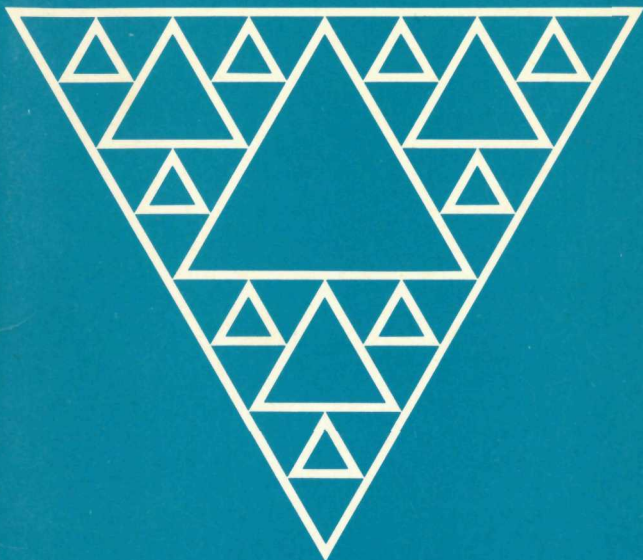


Nova Scotia

Alexander  
Graham Bell  
National Historic  
Park



*The inventor is a man who looks around upon the world and is not contented with things as they are. He wants to improve whatever he sees, he wants to benefit the world; he is haunted by an idea, the spirit of invention possesses him, seeking materialization.*

*Alexander Graham Bell*

### **Alexander Graham Bell Museum**

Although Alexander Graham Bell is best known to the world as the inventor of the telephone, his genius carried him much further into scientific research than most people realize. He made important contributions in medicine, aeronautics, marine engineering, genetics and eugenics. He did extensive research in electricity, in sound and in speech. He was a teacher and, perhaps above all, a great humanitarian.

Born in Scotland in 1847, long-time resident of Canada, citizen of the United States of America, Alexander Graham Bell is a symbol of the internationality of his scientific achievement. He came to Canada in his early years and later went to the United States to pursue his career as a teacher and scientist.

It was not long before he returned to Canada. Amid the rugged beauty of Cape Breton, so reminiscent of his Scottish homeland, he built and developed the estate known as "Beinn Bhreagh" on a headland across the bay from Baddeck.

Beinn Bhreagh became his second home, and here he built the famous laboratory and workshops which produced so many of the items now displayed in this museum. In the course of his work here he gathered about him a group of brilliant and energetic young men, keenly interested in the scientific problems which Bell had set himself to solve.

Out of this group was formed the Aerial Experiment Association, led by Bell and financed by funds provided by his wife. The A.E.A., one of the many research associations organized by the great inventor, included such famous men as F. W. ("Casey") Baldwin, J. A. D. McCurdy (later Lieut. Governor of the Province of Nova Scotia), Glenn H. Curtiss and Thomas E. Selfridge. To all these associates of Bell this museum is also dedicated.

The daughters of Alexander Graham Bell, Mrs. Gilbert Grosvenor and Mrs. David Fairchild, generously offered relics and

authentic records of their father's work, if Canada would, in turn, provide a building in which to exhibit them.

The architectural theme chosen recalls Dr. Bell's researches at Baddeck for it is based on the tetrahedron, a geometric form he used in kites which tested the principles of flight.

In 1954-55 the museum, designed by O. H. Leicester, then Chief Architect for the department, in collaboration with a firm of consulting architects, was erected on a site donated by the Government of Nova Scotia. Its administration is a responsibility of the National and Historic Parks Branch of the Department of Indian Affairs and Northern Development.

### **Bell - The Man**

Like other Scots who came to the New World, Alexander Graham Bell was a pioneer who strove to fill not the empty spaces on the map but the unexplored areas of science and engineering. As an innovator, teacher and leader, he overcame the skepticism of his age to extend the boundaries of scientific knowledge. His ability to communicate his enthusiasm and daring to others spread his ideas far beyond his own scientific circle and provided a foundation of research that others would build upon. Throughout his life, Bell organized and encouraged with financial and scientific help numerous research projects and groups, educational institutions, scientific societies and publications.

He was one of the first to popularize science, to bring the work of the inventor and research worker from the laboratory into the marvelling gaze of the people. To promote the study of the natural and scientific world, Bell and his father-in-law, Gardiner Greene Hubbard, in 1888, helped to found the National Geographic Society, and in 1899, while President of the Society, he engaged as editor his son-in-law, Dr. Gilbert H. Grosvenor, who developed the National Geographic Magazine into the



world's leading publication of its type. Bell's service as Regent of the Smithsonian Institution at Washington enabled him to provide the essential recognition and incentives to many outstanding North American scientists.

From teaching the science of speech Bell turned to research in the transmission and reproduction of sound. This research led to his development of the multiple harmonic telegraph, the telephone, the photophone, the graphophone and other inventions. His early work with the deaf led logically to genetic studies on the heredity of deafness, longevity and scientific sheep breeding.

His attention to medicine produced a surgical probe, theoretical presentations of the iron lung, and the use of radium in the treatment of deep-seated cancer. His aeronautical research developed early from his observations of the flight of birds and progressed through heavier-than-air flight experiments to hydrofoil boats.

Alexander Graham Bell was born at Edinburgh, Scotland, on March 3, 1847, the third son of Alexander Melville Bell. From his father and grandfather, he developed a lasting interest in speech studies. This early training, extended by formal studies at the University of Edinburgh and the University of London, enabled him to join his father's practice as a full partner at the age of 21. When tuberculosis took the lives of two sons and threatened Alexander Graham Bell, Bell's parents moved to Canada. At his parents' home at Tutela Heights, near Brantford, Ontario, Bell regained his health and launched his great scientific career.

While teaching at Boston, Bell gained the friendship of Gardiner Greene Hubbard, a wealthy Boston lawyer who later became a founder and the first president of the National Geographic Society. Hubbard sought Bell's advice on the education of his daughter, Mabel, who had been deaf since a childhood attack of scarlet fever.

