Fact Sheets on Sweden

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Swedish Inventions and Discoveries

Many well-known inventions and discoveries—historical and modern—were made by Swedes. The following pages present some of these and the people behind them.

Through their discoveries and skills in utilizing international knowledge, inventors and scientists laid the groundwork for many of the innovations that played a major role in Sweden's industrialization and evolution into an affluent country. Today's inventions help keep Sweden firmly on the map as a country of innovators and inventors.

HISTORICAL INVENTIONS AND DISCOVERIES

The Swedish scientific "revolution" occurred in the 18th century. At that time, Sweden was a predominantly agrarian country. The technical advances achieved during the 16th and 17th centuries were mainly attributable to the immigration of skilled craftsmen, merchants and professionals—among them many Germans, Scots, Dutchmen and Walloons.

The Swedish scientific establishment is often said to have been born in 1739, when the Royal Academy of Sciences was founded. In fact, scientific research had taken place earlier in Sweden, but for the first time this research became systematically organized.

The Swedish scientists of the period were often broadly knowledgeable "universalists" who made vital contributions to scientific and technological progress.

Olof Rudbeck the Elder (1630–1702) was a teacher, university rector, scientist, archaeologist and more. Arriving at the University of Uppsala in 1648, he pursued his medical studies so successfully that in 1652 he unveiled an epoch-making discovery: the human *lymphatic system*. In 1654 he laid out Sweden's first botanical garden at Uppsala. Rudbeck was one of the most versatile men that Sweden has ever produced. He urged the establishment of secondary schools focusing on technology and science, built bridges, planned water systems and taught many subjects including mathematics, astronomy and architecture.

Portrait from the young Linnaeus's first scientific journey—the Lappland journey of 1732.

Christopher Polhem (1661–1751) lived in an age when it was still possible for one individual to learn and to master a large proportion of human knowledge. Without question, he was among those who strived to be universalists. He designed lathes, clocks, tools and a wide variety of machines. During his 90-year life, Polhem turned out numerous inventions and ingenious designs. Unlike many of his contemporaries, he built his own machines and carried out many of his own projects.

Anders Celsius (1701–44), astronomer and mathematician, is best known today for the *centigrade thermometer* that bears his name and is now used in much of the world. But Celsius initially designated the boiling point of water as zero degrees and the melting point of ice at 100°. Later, Linnaeus is said to have turned this scale upside down. Celsius carried out a number of highly important astronomical measurements as well.

Carl von Linné (1707–78), born Linnaeus and known in English by the latter name, is mainly famous for the systematic classification of plants, animals and minerals presented in the work *Systema naturae*. Linnaeus made his first scientific journeys in Sweden, resulting in lengthy, many-faceted reports: he traveled to the province of Lapland in 1732, to Dalarna in 1734 and finally to Skåne in 1749. He also sent his disciples to all corners of the world to collect specimens and report their observations: Anders Sparrman and Carl Peter Thunberg traveled to China; Sparrman and David Solander participated in James Cook's round-the-world expedition; Thunberg visited Japan; Johan Peter Falck explored the interior of Asia; Pehr Kalm traveled to North America; Anton Martin to the Arctic Ocean, Daniel Rolander and Pehr Löfling to South America, Fredrik Hasselqvist to Palestine and Peter Forsskål to Arabia. Only in recent years has it been possible fully to appreciate Linnaeus's greatness as a scientist, especially as a botanist, and asa physician. His insistence on empirical evidence for all conclusions furthered the cause of the inductive method in the natural sciences.

Pehr Wilhelm Wargentin (1717–83) combined scientific talent with good organizational skills in leading the Royal Academy of Sciences to a position of stability and renown. He laid the groundwork for modern Swedish *population statistics* on the basis of a 1686 law requiring the Church of Sweden to keep records of births, deaths and people who moved into or out of each parish. In 1749 *Tabellverket*, a government agency for statistics headed by Wargentin, was established to compile this Church-collected material. As a result, Sweden (along with Finland, then part of the country) has the world's oldest official population statistics. Wargentin's agency was the forerunner of Statistics Sweden (*Statistiska centralbyrån, SCB*).

