Rival Centennial Casts New Light on Edison

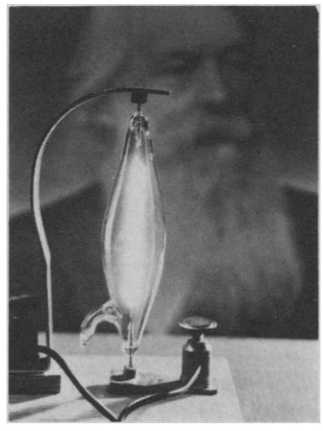
It's the 100th birthday of the light bulb, and some Britons say that Edison didn't invent it

One day last year some of the folks from the Thomas Alva Edison Foundation got together with representatives from Ford Motor, American Telephone and Telegraph, General Electric, Westinghouse, Consolidated Edison, Sylvania, and a dozen other companies. One of the topics they discussed was the impending 100th birthday of the incandescent light bulb, and how to celebrate it. They decided in the end to throw a year-long, multimillion-dollar party in honor of the bulb's inventor, Thomas A. Edison. The celebration, dubbed the "International Centennial of Light" is now getting into high gear. But a slight problem has come up. There seems to be a small but vocal band of party crashers in England who claim that all the hoopla is unwarranted. Edison, they say, was not the first. Not only that, but they have gone and organized their own "Electric Lamp Centenary" in honor of one Sir Joseph Swan, who they claim had the bulb at least 8 months before Edison.

One might dismiss this as madness except that the Swan people, in the course of digging through old files for their centennial material, have come up with facts that seem at least to partially support their case. To complicate the situation, a new myth-breaking biography of Edison has just been released in the United States to coincide with the U.S. celebration. In *A Streak of Luck*, author Robert Conot reveals for the first time that at least one of Edison's key ideas was snatched from Swan.

Far from casting a pall on the Edison celebrations, these attacks seem, for the most part, to have gone unnoticed. The chairman of the International Committee for the Centennial of Light (ICCL), Robert I. Smith, told *Science* he knew nothing about the Swan centennial. Another member of the committee said he knew about it, but was trying to forget. James G. Cook, executive secretary for the ICCL and president of the Thomas Alva Edison Foundation, said that he didn't think much of the Swan claim and that the Edison centennial would go on as planned.

On the surface, at least, that seems to be the case. The centennial was kicked



A model of the electric light first demonstrated to the English public by Joseph Swan in 1879.

off on 1 January with a float in the Tournament of Roses Parade, featuring a life-size floral statue of Edison, flanked by waving co-eds. In February, President Carter received an Edison bulb. Hundreds of high-school seniors went to Disney World in February for an Edison birthday symposium, and more than 100,000 U.S. grade and high schools are now being offered "education-tested kits of Edison-based teaching materials." Features on Edison are being sent to newspapers. Centennial coins will be distributed worldwide. Centennial events are planned for Japan, Germany, and the Netherlands. In the United States, scholarly symposia are in the lineup. There will also be an Academy Awards tribute to Edison, game and talk show appearances by Edison boosters, and a 20-minute "Salute to the Centennial of Light" at the 40th Annual Ice Capades. Things will come to a climax on 21 October 1979 with a media event featuring a reenactment of Edison, 100 years ago to the day, basking in the light of his first practical bulb.

Cook calls all this "an 8- to 10-million dollar expenditure on the part of industry to advance science and engineering education." The Swan supporters are polite but firm. They call it a mistake.

To counter the Edison effort, they have launched their own celebration—albeit on a smaller scale. According to Peter L. Kirby, chairman of the Electric Lamp Centenary Committee, it peaked on 3 February this year when 38 members of the Swan family came from all over England to see exhibits and to hear talks in Newcastle upon Tyne, the home of Joseph Swan's light bulb. It was 100 years ago to that day, says Kirby, that Swan demonstrated his bulb to a crowd of more than 700 people. A small traveling exhibit on Swan is also making the rounds through several cities. The British Post Office has issued a Swan cover. And the British Broadcasting Corporation has shown a half-hour special on Swan.