With the Hubbards the young inventor found warm friendship, financial encouragement, and love. His friend supported his experiments on the multiple harmonic telegraph and telephone and gave his daughter's hand in marriage. Bell's marriage to Mabel Hubbard in 1877 provided him with a constant source of inspiration and encouragement; the influence of his wife can be detected in all his great achievements.

Alexander Graham Bell and his family visited Baddeck first in 1885. While en route to Newfoundland, they took a steamer trip through the Bras d'Or Lakes of Cape Breton Island and stopped briefly at Baddeck. To the inventor this scenic location evoked nostalgic memories of his native Scotland and the next year he returned to live with his family in a small cottage. So began an association with Baddeck that was to last until his death in 1922.

Seven years after his first visit Bell established an estate on an impressive headland overlooking the Bras d'Or Lakes. This was his "Beinn Bhreagh" or "Beautiful Mountain", a summer home where he could escape the heat of Washington. While at his summer home, he continued his experiments, working in a laboratory he built on the grounds. His secretary and assistant for many years was Arthur W. McCurdy, of Baddeck, inventor of the photographic accessory that later became the Eastman developer.

At Baddeck Alexander Graham Bell led for two years the research of the Aerial Experiment Association, a group of five men from Canada and the United States. Bell's leadership in the experiments in powered flight carried out at Baddeck and Hammondsport, N.Y. helped develop the science and industry of aviation on the American continent.

Bell died at Beinn Bhreagh on Aug. 2, 1922 and was buried in ground of his own choice high on the side of the "beautiful mountain" that he loved so well.

## **Bell—The Humanitarian**

### *Work with the Deaf*

Some of Alexander Graham Bell's greatest contributions to modern society were those which sprang from his work in voice therapy with the deaf. When he was twelve his mother began to lose her hearing and he became intensively interested in the problem of deafness. Uninformed public opinion then regarded deaf-mutes as feeble-minded and even the more enlightened believed that their muteness was caused only by defective organs of speech. To teach them to speak, therefore, was considered impossible.

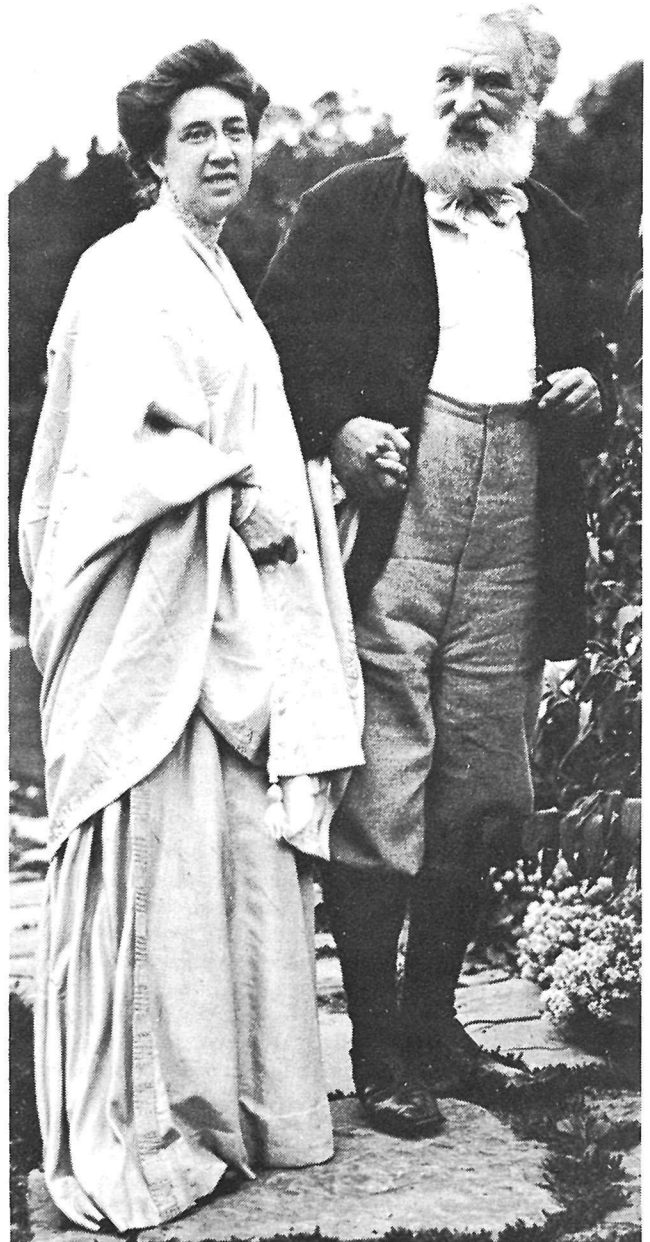
The result was that these unfortunates were generally confined to institutions early in life where they were taught, often by other deaf-mutes, to communicate with each other in sign language. Having no recourse to spoken language, they were thus separated by an almost impenetrable barrier from normal people.

Bell dedicated his life to the penetration of what Helen Keller called that "inhuman silence which severs and estranges", and to raising the standards of education for the deaf. His was the greatest single influence in the English-speaking world in successfully integrating the deaf child with society.

### *Helen Keller*

One of Bell's most outstanding successes was the education of the famous Helen Keller, who was brought to him as a child, unable to see, hear or speak. Later Miss Keller wrote: "Hearing is the deepest, most humanizing philosophical sense man possesses, and lonely ones all over the world, because of Dr. Bell's efforts, have been brought into the pleasant social ways of mankind."

In 1871 Bell replaced his father at a lecture appointment at Boston. Soon after he became a teacher of the deaf, at Northampton, Mass., achieving incredible results with deaf children.



In 1872 Bell established a small school in Boston for the instruction of teachers of the deaf. Here he edited a manuscript periodical which he called the *Visible Speech Pioneer* and circulated it to schools using his father's method of teaching. In the next year he moved his classes to the University of Boston where he had received an appointment as Professor of Vocal Physiology.

