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MedHistory Milestones

Stories

from the MedMuseum

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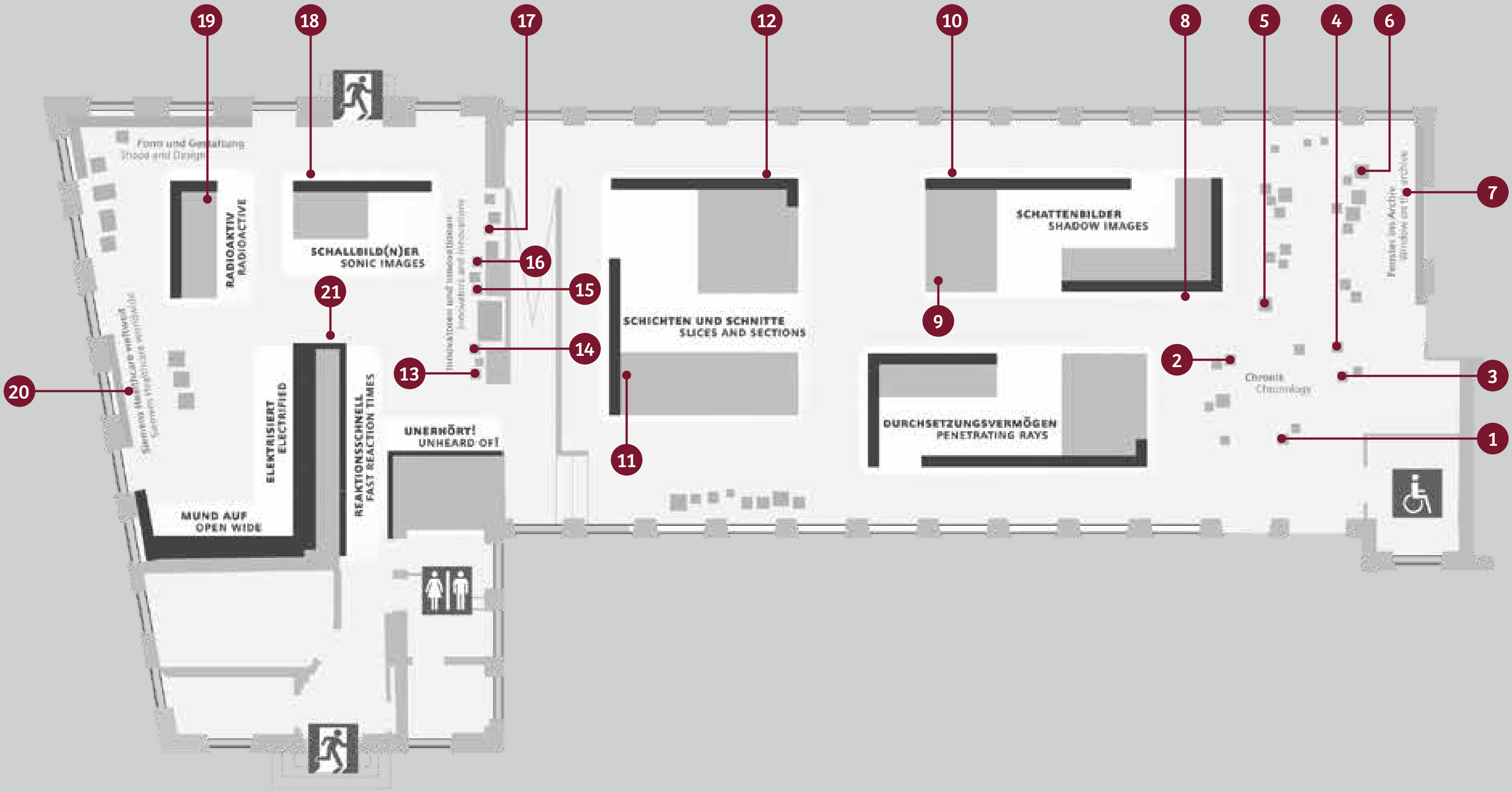

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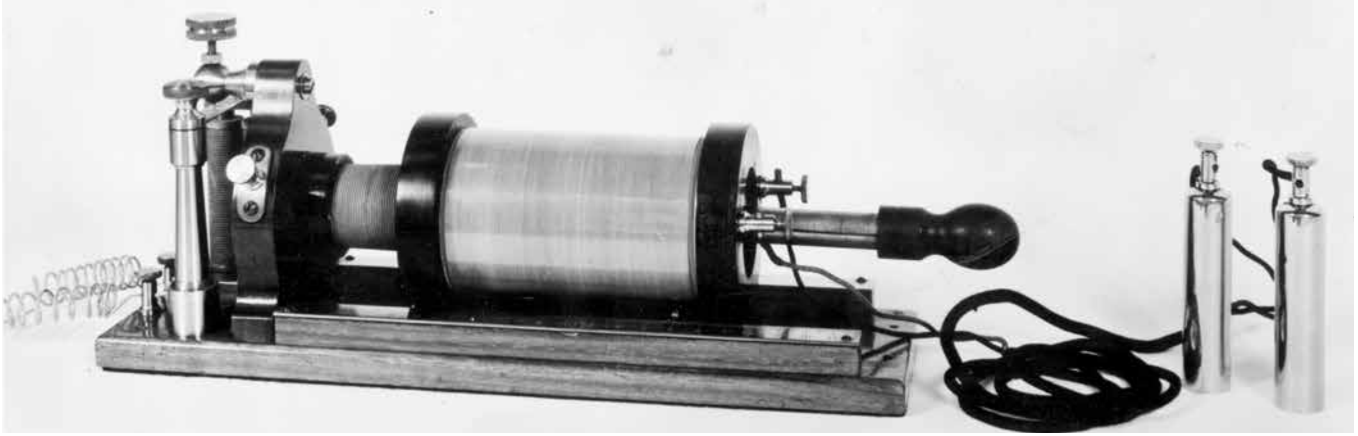
How tooth pain changed the world...

Florian Kiuntke



Reconstruction of a slide inductor, ca. 1846

The bust of Werner von Siemens in the MedMuseum

A toothache can be agonizing. You can't sleep or think clearly. All you want is just to be left in peace. That is how Friedrich Siemens, younger brother of Werner Siemens, felt one evening in 1844. He was suffering from "rheumatic tooth pain," for which there was no known treatment or cure. His older brother Werner had the idea of trying out his latest design, which he had named the "Volta Inductor." With ramifications extending right up to the present day...

Werner Siemens – from 1888 onward Werner von Siemens – was born in the village of Lenthe, near Hannover, in 1816. He was the fourth of 14 children. His father, Christian Ferdinand, was the leaseholder for the estate there, and the family belonged to the middle class. But the family often faced serious financial difficulties, making it difficult to give the children an education commensurate with their middle-class ambitions. Werner ended up leaving secondary school without a diploma and joining the Prussian army instead. The vocational training he received there in the artillery and engineering school spurred his interest in science and technology and laid a solid foundation for his future work in the electrical engineering segment.

During his years of service as an artillery lieutenant, Werner Siemens lived with several of his younger siblings. Among them was Friedrich, who was writhing in pain from a toothache one evening in 1844.

Werner had the solution: His "Volta Inductor" was able to generate strong voltage using relatively little electricity. Now, as both brothers were experimenting with the device, they had an idea: Might the current generated by the Volta Inductor not alleviate the unbearable pain – or perhaps even eliminate it altogether – if it were applied through the roots of the tooth? No sooner said than done. The unit was hooked up to the most painful tooth and the power was turned on. The pain was immense at first, but then subsided entirely. Friedrich was thrilled, treating all of his teeth right away with the live voltage and enjoying a few days' respite. Unfortunately, the effect did not last very long, even vanishing completely after a few treatments, but the two brothers had shown that electricity could be used to treat medical problems. An exciting audio segment at the MedMuseum in Erlangen tells the full story.

In 1847, a few years after this memorable occasion, Werner Siemens teamed up with Johann Georg Halske, a mechanic, to found a company called Telegraphenbauanstalt von Siemens & Halske. The new company's core business focused on building the pointer telegraph that Werner von Siemens had improved, which allowed even relatively untrained people to communicate over long distances for the first time. It is less widely known that Halske contributed his own activities involving building equipment for scientific and research use at the university in Berlin to the joint company. The slide inductor that he had designed together with physiologist Emil du Bois-Reymond is considered a milestone in the field of electromedicine. It was also produced successfully at the workshops of Siemens & Halske (S&H) for years. That means medical technology has a history stretching back over more than 170 years at Siemens, just as long as the company itself has existed.

It is likely that neither Werner von Siemens nor Johann Georg Halske ever visited Erlangen, but the company they founded has been active here for decades. Siemens Healthineers today is not only descended from Siemens AG, but also from Reiniger, Gebbert & Schall (RGS), a company founded in 1886. At first a major competitor of Siemens, RGS ran into serious financial trouble and was acquired by S&H in early 1925. The two businesses were initially run separately, but in later years Siemens pooled all of their activities together in a newly founded company, Siemens-Reiniger-Werke AG. Today, Siemens Healthineers is a separately managed healthcare business of Siemens AG and a leader in medical technology.

1816 Ernst Werner Siemens born at Obergut Lenthe estate, near Hannover, on December 13.

1847 Telegraphen-Bauanstalt von Siemens & Halske, a telegraph firm, founded in Berlin on October 1.

1866 Werner Siemens discovers the dynamoelectric principle.

1888 Werner Siemens raised to the Prussian nobility by Kaiser Friedrich III.

1890 Management of the company passes to his brother Carl and his sons Arnold and Wilhelm.

1892 Werner von Siemens dies in Charlottenburg on December 6.

Werner Siemens as an artillery officer, ca. 1843

2

Women's rights and X-ray units – Max Gebbert

Doris Vittinghoff

Max and Marie Gebbert at their wedding, 1886

In many ways, he was far ahead of his time: Max Gebbert was a vegetarian, a Freemason, a free thinker, a supporter of equal rights for women. And he shaped the corporate culture of the Erlangen-based medical technology company Reiniger, Gebbert & Schall (RGS) in the late 19th century like no one else.

Born in 1856 in the village of Rothaus (now Osiny), near Neisse (Nysa), in the former Upper Silesia, now part of Poland, Gebbert first apprenticed as a mechanic before becoming a wandering journeyman in 1878 on travels that took him to destinations as far away as Switzerland, France, and the United States. After returning to Germany, he opened a mechanic's shop with Karl Schall in Stuttgart. The two of them met Erwin Moritz Reiniger at a conference in Strasbourg in 1885. He had run a workshop of his own at Schlossplatz 3 in Erlangen since 1877, with electro-medical equipment among its products.

The three men founded their joint company, Reiniger, Gebbert & Schall (RGS), in 1886. The new company, formed to produce medical technology products, was headquartered in Erlangen. The company was successful, adding more and more staff and soon outgrowing the Schlossplatz site. A large new factory was built on Luitpoldstrasse, with a wealth of space for numerous workshops and offices, but also a gauge room and laboratories. In 1893 the company moved into its new space, where the Siemens MedMuseum is now located.

RGS came to occupy an international position within just a few years. The 1888 catalog already listed 142 RGS representative offices in Germany and elsewhere. Branches were opened in Vienna, Berlin, and Munich in the 1890s. Hamburg, Budapest, Cologne, and Leipzig became home to general representative offices. Karl Schall became the successful sole agent for the products from Franconia in the UK. The products were viewed as high-end, and the sales and distribution organization was efficiently organized and customer-oriented.

After Schall (in 1888) and Reiniger (in 1895) left the company, Gebbert continued to do business as the company's sole owner. Shortly after the news of Wilhelm Conrad Röntgen's discovery of X-rays in Würzburg in November 1895 took the world by storm, Gebbert made sure the company produced X-ray systems and accessories right away. Röntgen himself bought X-ray tubes from RGS.

The RGS corporate culture was heavily influenced by Gebbert's personality. At the time, there were not yet any generally applicable rules for labor and employment law, so the measures he enacted within the company can definitely be viewed as innovative, even groundbreaking. Gebbert established a nine-hour working day and guaranteed apprentices a several-year, holistic training program that incorporated both theory and practice. He gave the staff the chance to have internal representatives who came to him with employees' concerns. This allowed the company to avoid strikes as a means of enforcing internal demands.

But Gebbert was also ahead of his time even beyond his own company, such as in his support for women's rights: "I am convinced that if women had the opportunity to become clear on many questions (...) they would listen more to their feeling for their fellow people and we would move forward in this."