In addition, the Swan supporters have been publishing papers and articles that attempt to tell their side of the light bulb story. The Edison backers who have bothered to read them take issue with some points and fall suspiciously silent on others. To further complicate matters, it seems that all the details of the Swan-Edison rivalry have yet to come out into the open. In outline, however, the story goes like this.

In September 1878, after seeing a series of glaring 500-candlepower carbon arc lights in a Connecticut factory, Thomas Edison had a vision. Fresh from the triumph of the phonograph, he would now invent a safe, mild, and inexpensive electric light that would replace gaslight in millions of homes. A month later he told a reporter from the *New York Sun*: "I came back home and made continuous experiments two nights in succession, and discovered the necessary secret, so simple that a bootblack might understand it . . . I made my first machine. It was a success. The subdivision of light is all right. I am already positive it will be cheaper than gas, but have not determined how much cheaper."

Edison did not divulge his "secret," yet his renown was such that gas stocks tumbled both in the United States and in Europe. The secret, however, proved to be idle boast. It took a search of 13 months before he found a "burner" that would not melt.

Edison was not the first to search for one. Moses Farmer, Hiram Maxim, Albon Man, William Sawyer, and St. George Lane-Fox were but a few of hundreds who had tried. The English experimenter De la Rue patented as early as

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1809 an electric lamp that used a platinum wire in a partial vacuum, but there were many problems to overcome. By 1878 Edison was in a position to attack these problems. His first choice of burner material was also platinum, which had the highest melting point of all the metals then known. It produced a fair glow, but its high price, which would put platinum lamps at about $98 each, was prohibitive. Edison sent 2000 inquiries to prospectors, miners, and telegraphers all over North and South America to ask for news of platinum deposits. He had little luck, however, and even platinum melted at incandescent temperatures. Edison tried other materials: aluminum, boron, chromium, gold, iridium, ruthenium, silver, titanium, tungsten. To keep the "burners" from melting, he built elaborate devices that interrupted the circuit and allowed the hot filament to cool. When the temperature dropped, the circuit closed again. The upshot of all this was a flickering light surrounded by an ugly and expensive assortment of regulating devices. Compared to the simplicity of a gas jet, it must have seemed hopeless.

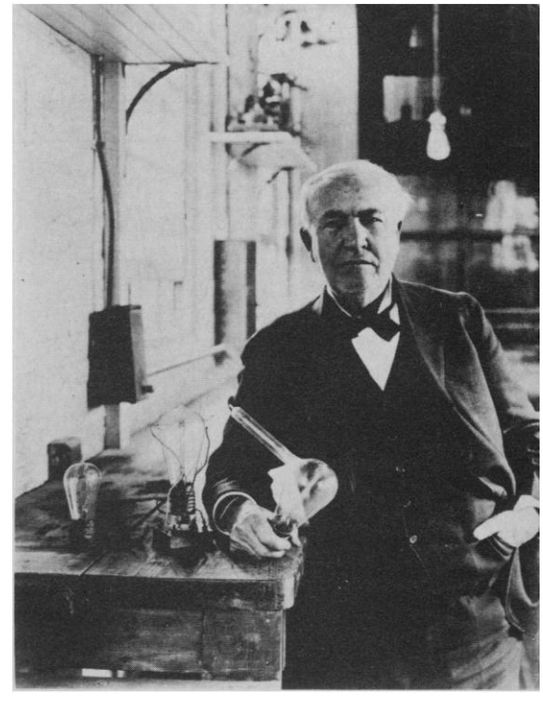
More than a year later, things had not significantly improved. Edison's boast of "success" with the electric light now rang hollow. Creditors were edgy. Morale in the lab was low. And no solution was in sight. An article in a *Scientific American* during October 1879 summed up the public's feelings. "The daily papers from time to time printed reports of progress in electric lighting, which, from their extravagance and inaccuracy, placed Mr. Edison, to say the least, in an extremely embarrassing position as regard his alleged promises and the expected fulfillment of them . . ."