### **Bell – The Communications Scientist** *Multiple Telegraph*

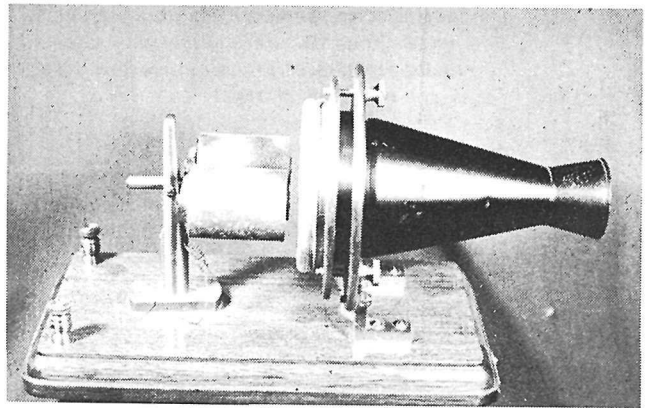
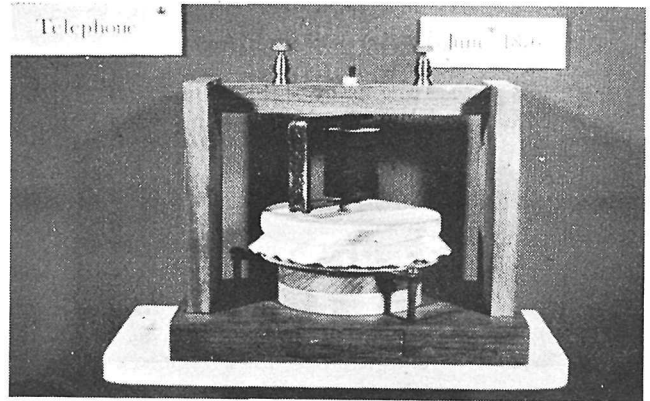
By day he taught but late into the night, every night, he worked to perfect his multiple harmonic telegraph, an apparatus designed to send more than one Morse message simultaneously over a single telegraph line.

### *Telephone*

His interest in the latter experiments began to fade when, in 1874, a line of research he was pursuing to reproduce sounds visibly for the benefit of his deaf pupils showed him the basic solution to the problem of transmitting and receiving speech along an electrified wire. From this line of research developed his invention of the telephone, conceived in principle at Brantford in 1874 and practically tested at Boston in 1875. What greater experts in electrical science had been unable to do, Alexander Graham Bell accomplished, chiefly as a result of his extraordinary training in the science of speech and sound. For Bell the 1870's were lean years and his impressive qualities of determination and courage in the face of adversity were well displayed in this period. The next decade saw him rise to fame and financial security as a result of his invention of the telephone.

### *The Volta Prize*

In 1880 France bestowed on him what Alexander Graham Bell always considered his most treasured award, the Volta Prize



for his invention of the telephone. With the money from this award he established the "Volta Laboratories" in Washington with two associates, Sumner Tainter, an optical instrument maker, and his cousin, Chester Bell.

#### *The Photophone*

Previously, Graham Bell and Tainter had been making experiments with the element selenium and the results of their work were embodied in the photophone. This unusual device transmitted speech in the form of light waves. Bell was convinced of the practicability of this invention but it was never fully developed in his lifetime. In recent years, however, his work with the photophone, and particularly with selenium, has been revived in the further development of the telephone.

#### *The Graphophone*

The Volta Laboratories engaged in many experiments with the photophone, with selenium, and in other fields. But their most impressive legacy to future generations was their recording machine, the graphophone.

In 1877 Edison had invented what he called the "phonograph", the first device to record sound successfully. His invention was really little more than an interesting toy, for the recording method used of indenting on cylinders of metal foil was not suitable for commercial development and Edison's original machine was soon abandoned.

Dr. Bell and his Volta associates took up the challenge of developing a commercial sound recording machine. They were the first to discover the good recording qualities of the wax cylinder and their development in 1886 of this discovery provided the basis for the entire modern recording industry. They were also the first to make experiments with the flat disc, the ancestor of our modern phonograph record.

#### *Volta Bureau*

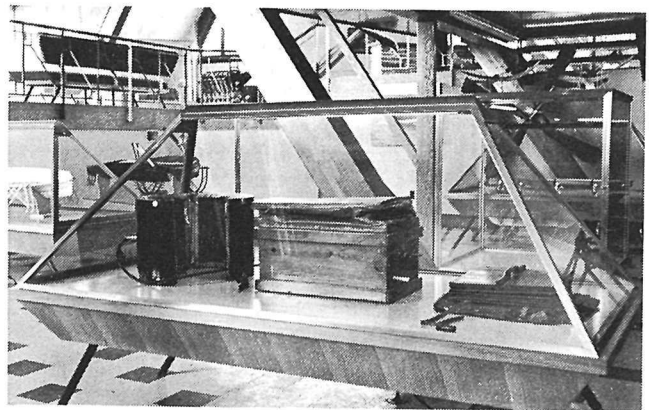
While the Volta Laboratory was working on a variety of researches, Bell was also carrying on inquiries into the heredity of deafness and he set aside a portion of the laboratories for work in this field. Thus was born the famous Volta Bureau which continues today as a central agency "for the increase and diffusion of knowledge relating to the deaf", and home of the Alexander Graham Bell Association for the Deaf.

When the Associates perfected and sold patents on their graphophone, Bell contributed his full share, amounting to \$200,000, to the Volta Bureau so that it could continue its important work.

#### **Bell – The Medical Scientist**

##### *Eugenics (improving a Race or Breed)*

One of Bell's important contributions in eugenics was his massive work "Duration of Life and Conditions Associated with Longevity", published in 1918. This is an exhaustive study of the statistics which Bell obtained on 8,907 members of a family. Tracing the Hyde family history back to a common ancestor, he made a scientific study of its genetic development. This is one of the early works of its kind and scope in genetic science. His contributions were recognized by his election to the



honorary presidency of the Second International Progress of Eugenics.

In establishing his summer home near Baddeck in the eighties, Graham Bell had acquired a number of farms and large flocks of sheep. For many years he used the sheep for scientific breeding experiments, trying to develop a strain of ewe that would bear several lambs at a time instead of the usual one.

He achieved much success at these experiments in his lifetime.

