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HONOURED CREATIVITY

NOBEL LAUREATES OF HUNGARIAN ORIGIN

On the verge of the third millennium, science is playing an increasingly important role in shaping our world. The future belongs to a knowledge-based society. As such, support for scientific activity, the assessment of its performance, its material and moral recognition, in other words motivating scientists to achieve new results, is vital. In this respect a system of prizes is of key importance. In the field of sciences, the best known honour given for outstanding performance is the Nobel Prize. The first Nobel Prizes were awarded in 1901. The centenary in 2001 will be celebrated with a large exhibition that places the emphasis on the culture of creativity, the creative individual and the milieu supporting this creativity. During the anniversary, attention is - quite rightly - being focused on the remarkable achievements of Hungarian scientists and also Budapest, the capital of Hungary. In his Neumann-biography published in 1992, Norman Macrea, former editor-in-chief of The Economist and the researcher of the Japanese economic miracle, wrote about Budapest at the time the first Nobel Prizes were awarded: "Early in this century, Budapest was the fastest developing metropolis in Europe. This city produced a multitude of scientists, artists and future millionaires, which is unparalleled except in the renaissance city-states of Italy." Hungary, although a small country with respect to its population, is, however, a major one with respect to the recognition its has earned in the scientific community and the performance of its scientists; over the course of the 20th century no less than twelve Nobel Laureates - seven of them sons of Budapest - trace their roots back to Hungary. In the following, the Nobel Laureates of Hungarian origin and their messages that point to the future are presented.

Alfred Nobel and the Nobel Prize

Alfred Nobel, who gave his name to the most high-ranking scientific honour, now celebrating its centenary, was born in Stockholm on 21st October 1833. A chemist of considerable renown, Nobel used the fortune he gained from the development of explosives and the industrial application of science to launch a foundation with a noble purpose. His last will and testament of 27th November 1895 raised a monument to his own memory, while also rendering a service to mankind.

His intention was to reward the most prominent figures in the most diverse of fields, irrespective of nationality and taking only performance into consideration, including basic research in natural sciences and the creation of a peaceful society. Nobel died in San Remo on 10th December 1896. Thus, his last will entered into force and the first steps towards the establishment of the Nobel Foundation were made. The Swedish Royal Council in its decree of 29th June 1900 confirmed the statutes of this Foundation. The first Nobel Prizes were awarded in the first year of the 20th century, on 10th December 1901, the anniversary of Nobel's death. As such, the Nobel centenary is a process covering four main stations. These stages are immortalised by the centenary series of stamps of four face values, of which the first depicts the Nobel testament of 1895 and the last shows the first prize awarding ceremony in 1901.

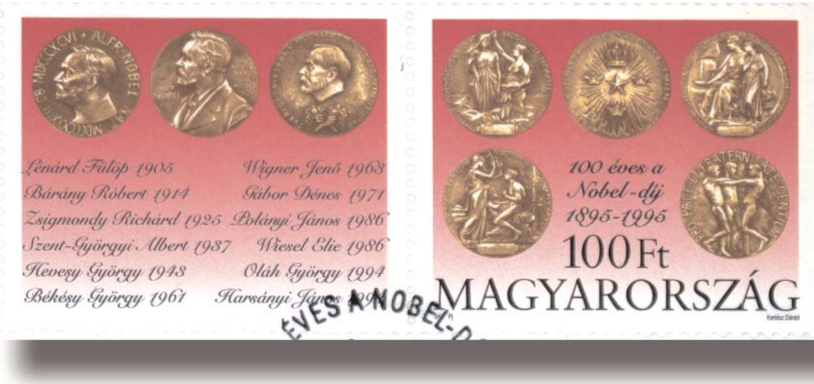
Nobel founded five prizes, to be awarded in *physics, chemistry, physiology or medicine, literature* and *peace.* These categories were complemented

by a prize awarded for work in *economic sciences*, founded in memory of Alfred Nobel by the Bank of Sweden on the occasion of the 300th anniversary of its existence in 1968. The ‘Prize of Prizes’ is accompanied by a diploma bearing a citation, a gold medal and a sum of about 1 million US dollars. Today, the moral prestige of the prize has increased to such an extent that this represents its main value. On receiving the prize, the recipients make a short speech of acknowledgement and, as part of the ceremony, they give a Nobel lecture on how they achieved their result.

The Nobel Prize does not serve to honour an outstanding scientific career and the lifework of a scientist. As a researcher and inventor, Nobel himself was well aware of the essence of discovery and invention. Accordingly, he directed in his will that the prize be awarded for specific performances and results. The reasoning behind the awarding of the Nobel Prize always includes a sentence that accurately defines the specific performance that is being recognised.

In accordance with the rules, a Nobel Prize can be shared by up to three persons. Consequently, only few from among the large number of scientists can hope to be honoured with a Nobel Prize. Considering that the list of Nobel Laureates is, for the most part, a list of scientific world-celebrities of the century that has passed since the first prizes were awarded, it is indeed a great honour to qualify for this list.

Essentially, science is international, and scientists can contribute to several professional fields and to the wealth of several countries through their work, which, at the same time, also enriches these countries in both scientific and human terms. As an example, we only have to look at the personal careers and scientific lifework of those Hungarian and Hungarian-origin Nobel Laureates who have qualified for the “Pantheon of Immortals”.



