Lessons
From History

"Crackpots" Who Were Right II

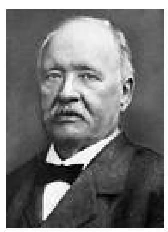
Philip E. Gibbs*

Abstract

This is the second instalment of the series entitled "crackpots" who were right. It is a collection of my postings at http://blog.vixra.org . The cases described so far are just the tip of the iceberg. These are the scientists whose work eventually led to a paradigm shift in their discipline and in several cases the work was recognised with a Nobel Prize, though not always for the scientists who made the initial breakthrough. For every scientists who makes such a major advance in science there are many others who take smaller steps. Undoubtedly there must be many other independent scientists whose work was so completely rejected and ignored that it never garnered any recognition and has long been forgotten. Science suffers through such neglect and that is why we think viXra.org is so important.

Key Words: crackpot, who were right, Svante Arrhenius, Abel Niepce de Saint-Victor, Fritz Zwicky, James Lovelock, Karl Jansky, Roger Apéry.

"Crackpots" Who Were Right 5: Svante Arrhenius



Our first four accounts of "crackpots" who were right all had tragic endings, so it is a pleasure to find one that has a happy ending. This is the story of Svante August Arrhenius whose thesis for a doctorate in chemistry was lambasted by his examiners, yet he went on to win the Nobel Prize for it.

Svante Arrhenius, born 1859 in Sweden, was a prodigious child who taught himself to read at just three years old and became an expert at arithmetic by watching his father doing his accounts. He graduated from his school as the youngest and most able student at 17 and went on to study at the University of Uppsala and then Physical Institute of the Swedish Academy of Sciences in Stockholm where he produced his theses.

As a chemist Arrhenius set himself apart from other post-graduate students of the day by doing almost no experimental work. Instead he set about looking for an explanation for how chemical reactions work in solutions based on principles of physics. The leading clue came from the process of electrolysis in which chemicals in solution are separated by passing a current between two

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electrodes. Faraday had suggested that the current was conducted by charged ions but it was Arrhenius who identified these with charged atoms. He concluded that salts in solution must disassociate into separate ions. At the time it was hard for other chemists to accept the idea that chemicals such as table salt could separate into reactive chemicals such as sodium and chlorine in solution but we now know that this is indeed the case.

Arrhenius submitted his dissertation to Uppsala for examination where it met with a cold welcome. The professors there were so unimpressed that they gave it just a fourth grade pass, the lowest possible. Such a low mark meant that his hopes for a future as a scientist were virtually non-existant. This story might have ended there along with his career except that Arrhenius sent copies of his work to chemists in other European countries in the hope that someone would recognise its worth. Only a few did. The older generation were not ready for the radical ideas, but some younger scientists saw that Arrhenius had indeed made a brilliant discovery.

Today we know Arrhenius as the founder of physical chemistry. Here we have just summarised the work of his theses in a few lines but actually it contained 56 original claims describing the chemistry of solutions and the principles behind acids and bases. A chemist who looked at his dissertation today would find little to dispute.

Despite the rejection from scientists in his own country, Arrhenius was very patriotic. Wilhelm Ostwald tried to persuade him to join his research team in Riga, but Arrhenius wanted to stay in Sweden. A compromise was worked out whereby he took an appointment in Uppsala based on the recommendation of Ostwald along with a travel grant that allowed him to spend time in Riga and other European countries. In this way he led a long and productive career. As well as further work on physical chemistry he also developed the theory of the greenhouse effect and its potential consequences for global climate. That was an idea that would not be accepted in his lifetime and it was just one of several ideas he had that were well ahead of their day.

In 1901 Arrenius was elected to the Swedish Academy of Sciences despite continuing opposition from the older chemists in his homeland. By then a new generation of chemists were in no doubt of how the subject had been revolutionised by the work of Arrenius. In 1903 he has honoured in his own country when he became the first Swede to receive the Nobel Prize for his work. He became happy in his writing books for students and the public before he died at the age of 68.

"Crackpots" Who Were Right 6: Abel Niepce de Saint-Victor

Who discovered Radioactivity? Every physics student has heard the story of how Henri Becquerel made the chance discovery while studying the effects of light on chemicals using photographic plates in 1896. He normally exposed the chemicals to sunlight and then left them on a photographic plate in a dark drawer to see if they would expose the plate. One day he was trying the experiment with some uranium salts but the sky stayed cloudy, so he put the plates and chemicals in the drawer without the exposure to wait for better light. When he took them out he decided to develop the plates anyway and was surprised to find that they had been darkened despite the lack of light. He had discovered the effects of radioactivity.