#### *The Surgical Probe*

In 1868, as a young man, Graham Bell entered the University of London for two years to study the anatomy of the vocal organs. Twenty years later during the celebrations marking its 500th Anniversary, the University of Heidelberg conferred on him an honorary Doctorate of Medicine.

The award was made specifically for Bell's ingenuity in developing a surgical probe for locating pieces of metal buried deeply in the bodies of patients. The probe was unsuccessful at first but a later model was used by medical science until the X-ray superseded it.

#### *Radium Treatment for Cancer*

At the turn of the century radium was in use for the treatment of external cancers, but it had not proved effective in treating deep-seated ones. In July 1903, a letter which Bell wrote to his friend Dr. Sowers of Washington was published in a medical journal. In it Bell suggested that this was due to the amount of healthy tissue between the radium and the deep-seated cancer. But, he said, ". . . there is no reason why a tiny fragment of radium sealed up in a fine glass tube should not be inserted into the very heart of the cancer."

Characteristically, Bell did not claim priority for his idea, though it was soon developed and used widely in cancer treatment.

#### *Iron Lung*

An early idea of Alexander Graham Bell's, which he outlined in an article "A Proposed Method of Producing Artificial Respiration by means of a Vacuum Jacket", anticipated by many years the development of today's iron lung.

#### **Bell – The Aeronautical Scientist**

##### *Kites*

Bell had been interested in the subject of aerial locomotion even before he invented the telephone. Realizing the limitations of the motors of the day, Bell began in the early nineties to experiment extensively with kites, notably the "Hargrave" kites, partly for his own amusement and partly to acquire basic knowledge on flight. But as he inquired more deeply into the science of flight, he realized clearly the great practicability of these experiments, and mere amusement was soon replaced by a sense of dedication and even urgency.

In his experiments with kites, Bell started from the first principles of flight. It was already common knowledge that a kite would stay aloft if held on a string against a wind. In Bell's opinion the problem of heavier-than-air flight was to design a kite light enough to be supported in the air by its flat surfaces and strong and stable enough to carry both a man and motor safely. The motor would drive an airscrew which would draw air back against the kite like a strong natural wind, keeping it aloft and pulling it forward at the same time.

Bell's theory was difficult to put in practice. No engines of that period were powerful enough to maintain flight in a machine whose safety and stability depended on strong construction.

##### *The Tetrahedral Cell*

In 1901 Bell surmounted this obstacle by developing the tetrahedral cell, an almost perfect engineering construction, extremely light and extremely strong.



He arrived at this design by trial and error after experimenting with every conceivable shape, circular, polygonal, triangular. With the tetrahedral design he progressed gradually to bigger and stronger kites. The early frames of slender spruce gave way to stronger ones and eventually to sturdy and durable aluminum tubing. Beinn Bhreagh became the centre of a most unusual industry as workmen and seamstresses turned out thousands of colourful silk-covered kite cells.