Yet even while *Scientific American*, the journal of record for 19th century inventors, was cutting him down, Edison kept trying new materials. On 11 October he tried carbon. Earlier he had dismissed it as useless because it burned up, but now he had a much, much better vacuum in his bulb. This time it worked—and worked extremely well. It was brighter than any platinum lamps, and its melting point was so high that all the regulatory gadgets became unnecessary. One week later Edison told the world that he had a bulb of vast commercial potential. And this time it was true. Soon lights went up all over Menlo Park in New Jersey, and Edison was quickly besieged by orders for generators, distribution networks, and bulbs.

How did he come to use carbon? Edison had a feel for good copy, and he wasn't shy about using it. In the *New York Herald* of 21 December 1879 a reporter wrote: "Sitting one night in his laboratory . . . Edison began abstractedly rolling between his fingers a piece of compressed lampblack mixed with tar for use in his telephone. For several minutes his thoughts continued far away, his fingers in the meantime mechanically rolling over the little piece of tarred lampblack until it had become a slender filament. Happening to glance at it the idea occurred to him that it might give good results as a burner if made incandescent. A few minutes later the experiment was tried and, to the inventor's gratification, satisfactory, if not surprising, results were obtained. Further experiments were made with altered forms and compositions of the carbon, each demonstrating that at last he was on the right track."

Fifty years later, in 1929 during the "Golden Jubilee of Light," Edison himself was telling the same story—while millions listened on the radio. Yet some were skeptical. Historians of science, ill at ease with serendipity, slighted the story and instead claimed that Edison must have come upon the carbon in a logical fashion. They pointed to his knowledge of carbon's properties from his work with the telephone transmitter.

Their explanation may be partially correct, but the complete story, according to new research, is a bit unseemly. Conot, author of *A Streak of Luck*, found a lab notebook in the inner vault of the Edison National Historical Site in West Orange, New Jersey, that reveals another source of Edison's ideas on carbon. On 11 October 1879, according to the notebook, Edison pulled out an issue of *Scientific American*. In it was a short article about an English inventor who was having success using carbon as a "burner" for the incandescent light. That Englishman was Joseph Swan.

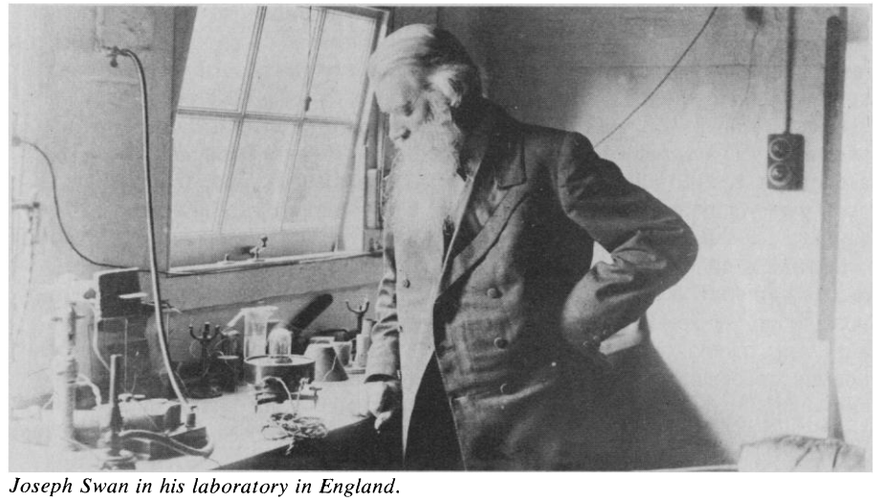


Thomas Edison in his laboratory.

Though Edison had early on abandoned carbon, Swan's success called him back to it. That same day Edison instructed his assistants to put down the platinum lamps and try carbon. The rest is history.

These revelations have not gone down well with the Edison people. "Conot took one thing that was sensational and ignored all the rest," says Cook, president of the Edison Foundation. " Edison knew the properties of carbon and tried to carbonize a lot of things. It had nothing to do with Swan. . . . There are a lot of good books around on Edison. We didn't need that one."