Becquerel was awarded the Nobel Prize in 1903. His contribution is further recognised in the modern name for the unit of radioactivity.

What most people don't know is that the same discovery had been made some four decades earlier by Abel Niepce de Saint-Victor. Like Becquerel he was studying the effects of light on various chemicals and was using photographic plates to test the reaction. He also used uranium salts and found that they continued to blacken the plates long after any exposure to light had been stopped. Fluorescence and Phosphorescence had been known for many years and Niepce knew that this new observation did not conform to either phenomena. He reported his results to the Academy of Sciences in France several times.

A few scientists including Foucault commented on the findings but no-one had a good explanation. Surprisingly no-one seems to have tried to replicate them and it is likely that everyone thought that there was most likely some experimental error. In any case Niepce and his discovery were soon forgotten.

When Becquerel rediscovered the same result as Niepce the situation was very different. By then X-rays were known and physicists were ready to appreciate that another new type of ray could exist. One physicist Gustave Le Bon pointed to the prior work of Niepce de Saint-Victor but he was ridiculed. Any further chance that Niepce might gain some recognition were extinguished when the Nobel Committee awarded the physics prize to Becquerel.

The story of Abel Niepce de Saint-Victor is typical of what happens to scientists who make a discovery whose importance is not recognised at the time. You would expect that when the effect is rediscovered later, people would appreciate the original discoverer, but that is not what happens. Usually the new discoverer gets most or all of the credit and the original scientists contribution is neglected because he failed to grab everybody's attention, even if he managed to publish the result six times. In this case it is only in recent years that some small amount of appreciation for the work of Abel Niepce de Saint-Victor has finally emerged.

"Crackpots" Who Were Right 7: Fritz Zwicky

Fritz Zwicky was a Swiss astronomer who worked most of his life at Caltech in the US. He had a good reputation as an astronomical observer but his real passion was for astronomical theory based on applications of physics. He was in fact one of the first true astrophysicists from the 1920s onwards. But during most of his lifetime he was very underappreciated for his theories of cosmology and stellar physics. In fact that is really putting it mildly. Many of his colleagues were very hostile towards him and his theories. Of the scientists described in this series he is arguably the one who was most regarded as a "crackpot". That is until many of his ideas were proved right many years later.

Zwicky had a remarkable ability to consider a problem from a fresh perspective and disregard any misguided preconceptions of the time. Because of this he was capable of coming up with what seemed like wild theories to others. With hindsight it seems like about half of these ideas turned out to be right while the others really were just too wild, or perhaps some of them are still ahead of their time.

In 1935 Zwicky published his theory in collaboration with Walter Baade that when supernovae explode they leave behind them a star with the density of nuclear matter made of neutrons. They predicted that these neutron stars were responsible for cosmic rays and proposed Supernovae as standard candles for measuring distances to other galaxies.

Today these ideas are so much a standard part of our astrophysics that it is hard to appreciate just how revolutionary they were at the time. Neutrons had just been discovered two years earlier while cosmic rays had only been observed since 1912. Even the term "supernova" had only been coined in 1926 by Zwicky himself. To other scientists of the time, putting these new ideas together in such a way must have seemed like just a historical trick that was too much to swallow.

In fact the theory was based on sound reasoning and built on the theory of white dwarfs as a Fermi gas which had developed over the previous decade. At the same time as Zwicky and Baade proposed their theory of supernovae another controversy was raging on the other side of the Atlantic between Chandrasekhar and Eddington. Chandrasekhar predicted that there was a limit to how heavy a white dwarf could be before it must collapse to form a black hole. Eddington could not accept that nature would include black holes and argued that relativity must be modified in such extreme circumstances to avoid the Chandrasekhar limit. Astronomers now believe that the neutron star is the densest stable state before this limit is reached.