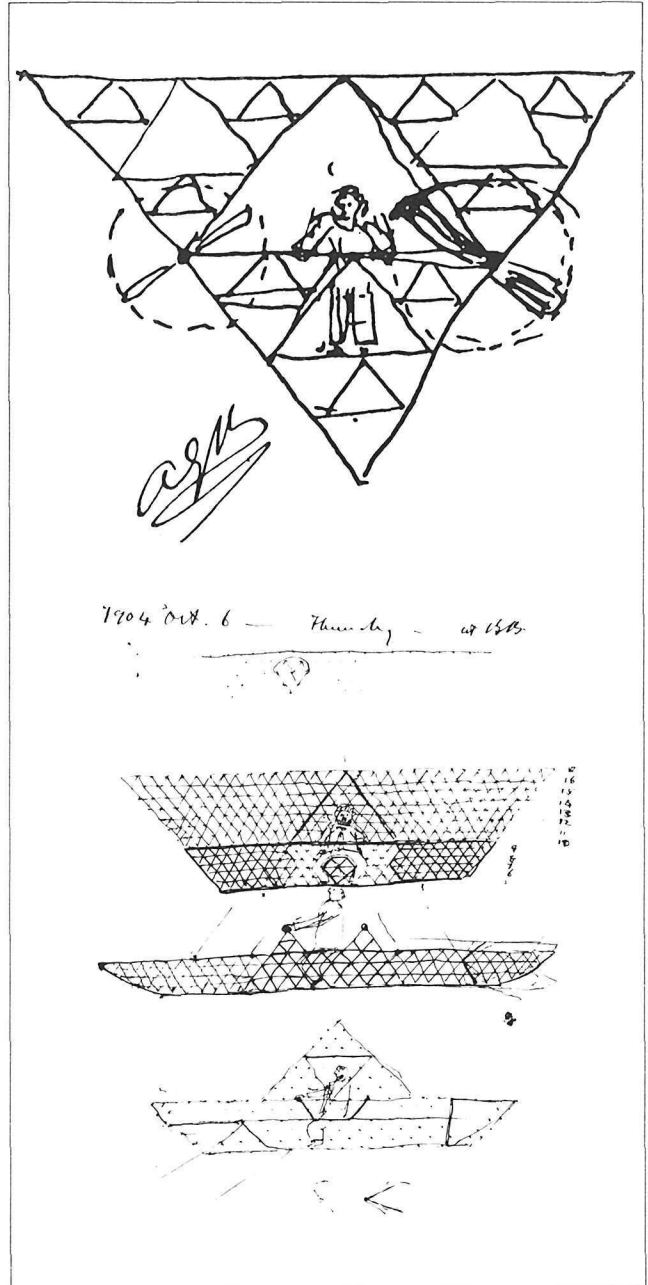
#### *The Cygnet*

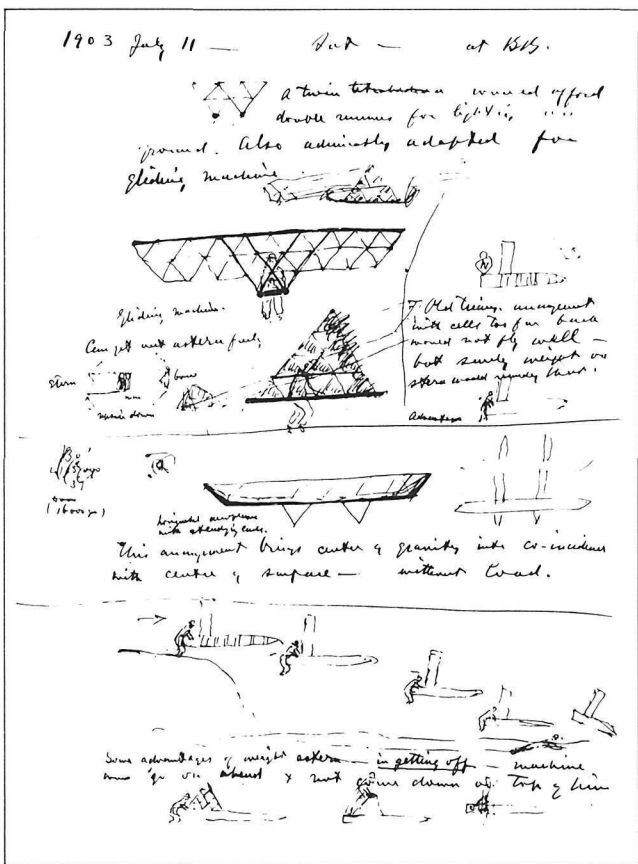
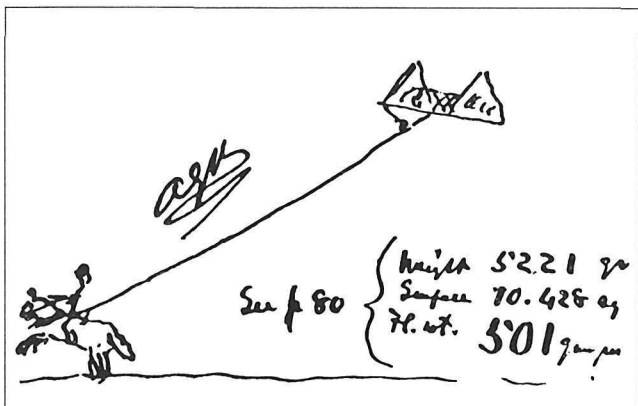
By 1907, Bell's giant man-carrying kite, the "Cygnet", was built and was ready to be fitted with an engine and flown. Carrying Lieut. Thomas E. Selfridge of the U.S. Army, it was taken out on December 6 for a test run before the motor was installed. Towed by a steamer along Baddeck Bay, the "Cygnet" rose 168 feet above the water and made the first recorded flight in Canada of a passenger-carrying kite. The advantages of great strength and lightness which the tetrahedral construction possessed could not ultimately outweigh its great drawback: the multiplicity of cells offered too much wind resistance. Nevertheless, Bell rightly considered his kite experiments as "milestones along the road of progress." The success of his experiments served effectively to prove false many prevailing opinions on flight.

#### *Aerial Experiment Association*

Experiments with the "Cygnet" were destined to result in something far more significant to the development of aviation. A group of imaginative young engineers were gathered by Graham Bell at Baddeck. Arthur McCurdy's son, John A. D., then an engineering undergraduate at the University of Toronto, was a favourite of Dr Bell's and an eager disciple.

In the summer of 1906, he brought a friend back with him to Baddeck. This was F. W. "Casey" Baldwin, grandson of the





Honourable Robert Baldwin, champion all-round athlete and a graduate in mechanical engineering from the same university. Baldwin, too, became absorbed in the Beinn Bhreagh researches on man-carrying kites.

Soon two Americans were added to the group. The first was a young motorcycle manufacturer at Hammondsport, N.Y., Glenn H. Curtiss, who had acquired a considerable reputation as an expert on engines. Bell invited him to Beinn Bhreagh in 1907 for advice on the type of engine needed for the "Cygnet"

Lieut. Thomas E. Selfridge was the next. He was an expert on aeronautics with the U.S. Army, and when word came to him of Dr. Bell's promising experiments, he requested and got approval to investigate as an official observer.

These were happy days for Dr. Bell. He always chose his assistants or associates wisely, and now he had the help and company of four energetic young men, each an expert on phases of his work.

On October 1, 1907, at Mrs. Bell's suggestion and with her financial backing, the five men founded the Aerial Experiment Association to foster aviation in America, to conduct experiments conjointly on aerial locomotion and specifically to construct an aircraft that could fly under its own power, carrying a man. In the words of Selfridge, the object of the Association was simply "to get into the air".

The Association had two headquarters, one at Dr. Bell's home, Beinn Bhreagh, and the other at Hammondsport, N.Y., where Curtiss had his motorcycle factory. At the latter place the Associates began their first joint project, the "Hammondsport Glider", which they successfully flew.

### Red Wing

With the experience in the basic problems of flight thus gained, they then constructed their first motor-driven machine, which they called the "Red Wing".

This was a biplane, equipped with a fixed stabilizer and rudder at the rear, and an elevator mounted at the nose. The flying surfaces were covered with silk and, as in the Wright's craft, the undercarriage consisted of two runners. Its 40-h.p. V-8, air-cooled engine was designed and built by Curtiss.

#### *Baldwin's Flight*

March 12, 1908, was the historic day of its first flight. "Casey" Baldwin flew it 319 feet, 10 feet above the ice at Lake Keuka, near Hammondsport, becoming the first British subject and the seventh person in the world to fly. His was also the first public flight in North America, for although the Wright brothers had already successfully flown in the South, their flights were made in secret.

#### *White Wing*

The "Red Wing" was destroyed in an accident five days later, but in two months the Associates finished "Baldwin's White Wing". Although its general design was similar to their first machine, it incorporated a new feature which was recognized eventually to be one of the most outstanding contributions of the Association to the development of the flying machine: steerable tricycle undercarriage.

#### *Aileron*

The Red Wing's accident clearly revealed the necessity of devising some means of maintaining stability in an aircraft that was tossed by the wind. The Wright brothers tried to keep their flight level by twisting the wing-structure so that one wing would lift and the other lower.

The Association's solution to the problem of balance was to mount flat ailerons at each wing-tip. A pivoted lever, which embraced the shoulders of the pilot, was attached by wires to the ailerons and he could raise or lower each wing-tip by simply leaning to one side or the other.