Gebbert died in Erlangen in 1907. The trading company RGS was converted to a stock corporation later that year, with the majority of shares resting with Gebbert's widow, Marie. The business strategy pursued by RGS general director Karl Zitzmann – who bought tangible assets on credit in the early 1920s, speculating that

Staff field day, May 1891: RGS founders Erwin Moritz Reiniger (third to the left of the barrel at center, hat in hand) and Max Gebbert (to the right of the barrel)

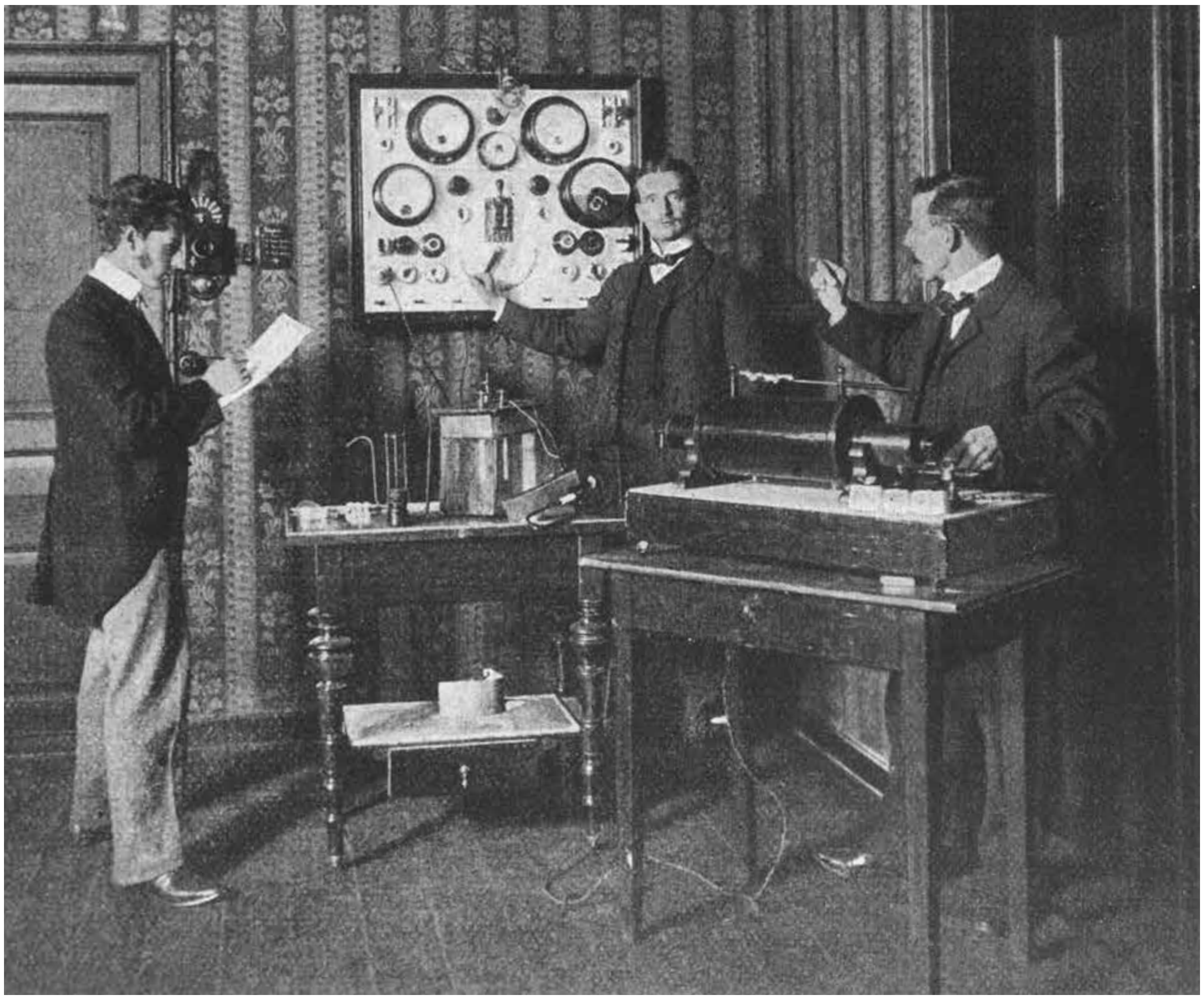
the loans would lose value due to inflation – put RGS in serious financial difficulties after the German currency reform. In 1924, the company posted a deficit of six million gold marks, at an interest rate of 24 percent. In their search for a strong financial backer, the new leadership of RGS offered the company to various potential investors, including the Berlin-based Siemens & Halske (S&H), but on the condition that acquisition of the shares must not lead to relocation of production operations. S&H acquired a majority stake in RGS as of January 1, 1925, but RGS continued to do business with external parties as an independent stock corporation.

The bust of Max Gebbert in the MedMuseum

S&H subsequently pooled sales, distribution, and X-ray system production activities together in order to leverage synergies and become more economically efficient. In the course of the global economic crisis, the merger was also executed in organizational terms in 1932, when RGS merged with other companies and was renamed Siemens-Reiniger-Werke AG (SRW). The company's headquarters were relocated to Erlangen in 1947.

A passionate pioneer in the field of X-rays

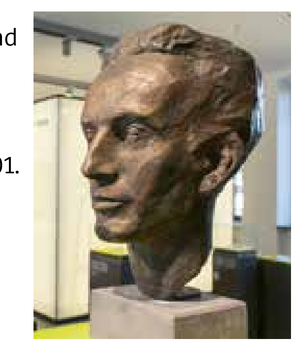
Doris Vittinghoff



Friedrich Dessauer (left) at his X-ray lab, about 1902

Friedrich Dessauer was born in Aschaffenburg on July 19, 1881, the tenth of eleven children. His childhood was shaped by the prevailing belief in progress and by the technological advances that were making such great changes throughout life and society at the time. Small towns were being illuminated, households had electricity, streetcars were in use in the big cities, and telephones were just beginning their triumphant advance.

Dessauer was an unusual boy. His favorite way to spend his free time was to go to his father's factory and watch the machines. His room looked like a miniature physics lab. It was there that he experimented with electrical equipment and built devices of his own. In January 1896, at the tender age of 14, Dessauer learned of what was, to him, the most exciting discovery of his life: X-rays, which Wilhelm Conrad Röntgen had discovered in Würzburg, not far away. Dessauer developed his first X-ray system a short time afterward. He went on to study physics and medicine and then founded his own company, Elektrotechnisches Laboratorium Aschaffenburg (ELA), in 1901.



The bust of Friedrich Dessauer in the MedMuseum

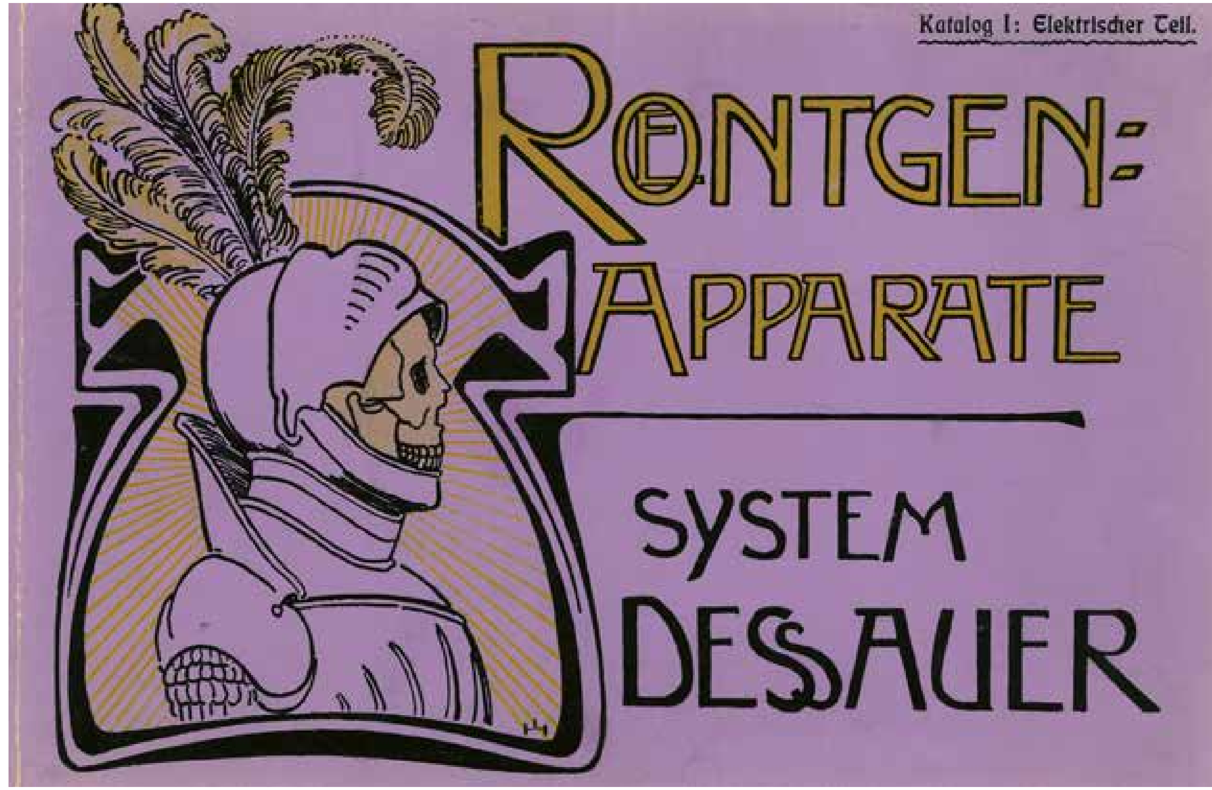
The company produced X-ray equipment and offered free classes for doctors on how to use the devices. One of Dessauer's early X-ray systems, from

1902, is also on display at the Siemens MedMuseum. In 1904, Dessauer embarked on efforts to use X-rays not only for diagnosis and to treat skin problems, but also to treat deep-seated cancers.

Dessauer suffered serious harm from radiation due to careless handling of X-rays at the start of his career. He had to undergo well over 120 skin operations during his lifetime.

At the same time that Dessauer was conducting his experiments, he was also pushing his company's economic success forward. ELA merged with another company, Elektrotechnisches Institut Frankfurt, in 1906 to form Vereinigte Elektrotechnische Institute Frankfurt- Aschaffenburg (Veifa-Werke). And just a few years later, in 1909, he had another sensational scientific success, developing a new kind of X-ray system that could take as many as six images per second. He used it to take the world's first images of a beating heart.

But Dessauer's successes as a businessman stood on shaky ground. The more successful Veifa became, the stiffer the competition with Erlangen-based Reiniger, Gebbert & Schall (RGS). In January 1916, Dessauer decided to put an end to the companies' rivalry, opening negotiations with RGS. On November 16 of that year, the Erlangen firm acquired all shares in Veifa-Werke. Dessauer made extensive efforts to ensure that his employees were still well taken care of. In Frankfurt at the end of World War I, he was viewed as the model of a socially responsible employer.



Customer catalog of "Elektrotechnisches Laboratorium Aschaffenburg", 1902

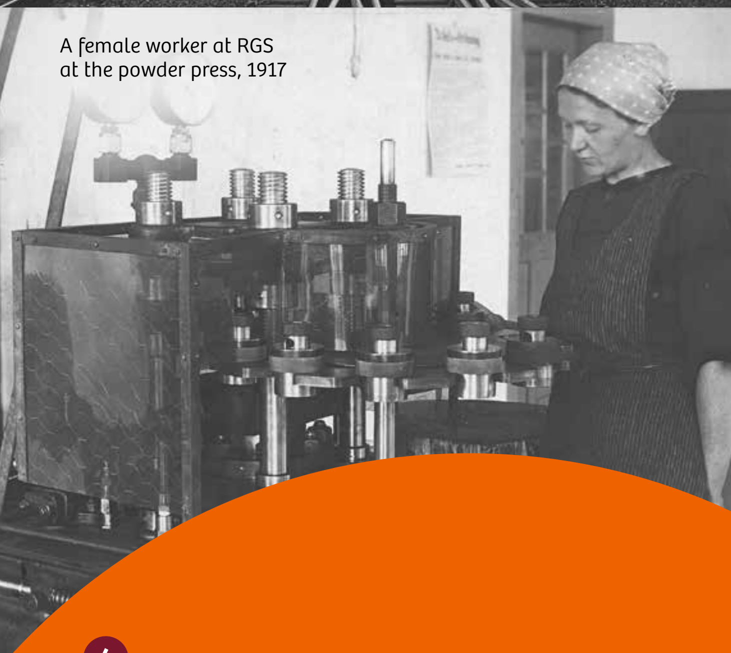
After Veifa was acquired by RGS, Dessauer dedicated himself increasingly to his research. But even though he had a reputation as a pioneer in deep X-ray therapy, he struggled for years to obtain a position as a university professor. Then, in 1920, the first chair in "Physical Foundations of Medicine" was established for him at the University of Frankfurt.

But Dessauer was not only committed to science. He was also passionately dedicated to economic and social policy. He served in the Reichstag, the German parliament, for the Catholic Zentrum party from 1924 to 1933, when he also published political writings.

He was arrested by the Nazis several times starting in 1933. He fled to exile in Turkey in 1934 and then in Switzerland in 1937.

Friedrich Dessauer – doctor, physicist, entrepreneur, politician, and groundbreaking researcher – died in Frankfurt on February 16, 1963, at the age of 81, due to the long-term consequences of radiation exposure. He had been a true Homo universalis – a polymath and Renaissance man – for the 20th century. He is buried at the Altstadtfriedhof cemetery in Aschaffenburg. The inscription on his grave reads, "Vita mutatur – non tollitur." Life is changed, not taken away.

Hospital train “Bayerischer Vereinslazarettzug” in Charlottenbrunn, Silesia (now Jedlina-Zdrój, Poland), 1915



A female worker at RGS at the powder press, 1917

A visit in the hospital train “Bayerischer Vereinslazarettzug V3”, 1915

4

Reiniger, Gebbert & Schall during World War I

Claudia Alraum

August 1914: The machinery of war had been mobilized to an unprecedented degree. World War I, also known as “the Great War,” claimed the lives of millions of soldiers. But even on the home front, the civilian population saw their lives turned upside down. The effects on the business sector and on the workforce were drastic. Skilled workers were called up to fight, and their absence was felt keenly at businesses at home. The ongoing war of attrition with both sides in static positions on the front lines brought an endless battle to grind down the other side through heavy losses in military material, so demand for the equipment needed for the war effort was almost impossible to meet. To fill the gap, the military began looking to industrial firms that had not previously produced armaments.

Erlangen-based RGS, founded in 1886, was among those forced to shift their production operations. The factory on the corner of today’s Gebbertstrasse and Luitpoldstrasse had previously focused on producing electromedical devices, such as X-ray systems and dental drills. But with the onset of the war, the business ground to a sudden halt. The military began placing orders with RGS for “lightweight military equipment”: field gear for draft and saddle horses, such as stirrups, curb bits for riding, spurs and curb chains. Later, canon fuses, howitzers, and throw mines were added, becoming the company’s main area of business.

But RGS remained true to its core business in electromedicine, at least in part. Easily transportable X-ray systems for use in the field were on the production list, as were systems specifically designed for wartime injuries, whether to locate foreign bodies or treat the wounded. Sales of electromedical equipment for civilian use were low, however.

While the general populace struggled with shortages, industrial firms were generally better off. Many companies saw economic growth during the war, RGS among them. The profit was invested in things like war bonds and government bonds, including those issued in Germany, Austria, and Hungary. During the war years, RGS provided a certain level of economic stability in Erlangen. The company offered jobs and distributed food rations, not just to its own staff, but also, on the orders of the local authorities, to workers at other plants in Erlangen that were producing armaments.

Many of the company’s own skilled workers had been sent to the front, so RGS gradually began suffering a shortage of personnel. Women and apprentices stepped in to do the job, becoming a major driving force at the factory. Female workers were tasked in particular with manufacturing mass-produced items that were important to the war effort, such as fuses. Toward the end of the war, in early 1918, women made up almost seventy percent of the 1,912-person workforce, and apprentices accounted for another eleven percent. Wages rose sharply during the war across all areas of German industry, including at RGS, but rising pay was not enough to keep workers from falling increasingly into poverty; food shortages were common, and prices were high.

