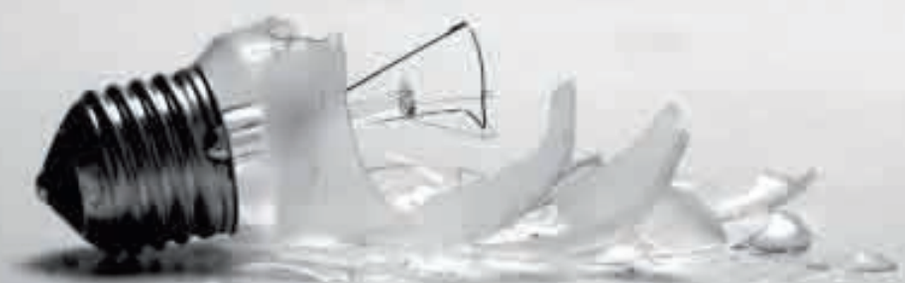
Same Time, Same Idea



Discoveries are made when the time is ripe for them. This is the reason why so many original ideas have a number of creators. But the person who makes the final breakthrough with an idea or product is not necessarily the one who was first on the scene.

Text: Mathias Plüss

Germany, 1895. A glassblower creates three identical tubes, packages them up individually and sends them to three physicists. Two of the tubes are broken in transit. The third is received intact by Wilhelm Conrad Röntgen, who makes use of it in the discovery of Röntgen radiation, now known as "X-rays" in the English-speaking world, but still by the scientist's name in German. "It is therefore simply a matter of postal coincidence that we talk of Röntgen rays and not Hallwachs rays," observed Wilhelm Hallwachs, the recipient of one of the two broken tubes. A joke? Certainly, but it contains an important grain of truth. Röntgen was not the only one experimenting with glass tubes: At least three physicists had discovered X-rays before Röntgen and had assumed that what they were seeing was not something new, but merely a "dirt effect."

How do breakthroughs in science and technology come about? Are discoveries strokes of individual genius, or do they simply occur when the time is ripe? In the case of X-radiation, we can cede that there was experimental skill and the power of observation behind the discovery, as well as the art of drawing the correct conclusions from what was observed. But without diminishing Röntgen's role in the process, we can also say that X-radiation would have been discovered even without the man whose name is still associated with the phenomenon in the German language. And to be honest, probably not a great deal later.

Science as a Collective Process

We like to imagine scientific pioneers as isolated geniuses, like authors, somehow creating something new out of nothing. But this romantic notion is misplaced: The scientific community functions as a collective, with researchers being very closely networked. And as the Röntgen example demonstrates, there are often any number of protagonists working toward the same discovery. In the world of literature, by contrast, it all comes down to the imagination of the individual. Goethe made this distinction clear when he explained why scientists were so prone to intense bickering about the "priority" of a discovery. He pointed out that in literature "a single idea can form the basis of a hundred epigrams, and it becomes merely a question of which poet can then encapsulate this idea in the most effective and beautiful manner. But in science the treatment is naught, and all efficacy lies in the aperçu."

Can we imagine "Anna Karenina" without Tolstoy? Of course not. Can we imagine the lightbulb without Edison? Certainly. Indeed, the first filament lamps appeared as early as 1820, 60 years before Edison received his famous patent. Edison may have decisively improved and successfully marketed the lightbulb, but to assert that he was the "inventor" is simply wrong. An even more extreme case of this is the telephone, which was "invented" at least five times. Alexander Graham Bell, who is nowadays most commonly cited as the inventor of this device, submitted his patent application on February 14, 1876, just two hours before the American engineer Elisha Gray submitted the very same thing.