Carl Wilhelm Scheele (1742–86) began as an apprentice to an apothecary. Working on his own, he gained a broad knowledge of chemistry surpassing that of most internationally famous chemists of his era. Scheele devised many outstanding *analytic techniques* and was the first to verify that the same metal may go through different stages of oxidation. He discovered several *chemical elements*, among them chlorine and molybdenum, and isolated many other substances.

Jöns Jacob Berzelius (1779–1848) was among the first scientists to embrace Dalton's atomic theory. Using this as well as Gay-Lussac's gas law and other theories, he pursued the daunting task of working out the earliest *table of atomic weights*, which he published in 1818. With the aid of precise calculations, he determined atomic weights for 45 of 49 then-known chemical elements. He also introduced the simplified *system of denoting the elements* by one or two letters from their Latin names. In 1817 Berzelius discovered the element selenium, in 1823 silicon, and in 1828 thorium.

The pioneering work of *Anders Jonas Ångström* (1814–74) in *spectral analysis* forms the basis for this entire modern discipline. He analyzed the sun's chemical elements, and in 1868 he published a map of the spectral lines of nearly 100 elements. Ångström was also the first to measure wavelengths in absolute terms. For this purpose he introduced a basic unit, one ten-millionth of a millimeter, later (1905) named after him.

Anders Celsius's centigrade thermometer. Celsius himself described it either as an "ornament" or as an instrument for seeing "how much the heat in a room rises or falls".

Museum Gustavianum, Uppsala

EARLY INDUSTRIAL INVENTIONS

In the 1870s, the Swedish engineering industry entered a period of expansion unparalleled before or since. The next few decades witnessed the creation of a number of companies that would gain a dominant role in Swedish industry. For the most part, they manufactured mechanical products, some so successfully that the engineers that invented them became the heroes of their era. Many of their names remain familiar in Sweden and internationally. Here are a few of them.

After engineering studies in Göteborg and Zurich, *Nils Gustav Dalén* (1869–1937) became interested in acetylene for lightning. Appointed chief engineer of AB Gasaccumulator (AGA) in 1906, he was responsible for a series of important inventions: *agamassa*, a substance that absorbs acetylene, reducing the risk of explosions; a *switch for maritime beacons*; and the *sun valve*, which automatically turned on the beacon at nightfall and turned it off at dawn. The AGA beacon meant major savings in personnel and materials and made shipping safer along Sweden's long coastlines. In 1912 Dalén was awarded the Nobel Prize in physics.

In 1872, after jobs and studies in Sweden and Germany, *Gustaf de Laval* (1845–1913) began to concentrate on what would be one of his most important inventions, the *cream separator*. The first model was patented in 1878. In 1883 a company called AB Separator (later Alfa-Laval) was established to manufacture and export the separator. Laval also designed a milking machine, but his other great invention was a steam turbine with a resilient axle, which he completed in 1892.

John Ericsson (1803–89) showed great engineering talents from an early age. In 1826 he moved to England, where he designed the locomotive "Novelty" which competed with George Stephenson's "Rocket." He also developed caloric (hot air) engines, solar collectors and other mechanical devices, but his most important invention was the *screw propeller* for ships. Ericsson gained widespread fame by designing an ironclad vessel, the *Monitor*, which defeated the Confederate armored steamer *Merrimac* in 1862, during the American Civil War. The only monitor still in existence—the "Sölve"—is on display at the Gothenburg Maritime Museum.

In 1876 *Lars Magnus Ericsson* (1846–1926) and a partner started the company that evolved into Telefonaktiebolaget L.M. Ericsson, today abbreviated Ericsson. It began manufacturing *telephones* in 1878 but soon ran into competition from the American-owned Bell company. Lars Magnus Ericsson was chiefly an outstanding entrepreneur, but he also made various improvements to early telephone equipment, designed switchboards and set up telephone networks. As early as the 1890s he established subsidiaries abroad, and Ericsson's products attracted international attention.