The Swan supporters disagree, of course. They say it's just one more factor in Swan's favor. Swan, they point out, had been experimenting with carbon as a burner for incandescent bulbs since 1845, when he was 16. Unlike many of his competitors, he avoided metal wires



Joseph Swan in his laboratory in England.

Relations Board decision to include department chairmen in the union bargaining unit. Administration officials note that most grievances by unionized faculty are filed, at least formally, against department chairmen, and that this creates an obvious conflict between union and management roles for the chairmen. This is the main issue in the court case which BU has appealed to the U.S. Supreme Court.

The larger question of the legality of collective bargaining in private colleges and universities is the subject of another case, involving Yeshiva University in New York City, which the Supreme Court in February agreed to hear on appeal. In the Yeshiva case, the U.S. Court of Appeals for the Second District in New York last year ruled that Yeshiva faculty performed broad management functions and, therefore, were not eligible as employees to bargain collectively under the National Labor Relations Act. In the BU case, the First Circuit Court of Appeals in Boston found that BU faculty were not management and could, therefore, unionize under the federal statute. An apparent conflict was created by the decisions and BU officials hope that whatever the decision in the Yeshiva case, the court will agree to hear the BU appeal.

BU, the fourth largest private university in the country, is the most sizable private university to be unionized so far, but is by no means the first. Faculties in about 80 private colleges and universities have concluded union contracts since the early 1970's, including such sizable institutions as Adelphi, Hofstra, Fairleigh Dickinson, and St. John's universities in the New York area and the University of Bridgeport. Faculty in public colleges and universities are not directly affected by the cases because they are covered by state labor laws rather than federal legislation.

It seems possible that the courts may not provide a clear-cut answer on the unionization issue. In the Yeshiva case, the appeals court judges appeared disposed to examine the extent of the faculty's actual role in management in a particular institution. If that were to become the standard, the ironical effect could be that antiunion university administrations, to thwart unionization, might find themselves thrusting more power on the faculty.

—*John Walsh*

because they fused. By 1848 he produced elements from paper strips carbonized in a fireclay crucible containing charcoal. By 1855 he had succeeded in producing strong and flexible carbon spirals.

But since the vacuum in the bulb was incomplete, his experiments at the time were doomed to failure. The carbon oxidized, and the filament disintegrated. Swan thus quit his experiments sometime after 1860. Meanwhile, in 1865, a German chemist living in England, Hermann Sprengel, invented a pump which gave a much better vacuum. In 1877, Swan, by now having invented the dry photographic plate, returned to his carbon filament experiments, only this time with the new pump. Results were encouraging. By 1878 he found that if the carbon filament was illuminated for a short period while the pump was still working, it pulled out impurities released from the incandescing filament. The lamp thus lasted much longer, and the blackening on the inside of the glass bulb, which was a problem in earlier lamps, was eliminated. Edison, the Swan supporters note, did not hit upon this process until April 1879.

On 3 February 1879, Swan demonstrated his new bulbs before an audience at the lecture theater of the Literary and Philosophical Society of Newcastle. According to Kirby, it is this date, when the bulb was first shown to the public and some 8 months before Edison claimed success with a carbon burner, that the English celebrate as the birth of the incandescent bulb.

So why hasn't Swan received any credit in the past? Edison, says Kirby, had so many firsts to his name that people naturally assumed that he was first with the light bulb. The situation was compounded, he adds, by "the powerful publicity machinery which Edison himself developed and utilized to assist in the commercial success of his developments." It adds up, says Kirby, to an unjust prejudice against other contenders.

Not so, say the Edison backers. They claim that after an examination of all the facts the balance still tilts in favor of Edison—even though Swan may have built an early carbon burner. Their main claim is that Swan worked on a bulb whereas Edison perfected not only a bulb but a whole electrical system that could compete with the gas light. The electrical generator was an important part of that system. Its rapid development by Edison brought about the practical distribution of electrical power from a central source in the same way as gas. Another example is circuit design. Edison employed parallel rather than series installations, so that when one bulb failed, as often happened in the early days, the rest of the bulbs did not go out, as was the case with the series system first used by Swan. And the Edison people note that today's electrical distribution system is nothing but a highly sophisticated version of Edison's system.

