ALEXANDER GRAHAM BELL

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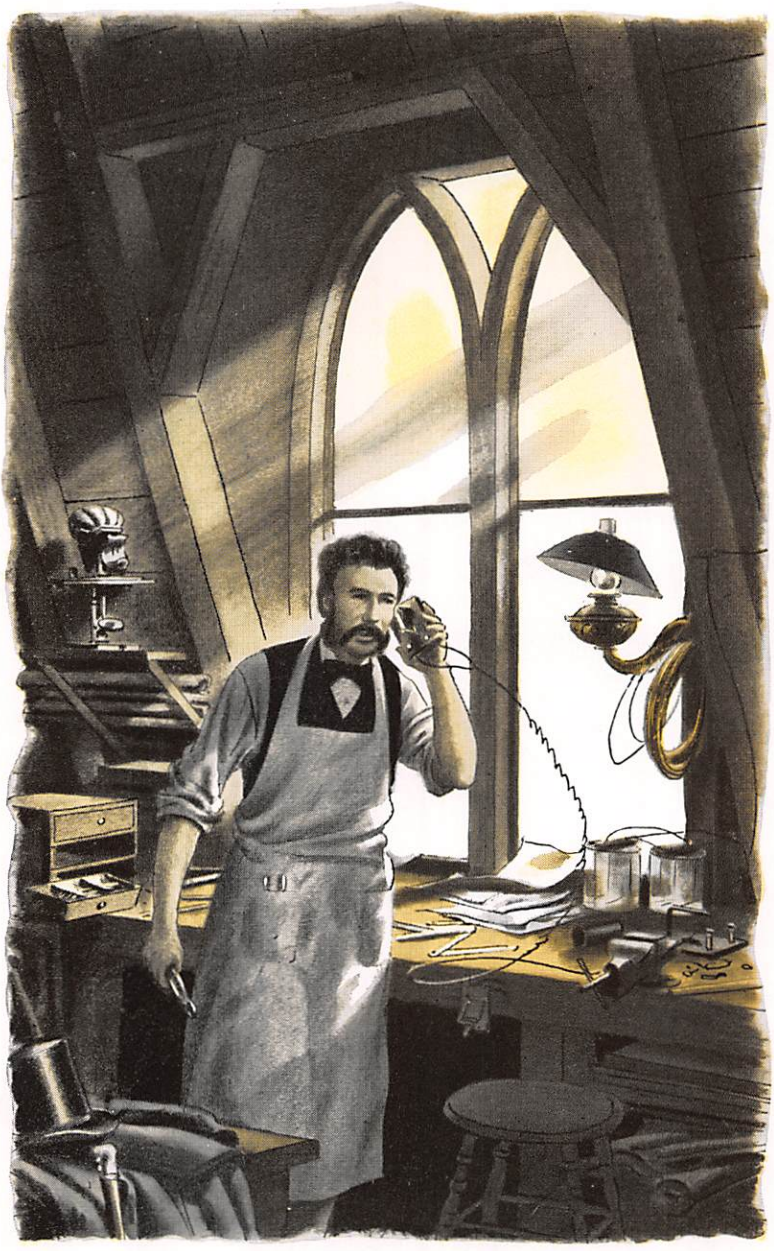
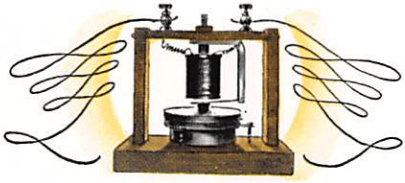


"Twang!" The sound of a reed proves Bell's theory of the telephone.

ALEXANDER GRAHAM BELL

Inventor of the Telephone



BELL TELEPHONE SYSTEM

"It is conceivable that cables of telephone wires could be laid underground or suspended overhead, communicating with private dwellings, counting houses, shops, manufactories . . . Not only so, but I believe in the future, wires will unite different cities, and a man in one part of the country may communicate by word of mouth with another in a distant place."

—ALEXANDER GRAHAM BELL (1878)

ALEXANDER GRAHAM BELL

ONE DAY in the early 1870's a young man was writing to the girl he was later to marry. In his letter he described his father's home in Canada. The house, he explained, was built upon heights overlooking the Grand River at Brantford, Ontario, and on the edge of a nearby cliff was a grassy depression so like a couch that the family called it the "sofa seat."

"This is my dreaming place!" the young man wrote. "Miles of country lie extended below me like a huge map. When I lived here I used to take a rug, a pillow and an interesting book, and dream away the afternoon in luxurious idleness."