Carl Edvard Johansson (1864–1943) worked at the government-owned Small Arms Factory in Eskilstuna, where he discovered that the *gage blocks* being used there did not allow sufficiently precise measurement. His gage blocks from 1901 had a tolerance of one thousandth of a millimeter, and in 1907 he patented a gage block set with even finer tolerances. C.E. Johansson's gage blocks eventually played an important role in the Swedish and international engineering industry, particularly in the American automotive industry.

Johan Petter Johansson (1853–1943)discovered while working as a mechanic in an industrial plant that he and his assistants often had to carry around numerous wrenches for different nuts and bolts. So he came up with the concept of the universal pipe wrench (1888), and in 1892 he designed and patented the *adjustable wrench* (monkey wrench or universal screw spanner). He established a company that later became Bahco. More than 100 million monkey wrenches have now been manufactured by the company, which is known today as Sandvik Bahco, and production continues. Throughout the world, about 40 million monkey wrenches of J.P. Johansson's model are produced annually. Johansson made a total of 118 inventions, several of them world-famous and still in production.

Johan Petter Johansson's adjustable wrench in its original 1892 design and in 1992, after a century of refinements.

When only 16 years old, *Birger Ljungström* (1872–1948) invented and designed a bicycle that had a free wheel and a rear-wheel brake (still the most common type in Sweden). His first prototype, completed in 1892, was later mass-produced under the name Svea. He and his brother *Fredrik Ljungström* (1875–1964) invented high-pressure steam boilers and a new type of steam turbine, the *Ljungström turbine* (patented in 1894). Other important inventions include the turbine-powered locomotive and the air preheater.The American Society of Mechanical Engineers (ASME) designated the Ljungström regenerative air preheater the "International Historical Mechanical Engineering Landmark", calling it the greatest mechanical invention of all time. This is a rotating heat exchanger which improves the conversion efficiency of steam boilers by recirculating heat from the hot exhaust gases to the incoming combustion air. More than 20 000 air preheaters are installed world-wide and they are still manufactured by Svenska Rotormaskiner in Stockholm.

Gustaf Erik Pasch (1788–1862), *Johan Edvard Lundström* (1815–88) and *Alexander Lagerman* (1836–1904) laid the groundwork for the Swedish match industry. In 1844 Pasch received a patent for the *safety match*. He replaced the hazardous yellow phosphorus found in the matches of that period with red phosphorus and put it on the striking surface instead of the match head. In 1845 Lundström and his brother started a match factory which adopted and improved Pasch's invention. In 1864 Lagerman designed the first *automatic match fabricating machine*, thereby opening the way to mass production of matches. His "full-service machine" produced both matches and match boxes, turning out filled match boxes that were ready for sale.

Carl Edvard Johansson's gage block set.

Alfred Nobel (1833–96) was only 29 years old when he patented a detonating cap for nitroglycerine and nitric acid, but nitroglycerine was still likely to explode on the slightest impact. In 1866 Nobel discovered that nitroglycerine flowing out of a broken bottle was absorbed by kieselguhr—a porous diatomite—which protected the container from blows. He noticed that the mixture was very stable and easy to handle, but retained its explosive characteristics. This marked the birth of *dynamite*. Nobel companies expanded throughout Europe, and dynamite production climbed from 11 metric tons in 1867 to 66,000 tons in 1895. Upon his death in 1896, Nobel held a total of 355 patents. Alfred Nobel's will created the Nobel Prizes in physics, chemistry, medicine/physiology, literature and peace. They were awarded for the first time in 1901.

Together with a brother, *Frans Wilhelm Lindqvist* (1862–1931) developed the *kerosene stove*, which was patented in the late 1880s. In partnership with a factory owner, he began to manufacture the new stove, dubbed the *Primus*. About 50 million Primus stoves were made. A clever marketing specialist named B.A. Hjort was instrumental in the success of the Primus stove—and the monkey wrench—to which he enjoyed worldwide exclusive sales rights.