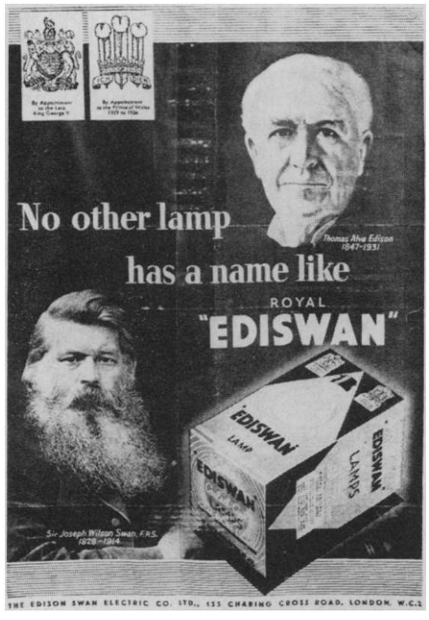
But parallel circuits did present Edison with a problem. Each added lamp (and he pictured thousands) reduced the total resistance of the circuit. This, according to the laws of electronics, meant that a huge current would be needed to power the load. It was impossible. The power lines from such a central distribution system would have to be of such vast diameter that there would not be enough copper in the world for even a modest system of parallel lighting. To get around the problem, Edison had to make the resistance of his lamps very high. The diameter of his power lines could then be kept reasonably small.

The hallmark of such a high-resistance carbon lamp is a very thin filament—and therein, say the Edison backers, lies the critical difference between the English lamp of 3 February 1879 and the American lamp of 21 October 1879. Edison's filament was thin. Swan's was thick. It sounds insignificant now, but billions of dollars worth of business hung in the balance. Edison's bulb could be used in parallel circuits employing thousands, even millions of bulbs; Swan's only in small series systems. Swan may have worked with a carbon burner earlier than Edison, but it was Edison, say his backers, who took the carbon filament and made it work for the masses.

By the time of the Paris exhibition of 1881, Edison had completed most of his system and decided to ship a unit over to France. Once at the exhibition, Edison found himself face-to-face with Swan, who was exhibiting in a nearby booth. When it came to giving the official prizes, it was Edison who won the Diploma of Honor, and Swan who had to be content with a prestigious, but definitely inferior, Gold Medal. Said Swan: "The jury had a difficult task to perform and I suppose they did the best they could with it."

It was not just a matter of individual prowess, say the Swan historians. The two men worked in very different climates. In the United States, for instance, Edison was able to attract large-scale capital to support his large-scale visions. By 30 September 1878, just 3 weeks after he first set out to invent an incandescent lamp, a syndicate of leading financiers, including Morgan and the Vanderbilts,

advanced him $50,000 for research. A stock company was also soon capitalized at $300,000. By comparison, Swan in England was financially crippled. And the interests of the powerful gas monopolies also hurt him. By 1882, for instance, Parliament passed the Electric Lighting Act, which stopped the development of central systems. Swan, who had worked against passage of the act, was appalled. Said Edison, when he learned of its probable impact on the in-



The "Ediswan" company, which combined the interests of both Edison and Swan, continued to do business in England into the 1930's, when this poster was made. Soon afterward, the company folded.

fant electrical industry: "Why, they've throttled it."

And the two men worked not only toward different ends (single lamps versus huge systems), but with very different means. Edison worked according to his oft-quoted adage: "Invention is 1 percent inspiration and 99 percent perspiration." Unlike his rivals, however, Edison had a large staff to do the perspiring while he concentrated on the inspiration. Swan, on the other hand, worked with a lone collaborator.

Differences in style also show up in the continued development of the bulb. Edison in July 1880 decided that carbonized bamboo was the perfect filament, but where could he find the right type? Edison sent one man to Japan, another to India, and two to the Amazon. Another agent, dispatched by Edison to the swamps of Florida, wrote: "What makes this job extremely interesting is the strong probability of getting bitten by a snake." With no luck in Florida, Edison sent him on to search for bamboo in Cuba. There he died of yellow fever. "Bury him," Edison wired, "at my expense."