Stamp issued on the centenary of the Nobel testament depicting Nobel Prize winners of Hungarian origin

Nobel Laureates of Hungarian origin

Albert von Szent-Györgyi Nagyrapolt was the one of those Hungarian scientists who travelled from Hungary to Stockholm to receive the highest-ranking scientific prize. His Nobel medal is today held at the Hungarian National Museum in Budapest.

Obverse and reverse of Albert von Szent-Györgyi’s Nobel medal

Our scientist took the 66-mm diameter, 208-gram gold medal Nobel Prize from the Swedish capital to his research laboratory at the University of Szeged and kept it there until the outbreak of the Second World War. As a result of the war, he lost the money which came with the prize; in fact, he had invested the money so as to link his personal financial interests to peace.

When the Soviet Union attacked Finland in autumn 1939, a money-raising campaign was launched and the world famous researcher offered his gold medal to support the Finnish nation. This meant there was a risk that this exceptional honour of the Hungarian nation would be taken out of the country and melted down. On the initiation of count István Zichy, then director of the Hungarian National Museum, and with the assistance of Onni Talas, Ambassador for Finland, Wilhelm Hilbert, company director in Helsinki, purchased the valuable medal and donated it to the Hungarian National Museum in June 1940.

This Nobel gold medal with its famous history was first put on display to the general public in 1993, when an exhibition of Nobel Prize winners was opened in the Hungarian National Museum on the occasion of the hundredth anniversary of the birth of Albert von Szent-Györgyi Nagyrapolt.

Together with Albert von Szent-Györgyi Nagyrapolt, 12 scientists of Hungarian origin have been granted this high-ranking and rare distinction. In their honour, the Hungarian Post Office issued a stamp in 1995, the centenary of the Nobel testament. The Nobel Prize was awarded to: *Philipp E. A. von Lenard* in physics in 1905, *Robert Bárány* in medicine in 1914, *Richard A. Zsigmondy* in chemistry in 1925, *Albert von Szent-Györgyi Nagyrapolt* in medicine in 1937, *George de Hevesy* in chemistry in 1943, *Georg von Békésy* in medicine in 1961, *Eugene P. Wigner* in physics in 1963, *Dennis Gabor* in physics in 1971, *John C. Polanyi* in chemistry in 1986, *Elie*

Wiesel for peace in 1986, *George A. Olah* in chemistry in 1994 and *John C. Harsanyi* in economics in 1994.

As is apparent, scientists working in the natural sciences are dominant: three prizes in physics and physiology-medicine each and four prizes in chemistry, one prize for peace and one prize for economics. Hungarian scientists are characterised by their interdisciplinarity. For example, Albert von Szent-Györgyi Nagyrapolt started in medicine and, through biochemistry, arrived at physics. Georg von Békésy did this the other way round: he was educated in physics and lectured as a professor of physics, worked as a telecommunications research engineer and, finally, he was granted the Nobel Prize for Physiology-Medicine. Let us now consider in detail what achievements in the fields of physiology and physics to economics were rewarded with Nobel Prizes.

Nobel Laureates in physiology and medicine

Albert von Szent-Györgyi Nagyrapolt (1893 - 1986) was awarded the Nobel Prize for Physiology and Medicine in 1937 "*for his discoveries in connection with the biological combustion processes, with special reference to vitamin C and the catalysis of fumaric acid.*"

Szent-Györgyi's discovery of vitamin C had a part to play in winning the prize; in fact, vitamin C in the quantity necessary for his research was obtained from Hungarian paprika. However, this represented only a sideline of his scientific activity. Throughout his long career, Szent-Györgyi focussed his research on life and the essence of life.

Energy is required for the functioning of a living organism. This energy is derived from the combustion of nutrients. At that time there were two schools of thought to explain the method of combustion. In the Warburg school, oxygen is activated while, according to the Wieland school, it is the hydrogen in the nutrient that is activated. Szent-Györgyi combined these two schools of thought and showed that the active oxygen oxidises the active hydrogen. This process consists of a long string of complicated reactions in which the energy of hydrogen atoms is progressively released during the sequence of step-by-step conversions.

Szent-Györgyi devoted more than ten years to the examination of oxido-reduction processes. The discovery of a significant part of the oxidation chain-links was the basis on which he was awarded the Nobel Prize. The remaining elements of the citrate cycle and its complete mechanism were explained by one of his friends, Hans Krebs (1900 - 1981), who also obtained a Nobel Prize; the correct designation of the cycle is the Szent-Györgyi-Krebs cycle.

Following the presentation of the Nobel Prize in 1937, Szent-Györgyi did not rest on his laurels: in 1939, new research and discoveries were started. There is no doubt that the blossoming of muscular research in both Hungary and at the international level is linked with the results achieved by Szent-Györgyi and his school in Szeged. "The years 1940 to 1942 were a great success not only for Szent-Györgyi but also for us in what we were able to achieve with respect to the contraction of muscles. In my opinion, in the life of Szent-Györgyi, this success surpassed that rewarded by the Nobel Prize," said Bruno Straub (1914 - 1996), a senior research worker in the former team of Szent-Györgyi and an internationally reputed scientist, who continued research in this field, while evaluating the results obtained half a century ago. Their discovery achieved at that time is considered the beginning of modern muscular biology.

