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Innovators and Innovations

Thanks to archeology and a study of the contemporary sources, we now have a much more detailed picture of the Magyar tribes which settled in the Carpathian Basin 1100 years ago. Searching for a home to settle in, they already possessed a wide range of knowledge, gained during their life on the steppes; this knowledge and experience included animal husbandry and farming, the use of the **stirrup** and the **wooden-frame saddle**, the processing of leather, toolmaking, the making of weapons (especially the **famous reflex bow**), spinning, weaving, tailoring, ornamental metalwork and the preparation of cooked meals. Their eating of meat led to a unique invention: when cooked meat was dried and pounded, it could be kept for a long period of time. Boiled in water, meat prepared in this way could provide a nutritious soup. Their warriors took this meat and a shredded dried pasta (tarhonya still used in the Hungarian home) with them on raids that could last for months at a time.

Hungary's first king, Stephen, was crowned in the year 1000. Stephen laid the foundations of the Hungarian state, the counties and the ten bishoprics he established are still in existence.

The first mint in Hungary was established (in Esztergom, where the King held court). This mint introduced an old engraving method to minting, the edge of the coin (the silver Denarius) being decorated with a row of fine dots. There were several advantages: the dots on the most vulnerable part of the coin made clipping or removing the silver much harder). As a result, Hungary's coinage became one of the most favoured in Europe.

A significant invention was the pivoting of the front wheels of carts. The pivot allowed the cart or wagon to turn quickly within a very small radius. A lightweight coach with small front wheels, indicating a pivoted assembly, was first mentioned in writing by a French knight, Bertrandon de la Brocquère, who visited Hungary in 1433. In that same century, the kocsi, a four-wheel horse drawn vehicle developed in Hungary, was an exceptionally practical form of passenger and light freight transport. It began to be produced in large numbers.

The actual name comes from the village of Kocs and the origin is reflected in other countries where it began to be used or manufactured: Kutsche in German, coche in French, coach in English, coccio in Italian, goetse in Flemish, koczi in Polish, koczy in Czech, and kusk in Swedish. (Even in the Caucasian region the word used was madzsar, the local name for Hungarian-type carts.)

Several countries may claim **Faustus Verancsics** (1550-1617), who was born in Dalmatia, and educated in Hungary from childhood (in the Pozsony home of his uncle, Antal Verancsics, the Archbishop of Esztergom). After studying at the university in Padua, he returned to Pozsony to devote himself to the study of scientific problems. He was given the captainship of the castle of Veszprém, in western Hungary, before becoming the Emperor Rudolf's secretary for Hungarian affairs. Later he became a priest and ultimately the Bishop of Csanád. In the last one and a half decades of his life he went to Italy, where he became a monk. He lived in Rome and Venice and his writings were published there. He compiled a five-language dictionary;Latin, Italian, German, Croatian, Hungarian;which was published in 1595. All his life he pursued solutions for technical problems, thus developing several new ideas and inventions. In 1616 he published Machinæ Novæ, which was a summary of his ideas and a significant work in the history of science. The book describes more than sixty inventions, forty-nine of them with detailed illustrations.

His inventions cover a wide range: grinders, windmills, tide-mill, compacting machine, twelve variations of bridge structures, the suspension-bridge, the parachute (closer to the present paraglider), a dredger, a rope-weaving machine, a steel spring and friction brake for coaches.

From the fifteenth century French **tanners** were familiar with the Hungarian method of tanning (hongroyage), which used the chemical alum. In the seventeenth century "Hungarian tanning" was used in several European countries and especially in France. In the middle of that century, the French tanner La Roche studied leather-making in Hungary. Jean Baptiste Colbert, the finance minister of Louis XIV, invited Hungarian tanners (hongroyeurs) to France under highly advantageous conditions. Part of the Paris Leather Code, written in 1673, states that "Only leather prepared by the Hungarian method shall be used for straps used for coaches." High resistance leather, manufactured by the Hungarian method, was used mainly for straps, load-bearing belts and girdles.

In the later Middle Ages, the Hungarian Kingdom, more precisely Transylvania, was an important producer and supplier of **gold and silver** for centuries, first in gold, second in silver. Her importance diminished with the the discovery of America and the arrival of the Turks, which occured after it, although mining remained significant.

Several technical advances were made in mining and metal processing. From the seventeenth century on, Selmecbánya (now Banská ©tiavnica) and its vicinity (in old Northern Hungary) was a significant mining and metal processing centre.

Water was and is important in mining, in that it had to be brought to the surface where it was a godsend, used for operating equipment. Too much or too little water caused equally large problems. To get around these, the decision was made to build a water management system in the early 1700s, involving the construction of a huge water reservoir. Sámuel Mikoviny had a significant role in the final workings of this grandiose project. In its time this construction was unique, it included 16 ponds with 7 million cubic meters of water. A system of almost 130 km of drains was used for nearly 200 years afterwards. This system is a significant monument and has been a World Heritage site since 1995.

Mining at Selmecbánya required organized training for the 7 to 8,000 involved, and this included higher education. The institute for the training of miners and foundrymen was established in 1735, the first of its kind anywhere. In 1770 it was upgraded to a tertiary institution. Sámuel Mikoviny was the first lecturer here, a man who is also one of the greatest names in Hungarian cartography. Students performed laboratory experiments in this institute on their own - another innovation - ; the French copying the idea in 1794 at the École Polytechnique, before it became general practice.