Some other inventions

Carl Richard Nyberg (1858–1939) invented the *blow torch* in 1881.

Baltzar von Platen (1898–1984), together with Carl Munters, designed a *refrigerator* without moving parts in 1921. In 1953 he made the first synthetic diamonds.

In the 1940s *Arne Tiselius* (1902–71) discovered *electrophoresis*, a method for protein analysis. He received the Nobel Prize in 1948. Electrophoresis is based on the different charges possessed by molecules in different environments—positive or negative. In electrophoresis, molecules mixed into a gel such as Sephadex (see below) are exposed to an electrical field, causing them to move in different directions and at different rates, thereby separating molecules of different sizes. The work of Tiselius has been continued by other Swedish researchers, resulting in new analytic techniques such as focusing electrophoresis, zonal electrophoresis and isolectric focusing. These methods are of great importance in medical and biological research.

Theodor "The" Svedberg (1884–1971) presented in 1924 his *ultracentrifugation method* for the determination of molecular weights. He received the Nobel Prize in 1926.

Sven Wingquist (1876–1953) is regarded by many as the father of the modern ball bearing—an invention of revolutionary importance to mechanical design. In 1907 he invented the *spherical ball bearing*. He also founded AB Svenska Kullagerfabriken (SKF), which remains the world's leading producer of industrial bearings.

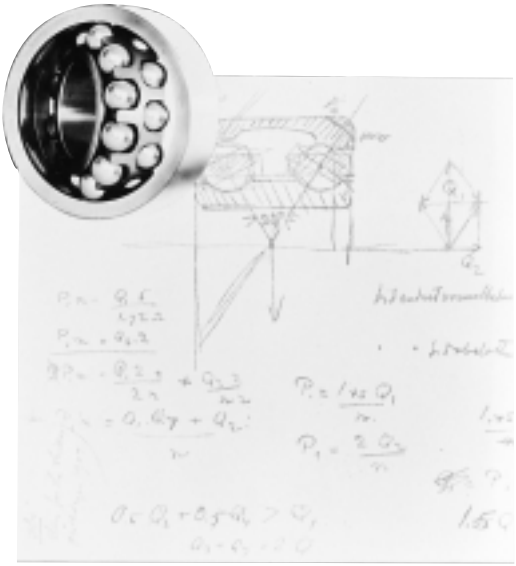
SKF conducts intensive product development which has led to improvements in earlier products and generated completely new ones, for example, successive generations of spherical roller bearings. A new product of considerable

SEK 1 (Swedish krona) = USD 0.11 or GBP 0.07 (April 2000)

significance is the compact aligning roller bearing known as CARB, which was developed by Magnus Kellström (b. 1941) at SKF in Gothenburg. CARB can handle heavier loads, misalignment and axial expansion within the bearing. It provides scope for lighter designs and lighter, less costly machinery.

It is interesting to note that Volvo, Sweden's largest automobile manufacturer, was founded in 1915 as an early spin-off of SKF.

Jonas Wenström (1855–93) invented the *three-phase electrical system*, which uses three electrical lines instead of the normal two. Together with Nikola Tesla, he is honored as the father of alternating current systems (Wenström was first, according to one court judgment). Wenström produced a number of other electrical inventions, including his classic direct current generator. His inventions formed the basis for the multinational company ASEA (today half owner of the Swedish-Swiss ABB). ASEA's early expansion was due in part to the royalties Wenström received for his patented three-phase system.



Sven Wingquist's first sketch of the spherical ball bearing (1901).

Victor Hasselblad (1906–78) wanted a precision camera with a system of interchangeable lenses, film magazines and viewfinders. After six years of development work, he unveiled his system, based on a *single lens reflex camera*. This was in New York in 1948, and the camera created a sensation. One major success for Hasselblad came when his camera began to be used on U.S. voyages to the moon.

RECENT SWEDISH INVENTIONS

The term "recent inventions" refers here to those generating sizable revenues (at least SEK 500 million per year) and with a product concept dating from 1945 or later. We see many of these on a daily basis as consumer products, but the following account will also mention inventions that have become very important to the business sector as producer products.