After that, Szent-Györgyi rushed off to his laboratory every morning for a further 40 years, even after his emigration to the United States in 1947. The third field of his research became the illness that carried away his wife, his daughter and John von Neumann, his friend. He was still engaged in researching the secret of cancer at the age of 90. For Hungarians, he became the symbol - even during his lifetime - of a free spirited, humanist scientist.

Georg von Békésy (1899 - 1972) was awarded the Nobel Prize for Physiology or Medicine in 1961 *"for his discoveries of the physical mechanism of stimulation within the cochlea".*

The most significant element of Békésy's lifework is the observation and description of the mechanical-physical processes that take place in the cochlea and the development of a new theory relating to the nature of hearing. Békésy was the first to develop a model that effectively functioned

Georg von Békésy's Nobel diploma

in a manner similar to the cochlea, and which allowed the processes to be observed and photographed more accurately as compared to ear dissections. His success was the result of careful and profound examinations and a large number of measurements relating to the components of the cochlea.

Békésy received the Nobel Prize after he had been working for more than a decade in the USA, while the Nobel Prize was actually awarded for work he carried out in Hungary. This was confirmed by János Szentágothai (1912 - 1994), the world-famous brain researcher, who said "In the years between 1931 and 1944, I, being in close relationship to him - as a medical student at the beginning and later as a researcher engaged in a field close to his research activity - knew that his theory of hearing that formed the basis of his Nobel Prize was completed as early as 1944. Indeed, his theory on how the mechanism of nervous inhibition contributes to the distinction of 'signal' from 'noise' was perhaps more brilliant. This theory in itself would be worthy of a Nobel Prize today".

For Békésy, research on the ear and hearing was one of the ways of approaching a comprehensive study of the human senses. In his Nobel lecture, he called attention to this subject. "Perhaps the day is not very far when the three organs of sense – ears, skin and eyes – which are clearly separated from each other in the biological manuals, will form a common chapter in certain respects."

In his lifework, he linked research activity performed in the fields of physics, communications technology and physiology, and his scientific work with the arts. He collected works of art of particular value and passed them on to the Nobel Foundation in his will. Right up until his death he worked on interdisciplinary synthesis, leaving as his heritage the continuation of this task.

In his speech delivered when he received the Nobel Prize, he said his work could be traced back to the 'founding father' "...Robert Bárány, the first holder of a prize for otology, who is similarly of Hungarian origin. I do not believe this to be mere chance. Otology in Hungary is practised at a very high level and surrounded with interest. I long suspected that there had been an outstanding person who founded all this. I had already been searching for a considerable time when I discovered his name. He was Hőgyes..." Endre Hőgyes (1847 - 1906) had been engaged in the research of the reflex path of associated eye-movements and their relationship with the labyrinth system since 1880. These extremely important experiments conducted on animals preceded similar tests performed on humans by Robert Bárány. In his Nobel speech, Bárány also made reference to Endre Hőgyes.

Robert Bárány (1876 - 1936) was awarded the Nobel Prize for Physiology and Medicine in 1914 *"for his work on the physiology and pathology of the vestibular apparatus".*

Robert Bárány completed his medical studies at the University of Vienna. He went on to study at German universities in the field of internal medicine and neurology-psychiatry. Later, he joined the otology clinic in Vienna. His work that won him the Nobel Prize was founded on clinical and experimental examinations he carried out here.

A simple clinical observation attracted his attention to the balancing organ located in the cochlea. He often performed ear rinses on his

Harvard University Memorial Hall where Georg von Békésy worked

patients, during which the patients often became dizzy. It appeared that their dizziness was in direct relation to the temperature of the rinsing liquid. The patient did not become dizzy if lukewarm water was used, while the use of cold or overly warm water caused dizziness. This is explained by the fact that the temperature of lympha circulating within the ducts of the cochlea is about 37 °C. Variations in temperature cause this liquid to circulate and, depending on whether cold or warm water is used, the liquid passes to different ducts and results in dizziness. So, the information gained on the position of the human body is disturbed, and this is reflected by the rapid involuntary oscillation of the eyeballs (nystagmus). The phenomenon corresponds to a biological reflex mechanism and is called Bárány's caloric reaction. Its failure is of a pathological character as it indicates that the pathological (mostly inflammatory) processes have reached the cochlea. This biological process is also connected to the phenomenon of seasickness.

In fact, the whole of Bárány's work covered the boundary areas of otology and neurology. His descendants include a number of physicians. One of his grandchildren, Anders Bárány, became a physicist and, as a secretary of the Nobel Prize Committee for Physics, he was able to participate in awarding a number of honours.

Nobel Prize Laureates in Physics

Philipp Eduard Anton von Lenard (1862 - 1947) was awarded the Nobel Prize for Physics in 1905 *"for his work on cathode rays".*

He started his research activity under the leadership of Heinrich Hertz (1857 - 1894), examining the radiation generated in the Crookes tube. He passed cathode rays through a thin leaf of metal (Lenard window) out of the tube to the atmosphere or into another closed tube, thus allowing them to be studied. He found that the permeation capability of the rays depends on their velocity. During their permeation through materials, the rays are exposed to forces. He came to the conclusion that the atoms are composed of positive and negative particles that fill only a very small part of the space (dynamide theory), and that the cathode ray somehow carries a negative charge.

