(*February 20, 1922.*)

The Wireless Transmission of Power

By A. H. Morse.*

Mr. President and Gentlemen,—I am afraid my voice will not reach around this room, but I am not as nervous as I look, and I won't mind if anyone tells me they do not hear me. I am afraid you will be a little disappointed if you came to hear some of the mysteries of wireless explained, because really there are no mysteries. Such things as you cannot understand are not mysteries at all, but very simple.

I want first to take exception to something the President said. He said you probably were fed up with these economic questions and would be glad to hear about a subject such as this. Now this is primarily an economic question and it is because it is an economic question that I want your close attention to-day. Wireless telegraphy (and I mean also telephony), and Canada's future are almost one and the same thing. It applies more to Canada than to any other country on the earth. That is the only criticism I have to make of what the President said, but it is really important that you should regard this as an economic question.

I want to express my thanks to the Deputy Minister of Naval service at Ottawa for his permission to bring this gear here to give you this demonstration. Also to the Chief Engineer of the Marconi Co., and Mr. Payne his assistant, and Mr. Eaton, the Marconi man who came here and worked hard to get these things ready.

It is obviously because I am associated with the Marconi Co. that you invited me here, but I want you to forget that association for this afternoon because I want to speak to you simply as a Canadian citizen, and one who has peculiar opportunities for keeping in touch with the developments in wireless telephony and telegraphy, and who perhaps is particularly in a position to realize what this development means to Canada.

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I have chosen as my subject, "The Wireless Transmission of Power," not because I am going to talk about that, but because this is the cradle of wholesale power transmission, and the wireless transmission of power is the essential of what radio engineers are after. They are after other things but it is essentially their problem to get enough energy over to give a positive signal at distant ends. The most tireless wireless transmitter we know of is the sun, whose waves reach this earth, conveying warmth, light, and life. I want you to keep in mind that these waves are identical in nature with those which we use in wireless telegraphy. It is a copy-book headline almost, but one is apt to forget it.

Electrical power transmission waves are also essential wireless transmitters. A 25 cycle distribution system radiates waves 12,000,000 metres in length, and so 60 cycle lines radiate a wave of 5,000,000 metres in length. These are too long or too slow for wireless telegraphy, but they are being radiated and you can pick them up. Therefore you have already the wireless transmission of power, but you do not want that incidentally. A certain gentleman was here trying to offset that by using high tension continuous current. That was the idea last year, using current of high tension. In dealing with enquiries, and of course in my business we have very many from people who are not well acquainted with the subject, and that is one of the reasons I am so glad to have any opportunity of conveying to you some of the essential principles, we find there is much confusion due to the fact that people are apt to confuse wave range with the length of transmission. If we tell them this station has a wave length of 14,000 metres whereas that has one of 200 metres, they are apt to think that the station with the longer wave is essentially the station of greater power, longer radius of transmission. Not necessarily so! There are no definite data yet on the precise relation of wave length to range of transmission. As a matter of fact waves of which I have already spoken radiated by the sun are so short that they are comparable to the skin of a soap bubble. You can see them reflected in a soap bubble and you have to keep the bubble so thin that it is not reflected. Then you see a black spot. That is the length of the smallest visible wave. Of course I mean always the effect of the waves being visible, and when I say heard or audible, I mean the effect of the waves being audible. But it is obvious that long waves are not essential to long distances. Very much confusion would have been obviated in the earlier days in this art or science or business if the practice had been established of identifying

waves by their frequency rather than by their length, since their frequency is a direct relation of their length and you cannot vary one with the other and always in the same measure and it would be simpler now, especially in view of the lines that the science has taken. If we had referred to this in terms of frequency you would recognize at once whether your own wave was of audible frequency or not. Always bearing in mind, of course, that when I say hearing a wave I mean the effect of the wave. The upper limit of audibility of the human ear is practically around 20,000 metres. The shortest wave or the slowest wave used in wireless telegraphy is of the order of five hundred millionths, or considerably longer than that. The longest wave we use is radiated by a station in France in Bordeaux, which is very near the upper limit of audibility in its frequency. That is to say the effect of that wave would create mechanical disturbances in a telephone which would be audible. They are wireless waves coming in on the wire, of an audible frequency.

