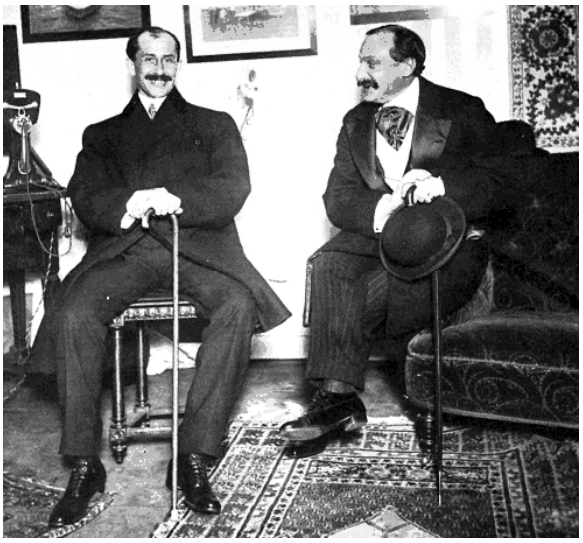
Rothwell, J., *The Wright Brothers and Cold Fusion.* Infinite Energy, 1999. **2**(9): p. 37.

The Wright Brothers and Cold Fusion

Jed Rothwell

Hart O. Berg was an engineer and high tech military industrial wheeler-dealer. He was an agent for the Charles Flint Company, an investment firm that organized trusts and once sold an entire naval fleet to Brazil. Berg managed the European operations, selling American submarines, machine guns, and electric automobiles. In 1908 he sold the airplane to the world. If he had not done that, Wilbur Wright would have died in obscurity in 1912, carrying many of his secrets to the grave. T.O.M. Sopwith and a half-million other people would not have latched onto aviation and developed it intensively before World War I. The airplane would not have been ready. The allies would have lost without the Sopwith Pup and Camel. Or if they had pulled through, they would have lost the Battle of Britain twenty years later without Sopwith's Hurricane fighters. Berg, the Wrights, and Sopwith together twice saved Western civilization by narrow margins. The high tech entrepreneur Berg changed history by showing the Wrights how to make money.



Orville Wright with Hart O. Berg, the Wright's agent in Europe

People often ask: if cold fusion is real, why is it ignored and attacked? I say we have been down this road before. People had to fight to win acceptance for antiseptics, amorphous semiconductors, and even the transcontinental railroad. There are many lessons for cold fusion in the Wright story. Here are a few of them:

History is not inevitable. If the Wrights had not built the airplane, man would not have flown for another ten or twenty years, most experts agree. History is a product of free will. People make decisions, take actions, and shape events. Things do not get invented just because they are needed. We learn to live with awkward machines like the automobile transmission. If Bell Labs had not come up with the transistor, by now we would have computers with a million "vacuum tubes on a chip." (Such chips were fabricated for a special application years ago. [1] Technology is flexible; transistors are not the only things you can miniaturize.)

New technology is unpredictable; the only way to get a handle on it is to use it. When something new bursts upon the scene, you cannot predict where it will go or who will be the leading players. The Wrights, Tom Sopwith, Bill Gates, or Michael Dell beat the big guys because they know the technology. The only way to master technology is to get a machine and play with it. In the 1980s IBM lost out because its managers did not use computers. As Paul Carroll of the *Wall Street Journal* put it: "IBM had become like a music-publishing company run by deaf people." [2]

To introduce a new technology you must fight two groups of people: the scientists who oppose it and the scientists who invent it. The Wrights were their own worst enemies from 1906 to 1908. After battling with the establishment for five years, they began acting like paranoid flakes. Some cold fusion scientists are worse.

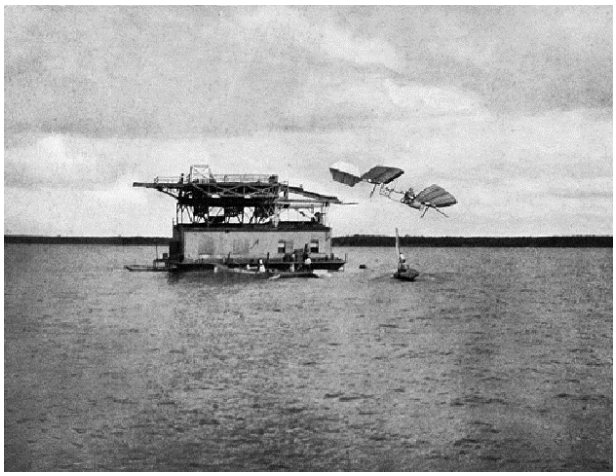
It is never easy to sell revolutionary technology. Invent a better mousetrap and the world will beat a path to your door, burn your house down, and run you out of town.

The Wright's History

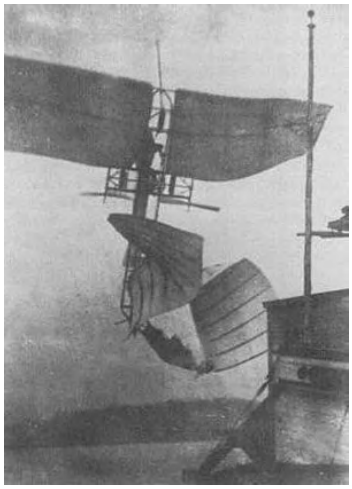
Although it is well documented, the Wrights' history is not well known. Myths, misperceptions, jealousy, and revisionist history have obscured the facts. [3] Their achievement deeply embarrassed the establishment. *Scientific American* has been trying to rewrite its buffoonish role in the affair for years, most recently in a 1993 article! [4] The Smithsonian Institution denigrated the Wrights for years in a feud over Langley's priority.

