TELEPHONE BELL IN 1904.

The Famous Inventor Talks to Mr. Carpenter About His Work, Including His Recent Experiments in Aerial Navigation.

He Gives the Autobiography of the Telephone, and Tells Why an Electrician Could Not Have Invented It—The Future of Sound Transmission—An Automatic Telephone Service at Minimum Rates—The Inventive Age Only Beginning—The Possibilities of Radium and Helium—Trying to Learn to Fly—Dr. Bell's Mighty Kites Which Could Carry Men and Engines—Has He Discovered the Basic Principles of Aerial Navigation?

WASHINGTON, D. C., June 7.—"Call upon me at my house at any time tomorrow night, between 10 and 4 o'clock in the morning, and the later the better."

These were the words of Dr. Alexander Graham Bell. I had asked him when we could beat meat for a good long chat about the telephone and his recent experiments in the field of aerial navigation, and this was the answer. Dr. Bell's favorite working time is at night, and his mind is at its brightest from midnight on. He is then free from interruption, and can give up his soul to the scientific experiments and inventions which form his life work. He never goes to bed until after 4 a. m., his usual sleeping hours being from 4 until 11. The afternoon is devoted to social and business engagements, and the night alone to reading and work.

DR. BELL IN 1904.

These have been the habits of a lifetime, and they are excellent ones if Dr. Bell's health may be considered a test. He is now 57 years of age and is in his physical and intellectual prime. Tall and well formed, with a great head fastened by a strong neck to broad, full shoulders, he is one of the finest looking as well as one of the most active of the men who are doing great things in the world today. The telephone was first patented in 1876. Since then he has made many other important inventions, and has been granted the highest honors by the chief scientific societies of Europe, including the Volta prize of 50,000 francs, given by the French government to the few whose inventions are deemed of the greatest good to humanity. It takes imagination to invent, and Dr. Bell has this faculty to a remarkable degree. His vision, based upon his great scientific knowledge, is wider than that of the ordinary thinker, and his creative mind is always searching out and suggesting new things. This was evident throughout our conversation, of which I can repeat only a part.

The talk covered a wide range, now personal, now scientific, and now almost prophetic as to the possibilities of the future. It jumped from Japan to Nova Scotia and from Washington to London; from the use of a dead man's ear in telephonic experiments to oratorical and musical exhibitions over the telephone and graphaphone; and from electricity to helium and radium and the navigation of the air.

ELECTRICITY AND THE TELEPHONE.

In our conversation about electricity I asked Dr. Bell whether his scientific knowledge of that force had not aided him in the invention of the telephone.

"Not at all," he replied. "When I began my experiments upon the telephone I had no scientific knowledge of electricity. I knew practically nothing about it; and had it been otherwise I could never have made the discoveries which culminated in my success. I don't believe any electrician could have invented the telephone."

"Why not?" I asked.

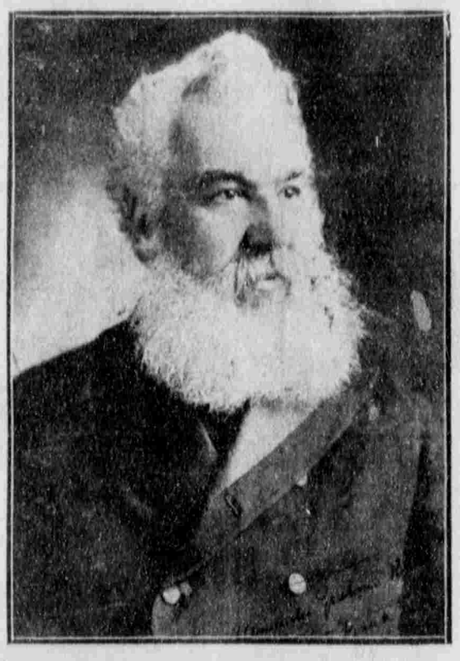
"Because the elements which we now think essential to the telephonic transmission of sound are such that the electrician of that day would not have believed in their practical application. The ideas which brought forth the telephone would not have come to me, and had they done so I would have at once discarded them as foolish and impractical."

"But did not electricity have much to do with the first telephone?"