We always speak of wave lengths in terms of metres. Of course there is a lot of inconsistency in all new arts and sciences. The endeavor is to keep to the metric system. It is much simpler, but unfortunately weights and measures were established before. Weights and measures belong to electricity and we use miles for range and metres for expressing wave length and electrical values. In order to keep in your mind just what it is distances mean where we measure in metres it is well to keep before one the fact that the metre is one ten millionth of an earth quadrant, consequently there are 40,000,000 metres in the circumference of the earth and the speed of light waves through the ether is 300,000,000 metres per second. Therefore, in a second, a wave, if it chose to, would travel more than seven times around the earth. That is not as important as it seems because although it is faster than impulse travels along the telephone lines, the time a signal takes to travel along telephone lines is negligible and not important. Light and heat and wireless differ only in length and frequency and I want to add to that that the light waves are visible to the eye. We have a detector, if you will, which is capable of being actuated by those light waves. Wireless waves are all too long, which means also too slow for the eye, and by the same token they are too short for the ear. Their frequency is too high for the ear, and they are consequently—what do I mean, long or short?—however they are too slow for the eye and too quick for the ear. You can translate it into terms of the ear at your leisure.

The transmission of power as such by wireless is not yet commercial nor is it likely to be for a long time. In the daily press one sees things about wireless. We who have been in the wireless business have been very much pained by the rot that is talked about wireless every once and awhile—not intentionally of course—because it gives us a lot of trouble and we have always felt that it was not and never would be necessary to lie or stretch a point about wireless. Even in the very earliest days it was sufficiently wonderful if you just told the truth about it, if you wanted to enthuse people.

Our problem is to transmit sufficient energy to give a dependable signal at the distant point, and you know as well as I do that we are getting signals from distances of from eight to ten thousand miles—it is a daily occurrence. In Australia throughout the year, day in and day out, they copy quite a number of European stations at distances of approximately 8,000 miles. And there is one paper in India which has for some years taken daily British news by wireless which it gets from the United Kingdom.

I come to a point now which makes me a little nervous. It is said that 21,600 miles is the circumference of the earth. We find we cannot square that. For instance when the earth's circumference is 400,000,000 metres it does not square very well. So we made a compromise. We put down about 25,000 miles, that is statute miles, as distinguished from geographical miles. It helps us a bit but there is still a bit of discrepancy there. Obviously, but perhaps it is not so obvious, you never want to work more than half way around the earth. The earth is finite and when you find it inconvenient to work to a station one way you work around the other way, and in any case the signals will go both ways. If the surface of the earth is the limit that you ever want to negotiate I want to tell you in all seriousness that we are very near that limit in point of dependable communication. In fact we would not hesitate, were the ways and means provided, to undertake to build a station any place on earth to work to any other place on earth to-morrow.

The difference between telegraphy and telephony is very small. In telegraphy it is the practice to signal by means of signals and spaces of varying duration. Bear in mind that the spaces are signals; the length of the space between currents determines what you say. So you have two basic classes of signal, the mark and space, whereas in telephony you signal by means of mechanical device. Whereas you have a key in telegraphy you have something which you do not manipulate

in a direct mechanical way, but you cause to vibrate by means of waves which we call manipulation of the voice. You impress upon that current the rise and fall and the pitch and tone of the voice. In telegraphy you signal by means of opening and closing a main switch, but in telephony you signal by extremely small modulations of what we call a carrier wave in wireless and in what is known as wired wireless, and in telephony you signal by means of impressing the voice modulations upon the current. That is why long distance wireless telephony and long distance telephony has always lagged and always will lag behind long distance wireless telegraphy and ordinary telegraphy.

The ether is something which necessarily has its property rights vested in the Government, and you have got to apply to the Government for a slice of the ether if you want to operate wireless telegraphy. They allot to you a wireless length which you have got to keep to, and which won't be given to anyone else, so that you won't get jammed or jam anybody else. Your gear will be adjusted for you by the experts from whom you buy it and it is up to you to keep it adjusted. Wireless telephony is essentially a little broader on the wave than wireless telegraphy. When you modulate the wave you have the effect of sort of speaking a little more carefully; the toning is not so fine. In wireless telegraphy you radiate a wave like this —There is very little energy in each one of these impulses but they are so fast that they build up quite a big effect at the receiver. Your tuner is very finely adjusted to these waves and you can turn a deaf ear to a wave which differs by about one per cent. from that. But when you use telephony you get a little broader on the wave and you are liable to jam in. I cannot go into that because I get tied up myself, as a matter of fact. They are always a little more loth to give licenses for wireless; in fact they are not keen to give licenses to anybody.

