Marconi Discusses the Future of Radio

2YA drew upon an impressive interview with Senatore Guglielmo Marconi, G.C.V.O., D.S.C., from the pen of Frank Parker Stockbridge in the "Saturday Evening Post" for an interesting quarter of an hour recently to fill in the time usually devoted to Imperial affairs. This summary is so excellent that we reprint it for the benefit of those who did not hear or who may wish to review at leisure the views expressed.

THIRTY-TWO years ago I began to experiment in methods of generating, transmitting, and receiving the electrical impulses known as Hertzian waves The result was what we at first called wireless telegraphy, or simply wireless, which is now known to the whole world as radio.

Since 1901, when I first succeeded in transmitting inteligible signals across the Atlantic, much of the knowledge which we thought we had on the subject has had to be revised and nearly all the methods then in use have been discarded. A few examples will illustrate the changes which have come about, and possibly help to make the present status of radio and its possibilities for the future more clear to the non-technical mind.

Radio transmission, as everybody knows was formerly much better at night than in the daytime. This has been changed by the most modern methods, so that the exact reverse is now true

Formerly the radio worked better in the high latitudes; the modern radio is more effectively operated in the tropics

WIRELESS IN REVERSE GEAR.

ONCE radio transmission was better over sea than over land; now the most efficient long-distance radio communications, extending halfway around the earth, are chiefly over land, while much shorter distances over sea offer greater obstacles

In the early stages of development radio transmission over short distances was easier and simpler than at long range now long-distance transmission is the easier and less expensive.

"Wireless has gone into reverse gear,' said an American friend the other day, "and we don't know what it is going back into."

We can tell, however, by the direction in which it is going, the nature of some of its future manifestations if we do not try to look too far ahead. Long-range predictions are always hazardous, especially when they deal with a development so dynamic as that of radio. I have had my share of ridicule for forecasts which I made in the infancy of the art, although I have always tried to be conservative in the role of prophet, and those early predictions have since become realities.

To the younger generation it may sound incredible that general scepticism, on the part of both the scientific world and the general public, greeted my prediction that eventually every ship would be equipped with wireless and that thereby such disasters as the sinking of the French liner Bourgogne, with the loss of almost every soul on board, would be averted. That was ten years before Jack Binns won deserved renown by summoning aid by radio to the sinking Republic, fourteen years before the heroic Phillips went down at his post on board the Titanic, sounding his S.O.S. to the very last. It is a great satisfaction to us who took part in the development of wireless, not so much to have triumphed over that early scepticism as to have provided the means whereby thousands of lives have been saved at sea.

The public mind to-day in respect to radio is the reverse of sceptical. Whereas at first it expected nothing, now the tendency is to expect too much. I would hesitate to say that any of the expected miracles is impossible; that is a word which must be used cautiously in discussing any phase of man's command of the physical forces of Nature. I would simply say that many things which the public is ready to accept as among the possibilities of wireless are not yet within the range of the engineer's mental vision, but I may point out some of the developments to which, I believe, we may confidently look forward before long, which are themselves sufficiently interesting and important for the time being.

NEW USES FOR RADIO.

THE prime use of radio has always been, still is, and is likely to continue to be, as a means of communication between individuals or groups otherwise widely separated. At first this communication was indirect, through the medium of the Morse code —wireless telegraphy. Later it was found that the human voice could be transmitted as well by radio as over a wire, and wireless telephony was developed, establishing a more direct communication From this discovery sprang broadcasting, whereby the individual communicates simultaneously not with one person alone but with millions.

Broadcasting was the first achievement of radio—if we except communication between ship and shore—which could not be duplicated by the use of wires. Direction finding at sea and in the air, the control of mechanism, and the ignition of explosives at a distance have been proved feasible, as has the transmission of drawings, photographs, and writing in facsimile. In all these functions of radio, development and improvement are constantly going on.

I look forward, moreover, to certain radically new uses of radio. I refer to television and to the transmission of power. Before going further into these possibilities, however, it is necessary to describe the recent advance in the earliest of all applications of radio, the wireless telegraph, for it is upon these developments that the expectations of the future are based.

SHORT STEPS FOR GREAT DISTANCE.

THESE developments consist of, first, the utilisation of short electrical waves, very much shorter than those in general use up to a few months ago, and, second, the adoption of devices in the nature of reflectors, whereby these short waves are transmitted in one principal direction, in a beam which diverges at but a slight angle from the focal point at which the waves are generated. This directed short-wave system—or beam system, as it is also called—is now in service between England and the British Dominions, of Canada, South Africa, Australia, and India, the installations of these services having been made in November, 1926, and March, May, and August, 1927, respectively. In October, 1927, wireless communication between England and the United States was established by the directed short-wave, or beam, system.