In 1900 a small band of scientists worked at the fringes of respectability, trying to learn to fly. Some were distinguished men like Alexander Graham Bell, Langley, Maxim, and Chanute. They were old, discouraged, and lonely. Little progress had been made since the death of Otto Lilienthal. Young scientists would not touch the field. That is true of cold fusion today: our champions are the old mavericks like Bockris and Fleischmann. In 1900 there was only one serious, properly funded aviation R&D program in the world. It was at the Smithsonian, where the director, Langley, was trying to scale up his steam driven small models that had flown successfully in 1895. To the vast majority of other scientists, and in all popular journals and newspapers, the issue was settled. A heavier-than-air flying machine was physically impossible. It was an absurdity, a gross violation of the laws of nature. This had been proved mathematically with "unassailable logic" by leading experts in physics, writing in distinguished journals and magazines. [5]

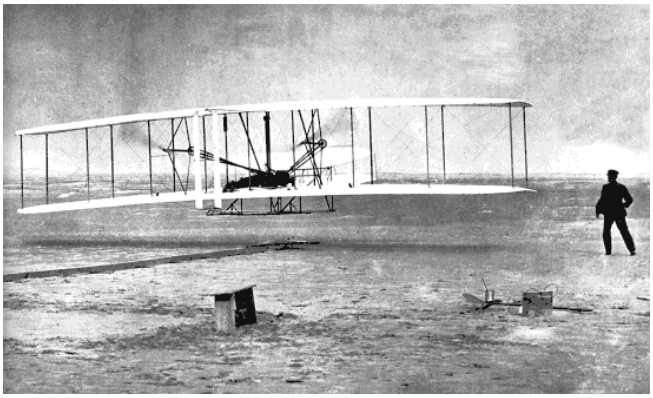
We admire Chanute and Langley, but the fact is they were stuck, just as most cold fusion scientists are stuck today. The field was "moribund," as one expert put it. [6] Langley's experiments ended in a fiasco in December 1903. He was lambasted by the press and by Congress for wasting $50,000 of the taxpayer's money. There was, at that moment, nothing left of aviation—not a single research project and seemingly no hope of success—until the Wrights flew two weeks later at Kitty Hawk, in one of history's great ironies.



October 7, 1903, Langley's Aerodrome plunges into the Potomac River



December 8, 1903, the Aerodrome collapses, plunges into the Potomac again



December 17, 1903, 10:30 a.m., Kitty Hawk, North Carolina

Going back to 1898, what aviation needed was new blood and a spark of genius. It got that in Wilbur and Orville Wright. Let me puncture myth number one here. The popular image is that they were small town bicycle mechanics who by trial and error stumbled on a workable design. Nothing could be further from the truth. They were scientific geniuses. They invented the airplane by observation, experiment, database compilation, and analysis. They performed highly complex mathematical modeling of everything from the wings, the fuselage, and propeller to the wind resistance of the pilot's head. Their wind tunnel data was so accurate it was not improved upon until the 1920s. Before they cut wood to build the first propeller, they modeled it, optimized it, and predicted its performance. They got it right to within one percent. [7,8] Their science, engineering, craftsmanship, and experimental technique were beautiful. Their work has the distilled elegance you see in Faraday's experiments and Niklaus Wirth's program code. They were wonderful scientists and lousy businessmen.

They first flew in 1903. In 1904 and 1905 they flew on Huffman Prairie, next to the trolley car line in Dayton, Ohio, where many people saw them. When the Wrights were later accused of secrecy, they produced a list of more than 60 people who had witnessed flights. They had signed affidavits from leading citizens of Dayton, the city auditor, a bank president and so on. Their longest flight was twenty-four miles.

The Wrights stopped flying from 1906 to mid-1908. They devoted much of this time to pursuing business deals in the U.S. and Europe. They also built improved airplanes and engines. In late 1906 the Charles Flint Company contacted them and agreed to act as their agents.

The Wrights spent three years trying to peddle their machine to national governments, getting nowhere. They asked for no down payment, but they demanded a written guarantee that the customer would pay after a successful demonstration. That may seem reasonable, but not to a customer who thinks your machine is impossible and you're crazy. When French and British government agents visited the Wrights in Dayton, they were shown photographs and affidavits, but no flights, because the Wrights would not fly without a contract. The agents reported back to headquarters that the claims must be true. It was not enough. The Wrights should have followed up by sending photographs and documentation. They should have understood that these negotiations required approval at the highest levels, and you cannot ask the French Minister of War to come to Dayton. As Crouch says: "a personal visit to Washington with a handful of the astonishing photos of the long flights of 1904-05, accompanied by affidavits from the Huffman Prairie witnesses, would surely have convinced the [Army] board." [9] The cold fusion scientists make the very same mistakes! They should circulate more data, more photos, and they should perform more demonstrations. They should stop trying to sell their machines to governments and big corporations who do not want them, and find live customers who do.