With this in mind, the RGS management granted additional financial support to certain longstanding employees who had been drafted to serve in the war and their families. Paul Wahrenholz, head of the Vienna branch of RGS, wrote a letter to RGS general director Karl Zitzmann in the summer of 1917, asking for help: “My field pay is low and far from sufficient to support my family in Vienna, especially now, with prices here so high as to be almost unaffordable because the war has gone on so long. I am therefore turning to you, after already sacrificing the better part of my savings, to humbly ask if you [...] would be willing to assist me by approving an extra allowance.” Wahrenholz received a response a few days later approving an additional 200 Austrian crowns per month.

Female workers produce fuses at RGS, 1917

RGS donated a hospital train to the Empire. Called Bayerischer Vereinslazarettzug V3, it set out for Łódź from Erlangen in March 1915 and from then on was used to transport sick and wounded soldiers from the war zones to military hospitals in the interior of the country. The train offered various amenities, including space for 202 patient beds, and it even had its own operating room.

Life at RGS slowly returned to normal when the war was over. The shift to peacetime production operations posed a serious challenge, one that was further exacerbated by shortages of materials, rising wages, and inflation. Despite the tough conditions, RGS was able to reestablish itself on the domestic and foreign market in the postwar period. Expansive investments in the early 1920s led to lasting high debts, however, and as a result, the company was acquired by Berlin-based Siemens & Halske as of January 1, 1925. A new company, Siemens-Reiniger-Werke, was formed on this basis in 1932/33.

5

When you're hungry, everything is tasty

Heidi Leidig-Schmitt

Kitchen staff in the canteen of SRW, 1963

Cutlery with Siemens-Reiniger-Werke (SRW) engraving

Serving lunch at the canteen, 1963

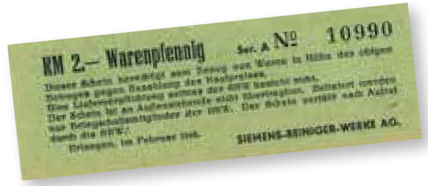
What is a set of cutlery doing at the MedMuseum? It shows that Siemens-Reiniger-Werke (SRW) was taking care of its employees at a factory canteen of its own as far back as the 1940s. To make sure everyone knew who owned what, each knife, fork or spoon was engraved with the SRW initials.

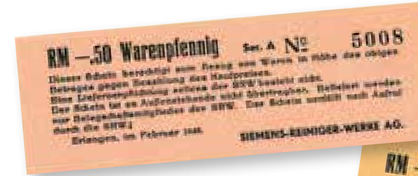
The canteen was closed during World War II. And even after the war, the situation was dire: apartments were in short supply, but food was even harder to come by. Shortly after the war, groceries were distributed via ration stamps. Long lines formed at food distribution points. One report from the Erlangen municipal administration to the military government says, "The supply of bread, fat, and meat had to be reduced in the first quarter. The supply of potatoes could only be called disastrous."

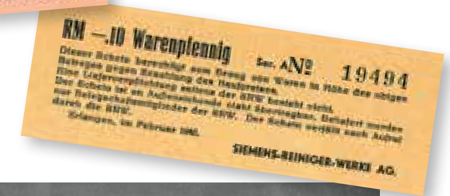
To be able to estimate the demand for the reopening of the canteen in 1946, those who were interested were supposed to report to their supervisors. The list came to 450 people in all. The company's goal was to ensure that employees got at least one hot meal a day, especially those who did not have a way to cook at home or lived too far away to get home at lunchtime. Traditionally, lunch has always been the heartiest meal of the day in Germany. Participants had to hand in ration stamps for 100 grams of meat, 25 grams of fat, and 50 grams of other nutriments weekly. Nowadays we have many times that amount on our plates – every single day!

In the fall of 1946, Siemens introduced an additional meal: breakfast soup, which was initially free of charge. But the situation was still desperate, and some employees turned to self-help. The factory's security team reported in November 1946 that they had foiled an attempt to steal 100 kilograms of carrots. A new member was added to the team in response: a "pedigreed guard dog," bought for 250 marks.

The winter of 1946/47 was a grim one. Vegetables and potatoes were scarce. Staff performance at Siemens plants deteriorated. In August 1947, the company decided to introduce its own "currency," dubbed the "goods mark" (Warenmark), as an incentive. An internal note commented on the move: "This would remind dawdlers to fulfill their duties better, in that in addition







to their pay, the amount attributed to the lost time for the so-called Warenmark account is lost as well."

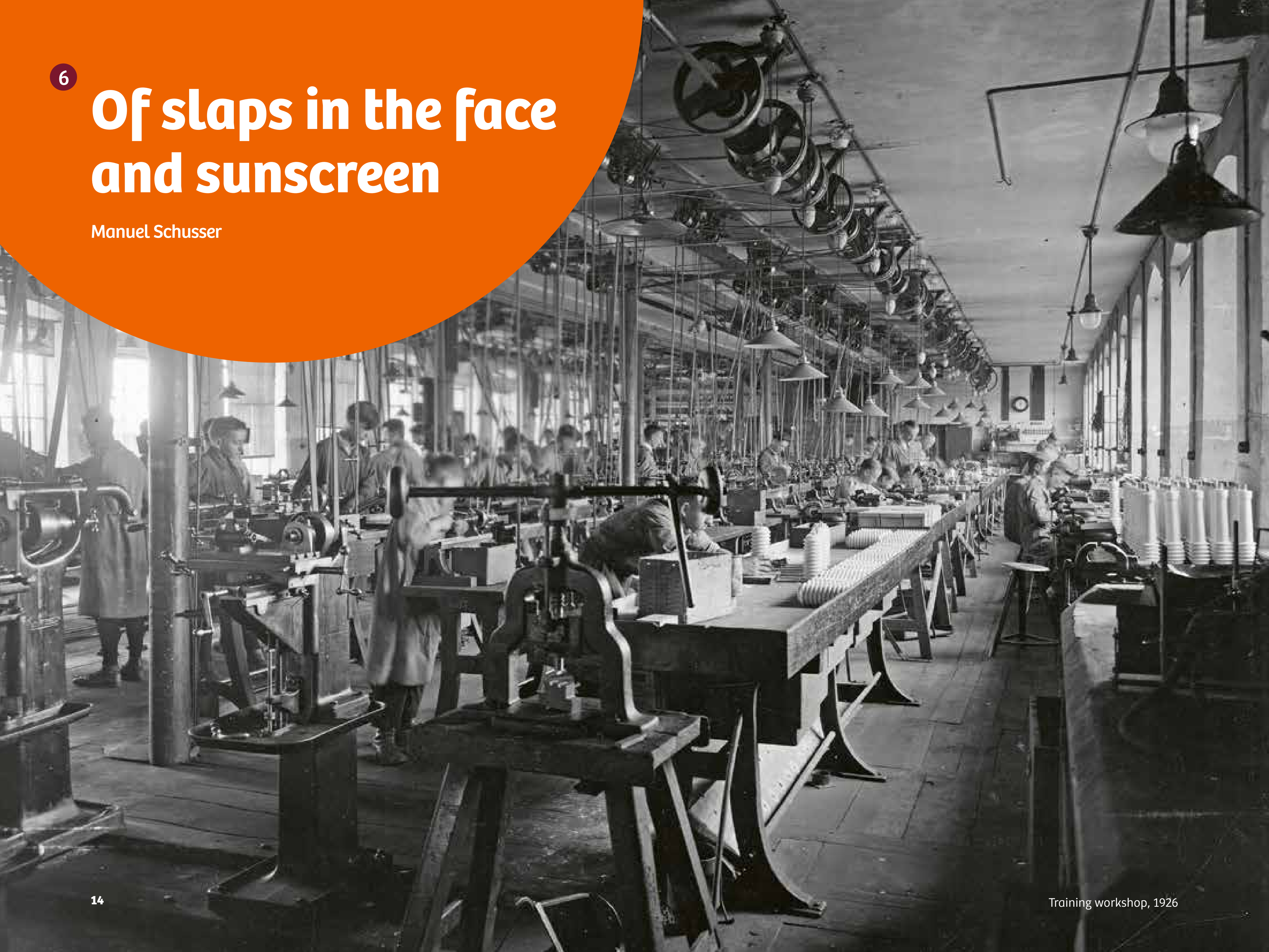
For the "goods mark," employees received five cents for every hour worked, along with an additional cent for each additional family member. The amount was credited to a separate account and applied in addition to their actual pay. The idea was that employees could use their accrued capital to purchase items produced at Siemens itself, or products from the company's barter or in-kind transactions. The company reasoned that any money the employees did not have to spend on these products would be available for food.

Shortages of everything

The "goods marks" could be used for a lot of things, such as aprons, work pants, slippers, or stockings. The goods were distributed by the works council, which was pleased to be able to offer a large number of goods: "The following items are available for purchase with Warenpfennig: 60 small handcarts and 90 flat irons; we have also received 2,200 sets of cutlery, 150 hotplates, 500 pairs of underwear and 30 sheet-metal wheelbarrows."

But even with the best of intentions, the quality of the available goods apparently fell short of expectations at times. Discontent spread among the staff. The days of the internal currency were obviously numbered. The final settlement of accounts took place in September 1948, and it turned out that 63.5 percent of the goods marks accrued had in fact been redeemed. The total value of the goods handed out came to DM 135,587.40 (approx. 950,000 euros by today's standards) before the Siemens currency was finally phased out.

Preparing stuffed cabbage in the kitchen of the SRW canteen, 1963



6

Of slaps in the face and sunscreen

Manuel Schusser

Training workshop, 1926

Apprentice
Georg Gugel, 1910

Training workshop,
1939

Rendering of the new Siemens training center in Erlangen (completed beginning 2017)

"People who […] have character are rare, so one should make every effort to find them and, once found, do everything possible to teach them…" Those are the views of Max Gebbert, one of the founders of RGS, writing in his treatise titled "Die Organisation" ("Organization"). And he did indeed set great store by ensuring that his apprentices received thorough training and education. He even taught some of them himself, employing relatively strict methods in the process. Alcohol and smoking were taboo, for one thing, and he didn't hesitate to dole out a slap in the face now and then, either.

Despite the strict rules, apprenticeships at RGS were highly coveted, and only about 30% of the young applicants wound up being hired at all. As basic prerequisites, apprentices had to be 14 or older and in excellent health and have good school reports. The first apprentice joined RGS already in 1877. At the time, a formal apprenticeship was still very rare. Then, in 1909, the company went even farther, building a separate workshop for teaching activities at the new plant on Zollhausplatz. Depending on the specific occupation, an apprenticeship lasted four to five years. Apprentices had to work nine hours a day (only seven on Saturdays). The training system introduced by Max Gebbert was based primarily on thorough practical training, combined with theoretical education. The system continued until long after his death. From 1898 to 1920, the company trained 569 apprentices in all, and the number was even higher from 1921 to 1945, at 783.

Unlike Max Gebbert, Werner von Siemens considered apprenticeships superfluous for a long time. Solid training in a craft seemed to him to be unnecessary in a factory geared toward serial mass production. But then, in the early 1890s, training workshops were set up on a trial basis, and finally, in November 1906, the Siemens & Halske plant school in Berlin was founded, beginning operation with 77 students. The curriculum focused on practice, but there was also a theoretical component, with instruction in German, arithmetic, civics, mathematics, drawing, and technology. The school founded back then still exists today as the Werner von Siemens Plant Vocational School (Werner-von-Siemens-Werksberufsschule).

Head engineer Max Pohlmann made a particular contribution to training activities at Siemens-Reiniger-Werke. In 1942, he was tapped to head the company's industrial training activities. His first step was to rebuild the company's programs after the end of the war. After that, he restructured them, laying foundations that would remain valid well after he retired. But most of all, he was active even outside the company, becoming a co-founder of what is today the Specialized School for Engineers and Technicians (Fachschule für Techniker) in Erlangen.

One unusual aspect of the training and education activities at Siemens is what the company calls its "headquarters training" (Stammhauslehre). This option gives secondary school graduates a chance to complete a two-year training program to become certified management assistants in industry, getting to know the full scope of the company in the process. Quite a few graduates go on to become members of the upper management of Siemens AG later on.

Training and educational activities have been run centrally by Siemens Professional Education since 2004. Nowadays, Siemens offers a wide range of apprenticeships and training programs in the fields of technology and engineering, IT, and business. The first building to be part of the new Siemens campus in the south of Erlangen, a training center for 1,300 apprentices and trainees that will encompass 10,000 square meters, has been completed beginning 2017. The new facility is home to more than just workshops, labs, and seminar rooms. In keeping with the focus on practical experience espoused by Max Gebbert and Werner von Siemens, it also has a fully automated process engineering production facility for sunscreen and shower lotion so that people can learn in practice just how automation technology works.

7

From “living room archive” to company museum

Stefan Dirnberger

How much would the “key to success” be worth to you? After all, what we’re talking about here is the original key to the workshop of Erwin Moritz Reiniger. All local historian Adam Martius asked in return was foreign stamps from day-to-day correspondence when, almost 80 years after the workshop’s 1877 opening, he turned over the key to the archives of what was then Siemens-Reiniger-Werke for safekeeping. The key is one of the most important objects in the MedArchiv’s extensive collections, so it has also made it into the Siemens MedMuseum, where it now symbolizes the start of the success story of medical technology in Erlangen.

Incinerating records, 1961

When the archive was founded, in 1948, it seemed doubtful that it would be a success story, or that there would be any exhibition at all: Destruction of files, improper storage, and damage due to the war had decimated the company’s scattered holdings. With this in mind, Karl Lasser, the first archivist, set out to collect the materials that were no longer needed for business operations. He suspected that retirees had some hidden treasures as well. However, he writes, he had “quite a hard time convincing these individuals through all kinds of devious means to add their materials to the archive.” Suffering from poor health himself and therefore homebound, Lasser was forced to collect these “treasures” in a room in his own apartment that was specifically reserved for the archive. “During his work, the documents were spread out everywhere, not just on the desk, but on every available surface, including the floor and chairs, and stored that way for quite some time,” as Gustav Oefele, Lasser’s successor, reports.

Lasser’s wish list included more than just documents and images, though. As far back as 1949, he suggested to the board that a “collection of interesting pioneering accomplishments” of the company should be started and made available to people working in the field in the form of an exhibition. But a collection like that needs space, and space is always in short supply. Oefele also regretted – with a hint of sarcasm – that no museum had yet been set up “because no one really wanted to deal with it, and we had such a good explanation for neglecting it because of the shortage of space at our plant, with its 60,000 m2 of usable space.”

