

Negative Science and "The Outlook for the Flying Machine"

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The history of negative science has long fascinated me. There are always theoreticians around who can "prove" that almost anything can't be done. The history of heavier-than-air flying is full of such pessimistic predictions. And similar examples can probably be found in most branches of knowledge.

An often-quoted example is reprinted on page 17. "The Outlook for the Flying Machine"¹ by Simon Newcomb is a logical, rational, reasonable argument against building a flying machine. The argument is now amusingly preposterous. But given the state of aeronautics in 1903 one can easily see how Newcomb's authoritative article convinced most readers.

For many, Newcomb's prognosis for heavier-than-air flight now symbolizes the potential shortsightedness of leading establishment scientists. The example is invoked to support proponents of astrology, psychokinesis and the theories of Velikovsky.² If a person with Newcomb's credentials could be so wrong, why couldn't Newton, Einstein, Darwin, etc. have been equally wrong?

Newcomb was a pillar of the scientific establishment. He directed the American Nautical Almanac Office, was professor of mathematics and astronomy at Johns Hopkins University, was a founder and first president of the American Astronomical Society, and was vice-president of the National Academy of Sciences. He received numerous awards, published dozens of scholarly papers and books, and was a popularizer of astronomy and economics.

Newcomb's mathematical ideas are largely responsible for the genesis of one of the classic novels of science fiction--if not for a whole genre of science fiction which now comprises thousands of books and stories. In *The Time Machine*,³ H.G. Wells links the idea of a fourth spatial dimension specifically with a "Professor Simon Newcomb." Apparently, Wells had read a paper in which Newcomb postulated a *spatial* dimension "at right angles to the other three."⁴ Wells proposed instead that the fourth dimension is *time*--a dimension through which man can travel as easily as he travels through the three dimensions of space.

In the *National Observer* serialization which preceded the novel, Wells has his "Philosophical Inventor" explain that:

...space, as our mathematicians have it, is spoken of as having three dimensions, which one may call Length, Breadth, and Thickness, and is always definable by reference to three planes, each at right angles to the others. But some philosophical people have been asking why *three* dimensions particularly--why not another direction at right angles to the other three?--and have even tried to construct a Four-dimensional geometry. Professor Simon Newcomb was expounding this to the New York Mathematical Society only a month or so ago. You know how on a flat surface which has only two dimensions we can represent a figure of a three-dimensional solid, and similarly they think that by models of three dimensions they could represent one of four--if they could master the perspective of the thing. See?⁵

Incidentally, H.G. Wells also referred to Newcomb in a nonfiction article entitled "The Cyclic Delusion."⁶

Newcomb himself was no slouch as a philosopher. In 1898 he discussed the notion of "hyper-space"--a term which has now become a science-fiction cliché used to explain faster-than-light travel. And seven years before Einstein's special theory of relativity, Newcomb wrote,

The laws of space are only laws of relative position.... For us the limits of space are simply the limits to which we can suppose a body to move. Hence when space itself is spoken of as having possible curvatures, hills and hollows it seems to me that this should be regarded only as a curvature if I may use the term of the laws of position of material bodies in space.⁷

The first paragraph of the reprint which follows refers to Samuel Pierpont Langley, secretary of the Smithsonian Institution and an astronomer, mathematician, inventor and optimist.⁸ With a \$50,000 War Department grant and five years' effort, Langley built a "man-carrying Aerodrome," which was tested by his assistant, Charles Manly, in October 1903. The result was total failure. The Aerodrome, which was launched from a catapult device mounted on a barge in the Potomac River, travelled only a few yards before falling into the water.

Two months later, on December 8, the second test failed. Although Langley blamed the failure on the launching mechanism rather than on the Aerodrome itself, he was ridiculed and abused in the press. His government funds were cut off, and he was threatened with a Congressional investigation for wasting public money. Nine days later, on December 17, 1903, the Wright brothers' "Flyer 1" rose from the sands of Kitty Hawk.