Something "in the Air"

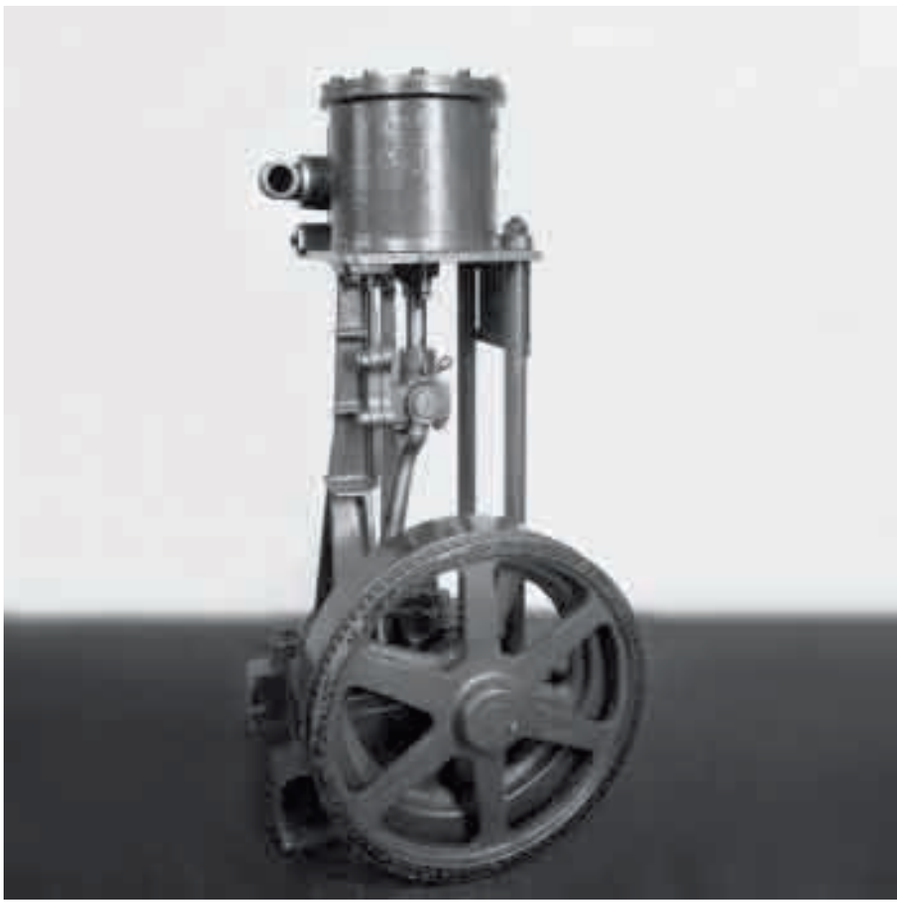
There are several hundred examples of such "simultaneous" inventions, proving that breakthroughs are often not the result of individual strokes of genius, but are more likely to appear when the time is right. In other words, when the wider parameters are favorable, when the necessary preparatory work has been done and when there is a need for the invention in question. "It is notorious that the same discovery is frequently made simultaneously and quite independently, by different persons," wrote the British statistician and psychologist Francis Galton. "It would seem that discoveries are usually made when the time is ripe for them, that is to say, when the ideas from which they naturally flow are fermenting in the minds of many men."

Is it the case perhaps that the phenomenon of simultaneous discovery is limited to small breakthroughs? Amazingly, no. Even where the most significant theories of physics, biology and mathematics are concerned, there are some astonishing parallel precedents.

■ The special theory of relativity: This is traditionally traced to a work by Albert Einstein in 1905. But the French mathematician Henri Poincaré was also within touching distance. He had already worked out the right equations and had formulated the relativity principle >

Photo: Image Source, Getty Images

The British engineer Hubert Cecil Booth (1871–1955) submitted a patent for a vacuum cleaner in 1901. However, 23 other patents for machines that functioned in a similar way had already been submitted. What finally convinced the judges was the mouthpiece of Booth's construction, which was the only one to directly touch the ground and thereby by far achieved the greatest effect.



in 1904. Even today, Einstein is still sometimes accused of plagiarism in this respect. Einstein later asserted that he was unaware of Poincaré's key work in this field. But he willingly admitted that "the special theory of relativity, if we look at its development with hindsight, was ripe for discovery in 1905." As he pointed out, it was "not improbable" that the theory of relativity could have been discovered decades earlier if physicists of the period had been discussing the things that were preoccupying their successors at the beginning of the 20th century.