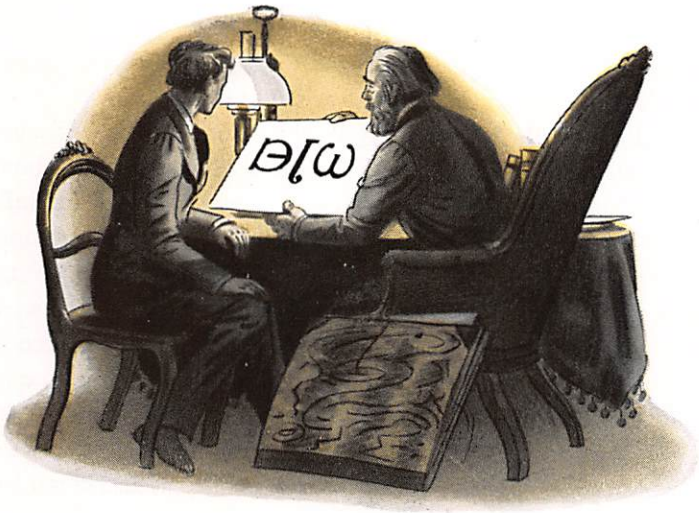
But the dreamer was practical thinker and man of action too. In Boston, where he worked by day as a teacher of the deaf, he also worked far into the night experimenting with the electrical transmission of sound. "You can't make an owl sleep at night," he wrote in another letter. "The more I explore this wonderful subject of electricity, the more boundless seems the prospect before me." And

he told his housekeeper, "I want a table upon which I can hammer and saw to my heart's content—and a floor upon which I can spill acids without fear of damage."

Out of the dreams, the vision, the disciplined thinking and the hard work of this young man came the telephone. Alexander Graham Bell was 27 years old when he worked out the principle of transmitting speech electrically, and 29 when his basic telephone patent was granted, in 1876.

But his invention was not a happy accident of youth. It was the fruit of long years of scientific training, from which he had gained, among other things, an extraordinary understanding of the way sounds of speech and music are created and heard. Along with this knowledge he had a searching mind and vigorous imagination which enabled him to make important contributions to progress in other fields, as well as in telephony. All through his life, too, he maintained a deep interest in the problems of the deaf. In fact, his modesty and humanity were such that he told his family he would rather be remembered as a teacher of the deaf than as the telephone's inventor.

Yet the telephone was an achievement of such historic importance that the name and fame of Alexander Graham Bell will always be associated with it. He understood, and in remarkably prophetic words foretold, how the usefulness of his invention might be extended throughout the world. With him began the unceasing scientific progress which has overcome the barriers of distance, one by one, so that today there are no earthly limits to human speech. All who give telephone service, and all who use it, are his inheritors.



Exploring the World of Speech

THE FAMILY background and early education of Alexander Graham Bell had a profound influence on his career. He was born on March 3, 1847 in Edinburgh, Scotland, the son of Alexander Melville Bell and Eliza Grace Symonds, daughter of a surgeon in the Royal Navy. His mother, who was a portrait painter and accomplished musician, began to lose her hearing when Graham was a boy of twelve. His father enjoyed a world-wide reputation as a teacher and author of textbooks on correct speech, and as the inventor of "Visible Speech," a code of symbols which indicated the position and action of the throat, tongue and lips in uttering various sounds. Melville Bell intended Visible Speech to be a key to the pronunciation of words in all languages, and it has been so used, but it soon developed that the symbols could also help to guide the deaf in learning to speak, and Graham as he grew up became expert in their use for that purpose.

The boy's grandfather, Alexander Bell, was also a specialist in the art of good speech. He had been on the stage for several years; later he gave dramatic readings from Shakespeare, and also developed a considerable practice in the treatment of stammering, lisping and other defects of speech. Both father and grandfather studied the

processes of speech with scientific thoroughness, and their methods and Melville Bell's textbooks were widely used.

Named originally for his grandfather, young Alexander adopted his middle name, Graham, from a friend of the family whom he greatly admired. He had such talent for music that from infancy he could play by ear; accordingly he was given an extensive musical education under August Benoit Bertini. For a while he planned a musical career, but later he decided to follow in his father's footsteps.

The boy's inventive ability appeared before he was fifteen. One day he visited a flour mill near Edinburgh. The owner, whose name was Herdman, asked if he could suggest a way to remove the husks from wheat before grinding. Graham found that the husks could be removed with a stiff brush, so he suggested that Herdman install a rotary brushing wheel. The latter did so, and was so pleased with the process that he used it for many years.

Later Graham and his brothers made a model skull and fitted it with a reproduction of human vocal apparatus that was worked with a bellows. They were able to make their model wail "Ma-ma" in such life-like imitation of a baby that the neighbors turned out to search for the child in distress. At about this time, too, Graham trained his Skye terrier to growl steadily while he manipulated the dog's mouth and vocal cords, trying to shape the growls into words. At the peak of the terrier's career, it was able (with its master's help) to say "Ow ah oo, ga-ma-ma", meaning, "How are you grandmother?"

