequently repeated in the technical Press of the world without emphasis on the country of origin. It was thought that British prestige had suffered through these delays. The cavity magnetron, produced by Randall, Boot and Sayers was considered the most important single development.

Parts of the inner story of radar development were still coming out as late as 1952, when Government awards were made to the pioneers: £50,000 to Watson-Watt "for the initiation of radar" and other awards ranging from £12,000 to £250 to twenty others.

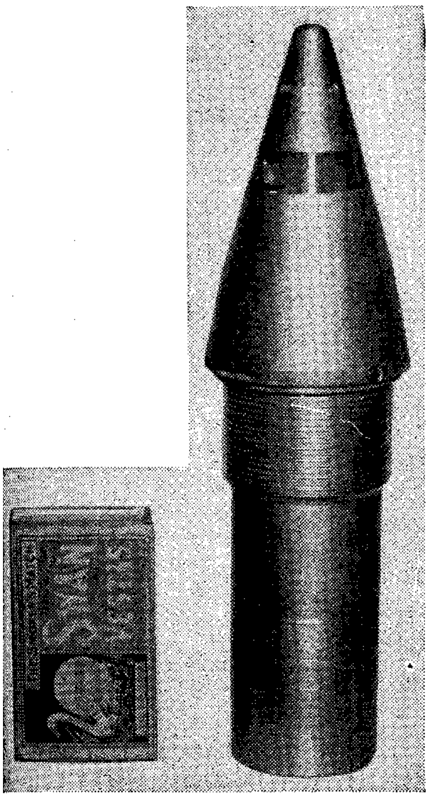
The Physical Society's first post-war exhibition in 1946 showed in an impressive manner how deeply radio techniques had infiltrated into most branches of applied physics during the war years.

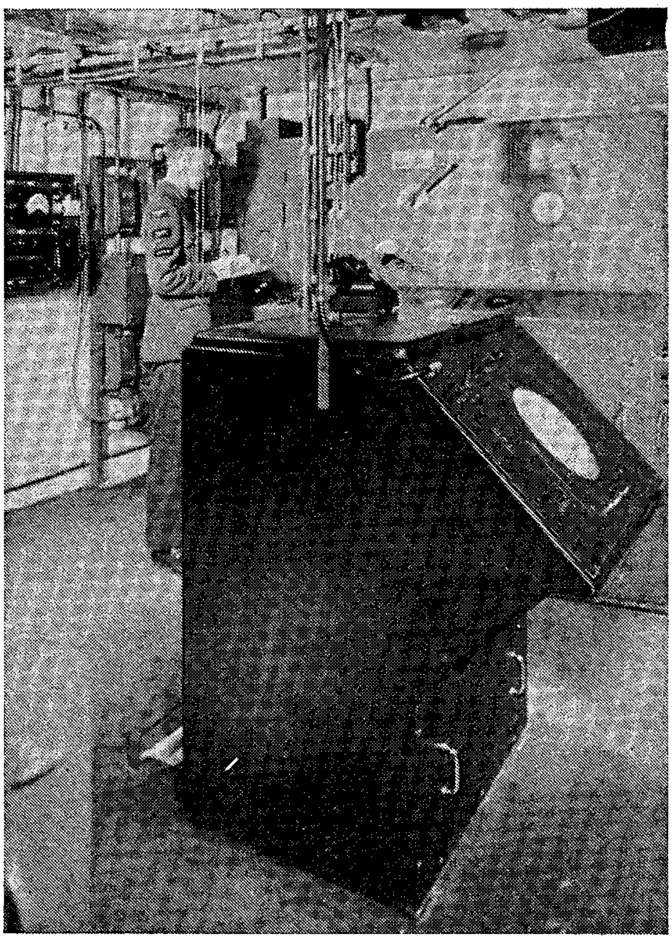
In brief: London television station re-opened; the Decca navigational system described; death of Baird, aged 57; the German Magnetophon tape recorder described.

1947

THE first post-war Radio Exhibition gave a clear indication of how the industry had progressed during the past seven years. Equipment of every kind was better designed and better

The proximity fuse, "a radio station (sending and receiving) in the nose of a shell."





One of the first photographs of radar equipment to be released: an underground station for location of enemy aircraft and fighter control.

made, while the uses of radio and radio-like devices had been vastly extended, partly thanks to miniaturization and tropicalization. In communications, the greatest advance had been in pulse modulation techniques and in the attainment of a high degree of secrecy by the use of centimetric waves in narrow beams.