The French capitalists who were backing a syndicate pushed the Wrights to make a demonstration flight. The Wrights intended to do one eventually, but they procrastinated. If the capitalists had not pushed them, history would have passed the Wrights by and the aviation boom would have been delayed two or three more years. Fortunately, things got moving. In Washington, President Theodore Roosevelt personally intervened to break the logjam. At last, in December 1907 the Army Signal Corps agreed that if the Wrights could do a demonstration flight, carrying a passenger at 40 mph over a distance of ten miles, they would be paid $25,000. The press lambasted the War Department for encouraging crackpots. Newspapers said that if an airplane capable of doing this existed, everyone would already know about it and it would be worth millions, so why would the inventors settle for a mere $25,000? As the *New York Globe* put it: [10]

> One might be inclined to assume from the following announcement, "the United States Army is asking bids for a military airship," that the era of practical human flight had arrived. . .A very brief examination of the conditions imposed and the reward offered for successful bidders suffices, however, to prove this assumption a delusion.
>
> A machine such as is described in the Signal Corps' specifications would record the solution of all the difficulties in the way of the heavier-than-air airship, and, in fact, finally give mankind almost as complete control of the air as it now has of the land and the water. It would be worth to the world almost any number of millions of dollars, would certainly revolutionize warfare and possibly the transportation of passengers . . .
>
> Nothing in any way approaching such a machine has ever been constructed (the Wright brother's claims still await public confirmation) . . . If there is any possibility that such an airship is within measurable distance of perfection any government could well afford to provide its inventor with unlimited resources and promise him a prize, in case of success, running into the millions.

In other words, we shouldn't have a demonstration because we already know it doesn't work because there hasn't been a demonstration. A Catch 22! We hear the same kind of stuff from the cold fusion opposition today.

The story has a happy ending. On August 8, 1908, Wilbur made a flight in front a few hundred people in France. Within days he was a hero on the front page of every European newspaper. He was given gold medals, thousands of dollars in prizes, and contracts in every European capital. Thousands of people flocked to see the flights. He wrote that "princes & millionaires are as thick as fleas." Meanwhile, not a word of the European frenzy reached the American newspapers. So, on September 3, when Orville

prepared for his first test flight at Fort Meyer, only a few hundred people turned out to see him. President Roosevelt's son was there. Orville took off, circled the field one-and-a-half times, and landed after a minute and eleven seconds. Years later Roosevelt described the scene:

> [The crowd] went crazy. When the plane first rose, the crowd's gasp of astonishment was not alone at the wonder of it, but because it was so unexpected. I'll never forget the impression that sound from the crowd made on me. It was a sound of complete surprise.

The lesson is obvious. People believe what they see with their own eyes. The only way to convince people that revolutionary new technology is real is to demonstrate it in public. Let the whole world see it. Put it into the hands of as many customers as you can, as quickly as possible. Cold fusion scientists today are asking only fellow scientists to look at their data. It is as if the Wrights showed wind tunnel data instead of airplanes, and talked to a few other scientists while ignoring the public.

Secrecy

Another myth is that the Wrights were deeply secretive about their work. This was the establishment's excuse for the five years of official neglect after Kitty Hawk. Here is a wonderful section from the authorized biography: [11]

> Dan Kumler . . . city editor *Daily News*, in Dayton, recalled in 1940 . . . that many people who had been on interurban cars passing the Huffman field and seen the Wrights in the air used to come to the Daily News office to inquire why there was nothing in the paper about the flights.
>
> "Such callers," said Kumler, "got to be a nuisance."
>
> "And why wasn't there anything in the paper?" Kumler was asked.
>
> "We just didn't believe it," he said. "Of course you remember that the Wrights at that time were terribly secretive."
>
> "You mean they were secretive about the fact that they were flying over an open field?"
>
> "I guess," said Kumler, grinning, after a moment's reflection, "the truth is that we were just plain dumb."

Today, people say cold fusion researchers are secretive. I say, "You mean we are secretive about the fact that MITI is sponsoring an international conference next month?" However, it is true that the Wrights and the cold fusion scientists became secretive over time. A few years ago Pons and Fleischmann were showing videos of boiling cells and publishing papers in major journals. Now we hear nothing from them. Even after they got a patent, the Wrights did squirrely things like publishing blurred photographs, to hide details. They made up strange justifications for their strategy, such as the idea that the airplane is more valuable as a secret weapon: the British will pay more if the Germans have not seen it. "The less other governments know, the more it is worth to the purchaser. At present we are able to give positive assurance to any government that other governments have not seen the machine." [12] They gave two main reasons for their secrecy; reasons I have heard many times from cold fusion scientists:

1. Some design improvements were not covered in the 1906 patent. Why didn't they simply file another patent?

2. The competition was far behind, and making little progress in spite of the patent. The Wrights thought this gave them a precious lead they should "conserve." In 1907 they wrote to Charles Flint: "We can furnish governments with practical machines . . . now: no one else can. There is no certainty that anyone else is within three years of us . . . The progress made by others since the announcement of our final success at the end of 1905 is as rapid as could reasonably be expected, but it by no means indicates that others will reach the goal in less time than we required." [13]