In studying the photoelectric effect, he found that the speed of electrons leaving a metal surface depends only on the frequency, while the number of electrons depends on the intensity of light. This former discovery of his founded the basis for the atom theory of Ernest Rutherford (1871 - 1937), while the latter served

as a basis for the discovery of the law of the photoelectric effect developed by Albert Einstein (1879 - 1955). His most important results were the discovery of limit wavelength in the photoelectric effect and the role of activators in phosphorescence.

Eugene P. Wigner (1902 - 1995) was awarded the Nobel Prize for Physics in 1963, shared with Maria Goeppert-Mayer (1906 - 1972) and

Hans Daniel Jensen (1907 - 1973) *"for his contributions to the theory of the atomic nucleus and the elementary particles, particularly through the discovery and application of fundamental symmetry principles".*

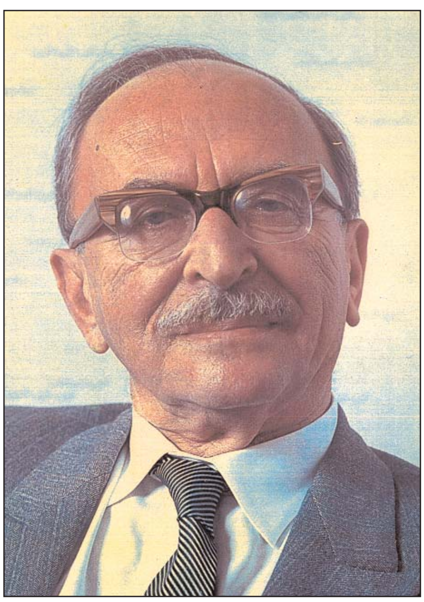
Eugene P. Wigner pursued his grammar school studies in the famous Fasor evangelic grammar school in Budapest, and gained admission to the University of Berlin to become a chemical engineer according to the wishes of his father. In the twenties, Berlin was the centre of modern physics. Wigner also attended the classes and seminars of Albert Einstein (1879 - 1955), Max Planck (1858 - 1947) and Max von Laue (1879 - 1960). In Berlin, he prepared his doctoral thesis - a pioneering work in quantum-chemistry - under the guidance of Michael Polanyi (1891 - 1976).

Having completed his university studies in Berlin, he returned home to utilise his qualification in his father's tanning factory. When he learned that Werner Heisenberg (1901 - 1976) and Max Born (1882 - 1970) had developed the science of quantum mechanics, he returned to Berlin. With the help of his old teacher, Michael Polanyi, he joined the Kaiser Wilhelm Institute where he examined the problem: why do atoms "prefer" to sit in the symmetry planes and at symmetry points of crystals? Starting from this, he was the first to realise that space-time symmetries play a central role in quantum mechanics. In his book entitled *Group Theory and Its Application to the Quantum Mechanics of Atomic Spectra* he showed that all the significant precise results of quantum mechanics could be achieved through symmetry groups. This is also emphasised in the reasoning of the Nobel Prize awarded in 1963.

In the thirties, Wigner travelled to the United States where he worked at Princeton University for the next six decades. During the Second World War, he played an outstanding part in launching the atomic age and, after the war, in the peaceful and safe utilization of nuclear energy. It can be said that he was the first reactor engineer in the world. When he died, the New York Times, in a five-column article, commemorated "the man who introduced mankind to the atomic age and had the courage to re-tailor the science of sub-atomic particles".

"He was one of those scientists endowed with remarkable imagination and foresight who were born and who studied in Budapest and came to the West to alter the modern world."

Dennis Gabor (1900 - 1979) was awarded the Nobel Prize for Physics in 1971 "*for his invention and development of the holographic method*".



Nobel Prize winners of 1971. From left, Simon Kuznets, Pablo Neruda, Earl Sutherland, Gerhard Herzberg and Dennis Gabor

As a 10-year-old student, he applied for his first patent for a new type of merry-go-round. By perfecting millions of street lamps, he improved public lighting. He constructed a Wilson fog chamber to measure the speed of particles, he designed a holographic microscope, built an analogue calculator, and carried out pioneering work in the development of flat, colour TV picture tubes. His entire career is paved with a whole string of inventions. Among them, it is holography that brought him the Nobel Prize and world reputation.

He had been interested in the problem of the electron microscope right from his youth. In 1947, he linked two apparently far-removed fields; namely, the study of electron rays aimed at improving the electron microscope, and the study of information theory. He recognised that for perfect mapping, all the information present in the waves reflected from the object should be used - not just the intensity of waves, as the traditional devices did, but also the phase and amplitude of the wave. With this, a complete (holo) and stereoscopic (graph) picture can be obtained from the object. Dennis Gabor developed this and published his invention in 1948.

However, the widespread propagation of holography required the development of a coherent light source. This occurred in 1962 with the invention of the laser. Then, by combining laser technology and holography, laser holograms could be produced. Dennis Gabor also participated in this activity and, by means of his research work, he contributed to the opening of new perspectives in the field of text storage, letter and pattern recognition, as well as in associated information storage. At the exhibition arranged on the occasion of the awarding of the Nobel Prize, Dennis Gabor was able to present a three-dimensional self-portrait using laser technology. From the beginning, his interests also covered the theory of hearing and the problems of acoustic holography, which finally led him to the field of medicine.