"Not a great deal," was the reply. "We had two electro-magnets, one at each end of the wire. These were all that were used in the first instruments and we transmitted sound with them almost as well as we do now. The batteries and other electrical machinery have been the outgrowth of other necessities in the practical working of the invention rather than in the pure transmission of the human voice. That part of the instrument, which you now put to your ears, was at first used to speak into; and the diaphragm, as it is, was made for speaking, not for hearing. A piece of iron or steel would do just as well for the purpose of which it is now used. We had at first two such mouth-pieces, one held at the ear and the other to speak into. While listening the receiver often puts one of these at each ear to better the transmission. The batteries were necessitated for calling the subscribers. We had to have call bells, which were originally rung with a crank, as is done in some of the old 'phones today. These bells necessitated an electric battery for every instrument, and other things have added electrical machinery which was entirely unknown at the start."

THE AUTOBIOGRAPHY OF THE TELEPHONE.

"Cannot you give me the autobiography of the telephone, Dr. Bell?" I asked.



ALEXANDER GRAHAM BELL IN 1904.
From a Photograph Secured for the Deseret News.

"I will give you some of it at least," was the reply. "The invention was born, I may say, in my long study of sound in connection with the human voice. I might perhaps say that its birthplace dated still farther back. My father's life was devoted to the study of vocal sounds. He was an authority on voice culture, and also the inventor of visible speech, an alphabet in which the actions of the organs of the mouth in producing speech are symbolized. By this invention the sounds of any language may be expressed, and by it a large number of deaf people are taught to speak. Even back of that, my grandfather was a student of sound. He was an orator, well versed in elocution and voice culture, so that if there is anything in heredity the germ of the telephone may have come from my grandfather."

"Please carry the autobiography down into your own life," said I.

"As I think of it in that way, I can mark several interesting stages which now seem to point to the telephone," said Dr. Bell. "I have told you, in the past, how father once offered myself and my brothers prizes if we could invent any kind of a machine that would talk. This was after he had taken us to see a speaking automaton. I did invent a mouthpiece of rubber and other material that would say mamma and cry like a baby. Another stage might be marked by my ambition to be a singer and a musical composer. I had a good voice, and, just before reaching manhood, I was devoting myself to its training with that life work in view. This led me to the further study of the voice and the transmission of sound. That ambition was given up on account of my health, and for the same reason father brought me to Canada, where we purchased a farm. This migration now seems almost providential in the life of the invention, for I am sure had I remained in England I never should have made it. The intellectual atmosphere of Great Britain is too cold and conservative to incite great discoveries, whereas that of this country is stimulating and friendly to all new things. Our patent system is also far more encouraging."

"Well, to continue my story," Dr. Bell went on, "I found the Canada farm just what I needed. The change and the out-of-door life soon made a new man of me, and father, in the meantime, having again taken up his studies of the teaching of the deaf, I became interested in that and was made professor of vocal physiology in the Boston university.

PARTLY AN ACCIDENT.

"All this work, you see, was along the line of sound and sound transmission. Then another stage appeared which connected my vocal studies with the machinery of the telephone. I became interested in multiplex telegraphy, and tried to make an invention by which several messages could be simultaneously sent on one wire by using the musical scale with signals of different pitch. We employed a series of reeds as sounding instruments in these experiments, connecting them by means of a wire. One day one of the reeds accidentally struck the diaphragm at one end of the wire, and its vibration was seen on the diaphragm at the other end. If that sound could be transmitted, why not other sounds. The thought was one of the suggestions which resulted in the telephone. Later I had the wire conducted from one of the top rooms of the house to the electrical work shop in the basement, and speaking into the diaphragm was heard by Mr. Watson, my assistant, below. I tried to get him to reply, but could not hear him. He came in a little later, much excited, and I asked him why he did not answer. He said he had tried to. I then went down and took his place, but I could not distinguish his words. I can only explain this by the fact that my trained voice was more easily heard than his untrained one, and that his hearing, sharpened by the necessities of a noisy workshop, was better than mine. This experiment, however, showed me that the telephone could be made a success, and I at once applied for my patents."

THE TROUBLES OF SUCCESS.

"How did your friends view the invention?"

"The most of them laughed at it," said Dr. Bell. "They considered it a toy at best, and, even, after it was proved a success in the transmission of sound, some told me I was foolish to devote myself to a thing that could never be of practical value, while I had a chance of making a fortune if I kept at my work in multiplex telegraphy."

"Did you have much trouble in protecting your invention?"