Beginning in 1862, Graham and his brothers assisted Melville Bell in public demonstrations of Visible Speech. The boys would be sent from the lecture hall and return to pronounce symbols written by their father at the suggestion of the audience—Gaelic or Russian words, perhaps, or the sound of a yawn or a kiss. At about this time, too, Graham enrolled as a "student teacher" at Weston House, a boy's school near Edinburgh. There he taught music and elocution in exchange for instruction in other subjects. Later, after study at the University of Edinburgh, he became a full-time teacher. Also, during the years 1862-1866, he found time to qualify for studies at the University of London, and to use Visible Speech in teaching a class of deaf children.

In 1866, while still at Weston House, he carried out a series of experiments to determine how different vowel sounds are produced. Putting his mouth and tongue in position to pronounce the vowel, he would then tap throat or cheek with his finger or a pencil. Since the two principal cavities of the mouth are in front and in back of the tongue, which moves to help form the sounds, Graham's sensitive ear could distinguish the tone of each cavity in the resonant sound that resulted from tapping in various ways. He concluded that every vowel sound is a combination of resonances from different cavities of the mouth.

Melville Bell showed his son's report on these experiments to a scientist in London. The latter told Graham about a book called *Sensations of Tone,* by Hermann von Helmholtz. In this work, Helmholtz reported experiments in combining the notes of electrically driven tuning forks to make synthetic vowel sounds. Graham tried to read the book in German and got the wrong impression that Helmholtz had managed to "telegraph" the vowel sounds, or send them from one point to another over a wire. He soon learned his mistake (Helmholtz had merely made the forks vibrate by electrical means), but he could not dismiss from his mind the possibility

Graham succeeds in making his dog utter "words".

of "telegraphing" speech, though he then had no idea how to go about doing it. Indeed, he had performed no electrical experiments up to that time, and it was not until 1867 while teaching at Somersetshire College, that he became interested in electricity and installed a telegraph wire from his room to that of a friend.

By the time he was 21, Graham Bell was able to take full charge of his father's professional affairs while the latter was on a lecture tour in America. And in the following year, Melville Bell took his son into partnership with him in London, where he was now established. During the same period (1868-1870) Graham specialized in the anatomy of the vocal apparatus, at University College, London.

Then disaster uprooted the Bell family. Graham's younger brother, Edward Charles, had already died of tuberculosis. Now, in 1870, his elder brother, Melville James, died from the same disease. And doctors gave warning that Graham, too, was threatened.

His father did not hesitate. He sacrificed his career in London at its peak, and in August 1870 moved the family to Brantford, Ontario, where he had found during his travels what he considered a most healthful climate. There Graham soon recovered his health.

The Bell family arrive at their new home in Brantford.

Graham Bell Goes to Boston

THE TALENTS, training and interests which Graham Bell took with him when he sailed from England seem to have been combined especially to help him succeed in inventing the telephone. His mind was instinctively inventive. He had a sensitive ear and an excellent training in music. He was second to none in his understanding of the organs of speech and the production of speech sounds. His interest in electricity was growing day by day. And his intense desire to help the deaf, stemming from boyhood days when his mother first began to lose her hearing, led him directly to friendship with men who gave him financial backing for his electrical experiments. Here is what happened:

Sarah Fuller, principal of a school for the deaf in Boston (which continues today as the Horace Mann School) asked Melville Bell to show her teachers how to use Visible Speech in teaching the deaf to speak. Melville could not go, and recommended Graham. So in April, 1871, Graham went to Boston. There, and soon afterward at the Clarke School for the Deaf in Northampton and the American Asylum in Hartford, he met with great success. At the Clarke School, for example, using Visible Speech, he was able in a few weeks to teach the children to use more than 400 English syllables, some of which they had been unable to learn in two or three years under other methods of teaching.

The idea that deaf children could be taught to speak was relatively new in America. The prevailing view was, "Nothing can be done. At the age of ten or eleven, send the deaf child to an institution to learn the sign language. The deaf have no place in normal society." Graham Bell opposed this view. Another man who opposed it was Gardiner Greene Hubbard, a Boston attorney whose daughter Mabel had been left deaf by scarlet fever when she was four years old. Hubbard was, among other things, president of the Clarke School and also actively interested in Miss Fuller's school in Boston. He and Bell soon became good friends.

So deeply interested was Bell in carrying on this work that he

Teaching deaf children to speak was an absorbing interest to Bell.

Little George Sanders is brought to Bell for instruction.

decided to settle permanently in the United States. In October, 1872, he opened a school of "Vocal Physiology and Mechanics of Speech" in Boston. This was a school for teachers of the deaf, but it gave direct instruction to deaf children in order to demonstrate the teaching methods. In the following year, Graham became Professor of Vocal Physiology at Boston University, transferring his classes there.