The Williamson amplifier design, published this year, seemed to satisfy the most exacting requirements of the "high-fidelity" enthusiasts and soon variants of it were to appear in many countries. It was the first design for home construction to exploit the use of direct coupling and meticulous design in the output transformer to reduce phase shifts and to enable a high degree of negative feedback to be used with stability.

The Marconi Company celebrated its 50th anniversary.

Sir Edward Appleton, whose pioneer scientific work paved the way for radar.

Sir Robert Watson-Watt who directed the initial investigations into the use of radio wave reflections for the location of aircraft.

1948

THE transistor, probably one of the half-dozen most significant radio devices of the half-century, was announced. What was now briefly described was the original point transistor produced by Shockley, Bardeen and Brattain in the Bell Telephone Laboratories.

The International Radio Convention, the first to be held since 1938, issued its decisions. Since the previous Convention in 1938, the highest frequency allotted had risen from 200Mc/s to 10,500Mc/s.

In brief: Appleton awarded the Nobel Prize for ionosphere researches; British sub-miniature valves, 10mm diameter, 25-mA filaments introduced by Mullard; frequency-shift keying now widely used for high-speed telegraphy; mobile radio licences granted more freely by the G.P.O.

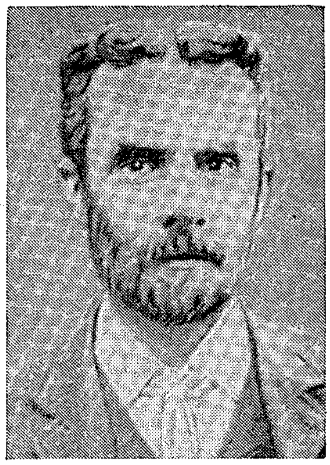
1949

AROUND this time there was much discussion of television standards. In the previous year the Postmaster-General had decided the 405-line British system was to be retained "for a number of years": later, an international study was made to decide upon the standards for the continent of Europe. *Wireless World* now decided the British system was even better than had been originally thought, being economical in both bandwidth and receiver cost. Its general adoption was therefore advocated and much information was published on line standards in relation to true definition in both horizontal and vertical planes.

In brief: commercial radar began to make spectacular progress; printed circuits were coming into the limelight; a new Wireless Telegraphy Act, extending the P.M.G.'s powers and allowing him to control interference, was passed.

1950

TELEVISION was now beginning to spread over the country and, as a result, the tunable receiver appeared. It was more usual, though, to provide interchangeable tuning units for the various channels. In anticipation of v.h.f. sound broadcasting, the provincial television stations were fitted with a superstructure carrying a slot aerial.



"There may possibly be a sufficiently conducting layer in the upper air. . .". Oliver Heaviside, the centenary of whose birth was celebrated in 1950.

At the British Sound Recording Association's exhibition $33\frac{1}{3}$-r.p.m. records (which had been exported for some time) made a first appearance. In addition to longer playing time they offered, thanks to the use of improved moulding material, lower surface noise, increased dynamic range and longer life.

In brief: centenary of Heaviside's birth; television boom in America ($2\frac{1}{2}$ million sets sold in 1949).

1951

WHAT amounted virtually to a new use of radio technique was now coming into prominence. As long ago as 1932 it had been known that radio waves were reaching this planet from outer space; in 1948, localized sources of emission, since known as radio stars, had been detected. Now radio astronomy—the use of the so-called radio telescope—was made possible by improved low-noise receiving techniques. The famous station at Jodrell Bank, with its huge steerable "dish," had already begun probing into space at distances far beyond the range of optical telescopes.

In brief: Interest in electronic computers began to widen; much discussion on frequency *versus* amplitude modulation for v.h.f. broadcasting; marked growth of mobile radio telephony, including installations in London taxicabs; tape recorders the centre of interest in sound reproduction.

1952

SOME of the exhibits at the Physical Society's annual exhibition showed how widely electronic techniques had now been adopted for "run-of-the-mill" industrial processes, as opposed to their original laboratory uses. In the textile industry it was being used for measuring the tension of yarn and for showing irregularities in its weight per unit length. Supersonic waves were being used as a matter of routine for the detection of flaws and for determining thicknesses with high accuracy. Perhaps the most important of all was the growing use of electronic controls in the chemical industry.