While a few scattered pieces of old medical equipment were saved from landing on the scrap heap before then as well, it was in the mid-1960s that people began deliberately collecting appropriate items to exhibit in a museum. These historic objects, together with a modern exhibition space where customers would be able to look over the latest developments, were supposed to offer a comprehensive overview of the accomplishments of Siemens in the field of medical technology. But the plan did not come to fruition. Instead, the objects went on display at Munich’s Werner von Siemens Institute, in a museum and study room dedicated to medical technology. By the time the anniversary marking 100 years of electromedicine in Erlangen rolled around, in 1977, there was no equipment left at all for a small special exhibition at the plant.

In the year 2000, Doris Vittinghoff revived the dream of a separate exhibition in Erlangen. The original plan was to present the history of Siemens medical technology in a modest space at the MedArchiv. But even for a small exhibition, you need something to exhibit – so items were purchased from an Internet auction house without further ado. That laid the groundwork for the collection, which now also includes the equipment from Munich. Today, it encompasses several thousand pieces – from a tiny hearing aid to the Siretom, the first CT scanner from Siemens, which weighs tons.

The digital station titled “Window on the Archive” lets museum visitors find out more about the MedArchiv’s collections.

Construction of the museum finally got under way in 2009. One thing was clear right from the start: The museum was supposed to allow not just specialists, but anyone, to dive into the exciting history of medical technology, using a number of treasures from the archive that would otherwise remain hidden away. The exhibition site could not have been more fittingly chosen: It is the historic machine shop of Reiniger, Gebbert & Schall, one of the predecessors of Siemens Healthineers. When the museum opened its doors, on May 23, 2014, things had come full circle – and the archivists’ long-cherished dream finally came true, almost 65 years after Karl Lasser had first proposed it.

Key to the house at Schlossplatz 3, ca. 1877

8

Bringing the invisible to light

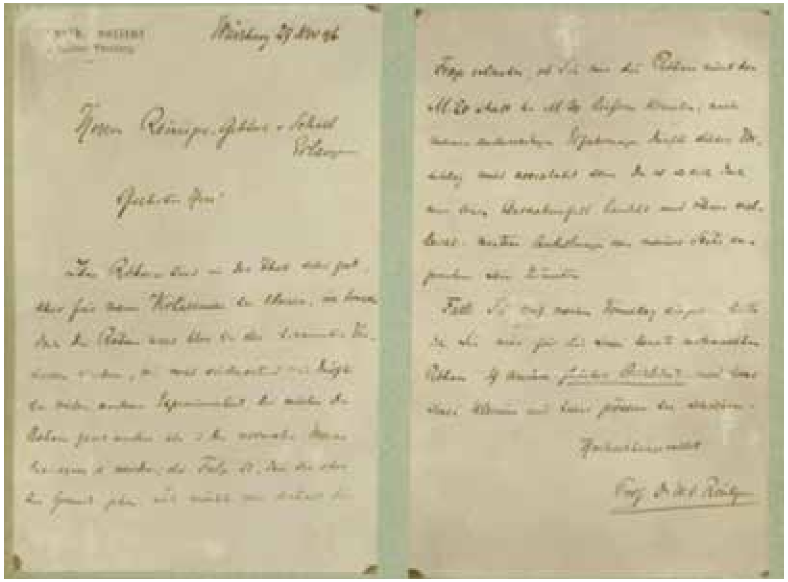
Doris Vittinghoff

On November 8, 1895, Wilhelm Conrad Röntgen, a scientist working in his lab in Würzburg, discovered a new kind of radiation, which he called "X-rays." The rays penetrated materials and the human body to varying degrees and could be captured on a photographic plate. The first medical imaging method was born. Unlike conventional photography – from the Greek photos, for "light," and graphos, for "drawing" – early X-ray images were called "shadow images". On December 22, 1895, Röntgen succeeded in taking the very first X-ray image of a human, showing the hand of his wife, Bertha.

The first detailed newspaper report was published in Vienna not long afterward, in January 1896. The news of the mysterious new rays swept the globe after that. People were fascinated by the ability to look inside things and people. X-ray fever took hold. Kaiser Wilhelm II summoned Röntgen to Berlin to give him a personal report.

Anything and everything was X-rayed: coin purses, luggage, human bodies. Throughout the country, public demonstrations were organized to offer visitors completely new insights. Viewing the inside of the body became a huge attraction. Röntgen himself believed his discovery was certainly important in scientific terms, but he was rather reticent in his comments about the possible practical applications of X-rays in medicine. But physicians were thrilled by the discovery right away, believing that it held previously undreamt-of possibilities for diagnosing disease. In Erlangen, as elsewhere, the new technology received an enthusiastic response, and local newspaper Erlanger Tagblatt commented on the "marvelous discovery" on January 10, 1896.

Bertha Röntgen's hand, 1895
Source: German Röntgen Museum



Röntgen's letter to RGS, 1896

Skull X-ray taken by Joseph Rosenthal at RGS, 1896

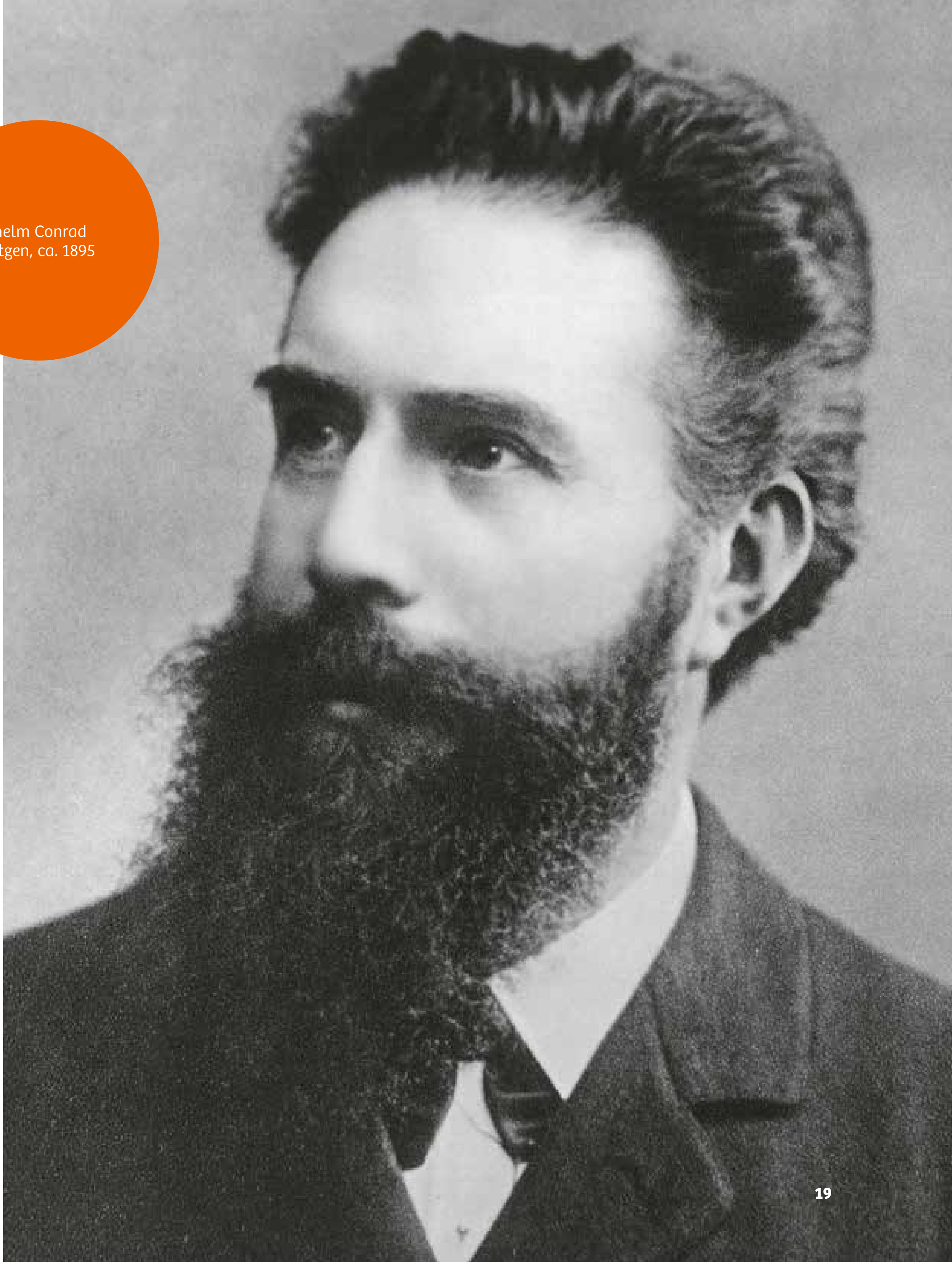
Max Gebbert, owner of the Erlangen-based firm of Reiniger, Gebbert & Schall (RGS), recognized the great potential of X-rays. He sent Robert Fischer, one of his salesmen, to Würzburg to learn about the method and “immediately [procure] the necessary devices to generate X-rays.” Shortly after that, Gebbert hired two physicists, Willibald Hoffmann and Joseph Rosenthal, to further develop the new technology.

Rosenthal designed a special X-ray tube for use in medical diagnosis. Before the year was out, RGS launched its first X-ray equipment on the market. Rosenthal used it to perform a head scan. He sent the image to Röntgen, who personally wrote back to thank him for “sending me the very nice photograph of a head.”

In a letter to Gebbert, Röntgen praises the high quality of the tubes, but also complains about the price: “Your tubes are in fact very good, but too expensive for my circumstances... I would therefore like to ask if you could supply the tubes to me for M 20 instead of M 30.” Gebbert’s answer is lost to history, but another letter from Röntgen indicates that he was indeed given the discount.

Gebbert mounted “X-ray expeditions” to a number of major cities in Germany, Austria, and Switzerland starting in the fall of 1896 to demonstrate how X-rays worked. These mobile events, to which mayors and city council members, teachers and doctors had been invited, brought the Erlangen-based company RGS to national and international prominence. The first few medical practices and hospitals were equipped with the new technology very soon afterward.

The surgical clinic at the University of Erlangen also received its first X-ray unit that same year. Röntgen did not apply for a patent on his discovery, since he wanted the invention to remain accessible to the general public. In 1901, he became the first scientist ever to be awarded the Nobel Prize in Physics. He donated the prize money, 50,000 Swedish kronor, to the University of Würzburg.



Wilhelm Conrad Röntgen, ca. 1895

9

Tuberculosis onscreen

Bianca Braun and Marcel Michels

Tuberculosis is a highly contagious disease that sickened tens of thousands every year in Germany alone right up into the 1970s. Because many of those who contract the disease infect others before ever experiencing any symptoms, early detection is the only way to prevent tuberculosis from spreading. With this in mind, large-scale X-ray screening was introduced in Germany in the late 1930s as a way to fight the disease. "Mobile X-ray units" equipped with Siemens X-ray technology were used in Germany and many other countries. One of these units is on display at the Siemens MedMuseum.

In the early 20th century, tuberculosis was considered one of the most serious widespread diseases. As early as 1926, Franz Redeker, a German physician and tuberculosis specialist, called for mass screening via X-ray as a way to fight tuberculosis. It had been noted early on that tuberculosis is apparent in X-rays of the lungs due to the typical "moth-eaten" appearance of the image in those with the disease.

The transportable X-ray unit „Seriomat 9 with Seriophos 5", 1959

But systematically X-raying large swaths of the populace was practically unaffordable at the time.

In the mid-1930s, Manoel de Abreu, a Brazilian physician and researcher, discovered a way around using expensive X-ray film for the images. To produce his images, he used an X-ray unit with a fluoroscopic screen that presented a moving X-ray picture while the tube was running. Abreu took a photograph of the moving picture and developed it using 35 mm film, which he then studied and analyzed through a magnifying glass. An image produced using this method cost less than 1/100 as much as a normal X-ray image of the lungs. Not long after Abreu's discovery, Casa Lohner, the entity that represented Siemens in Brazil, built the first X-ray unit designed specifically for mass screening, which was combined with a Siemens X-ray generator. It was first tested at the German hospital in Rio de Janeiro in early 1936 and then used by Abreu himself at the "Centro des Saúde no 3" health office for large-scale screenings of the populace starting in late 1936. Additional systems in other cities in Brazil soon followed. The process became known worldwide as mass miniature radiography.

The new X-ray technique caught on in Germany, like elsewhere. Hans Holfelder (1891–1944), a German radiologist, visited Brazil in 1937 and learned about the method there. After his return to Germany, he asked Siemens-Reiniger-Werke (SRW) to construct an improved X-ray system based on the Casa Lohner model. At the same time, Robert Janker (1894–1964), a professor in Bonn, was also working on developing mass miniature radiography.

He had been using the method since the mid-1920s, but his work had been limited to making X-ray movies showing movement processes inside the body. A competition had now been sparked regarding the practical use of X-ray technology for mass screening purposes, and Holfelder and SRW were determined to win.

The occasion for the first large-scale trial of the apparatus developed in Erlangen came in 1938, during the Nazi party's Nuremberg rally, when Holfelder screened 10,000 members of the SS in a single week. Between March and July 1939, an improved model of the SRW mass miniature radiography unit was then used to X-ray almost the entire population of the province of Mecklenburg: 95 percent of approximately 900,000 people. It was the first step toward what became known as an "X-ray register" – a survey of the entire German population via X-ray images.

X-ray technology was used for mass screening in Germany from 1939 right up into the 1980s. Many scientific studies confirmed the reasonable use of this method. Measures to fight tuberculosis were used in other countries as well. After World War II, the newly established World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) launched worldwide initiatives aimed at early detection of tuberculosis of the lungs using mobile X-ray mass miniature radiography unit.

Siemens-Reiniger-Werke developed a mobile X-ray unit with a special camera, the Seriomat 9 with Seriophos 5, in 1961. It was designed to be installed,

X-ray unit as designed
by Franz Redeker, 1931

as the Siemens employee magazine announced at the time, “in two small vehicles, such as Land Rovers or Willys Jeeps.” The unit was also used in large buses, which were used as mobile X-ray stations, primarily in Asia, Africa, and Latin America. The system on display at the Siemens MedMuseum was used from 1959 until the 1970s to perform scans at Siemens plants and offices throughout Germany.

Tuberculosis is now once more on the rise worldwide. Especially in developing countries, it represents a growing health risk due to increasing drug resistance.