The *New York Times* and other newspapers had supported Newcomb's views. The *Times* editorial stated:

It would serve no useful purpose to say anything which would increase the disappointment and mortification of Professor Langley at the instant and complete collapse of his airship, which broke in two and dropped into the Potomac, carrying Professor Manly to his second involuntary cold bath in that stream. The fact has established itself that Professor Langley is not a mechanician, and that his mathematics are better adapted to calculations of astronomical interest than to determining the strength of materials in mechanical constructions. Had his machine collided with a stronger and heavier machine in the launching, it might have broken its back without discrediting the formula of its inventor. But since it encountered only air, the fact that it broke in two means nothing other or different than that it was not strong enough for the work expected of it. Obviously the calculations which inspired Professor Langley with so much confidence were correct to a demonstration; probably that happened in this instance which is liable to happen in all mechanical constructions, the materials did not conform to the data on which the calculations were based. They never will. The margin of safety which the engineer allows arbitrarily for strength in excess of that which his calculations show him is sufficient is based upon experience that materials do not always, if often, do what is expected of them, and what they are theoretically capable of doing. That "there is always, somewhere, a weakest spot," is why the factor of safety is allowed. To allow it in an aeroplane would be to weight it so that it would be too heavy for its purpose.

We hope that Professor Langley will not put his substantial greatness as a scientist in further peril by continuing to waste his time, and the money involved, in further airship experiments. Life is short, and he is capable of services to humanity incomparably greater than can be expected to result from trying to fly.... For students and investigators of the Langley type there are more useful employments, with fewer disappointments and mortifications than have been the portion of aerial navigators since the days of Icarus.⁹

Wilbur and Orville Wright are often thought of as semi-literate bicycle mechanics who luckily stumbled upon a workable airplane design. The fact is that the brothers were not only research scientists, but were also expert engineers and mechanics. In order to succeed in building a flying machine they had to solve many theoretical and practical problems. They did so using what is now regarded as scientific method, beginning with kites and moving on to gliders before considering the special problems of powered flight. They even began their research by requesting that the Smithsonian Institution perform a literature search on the subject of flying.

On December 17, 1903, at 10:35 a.m., Orville Wright took off at the controls of "Flyer 1," flew for 12 seconds, and landed safely--the first controlled, man-carrying mechanical-powered flight in history.

But almost five years went by before it was generally accepted that the Wright brothers had flown in their machine. After all, who were the Wright brothers to make such a claim when the most learned professors--including Professor Simon Newcomb--had "proved" that powered flight was impossible?

In fact, the first published eyewitness account of the Wright brothers' flight was published not in *Science*, *Nature* or the *New York Times*--but in the January 1905 issue of *Gleanings in Bee Culture*. The editor, A.I. Root, had travelled to Dayton from Medina, Ohio, to watch the flight.

Even three years after the Wrights' success, Simon Newcomb remained as adamant as ever in his conviction that man would never fly. In 1906 he wrote,

The demonstration that no possible combination of known substances, known forms of machinery, and known forms of force can be united in a practicable machine by which men shall fly long distances through the air, seems to the writer as complete as it is possible for the demonstration of any physical fact to be.¹⁰

In light of the discrepancy in their forecasts for the flying machine, it is interesting to examine the later citation records of both Newcomb and the Wrights. According to *Science Citation Index*[®] (*SCI*[®]) data, in the 16 year period from 1961 to 1976, Simon Newcomb was cited 183 times. Most of the citations were made in astronomical articles on the planet Mercury. His mathematical papers on probability and statistical sampling theory were less often cited. It is a tribute to Newcomb's talents that his work is still being cited eighty years after publication. In one case, however, Newcomb was cited in a listing of ridiculous predictions.¹¹ Ironically, the Wright brothers, whose invention has now significantly changed our civilization, and who did publish reports of their experiences and discoveries,^{12, 13} have been cited only once in the 16-year period.¹⁴ It would be interesting to know how long it took before their work became obliterated.¹⁵ We may learn this if we can ever compile an *SCI* for the period 1900-1960.

Of course, Simon Newcomb was not alone in his prediction of doom for the flying machine. For example, in 1888 Joseph Le Conte, Professor of Geology and Natural History at the University of California, wrote, "I am one of those who think that a flying-machine...is impossible, in spite of the testimony of the birds." Surprisingly, Le Conte admitted that "many wonderful and apparently impossible things have indeed come to pass; and that, too, in spite of the adverse predictions of some rash scientists." However, he went on to announce three "indisputable facts":

1. There is a low limit of weight, certainly not much beyond fifty pounds, beyond which it is impossible for an animal to fly. Nature has reached this limit, and with her utmost effort has failed to pass it.