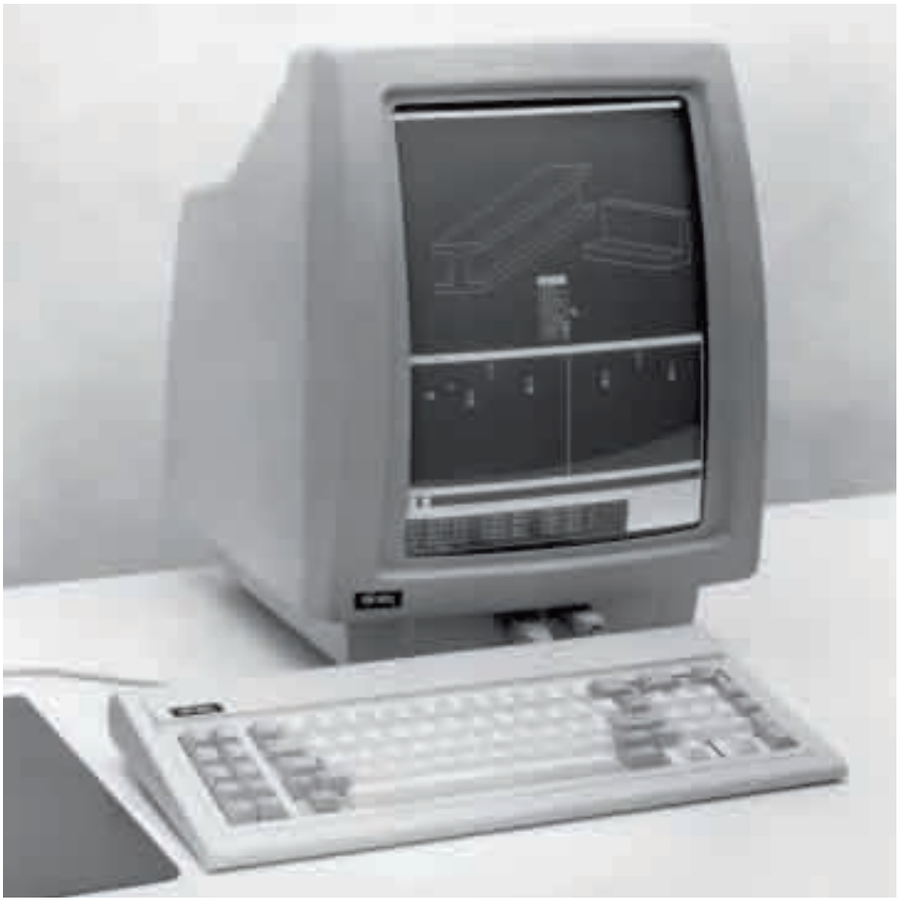
■ The theory of evolution: Charles Darwin's work in his first book on evolution was already far advanced in 1858, when he came across an article written by the English naturalist Alfred Russel Wallace, who had formed a theory that resembled his own "to a highly remarkable degree" (as recalled by the biologist Ernst Mayr). For Darwin, it was as if the roof had fallen in: "I never saw a more striking coincidence," he commented. "If Wallace had my manuscript sketch written out in 1842, he could not have made a better short abstract. So all my originality, whatever it may amount to, will be smashed." But Darwin would be proved wrong in this respect: He and Wallace joined forces to publish their findings, initially together. In the public memory, Wallace has been wrongly forgotten.