Detailed information came from the U.S. Bureau of Standards on "a new kind of v.h.f. propagation," later to be known as "ionospheric scatter." Weak but consistent signals on a frequency of 50Mc/s had been received over a period of many months at a distance of 774 miles. The power used was 23kW, the signals being radiated from a high-gain aerial set at an elevation angle of seven degrees.

1953

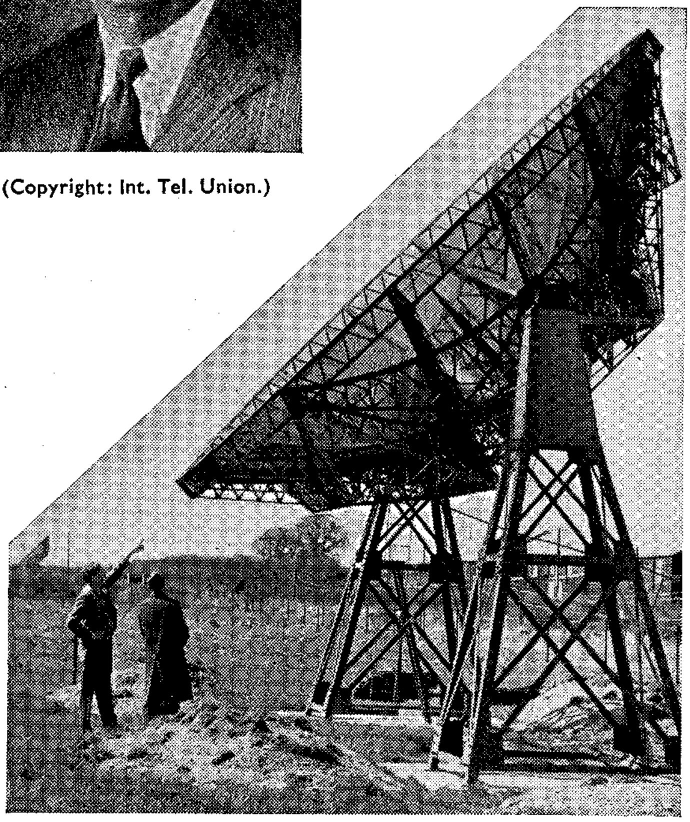
FOR nearly a quarter of a century there had been agitation for control by law of man-made interference with radio reception. In 1933 a committee had been set up at the suggestion of *Wireless World* to investigate the possibilities but the labours of that committee and of various successors had failed to produce an agreed basis for legislation. Now, at last, the Postmaster-General, using powers conferred on him by the Wireless Telegraphy Act of 1949, made a start by issuing regulations for the compulsory suppression of interference from newly-built internal combustion engines.

A minor difficulty in presenting information on a rapidly growing science is that the terminology, sometimes hastily and arbitrarily chosen, is often quickly out-dated by developments. One of the words about which ambiguity had long existed was "electronics." Transistors were now coming into general use and the fact was recognized by the addition of the words "and semiconductors" to the official definition.

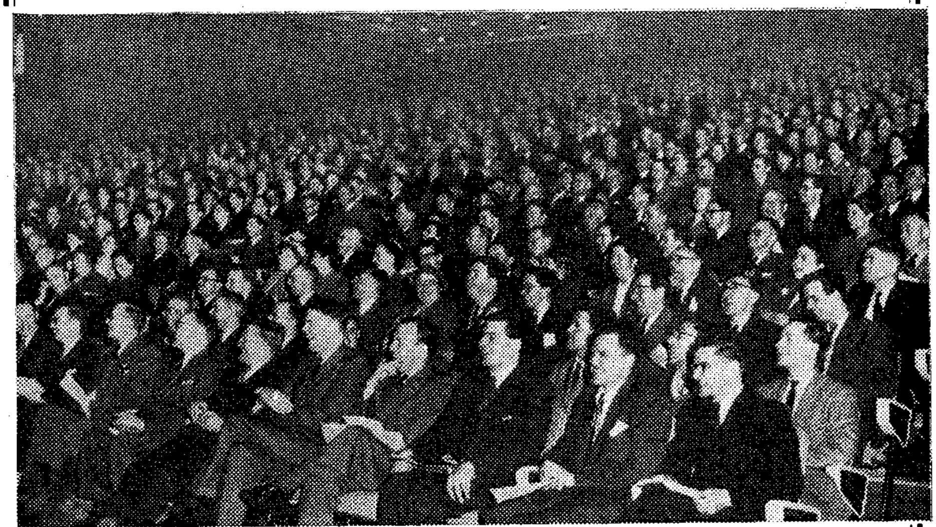
In brief: The Coronation broadcast, the B.B.C.'s most ambitious undertaking, relayed on television to the Continent; 50th anniversary of the first international radio conference.