Without the control afforded by lateral balance, practical manoeuvrability in an aircraft is out of the question. It was the first use of the "wing-tip" aileron in North America.

#### *Tricycle Undercarriage*

The tricycle undercarriage was also an important innovation, for it enabled, for the first time, an aircraft to take off from a field rather than from the ice, and without using a launching device as the Wright's had done.

On May 18, 1908, at Hammondsport, "Casey" Baldwin flew his "White Wing" a distance of 279 feet at an altitude of ten feet. Several days afterwards it too was destroyed in an accident.

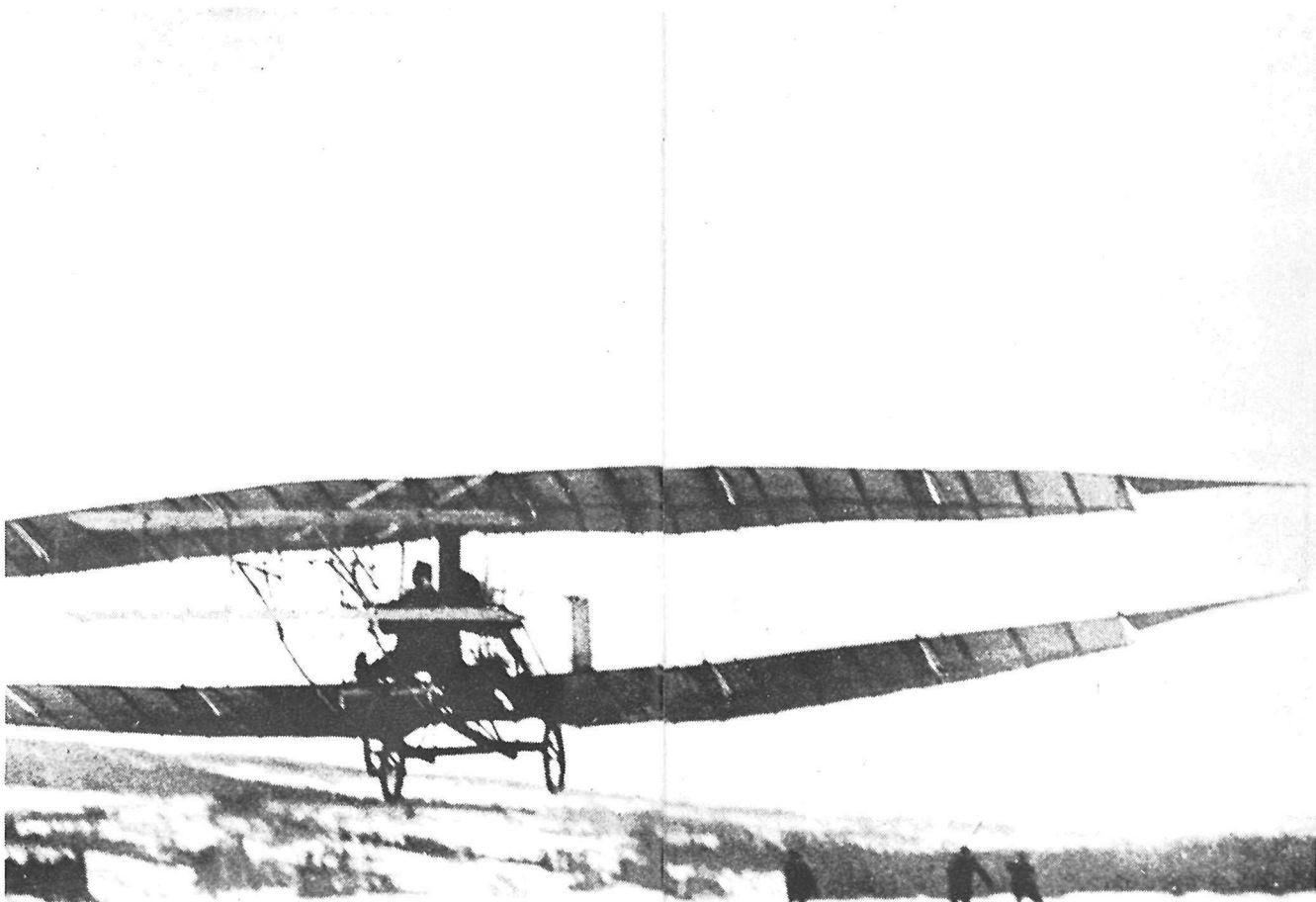
#### *June Bug*

The group's third machine, the "June Bug", was completed on June 19 at Hammondsport. As well as incorporating the ailerons and tricycle undercarriage into its design, the associates added another important innovation. For more lifting power they varnished the silk surfaces of the wings thus making them air-tight.

On July 4, 1908 Glenn Curtiss piloted the "June Bug" to win the Scientific American Trophy for flying the first measured kilometer in a heavier-than-air machine under test conditions, this flight being officially observed by representatives of the Aero Club of America. Twin floats were later substituted for wheels on the "June Bug" in an attempt to fly it from the water and its name was changed to the "Loon". This marked one of the first uses of pontoons on an aircraft.

#### *Silver Dart*

Shortly after Curtiss's historic flight, work was started on a fourth machine, McCurdy's "Silver Dart". The heaviest craft built by the Aerial Experiment Association to date, it incorporated a number of minor alterations in design to improve its flight.



A large kite in flight.  
Possibly the oldest ailerons in existence. These  
aileron are from "Baddeck II", an aircraft built  
at Baddeck in 1909.  
Early Propellers.

Its silk wing under-surfaces were coated with rubber to seal out the air. For the "Silver Dart" Curtiss designed a more powerful V-8 water-cooled engine.

#### *First Flight in Canada*

The "Silver Dart" was taken to Baddeck early in 1909 and on February 23 Dr. Bell was able to telegraph to The London Times that the first flight by a British subject in Canada and the British Empire had taken place in it on that day. J. A. D. McCurdy had flown a distance of half a mile, about 30 feet over Baddeck Bay. A few days later, McCurdy flew his "Silver Dart" eight miles in about 11 minutes.