"Yes," replied Dr. Bell. "As soon as its practical advantages were understood, claims to a prior invention of the same thing sprang up on all sides. Half a dozen electricians came forth, each announcing himself as the original inventor, and claims and interferences were filed against my patent. One newspaper report alleged that I had paid an examiner of the patent office $100 to illegally secure my patent, having stolen the idea from prior claims, and a mark was made on the hall floor of the interior department, where it was said the clerk stood when he made the alleged bargain with me. This story seems all the more ridiculous now when I remember how scarce $100 bills were with me in those days."

WHY THE STORY OF INVENTION WAS NOT TOLD.

"How could you reply to such attacks?" I asked.

"That was one of the worst features of the trouble," said Dr. Bell. "I was instructed by my lawyers not to say anything about my invention, to bear all such attacks without comment, and to let the battle of its originality be fought out in the courts. The result is that I have never told the story of the telephone and its invention. The last time I made any public utterance on the subject was in 1877, now more than 26 years ago."

"But will you not write it some day?" I asked.

"Possibly I shall," said Dr. Bell, "but not until my life reaches its reminiscent stage. I am now so much occupied with the present and the possibilities of the future that the past seems far behind me."

"Has the telephone reached its perfection?"

"By no means," was the reply. "It is still in its infancy as an instrument for the transmission of sound and in the extent of its use. Its business and mechanical arrangements are still clumsy and unwieldy. The telephone industry is one of the few which cost more to handle at wholesale than at retail. What I mean is that it now costs enormously more in proportion to run a large telephone business than a small one. Suppose you are one of one hundred families connected with a telephone exchange. You and each of the rest will each have ninety-nine other families to talk with, and it will require a certain number of operators to conduct your conversations. Now suppose the patrons of the exchange be doubled. Each family will now have, instead of ninety-nine families, one hundred and ninety-nine to talk to, and the possible number of conversations of every one in the exchange has been multiplied, not by two, but by one hundred; for every one has one hundred families more to talk to. This requires a proportionate number of new operators, and makes the big business very expensive, necessitating the finest machinery at the exchanges. A single switchboard for instance in the central office of New York costs $75,000.

AN AUTOMATIC TELEPHONE SERVICE.

"In the improvement of telephones," continued Dr. Bell, "in the telephone of the future I look for all this business to be done automatically. Instead of a single wire there will be a little cable of wires connecting each house with the central exchange; and it will be possible for 10 wires to do the work that a thousand do now. There may be a system by which the subscriber can move certain buttons and call up whom he pleases. The calls will be automatic, causing the idle wires among those in the cable to automatically come into use, and when the conversation is over the disconnection will be automatically made. If this can be accomplished it will do away with the vast army of telephone operators, and so reduce the expense that the poorest man cannot afford to be without his telephone."

"Will sound transmission be also improved?"

"Yes; we now have a wire loaded with several unnecessary processes or attachments. These will be gradually eliminated and each wire will have but one work to do, and it will do its work better."

"How about telephoning without wires?"

"I think that will come some day," replied Dr. Bell. "Indeed, I have done such telephoning. Through my invention of the photophone I have also been able to send sounds upon the rays of light. The sound-carrying medium is of the same nature as the electrical medium, and it may be that we shall some day send sounds through the air with the rapidity of light transmission. You know what is being done in wireless telegraphy. Some day we may have wireless telephony as well."

GREAT INVENTIONS OF THE FUTURE.

"Then you evidently think we have not come to the end of the inventive age?"

"No. Indeed, it is difficult to say how near we are to its beginning. We are discovering new forces and new principles every day. We did much in the nineteenth century, but here at the dawn of the twentieth, we have an entirely new field opened up by the discovery of radium, and that discovery the work of a woman. We have several new forces—so new that we do not yet know what they are nor how they may change the life and work of the world. We have radium, helium, thorium and other wonderful things. By liquid air we have frozen some of these rays into a liquid, and have, as it were, bottled up the rays of the sun, and also of these powerful and, until now, altogether unknown forces. Indeed we are daily more and more surprised at how little we know, and we cannot but think that the greatest treasures of nature are yet to be discovered."

AERIAL NAVIGATION.

"How about the air and its navigation, Dr. Bell?"

"That is one of the most interesting fields of scientific investigation. We know so little of the air and its movements that there is much to discover. I have been charged with attempting to invent a flying machine. There may have been some reason for such a supposition, but the fact has no foundation whatsoever. I am experimenting to discover the properties of aerial flight and the constituent elements necessary to its success. When I have ascertained these facts I may be ready to attempt to invent a flying machine, but not until then."

"What have you discovered?" I asked.