2. The animal machine is far more effective than any we may hope to make; therefore the limit of the weight of a successful flying-machine can not be more than fifty pounds.

3. The weight of any machine constructed for flying, including fuel and engineer, can not be less than three or four hundred pounds.¹⁶

Although Le Conte later partially retracted his negative prediction,¹⁷ in 1888 he concluded,

A pure flying-machine is impossible. All that we can expect--all that true scientists do expect--is, by skillful combination of the balloon principle with the true flying principle, to make *aerial navigation* possible in moderately favorable weather--in other words, to make a *locomotive balloon*; or, if we choose so to call it, an *aerial swimming-machine*. That something really useful of this kind will eventually be made, there can be no reasonable doubt.¹⁶

Even earlier, it seems that it was fashionable to ridicule those men who were working on flying machines. In 1868 the London *Daily Telegraph* published an editorial which compared "flying philosophers" to "the proprietors of donkeys which are announced to ascend a ladder. The donkey never really goes up, and the philosopher has not yet flown."¹⁸ (p. 64) Unfortunately, some prominent scientists tended to agree that powered flight was impossible. Lord Kelvin (William Thomsen), the engineer and physicist, commented, "I have not the smallest molecule of faith in aerial navigation other than ballooning."¹⁸ (p. 80) The often-quoted "If God had intended that man should fly He would have given him wings" is widely attributed to the 1901 remark of George W. Melville, Chief Engineer of the United States Navy.

Even after the Wright brothers' 1903 success, some commentators hedged their bets, conceding that a heavier-than-air machine just might possibly fly, but certainly *never* would carry passengers, be used commercially, etc.

The engineer Octave Chanute said,

This machine may even carry mail in special cases. But the useful loads will be very small. The machines will eventually be fast, they will be used in sport, but they are not to be thought of as commercial carriers.¹⁹

Only eleven years later the first air passenger service began in Florida. The astronomer William H. Pickering also debunked the idea of commercial, trans-Atlantic air service. He wrote,

The popular mind often pictures gigantic flying machines speeding across the Atlantic carrying innumerable passengers. It seems safe to say that such ideas must be wholly visionary. Even if a machine could get across with one or two passengers, it would be prohibitive to any but the capitalist who could own his own yacht.¹⁹

Even as late as 1910, the following predictions regarding commercial aviation were made by the mechanical engineer Robert W.A. Brewer:

One thing is certain, and that is that the future flyer will be a larger and heavier machine than it is at present--it will probably weigh at least three tons, and will be of the form of a flying yacht. It will probably have a boat body, decked in, and proper accommodation will be provided for living and sleeping.... A large area will be used for starting, and special starting and alighting grounds will be prepared throughout the civilized countries of the world. These grounds will be fitted up with large starting machines similar to enormous catapults....

A trailing line will be lowered from the machine and special apparatus will be devised for picking up stores on the same lines as those adopted in railway practice for picking up mails by a passing train.

It may be necessary for the machine to encircle the depot a few times for this purpose, but such manoeuvring will be an easy matter when the full area of sustentation is used. This idea can be carried out in a practical manner, and is not merely mad anticipation.²⁰

It seems that at the turn of the century negative science reached a peak. Having witnessed tremendous technological changes during their own lifetimes, some scientists felt that the rate of change just had to wind down. In 1894 Albert Abraham Michelson, the co-discoverer of the speed of light, proclaimed,

The more important fundamental laws and facts of physical science have all been discovered, and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote.... Our future discoveries must be looked for in the sixth place of decimals.²¹

In the nineteenth century some of the most accurate forecasters of things to come were the writers of science fiction. Over a century ago Jules Verne

described voyages around the world in airships, and even postulated helicopters. In 1886 Verne wrote,

But we must admit the possibility that continued investigation and experience will bring us ever nearer to that solemn moment, when the first man will rise from earth by means of wings, if only for a few seconds, and marks that historical moment which heralds the inauguration of a new era in our civilization.¹⁸ (p. 72)

It is remarkable that in the thirteenth century, Roger Bacon wrote,

It is possible to make engines for flying, a man sitting in the midst thereof, by turning only about an instrument, which moves artificial wings made to beat the air, much after the fashion of a bird's flight.¹⁸ (p. 24)