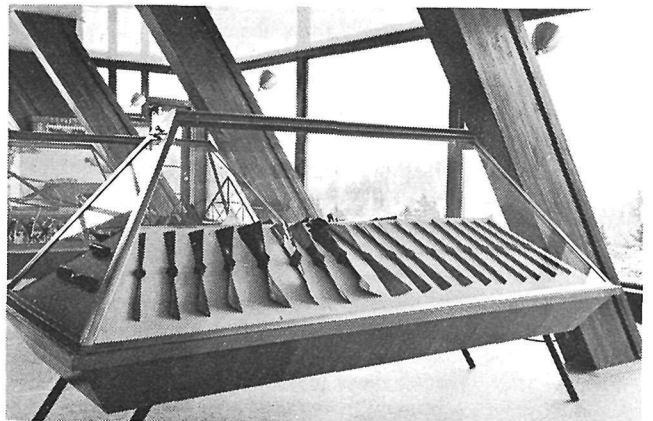
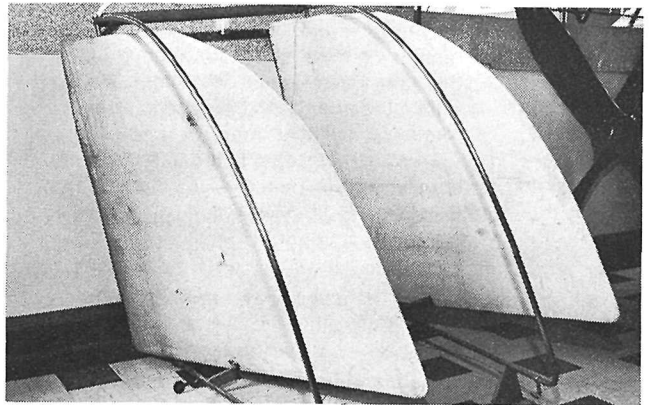
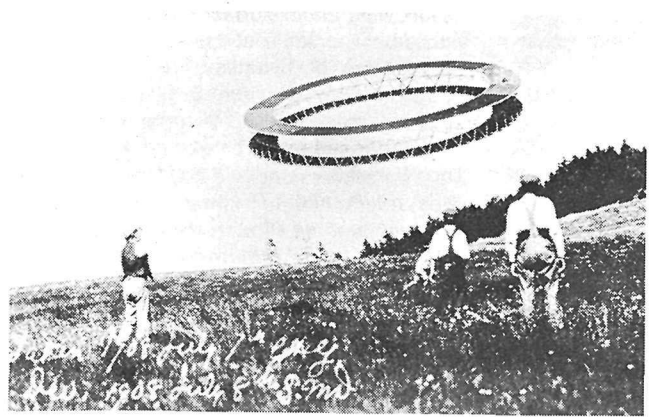
The last of the Aerial Experiment Association's machines was the huge "Cygnet II" of tetrahedral construction, which Dr. Bell himself designed. Several engines were tried out on the "Cygnet II", but it was never successfully flown.

By the terms of its agreement, the Aerial Experiment Association was dissolved on March 31, 1909, a year and a half after its formation. During that brief time it had succeeded in making aviation history and, certainly, it had fulfilled its objective of "getting into the air".

#### *The Canadian Aerodrome Company*

Immediately following the dissolution of the Aerial Experiment Association, the first aircraft manufacturing company in Canada was formed at Baddeck, comprising the same membership, and backed financially by Dr. and Mrs. Bell. This was the Canadian Aerodrome Company.

Five aircraft, or "aerodromes" as Bell called them, were designed and built by the company, two of which, the "Baddeck I" and "Baddeck II", were very successful. One biplane aileron from "Baddeck II" is displayed in the museum; it is probably the earliest aileron left in the world. The machine was tested by the Canadian Army at Petawawa in the summer of 1909. Unfortunately, the landing was not as



level as the Baddeck ice. The wheels could not stand the sudden jar of the rough terrain, and the "Baddeck" folded up when it landed. The pilot, J. A. D. McCurdy, suffered the only injury he received in a long flying career—a broken nose.

Army officers decided that the aeroplanes were impractical for military purposes and they refused the support that the members of the Canadian Aerodrome Company had hoped for. Not long after, the Canadian Aerodrome Company closed its doors for good.

This event virtually marked the end of aviation experiments at Beinn Bhreagh and the group reluctantly broke up. Selfridge had been killed several years before in an accident with one of the Wrights' machines, achieving the tragic distinction of being the first victim of powered flight. McCurdy and Curtiss joined forces to go "barnstorming" around North America, and each carved for himself a niche in Aviation's Hall of Fame.

McCurdy was the best flyer of the group and collected a sizable number of "firsts" in that field. Among other accomplishments, he was the first to make a "figure eight" in the air, the first to send and receive a wireless message in an aircraft and one of the first to advocate aerial bombing.

### **Bell—The Marine Researcher**

Alexander Graham Bell also concerned himself with inventions that would benefit marine navigation. His most important work in this field was the development of the hydrofoil boat, but he also outlined the theory of modern sonar and ocean sounding equipment.

### *Echo Sounding*

As early as 1885, Bell suggested a method of detecting icebergs by projecting sound electrically and receiving the returning echo. This same method could be used for measuring the depths of the ocean.

### *Distillation of Salt Water*

Ever the humanitarian, Bell was horrified by accounts of sailors dying of thirst. He devoted much thought to providing some device that would prevent such suffering and investigated methods of obtaining fresh water from sea water and condensing water vapor from the air, breath and fog.