By short waves I mean impulses having a wave length of less than 100 metres. Practically all American broadcasting stations use waves of from 200 to more than 600 metres in length; commercial radio telegraph systems for long-distance operations, such as communications between ship and shore or across the sea, use waves of much greater length, up to 3600 metres or more. The tendency until recently has been toward increasing the wave-length in the effort to gain distance.

THIS tendency has been completely reversed. Much greater accuracy, higher speed, and more efficient operation, all at very much lower cost of installation and operation, are now achieved by the use of directed short waves over the longest possible terrestrial distance, which is half way around the earth. Between England and Australia, communications are now conducted on a wave-length of only twenty-six metres—slightly shorter than that, to be accurate. The services to Canada, South Africa, and India use wavelengths of sixteen and a fraction metres, or between thirty-two and thirty-five metres, the choice being determined by technical considerations. The point is that it has been found that very much shorter waves than were in current practical use a year ago, are now found to give far more satisfactory radio operation over immense distances than long waves give.

The development of the short wave is, in fact, a return to the original experiments of Hertz, upon which all wireless communications are based. Hertz used only short waves in his classical research.

It was not until 1916 that I began to feel that we perhaps had got into a rut, and commenced experiments anew with shortwaves, with the able assistance of my engineering associate, Mr. C. S. Franklin. These experiments were continued until 1922, when I made the first public announcement of our conclusions. Those conclusions, were that very short waves, properly directed, possessed properties which made them superior to long waves in certain respects. It had been believed that the range of the short waves in the day time would be very short; that their night ranges would be variable and subject to long periods of fading and hence unreliable for commercial purposes; and that any considerable stretches of intervening land, especially if mountainous, would greatly reduce the distance over which it might be possible to communicate.

WE discovered that these beliefs were wrong; that the daylight ranges were very much greater than had been anticipated; that the night working was much more reliable than had been believed possible; that fading was not at all serious and that the great strength of the signals received indicated that the night range would probably be much greater than anyone, myself included, had ever before expected. We found, too, that static, even in the tropics, was much less troublesome with the short waves than with the longer waves then universally used for long-distance transmission.

Some remarkable results were achieved in 1923 and 1924 with waves of from ninety-seven metres down. The most important of these was the discovery that the shorter the wave, the longer its range by daylight, but that very short waves had a comparatively short and unreliable range during darkness.

ANOTHER important discovery, already anticipated, was that very small amounts of power sufficed for very long range communication. Without the use of a reflector, messages were sent to Canada, New York, South America and Australia on a thirty-nine metre wavelength with an energy of only twelve kilowatts at the transmitter. To Japan intelligible signals and messages were sent from England with only one-fifth of a kilowatt, or about the power required to light five ordinary incandescent lamps. When it is considered that as high as 1000 kilowatts of power is used for long-wave transmission, the economic saving, if we could make the short waves do the work as well, is apparent.

As a result of these demonstrations, the directional short wave, or beam, system was adopted by the British Government to provide a better and quicker means of communication between the mother country and the dominions than then existed, and a year of experience with the first of these services to be installed—that between England and Canada—has proved highly successful, as also has the briefer experience with the systems operating between Australia, South Africa, India and England. There is no doubt that, through the establishment of the beam system, intercontinental telephone rates will be greatly reduced.

THE operation of the beam system thus far, although it is still subject to further improvement and development, provides a sound basis for conservative forecasts of the future of radio communications.

With the overcoming of the major difficulties in transmission, which has already been accomplished, we shall see radio increasingly used instead of wires in the establishment of telegraph lines in the undeveloped parts of the world. I do not look to see it displace existing telegraph systems—to supplement and extend them perhaps, but in the older civilisations the wire systems will continue to be operated for land lines. But over the great continents of Asia, Africa, and South America, where immense spaces of undeveloped country lie between the settled regions, I think it reasonable to doubt whether wire telegraph lines will ever be constructed. The reliability of the shortwave system already approximates that of the wire, and with the closing in of the angle of reflection, which is rapidly being accomplished, the element of secrecy, the only other advantage which wire systems have over radio, will be approached.

TAKE OUT YOUR LICENSE NOW AND SAVE DELAY LATER

ASK ANY POST OFFICE

I BELIEVE that in a very short time, perhaps within a year, we shall see a great increase in the speed of transmission of intercontinental messages, as well as a great reduction in their cost.