I spoke about the lagging of long distance telephony and I want to add that there is a commercial consideration there too. You take a given line. You can by modern means use modern systems. We can put over a certain number of words by means of telegraph. We can work up to two hundred or three hundred words a minute. Inherently we should be able to go up to four hundred. But you can safely say we can work 200 words a minute. No one can speak over 200 words a minute and no one would let him, and I doubt whether the average number of words that passes over a telephone line is more than 30 a minute, and engineers to-day are put to it to

know how can we make a trunk line pay. We consider if we had that trunk line we would push through words at so much a word which would make the trunk line tolls look very small. But I want to qualify that by saying I am considering simply the use of the line for one telephonic conversation, whereas we know telephone companies run two or three conversations over the same line, and are selling the same line maybe half a dozen times to half a dozen people.

The more serious part and the economic part is that it is generally admitted that the telegraph is the life blood of trade. You remember Mr. Secretary Hughes in convening the disarmament conference at Washington referred to the open door in China, and he said, "We ought to make this a fact rather than a motto." Well, I think it is up to the business men of Canada to make that a fact rather than a motto, that the telegraph is the life blood of trade. We do not seek by means of pushing the telegraph or telephone to develop new areas for trade.

Take the question of linking up our hinterland; imagine isolated farms and mining and trapping settlements throughout the Dominion being linked up by wireless, and there is no reason why they should not. Imagine if every farmer and trapper of fixed location could be in daily touch with the culture and news of civilization by means of wireless, as he could, by the use of a very simple and inexpensive apparatus which he can adjust. All that would be necessary would be the building of a dozen broadcasting stations throughout the Dominion, and these need not cost more than $15,000 apiece, that is exclusive of transportation—F.O.B. if you will. But that is a bagatelle compared to what is spent on public services which do not mean anything like the same to the Dominion.

Imagine the intercommunication with Edmonton and Fort MacPherson. Ice and weather reports would be dependable at all times for the whole system, and one of the immediate results would be probably that the season of navigation would be extended by ten or fifteen per cent. That would be enough. If the steamers were fitted with wireless and modern wireless you people at the point of call would know just when she was due to arrive and depart and think of all the time that would be saved. Imagine, too, if the proposed Hudson Bay route had two or three stations. We know that there is now one at Port Nelson but it is not being used. That station could be equipped for a bagatelle and used at once. Only last summer two steamers of the Hudson Bay Co., one off Charlotte Island down in James Bay and the other in Hudson Strait, got

most important instructions direct from their London house by means of Canadian stations governing their movements, but of course there is no regular arrangement providing that we shall keep in touch with anything on Hudson's Bay, and consequently we did not know until they came out that they got these instructions. One of the same steamers was up the coast of Baffin land and was never without its daily news bulletin from our station at Louisberg. Last week we read of President Harding calling a conference at Washington to consider what shall be done towards a better regulation of wireless in the States. Gentlemen, it will be a great day for Canada when our Premier or some other important statesman takes the same interest in wireless that Mr. Harding evinced in that call. It is of vital interest to Canada. Alaska has a far better wireless system than any part of Canada. Notwithstanding that there is in Canada in store sufficient gear, and has been for over a year, to meet all Canada's urgent requirements—and gear of the most modern type. As to the reason that gear is in store I must leave it to your imagination.