In the seventeenth century, Robert Burton concurred,

If the heavens then be penetrable, and no lets, it were not amiss to make wings and fly up; and some new-fangled wits, methinks, should some time or other find out.¹⁸ (p. 24)

Greater precision was demanded by Bishop John Wilkins, who in his book *Mathematical Magick* not only conceded that man might fly, but categorized the known methods for doing so:

There are four several ways whereby this flying in the air hath been or may be attempted. Two of them by the strength of other things, and two of them by our own strength. (1) By spirits, or angels. (2) By the help of fowls. (3) By wings fastened immediately to the body. (4) By a flying chariot.²²

Among the many nineteenth-century engineers and inventors who considered the problem of powered flight, one of the most nearly successful was Sir George Cayley, now widely regarded as the inventor of the airplane in its present configuration. In 1809 Cayley foresaw the societal changes that the airplane would bring:

I may be expediting the attainment of an object that will in time be found of great importance to mankind; so much so, that a new era in society will commence from the moment that aerial navigation is familiarly realised.... I feel perfectly confident, however,

that this noble art will soon be brought home to man's convenience, and that we shall be able to transport ourselves and families, and their goods and chattels, more securely by air than by water, and with a velocity of from 20 to 100 miles per hour.¹⁸ (p. 40)

Incidentally, Cayley succeeded with a manned glider flight in 1852. The pilot for this historic flight was his coachman--who also contributed an historic comment. Upon completion of the flight, the coachman remarked, "Please, Sir George, I wish to give notice. I was hired to drive and not to fly."²³

It is interesting that even today, almost a decade after man first set foot on the moon, a "Man Will Never Fly Memorial Society" flourishes in North Carolina. According to its founder, Dr. Ed North, it is a "bottle-in-hand, tongue-in-cheek organization" of about 5,000 people who meet each December 16 at Kitty Hawk, North Carolina. The Society contends that,

...deep down inside you know that no machine made of several tons of metal is going to "fly"....

The Wright Brothers' alleged first flight was faked. They got their "Flyer" a few feet in the air on a windy morning just as you might get a big kite off the ground, a photographer snapped a picture of it as "proof" and people have been soaring into--and plummeting from--the skies ever since because they *believe* it can be done.

But how many "unexplained" air crashes are there? And in how many of those did the pilot suddenly say to himself, "By George, The Man Will Never Fly Memorial Society is right. This thing can't possibly fly." Crash! Headlines!²⁴

Of course, the society is not serious--its required pledge is, "Given a choice, I will never fly, or given no choice, I will never fly sober"--but its very existence demonstrates that people still enjoy indulging in the fantasy that flying machines are impossible.

It is unfortunate that even in this century, as air travel was becoming commonplace, the naysayers were in abundant supply. Now their attention was focused on rocketry, paralleling and repeating the embarrassing mistakes of their predecessors. Since these later pessimists were probably familiar with the ridicule directed at the airplane, which had resulted in embarrassment for those who said it couldn't be done, perhaps we should admire the blind perseverance of those who continued to insist that the next step--space travel--remained impossible.

Even as commercial airmail services flourished, the *New York Times* did not learn from its previous error. Commenting on Robert Goddard's rocket research, the *Times* in 1921 remarked,

That Professor Goddard with his "chair" in Clark College and the countenancing of the Smithsonian Institution does not know the relation of action to reaction, and of the need to have something better than a vacuum against which to react--to say that would be absurd. Of course he only seems to lack the knowledge ladled out daily in high schools.²⁵

In 1935 the astronomer F.R. Moulton wrote,

In all fairness to those who by training are not prepared to evaluate the fundamental difficulties of going from one planet to another, or even from the Earth to the Moon, it must be stated that there is not the slightest possibility of such journeys. ²⁶

And in a 1948 editorial the London *Daily Mirror* announced,

Our candid opinion is that all talk of going to the Moon...is sheer balderdash.²⁷