The search was in vain, according to Matthew Josephson, a biographer of Edison. "By the time the last of the Jules Verne type explorers got back to New Jersey in 1889, the whole technique of lamp manufacture had been abandoned by Edison in favor of the squirted cellulose, a product perfected by a chemist, Joseph Swan, who had stayed at home and pursued the methods of theoretical as well as empirical science."

In his headlong quest for commercial success, Edison patented every new improvement he came across—"real or imaginary," as one patent judge put it in 1891. Edison, for example, filed patents for a lamp in 1878, just 2 weeks after he first started work on the whole problem, and while, as one biographer put it, "the devices existed mostly in Edison's head." By 1883 Edison had 147 patents related to electric lighting. Swan, on the other hand, didn't file his first lamp patent until 1880—some 32 years after he made his first carbon filament lamp. And even then, the patent was for his method of pumping out vapors from the lamp while it incandesced—not for the basic features of the bulb.

Forget the stuff about the system and look at the issue of the lamp, say the Swan people. Look at the patents. It was this difference between the two inventors that more than anything else has kept Swan's efforts from being recognized. After years of slow experimentation, all the while noting the work of others, Swan felt that the basic concept of the incandescent lamp was not patentable. He therefore took no action to protect his invention—despite the fears expressed by some of his colleagues. History, of course, has shown that his colleagues were correct.

Edison patented his carbon-burner lamps in England in 1879. When Swan formed a lamp manufacturing company the next year, he was almost immediately faced with threats of litigation. Edison's application for an injunction, however, was refused in the British courts. This did not necessarily mean that the Edison company would lose a full trial, but it was a bad omen. If the case had gone to trial and been lost, moreover, the effects would have extended to the United States, where Edison was preparing to use his patents to prevent competition. A British defeat could have set a bad precedent. As it was, the British trial never came about because the two sides settled out of court, and in 1883 they formed the Edison and Swan United Electric Lighting Company Ltd. Sixty percent of the shares went to Swan, 40 to Edison.

The company soon became known by its trademark "Ediswan" and at first everything sailed smoothly. Swan got immunity from the Edison patents. Edison kept his patents unchallenged, which immediately was useful in forcing several small competitors to accept the company's terms for licensing. But Ediswan's competitors soon realized that Joseph Swan's work of 1878 and his demonstration of 3 February 1879 might be used to invalidate Edison's patents, and fierce litigation over the basic patent rights soon broke out. It was a painful choice for Swan—either lose his business or lose the claim to the lamp. He decided to sit tight. In 1886, the British courts upheld Edison's basic carbon filament patent, and as a result, Ediswan enjoyed a virtual monopoly in England until 1894. Yet it was this ruling, according to R. C. Chirnshide, a British chemist and Swan historian, that "served to diminish Swan's undoubted claim to priority and to create or condone the common belief that Edison was the inventor of the incandescent carbon lamp."

It's not that simple, according to the Edison people. They claim the British court ruled not in deference to Swan but on the basic issue of filament diameter.

And so it goes. The controversy rolls on, each side making its claims and rebuttals. Some say it cannot be settled until all the facts come to light. With Swan this will be a problem, because he patented little and kept few laboratory notebooks. One lucky break, according to Kirby, is that a box of Swan's patent records has recently come to light and is now being examined. With Edison, the problem is the opposite. He left more than 2 million pages of lab notebooks, patent applications, drawings, and diaries. These items are now being collected and organized at Rutgers University in New Jersey. Historians at the Edison Papers Project estimate that the process is going to take $5 million and 20 years.

In the meantime, the image of Edison as the lone inventor of the light bulb seems likely to be revised little by little. The facts raised by the Swan people will not just go away. Even a hard-core Edison supporter who claimed to know nothing about Swan and his light bulb seemed ready to sit up and take note. Said Robert I. Smith, chairman of the International Committee for the Centennial of Light: "I'd be interested in finding out about Swan. Do you have some information you could send me?"

—WILLIAM J. BROAD