In parallel with this, the interests and activities of this scientist with qualifications in physics and engineering became increasingly focused on the problems of industrial civilisation and the future of mankind as a whole. This is indicated by a number of works such as *Invention of the future (1963), Scientific, technological and social innovations (1970), The mature society (1972)* and *Following the age of wasting (1976)* written as a report to the Roman Club.

Shortly after receiving the Nobel Prize, he presented himself in a television interview in 1972 as a man combining the real and human culture in his lifework: "I have lived a dual life for years. For 15 years I have been a physicist and an inventor. This is one life of mine, while the other one is: I am a social writer. I have realised for a long time that our culture is in great danger."

The consumption of irreplaceable natural raw material resources and environmental pollution undermine the very conditions for our survival. If this continues, "in about a hundred years, we will consume and exhaust the wealth of nature and the Earth will become very poor". Therefore, an enormous responsibility falls on science of every kind. "A new science and a new technology need to be created that draw from nature only as much as can be restored, returned or that can be replaced."

"Invent the future" - he encouraged us. In fact, the future needs to be invented in respect of both engineering and society. While analysing the inventions that can be expected in the future, he came to the conclusion that the inventions that are probable are not those that are needed. "There will be even larger computers, even faster communication etc. But, where is social stability?"

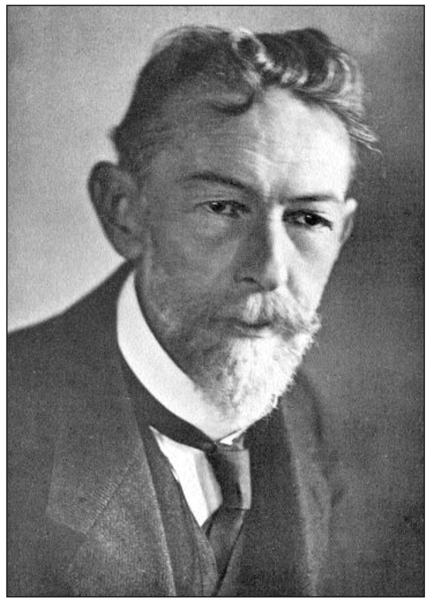
Dennis Gabor, a man who recognised the problems of the near future and advised of the danger in time, was, however, not a pessimist. His world concept and vision came from a deep understanding of reality. He made us aware of these global problems in order to motivate us to solve them. "I believe that the problems can be solved; although I admit that my hope derives from my optimism rather than on well supported data. It is, however, optimism that I always considered to be the sole work hypothesis of responsible people."

Nobel Prize Laureates in chemistry

Richard Adolf Zsigmondy (1865 - 1929) was awarded the Nobel Prize for Chemistry in 1925 *"for his demonstration of the heterogenous nature of colloid solutions and for the methods he used, which have since become fundamental in modern colloid chemistry."*

Richard A. Zsigmondy obtained his doctorate from the Erlangen University in 1889 in the subject of organic chemistry. He worked as assistant to August Kundt (1839 - 1894), the physicist, in 1891-1892, and he was private docent at the Technische Hochschule of Graz between 1893 and 1899. Then he continued his teaching career in Jena. At that time, he was primarily engaged in researching the peculiarities of silicon compounds. As a consequence of his results obtained with glass, he was asked to join the staff of the Schott glass factory of Jena; in parallel with this, he also continued his teaching activity.

At that time, he had already achieved fundamental results in colloidics and was a true classicist of this subject. In 1903, in co-operation with Henry Siedentopf (1872 - 1940), he developed the ultramicroscope as one of the most important testing devices of colloid



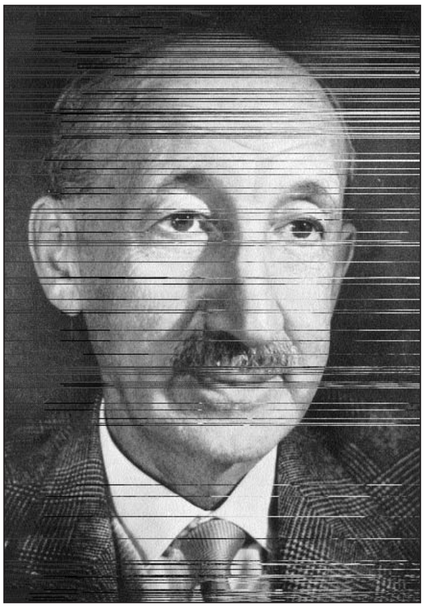
solutions. By means of this, he came to fundamentally important conclusions on the nature of colloids, the distribution of particles and the stability of sols. From 1907 onwards, he became a professor at the famous Göttingen University. In 1918, he developed the diaphragm filter used for research in the fields of colloid chemistry and biochemistry, and then in 1929, an improved version called the ultra-filter. Using these devices, particles of various sizes (including bacteria and viruses) can be separated from each other and from the solvent, respectively.

Göttingen University during the time of Richard Zsigmondy

George de Hevesy (1885 - 1966) was awarded the Nobel Prize for Chemistry in 1943, *"for his work on the use of isotopes as tracers in the study of chemical processes."*

He is a pioneer in radioactive tracer techniques: not only for discovering the method - even before the term 'isotope' was thought up - but also for leading it to victory and revealing its most important fields of application. By using the method of radioactive tracing, not only can hidden caves, water flows and the inner structure of materials be detected but, more importantly, the living organism - the parts and processes of which are inaccessible by any other method - can be studied.