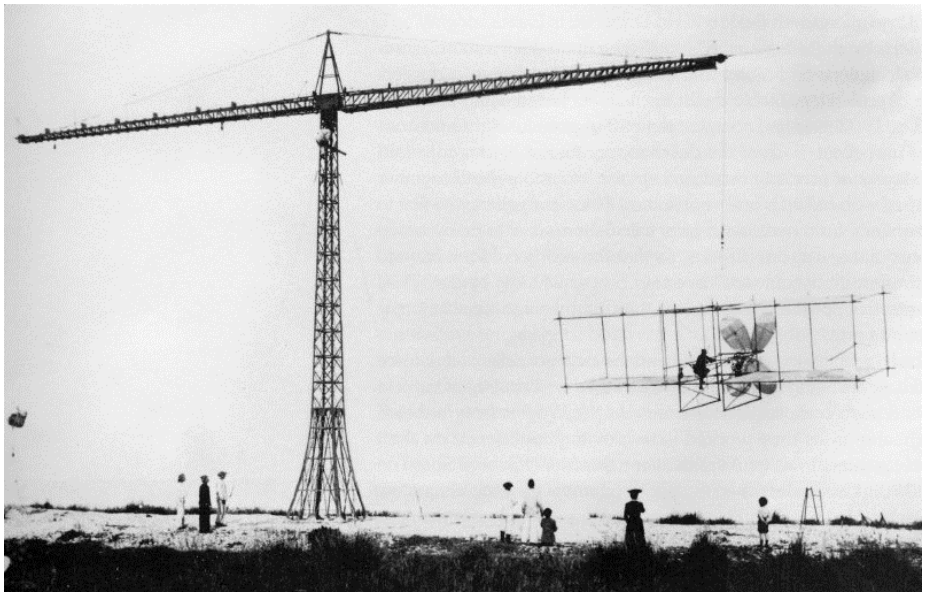
Their strategy was predicated on the preposterous idea that you can keep a patented airplane secret. It never seems to have occurred to them that once intense public interest ignites, the quality of replications must improve dramatically. Furthermore, they did not grasp that it is much easier to replicate than it is to invent something in the first place. They should have seen that only third-rate people were trying replicate them during this period, but that in a boom thousands of talented people would soon get to work and progress would be immeasurably swifter. I am distressed to read that Charles Flint agreed with their tactics of keeping the invention under wraps. Many of the entrepreneurs backing cold fusion make this same mistake. They have the same mindset as the scientists.

Many cold fusion scientists want praise and recognition, but they do not want people to steal their ideas, so they play peek-a-boo with their results. Like the Wrights, they are concerned about losing their lead, and like the Wrights I am sure they will lose it a few months after they go public. Nothing becomes obsolete faster than the early models of a new technology. Think of the microcomputers of the 1970s: the TRS-80, SOL, North Star, and Cromemco. It is absurd to worry about being overtaken. You will be competing with every industrial corporation on earth; of course you will be overtaken! If you have no patent then you have no protection, so you might as well give the technology away. And if do have a patent, the competition will find out everything there is to know the moment they take you seriously. Either way, there is no point in keeping it secret.

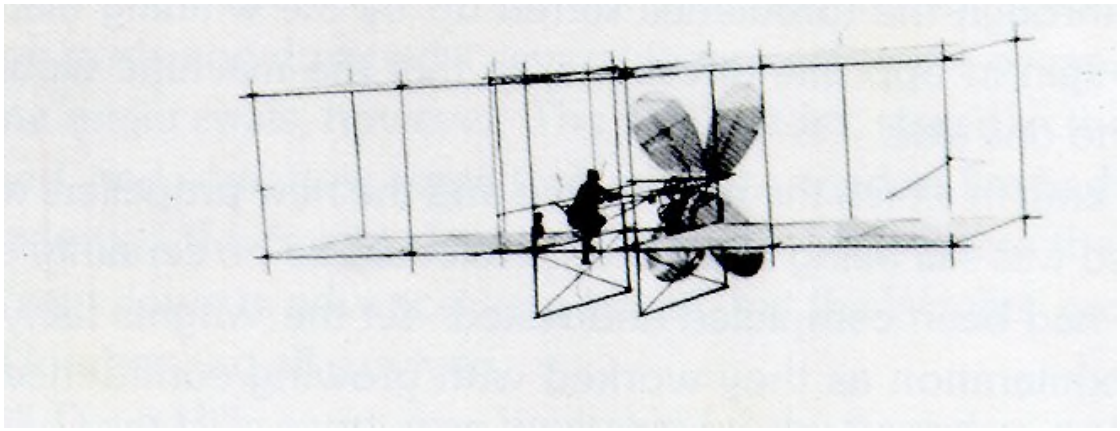
Incremental improvements to established technology must be kept secret. Revolutionary devices that are still at the impractical stage must be made public, or they will never attract the critical mass of people necessary to make them into practical, commercial products. The Wrights' secrecy and their precious three-year lead turned out to be millstones around their necks. They finally began earning money and recognition after they went public.