Twenty-five years ago I predicted, among other things, a telegraph rate of a cent a word between Europe and America. Considering the decline in the purchasing power of the cent, that is not likely now, but I think we are close to realisation of a much lower rate than the lowest now in force. This I expect to see accomplished by the telephotographic, or facsimile, system, which has just emerged from the laboratory stage.

THE facsimile telegraph device transmits at high speed, over the radio waves, an actual picture of a message or document in perfect detail. A message covering a sheet of paper of the size used in a typewriter can be transmitted in a matter of seconds over any distance. Such things have been done in a small way heretofore, but not with the greatest speed or the lowest possible cost. With the general adoption of this method, the Morse code will become obsolete. Telegrams will be charged for by the square inch and there will be no limit to the number of words which may be written on a page. The person addressed will receive an exact facsimile copy of the original, whatever its errors or omissions. This system will lend itself to secret codes based upon the spacing and arrangement of the words; sketches and drawings can be embodied in telegrams at the minimum of cost; lengthy press messages can be forwarded as cheaply as a short private cablegram is now sent.

In the field of broadcasting, the directional shortwave system will be utilised not alone as a telephone system but for actual broadcasting within the angle of reflection. As soon as the projected telephone system is added to the existing beam telegraph system, it will be possible to make a broadcasting hookup by means of which the entire English-speaking world can be brought within the range of one speaker's voice. And on the other hand, by adjusting the reflector to take in a predetermined angle, broadcasting can be limited to a particular sector of the map.

A LITTLE farther in the future, but perhaps much closer than we now realise—certainly not very far off—will come television. We are very close to the commercial application of laboratory experiments which have proved successful in America and Europe in transmitting actual scenes by radio. This is something quite different from the projection of a picture; it is the projection over a distance of actual objects in motion. I see no obstacle save the economic one to its extension over any possible terrestial range.

Once television is made available, it will be possible for people in Calcutta, say, actually to watch the running of the Derby. Chicago, San Francisco and the rest of the world can look on while heavyweight boxers' contend for the fistic championship Not only the spectators in the Yale Bowl but the whole world can see the classics of the gridiron. The coronation of a king, the inauguration of a president, every great spectacle and pageant can and will, I believe, be made visible to all who care to see them, wherever they may be.

Like flying, television has been one of humanity's dreams from the beginning of time. We have realised flight; we are about to realise this other cherished ambition.

I DO not imagine that the application of television—in its earlier stages, at least—will take the precise form which some of the depicters of Utopia have described. It is not likely to be possible, for a very long time at any rate, to sit by one's own fireside and tune in one's private television receiver to watch a horse race or a prize fight as one now listens to its description over the home radio receiver.

NEW MOVIES.

THAT may be done by a few men of wealth, but I am afraid that the cost of an adequate receiving installation will be too great for the private means of most. It will be not only possible, however, but commercially practical in every way for theatres to throw these actual pictures of current happenings upon the screen, just as they now show motion pictures of them long after the event; and this may be done at an admission fee little if any more than now charged.

This may not seem at first impact to offer anything greatly different from the present news reels, but there is an important psychological difference. The spectator to-day, viewing the motion picture of a past event, knows beforehand, through the newspapers, from listening to its description broadcast by radio, just how it came out, which horse, which boxer, which team won. With television, the spectator in the theatre, 1000 miles or half the world away from the actual scene, will see it as news, as a contest the outcome of which is still in doubt. He will have all the thrill and suspense for which people travel long distances and spend large amounts.

I LOOK for great development of the use of the radio beam for direction finding at sea and in the air. The radio is already in successful use for this purpose, and there has been and is now going on an extensive application of it as a guide to flyers. It will simplify navigation greatly when a ship can traverse any given great circle route under the constant guidance of a radio beam; the aberrations of the magnetic compass and the necessity for solar observations will both be done away with.

I anticipate great development also in the control of mechanism from a distance by means of directed short waves. By the control of mechanism at a distance I do not mean the transmission of the actual motive power of the mechanism, but merely the opening or closing, under the influence of the radio beam, of electrical circuits which serve to start or stop the machinery. Nobody has as yet transmitted actual power by radio, but I trust I may not be regarded as too visionary when I say that that, too, is among the future possibilities of radio.

EVERY LITTLE BIT ADDED.