One of the most significant innovators at Selmecbánya was Károly József Hell, who built power engines based on new principles: in 1738 his beam-box water-raising engine was introduced; in 1749 the first water pressure piston pump (a reliable and efficient pump that rapidly spread in Hungary and abroad, several of them still operated over a century later); in 1753 his was the first "air-lift", for the first time utilizing air pressure to elevate water (thus eliminating the pump). This principle is still in use in current hydrocarbon extraction.

In 1758, Hell improved a "fire-engine" already in use at Selmecbánya (its first steam-engine).

In 1729 Sámuel Köleséri was the first Hungarian elected to the Royal Society in London. This distinction was awarded for his study on gold mining in Transylvania, Auraria Romano-Dacica. The first international scientific congress on mining was held at Szkleno near Selmecbánya in September 1786: 27 scientists from eight countries participated and studied the new method of extracting precious metal developed by Ignác Born. Born was a distinguished metallurgist, who published his method and made the practice available to everyone. Here, at the same time, the world's first international technological and scientific society, the Sozietät der Bergbaukunde was established. The society only functioned for a few years due to the wars following the French Revolution; its 150 members included James Watt, Lavoisier and

Goethe. The aim: "To collect every possible information which is useful to miners and disseminate this knowledge among the members in order to make them useful in their own countries for the improvement of mankind."

From the 1730s, Ferenc B. Kéry built reflectors (telescopes made of concave metal mirrors) at the University of Nagyszombat. Some of them were unusually large for that time. Several of his astronomic instruments were in use far from Hungary: the Jesuit János Zakariás wrote in 1749 that Kéry telescopes were used at the University of Peru.

In 1747, András János Segner, who was born in Pozsony (now Bratislava) and taught at universities in Germany, introduced his new principle of the Segner-wheel, a water reaction turbine. This principle is familiar today to everyone who waters their lawn, in the form of the garden sprinkler.

In 1770, the Sultan of Turkey commissioned Ferenc Tóth to construct the defences of the Dardanelles, including the establishment of modern Turkish artillery and sappers. Tóth, originally from Hungary, had been a captain of the Bercsényi Hussars in the Royal French Army and had served as a French diplomat in Constantinople. He advocated cutting across the Isthmus of Suez and even prepared plans for a canal for Sultan Mustafa III.

1782 saw the establishment of the Institutum Hydrotechnico-Geometricum at the University of Buda. It was the first tertiary institution that awarded degrees in engineering to civil engineers.

Farkas Kempelen was one of the eighteenth century's notable figures. He tackled various technical and scientific problems and solved several of them. He was greatly interested in the arts as well. In 1769 he exhibited his chess machine, the Chess Playing Turk, to the court in Vienna; it attracted wide interest in Europe, although he regarded it as a mere toy. (The machine was lost and its operation has remained a secret.)

He built a floating bridge, introduced water piping in Pozsony, and also designed the fountains at Schönbrunn. The move of the university from Nagyszombat (now Trnava) to Buda required his design, and he also contributed to the building of the Royal Castle of Buda. He also submitted a patent for a steam turbine on 17 July 1788. (He requested a 12-year exclusive patent for the Habsburg Empire for a device, which was the combination of a fire-engine and a reaction turbine.)

His greatest accomplishment was the study of the human voice. He unveiled the secret of voice production after a decade of meticulous work. To support his findings, he built the world's first "talking machine" (he called it a voice imitator), which was displayed in 1790, and in the following year he published a book on acoustics, Mechanismus der menschlichen Sprache, which included a detailed description of his talking machine. His work laid down the foundations for biological linguistics.

Farkas Kempelen and Ignác Born were friends, and Kempelen dedicated his book to Born, both of them well known figures in contemporary Vienna. (Mozart based Sarastro in The Magic Flute on Ignác Born.)

On November 3 1823, János Bolyai, a military engineer, wrote a letter to his father in which he described his discovery of a new (non-Euclidean) geometry. In 1832, at Marosvásárhely (now Targu Mures¸), he published his revolutionary work on absolute geometry in Latin. This 26 page study, "The absolutely true science of space", appeared as an appendix to the first volume of his father's mathematical book, Tentamen, therefore it was named Appendix. (The second volume of Tentamen was published in 1833.)

Another military engineer, Károly Kõszeghi-Mártony, invented in 1829 a breathing apparatus, which utilized compressed air in a steel tank, an invention which is still being used today by fire-fighters, and by rescuers and divers.

János Irinyi invented a safety match that produced neither noise nor an explosion in 1837. In the same year István Rómer, a Hungarian pharmacist in Vienna purchased the patent and started manufacturing Irinyi matches. In 1840 János Irinyi established his own match factory at Pest.

In 1840, József Petzval, an engineer and lecturer at the University of Vienna, constructed a high intensity, achromatic dual-lens (16 times more powerful than current lenses). The device was based on his own mathematical calculations. That same year Petzval invented the predecessor of the instantaneous shutter. Cameras equipped with Petzval lenses brought fame to the Voigtländer company.

1851 was the year of the World Exhibition in London, at which the products of the Herend Porcelain Manufactury were presented, with huge success. Queen Victoria, who visited the exhibition, immediately ordered a service with butterfly-floral decorations. This has remained one of the most favoured designs and is named in honour of Queen Victoria.