No Replications and Little Progress Until 1908

News of the Wrights work caused a rebirth of interest in aviation, particularly in France. Yet nobody else flew until 1906, when Santos-Dumont staggered off the ground in barely controlled hops. The French tried some of the innovations the Wrights described in their papers and patents, which circulated widely. But nobody tried all of the innovations in a single careful copy of the patent. For seven years, nobody really tried to replicate. Popular revisionist history books still blame the Wrights because the French did not do their homework. [14]



How Not To Replicate. French army captain Ferdinand Ferber tests his powered Wright-type glider, suspended from a huge whirling arm, near Nice in June 1903



Close-up of the Ferber non-flying airplane. Note flat wings and absurd propeller design

The photo above shows a famous example of how not to replicate, paid for by the French army in 1902. It built this whirling tower in Nice, France and suspended a biplane built by Captain Ferdinand Ferber. He said it was designed "along the same lines as" the Wright machines. Please note the wings are flat, not chambered. Ferber figured he did not need any fancy wing chambering or warping controls (flaps). He missed the whole point of their work!

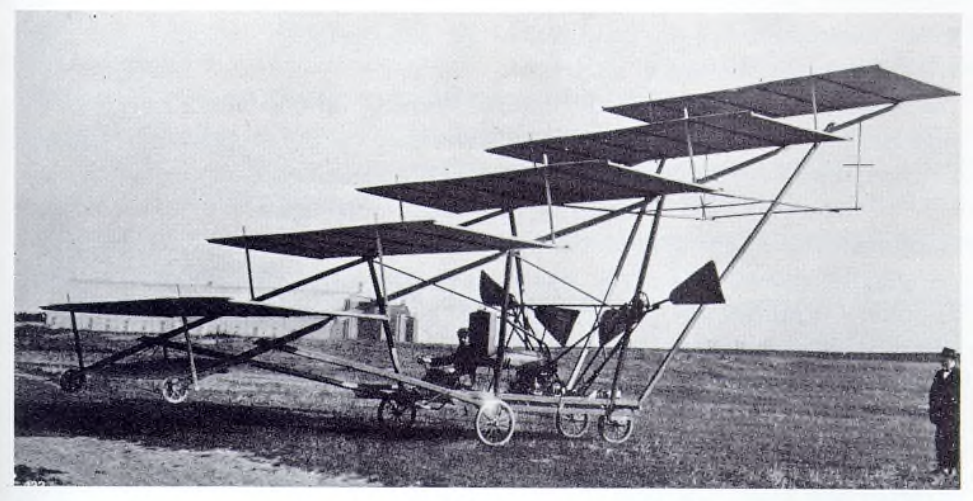
You might think that scientists are more sophisticated today and they would never perform such inept "replications." Well, think again. A scientist at a national laboratory once told me that he had done a close replication of the Mills experiment, except Mills used water and he decided to use acid instead. A few weeks ago Barry Merriman at the University of California announced that he had done a replication of the Patterson cell, and he saw no heat. [15] Well:

- Merriman used glass beads. Patterson used plastic. Merriman called that a “minor” difference but for all he knows it could be critical.
- Merriman has no idea whether his beads absorb hydrogen rapidly, as shown in the patents. He has not even measured that parameter; like Ferber, he ignored the most critical point in the published work.
- The man who fabricated the beads never saw the patents.

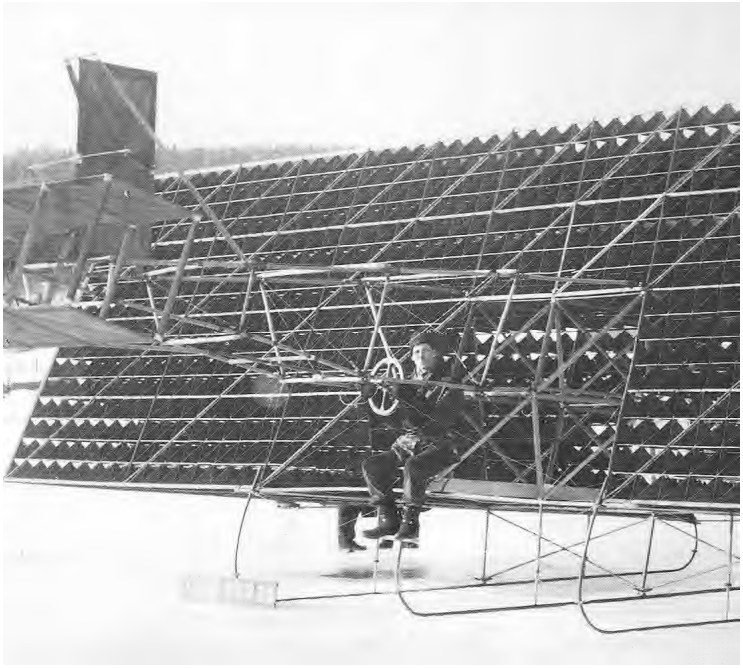
Many Frenchmen tried to replicate the Wrights, apparently without bothering to read their scientific papers or patent. They thought they knew better than the Wrights. When their machines failed, they blamed the Wrights, saying the design was fraudulent. Today, many scientists who made equally ridiculous mistakes pontificate in the newspapers about how they proved cold fusion is wrong. They do what I call “South Pacific cargo-cult science,” where you tie a pinecone to a stick, pretend it is a microphone, and you call down results from the sky. Going through the motions is not enough.