There is too much of a tendency, I submit, to regard Canada as just a thin strip of territory extending from ocean to ocean, whereas you can go a thousand miles due north of Montreal before you strike the sea, and if you go in a straight line a thousand miles due north of Winnipeg you approach Fort Norman, and you still have 300 to go to the sea. It is obviously a platitude to say that Canada needs wireless. But if she is to maintain her lead in commerce I submit that the Government will require to modify its present attitude; but in saying that I must qualify it by saying the present Government has not yet revealed its attitude to commercial wireless. Canada had the first Transatlantic wireless service in 1906. She had the first inter city commercial wireless operating for some two or three years. She had the first all valve long distance transmitter in the world—and you cannot realize what that means to civilization. That works silently. You have been on ships and heard the crackle of the wireless. Well, gentlemen, the noise you hear on a ship has nothing to do with the distance of transmission. This works silently. They are just like huge lamps, or a bank of them, but the power that is radiated is enormous and out of all proportion to both the cost of the transmitter and of the room that the installation takes. That inter city service was between Montreal, Ottawa and Quebec. It was to be extended to Toronto but the bottom fell out of the company.

We had the first and still have the best coast direction

finder service in the world, and I say that without any reserve at all. You may say Canada has the only coast direction finder service in the world at all. That means that ships every year are saved, big ocean liners are saved, maybe some hundreds of days in the aggregate, and you know that a day of a big ship represents a good deal of money—thousands of dollars. Also incidentally it has caused serious loss to residents in the south of Newfoundland, because the graveyard of the Atlantic is not getting many victims. If you have been around Cape Race, it is a pathetic sight, to see the huge ships lying there—rusted iron. I saw one and said, "What ship is that?" "The Christianiaford." Well I was in Christiania when they were talking about getting the ship, and saw her building only a year or two ago, and she was a lovely boat. And then I saw her, a bit of iron, there. It was really sad. And she is only one of many, but they are getting rarer and rarer by the use of wireless direction finder.

Just a year ago now the steamer "Fannerhead," fitted with wireless direction finder, got a distance signal from the "Ontened," giving position, and so forth. A number of other steamers immediately set courses, but the "Ontened" was running ahead. The "Fannerhead" ignored her position but steered toward the signal, and the consequence was she found her and saved the whole of the crew just before the ship went down. Some of those other big Atlantic steamers may be looking for her yet. They went to her position, which was 90 miles out of her true position.

Also Canada had the first regulation broad casting station for music and what not in the world. You hear all that now from the States, but it is coming back. The American public reacted more readily to it than did the Canadian public, and now it appears to be coming back as an American invention. It started in Canada and is being rapidly extended. I shall be disappointed and surprised if within two years Montreal has not a station to work direct with the United Kingdom and also a station at Vancouver.

I have before me the report of the Royal Commission just issued. They recommend a conference of Canadian Government representatives to discuss the special problems obtaining in Canada. They are special problems, and this is the first time I have seen any government recognition, particularly the Imperial Government, that Canadian wireless problems are peculiar. They are problems which cannot be interpreted in terms of the requirement of the old country. You have got essentially domestic problems here. And also these recommendations recommend a station in Vancouver which they say would work with Australia and also with England, which is going some, but it is reasonably true now. But they do not say with the Orient. To work with the Orient is very important to commercial Canada. It is important that you should work with the east, and of course by the same token a station at Vancouver could. And of course the station in Montreal would work with England very well.

If you extend the great circle route from England to down the St. Lawrence you find it follows generally the St. Lawrence River. Suppose you leave Toronto and go down the St. Lawrence you will make a bee line to a point near Glasgow, and if you extend that great circle it brings you up in Mexico City—you would think probably over in Vancouver.

The most pressing problem is perhaps soldiers' civil re-establishment and the provision of work for the unemployed. It is my firm conviction that no more economical and effective step could be taken to solve this problem than by the erection of stations linking up all the outposts of Canada. I am not suggesting the erection of the stations themselves would provide work, but it would open up to thousands of people areas that to them are absolutely unknown and impossible by reason of their intense isolation. These areas would become productive fields of enterprise. There are many men who for family reasons cannot cut themselves off entirely from their homes, therefore they are shut out from these huge territories.

You do not want it too finely tuned for aids to navigation.

(Mr. Morse, with the assistance of wireless gear which he said anyone could have in their home at small cost, then gave the members an exhibition of wireless, concluding with a cornet solo, transmitted from the Marconi broadcasting station in Toronto, but which Mr. Morse said could just as easily be transmitted from Pittsburg or elsewhere.)