(Copyright: Int. Tel. Union.)

Edwin H. Armstrong, pioneer of frequency modulation and among the earliest workers in regeneration, super-regeneration and the superheterodyne. ◀



▲ *Radio-astronomy: two spaced paraboloids for producing a multi-lobed interference pattern (Cambridge University).*



▲ *Interest in sound reproduction: G. A. Briggs' demonstration of comparisons between reproduced and "live" musical performances filled the Royal Festival Hall, London.*

1954

WE had the sad duty of recording the death, by his own hand, of Edwin Armstrong, one of America's most distinguished radio pioneers. His most important work had been in the fields of valve regeneration, the superheterodyne receiver, super-regeneration and frequency modulation. He had been involved in much patent litigation. Only a few weeks before his death Armstrong had written a lette for our correspondence columns ' to keep the history straight" on the early development of the triode. Nobody, he contended, had made a serious study of how it worked until six years after it had been introduced.

Parliament passed an Act setting up the Independent Television Authority. As a result, there was a minor revolution in the design of television receivers, which in future would have to work on Bands I and III.

In brief: Printed circuit techniques now widely used; ferrite rod aerials in portable receivers; permanent "Eurovision" television links set up on the Continent; interest in high-quality sound reproduction reached new heights.

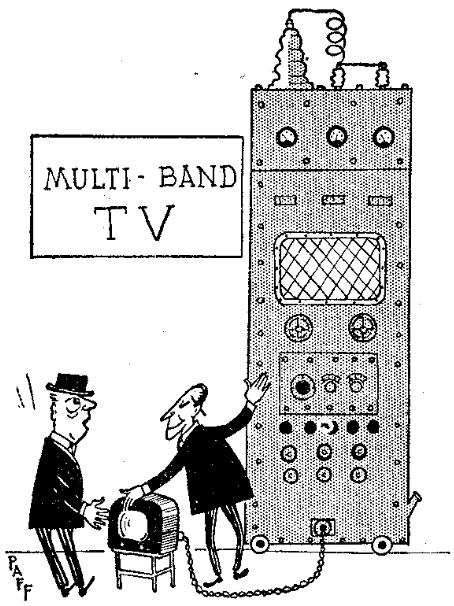
1955

NARROW-BAND ionospheric "scatter" transmission, first reported some years earlier, had now been tested up to ranges of 1,250 miles on the v.h.f. band. This year attention was turned to tropospheric u.h.f. scatter, offering ranges up to 200 miles with a much wider bandwidth. Both systems called for highly directional aerials and, between them, were thought to have a useful future for communication at ranges too long for normal v.h.f. and too short for reliable high-frequency working.

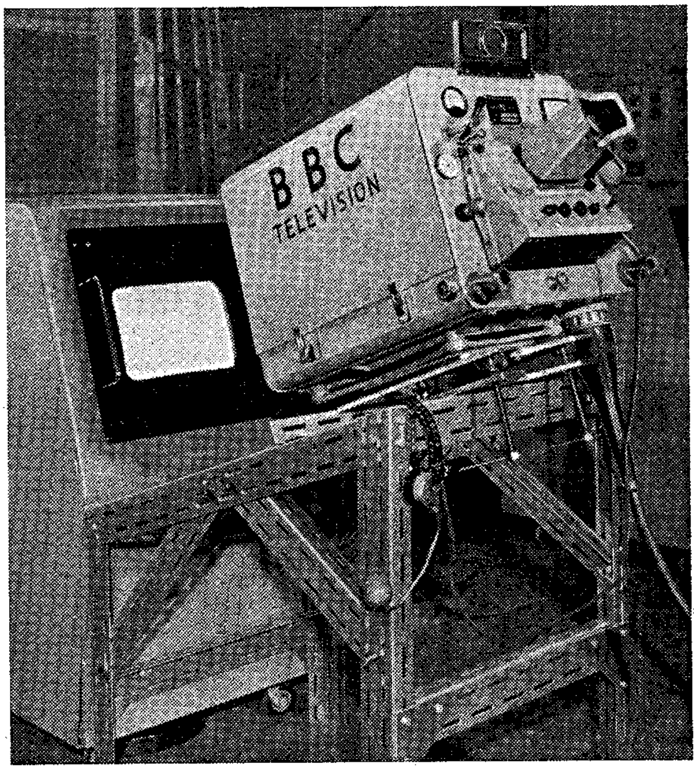
Electrostatic loudspeakers had hitherto been considered incapable of reproducing low notes. The description (by P. J. Walker) of a wide-range electrostatic speaker, working from 40c/s upwards, caused great interest.