From 1920 onward, he continued his career in Copenhagen at the institute of Niels Bohr (1885 - 1962). It is in this institute that he discovered element No. 72, hafnium. In the



same year, he launched the first experiments in the biological application of tracing, starting with plants, by using lead and thorium isotopes. In 1926, he was invited by the Freiburg University to work at the Department of Physics and Chemistry. During the eight years spent here, he began the application of tracing in animal tissues. He showed that the bismuth concentration in tumorous cells is significantly higher than in healthy cells.

When the Nazis came to power in Germany, he left and moved back to Copenhagen. It was here in 1934 that he discovered activation analysis, the 'in vivo' method of tracing. From this time onward, he was almost exclusively engaged in medical, biological and biochemistry subjects, so much so that many of his colleagues truly believed themselves to be working with a great medical doctor.

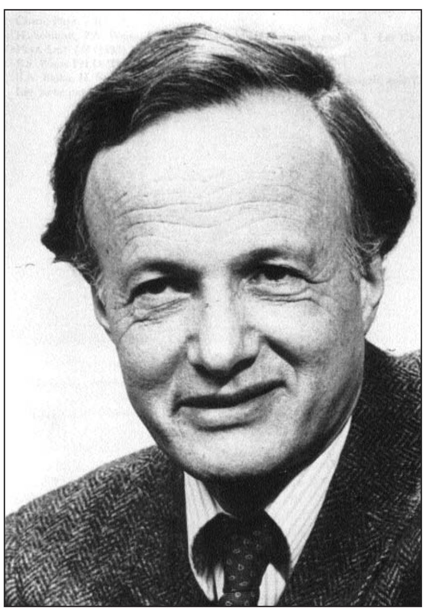
His work became complete following the beginning of the artificial production of isotopes. Following the discovery of deuterium, he was able to demonstrate the exchange process between goldfish and water. Following the discovery of artificial radioactivity, he started using the isotope P32 for the examination of the skeletal system and demonstrated its continuous renewal. He quickly extended this form of study to other organs as well. He measured the rate and extent of renewal, the path and creation of various molecules in the organism and, in the meantime, increased the number of isotopes used.

From 1940, he carried out further experiments in Stockholm where he found the conditions for his biological examinations to be better than those in the institute for theoretical physics in Copenhagen. At that time, he was interested primarily in DNA formation, and this led him to the examination of certain malignant tumours. During the war, he moved from Denmark to Sweden. By that time, the importance of tracing had been completely developed. In recognition of his work, the scientific world awarded Hevesy the Nobel Prize for Chemistry in 1943.

Following this high honour, he continued his scientific activity in an increasingly wide sphere. By means of tracing, he conquered newer and newer fields for medical science. He examined the various processes of the metabolism (e.g. iron metabolism), continued to research tumours and, when he was older, he also started studying haematology.

Hevesy is famed as the founder of a totally new discipline, nuclear medicine, and he devoted his entire life to chemical, physio-chemical, biological and medical knowledge and to curative applications.

John C. Polanyi (1929 -) was awarded the Nobel Prize for Chemistry in 1986, shared with the



American *Dudley R. Herschbach* (born in 1932) and the American of Chinese origin *Yuan Tseh Lee* (born in 1936) *"for their contributions concerning the dynamics of chemical elementary processes."*

The activity of the above three scientists furnished the basis of *reaction dynamics* - a new field of chemistry that provides assistance in the more profound and detailed understanding of chemical reactions.

In order to trace the elementary steps in chemical reactions, Polanyi introduced the method of *infrared chemiluminescence*. This enabled infrared radiation of very low intensity to be detected and analysed. Thus, indispensable information can be obtained on the state of a multidimensional surface that describes the potential energy of the system. Polanyi succeeded in harmonising the data calculated from the potential energy surface of reactions with the values of parameters measured experimentally.

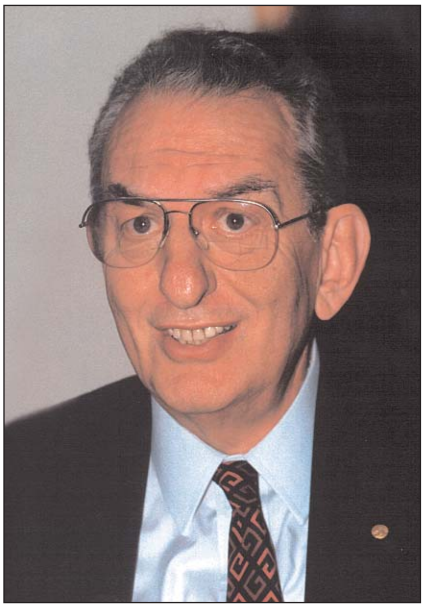
His research introduced laser methods that serve for studying the dynamics of chemical reactions. His name is also linked with the development of *surface photochemistry* - a new discipline studying the detailed mechanism of reactions that take place on surfaces.

In addition to his scientific papers, he published about one hundred articles on subjects ranging over science politics, weapons reduction and papers dealing with the effects of the sciences on society. He is co-editor of the book titled: *"The dangers of nuclear war"*. His scientific activity has brought him a number of high-level awards, among them the Wolf Prize in 1982.