A second man whose friendship Bell won was Thomas Sanders of Salem, a successful leather merchant. Sanders had brought his five-year-old son George, born deaf, to Bell as a private pupil. When the little boy showed progress in learning to talk, his father was deeply grateful. In 1873, both Hubbard and Sanders learned of certain electrical experiments which Bell was carrying on at night, and within a few days of each other they both offered to pay the cost. Bell brought them together, and an agreement was formed under which Sanders and Hubbard would share the expense and all three men would share in the profits, if Bell's experiments proved successful.

Bell was not attempting, at this stage, to transmit speech. He was trying to send several telegraph messages over a single wire at the same time. He had been interested, as we have seen, in Helmholtz' work with tuning forks. He knew also that others had trans-

mitted musical tones over a wire by using the "make and break" current of telegraphy. Would it be possible, by using several forks, to send *more* than one tone over the same wire simultaneously, and then separate the tones at the receiving end? Bell thought he could do it, and the apparatus he devised for the purpose he called the "harmonic telegraph."

He soon found that he lacked the time and skill to make the necessary parts himself, so he went for help to the electrical shop of Charles Williams, Jr., at 109 Court Street, Boston. The man assigned to assist him was Thomas A. Watson. They not only became fast friends, but eventually Watson received a share in Bell's telephone patents as part pay for his work.

It was through his experiments with the harmonic telegraph, plus his knowledge of music and human speech and hearing, that Bell found the way to the telephone. Let us trace the process, for it was a masterpiece of inventive reasoning.

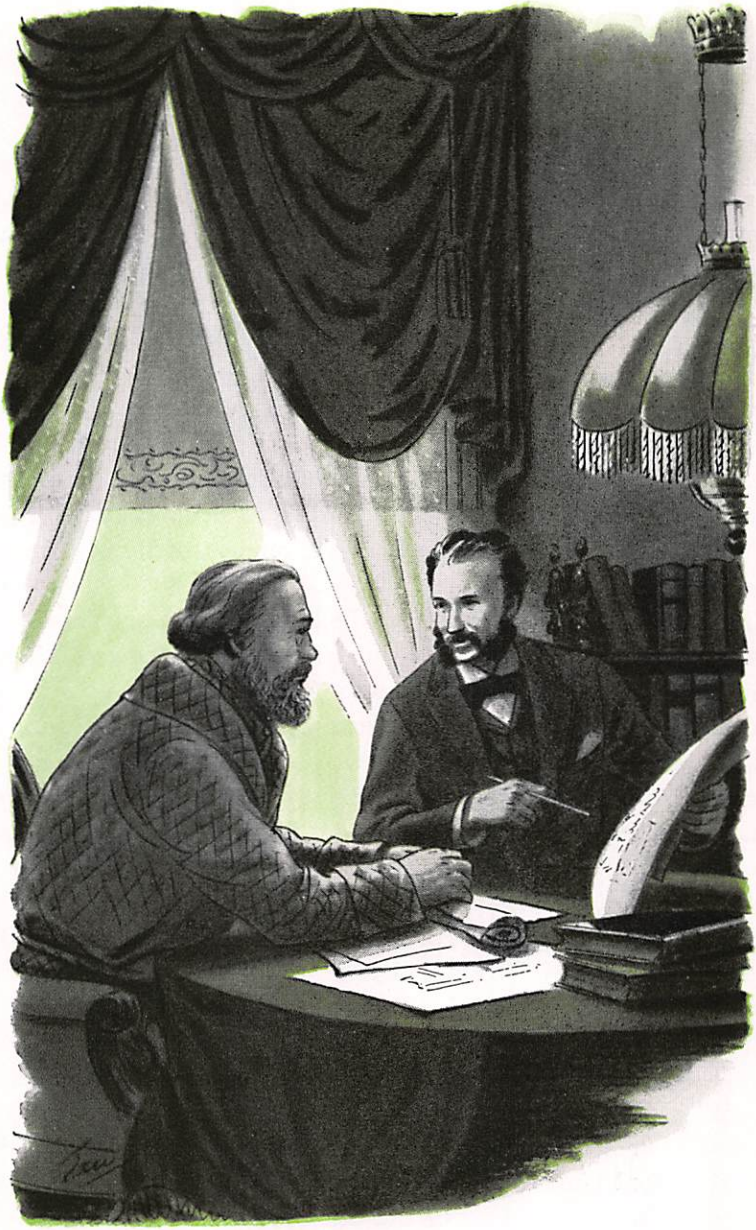
Charles Williams introduces Bell to Tom Watson.

Toward the Telephone Idea

BELL SET UP his first telegraph instruments so that pressure on a telegraph key would send current from a battery through an electromagnet—a bar of iron with a coil of wire around it. The electromagnet would cause a tuning fork mounted over it to vibrate like the clapper of a bell. Each vibration of the fork would cause one of its prongs to make a connection that would send a pulse of current from another battery along a wire. As long as the telegraph key was held down, this intermittent current would cause another electromagnet to vibrate another tuning fork at the receiving end, in resonance with the sending fork. Therefore you could send a Morse message with the key and, according to Bell's theory, only a receiving fork of the same pitch as the sender could receive the sender's message.