The resistance towards these ideas persisted so long that when pulsars were observed 32 years later, few people were prepared for the discovery. The pulsing radio signals observed by Jocelyn Bell in Cambridge were at first thought to be interference and then alien signals. Bell's supervisor Antony Hewish could not accept the observation at first because the strength, rapidity and regularity of the signal meant that it had to come from a small dense source. It was not until the following year that Thomas Gold and Franco Pacini proposed that pulsars were rotating neutron stars. When Stephen Hawking heard of the discovery that neutron stars exist he told Hewish that now they must accept that black holes too are out there in space waiting to be found.

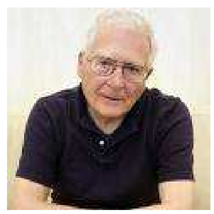
There is a story that in the 1950s a woman member of the public viewed the Crab Nebula source at the University of Chicago's telescope, and pointed out to the astronomer Elliot Moore that it appeared to be flashing. Moore, told her that it was just the star twinkling due to atmospheric waves. The woman protested that as a qualified pilot she understood scintillation and this was something else. We now know that it is a neutron star that flashes 30 times a second. At the time most astronomers could not have accepted such an explanation.

Neutron stars were not Zwicky's only successful theory. He also believed that galaxies were held together in clusters with unseen dark matter accounting for the gravitational forces needed. he predicted on this basis that such clusters could act as gravitational lenses producing effects that would be observed. he was of course right on all counts but it is only in the last few decades that the theory of dark matter has finally become widely accepted over alternative explanations.

Not everything Zwicky thought of turned out to be right. His notable failures include his theory of tired light which he invented because he did not accept the expanding universe theory. Even though such ideas our now discounted, at the time they were not so unreasonable and such alternative theories are important in the development of cosmology and physics as counterfoils against which observations can be used.

Nevertheless, in his time almost all of Zwicky's theories were rejected by his colleagues. He garnered respect only for his careful astronomical observations which included the discovery of over a hundred supernovae, more than any other individual has found. He lived just long enough to see neutron stars become excepted but it took longer for other astronomers to admit he had been right and credit him with the greatness he deserves. He received very few honours for his scientific work but was awarded a gold medal of the Royal Astronomical Society.

"Crackpots" Who Were Right 8: James Lovelock



James Lovelock is the first scientist in this series who is still alive. This also means that some of his work remains controversial, but a great deal of his research that was originally attacked is now widely accepted.

As a child, Lovelock was fascinated by science and read many books about physics and chemistry at the library. His school life was not very happy and his teachers did not rate him very highly. Towards the end of his secondary schooling he took part in a written test on general knowledge and came top. His teachers were indignant.

Although he was interested in a broad range of science topics he went on to study chemistry at university because he had a form of dyslexia that made it difficult for him to succeed in more mathematical subjects such as physics. He went on to work for the Medical Research Council and gained a doctorate in medicine in 1948. He invented a number of detection devices including the electron capture detector which made it possible to detect very small amounts of certain chemicals in the atmosphere. Although he has at times worked for various institutions and universities he has done most of his research as an independent scientist funded by revenues from his inventions.

Working from his home laboratory, Lovelock decided to investigate the effects of human pollution on atmospheric conditions such as haze. He used his electron capture detector to measure concentrations of CFC compounds in the atmosphere and correlated the results with conditions of visibility,finding a strong relationship. Because CFCs have no natural origin this demonstrated a clear link between pollution and its effects on the weather. The work drew attention to the buildup of CFC's in the atmosphere which nobody else had measured before Lovelock. It was then realised by others that CFC gases were harming the ozone layer that protects us from ultraviolet radiation and a worldwide ban on the substances was put in place preventing a natural disaster. In 1974 Frank Rowland and Mario Molina were awarded the Nobel prize for this discovery. Once again we see how the most independent thinkers seem to make discoveries that lead to Nobel Prices for others who work in a more institutionalised environment.

Lovelock established a good reputation through his work and was called on by NASA when they wanted to develop tests that would detect life on Mars. Lovelock worked with other scientists on the project but became critical of the approaches others were taking. The director told him he must produce a good test himself or leave the team. He came back with the suggestion that they should measure the composition of the Martian atmosphere because if there was life on Mars it would result in a mixture of compounds that would be hard to explain through inorganic processes. This idea had the benefit that it could be carried out without sending probes to Mars and measurements were soon taken showing that the atmosphere was almost entirely carbon dioxide. It was concluded that there is probably very little or no life on Mars at this time.