A tuberculosis stamp from the 1950s: The “tuberculosis cross” at bottom right is the recognized international symbol of the fight against tuberculosis. It is still in use today.

Exploring the heart with a rubber tube

Bianca Braun

It was a hot June day in 1929 when Werner Forßmann (1904–1979), a young assistant doctor, crept through the Auguste-Victoria hospital facility, in Eberswalde, Brandenburg. His intention was to secretly use his lunch break to engage in daring self-experimentation: He wanted to insert a lubricated rubber catheter, normally used for the bladder, into his heart through a vein, allowing for an X-ray diagnostic examination of the heart. Cardiac catheterization, now an essential and widespread practice in cardiology, was still a fairly outlandish idea back in 1929. Forßmann did it anyway.

The historical X-ray image of the selfexperiment: The rubber tube in the right ventricle of Werner Forßmann, 1929

Klinische Wochenschrift 8, No. 45, 2085-2087

Just 25 years old, Forßmann had only recently earned his medical license. Before then, only a few physicians had experimented with inserting vascular catheters into human cadavers and animals. No one had ever dared to try it on a living person. At the time, cardiac scans relied primarily on X-rays and electrocardiograms – until Forßmann put his idea into practice. He wanted to know once and for all whether it would work, so he decided to insert a catheter into his own right ventricle. He succeeded right away on the first try, without any complications.

Forßmann planned his first experiment on himself meticulously, demonstrating both courage and finesse. He took advantage of the quiet period during lunch break at the hospital, knowing that he needed to do everything in secret. Forßmann received no support from his colleagues or then-supervisor for this experiment. And yet the attempt was a success anyway: The tube was already inside his body when he raced to the X-ray room to finish the experiment and document it by way of an X-ray image. Forßmann later described the event in his memoirs, saying, “The catheter was child’s play to insert 35 cm high.” In a second attempt, he then reached the right ventricle after 65 cm. The image of Forßmann’s heart with the catheter inside it is also on display at the Siemens MedMuseum.

The journal “Klinische Wochenschrift” published a description of Forßmann’s self-experimentation in November 1929. But his unusual method met with little approval in the medical world at first. At the time, he was already working at Berlin’s famed Charité university hospital, so he hoped for support from his superior Ernst Ferdinand Sauerbruch, a surgeon who worked there. But Sauerbruch was so outraged at Forßmann’s self-experimentation and the publication that he fired him, commenting, “This kind of stunt might qualify a person to work at a circus, but not a respectable German hospital.” Sauerbruch would prove to be deeply mistaken; cardiac catheterization is still considered the gold standard in diagnosis and treatment of coronary heart disease today. In 2012, over 950,000 of these procedures were performed in Germany alone – and in over one-quarter of them, the vessels were widened (dilated) while the procedure was still in progress. X-ray monitoring is an essential part of this process, when it is used to visualize the catheter and the vessels.

Cardiac catheterization is a minimally invasive procedure. It is an important method used to diagnose and treat various kinds of heart disease – such as examining the coronary vessels through a method known as coronary angiography. In this procedure, a contrast agent is injected into the coronary vessels. If narrowing – or worse, a blockage – is discovered in the vessels during the procedure, a special balloon can be used to widen the vessels, treating the patient by implanting a stent.

As for Forßmann, he was not rewarded for his daring self-experimentation until 1956, when he shared the Nobel Prize in Medicine with André Cournand and Dickinson Richards for their groundbreaking work on diagnostic cardiac catheterization.

Werner Forßmann with his wife, Elisabeth, evaluating an X-ray image in his practice in Bad Kreuznach, early 1950s

Pre-series model of
the SIRETOM, 1975

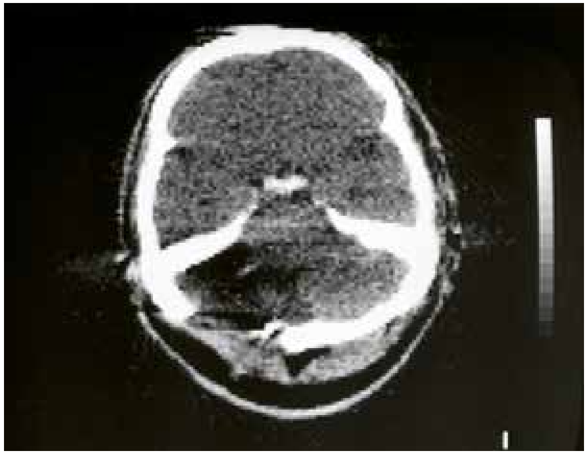
11 The origins of computed tomography

Ingo Zenger

Nearly eight decades after the discovery of X-rays, a new technology sparked fascination among medical professionals much as the first X-ray images had done in their time: Computed tomography (CT) is also based on X-ray technology, but it shows the inside of the body onscreen in slice format.

To undergo a CT scan, the patient lies on the scanner's table, which slides into the machine's ring-shaped opening. Often referred to by laypeople as the "donut," this opening is known in the medical community as the gantry. The gantry houses the measurement system, consisting of the X-ray tube and the detector positioned opposite it. While the measurement system circles the patient, the tube emits a fan-shaped X-ray beam. These rays pass through the patient and strike the detector, which converts the measurement values and forwards them to a computer for calculation. The result is detailed, high-contrast images of the inside of the patient's body that the physician can view onscreen.

Serial model of the first Siemens CT SIRETOM from 1975 in the museum



A CT image of the head produced by the SIRETOM, 1975

CT technology allows medical professionals to pinpoint things like tumors and internal injuries with superior accuracy. In a conventional X-ray image, the structures of the body are superimposed over one another; images of the lungs are affected by the ribs, for example. By contrast, CT images are free of superimposed layers, just as if individual slices had been taken from the body itself.

The first CT scanner was introduced in London in April 1972. It was a surprise in two ways: First, the medical community was astonished by the images it produced, and second, it came from a surprising source – EMI, a record company. Godfrey Hounsfield, an engineer who is viewed today as the father of computed tomography, worked at the research lab at EMI. Together with his colleagues, he developed a CT system known as a "head scanner" to perform brain scans. Physicians were thrilled by the quality of the resulting images, and many of them acclaimed computed tomography as the most important invention since the discovery of X-rays.

Not long afterward, "CT fever" broke out. More than 15 other companies joined EMI in developing CT scanners. The fundamental research unit at Siemens in Erlangen established a development department dedicated specifically to CT before the year was out. In their early work, the Siemens engineers were able to build on their experience with X-ray technology. Many of the necessary components were already on hand and merely needed to be adapted to their new purpose, while others were newly developed by technicians from the ground up. The team grew and received support from other Siemens departments. "Unforgettable" is how Friedrich Gudden, the head of development, describes "the tremendous enthusiasm of our […] significantly larger development team." Work continued until late night every day. Gudden often drove employees who relied on public transit home personally after midnight. Image quality made great strides, to the team's delight. In mid-1974, the preliminary work was complete and the prototype had been given a name: The first computed tomography system from Siemens was named SIRETOM.

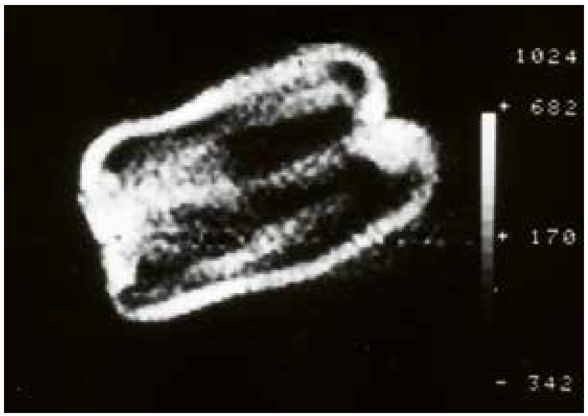
About 18 months later, after numerous trial runs and clinical tests, the big moment had finally arrived: On December 1, 1975, the neuroradiology department at the Goethe University medical center in Frankfurt received the first series-produced SIRETOM model.

Today, after four decades of development and many prominent discoveries, CT technology yields images of the entire body at levels of quality that were once unimaginable. Today's high-end scanners make it possible to visualize even bodily structures smaller than 0.25 millimeters. This allows, for example, the visualization of the fine side branches of the coronary vessels during heart examinations. Physicians can turn images, zoom in and out, and even do a virtual "fly-through" to examine structures such as the intestine.

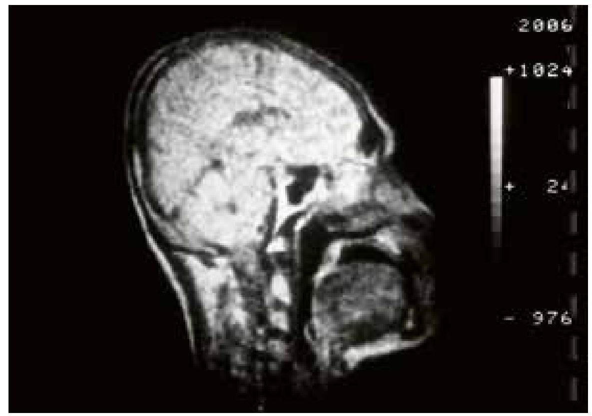
12

The first patient: a bell pepper

Bianca Braun



The first MRI image in Germany, taken on Erlangen's Hartmannstrasse: the bell pepper, 1980



Physicist Alexander Ganssen was the first to dare to undergo a head scan using the MRI unit, 1980

It all started out with a bell pepper. In February 1978, Siemens Med, in Erlangen, began developing a new technology for medical imaging, a technology that would come to be known today as magnetic resonance imaging (MRI). But before the Siemens developers entered the unit's narrow opening themselves, they used an unusual test subject – a bell pepper. Its fairly blurry image is now on display at the Siemens MedMuseum, bearing witness to an extraordinary story.

"A bell pepper is a nice size, it has a lot of internal structures, and it doesn't move during a long exposure time," says Arnulf Oppelt, one of the first MRI developers, looking back at the exciting early days of this technology.

Together with other colleagues, Oppelt worked in fundamental development of MRI technology at Siemens back then. The bell pepper image is the first one taken in Germany using this new method. It took several hours. And the location of the development was also an unusual one – a wooden research lab on Hartmannstrasse. Because of the strong magnetic fields used to create MRI images, the scans had to be performed in a room with no iron or steel parts at all. After the success with the bell pepper, the team's courage grew. The first image of a human skull followed just a few months later, in March 1980. Alexander Ganssen, a physicist, volunteered for the scan, lying in the narrow confines of the unit for eight minutes.

He had been working with MRI since he was first hired by Siemens, in 1965. His suggestions and developments were instrumental in making advances in the use of magnetic resonance imaging in medical applications. Ganssen also spurred the development of an MRI system in-house at Siemens.

In January 1983, three years after the bell pepper image was taken, the first Siemens MRI system, still a prototype, was installed at Hannover Medical School. More than 800 patients were examined with the system in clinical tests. Not long afterward, the new imaging system also had a name: Magnetom. This system is also on display at the MedMuseum. Like the building where it was developed, the unit's patient table was also made of wood.

Then, in August 1983, Siemens became the first company in the world to install a commercial MRI system for clinical applications, when the Magnetom was put into operation at the Mallinckrodt Institute of Radiology, in St. Louis, Missouri. The first series-produced models were shipped to German medical practices and hospitals not long afterward, in late September.

In the first four years, Siemens sold more than 150 Magnetom units worldwide, many of them to customers in the United States. "Ahead in Japan as well" was the message in 1987, when Siemens became the first manufacturer of MRI systems to win approval there for systems with a higher field strength of 1.5 tesla. Alongside sales successes – Siemens Healthineers is currently the world's leading provider of MRI technology – great technological strides have also been made in the period since then.

Higher field strengths have brought steady improvements in image quality. To many patients, though, it is a completely different step in MRI development that plays an important role: The systems' tunnel diameter has been enlarged on an ongoing basis as the magnet itself has grown slimmer. Another crucial advance is that an MRI scan now takes much less time to complete than in the days of the historic bell pepper image, which makes undergoing one much more pleasant. After all, there is good reason that MRI systems are now part of radiology practices' basic equipment.

Magnetic resonance imaging (MRI) has been used as an imaging method in clinical medicine in Germany since the early 1980s. The physical phenomenon behind it, nuclear magnetic resonance, had already been known for several decades at the time. Paul Christian Lauterbur (1905–1983), a chemist, was the first to use it to generate images of the human body. He published his images in 1973 and 1974, sparking research and development of systems that were suitable for medical use. Within just a few years, the method – which has no known side effects – was in use across the board. MRI scans provide significantly more accurate images of organs, nerves, and connective tissue than previous methods. Lauterbur and Peter Mansfield, a physicist, were jointly awarded the Nobel Prize in Medicine in 2003 for their work in this field.

"The first test subjects had to crawl into the magnet on a wooden board, which was quite uncomfortable," reports one early MRI developer.