George A. Olah (1927 -) was awarded the Nobel Prize for Chemistry in 1994, *"for his contribution to carbocation chemistry"*.

In the field of modern organic chemistry, his activity disproved the dogma of the quatrovalency of carbon and opened up new ways of producing hydrocarbons. The production of lead-free petrol is of outstanding importance.

George A. Olah completed his university studies at the Budapest



Technical University, Faculty of Chemical Engineering. His examinations carried out here under the leadership of Professor Géza Zemplén (1883 - 1956) opened up a new chapter in the chemistry of compounds that contain carbon atoms with a positive charge.

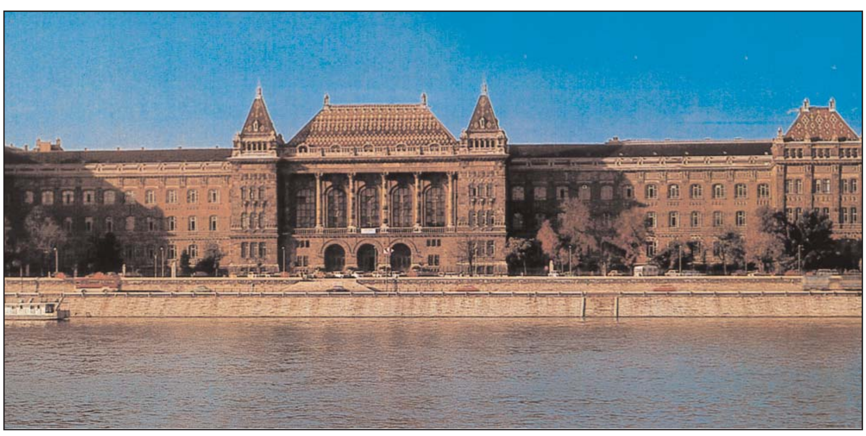
He applied the theoretical knowledge gained during the examination of carbocations in industrial syntheses as well: he produced high-octane hydrocarbons with branching chains from hydrocarbons with straight chains (poor quality and low-octane petroleum fractions). On his proposal, the ions containing positive carbon atoms are called collectively carbocations.

In recognition of his successful 12-year research activity, D.P. Locker and his wife as well as other sponsors founded a hydrocarbons chemical research institute for George A. Olah and his colleagues at the South California University in Los Angeles in 1976. Since then, the Locker Hydrocarbon Research Institute has been developing and growing under the leadership of professor Olah.

He is a chemist who has connected basic research with industrial applications; who is at home in the complete innovation chain between universities and industrial companies; whose research activity has become an economic resource while preserving the environment and nature. Nevertheless - together with the other Nobel Prize Laureates - he warns that our most important natural values are intellectual values, the most important value is human value, the civilised individual and a good education system.

"I hope very much to be understood at home" - said Nobel Prize Laureate professor Olah speaking in America - "that in the approaching 21st century, which is not far now, the most important thing for every nation will be the knowledge of its youth. Therefore, training, teaching and education are of fundamental importance. In both the 19th and 20th centuries economic resources were the greatest influences on which nations were able to progress. I believe this will be replaced to a large extent in the 21st century by what a country can offer in the education and professional qualification of its young people."

"Investment needs to be made in the future, and the best investment a country can make is in the education of its young people."

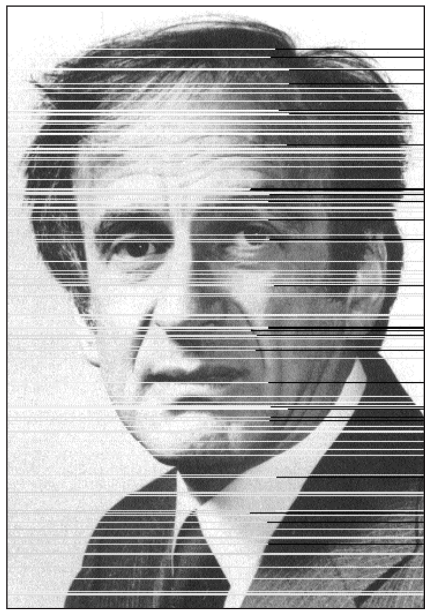


George Olah's alma mater, the Budapest Technical University

The Nobel Peace Prize Laureate

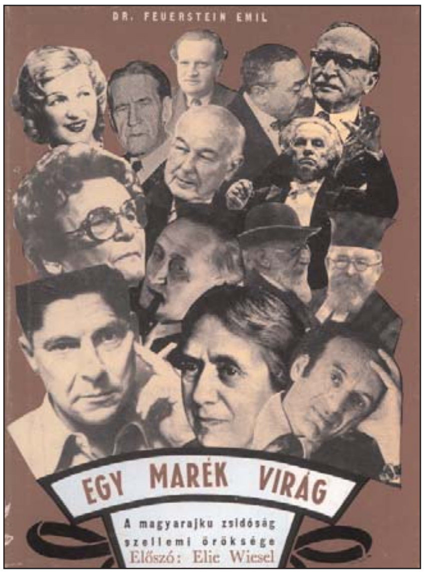
In addition to rewarding scientific and literary performances, in his will Alfred Nobel also envisaged a separate prize to honour outstanding humanists and heroes of peace. This is of particular importance; in fact, the 20th century is not only the era of nuclear energy, mankind setting foot on the Moon, global satellite communication, computer-based information processing, gene surgery and further results of scientific progress, but also that of Hiroshima and the Holocausts.