These non-replications share another quality with bad cold fusion experiments: more money and attention was lavished on the experimental apparatus than the actual device. Langley spent thousands on the elaborate launch platform built on top of the houseboat. The Wrights did a better job with a monorail costing a few dollars. The French Army must have spent a fortune on the whirling tower. Ferber’s airplane looks like an afterthought in comparison. Langley built a similar whirling tower in Pennsylvania that cost many thousands. The Wrights did a far better job with a wind tunnel that cost less than $50. In cold fusion we have seen many splendid calorimeters and ultra high tech neutron detectors hooked to sloppy, ill-prepared electrochemical cells.

Even after Farman, Voisin, Delagrange, and others finally did manage to replicate the Wrights in 1908, they used empirical trial-and-error methods, instead of basing their work on wind tunnel data and engineering analysis. The results were predictable. “It must have been an embarrassing situation, for despite having three and four and even five times as much engine power as was available to the Wrights, the thrust from their propellers gave them less flying power than the first Wright Flyer.” [16]



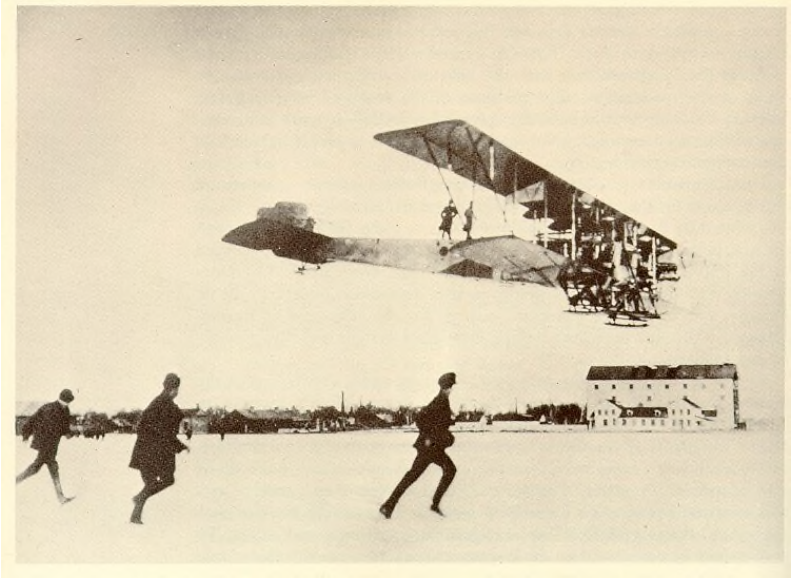
How Not To Replicate II. Two steps beyond the triplane, the five-decker Mertz multiplane was never able to achive sustained flight in its trials at Johannisthal (1910) [17]



How Not To Replicate III. Alexander Graham Bell's Cygnet II, February 1909. [18]

The Aviation Boom

After the Wrights became international media stars, French airmen copied them carefully. Still, many screwball ideas were developed after 1908. Alexander Graham Bell was no fool, but his Cygnet II never left the ground in 1909. In 1910 a Professor Mertz decided that if two wings were good, five wings must be better. But, for every Bell or Mertz there were soon dozens of talented people who got it right. By 1911, *Scientific American* said that a half-million men were working on aviation. Progress over the six years before the First World War was unprecedented. It was free-for-all competition. If you want rapid progress, you must make room for screwballs like Mertz along with geniuses like Sopwith. The boom culminated in 1914 when Igor Sikorsky set a record carrying six passengers for 6 hours 33 minutes in the Ilia Mourometz, a multimotored enclosed airplane that could carry sixteen passengers in comfort. [19]



Igor Sikorsky's Ilia Mourometz carried 16 passengers in 1914. It is shown here coming in for a landing with two men standing on the upper platform. (I. I. Sikorsky)

If the Wrights had not demonstrated the airplane to the world, progress would have limped along the way it did from 1901 to 1908, with just a handful of people. It takes thousands of people to develop revolutionary technology. Each individual works on his own ideas, in chaotic competition. An organized, centrally directed project like MITI's will not cut the mustard. The 1908 demonstrations galvanized the world. Without it, aviation would not have advanced enough to play a significant role in the war. The allies, who depended on a thin edge of technological superiority, might have lost.

Thomas Octave Murdock (T.O.M.) Sopwith (1888 – 1989). Signed photo dated 1913. This handsome young man, "well off financially, had drifted into aviation from yachting." Designed WWI Sopwith Camel, WWII Hurricane fighters [20]

Dealing With Geniuses

When Hart Berg met Wilbur, he wrote a wonderful letter to his headquarters describing what it is like working with a stubborn genius. Those who get involved with cold fusion must learn to deal with such people. Here is part of the letter: [21]

> At 12:30 yesterday I met Mr. Wilbur Wright at Euston Station. I have never seen a picture of him, or had him described to me in any way, still he was the first man I spoke to, and either I am Sherlock Holmes, or Wright has that peculiar glint of genius in his eye which left no doubt in my mind as to who he was . . .
>
> The company idea did seem to please him very much, as he first wanted to know himself exactly what the attitudes of the several governments were. After a long talk . . . I believe, please note that I say distinctly "I believe," that I made something of an impression as regards the impossibility of getting any sort of action in the near future from any government. He agreed he did not think the British Government would do any business. He also stated that perhaps it would be very hard to do anything with the French Government . . .
>
> About 5 o'clock in the afternoon, I think, you will distinctly note that I said "I think," I brought about some sort of action in his mind, and think he was on the point, you will note that I say that "I think he was on the point," of veering around from the government to company methods . . .