It was inspiration from this work that led Lovelock to the hypothesis for which he is now well-known. He suggested that the atmosphere and climate on Earth is not just affected by life, it is actually controlled by it. The temperature of our atmosphere can be controlled by phytoplankton that live in the upper sunlit layers of the ocean. In response to the sunlight they produce chemicals that rise in the atmosphere and increase the cloud levels. This in turns cools the planet. Carbon dioxide levels can be controlled by algae that bloom when there are high concentrations of the gas. This removes the carbon dioxide and deposits it on the seafloor. Even oxygen levels are controlled by vegetation that will burn more frequently when concentrations get too high.

At first Lovelock's hypothesis did not get much attention so in 1979 he gave it a catchy name and wrote a popular book about it: *"Gaia: A New Look at Life on Earth"* In the book he described the earth as acting like a superorganism that self regulates its systems. The reaction was probably not quite what he had anticipated. The cause was taken up by New Age thinkers in ways he did not particularly like. Evolutionary scientists such as Dawkins, Gould and Doolittle attacked the idea, saying that it was not consistent with evolution. Lovelock was not anti-evolution and set about more research aimed at showing how the Gaia hypothesis could arise naturally. Eventually he started to receive more support for his work.

Thrity years later scientists now accept that there are strong links between biological systems and the way our atmosphere is regulated by nature, much as Lovelock proposed. The way such systems developed is still open to question. Lovelock went on to suggest that human activity is now upsetting the balance that nature established and this has set the foundations of the environmentalist movement.

The reaction to Lovelock's research show how the scientific establishment still reacts negatively to new ideas that go against their accepted views. As he said himself *"Nearly all scientists nowadays are slaves. They are not free men or women. They have to work in institutes or universities or government places or industry. Very few of them are free to think outside the box. So when you come along with a theory like Gaia, it's so far beyond their experience that they are not able to react to it."* For a long time Lovelock and his supporters in science found it hard to get their results published in scientific journals because of the opposition from other scientists. He has called this "*wicked censorship*"

At 86 Lovelock is no longer considered a crank. He is appreciated as the founder of a new area of science investigating the relationship between biological systems and the atmosphere. Without his insight we would have been much slower to understand the negative effects we have been having on our climate through pollution.

"Crackpots" Who Were Right 9: Karl Jansky

In 1930 astronomers studied the heavens using only optical telescopes. Today things are very different and we now know that electromagnetic waves of different wavelengths from radio waves up to gamma rays are radiated by stars and other cosmic bodies, so we use a range of telescopes covering the whole spectrum. This change was instigated in 1931, not by a professional astronomer, but by an amateur and it took twenty years before the academics took notice.

Karl Jansky was a young radio engineer working for the Bell Telephone Labs who was tasked to look for sources of radio interference so that they could be eliminated from communication equipment. Jansky built a circular radio antenna some 30 meters in diameter that could be rotated on a platform and designed to pick up radio signals at 20 MHz. After some months he had identified different types of radio static including some that he understood to come from distant lightning storms, but another source was more enigmatic. He noticed that it repeated on a cycle of 23 hours and 56 minutes, the length of the sidereal day. This meant that it was coming from a fixed point against the stars and with more investigation he found that the strongest signal came from the centre of our galaxy.

The discovery was widely publicised and was even reported in the New York Times in 1933, yet professional astronomers did not see it as more than a curiosity. Jansky wanted to study the signal with a better purpose-built antenna, but times were hard and the Bell Labs were only interested in the practicalities of radio transmissions. Jansky's application was rejected. Writing to his father in 1934 he said "I'm not working on the interstellar waves anymore. Friis has seen fit to make me work on the problems of and methods of measuring noise in general. A fundamental and necessary work, but not near as interesting as interstellar waves, nor will it bring near as much publicity. I'm going to do a little theoretical research of my own at home on the interstellar waves, however."

The Great Depression was followed by World War II during which pure scientific research was put on hold while scientists contributed to the war effort. During that time another amateur engineer took up the cause of radio astronomy. Grote Reber built an impressive radio telescope dish in his back yard in 1937. He confirmed Jansky's observations and drew up detailed contour maps of the signal strength which he published in the Astrophysical Journal.

Wanting to persue his research further, Jansky applied for a teaching post at Iowa State University hoping to make use of their facilities. Sadly however he was struck by illness and could not fulfill his dreams. He died in 1950 without seeing how important his pioneering research was about to become.