■ Infinitesimal calculus: The application of "differentiation" and "integration" represents perhaps the key foundation of modern mathematics. But here too there are two father figures: the Englishman Isaac Newton and the German philosopher Gottfried Wilhelm Leibniz. Newton conceived his theory in 1665, Leibniz independently about 10 years later. But when Leibniz published his results, Newton accused him of plagiarism against his better judgment. And so developed one of the most poisonous priority disputes in the history of mathematics. Where the actual breakthrough is concerned, the question of who was first is not even what really matters. Newton genuinely was the first, but he did not spark anything off. By contrast, Leibniz formulated his own infinitesimal calculus in an astonishingly sophisticated way and introduced signs such as ∫ and dx that mathematics still uses today. In so doing, he opened up a new dimension for Continental European mathematics. This was in contrast to mathematical progress on the other side of the English Channel: The English stuck to Newton's convoluted method and made no headway for decades. Goethe, who himself was involved in a number of priority disputes, once commented: "That which is 'in the air' and demanded by its time may spring up in a hundred heads at once, without any man borrowing it from another. But … in the argument over priority and legitimacy, no one has a more rightful claim than the man who establishes himself in the mind of others."

That Miniscule Difference

If an invention fails to function properly it will be worth nothing. Often it is the perceived details that tip the balance in terms of a breakthrough. In the case of Edison, the quality of the filament was the decisive factor. In the case of the vacuum cleaner, it was the mouthpiece. The inventor of the vacuum cleaner is considered to be Englishman Hubert Cecil Booth, yet here too there were many parties involved and a long prehistory. When Booth submitted his patent application in 1901, he immediately attracted a host of objections. Twenty-three earlier submitted patents of similarly constructed vacuum cleaners were held up as proof of his lack of originality. At first, the judges were suitably skeptical: "Is it really an invention if he says that the mouthpiece needs to be closer to the

Photos: Science Museum Pictorial | Science Museum | Department of Computer Science, ETH Zurich | Frank Fremerey, Bonn



IT Professor Niklaus Wirth (1934) achieved global fame through the development and implementation of his programming language Pascal. He also developed the Lilith workstation at the Swiss Federal Institute of Technology (ETH in Zurich). However, the ETH lacked both the necessary means and marketing expertise to commercialize this successfully.

carpet so as to better suck in the dust-laden air?" scoffed one. But as it transpired, the fact that the mouthpiece of Booth's device did indeed directly touch the ground proved the decisive difference. In a test, it was shown that his machine could remove 150 grams of dust from a carpet, whereas the next-best device could only remove 1.5 grams from the same area. The judges were convinced, and Booth received his patent.

So, first of all, an invention must be useful if it is to assert itself. Second, someone must step in to propagate the invention. It is often bemoaned that no computer industry has evolved in Switzerland, despite the fact that countless innovations in this area have emerged through the Swiss Federal Institute of Technology (ETH Zurich). But the simple answer is that, unlike today, these innovations emerged at a time when no one at the ETH had the slightest interest in marketing their own inventions. And the Swiss manufacturing industry was either too conservative or insufficiently attentive. On only one occasion did Swiss investors try to commercialize an ETH invention, namely the Lilith workstation invented by Professor Niklaus Wirth. But because this was undertaken in an unprofessional way and the financial backers showed too little patience, the project failed after just one year. Wirth's most successful invention, the programming language Pascal, was offered to all interested parties by the ETH at cost price and it was finally an American who made money out of it.

Obsolete Inventions

Third, for a discovery to be successful, it must come at the right time. Leonardo da Vinci's ideas, which really were the work of genius, came to nothing in practice, as they were far in advance of the prevailing state of technology. But ideas can also come too late. In the 1920s, the German engineer Anton Flettner invented a totally new form of ship propulsion that used rotating cylinders instead of sails. The corresponding technical know-how had been around since as early as 1850, but for 70 years no one had come up with the idea. Once thought up, the Flettner boat had the potential to be vastly superior to the sailing ship, but because of the cheap price of oil it had no chance against the new technology on the scene: diesel propulsion. And so Flettner's idea disappeared off the radar.

But perhaps its time is about to come again. At the beginning of August 2008, a new type of freighter possessing a diesel engine and four Flettner rotors ran off the slipways in Kiel. The manufacturers are anticipating a fuel saving of 30 percent to 40 percent as a result of this technology. Who knows, if the oil price rises high enough, perhaps the Flettner ship will manage to make a belated breakthrough after all? <