Railways in the nineteenth century revolutionized the transport of passengers and freight all over the world. Hungarian industry contributed with a significant invention. Ábrahám Ganz, a master of metal casting, was born in Switzerland and moved to Hungary, where he established his own workshop within a few years, in 1844. He developed and patented (1853) a method of hard-casting, to be used for manufacturing carriage wheels. (Previously this method had been used only in America.) This process equipped the wheel with a very hard surface, allowing greater resistence to wear and tear. Within the following 10 to 15 years the Ganz plant was supplying railway wheels to approximately 60 companies all over Europe. Based on this casting method, the company expanded its product range and started manufacturing various machines, bridge structures and other equipment.

One of their most successful products was the diagonal flour roller-mill. In 1874 the company obtained the (very modern) F. Wegman flour mill patent from Switzerland. The technical manager of Ganz, András Mechwart, expanded this even further by replacing the fragile porcelain rollers with hard-cast and grooved steel rollers, making the machine suitable for mass production and allowing more reliable operation. Ganz mills, with a wide range of applications, were marketed all over the world, from America to Australia.

Hungary provided additional important inventions for the flour milling industry, for example the flat screen shifter by Károly Haggenmacher, which revolutionized grain sorting in other industries as well, and the semolina and coarse meal cleaner.

A simple and effective flour testing method was developed by Imre Pekár (named "pekaring" after him), which is still in use today. Not just specific machines, but complete and fully equipped mills were available from Budapest.

In 1860 János Luppis, a naval captain, constructed a model of his "coast defender", a form of the torpedo, in Fiume. In 1864 he presented the invention to the Austrian War Ministry, which, however, rejected it. Luppis turned to Robert Whitehead, an English factory owner in Fiume. They jointly developed a new weapon, the "mine-ship". On 26 December 1866 they introduced it to the Ministry with a new name, "torpedo" (electric stingray). The Ministry purchased the invention the following year.

Two more Hungarians made important contributions to this weapon: Lajos Obry, a foreman at the arsenal, developed the gyroscope and the alternative pistons component for maintaining horizontal direction, and János Gesztessy, a naval lieutant, invented the heating equipment that was needed to prevent rapidly expanding compressed air from freezing.

Another major technology introduced in the nineteenth century was electrical power. Here Ányos Jedlik as well as the employees of the Ganz factory, made significant contributions. Ányos Jedlik was a Benedictine, who taught in the order's schools at Gyõr and Pozsony before becoming the Head of the Physics Faculty at the University of Pest. He was engaged on a number of research projects, but decided to concentrate foremost on electricity. He developed several devices based on new insights and principles, although he was not interested in practical implementation. In spite of this fact, his achievements were important in the history of science and technology:

In 1829 he constructed the first rotating machine based on the electromagnetic impulse, which was the predecessor of the DC motor. In the 1850s he conducted optical and wave mechanical experiments, and at the beginning of the 1860s he constructed an excellent optical grate.

His journal records in 1859 that he discovered the principle of self-ignition and the fact that a remanent magnetic force in the core was sufficient for starting the process. In 1861 he constructed a "single-pole electric starter", which exploited the principle of self-ignition. His machine was a unipolar generator with no brushes. Jedlik also recognized that when electricity was connected to the device, it became an electric motor. In 1863 he discovered the possibility of voltage multiplication and demonstrated it with a "tubular voltage generator" (1868), which was successfully displayed at the 1873 Exhibition in Vienna.

In contrast to the theoretical approach of Ányos Jedlik, András Mechwart, the General Manager of Ganz, recognized business opportunities in electricity and in 1878 he established a separate electrical division within the works, the first of its kind. This division had an excellent work force, which was reflected in its subsequent success. In 1882 the illumination of the National Theatre was installed to the plans of Károly Zipernowsky. At the time, this was only the third theatre in the world to be illuminated by electricity (after the Savoy in London and the theatre in Brünn [Brno]). However, all had to use a local generator, as there was no method available for transporting electric power. This seriously handicapped the more widespread use of electric power, and experiments were conducted in many places to solve this problem. The first practical solution was found in Budapest, at the Ganz factory.

In 1885 three engineers, Károly Zipernowsky, Miksa Déri and Titusz Ottó Bláthy, after one year of research and development invented a device of two coils with a closed iron core, with variable ratio induction, which they called a transformer, the name used ever since. This device was the basis of alternative current (AC) power distribution networks. Such a network was installed at the National General Exhibition in Budapest (May to November 1885) where the system worked faultlessly without interruption.

During the following decades, the Ganz factory manufactured and installed several hundred power distribution systems using their own components. In 1886 they installed the Rome-Cerchi steam power plant, the first power plant built to supply a large city with electricity. This was the very first power plant which used, on the proposal of Bláthy, AC generators to supply a common network in parallel connection.

The Ganz factory produced electrical equipment for the power network of the city of Rome over several decades.

Faraday may have discovered electromagnetic induction but much else was needed - ;backed by many patents - ;to turn this discovery into an industrially useful technology. In a 1964 memorial exhibition held at the Smithsonian Institute in Washington, what Hungarians had done for the transformator was duly acknowledged.

It should also be mentioned that AC or DC was not a settled question from the start. Edison, who backed DC, was proved wrong, the young Hungarian engineers were right. The state of the art electric equipment they produced was admired by the trade all over the world. (Western Electrician, Chicago, May 25th, 1889.)