Shown here is Siemens employee Wilfrid Löffler, 1980

13

A lifesaving device formed in a plastic cup

Ingo Zenger

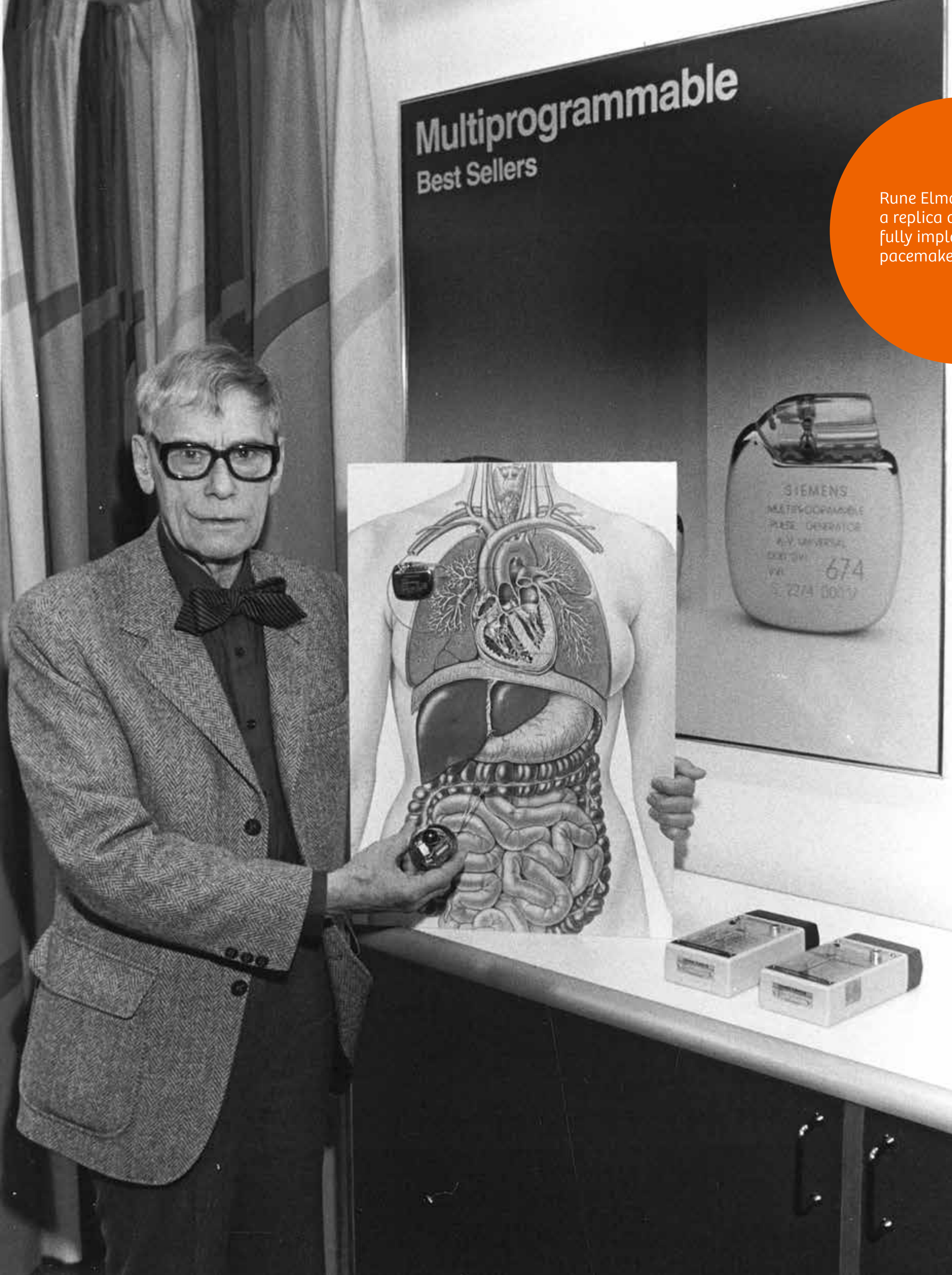
Experimental model of the first fully implantable cardiac pacemaker, 1958

They help without even being noticed: Today's cardiac pacemakers are generally only a bit larger than a two euro coin, weigh only a few grams, and are implanted in the patient's chest wall. This was all very different up until not very long ago. The first cardiac pace-maker, invented in 1952, was the size of a small cathode ray tube (CRT) television, and the patient had to push it around like a shopping cart. With the invention of small batteries and reliable transistors, pacemakers quickly became much smaller in the years after that, and as early as 1957 could be worn around the neck like a necklace. That same year, Swedish inventor Rune Elmqvist started working on the world's first fully implantable cardiac pacemaker.

Arne Larsson was doing poorly. Formerly a player on the Swedish national ice hockey team, by the fall of 1958 he could hardly set foot outside his bed and suffered frequent bouts of unconsciousness. His heart stopped beating as many as 30 times a day, and his wife, Else-Marie, had to resuscitate him each time with a blow to the chest. Larsson was just 43 years old – and his chances of getting much older were slim. But Else-Marie refused to resign herself to the situation. She had read in the newspaper that a doctor named Åke Senning was working with Rune Elmqvist, an engineer, at Karolinska Hospital in Stockholm to develop a cardiac pacemaker that could be fully implanted into the body. She began contacting the two researchers daily in an attempt to convince them to help her husband.

Senning and Elmqvist were skeptical, since their research up until then had focused on how strong the electrical current should be and how many impulses per minute should be used to stimulate the heart. But Else-Marie Larsson's persistence paid off: Arne Larsson underwent secret emergency surgery to implant his first pacemaker on October 8, 1958. The device was a makeshift one; time was short, forcing Elmqvist to mold the components in a simple plastic cup with synthetic resin. The pacemaker stopped working after just a few hours and had to be replaced the next morning. The new unit worked without any problems for the next six weeks, however. Several months later, Elmqvist and Senning presented their work for the first time at an international conference in Paris focusing on electronics in medicine. Elmqvist was still not convinced that his invention had a future, viewing cardiac pacemakers "as a technological curiosity, more or less."

He was mistaken. His employer, Elema-Schönander, later Siemens-Elema, went on to develop numerous models featuring complex technology that allows them to be adapted to individual heart problems. In today's advanced systems, for example, sensors analyze current physical activity and automatically adjust the impulse frequency.



Rune Elmqvist shows a replica of the first fully implantable pacemaker, 1983

Multi programmable pacemaker 668, 1983

On average, about 75,000 of these devices are implanted each year in Germany alone.

Larsson received 25 more pacemakers in the 43 years following the first implantation. A pacemaker restored his ability to swim or bicycle at a leisurely pace, dance, and even travel by plane.

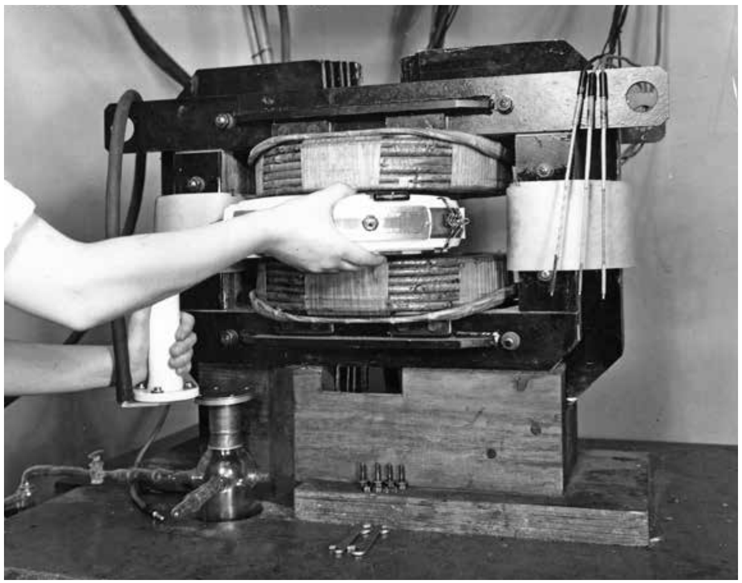
He was once again able to stand up to the demands of working life. Larsson held himself up as an example of how successful cardiac pacemakers could be, and he successfully lobbied manufacturers to keep up their development activities. Larsson died in 2001, at the age of 86. His death had nothing to do with heart problems or his pacemaker. Larsson even outlived Elmqvist himself, who had extended his life, by about five years.

14

Putting a spin on cancer

Manuel Schusser

Dr. Konrad Gund in a portrait photo taken around 1950



Experimental version of the first betatron at Siemens-Reiniger-Werke, 1944

"Driven to death by despair", "Nuclear physicist loses his nerve" – the event made headlines in many German newspapers in early June 1953. The "Erlanger Nachrichten" was among them, publishing a detailed report in its June 6 edition on the tragic story of the suicide of Konrad Gund, a gifted developer at Siemens-Reiniger-Werke (SRW).

Konrad Gund was born in Vienna on April 25, 1907, and his talents emerged early on. Alongside an inclination toward music, he was especially interested in mathematics and in the technological progress of his era. He went on to study electrical engineering at Vienna University of Technology and joined the electromedical department of Siemens & Halske AG in Vienna in mid-1931 as a young engineering graduate. From there, he moved to the SRW design office in Erlangen in 1936.

Gund demonstrated particular skill at resolving difficult tasks related to design theory, especially during the development of the betatron. Various physicists and engineers, including Max Steenbeck at Siemens & Halske, had been working on accelerating electrons in the 1930s. In 1940, Donald Kerst, working at the University of Illinois, developed an electron accelerator he called the "betatron." A year later, the invention also became known in Germany, and SRW decided to develop an electron accelerator for medical purposes – with Gund heading the project. In this system, electrons are accelerated along a circular path inside a vacuum tube, reaching nearly the speed of light. This makes it possible to fight tumors with both electrons and ultra-hard X-rays while largely sparing the surrounding tissue.

The first betatron was completed at SRW in Erlangen not long after that, in 1944. Once the war was over, however, the American military administration ordered the company to suspend all further work. It was not until the ban was lifted, in October 1946, that the team was able to resume its research on the electron accelerator. Then, in 1947, a betatron with six million electron volts (MeV) was installed at the radiology department of the university medical center's gynecology clinic in Göttingen, where it was to be used for physical and biological research. In 1949, the time had finally come: The first medical radiation treatments for skin cancer using the betatron were successful.

Gund had reached the high point of his professional career. He completed his dissertation on the development of the betatron at the University of Göttingen in 1946, and in 1949 he was appointed to the European Council committee for nuclear physics research. He was in close contact with the great physicists of the era, including Nobel laureate Werner Heisenberg. He also took over as head of the design office at Siemens-Reiniger-Werke at this time.

A betatron with even more power promised even better curative results, reaching even deeper-seated tumors. Under Gund's leadership, SRW developed a new 15 MeV betatron, which was installed at the dermatology clinic in Göttingen in 1953. The unit soon suffered technical difficulties, however, leading to interruptions in radiation operation. Gund threw himself into his work to solve the problem. He left for Göttingen on May 31, 1953. The next morning, he was found dead next to his betatron. He had taken his own life by breathing in gas. Ultimately, people can only speculate about the reasons; despair at his failure to solve the problem may have combined with what his contemporaries described as a tendency toward perfectionism, and a depressive disposition might have been the final factor that tipped the scales. His wife, Déjanire, to whom he was married for more than 20 years, took her own life the next night after hearing the news.

The problem that drove Gund to despair was solved just a few months later. The betatron he developed helped countless cancer sufferers over the years.

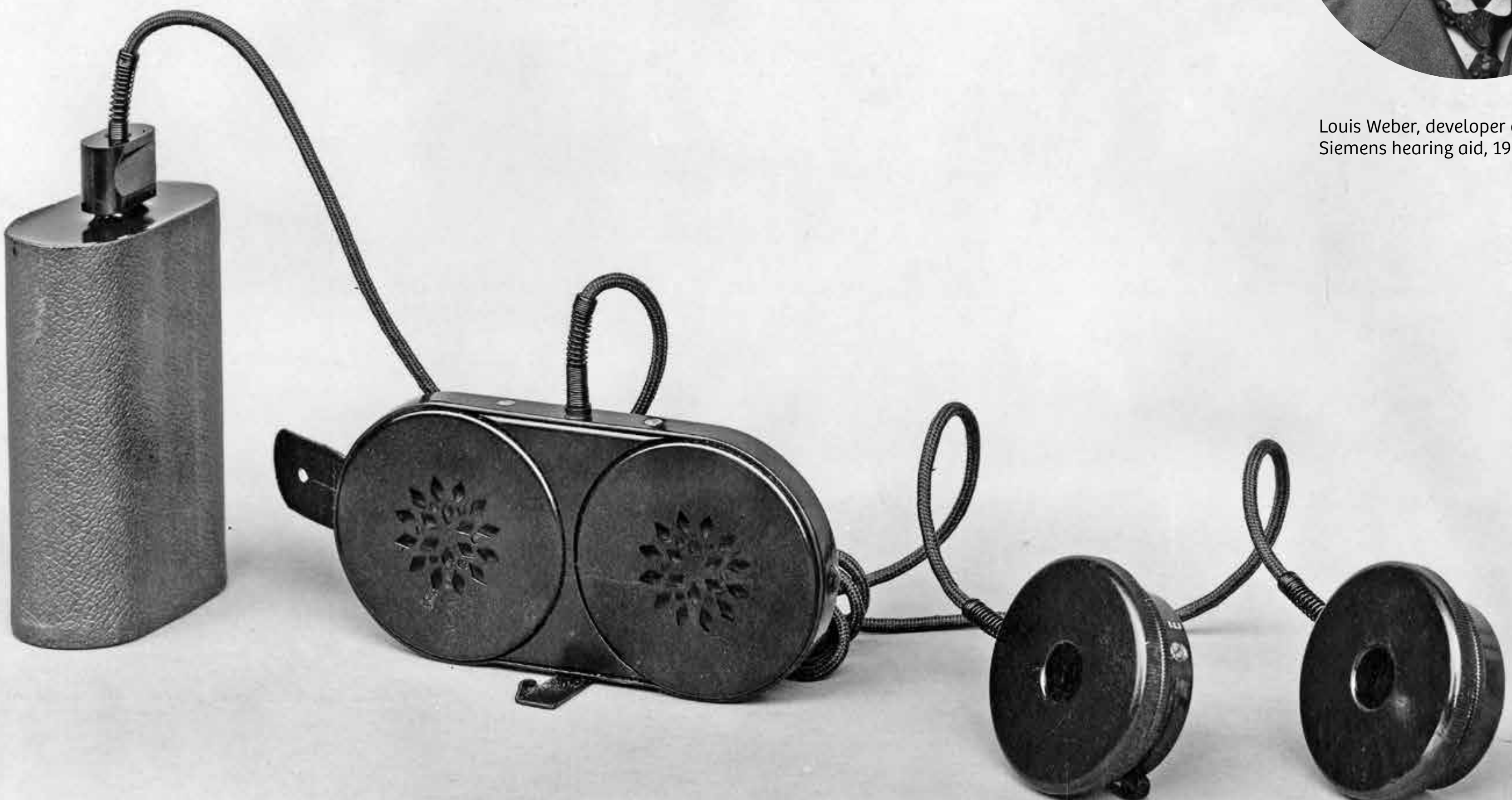
The betatron that was further developed by Konrad Gund, in the 15-million-electron volt configuration, 1952

15

Fighting deafness

Ingo Zenger

Louis Weber, developer of the first Siemens hearing aid, 1913



Phonophor with double receiver, 1913

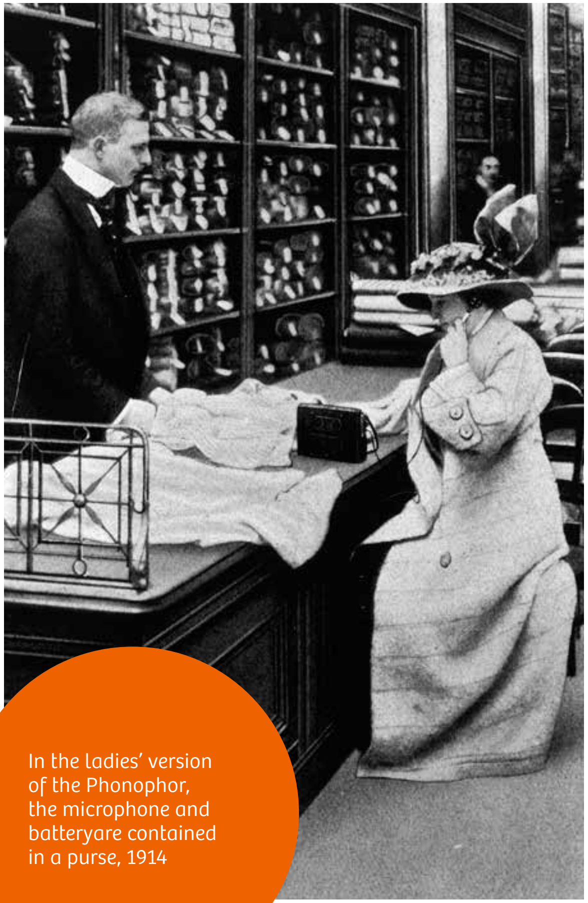
In 1878, Werner von Siemens built a telephone with a horseshoe magnet, considerably improving the unit's voice quality. At the same time, it was discovered that many people with hearing loss found it easier to follow a conversation on the phone than without any electrical device to amplify signals. This was the basis for Louis Weber's development, in 1911, of the first Siemens device designed specifically to improve hearing: the Esha-Phonophor. The device was supposed to amplify tones without interference while being as small and inconspicuous as possible. Originally planned as a single hearing aid for a friend of the company, the device turned out to be a huge success, and series production was launched in December 1913 – marking the start of the long and successful history of hearing aids from Siemens.