The problem, however, (which Bell never quite succeeded in solving) was to get each of *several* pairs of transmitting and receiving forks of different pitch to vibrate in resonance with each other—and *only* with each other—at the same time. Bell found the tuning forks unsatisfactory and decided to try steel organ reeds instead. Next he decided that the reeds would give better results if they were magnetized. When he reached this point in his thinking, he had to pause to consider a fact of fundamental importance, long known to electrical experimenters—that when a magnet is moved toward the pole of an electromagnet, a current is generated in the latter's coil, and when the magnet is moved away from the electromagnet a current of opposite kind is induced.

Now Bell's mind leaped beyond the thinking of previous experimenters—for he perceived that his rapidly moving magnetic reed would generate a current that would be alternately stronger and weaker, from instant to instant, as the vibrations of the reed varied. Next he asked himself this: If many reeds of different pitches were vibrating simultaneously over the electromagnet, would they not generate one complex varying current—the resultant of the combined motion of all the reeds?



Bell outlines his theory of the telephone to his father in Brantford.

Bell reasoned correctly that they would. Now, from his experience with music he knew that when you sing into the sound box of a piano when the strings are not damped, several strings will respond. If, then, a "harp" transmitter were built with enough strings or reeds, properly tuned, it would pick up every sound of the voice. Therefore, the combined vibrations of the reeds, mounted over an electromagnet, would generate an electrical current which would vary in intensity just as the reeds were vibrated by the varying sound of the voice. And this current would vibrate a receiver harp at the distant end so that the sounds would be repeated.

Bell was on the track. But he considered that there were two things wrong with his idea. First, his theoretical "harp" transmitter seemed too complicated to be practical. Second, he thought the current induced in the coil of the magnet would not be strong enough to work.

Meanwhile his interest in the deaf led him to study two devices used in the physics laboratory at Massachusetts Institute of Technology. One of these, called the phonautograph, had a mouthpiece that guided sounds against a membrane. When words were spoken the membrane vibrated and moved a lever which made a wave pattern on a piece of smoked glass. In the second device, as the sound waves moved the membrane, a gas flame made a corresponding wave pattern in a set of revolving mirrors.

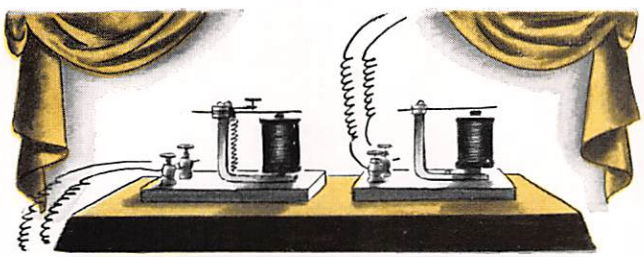
Bell wanted to use these devices to show his deaf pupils what

The human ear phonautograph traced speech patterns.

different sounds looked like, so that they could duplicate them. But neither instrument produced useful patterns, so he obtained from Dr. Clarence J. Blake, a Boston ear specialist, a specimen of a human ear. This was mounted so that the ear drum functioned as it does in life, by moving the bones of the inner ear, except that Bell substituted for one bone a wisp of hay that would make patterns on smoked glass.

Again the patterns were not satisfactory for teaching purposes. But Bell marvelled over the ability of the tiny diaphragm that was the ear drum to move the comparatively big bones of the ear. If that could gather and transmit complex sounds, could not a single diaphragm take the place of all the reeds in his theoretical harp transmitter? The end of one magnetized reed could be attached to the center of the diaphragm; as it vibrated to voice waves or music, *it would generate a current that would vary in intensity just as the air varies in density when a sound is passing through it!*

There he had it. While intent on the harmonic telegraph, he had worked out the principle of the telephone. In the summer of 1874, while on vacation in Brantford, he formulated and described the idea to his father. But he still doubted that the induced currents would be strong enough to work. In February, 1875, in Washington, he stated his theory to Joseph Henry, secretary of the Smithsonian Institution and dean of American electrical scientists. He told Henry he feared he lacked the electrical knowledge to bring his theory to practical success. Henry said simply, "Get it!" and Bell went back to Boston.



Transmitter and receiver of Bell's "Harmonic Telegraph".

The Telephone is Born

On June 2, 1875, came the "break" in telephone history. In the garret at 109 Court Street, Bell at one end of the line, and Watson at the other, in a different room, were tuning the reeds of the harmonic telegraph. One of Watson's reeds was screwed down so tightly that it "froze" to the pole of its electromagnet. Watson plucked it to free it. *Twang-g!* Bell at the other end of the line heard in his receiver a sound quite different from the usual whine sent out by the vibrating transmitter. He heard the distinctive twang of a plucked reed, a sound with tones and overtones, coming to him over the wire. Quickly he ran to Watson, shouting, "Watson, what did you do then? Don't change anything. Let me see."