In 1889 the Ganz factory started to distribute the first induction watt-hour counters (AC power meters), which were based on a patent held by Titusz Ottó Bláthy. Today's household power meters are the modernized version of these counters.

In Tivoli, near Rome, a hydroelectric power plant was built in 1892 by Ganz, which was the largest facility of its kind in Europe. A 5000 V overhead power line went all the way to Rome to transport electric energy, thus becoming the first system where high voltage AC generators supply power to a city network located at a distance. In the history of electricity this was the first system where generators driven by steam engines (Rome-Cerchi) and water turbines (Tivoli) operated in conjunction. (This was made possible by a reliable automatic water turbine controller. Bláthy was one of those who contributed to its construction.)

Hungarians have been attending foreign universities as both students and teachers for several centuries. Records show that in 1192 Béla III sent students to Paris and that a Nicolas Hungarus studied in Oxford after 1194; Hungarian students studied at the universities of Bologna, Padua and universities in German, Dutch and French cities. From the sixties of the nineteenth century many Hungarian students attended the Technische Hochschule at Zürich. In the eighteen-seventies approximately ten per cent of the students there were from Hungary, among them János

Feketeházy and Vince Wartha. János Feketeházy specialized in constructing steel structures and bridges. In 1878, at the World Exhibition in Paris he won an award for the structure of a new bridge over the river Danube.

As the engineer of the Hungarian State Railways he designed and built the first revolving bridge (in Fiume) which could carry both rail and road traffic. In 1894–96 he designed the Ferenc József Bridge in Budapest (still standing today as the Liberty Bridge). According to the publication Eisenbrückenbau (Iron Bridge Construction) by Professor George Mehrtens of Dresden, this "was the most beautiful Gerber-type bridge in the world."

Vince Wartha, a chemist, succeeded in searching for new technologies in ceramics. He developed the metallic eosin glaze (1892), used ever since for eosin decorations in the Zsolnay Porcelain Factory at Pécs. The Zsolnay factory also manufactures colourful pyrogen-granite tiles, which were very popular in the Art Nouveau era. These tiles were used on the façades of public buildings in many towns in the old Austro-Hungarian Empire.

On 11 February 1893, Donát Bánki and János Csonka applied for a patent "New solutions for petroleum engines". One of their solutions described the carburettor, the first ever in the world.

A service called Telefonhírmondó (Telephone News) started operating in Budapest on 15 February 1893. This was the first service of its kind (it remained in operation for several decades), where a central switchboard supplied news and broadcasting to any number of subscribers, who listened with headphones. This News was the predecessor of today's radio broadcasting and it was initiated by Tivadar Puskás; Nándor Szmazsenka, a technical director of the telephone company, played a significant role in its practical implementation.

Béla Gerster participated in the international expedition that surveyed the Panama canal area. In 1893 he designed and directed the construction of the Corinth Canal. The Emperor Nero had wanted to build a canal on the very same site. The Romans started work on it but were unable to bring it to completion.

In 1898, Donát Bánki invented the high compression Bánki-engine with a dual-carburettor (for evaporating fuel and water). This engine won an award at the 1900 World Exhibition in Paris. Dual evaporation has been in use ever since.

In 1898, Loránd Eötvös, Professor of Physics at the University of Budapest, built two pieces of his torsion pendulum. One of them won an award at the 1900 World Exhibition in Paris, the other was used by Eötvös, who performed his classic experiment in the winter of 1901 and 1903 on the frozen surface of Lake Balaton. The torsion pendulum, known as the Eötvös-pendulum, was used to measure the force of gravity and became an important tool in theoretical and practical research. The significance of the pendulum was all the greater because of its extraordinary accuracy, it was able to provide practical evidence for Einstein's theory of relativity. The inventor did not apply for a patent, thus making the device available to the scientific community. This gesture became really significant when Hungarian geologists developed a research tool in geophysics based on measuring gravity. The Eötvös-pendulum became useful in finding various natural resources, especially crude oil. In the twenties and thirties of the twentieth century, large oil companies successfully used this instrument (manufactured either in Hungary or in other countries) all over the world.

Its improved version, the E-54 Eötvös-Rybár-Banai type torsion pendulum, won a Grand Prix at the 1958 World Exhibition in Brussels.

Kálmán Kandó, a young engineer in the Ganz factory, engaged in electrical and mechanical design, recognized during the last years of the nineteenth century the importance of electric power for the railways. He also suggested that alternative current should be used instead of direct current. In September 1902 a 106 km section of the Valtellina railway, between Lecco and Sondrino in Italy was put into operation. This was the first high-voltage, AC powered electric railway system installed on a major railway line.

The Ganz works in Budapest developed, manufactured and installed almost every major item of equipment for this line, including locomotives, transformer stations and power networks - ;all under the direction of Kálmán Kandó. It was so successful that the Italian government ordered the electrification of an additional 2000 km of railway lines using the very same system. Kandó was invited to direct the design and manufacturing of electric engines in a new plant at Vado Ligure. The first locomotive manufactured in this plant, the Cinquanta, was designed by Kandó and gained worldwide admiration. A total of 369 units were manufactured, and this type was so reliable that the last units were only withdrawn from service in the nineteen-sixties.

Kandó returned from Italy at the beginning of the First World War. His idea that electric railways must be supplied from the national grid was too advanced for its time. In order to be able to implement it he developed the converter system, for which practical tests were started in 1923. Following this development, the first regular service started on 12 September 1932, with the operation of the Budapest– Hegyeshalom line, which had been electrified on the basis of Kandó's design.