"Automation," the witch-word of the year, enjoyed a short-lived vogue. Though there was some uncertainty as to its precise meaning it did clearly signify more work for industrial electronic control devices.

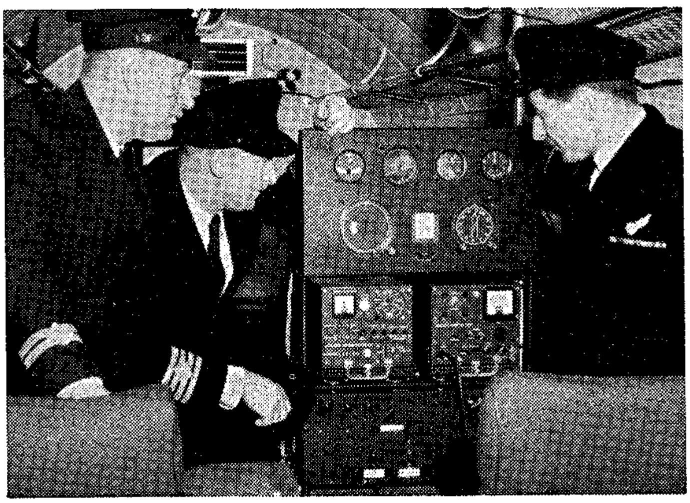
In brief: Atlantic telephone cable laid; B.B.C. started f.m. broadcast service.



No, Sir! This is the set and that is the converter. (Misgivings were being expressed about the technical difficulties of adapting existing television receivers for reception of the projected Band III service.)



B.B.C. equipment for converting the French 819-line pictures to the British standard.



Doppler navigation equipment (Marconi) in a Viking aircraft.

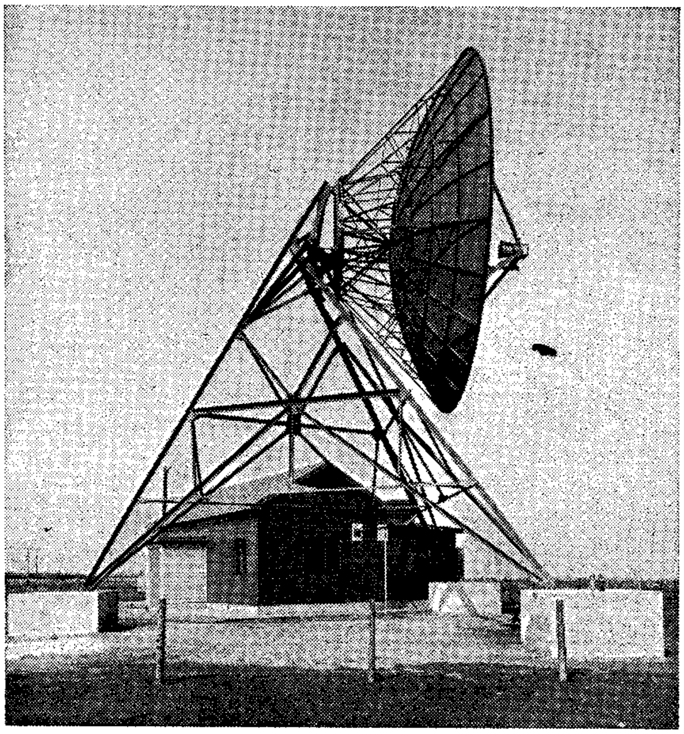
1956

BY now transistors had ousted valves in hearing aids and some all-transistor "personal portables" had appeared. But the transistor was still incapable of equalling valve performance at the higher frequencies and some of these sets had valves in the r.f. and i.f. stages, with transistors in the a.f. section.