Appendix A - How To Do Research Right

Much has been written about how to do science and research and development correctly, and how to develop products on time and on budget. Few people in history have understood the essence of this problem better than the Wrights, and few people have expressed it better than Wilbur did, fifteen days before his untimely death, in a text he was preparing for the Aero Club of America:

> When the general excellence of the work of Lilienthal is considered, the question arises as to whether or not he would have solved the problem of human flight if his untimely death in 1896 had not interrupted his efforts . . . One of the greatest difficulties of the problem has been little understood by the world at large. This was the fact that those who aspired to solve the problem were constantly pursued by expense, danger, and time. In order to succeed it was not only necessary to make progress, but it was necessary to make progress at a sufficient rate to reach the goal before money gave out, or before accident intervened, or before the portion of life allowable for such work was past. The problem was so vast and many-sided that no one could hope to win unless he possessed unusual ability to grasp the essential points, and to ignore the nonessentials . . .When the detailed story is written of the means by which success in human flight was finally attained, it will be seen that this success was not won by spending more time than others had spent, nor by taking greater risks than others had taken.
>
> Those who failed for lack of time had already used more time than was necessary; those who failed for lack of money had already spent more money than was necessary; and those who were cut off by accident had previously enjoyed as many lucky escapes as reasonably could be expected.
>
> Lilienthal progressed, but not very rapidly. His tables of pressures and resistances of arched aeroplane surfaces were the results of years of experiment and were the best in existence, yet they were not sufficiently accurate to enable anyone to construct a machine with full assurance that it would give exactly the expected results. Under such conditions progress could not but be slow. His methods of controlling balance both laterally and longitudinally were exceedingly crude and quite insufficient. Although he experimented for six successive years 1891 - 1896 with gliding machines, he was using at the end the same inadequate method of control with which he started. His rate of progress during these years makes it doubtful whether he would have achieved full success in the near future if his life had been spared . . .

The part about: “Those who failed for lack of time . . .” should be framed and mounted above the workbench of every cold fusion researcher. I am reminded of what Raphael Soyer used to say (and what his teacher told him): “You have time, but not an OCEAN of time.”

Appendix B – Engineering, Not Physics

The Wrights did applied science or engineering, not basic physics. From their wind tunnel work, they compiled data tables titled “Gliding pressure,” “Tangentials, gliding angles, drag: lift ratios” and so on. They used this data to determine the proper shape and chamber of the wings, the separation of the wings, fuselage shape, the design of the propellers and a host of other essential design parameters. They modeled the performance of their machines before building them. Then, based on actual performance of the full-scale machines, revised and refined the models. They could not have done it any other way. It would have taken too much time and money, and flight testing would have been too dangerous. As it was, both brothers were suffered dozens of crashes, some nearly fatal. Regarding the development of theory, Crouch writes (T. Crouch, *The Bishop’s Boys*, Norton, 1989, page 175):

> Engineering was the key. The Wright brothers functioned as engineers, not scientists. Science, the drive to understand the ultimate principles at work in the universe, had little to do with the invention of the airplane. A scientist would have asked the most basic questions. How does the wing of a bird generate lift? What are the physical laws that explain the phenomena of flight?

The answers to those questions were not available to Wilbur and Orville Wright, or to anyone else at the turn of the century. Airplanes would be flying for a full quarter century before physicists and mathematicians could explain why wings worked.

How was it possible to build a flying machine without first understanding the principles involved? In the late twentieth century, we regard the flow of technological marvels from basic scientific research as the natural order of things. But this relationship between what one scholar, Edwin Layton, has described as the "mirror image twins" of science and technology is a relatively new phenomenon. Historically, technological advance has more often preceded and even inspired scientific understanding.