The year 1908 marked the first mass-produced motorcar, the Model T Ford, of which approximately 15 million were made. József Galamb, who emigrated from Makó in the south of Hungary to America, had a significant role in designing the Model T and in organizing the production line. In a survey conducted for the millennium, the Model T was named "Car of the Century". József Galamb also had a part in designing the Fordson tractor.

In the first decade of the twentieth century, Pál Járay was engaged in designing aircraft and in preparing drag-resistant shapes for them. The efficiency of Zeppelin airships significantly improved because of his work. After 1918, he continued to work in Berlin and built the largest wind-tunnel in the world. In 1920 he patented an aircraft shape which caused the smallest drag. He extended his research to vehicles and in October 1920 he applied for a patent on an ideal shape, his "aerodynamic body". In March 1921 he further improved his design and developed a body with the smallest possible drag. Several car manufacturers used the Járay-shape in designing their new models.

Jenõ Fejes started to design engines manufactured of plate-steel in 1916. In 1921 he submitted his first patent, which reduced engine weight by as much as 30 per cent. The first car thus manufactured appeared in the following year. Fejes submitted a total of 14 patents on plate-steel cars. In 1927 a car plant was established in London to manufacture the Fejes-car, but the Great Depression intervened and the venture collapsed.

Moving forward to 1953, the Ikarus Chassis and Motor Vehicle Plant released their first rear-engine bus, the Ikarus 55. In Budapest in 1968, the Car Research Institute invented the combined turbo, an improvement on traditional turbo drive engines. This utilized gas resonances in the engine intake. Several major car manufacturers purchased and adopted this method. In 1969, the Ikarus Series 200 bus was introduced, of which more than 230.000 were manufactured and exported to 46 countries. The Ikarus 200 won an elegance award in the luxury category in that same year, at a bus exhibition held in Nice. In 1971 a super deluxe Ikarus conference bus won the Prince of Monaco Prize at the same exhibition.

Béla Berényi retired in 1974. This car designer was probably the most productive inventor in his field, with approximately 2500 patents to his name. From 1939 to 1974 he worked for Daimler-Benz, heading the strategic planning department for a significant period. Several of his inventions were decades ahead of their time.

In 1980 Ferenc Anisits, who had an international reputation as a mechanical design engineer, was invited to direct the diesel engine development division of BMW, to be built in Steyr (Austria). He supervised several successful projects until his retirement in 1999. The 6 and 8 cylinder diesel engines developed under his supervision were regarded as the best engines of 1999 and 2000.

In 1907, Sándor Svachulay, a Budapest mechanic, started to build various versions of his Kolibri airplanes, using a revolutionary new method which became common later: a welded steel tube airframe, retractable wheels. The canvas covering was joined by seams rather than by nails and stretched after installation. He also introduced the nose wheel, the adjustable metal propeller and a device to reduce the plane's speed after landing.

As early as 1912, Aladár Zsélyi and Tibor Melczer (an assistant to Donát Bánki at the Technical University in Budapest) designed a passenger airplane to carry 30 people. It appeared in an article entitled "The problem of large airplanes".

In May 1928 and in 1932, the mechanical engineer Albert Fonó applied for a patent in Germany for a gas turbine jet engine. In the two separate applications the inventor described four versions of the engines, which were suitable for supersonic and subsonic flight.

The first trans-oceanic flight by a Hungarian took place on 16–17 July 1931. György Endresz, pilot, and Sándor Magyar, navigator, flew across the Atlantic in a Lockheed Sirius aircraft, named "Justice for Hungary", from Harbour Grace (Newfoundland, Canada) to Hungary in 25 hours and 40 minutes. They set a new record: they covered more than 5000 km, longer than previous trans-Atlantic flights, and they flew faster than anyone else had done previously.

In 1936 a rocket research department was established in the Guggenheim laboratory of the University of Pasadena, California, which engaged in problems of supersonic flight. In 1944 this department became independent as the Jet Propulsion Laboratory. At the end of the 1920s Tódor Kármán had set up the Guggenheim Laboratory at the university's request. He headed this institution from 1930, after leaving the aerodynamics department of the University at Aachen, at the time one of the leading aviation centres. The first National Medal of Science, the highest scientific award in the U.S. established in 1963, was presented by J.F. Kennedy to Tódor Kármán, born in Budapest, for his extraordinary achievements in aerodynamics, aviation and rocket technology. The U.S. Post Office issued a stamp with his portrait.

Mass production of pharmaceuticals started in Hungary in 1910. The industry, in cooperation with researchers in universities and other laboratories, was highly successful and developed more than 50 original Hungarian drugs for domestic and export markets. Many of them gained international acclaim, because of their effectiveness.

Significant achievements were made in medical instruments, too. In 1907 Hümér Hüttl, a surgeon and university teacher in Budapest, invented a surgeon's sewing machine jointly with a mechanic, Viktor Fischer, which was patented in the following year. In 1920 Aladár Petz improved the instrument, which became famous all over the world.

In 1913, György Hevesy and Friedrich A. Paneth developed a method for using radioactive indicators in Vienna. The scientific and industrial application of isotopes has been based on this principle ever since - ;including medical applications. Hevesy won the 1943 Nobel Prize in Chemistry for this work.