For point-to-point radio-telegraphy the teleprinter had been steadily replacing older methods. Accuracy and speed had been progressively improved by refined and highly developed methods of "cleaning up" the received wave form.

We were able to take our courage in both hands and assert that the British television receiver was virtually standardized at last. "For the first time it is possible to put forward a general description of a receiver which will apply with remarkable accuracy to the great majority of modern sets." The "straight" r.f. amplifier had disappeared some years earlier and tubes were getting bigger; 17-in was now the most popular.

In brief: Decca introduced "true-motion" radar, Ampex television tape recorder announced; Shockley, Bardeen and Brattain awarded Nobel Prize for work on transistors.



Experimental tropospheric scatter station at Start Point: frequency 858Mc/s, power 10kW.

1957

THE terms psycho-acoustics and psycho-optics were by now becoming fairly familiar and it was realized increasingly that the "classical mechanistic approach" did not provide solutions to all the problems of electrical communication. As Dr. Colin Cherry pointed out in an important article, that approach often ignores the real purpose, which is to transmit information from person to person. Chains of communication should sometimes be modified to suit psychological needs.

An exciting event was the reception at many places in Britain of signals from the 1-watt transmitter in the first of the Russian artificial satellites.

In brief: Marconi Doppler navigation system for aircraft described first British all-transistor digital computer (Metropolitan Vickers).

1958

THE introduction of an experimental all-transistor television receiver gave an indication of the notable advances in transistors, which could now work at v.h.f. and also deal with considerable power.

Generally speaking *Wireless World* has through the years stuck closely to its last and, except when our specialized interests are directly affected, has taken little notice of the great social, economic and political changes of the half-century. We have, though, commented on the fact that the emancipation of women has had curiously little effect in technical radio, which remains an almost exclusively male preserve. This year we reported that Kathleen A. Gough had the distinction of being the first woman in nearly sixty years to be elected to full corporate membership of the I.E.E.

In brief: $1\frac{1}{4}$ milion licensed stations in U.S.A. (against under 1,000 when we started in 1911), stereophonic reproduction commercially established.

1959

AN article on automatic error correction in multiplex teleprinter working showed in an impressive way how radio-telegraphy had been improved and refined during recent years. It was suggested that, on a poor "unprotected" circuit producing one error per hundred characters, the introduction of automatic repetition of detected errors might well reduce the error rate to one character in 10,000.

Within the short space of ten years the digital electronic computer had grown from a university or Government laboratory curiosity into a fully developed and engineered commercial product. So far most of them had been "scientific" computers, but machines for business data processing were rapidly emerging.

Two "quiet" microwave amplifiers, the maser and the parametric amplifier, were described. Both offered a solution of one of the most basic problems of radio—how to improve signal/noise ratio.

In brief: much discussion of stereophonic reproduction; B.B.C. serving 98.7% of population with television and 96.4% with v.h.f. sound.

1960

THE idea of radio communication *via* artificial earth satellites, which seemed little more than "a pleasant exercise in speculation" when first put forward by Arthur Clarke in our pages 15 years earlier, now began to look much nearer realization. The practical possibilities of using both

A. D. Blumlein whose early and thorough investigations of stereophonic recording and reproduction were "re-discovered" in 1958.

passive (reflecting) and active (re-transmitting) satellites were discussed in an article by R. J. Hitchcock, who drew attention to the need for early international agreement on the allocation of suitable frequencies for the purpose, preferably in the band 2,000-6,000Mc/s.

Tribute was paid in an article by M. G. Scroggie to the memory of A. D. Blumlein, one of the most talented, versatile and prolific of British electronics technologists. During his tragically short working life of 17 years Blumlein was granted 132 patents—one every 46 days! "It is significant that the E.M.I. equipment of the Alexandra Palace [television] station, almost every part of which owed something to Blumlein, made straight up from drawings to begin the world's first public high-definition service in 1936, was still in use in 1950."

The death of Dr. G. W. O. Howe severed a link with our earliest days, since when he had been prominent in academic wireless circles. For 30 years he had been Technical Editor of our associated journal *Wireless Engineer* (now *Electronic Technology*).