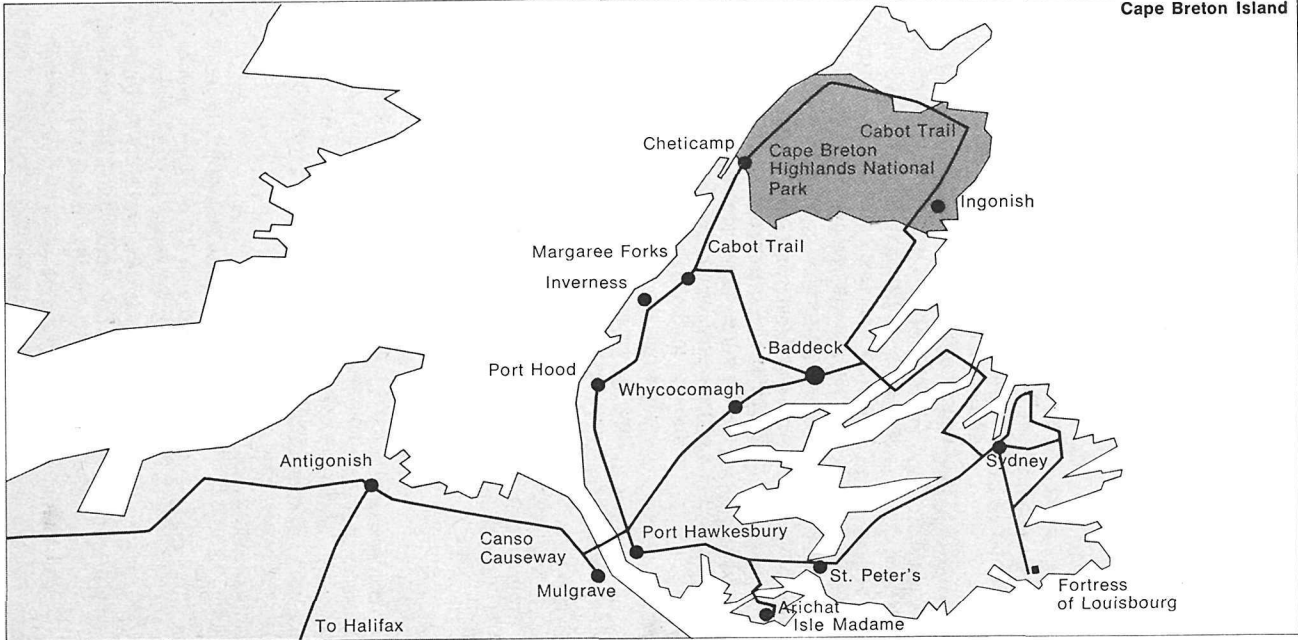
### *The Hydrofoil Boat*

Dr. Bell's early experiments in aerial locomotion led him to consider applying some of the principles of powered flight to a water craft. In this he was assisted by "Casey" Baldwin, who remained with Dr. Bell at Beinn Bhreagh. The objective was to build a boat that could transport heavy loads at speeds comparable to those attained by aircraft.

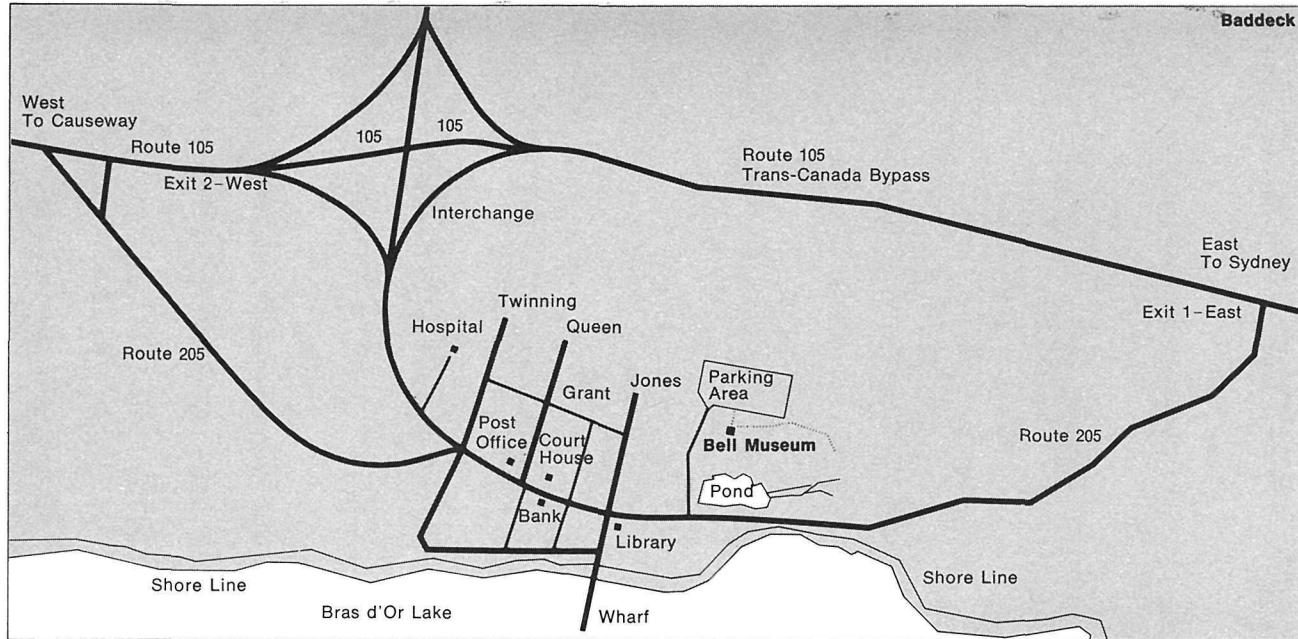
Bell and Baldwin's line of research was based on using air propellers to achieve driving force. To overcome the resistance of the water, which was much more dense than air, they attached a set of wing-like surfaces on the sides of the boat below the hull. These surfaces, known as hydrofoils, were arranged in vertical tiers tapering to the bottom. When the boat attained speed, it would rise on its hydrofoils like an aircraft until it rested only on the smallest tier of foils at the bottom, leaving the entire hull above water. In this way Bell attempted to free the craft from the drag of the water and permit the propellers to exert their maximum propulsive force. Working with models and with small hydrofoil boats which they towed, Dr. Bell and Baldwin developed successfully the hydrofoil boat.

### *"HD-4"*

By 1917, they had built their fourth full-sized "hydrodrome", the "HD-4", which reached a record speed of 70.86 miles an hour on Baddeck Bay in 1919 with Baldwin at the helm. For many years, Bell and Baldwin's "HD-4" was the fastest boat in the world. After Bell's death in 1922, Baldwin carried on the research with hydrofoil craft.



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