The eye surgeon József Dallos developed a technology for manufacturing glass in 1934, which was suitable for making contact lenses that take into account individual asymmetries of the human eye. His improved lenses were patented in 1934. Dallos later settled and practiced in England.

In 1939, the eye surgeon István Gyoörffy and an optician, János Pálvölgyi, manufactured the first unbreakable plastic contact lens in Budapest.

György Békésy, a physicist, won the 1961 Nobel Prize for his research into hearing. His comprehensive work on the subject was published in 1960.

In the 1980s Imre Juhász started to manufacture bone replacements in his plant at Hódmezõvásárhely (Protetim Kft.). The products were based on several patented inventions, which were the result of significant medical and scientific research and product development.

In 1906 the Egyesült Izzó (United Incandescent and Electric Co.) of Újpest started to manufacture light bulbs with a wolfram filament, exploiting a (three years old) invention of the chemist Sándor Just and the engineer Ferenc Hanaman. The patented large-crystal wolfram and the double spiral shape of the filament significantly improved the stability of filaments and the durability of light bulbs.

On 11 August 1930, Imre Bródy submitted a patent, "Gas filled light bulb with metal filament", which covered the principle of a light bulb filled with krypton gas. In 1935, Egyesült Izzó was granted a patent for the mass production of inert gases, primarily krypton and xenon, from air. Imre Bródy played a significant part in preparing this technology, with the help of Mihály Polányi from England. The first krypton gas factory in the world using this method was established in 1937 at Ajka. This factory enabled the company to engage in the large-scale manufacturing of krypton filled, highly efficient light bulbs.

On 7 June 1916, Dénes Mihály, a mechanical engineer, managed to produce a successful movie with a sound track. On 30 April 1918, he applied for a patent for a method called Projectophon for recording sound pictures. His method provided good quality sound tracks with 35 mm film stock using optical sound recording, and he can thus be regarded as the inventor of the sound film. His patent was published on 18 October 1922.

He was also engaged in early experiments in television from the 1910s. He initially developed his inventions at the Telephone Factory in Budapest, before going to Berlin in 1924, to work for AEG. His first practical piece of equipment, the Telehor, was introduced in 1928. On 8 March 1929 the Berlin-Witzleben radio station transmitted the first live television broadcast in the world, using the system developed by Dénes Mihály.

An officer in the Fire Brigade, Kornél Szilvay, patented his dry extinguisher in 1923. This sprayed a powder (sodium bicarbonate) onto the fire with compressed inert gas. His equipment came on the market in 1925.

Kálmán Tihanyi, a physicist, applied for a patent on storing charges for improving the light sensitivity of television recording systems on 20 March, 1926. His transmission-receiver system was named the Radioscope. He described several practical solutions for the picture tube and for the recording device in his principal patent registered in Hungary, Germany, England, France and America. RCA purchased his patents, which were the basis of the iconoscope, developed later by Zworkyn and his associates at RCA. This device was manufactured from 1930 on for transmitting television programmes. Charge-storage has remained the basic principle of modern television.

Tihanyi also developed a special, infrared-sensitive (night) television camera, which was patented for the control of airplanes and military vehicles in 1929. In 1939 he submitted a patent application in England for the flat TV tube.

Károly Péter Goldmark, an engineer born in Hungary, was a pioneer in the field of developing and applying electronic television tubes. From 1935 he worked for CBS in America, later becoming the head of the company's research laboratory. Finally he became a vicepresident of CBS. He developed the first colour receiver suitable for general applications, which was introduced by CBS in August 1940.

He was also involved in several medical applications of television, as well as in the practical use of television in space research (including the broadcast of the first moon walk). In 1948 he developed the first long playing (LP) disk.

György Jendrassik joined the Ganz company as a young engineer and eventually reached the position of general manager. He submitted a revolutionary Diesel-engine invention soon after joining the company. The golden age of Ganz was based on this family of engines, which were developed to cater for a wide range of applications, with more and more cylinders. The first, internationally renowned, Ganz-Jendrassik were produced in 1927. Eight foreign engine manufacturers purchased the rights to manufacture these engines.

György Jendrassik applied for two gas-turbine patents in 1929. The first low capacity (73 kW), highly efficient gas-turbine with an independent fire box was manufactured in 1938.

On 15 December 1934, the Árpád class of rail-bus made its inaugural journey to Vienna. This pride of the Hungarian railway industry was powered by a Ganz-Jendrassik engine. Ganz exported these vehicles to several countries.

In 1929, Jenõ Hankóczy improved the farinometer he invented in 1905. The new device was suitable for classifying flour and pasta. This farinograph was to be used internationally in flour milling.

In 1930 Ödön Riszdorfer (with his younger brother, László) invented the hand held, battery operated light meter. Following an agreement with Kodak, they started production of the device (in their workshop in Budapest) under the trade name Kodalux, later Superlux. He improved the device and developed an automatic shutter for movie cameras. His inventions, which were purchased and adopted by leading companies, revolutionized the photographic industry. More than 120 patents were registered under his name.

In 1930, István Juhász, a mechanical engineer, was granted a patent on an automatic fire director (the last of his three patents was dated 1939). The Gamma-Juhász automatic fire director (used by anti-aircraft gun batteries) was developed and manufactured in the Gamma Works (owned by the Juhász brothers). They exported the device to Sweden (a plant in Stockholm existed under Hungarian management), Switzerland, Italy, Holland, Norway, Finland, Poland, China, Persia and Argentine.