In contrast, back in 1634 the astronomer Johannes Kepler wrote a science-fiction story in which the hero travels to the moon (towed by a flock of geese) and meets the natives.²⁸ In 1822 Lord Byron asserted, "I suppose we shall soon travel by air-vessels; make air instead of sea-voyages; and at length find our way to the moon, in spite of the want of atmosphere."¹⁸ (p. 40). And between 1865 and 1870, Jules Verne's fictional forecasts verged on prophecy. His astronauts are mostly Americans; they blast off from Stony Hill, Florida (only 100 miles from Cape Canaveral); they encounter problems in space such as weightlessness; they land in the Pacific and are taken from their floating capsule by a battleship.²⁹

Even a technological forecast made by the Wright brothers themselves was proved wrong only a few years later. In 1917--ironically, the year that marked the entry of the U.S. into the first World War--Orville Wright said,

When my brother and I built and flew the first man-carrying flying machine, we thought that we were introducing into the world an invention which would make further wars practically impossible.¹⁸ (p. 40)

H.G. Wells had done better in 1902, when he predicted that by 1950 there would be heavier-than-air flying machines capable of practical use in war. However, Wells expected this view to excite "considerable ridicule."

But a decidedly modern, utilitarian attitude toward new inventions was

demonstrated by Benjamin Franklin, who witnessed the first ascension of a hot-air balloon in Paris. When someone asked what good a balloon would be, Franklin is reported to have replied, "What good is a new-born baby?" Franklin went on,

Convincing sovereigns of the folly of wars may perhaps be one effect of it, since it will be impractical for the most potent of them to guard his dominions. Five thousand balloons, capable of raising two men each, could not cost more than five ships of the line; and where is the prince who can afford so to cover his country with troops for its defense as that ten thousand men descending from the clouds might not in many places do an infinite deal of mischief before force could be brought together to repel them?³⁰

Clearly, technological forecasting is a risky business. Some of the most accurate predictions, at least in the case of the flying machine, were made by science fiction writers, perhaps because they guessed so often and so wildly. In this century, between 1914 and 1935 five science fiction writers prophesied the large-scale release of nuclear energy. As Anthony R. Michaelis, editor of *Interdisciplinary Science Reviews*, has written, "It is surprising how often the trained imagination of writers, when brought to bear on scientific facts which are not yet exploited by technology, can approach the truth."³¹ It is difficult to generalize about the views of scientists, either in the 19th century or today. But it is true that when asked to put their reputations on the line many scientists tend to be conservative. They are trained--quite properly--not to make categorical assertions.

As Arthur C. Clarke, the science fiction writer, has written,

When an elderly and distinguished scientist tells you that something is impossible, he is almost certainly wrong. The expert can spot all the difficulties, but lacks the imagination or vision to see how they may be overcome. The layman's ignorant optimism turns out, in the long run--and often in the short run--to be nearer the truth.³²

On the other hand, many gullible people with "ignorant optimism" have been conned out of their hard-earned money by those with more "imagination" and "vision."

There are an awful lot of crackpot ideas that have been popular at one time or another. Most are based on emotional, intuitive feelings rather than hard facts.

The awful truth is that hindsight is often better than foresight. How the openmindedness of a Benjamin Franklin and the closed-mindedness of a Simon Newcomb can be compared is a subject inadequately treated by

philosophers and historians of science. Even the formal training of most Ph.D.'s today would not enable them to deal with the persuasiveness of a Simon Newcomb. I wonder how many of the readers of the reprint could write the appropriate rebuttal--even though all of them take flying for granted! In fact, for lack of a proper citation index, I can not determine whether anyone ever *did* publish a paper showing that Newcomb was wrong.

The important point to be made here applies equally well to the flying machine, the computer, the laser, nuclear fusion, and every other important invention ever produced. It also applies to areas of investigation at present considered by many not worthy of scientific investigation: psychokinesis, telepathy, out-of-body travel, and even pyramid power. Science is a powerful tool for discovering the truth, but in some ways it is a conservative and stabilizing tool. Those phenomena and discoveries which do not fit into the present paradigms of science are not merely discredited, but are sometimes flippantly ridiculed.

Negative scientists can avoid future embarrassment by helping their antagonists design experiments that might prove or disprove the disputed scientific wisdom.

The reprint which follows should serve to remind all of us that what seems impossible, foolish, or ridiculous today may make perfect sense tomorrow. How much of today's negative science will be recognized--and perhaps reprinted--a century or two from now?

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