WE still have much to learn about radio. We cannot to-day even name with certainty the medium through which the electrical waves are transmitted; it is no longer fashionable in scientific circles to speak of the "ether," and we are forced to fall back upon the vague expression "space." Though we have gone a long way toward overcoming the handicap of static, there is still a long road ahead to travel in that direction. We know that all electric impulses are affected directly or indirectly by the sun, but just why and how we are not sure. Sun spots and magnetic storms, the aurora borealis and other phenomena of Nature, not yet fully understood, affect the wireless just as they also affect the cables and the land telegraph lines. The mysterious phenomenon known as fading has not yet been satisfactorily explained.

TO no one man belongs the credit for what has already been achieved by radio; thousands of scientists and engineers, professional and amateur, have contributed to the development of the art to its present stage. Thousands of others are constantly at work trying to solve the problems which remain unsolved, to discover new methods, new applications, more economical and more efficient apparatus. From the laboratory of any of these workers there may emerge, without warning, something so radically new as to set all our present calculations at naught. For that reason no one has a right to say that anything which might conceivably be accomplished by radio is impossible.

WHAT has been accomplished is the extension of our somewhat limited human senses. To-day we hear and speak to one another halfway around the world; to-morrow we shall see one another through mountains and across oceans.

Here is a new means of communication, unlimited in its scope and possibilities, against which no frontiers can form a barrier to the most precious of all human privileges—the free and unrestricted exchange of ideas. And that, I maintain, is the only force to which we can look with any degree of hope for the ultimate establishment of permanent world peace.

PARALYSED VALVES

CAUSE EXPLAINED

PRESENT-DAY valves, for the most part, have so-called thoriated tungsten filaments, the action of which, even at this late date, is not fully appreciated by the average listener.

The electronic emission of the thoriated tungsten filament depends upon the presence of a layer of thorium atoms on the outer surface of the filament. It will be noted that, unlike the oxide-coated filament found in some valves, the thoriated tungsten filament is not merely thorium-coated, but it is permeated throughout its entire mass with the rare element thorium.

During Normal Operation.

During the normal operation of such a filament the thorium on the outer surface is gradually evaporated, reducing the emission current, and, if permitted to continue, rendering the valve shortlived. However, while the heat of the filament serves to evaporate the thorium particles on the surface, it is also boiling fresh thorium particles out of the mass and up to the surface. Thus the surface is being continually replenished. Just so long as the filament voltage is not increased beyond 10 per cent. above the rated value, this evaporation and replenishing process continues at an equilibrium rate, so that a constant layer of thorium is maintained on the surface.

Valve Becomes Paralysed.

When subjected to an over-voltage on the filament, however, the evaporation becomes excessive, so that the valve accordingly becomes more or less paralysed. Operating these valves at sub-normal voltages is also liable to paralyse them slowly, as the filament temperature is then so low that the process of boiling out the thorium from the interior of the filament becomes abnormally retarded. Hence it is important that the thoriated tungsten filament valves be operated strictly at their rated voltage, by means of hand rheostats with an accurate voltmeter, or, better still and simpler, by means of amperites, the self-adjusting rheostats.

WRNY'S SHORT-WAVE

SCHEDULE OF TRANSMISSIONS.

Since WRNY's short-wave transmitter at Coytesville, New Jersey, went on the air recently (says the New York "Radio News"); many listeners have inquired for information concerning the station's operating schedule and its exact transmitting wavelength. For the benefit of these correspondents and other radio fans possessing short-wave receivers, the following information has been prepared by the WRNY operating staff.

The programmes of WRNY, originating in studios in the Hotel Roosevelt, New York, are broadcast on 30.9 metres (9700 kilocycles), at the same time that they are radiated on the station's regular broadcast wave, 326 metres (920 kilocycles).

CALL SIGN 2XAL.

The short-wave transmitter has been asigned the call letters 2XAL. The full operating schedule is as follows all hours are Eastern Standard Time, five hours earlier than Greenwich Time):

Tuesday, 7 p.m. till midnight.
Wednesday, 4 to 9 p.m.,
Friday, 7 to 11 p.m.
Saturday, 7 to 10 p.m.
Sunday, 4 to 6 p.m.

The signals of the WRNY short-wave transmitter have already been reported in all parts of the United States, many parts of Canada, in practically all the countries of Europe, and in Australia. Listeners hearing the station are requested to send report cards to the WRNY offices in the Hotel Roosevelt, New York City.

Printed and published for the New Zealand Radio Publishing Company, at the registered office, Dominion Avenue, Wellington, of the Wellington Publishing Company, by Archibald Sando, of 47 Frevberg Street, Lyall Bay, FRIDAY, MARCH 9, 1928.