In 1931, Béla Gáspár, a chemist who worked in Germany, produced the first colour film made using the subtractive method. In 1934 he invented Gáspár-colour, which was based on colour distraction. The first non-fading colour film was manufactured on this principle. The Cibachrome film was developed on an idea patented by Gáspár, as well as films manufactured in England since 1935.

Jenõ Dulovits and Miklós Tóth developed the DUTO type photographic front lens in 1932, in use all around the world and still being manufactured.

On 2 December 1933, the 120 kW transmitter of Hungarian Radio (which began broadcasting in 1927) at Lakihegy, 22 km from Budapest, started its operation. All the equipment of this major transmitter, then the most modern facility of its kind in the world, was manufactured in Hungary. The 307 m high special aerial was made by MÁVAG, and was the tallest aerial of its time and remained the tallest structure in Europe for many years. The tower was damaged in the Second World War, but it was rebuilt to a height of 314 m. It is now a protected industrial monument.

A new product from Kodak, the Kodak Six-20 attracted special interest at the 1939 EXPO in New York, as this was the world's very first automatic camera. Patents registered by two Hungarians, Ödön Riszdorfer from Budapest and József Mihályi, employed by Kodak at Rochester since 1923, contributed to the manufacture of this camera. Mihályi became the chief designer at Kodak for approximately 30 years and held more than 200 patents.

In 1939 Andor Rott, a Hungarian chemist working for Gevaert in Belgium, applied for a patent for his direct positive photographic method (2 November, patent application in England). The DTR (the internationally accepted abbreviation for "Diffusion Transfer Reversal") method revolutionized photography. Gevaert started the distribution of the new photographic paper in 1940, under the trade name of Transargo. (A chemist working for Agfa, Edith Weyde, applied for a patent in 1941 for a similar method.) E.H. Land in America also based his Polaroid method, patented in 1944, on Rott's idea.

From 1940 on, the engineer István Menyhárt designed huge industrial halls in Hungary, made of reinforced concrete shells. The first buildings of this kind were at the Csepel Port and at the Kõbánya Brewery. The bus garage, built in 1941 at Hamzsabégi Street in Budapest, was the largest hall with a reinforced concrete shell spanning over 82 m. It was covered with elliptic paraboloid segments. This garage has been in use ever since. An airplane hangar at Szolnok, a similar structure, also held the world record in its category.

On 2 December 1942, the first experimental nuclear reactor was installed in Chicago. Several famous scientists were involved in the project, but Enrico Fermi from Italy and Leó Szilárd from Hungary played the most significant roles. They applied for a patent on atomic reactors on 19 December 1944. The first patent for an atomic reactor was granted to these two scientists on 17 May 1955. The US Government then purchased this patent for the symbolic amount of one dollar.

József László Biró, a journalist and inventor who had emigrated to Argentine, obtained a patent on the ball point pen on 10 June 1943. Although there had been several attempts before, the first practical solution was found by Biró and Andor Goy, who participated in his experiments in Budapest.

In the 1940s Dénes Gábor, an electrical engineer who lived in England, conducted experiments in electron optics which resulted in his invention, holography. He developed the theory of optical holography and produced his first hologram in 1948. The invention of laser paved the way to the laser hologram. He received a Nobel Prize for his work in 1971.

John von Neumann (1903–1957) was a mathematician, chemist and the most significant theorist in electronic computing. He participated in the Manhattan project and in early computer development in the US. In 1945 - ;when computer technology was only at an embryonic stage - ;he published his study "First Draft of a Report on the EDVAC" (30 June), which laid the foundations of computer science. In this study he summarized his ideas on research and development in this field, describing the construction, specification and logic of a digital computer with data storage. His idea survived, and all commercial computers marketed so far have been based on Neumann's original idea, differing only in technical details. He founded the theory of cellular automation. (His teacher in Budapest, Rudolf Ortvay, called his attention to the possible analogy between the neural system and the computer.)

John von Neumann was a true genius, because he was able to recognize the future of a device which was only in its infancy. He made people aware that the computer was not only a more effective adding machine, but it was a fundamentally new device for data system management. He realized the computer's tremendous potential.

From the second half of the 1940s, high capacity (100 tons) floating cranes were built in the Ganz Shipyard for the reconstruction of bridges demolished during the war. They developed a wide range of floating and portal cranes with several original ideas. These cranes were highly successful on the international market.

Zoltán Bay, physicist and university teacher, and his associates conducted experiments with a radio locator (radar) in Újpest on 6 February 1946, at Egyesült Izzó, which they developed and manufactured in the same factory. They experimented with beams directed at the Moon and detected the reflection of these beams, only a few days later than American scientists who led the research in this field. Bay developed a new type of sensing method (in order to compensate for the low capacity of their transmitter), the signal adding method, which has been used ever since for receiving signals from a remote object with high noise level background.

From 1939 on, Mária Telkes (teaching at MIT) was involved in utilizing solar energy. She supervised these kinds of experiments from 1950. The first experimental house using solar heating was built under her supervision in 1948 in Dover, New Hampshire, Massachussetts. Later she designed two more dwellings that harness solar energy. She obtained approximately 20 patents on utilizing solar energy (distillation equipment, desalination of seawater, heat storage, cold storage).