It soon became apparent that the reed, too tight to send an intermittent current, had acted as a diaphragm and sent an induced, undulating current over the line—a current that varied in intensity precisely as the air was varying in density within hearing distance of that spring. The receiving reed, pressed against Bell's ear, had also acted as a diaphragm. And most important of all, the induced current had proved strong enough to be of real use.

"Mr. Bell, I heard every word you said—distinctly!"

After an hour or so of plucking reeds and listening to the transmitted sounds, Bell gave his assistant instructions for making "the first Bell telephone," and on the next day the primitive instrument transmitted the sound of Bell's voice to Watson. Not words, just recognizable voice sounds. The two men went on experimenting all summer, and in September Bell began to write specifications for his first telephone patent. Before he filed his patent application, on February 14, 1876, he cast about for a method of putting a stronger undulating current on the line than was possible with magnetic induction. He decided this could be done by causing resistance to a battery current to fluctuate, stronger and weaker, as his transmitter diaphragm vibrated. So he also described in his patent specifications a transmitter in which a short wire was attached directly to the diaphragm. As the diaphragm vibrated, the wire moved up and down in a liquid conductor. When it went deeper, resistance lessened; as it rose again, resistance increased; so that a current through the wire and fluid had to undulate as the sound waves required.

Bell's first telephone patent, from these specifications, was issued March 7, 1876. Three days later, on the top floor of a boarding house at 5 Exeter Place, Boston, where Bell had rented rooms to secure greater privacy than the Williams shop afforded, the telephone carried its first intelligible sentence. On that evening, Bell and Watson were about to try out the new liquid transmitter. Watson went to the other end of the line, in Bell's bedroom, and put the receiving telephone to his ear. Almost at once he was astonished to hear Bell's voice saying, "Mr. Watson, come here, I want you!"

Watson rushed down the hall into Bell's room, shouting, "Mr. Bell, I heard every word you said—distinctly!"

Bell had upset the acid of a battery over his clothes but forgot the accident in his joy over the success of the new transmitter.

In June, 1876, Bell was able to exhibit both magnetic and variable resistance telephones at the Philadelphia Centennial Exposition. On Sunday, June 25, a group of exhibit judges were about to give up for the day, when one of them, the Emperor Dom Pedro of Brazil, recognized Bell. Dom Pedro had already arranged to introduce

"It talks!" Dom Pedro is astounded by the telephone.

Bell's methods in schools for the deaf in Brazil. Now he insisted that the judges consider Bell's exhibit, and he was the first to listen at one of the receivers. It is said that he exclaimed, "My word! It talks," or possibly more forceful words in Portuguese to that effect. Another judge, Sir William Thomson (Lord Kelvin), later called the telephone "the most wonderful thing in America."

In July, 1876, Bell set up a one-way telephone circuit from Brantford to Paris, Ontario. It talked successfully. During the following months Bell and Watson gave many successful demonstrations of the telephone, and their work paved the way for the beginning of telephone service in America. Then in July, 1877, Bell married Mabel Hubbard, daughter of Gardiner Hubbard, and sailed with his bride for England to introduce the telephone there.

Queen Victoria, to whom he demonstrated his invention, wrote in her journal, "A Professor Bell explained the whole process which is the most extraordinary." But on the whole his efforts in England were disappointing. Indeed, a rival company, using a telephone which infringed his patents, captured most of the business. Perhaps the most noteworthy feature of his visit to England was Bell's foretelling of how telephone service would be rendered in the future.

Bell gives Mabel Hubbard a silver model of his telephone.

In a letter to English investors he included these remarkably prophetic paragraphs:

"At the present time we have a perfect network of gas-pipes and water-pipes through our large cities. We have main pipes laid under the streets communicating by side pipes with the various dwellings, enabling the members to draw their supplies of gas and water from a common source.

"In a similar manner, it is conceivable that cables of telephone wires could be laid underground, or suspended overhead, communicating by branch wires with private dwellings, country houses, shops, manufactories, etc., etc., uniting them through the main cable with a central office where the wires could be connected as desired, establishing direct communication between any two places in the city. Such a plan as this, though impracticable at the present moment, will, I firmly believe, be the outcome of the introduction of the telephone to the public. Not only so, but I believe in the future, wires will unite the head offices of the Telephone Company in different cities, and a man in one part of the country may communicate by word of mouth with another in a distant place."

The mind that had conceived the telephone understood also how it could be used in the service of all.

Bell returned to America in 1878. After 1881, when he moved to Washington, D. C., he did not take an active part in the telephone business, though he was called upon frequently to testify in law suits to defend his original patent issued in 1876, and a second issued in 1877. Many were the claims of others that they had anticipated his discoveries. Several suits reached the Supreme Court of the United States. In every one of them, the Court upheld Bell's rights.