Berlin, summer 1911: Carl Kloenne, a director at Deutsche Bank, was hard of hearing. He wanted an electric hearing aid. A friend, Professor August Raps, was the head of the Wernerwerk plant in Berlin's Siemensstadt district, where telephones were being produced at the time. Raps tasked his assistant, Louis Weber, with producing a device to help with Kloenne's severe hearing loss.

At the Wernerwerk plant in Siemensstadt, Weber worked to improve speakers and microphones for telephone systems. In 1911, when he started developing his "apparatus for the hearing impaired," electric hearing aids from other manufacturers were already on the market, but they were very large, making them both heavy and noticeable.
When designing his hearing aid, Weber was careful to focus not only on improving sound quality; the device, as he said, was also supposed to be "as small as possible, so it is not very bothersome to the wearer." After numerous attempts, he succeeded in producing a highly sensitive carbon microphone, two of which he combined with a small receiver and a three-volt battery to make an "apparatus for the hearing impaired." Weber took his device to Mr. Kloenne with the aim of "helping him with this apparatus where other attempts had failed [...]. But to no avail again."
After that, Weber made "one last desperate attempt": He had a double headphone made in the place of the single headphone that had been used previously, and set off to see Kloenne again. When Kloenne saw the double headphone, he said there would be no point in trying it, since he was completely deaf in one ear. Weber was finally able to convince him to try the device after all, and "lo and behold, Mr. Kloenne was now able to hear even in the ear he had thought was deaf, and he beamed at this success." Later, he noted, "I fondly recall the day when Mr. Kloenne told me, visibly moved, that the new hearing aid had allowed him to participate in a group again for the first time in a long while."

After Weber's successful development, Siemens & Halske (S&H) decided to market hearing aids under the name Esha-Phonophor. "Esha," pronounced "es-ha," mirrored the German pronunciation of S&H, the abbreviation commonly used for the company name at the time. The unit was launched on the market in late 1913, in several versions. In one configuration, a special ladies' version, the microphone and battery were held in a purse. Another version took the form of a folding camera, a popular accessory at the time, complete with a discreet leather carrying strap. Hearing loss sufferers were also able to choose from one, two, or even four receivers right from the start, for a configuration accommodating their individual level of hearing loss.

Weber's technology stayed in use for a long time, albeit in a revised form and with better materials. One year after the Phonophor, Weber developed a small device he called an "ear telephone," which was used as a receiver for switchboard operators. This earphone, affectionately known as the "hazelnut" due to its shape, was outwardly very similar to modern in-ear headphones, featuring a diaphragm made from an animal eardrum. Not long afterward, the headphone was offered as an alternative in newer Phonophor model series. After Siemens & Halske employees learned that famed X-ray inventor Wilhelm Conrad Röntgen was losing his hearing, they presented him with one of their new models as a gift in 1922.



In the ladies' version of the Phonophor, the microphone and batteryare contained in a purse, 1914

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Electric shocks in the dentist's chair

Ingo Zenger

William Niendorf as a soldier in Würzburg, 1891

From the "uberwulf" extractor and tooth extraction hook to the "pelican", there was only one solution for problem teeth for a long time: extraction with crude tools. In the 19th century, the invention of anesthesia and the use of drills led to a shift in dentistry: teeth with cavities could now be "restored" with fillings. The first drills were foot-driven, but low-rpm drilling was painful to patients and uncomfortable for dentists. Systems driven by electric motors were developed to help with this. William Niendorf built Germany's first electric dental drill in Erlangen in 1890. But the first models frightened not just patients, but also dentists themselves.

At the age of 14, William Niendorf knew he definitely wanted to be a mechanic when he grew up, but that was no easy matter in Berlin in 1884. Many businesses demanded several hundred marks in advance as payment for taking on an apprentice. Niendorf came from modest circumstances, and his family was unable to afford the fee. His guardian thought Niendorf should train as a wallpaper hanger, so he started an apprenticeship – but dropped out after just three months. He still dreamt of becoming a mechanic. Finally, his guardian managed to place Niendorf in a small workshop run by a former Siemens mechanic, where he quickly impressed others with his skill and was given various responsibilities. When the shop master fell ill, Niendorf – still an apprentice – managed the shop, where three assistants and three apprentices worked.

Niendorf finished his apprenticeship in 1888, and worked for a short time in Budapest and Nuremberg, winding up two years later as an assistant mechanic at Reiniger, Gebbert & Schall (RGS) in Erlangen.

It was not long before Niendorf's talent came to the attention of Max Gebbert, one of the company's founders. He tasked Niendorf with building Germany's first dental drill with an electric motor. The idea had been suggested to Gebbert by Dr. Friedrich Schneider, the court dentist in Erlangen, who worked closely with RGS. Schneider tested many of the devices developed by RGS at his practice at Theaterplatz 7 and engaged in regular discussion with the company management. He was immediately impressed with Niendorf's electric dental drill – with one minor caveat: The first trial models were not insulated adequately, so dentists and patients received the occasional electric shock Niendorf took this into account when developing the first mass-produced models, in 1891 and 1892, improving the insulation between the hose and the motor frame. Dentists were still afraid of the 110-volt electricity flowing into the device from the electrical grid, so RGS equipped the units with 12-volt batteries, each one the size of a small suitcase. Even then, dentists were still skeptical toward electric dental drills. It was not until 1893 that Schneider was able to significantly boost interest in the electric dental drill through his presentations at dental conferences.

As for Niendorf, his handcrafted drill was an important foundation, not only for the development of dental equipment in Germany, but also for his personal career. His conscientious work and emphasis on precision accuracy helped him advance quickly within the company. He became a foreman, then the head of the Erlangen plant, a member of the Managing Board and later the Supervisory Board, and even played a major role in the merger of RGS and Siemens & Halske to form Siemens-Reiniger-Werke. Dental equipment always remained close to Niendorf's heart during his 43-year career working for the Erlangen-based medical technology company.

Electrical dental drill from RGS, ca. 1900

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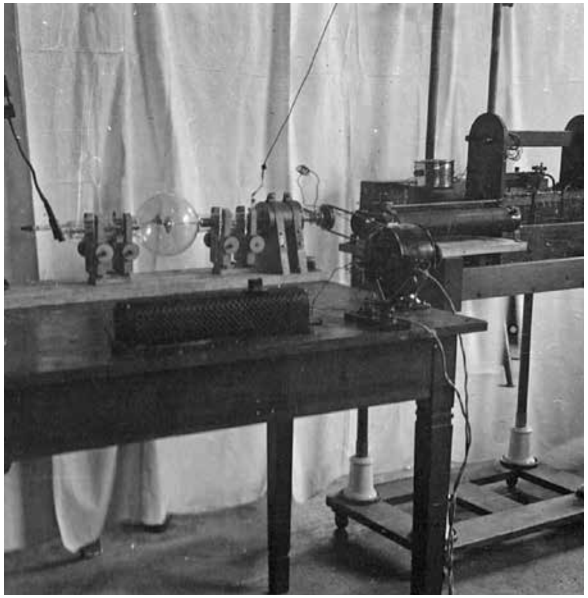
Pantix, a very special X-ray tube

Bianca Braun

It was shortly after World War I when Alfred Ungelenk, an engineer, and Otto Kiesewetter, a glassblower, founded their company, Ungelenk & Kiesewetter, in the city of Rudolstadt, Thuringia. They worked together to produce X-ray tubes from 1919 onward. By then, X-ray technology had already grown out of its infancy, but Ungelenk set out to build a completely new X-ray tube, a tube that was better than all those that had come before. He aimed to make it more resistant and more durable.

Up until the early 1930s, doctors used X-ray tubes with stationary anodes (see box). These tubes were powerful enough to take images of extremities. But if images of the chest or abdominal cavity were needed, there was often severe blurring due to movement – caused by things like breathing. Engineers first proposed back in 1897 that this problem be solved by having the anode rotate, enhancing the tube's resistance by ensuring that it would not become too hot. But actually making tubes like this a reality did not become technically feasible until several decades later.

Alfred Ungelenk, ca. 1933



The experimental version of the rotating-anode tube at the plant in Rudolstadt, 1927

It was a period of new beginnings, new ideas and a spirit of daring when Alfred Ungelenk, an engineer, and Otto Kiesewetter, a glassblower, founded their company in 1919. Via a circuitous path, the company would eventually come to form a part of Siemens-Reiniger-Werke (SRW) in 1932/33.

Ungelenk and his team started working on development of a rotating-anode tube in 1927, but progress was slow. When Hamburg-based tube manufacturer C.H.F. Müller and its parent company, Philips, launched the first rotating-anode tube, under the name Rotalix, on the market in 1929, Ungelenk and his department faced mounting pressure. They needed to catch up as soon as possible in terms of technology. In May of 1932, Ungelenk even believed the threat was so acute that the Rudolstadt plant was in danger of closing. But just a year later, he was finally able to report success to the management. He even thought

An experimental version of the Pantix rotating-anode tube is on display at the MedMuseum

the tube he had developed was so good that he wrote, "The new tube is (...) definitely superior to the Müller Rotalix tube. I think this thing has the best prospects of becoming a 'worldwide hit' (...). That should bring in quite a bit for SRW."

The "thing" in question was the Pantix X-ray tube, on display at the Siemens MedMuseum. Inventor Ungelenk himself tells its story at one of the listening stations. It was the first rotating-anode tube from Siemens. The disc-shaped anode kept the tube from heating up as fast, so it could be used longer in clinical operation.

The head of the X-ray department at the university medical center in Göttingen, Dr. Walter Brednow, was one of many satisfied customers at the time. In June 1934, he wrote to Siemens-Reiniger-Werke: "When we started working with these tubes, our goal was to have a tube that combined the advantage of the utmost image resolution with that of high resistance, especially for the many gastrointestinal scans we perform. In these scans, about 30 to 40 targeted images are taken, (...) often with only one to two seconds between them (...). The Siemens rotating-anode tube meets these requirements for us in an absolutely dependable way (...). This tube is (...) highly recommended."

The Pantix became the Rudolstadt tube plant's bestselling product in the years that followed, laying the foundation for the development of later high-performance X-ray tubes. The plant of Siemens Healthineers in Rudolstadt still produces tubes and emitters for computed tomography (CT) systems and radiography to this day, along with compact rotating-anode tubes for surgical applications.

The problem concerning X-ray tubes

Like light, X-rays are electromagnetic waves. Radiation is generated in an X-ray tube when electrons from an incandescent wire, the cathode, are beamed at a specific metal part known as the anode. When the electrons strike the anode, X-ray radiation is generated. Early X-ray tubes were unable to take a large number of images in succession, as they soon grew too hot. This was problematic, especially at large hospitals with many patients, since the most costeffective way to operate X-ray equipment is continuously. As a result, the first improvements in X-ray tubes were aimed at making them more resistant. Attempts to achieve this by using a rotating focal spot were made in the 1920s. The problem was ultimately solved with the development of the rotating-anode tube.

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Submarines, water baths, and fetuses

Bianca Braun

The foundations of ultrasound technology as we know it today were laid by the Curie brothers in 1880, when they discovered the piezoelectric effect. That was when it became known that there are ultrasonic waves that can be reflected. Early applications included "sonar" technology, which was used to locate submarines during World War I. Research on medical applications for ultrasound followed not long afterward – initially for treatment purposes. Early attempts to harness ultrasound for diagnostic purposes started with physician Karl Theo Dussik and the development of echocardiography, but it was quite a few years before the first medical diagnostic devices arrived on the scene. Ultimately, the technology's big breakthrough came when Siemens introduced the first ultrasound unit that created images in real-time and was suitable for routine clinical practices: the Vidoson 635.