"I think I have found that there is a peculiar form in which all things which are to be maintained in the air should be made. I have ascertained the shape of the cell which, in combination with similar shaped cells must compose the flying body; the brick, as it were, out of which the flying house must be made, the unit of which it seems to me all such machines must be constructed."

BASIS OF SUCCESSFUL FLYING MACHINES.

"What is the unit, Dr. Bell?" I asked.

"I call it the tetrahedral unit, because it has the form of a tetrahedron. If you will place three matches end to end in the shape of a triangle and then take three more, resting one end of each at a corner, so that the other ends will meet over the center of the triangle, you will have the skeleton of a tetrahedron. Now tie the ends of the matches together, and you will find that the framework, as a whole, is wonderfully strong in comparison with its weight. In aerial navigation we find that the questions of strength and weight are all-important ones, and that new elements must be taken into consideration which, prior to this time, have not been appreciated. To support a heavy body in the air a greater surface in proportion to the weight must be had than is generally supposed. In increasing the size we find that the weight increases as the cube of the dimensions, whereas the surface increases only as the square of the dimensions. Simon Newcomb recently brought this out in an article in attempting to show the futility of trying to make successful flying machines. In other words, as you increase the size of your machine you do not increase its ability to sustain itself in the air. The model may work perfectly, but the great machine made on that model will for this reason, not do at all. This has been proven again and again by actual experiment. It was so with the weather bureau kites made of a box shape. Those of ordinary size flew very well, but the great kites constructed in exactly the same way, with the hope that they would carry meteorological recording instruments high into the air, would not rise at all."

"This fact led me to experiment to find a shape which when increased or multiplied in size might have the sustaining surface and the weight equally multiplied. I have discovered this in the tetrahedral which I believe to be the only unit of construction in the flying machine of the future."

THE TETRAHEDRAL KITE.

"How could you test this?" I asked.

"Only by actual experiments," was the reply. "I have made kites of this shape in various sizes and combinations and have scientifically measured their flying capacity and strength. I have discovered that kites, large and small, may be made of these units, and that they are stronger in proportion to their size and weight than any kites ever made.

"But I can show you models and photographs of my work in this line," said Dr. Bell. He thereupon left the room and a little later returned, bringing several large scrap books filled with photographs and also some kites and kite frames of a peculiar shape.

"This is the way I note down my work," said he, as he opened a scrapbook. "I find it almost impossible to keep a record of inventive progress with pen or pencil. Just at the time one makes a discovery he is so interested in going on with it that he fails to put down the fact and the time. The result is there is danger of losing the record and the possibility of establishing his priority of the discovery. Now I have one man who does nothing else but make snapshots of everything I do in the way of experiments. This is one of the books showing our investigations in this particular line."

KITES WHICH WILL CARRY MEN.

Dr. Bell here handed me the volume. It was filled with photograps of kites of various shapes, in flight, at rest, and in construction. Some were made of small tetrahedral units combined together into a flying kite as big as a good-sized cottage; others were boats made of similar units and others had other shapes. There were large single kites with a framework of aluminum tubes and small kites of silk with wooden frames; little kites flying from the hand of Mrs. Bell and other ladies of the family; and kites so big that a steamer on the bay or a man upon horseback had to rush along with them to raise them into the air.

"The strength of the unit was shown in many of the photographs, and also the great power of the flying tetrahedrals. Some, Dr. Bell told me, were strong enough to carry a man into the air and some had seats in them where one might sit if he wished to risk a flight. Others when they flew up from the water carried the tetrahedral boats on which they rested up with them, and Dr. Bell said that some had almost torn the masts from the steam tug used to raise them. There were photographs of men hanging to the framework to test its strength, and, in short, a wonderful collection of snapshots, showing every phase of these hundreds of experiments and their results.

"You can easily test the sustaining power of each kite," said Dr. Bell, as we looked at one of the pages of the book. "We know, for instance, that if it takes a horse running at the rate of 10 miles an hour to raise a kite so that it may be kept in the air an engine of one horsepower will do the same, provided the weight is not greater than the power exerted by the kite as it flies. We have had such kites raise into the air bodies weighing 600 pounds and more. Such a kite could therefore sustain an engine and machinery which might direct its flight, provided their weight altogether was not more than 600 pounds. I say this, not to indicate that I have invented a flying machine, but merely to give you an idea along what lines I am working. I am merely seeking to discover the foundation principles upon which such an invention must be based. When I have reached that end, I may try to go farther, but not until then."

FRANK G. CARPENTER.