1961

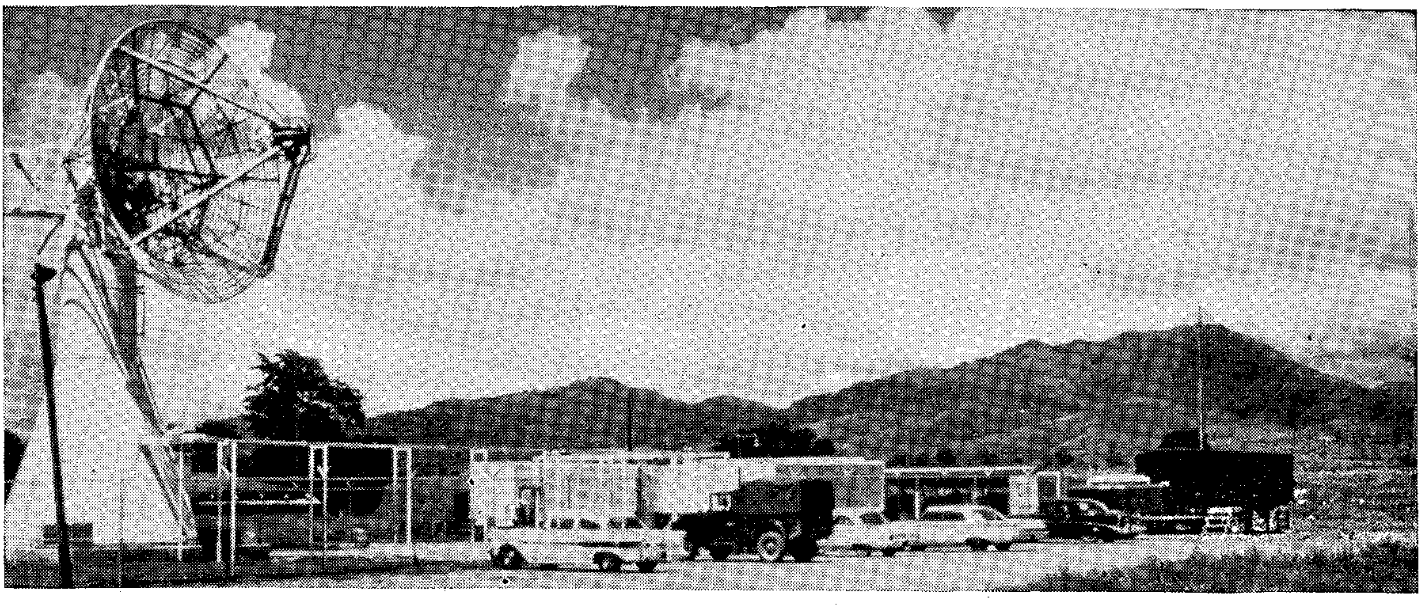
IT is easy enough to see in proper perspective the progress made during the first quarter-century covered by this survey and to say with confidence that at the end of it electronics technology was rapidly moving into Phase III, the era of high-definition television, industrial electronics, microwaves and radar. Enormous advances have been made during our second quarter-century, but have we in fact moved into a distinctly new phase of development during the period? If so, when and why? Has anything been introduced to compare with such far-reaching developments of the 1911-1936 period as the amplifying/oscillating valve, the exploitation of the h.f. and v.h.f. bands, telephony, sound broadcasting and scientific electronics?

All those questions are more appropriate to a debating society meeting than subjects for dogmatic pronouncements. It would be ridiculous to deny, though, that most of the techniques of 1936 have been refined almost beyond recognition and that many basically new things have come in. Of these, outstanding examples are transistors and masers, both of which depend on recent extensions of man's knowledge of the nature of matter.

Looking back over the longer term, it seems impossible to find a yardstick to measure the tremendous progress of the full half-century. Nearly all the activities with which we and our readers are now concerned had not even started when we began in 1911. A Rip van Winkle from our Volume I, resuming his readership during the past few months, would find most of our present contents entirely beyond his comprehension.

But our Rip Van Winkle of 1911 would discover one thing to seize upon. In his day, range of communication was the simple yardstick and the main criterion of progress; since wireless began each successive increase of distance had been a landmark. Remembering that Clifden, the wonder-station of his time, had just managed to achieve a dependable range of 2,000 miles, he would read with amazement of "successful communication out to a distance of 23 million miles" with a space vehicle. And would he be far from the truth in thinking that increase in range gives a fair measure of the achievements of the half-century?

The Puerto Rico ground station for working to the "Courier" satellite.



SOME OF OUR FRONT COVERS FROM 1917–1961