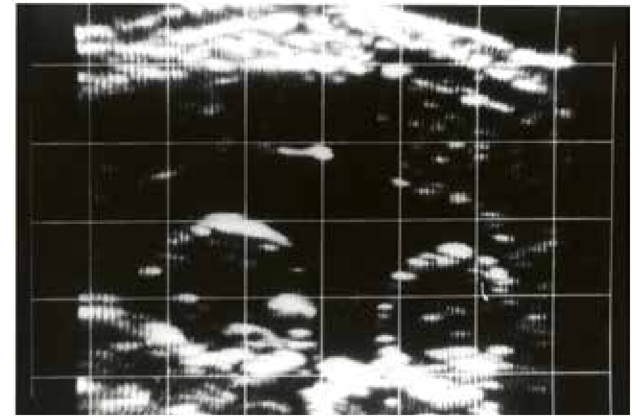
Ultrasound therapy system SONOSTAT, 1947

Siemens-Reiniger-Werke (SRW) first began studying the medical applications of ultrasound technology back in 1935. Reimar Pohlman was one of the major pioneers in ultrasound technology and the founder of ultrasound therapy. He was the first to study how ultrasound affected living human tissue, which he began doing in 1938. His medical research soon yielded success: Siemens began producing the first units for ultrasound therapy in 1947. Independently, Austrian neurologist Karl Theo Dussik was the first to use ultrasound to study the ventricles of the brain, which he did early on, in 1942. The first ultrasound scanners were used in the 1950s. But the application was a complicated one, since to undergo a scan, test subjects had to be immersed in large water tanks. The transducer circled the patient, generating simple two-dimensional black-and-white images. In the early 1950s, Dr. Inge Edler, a cardiologist, and Dr. Carl Hellmuth Hertz, a physicist, dared to perform a new experiment in Sweden: Using an ultrasound scanner that Siemens-Reiniger-Werke was then producing for testing materials, they managed to produce the first non-invasive image of moving structures in the heart, on October 29, 1953. The chart showed the echo of Hertz's own heart. This method, later known as echocardiography, went on to become established as an important diagnostic method in cardiology.

Ultrasound in real-time: the Vidoson 635

In the early 1960s, Siemens joined others in embarking on research on the development of ultrasound technology for imaging and diagnosis. At the time, there were already ultrasound systems known as "compound" systems, but they were still too cumbersome and slow to generate an image, so they were incapable of visualizing movements inside the body, all of which meant they were of limited utility in routine clinical operations. In 1961, Johannes Pätzold, the head of development at Siemens, tasked Heinz Kresse, a physicist, with developing a fast ultrasound method. Kresse got down to work, and it wasn't long before he came up with the first few solutions, which Richard Soldner, a young engineer responsible for hardware at the lab, was asked to build. Soldner was successful. The first real-time ultrasound scanner, the Vidoson, was introduced in Erlangen in 1965, but it was not yet ready for series production. Hans-Jürgen Holländer, a physician working in the city of Münster, recognized the scanner's benefits for use in obstetrical diagnostics. He was the first to use the early prototype of the Vidoson 635 in a clinical setting, and he made extensive suggestions for improvements, which ultimately paved the way for the first series-produced model. Siemens began producing the new model in 1967, and it became a bestseller in the years that followed. By 1970, Holländer used the device to perform 3,487 scans, 3,167 of them on pregnant patients. The ultrasound scanner visualized the inside of the human body at such short time intervals

An examination using the Vidoson, 1966



The first real-time ultrasound image: twin fetuses (17th week of pregnancy), 1965

that it was even possible to observe, photograph and film movements directly. And although many physicians still needed to learn how to work with the new technology and familiarize themselves with recognizing the images, which were completely new, this period still marked the start of a noninvasive diagnostic method that has no side effects on patients and has become an integral part of medicine today.

Development continues

The Vidoson was just the beginning of a long series of further innovations in the area of imaging ultrasound. Blood flow detection, the color Doppler method, panoramic imaging, and 4D images are just some of the advances that have been made in ultrasound technology in recent decades. Over the years, the scanners themselves have shrunk in size and grown ever more convenient to use, and nowadays, many emergency doctors carry along miniature versions. The range of medical applications has also grown significantly. Current devices and programs make it easier for physicians to do various things, including measuring cardiac valves, examining the female breast, and detecting liver tumors.

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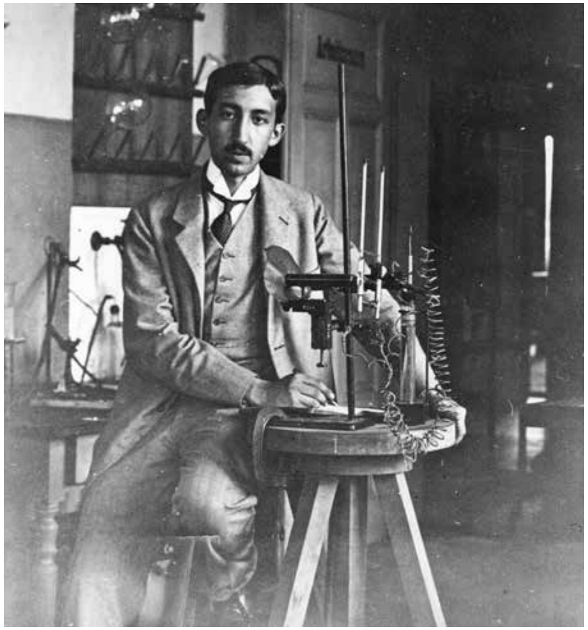
A grain of truth…

… or: how a historical meat scandal became painstaking archival research

Marcel Michels

There are a lot of anecdotes in circulation regarding George de Hevesy (1885–1966), who is known as the "father of nuclear medicine," most of them having to do with his descent from Hungarian nobility and the way he was raised as a result, along with his own idiosyncrasies. But the most famous story about him has to do with the tracer method, and with it, the origins of nuclear medicine.



George de Hevesy as a student in Freiburg, ca. 1910

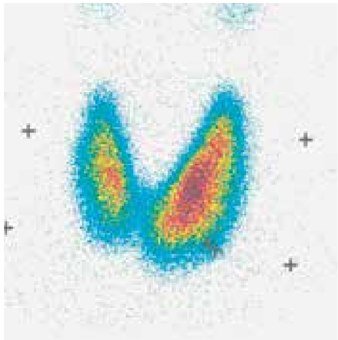
It is a story that has been retold many times over, sometimes with more embellishment and sometimes with less. It is sometimes set in Manchester, sometimes in Copenhagen, and sometimes the tracers go from the Sunday roast to the casserole, while in other accounts, his landlady cries out, "That's magic!". Many of these stories lack a reference to the source. Research on the origins of the quote showed that one author had copied the story from another. But finally, in a biography of de Hevesy, there was a source given for the original quote: de Hevesy had told the story at a conference at the University of California in Berkeley in 1962. So far, so good. But where is the transcript of the talk? There was a reference to that, too: "NBA," the usual abbreviation for the Niels Bohr Archive, in Copenhagen. For lack of further detail, it was impossible to turn up our text at first, so a trip to the archive became necessary. After quite a bit of searching, what we had spent so long looking for turned up on microfilm number 78, labeled "George de Hevesy 2": a transcript of de Hevesy's talk at a conference titled "Radiation Physics in the Early Days," given in Berkeley, California, on May 23, 1962.

At the end of the talk, de Hevesy is asked, "I'd like to ask Dr. Hevesy about the story I heard about the tracer experiment involving some boarding house food." De Hevesy answers: "Oh, that was no tracer experiment. If you mix thorium D in a hash, that is no tracer experiment: that is just a radioactive measurement. This landlady served always this same food all week, and when I suggested this, she said it was not possible – 'Everyday fresh food is served'. So one day when she didn't look I added some dose of radioactive material. And the next day the hash was radioactive!"

No more and no less – so all of the other embellishments are pure invention! But the trip also brought other findings to light: A lab book from his time in Manchester shows de Hevesy's address at the time as St. Paul Street 17, Withington, Manchester. The regional address book for 1911 then also gives us the name of the landlady in question: Mrs. Florence Barratt. Now we know at least who prompted the young de Hevesy to conduct this experiment.

But to return to the subject of nuclear medicine, what is the tracer method, anyway, and why is it essential to molecular imaging? Unlike other imaging methods, nuclear medicine makes it possible to see metabolic processes that take place inside the body. To do this, slightly radioactive molecules – generally different types of sugar or iodine – are introduced into the bloodstream. These molecules, known as "tracers," build up at spots in the body where the metabolism is elevated. Examples include disorders of the thyroid gland and tumors. A scanner records the radioactivity transmitted by the tracers and converts it into an image. In combination with the anatomically

George de Hevesy with Niels and Margrethe Bohr in Manchester, 1913



Scintigram of a thyroid gland, 1984

accurate methods of computed tomography (CT) and magnetic resonance imaging (MRI), this yields extremely accurate, detailed diagnostic images. George de Hevesy was the first to use this method in biological systems – first in plants, and then also in animals. The tracer molecules he used were isotopes of lead, phosphorus, and heavy water. He received the Nobel Prize in chemistry for his work on radioactive indicators in 1943, writing a standard work on the subject that was published in 1948. Between 1912 and 1963, he published over 400 scientific articles on various aspects of radioactivity and its use in biology; the title of "father of nuclear medicine" is just one of many honors and accolades he earned for his work.

An examination of the thyroid gland using the Siemens Nukleoskop,1955

20

Of cows, buses, and medical technology in India

Katharina Schroll-Bakes

Siemens India representative office building, ca. 1940

"The road was empty of all but two-wheeled oxcarts and troops of monkeys. (...) Two other species of animals also ruled the roads: first, the many cattle, and then the even more plentiful stray dogs roaming around. The cows were unpredictable: suddenly there they were, in the middle of the road...," Siemens employee Walter Sladek reported in 1961, detailing the difficulties he faced when transporting an X-ray system to a remote area of India.

India is nine times larger than Germany, and traffic conditions at the time were not comparable with European standards. This meant it was not easy to get these systems, which were quite bulky, to where they were going. But that didn't keep Siemens from supplying medical technology to practically the entire world. For example, Reiniger, Gebbert & Schall (RGS) – one of the predecessors of Siemens Healthineers – added Australia to its sales markets in 1894 and Brazil in 1906.

RGS had been equipping hospitals and private practices in India with medical technology since as far back as 1905. India soon became a promising market, and Siemens India opened a representative office of its own for the field of medical technology in Calcutta (now Kolkata) in 1927. That same year, the first Siemens X-ray system was installed at Chittaranjan Sadan Hospital, also in Calcutta. Four decades later, the system is still in operation and functions perfectly thanks to regular service and maintenance.

An internal presentation in 1972 concluded from this that “These kinds of lifespans have ultimately not only brought the Siemens name respect, but also helped to establish the good reputation of the ‘Made in Germany’ label.”

Indeed, the quality of Siemens products soon came to be emblematic of the Siemens brand, wherever its products were manufactured. After all, Siemens has production sites all over the world – and all of them meet the same high standards of quality. Some X-ray systems and other types of electromedical equipment now also bear a “Made in India” label. Siemens started out producing medical technology products with a handful of employees in Bombay (now Mumbai) in 1959. The factory soon expanded, and the number of employees grew steadily. After being relocated to Goa, the plant rose to prominence as one of the largest development and production centers for X-ray technology in Asia.

Employees of Siemens India in Calcutta, 1940

Special touch screens help the visitors to discover the beginning of medical technology in different countries worldwide

A Siemens Sanjeevan mobile clinic, 2000

Although India has made great strides in terms of its economy, it is still beset by general infrastructure problems. A large portion of India’s population of more than one billion lacks adequate access to medical care. Siemens is trying to help solve this problem with the “Sanjeevan” (or “hope bus”) mobile clinic concept.

What looks like a normal tour bus from the outside is actually a fully equipped medical practice with modern treatment and diagnostic equipment. There are now 26 of these mobile clinics traveling through remote areas of India to provide even rural Indians with basic medical care. Still, many of India’s roads still belong primarily to cows and other animals.

Visit the Siemens MedMuseum to explore these and other interesting stories and information on the locations at the station “Siemens Healthcare worldwide”.

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From uroscopy to automated large-scale labs

Ingo Zenger

Some of the components of the SILAB system, 1971

Blood, phlegm, yellow bile, and black bile – Hippocrates of Kos, arguably the best-known physician of all time, suspected that the fluids of the body affected our health back 2,400 years ago. With his doctrine of the "four humors," Hippocrates and his followers paved the way for systematic examinations of bodily fluids, believing that many diseases stemmed from an imbalance in these four humors. This belief gave rise to a diagnostic method that would remain one of the most important tools in medicine from antiquity well into the early modern era: sensory examination of urine. Practitioners of this method, known as "uroscopy," examined the urine's color and consistency and assessed its smell – and, on occasion, even its taste.

Advances in chemistry, especially in the 19th century, ultimately led to more accurate, more reliable methods of urinalysis. But even as late as the 1930s, these kinds of analyses were still laborious and time-consuming. To determine glucose levels for a diabetes test, the urine had to be mixed with a special detection fluid in a test tube and heated over a Bunsen burner. This did not change until 1941, when the first rapid urine test was introduced by a company called Miles. The test, called Clinitest, was an effervescent tablet that changed the color of urine, allowing clinicians to see its sugar content. Fifteen years later, the first test strips were brought out on the market, under the name Clinistix. Offering even greater ease of handling, the strips were the first-ever efficient urinalysis option for use at hospitals and medical practices. They were standardized so that medical professionals could read and compare them easily. Over time, many other tests have been introduced to do various things such as monitor a patient's immune system or diagnose hepatitis. For many symptoms, these kinds of test strips are still the first approach doctors use to gain an overview of the patient's condition.

Over the history of modern laboratory diagnostics, the number of tests has risen from year to year. To cope with the sample volume, a New York-based company called Technicon developed the AutoTechnicon Tissue Processor in the early 1940s. It was the first automated analysis device, significantly reducing staff workloads. Working overnight, the machine could handle the same volume that had previously taken a lab assistant days to complete. Numerous systems from various manufacturers followed. Large-scale machines now process hundreds of samples in just a short time, while smaller units are used in medical practices and ambulances, or right at the patient's bedside in the hospital. For example, the Siemens SILAB system, which was introduced in the late 1960s, was designed according to a modular approach. The user put the system together according to the requirements, with a wide range of options to choose from, encompassing everything from a small microscope workstation up to a large-scale automated lab. Advanced systems, both large and small, now analyze urine, blood, and tissue samples within just a short period.

A belief rooted in antiquity has evolved into an accurate, broad-based science that includes astonishing discoveries, especially in the past 75 years. The pioneering work done by two companies, Miles and Technicon, was crucial to these achievements. Today, both companies – or, more specifically, the companies that succeeded their laboratory diagnostics divisions – are part of Siemens Healthineers. Siemens links the physical values from the lab with other test results, including images from ultrasound systems, computed tomography (CT) scanners, or magnetic resonance imaging (MRI) systems. It is already the case today that laboratory diagnostics often makes the crucial contribution to ensuring optimum treatment, and current research will make the field even more meaningful in the future. Molecular diagnostics, for example, makes it possible to determine on an individual basis for each patient where that person's possible predispositions to disease lie and which medications will be most helpful to him or her.

Comparing a urine test strip to a color chart, 2012

A state-of-the-art fully automated large-scale lab, 2013

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