Swedish inventions and developments in the engineering industry remain important, but today they have keen competition from the medical and pharmaceutical industries, electronics and other high-technology fields.

Typically, recent research and development breakthroughs have resulted from extensive teamwork, although they originated from an idea by one or a few brilliant individuals. The following account therefore focuses on the products themselves.

Industrial inventions

Tetra Pak (1951) is a company producing systems for the processing, packaging and distribution of liquid foodstuffs such as milk and fruit juice. Ruben Rausing (1895–1983) developed the packaging invention by Erik Wallenberg (1915–99) in cooperation with Wallenberg and others, establishing the Tetra Pak Group. Since the company delivered its first liquid food packaging in 1952, it has developed various new types of packaging, of which the best known and most widely used is *Tetra Brik Aseptic*. When Ruben Rausing retired, his sons Hans and Gad Rausing took over management of the company. In 1991 Tetra Pak acquired Alfa-Laval (see above). The resulting Tetra Laval Group includes Tetra Pak, Alfa Laval and DeLaval and is now run by Gad Rausing's children. Today the group has annual revenues of around 6.8 billion Euro.

The whole range of food packaging from Tetra Pak.

High-voltage direct current (HVDC) transmission is a method that was developed at ASEA under the leadership of Uno Lamm (1904–89). This work, which took some years, consisted of a large number of subsystems that were patented. HVDC was tested for the first time on a large scale when an electrical cable was laid between the Swedish mainland and the Baltic island of Gotland in 1954. Remarkably, only one line had to be laid: sea water was used as the other electrical conductor. The Gotland cable was followed by numerous successors, and today transmission voltages of up to 1,000 kV are used.

The traction power of a locomotive is often excessive, causing its wheels to start slipping. A Swedish team led by Tore Nordin (b. 1932) found a solution in 1960. It used *thyristors* to facilitate non-skidding transfer of traction power, regardless of load. Thyristor-controlled locomotives are made by ABB and have become a major Swedish export product.

In the 1990s, in a project headed by Mats Leijon (b. 1958), ABB developed a new generator known as "Power Former", which produces high voltage for direct transmission to the grid without any intermediate transformers. The generator is based on a new revolutionary and unconventional technique and will be a highly significant product for ABB.

Freezing is a good method for preserving food, but many foods such as vegetables, berries, fruits and potatoes are difficult to freeze. In 1961 Per Oscar Persson and Göran Lundahl developed a process for quick-freezing vegetables in liquid nitrogen, known as *Flofreeze*. In this method, the vegetables are spread out and separated during freezing. Since the introduction of this process, frozen foods have replaced many kinds of canned foods in the market. By the late 1980s, fluidized freezing plants based on the Persson-Lundahl technique held 60 percent of the world market.

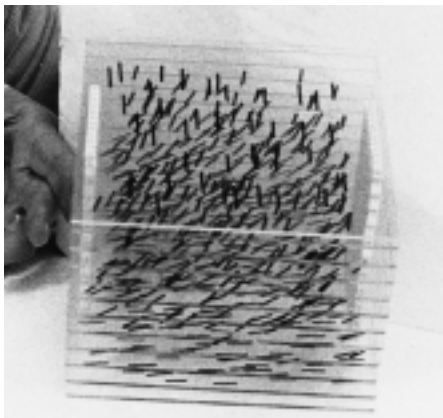
The *AXE system* is a fully electronic, computer-controlled digital telephone switching system. It was developed in partnership between Swedish Telecom (Televerket, now called Telia), Ericsson, and the jointly owned development company Ellemtel. Manufacturing takes place at Ericsson. Bengt Gunnar Magnusson (1925–95) was the project leader and chief source of ideas for the system. The first AXE exchange went into service in 1976. AXE gives the subscriber access to a variety of services such as wake-up calls, automatic call forwarding and programming of frequently dialed numbers. The system has been sold to over 130 countries.