The chemist László Vissy invented a lining material suitable for high temperature melting furnaces in 1954. The Mosonmagyaróvári Timföldgyár has been manufacturing this material since 1958. The product, called corvisit, from corundum and the inventor's name, has been used all over the world in a wide range of applications (the steel and aluminum industries, glassworks).

From 1957 József Thoma, an engineer, developed the sliding-shuttering method for construction work, which was based on his inventions: an automatic, continuous concrete laying method suitable for the construction of high, tower like buildings with a variable cross-section. Several projects have since been built with this method in many countries.

From the end of the 1950s the National Optical Works (MOM - ;Magyar Optikai Mûvek) added laboratory instruments to its product range. They started the production of the derivatograph, a thermo-analytical instrument based on the patent of László Erdey, Ferenc Paulik and Jenõ Paulik. Approximately 5000 units of various types of this instrument were manufactured and exported to more than 20 countries. They produced an ultra-centrifuge, based on the invention of Ferenc Rohonczi and Kálmán Nógrádi. This item, continually upgraded, was manufactured for over 30 years and exported all over the world. Ferenc Pusztai, the head constructor of geodesic equipment, received the Kossuth Prize (Hungary's highest state award for excellence) in 1963 for gyroscope theodolites based on his patent. These devices were used for civil and military purposes. Producing several thousand units of the gyro-theodolite, MOM was the largest supplier of this kind of equipment (for example, the GT-12 type was delivered to South Africa up to the beginning of the 1990s).

In 1975 Ernõ Rubik constructed his Rubik's Cube, which was declared Toy of the Year in 1980.

In the 1970s Tibor Jeney (with his wife Edit Oborzil) invented the aluminum bell, tuned with slots. Today there are several bells of this type in Hungary and across the world. They have prepared the plans for a giant World Bell.

Several of the instruments carried on board of the Soviet VEGA spacecraft launched to study Halley's Comet in 1984 included devices made in Hungary, in the Central Physical Research Institute and at the Technical University: the microcomputer controlled TV system, the Plazmag spectrometer used for studying low energy particles, the Tünde-M analyzer for high energy ions, the central data storage device and several Earth-based controlling units. One European, two Soviet and two Japanese probes passed the comet between 6 and 14 March 1986.

At the beginning of the sixties, Emil Rudolf Kálmán, an engineer and mathematician, teaching in the USA, developed a filter named after him, which has been used in controlling space research devices ever since (the first in 1963, in the unmanned Moon probe). In 1985 he received the Kyoto Award (the first recipient of this very prestigious prize) for his work on complex systems.

In 1985, Sándor Tarics, an engineer, designed and installed the first special spring loaded foundation in the US, which provided protection against earthquakes. Tarics was a member of the gold medal Hungarian water polo team at the 1936 Olympic Games. He was a professor at the Technical University at Budapest and has since 1949 lived in the US. His design office, established in 1951, prepared the plans of more than 700 projects. Tarics is one of the most respected expert advisors on earthquake-safe buildings.

In 1981, Charles Simonyi joined the Microsoft company. He established and heads the research team engaged in developing microcomputer applications. With his collaboration and efforts, Microsoft launched several applications in the 1980s (Microsoft Multiplan, Word, Excel etc.).

János Harsányi, an economist, received a joint Nobel Prize for his work on game theory in October 1994, and György Oláh, a chemist, received the Nobel Prize in chemistry for his "contribution to the chemistry of the carbon cation".

On 1 November 1995, András Gótzy applied for a patent for a giant, three dimension poster, which, although stationary, provides a sense of movement. (The date of the application for the international patent was 23 April 1997). At the time of application Gótzy, then only 23 years old, won several awards and received a unique (international) acknowledgement for his work

In 1995 Kürt Kft. of Budapest won the Hungarian Award for Innovation: the company's employees had developed a new method for recovering and restoring data from damaged hard disks. They have prepared a data saving technology that is unique.

On 12 December 1996, Zoltán Dárdai applied for a patent on "Delivering peptide-like products (especially insulin) into living organisms to be used for local delivery treatment". The colloid-chemical method of the inventor enables diabetics to obtain their regular insulin supply from a simple adhesive tape rather than a daily injection. Dárdai has been involved in new possibilities in the transdermal intake of medicines.

Tamás Székely as inventor, and TVK (the largest chemical company in Hungary), as the owner, applied for a patent, "Method for recycling mixed plastic waste", on 5 December 1997. The new material produced on the basis of this patent is an excellent bitumen additive, which increases the durability of roads by factors of ten by reducing frozen patches and grooving. On 18 July 2000, an experimental road with the new material, called Syntumen, was built at Szekszárd.

At the 1998 Junior Inventors World Championships (ages 14–21), Gábor Bernáth, a student from Budapest, won four first prizes and became the absolute winner. His device, a PC compatible three-dimension scanner, was capable of scanning three-dimensional objects, for example, human faces, in a few minutes (once a complex and protracted procedure). László Sipka an engineer-economist, is the author of books and other publications on economic history and the history of science, industry and technology.

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Hungarian born and educated US hydraulic engineer Bela Liptak: Integrated Solar energy-hydrogen-power-generating plans

Hungarian born and educated matematician, Janos Kemény invented- with Tom Kurtz the BASIC language for computer programing. Also helped Einstein with his superior matematical skills.

Béla Berényi, mentioned in the above article was the concept inventor owner for the Volkswagen according to the Manheim Patent Court of Germany.