There were several reasons why it took so long for the importance of Jansky's discovery to be recognised. The economic hardship and political unrest played its part, but in addition to that astronomers simply did not believe that the galaxy could be such a strong emitter of radio waves. This was not an observation they were willing to accept from amateurs at a time when professionals were concentrating on the revolutionary discoveries being made using optical instruments.

After the war radio astronomy gradually started to take off. In the US, John Krauss founded a radio observatory at Ohio State University, but it was Europe that took the first major lead. Bernard Lovell used equipment left over from the war to start a major project at Jodrell Bank in the UK. By 1957 he had built the giant radio dish 76 meters in diameter that would go on to revolutionise our knowledge of radio-active galaxies and the distant universe.

Karl Jansky did not live long enough to be honoured in his lifetime but posthumously he is accorded one of sciences most enduring forms of recognition. The metric unit for measuring the strength of radio sources is named the Jansky.

"Crackpots" Who Were Right 10: Roger Apéry

Up to now our series on people who were regarded as "crackpots" but who turned out to be right has not included any mathematicians. That is because most issues in mathematics can be resolved quite quickly. The logic of a claimed proof can normally be checked and either verified or debunked beyond doubt by examining its logic.

Not that mathematics is without its controversies. These have mostly arisen when a mathematician introduced a new level of abstraction whose validity was disputed. Here are a few classic examples just to give a flavour:

- 1545: Gerolamo Cardano introduced imaginary numbers which were further developed by his disciple Rafaello Bombelli, but they were not widely accepted until the work of Leonhard Euler in the eighteenth century.
- 1830: Nikolai Lobachevsky introduced hyperbolic geometry which was an early example of non-euclidean geometry, but his work was rejected by the St. Petersburg Academy of Sciences. Gauss and Bolyai had similar ideas at the same time but it was not until later when Riemann introduced more general non-euclidean geometries that the validity of the work started to be accepted.
- 1852: Ludwig Schläfli classified the six regular polytopes in four dimensions but his manuscript was rejected by the Austrian Academy of Sciences and then by the Berlin Academy of Sciences and was not published in full until after his death.

- 1873: Georg Cantor analysed transfinite numbers but his work was opposed by a number of mathematicians who believed that such entities do not exist. Leopold Kronecker was especially critical and prevented publication of the work in *Crelle's Journal.*
- 1888: David Hilbert's proof of his basis theorem was heavily criticised for being non-constructive. Paul Gordan who had originated the problem was particularly unimpressed and refused to accept the solution.
- 1945: When Saunders MacLane and Samuel Eilenberg tried to publish their seminal work on category theory it was at first rejected as being devoid of content.

Some of these examples could be justified as cases of "crackpots" who were right, and there are others, but a more striking story is that of Roger Apéry. His mathematics was initially rejected, not because it was too abstract, but rather because his colleagues would not believe that it could be right.

Roger Apéry was a Greek-French mathematician born in 1916. As a working mathematician in France he took a rebellious political and philosophical position that was not liked by his contemporaries. When he was asked to join the Bourbaki team who were famously compiling an encyclopedia of mathematics under the pseudonym, Apéry declined because he saw mathematics as a more individual pursuit. This led to his isolation from French mathematicians.

At the age of 61 Apéry was an undistinguished mathematician suffering from the dislike of his colleagues and his own problems with alcoholism. At such a late age mathematicians are not normally expected to produce ground breaking results so it is easy to understand the level of skepticism that greeted his announcement of a proof that the number $\zeta(3)$ is irrational.

The incredulity heightened when it was seen that the method of proof was very basic and used methods that could have been understood by mathematicians such as Euler who died nearly 200 years earlier. Many claimed proofs of old problems are rejected today at a glance simply because an experienced mathematician "knows" that methods that are too elementary can not solve the problem. All such avenues should have been explored before.

In 1978 he presented a lecture on his proof at the Journées Arithmétiques de Marseille which was greeted with doubt and disbelief. Each step he wrote on the blackboard appeared to be a remarkable identity that his audience considered unlikely to be true. When someone asked him "where do these identities come from?" he replied "They grow in my garden." obviuosly this did not boost anyone's confidence.

Nevertheless, a few mathematicians recognised that there was something significant in the proposed proof. They checked the identities numerically and found that they did indeed seem to hold. It was not long before the full validity of Apéry's work was confirmed and the skeptics were forced to eat their words.