In recent years, Ericsson has also captured a 40 percent share of the world market for *mobile (cellular) telephone systems*—supplying AXE exchanges, radio base stations, mobile phones and network engineering services. The team at Ericsson Radio Systems that initially developed this technology was headed by Åke Lundquist (b. 1932).

In 1979 Sven Torbjörn Lagerwall (b. 1934) discovered *ferroelectric liquid crystals* together with Noel Clark. This technology makes it possible to manufacture thin and flat video displays. In 1985 Canon bought a license for flat video display screens, which went into mass production in 1994. FLC screens have extremely high resolution, large image areas and very fast reaction times. The market for flat video displays for laptops and other computer applications is estimated at SEK 75 billion and will be many times larger if flat screens begin to be used for TV sets.

Åke Hörnell (b. 1948) has developed a protective *helmet with a welding shutter* which is transparent before welding and automatically darkens during welding, when liquid crystals in the shutter react to the welding arc. The welder has both hands free and does not suffer from "red eye". The helmet is sold all over the world by Hörnell's own company and retailers.

Håkan Lans (b. 1947) is regarded as one of Sweden's foremost inventors. His inventions have included the *digitizer*—a precursor of the computer mouse—and the fundamental principles of *computer color graphics*. He is also responsible for the further development of the satellite navigation system Global Positioning System (GPS) so that it can be used by aircraft,



Ferroelectric liquid chrystals were discovered by Sven Torbjörn Lagerwall together with Noel Clark.

ships and other craft (GP & C Total System). It has been proposed that Lans's system should become the international standard in civilian aviation and shipping. The *GP & C Total System* gives the exact position of a craft (vehicle, boat or plane) and information about all other traffic in the area.

Other technical inventions include the *three-point seat belt* constructed by Nils Bohlin (b. 1920) and introduced into Volvo cars as standard equipment as early as 1959, the *self-emptying railroad car* (1978) by Hilding Månström (b. 1932) and the turbocharged engine for everyday use (1976)—for example in mass-produced Saab cars—by Bengt Gadefelt (b. 1924).

Medical inventions[1]

During the 1930s two Swedish scientists, Nils Löfgren (1915–67) and Bengt Lundqvist (1922–52), conducted large-scale experiments leading to the development of the *local anesthetic LL-30* in 1943. Astra, the pharmaceutical company, took over the development work that year, and by 1948 it had developed Xylocain® (in English, Xylocaine®). When Xylocaine was launched, it signified something of a revolution in the local anesthetic field, because it anesthetizes with virtually no delay. Nils Löfgren was also a member of the team that developed the local anesthetic Citanest® (1957), which resembles Xylocaine but has fewer side effects.

In the 1940s, Sweden's Arvid Wretlind (b. 1919) decided to try to design a system for complete *intravenous nutrition*, as an alternative to ordinary food, in patients who could not eat. At the time his idea was considered bizarre and impossible to realize. Wretlind developed Intralipid®, a fat emulsion which was launched in 1962.

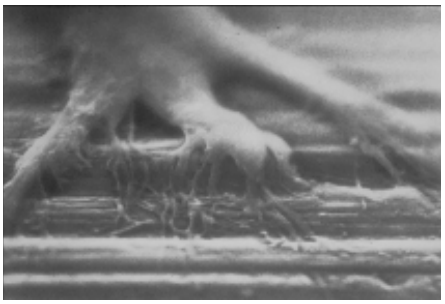
Sephadex is a substance that was discovered in 1958 by the Swedish researchers Björn Ingelman (b. 1917), Per Flodin (b. 1924) and Jerker Porath (b. 1921). Sephadex consists of molecules from the polysaccharide dextran, which can be cross-linked to create a three-dimensional network. This discovery led to further refinements in electrophoresis separation technology, which is extremely important in modern biochemical research and thereby also in pharmaceutical research. Another application for Sephadex is in the wound-care product Debrisan® (1973), which makes use of its cleaning and absorbent properties. This innovation was made by Ulf Rothman (b. 1942).