In 1915, during ceremonies that opened the first transcontinental telephone line, Bell in New York talked to Watson in San Francisco. He repeated, "Mr. Watson, come here, I want you!" and Watson replied that he would be glad to come, but it would take a week. In this way, Bell helped to fulfill his own prediction that some day entire nations would be united by the telephone.

Pioneering In Many Fields

For more than 45 years after his invention of the telephone, most of which he spent in Washington and at his summer home, Beinn Bhreagh, on Cape Breton Island in Nova Scotia, Bell lived a vigorous and creative life. His concern for the deaf caused him to give years of unselfish service in their behalf. He became tremendously interested in aviation, foresaw its importance, and did much to foster its progress. He produced other communication devices, though none of such significance as the telephone, and carried on constructive studies in eugenics. His mind was ever-inquiring, and the range of his interests wide.

About 1880, with Sumner Tainter, a maker of optical instruments, he used the element selenium, whose resistance to electricity changes when it is exposed to light, to develop an "undulating" light beam which would function through the atmosphere as his undulating current functioned over a wire. Thus he was able, over short distances, to transmit sound over a beam of light. With

his characteristic enthusiasm he wrote, "I have heard articulate speech produced by sunlight! I have heard a ray of the sun laugh, cough and sing!" He called this device the Photophone, but a French scientist, Ernest Mercadier, pointed out that in it Bell used radiant energy, so that it should more properly be called a Radiophone. It is probable, therefore, that this was the first invention to which the prefix "radio" was ever applied.

The French government in 1880 awarded Bell the Volta prize of 50,000 francs for his invention of the telephone. He used the money to help establish at Washington, with two friends, the Volta Laboratory. There he and his associates developed the basic method of making phonograph records on wax discs. The patents were sold and Bell used his share of the proceeds to establish a branch of the laboratory that he named the Volta Bureau. This he set up specifically to carry on his work for the deaf. The Bureau, still at Washington, does work for the deaf today.

Bell founded the American Association to Promote the Teaching of Speech to the Deaf and financed it with $300,000. For years he was president and trustee of Clarke School for the Deaf, Northampton. He made statistical studies of deafness and urged that more accurate records be kept. Much of this work was sheer drudgery, but his heart was in it. As a special agent (without pay) for the Twelfth Census in 1900, he arranged for the collection and tabulation of nation-wide information about deafness. All told he gave nearly six years to this voluntary task.

After the shooting of President Garfield, Bell devised electrical apparatus to locate bullets or other metals in the body. Early tests were unsuccessful because the doctors failed to remove the steel spring in Garfield's bed, and later it was impossible to move him. After the President's death, Bell perfected an electric probe which was used in surgery for several years before the X-ray was discovered. Also in the field of medicine, he published "A Proposed Method of Producing Artificial Respiration by Means of a Vacuum Jacket," in which he described a device having the same purpose as today's iron lung. In 1885, he advocated a method of locating icebergs at sea by detecting echoes from them. Years later he concerned himself with the problem of condensing fresh water from

Dr. and Mrs. Bell witness a flight of the airplane "Red Wing".

vapor in the air, for men adrift at sea in an open boat. In the construction of houses, he made suggestions to aid air conditioning. For 30 years he directed experiments in breeding sheep, trying to develop ewes that would bear more than one lamb at a time. The work was slow, but made some progress, and in other hands the experiments are still being carried on.

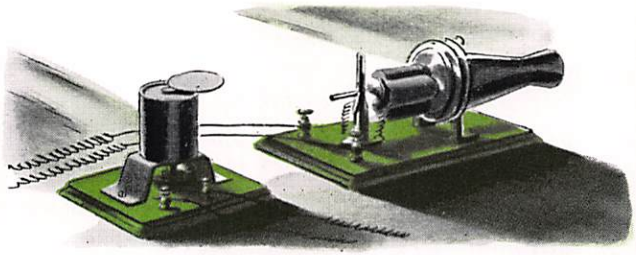
Indeed, in several of the fields in which Bell interested himself, others have gone further than he. That is natural. The point of interest is that Bell had a pioneering mind, and the power and influence of his mind is reflected in the achievements of others, as well as in his own.

All his life Bell was interested in flight. Even while on his honeymoon in England he made notes and drawings of the flight of birds. He helped to finance S. P. Langley's experiments with heavier-than-air machines and used all his influence in Langley's behalf. He himself conducted a long series of experiments with man-lifting kites, for the purpose of testing the lifting power of plane surfaces at slow speeds. In 1907, with J. A. D. McCurdy, Lieutenant Thomas E. Selfridge, F. W. Baldwin and Glenn H. Curtiss, he organized and Mrs. Bell financed the Aerial Experiment Association.