Appendix C - Early Aviation Time Line

1890s Progress in aviation "moribund" [Crouch] as Lilienthal and Pilcher are killed gliding, and experiments by Chanute, Maxim and others peter out. Only Langley continues.
1895 The Wrights become seriously interested in aviation.
1899 First kite experiments with wing warping.
1900 Tests at Kitty Hawk.
1901 Invent wind tunnel, compile world's first reliable data on airfoils. First published paper in the Proc. Western Society of Engineers.
1902 Tests at Kitty Hawk.
1903 Second paper in Proc. Western Society of Engineers.
Ferber tests a "Wright-type" glider suspended from a huge whirling arm in Nice, France
October and December: Langley attempts two flights, which end in disaster.
December 17: First powered flight at Kitty Hawk.
1904 Test flights at Simms Station trolley car stop, Dayton Ohio. First turns exhibit complete control. Flights are widely observed. Leading citizens of Dayton sign affidavits. Press ignores or attacks Wrights.
British and French government agents contact Wrights, first attempts to sell airplane to governments.
1905 Continued testing. Airplane now "a machine of practical utility" [O. Wright].
Longest test flight 24 miles in 39 minutes.
Continued attempts to sell airplane to governments.
1906 Wright's patent granted.
In France, Santos-Dumont makes first flight by anyone other than Wrights; nearly uncontrolled 50 meter hop.
Europeans become excited about aviation.
Continued fruitless attempts to sell airplane to governments.
Scientific American again attacks Wrights.
Wrights publish a list of 17 leading citizens of Dayton who have observed flights. (They have a list of 60 witnesses.)
Scientific American finally contacts witnesses, and in November sends an editor to meet with Wrights.
November: first contact from Charles Flint Company.
Charles Flint Company acts as the Wrights agents.
December, *Scientific American* finally retracts and endorses flights. Most other journals continue to ignore or attack them.
1907 Continued fruitless attempts to sell airplanes to governments.
President Roosevelt sees clipping from Scientific American, personally orders that the logjam should be broken and the Wrights invited to demonstrate airplane in Washington, but arrangements fall through because the War Department does not have $100,000 budget for purchase of an airplane.
In France, Farman makes first shallow, nearly uncontrolled turn.
December: After Roosevelt guarantees funds will be found, contract with War Department for payment of $25,000 contingent upon a successful demonstration flight. Press attacks War Department for signing contract.
1908 Continued fruitless attempts to sell airplanes to European governments.
Curtiss makes first serious attempt to replicate Wrights, resulting in first flight of over one kilometer by anyone other than Wrights; flight is barely controlled, skirts disaster.
June: Wrights fly for the first time in two and a half years with improved airplane, carry passenger for the first time.
August, Wrights publicly demonstrate flights in France and the U.S. All skeptical doubts and opposition instantly ends.
First fatal airplane accident. Wilbur crashes, passenger Lt. Selfridge killed.

Wrights become international heroes; first media stars of the 20th century. Business deals offered by leading U.S. and European capitalists.
Thousands of people begin replicating Wrights.
1909 Europeans take the lead in aviation.
1911 Special issue of *Scientific American* devoted to aviation reports that "more than half a million men are now actively engaged in some industrial enterprise that has to do with navigation of the air."
Wrights now spending much of their time in court fighting patent infringement.
1912 May: Wilbur dies of typhoid at age 45.
European armies begin serious pilot training and acquisition of airplanes.
1914 Igor Sikorsky's Ilia Mourometx multimotored airplane carries up to 16 passengers. It sets a record carrying 6 passengers for 6 hours 33 minutes.
German military pilot in endurance test flies 1900 kilometers in 21 hours 50 minutes.
World War One begins. From the start, air reconnaissance is crucial.
1920s Wright wind tunnel data improved upon by others for the first time.
First physics theories developed to explain airfoil lift, but the issue is still not completely settled as of 1996.

Footnotes

[1] This technology is undergoing a renaissance in low power, flat panel, high-resolution plasma screens, according to Charles Spindt. Regarding microscopic memory devices, he cited work by Ken Shoulders and Don Geppert. See http://www.essd.sri.com/apsl/vacuum.html. Spind is quoted in http://lenr-canr.org/acrobat/RothwellJtransistora.pdf
[2] P. Carroll, *Big Blues: The Unmaking of IBM*, (Crown Publishers, 1993)
[3] A. Golin, *No Longer an Island: Britain and the Wright Brothers 1902-1909*, (Stanford University Press, 1984), p. 31-33
[4] *Scientific American*, reprint of book review of *The Wright Brothers: A Biography Authorized* by Orville Wright in the "50 and 100 Years Ago" column, July 1993
[5] F. Kelly, *The Wright Brothers: A Biography Authorized by Orville Wright*, (Harcourt, Brace and Company, New York, 1943), p. 116, describing Simon Newcomb
[6] T. Crouch, *The Bishop's Boys*, (Norton: 1989), p. 231. See also: T. Crouch, *A Dream of Wings*, (Smithsonian Institution Press, 1985) for a detailed history of aviation before the Wrights
[7] H. Combes, *Kill Devil Hills*, (TernStyle Press, 1979), p. 186, and noted by most other biographies
[8] Golin, p. 34. Golin quotes British expert J.L. Prichard's description of the propeller design: "Of such stuff is genius made!"
[9] Crouch, *ibid.*, p. 305
[10] Kelly, *ibid.*, p. 209
[11] Kelly, *ibid.*, p. 135
[12] Wright's letter to Flint, April 12, 1907, quoted by Golin, p. 221
[13] Golin, *ibid.*, p. 243. See discussion of opinions of the Wrights and Flint during this period, pp. 240 250
[14] For example, see: C. Pendergrast, *The First Aviators*, (Time-Life Books, 1981), p. 7, p. 17
[15] On the web, http://www.math.ucla.edu/~barry/CF/CETIX.html
[16] Combs, *ibid.*, p. 181
[17] H. Villard, *Contact!* (Crowell, 1968), p 215
[18] B. Yenne, "The World's Worst Airplanes," (Dorset Press, 1993), p. 19
[19] Villard, *ibid.*, p. 220
[20] Villard, *ibid.*, p. 193
[21] Quoted in Golin, p. 245, and in many other biographies.