In 1958 Rune Elmqvist (b. 1906) developed a small *battery-powered pacemaker* which can be surgically implanted under the skin of a cardiovascular patient. It emits electrical impulses that cause the heart muscle to resume normal, regular contractions. The same year, Åke Senning (b. 1915) performed the world's first pacemaker operation at the Karolinska Hospital in Stockholm. Rune Elmqvist also invented the *Mingograph* (1948), an ink jet writing device that could capture rapidly changing physiological processes and is used in ECG machines and elsewhere.

Osseointegration was developed in the early 1950s by Per-Ingvar Brånemark (b. 1929). It is based on the discovery that the human body, which normally rejects foreign bodies, permanently accepts the metal titanium. Today the invention is most widely applied in the form of the *Brånemark System*® of dental implantation. It is likely that this method will be put to extensive use in other forms of surgery. Nobel Biocare, the company which develops and produces these products, has annual sales of some SEK 233 billion (1999).

Early in 1950 Hellmuth Hertz (1920–90) began research on *ultrasound* in medical examinations, thereby becoming known throughout the world. A Swedish physician, Inge Edler (b. 1911) told Hertz that he wanted to devise a non-invasive method for examining the heart. Echocardiography has revolutionized cardiovascular diagnostics. In 1977 Hertz and Edler received the American equivalent of the Nobel Prize in medicine, the Lasker Prize. The use of ultrasound in medical diagnostics is increasing sharply in a number of fields.

Other Swedish inventions in medical technology are the dialysis method, or *"artificial kidney"* devised in 1965 by Nils Alwall (1904–86) and Lennart Östergren (b. 1944), and Elekta's *Gamma knife* developed in 1968 by Lars Leksell (1907–86). The Gamma knife is not a knife in the conventional sense but uses a focused array of intersecting beams of gamma radiation to treat lesions in the brain. It is a non-invasive method and the patient can usually leave the hospital the same day.



A bone cell growing on a titanium surface and the titanium screw from the Brånemark System®.

Did you know that...

- In 1885 Stockholm was the city with the highest telephone density in the world, both per capita and in absolute numbers.
- The name Nobel became world-famous due to blasting projects such as the Gotthard railroad tunnel in Switzerland, the Hell's Gate shallows in New York and the Panama Canal.
- The zipper was admittedly invented by an American, but in 1900 Sweden's Gideon Sundbäck was the first to introduce a well-functioning design.
- Victor Hasselblad's camera has been used both in outer space and inside the human body, for example in Lennart Nilsson's famous photographic documentation of the origins of life.
- Every day more than a million injections of Xylocaine are given throughout the world.
- Nils Bohlin's Three-point seat belt saves a life every six minutes and is regarded as one of the most important innovations ever for traffic safety worldwide.

In the early 1960s, Swedish pharmaceutical companies began working with research projects based on receptor mechanisms. These projects led to some important drugs known as *beta-blockers*. This group of products includes Aptin®, a medicine for treating angina pectoris and heart arrythmia; Bricanyl® (1966), an anti-asthma agent without unwanted side effects on the heart; and Seloken® (1970), a selective beta-blocker that lowers blood pressure.

Losec® is an ulcer medicine of a new type that inhibits cells in the stomach lining from producing hydrochloric acid. The patient's symptoms fade more quickly, and it takes less time for the ulcer to heal than with previous drugs. Losec is sold and manufactured by Astra Zeneca and was developed by its subsidiary AB Hässle. The company's ulcer research began in 1969, and in 1988 Losec was approved as a prescription drug in Sweden. Losec is the world's most widely sold medicine and has been approved in more than 100 countries. In 1998, sales world-wide amounted to SEK 32 billion.

Dispensing consistently correct doses of a medicine can often be a problem. The *Turbohaler* developed by Kjell Wetterlin (b.1930) at Astra Draco is an inhaler used to deliver asthma medicine to the lungs. The Turbohaler is loaded to dispense a metered quantity of medicine and the patient controls the dosage by the strength of his inhalation. Experiments are now under way to see if the Turbohaler could be used for other medicines.

[1] **All pharmaceuticals are presented by their Swedish names.**

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