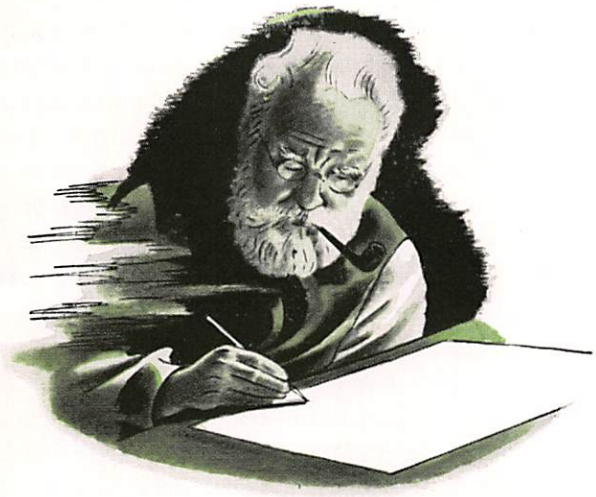
This Association did a great deal to advance the cause of aviation. The Wright brothers had already made many successful flights, but had preferred to avoid publicity. The Association built

machines that made three successful *public* flights; these aroused wide interest and were truly milestones in aviation progress. Equally important, the Association used ailerons, rather than the Wright brothers' wing-warping method, to keep their planes in lateral balance; and it is ailerons which are generally used today.

Bell's vision as to the future of aviation was remarkable. He urged establishment, by the Smithsonian Institution, of the Langley Medal for aviation progress, the first award of which was made to the Wright brothers. He predicted that it would not be many years before "a man can take dinner in New York and breakfast the next morning in Liverpool." And in a magazine article in 1908 he wrote, "The nation that secures control of the air will ultimately rule the world."



Telephone exhibited at the Centennial Exposition, 1876.



Bell's Legacy to the World

ALEXANDER GRAHAM BELL became a United States citizen in 1882—a fact of which he was very proud. The Government and Constitution of the United States he once described as one of the most remarkable inventions in the history of man. He died in August 1922 and was buried in Nova Scotia. During the funeral service on August 4, all telephones served by the Bell System were silent for two minutes. At his request, his epitaph on the grave near his Beinn Bhreagh home reads, "Born in Edinburgh . . . died a citizen of the U. S. A."

He was, however, something more—a citizen of the world, who left a legacy for all men.

Enthusiastic and tireless, he was apt in his younger days to wake others in the middle of the night to share with him the excitement and adventure of progress on some experiment. And teachers of the deaf tell of watching Bell communicate to large audiences his own enthusiasm for the teaching methods he advocated.

Bell was impulsive and generous too. Soon after he had invented

the telephone, when he had very little money, his first public lecture brought him $85. He spent it all on a silver model of the telephone for his fiancee. And though it was he who had founded the telephone art, as the father of Bell Telephone Laboratories, he was the first to give credit to those who came after him. In the last year of his life he said, "The telephone system, as we now know it, is the product of many, many minds, to whom honor should be given for the wonderful and beneficial work it has accomplished."

To telephone people everywhere, engaged as they are in rendering public service on which the lives and happiness of other men and women so often depend, Alexander Graham Bell's career of service to humanity offers special inspiration. And with them, others will write his name high on the roll of versatile American geniuses who have contributed to the welfare of mankind. Bell's work for the deaf hastened the development of enlightened methods for their education, and inspired improvement of institutions devoted to their care. His support of aviation led to the invention of the aileron stabilizer which continues in use today. His telephone has had incalculable influence upon the world and has largely shaped the whole pattern of modern life. It has given employment directly to hundreds of thousands of men and women engaged in providing communications service, and to hundreds of thousands more who supply raw materials and finished goods for use in the telephone industry.

For countless millions of others, in cities and on farms, the telephone is an indispensable tool of living—in the hour-to-hour conduct of business, in the administration of government, in minor emergencies and great ones, and in maintaining family and community ties. To make telephone service what it is today—and what it will be tomorrow—many people and many inventions have contributed and are contributing through a continuous succession of work and ideas. But it is not to be forgotten that this progress began with the achievement of Alexander Graham Bell.

With the airplane, Bell's telephone has made the world smaller. Swift communication and transport have already had a vast effect on human relations, and will have more. They are, of course, only agencies in the hands of man; but both, because it is their function

to bring people together, promise to be mankind's chief physical aids in achieving better understanding among the peoples of the earth.

In his thinking, as well as in his works, Bell left much for others. We may well conclude this tribute with words in which, speaking to children, he spoke to us all:

"Don't keep forever on the public road, going only where others have gone. Leave the beaten track occasionally and dive into the woods. You will be certain to find something you have never seen before. Of course, it will be a little thing, but do not ignore it. Follow it up, explore all around it; one discovery will lead to another, and before you know it you will have something worth thinking about to occupy your mind. All really big discoveries are the results of thought."