A living witness to this is *Elie Wiesel* (1928-), who was awarded the



Nobel Peace Prize in 1986. He was 15 when his family was deported. His mother and younger sister died in the gas chambers and his father died in the Buchenwald death camp. He survived the tragedy, became an accusatory witness of it, and then kept the memory of it alive through literature.

He moved to Paris in 1945 and during the sixteen years spent there, he won recognition in modern French literature. In 1961, he visited the United States. He has been an American citizen since 1963. Although he is a writer, it is not his literary activity that was the basis of this high moral recognition; instead, the Nobel Peace Prize was awarded - according to the official



reasoning - with special regard to the fact that *"he was the most important leading personality and intellectual leader in the times when violence, oppression and racism left their mark on the face of the world."*

In Tel Aviv, a series of books titled *"A handful of flowers - The intellectual heritage of Hungarian-speaking Jewishness"* edited by Emil Feuerstein was published about persons regarded as those who had contributed to the culture of both Hungary and Israel. On the title page of the third volume published in 1989, a portrait of Dennis Gabor is shown at the top and a portrait of Elie Wiesel, writer of the foreword to the Hungarian-language book, at the bottom.

The Nobel Prize Laureate in Economic Sciences

John C. Harsanyi (1920 - 2000) was awarded the Nobel Prize for Economic Sciences in 1994, shared with the American *John Nash* (1928 -) and the German *Reinhard Selten* (1930 -) *"for their pioneering analysis of equilibria in the theory of non-cooperative games."*

The Nobel Prize Laureate of the game theory was born in Budapest on 29th May 1920. As Eugene Wigner and John von Neumann before him, Harsanyi also completed his grammar school studies at the famous Fasor grammar school in Budapest. Here he acquired the foundations of his knowledge and humanism, which he always remembered with great emotion. In the year of his final examination, in 1937, and following in the footsteps of scientific world-luminaries like Theodor T. Karman (1881 - 1963), Leo Szilard (1898 - 1964) and Ede Teller (1908 -), he too won the high-ranking National Grammar School Mathematics Competition.

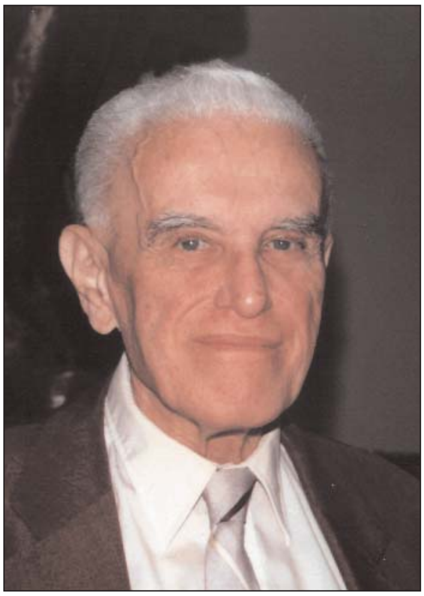
His father owned a pharmacy in Zugló, a part of Budapest; so, at the request of his parents, he studied pharmacology at the Budapest University of Sciences in order to take over the family business. However, the war intervened: in 1944, he was called up for work service. Due to luck and assistance from the Jesuit Fathers, he survived the Second World War.

When he enrolled again in the University of Sciences, he pursued his studies in another field. He obtained his doctor's degree in philosophy, sociology and psychology in the following year. In the academic year of 1947/1948, he joined the Institute of Sociology run by Professor Sándor Szalay, as an assistant professor. It is there that he became acquainted with Anna Klauber, a student in psychology, who became his life-long companion. "It is my family and my research activity that remain at the centre of my life," professor Harsanyi stated while looking back on his career.

The Stalinist political regime made it impossible for him to continue his research activity in Hungary. Therefore, in 1950, he and his wife risked their lives to escape abroad through mine fields. In Austria, he started his life again as a factory worker. In parallel with this, he studied economics. He continued his studies in America. From 1964 and for the next quarter of a century, he worked as a professor at Berkeley University in California. He retired in 1990. However, he continued his academic activity even after his retirement. He published four books and about one hundred academic papers.

This lifework was crowned by the Nobel Prize, awarded for his work carried out in the field of game theory. Harsanyi arrived in the United States in the very year John von Neumann, founder of the theory of games, died. In his letter of 26th May 1957, John Harsanyi, aged 37 at the time, notified Budapest of the death of the scientist genius and of the

King of Sweden Carl XVI Gustaf presenting John Harsanyi with the 1994 Nobel Prize for Economic Sciences, shared with J. F. Nash and R. Selten



mathematical revolution Neumann had launched as follows: “A number of mathematical disciplines were born in recent years to fulfil the mathematical needs of social sciences. (The traditional mathematical theorems were ‘dimensioned’ to the needs of natural sciences, thus, they could not completely fulfil the needs of social sciences.) One of them is the ‘theory of games’ founded by John von Neumann. (J.N. died a short time ago due to a brain tumour.) The objective here is to understand the economic and political equilibrium between the various groups of society.”

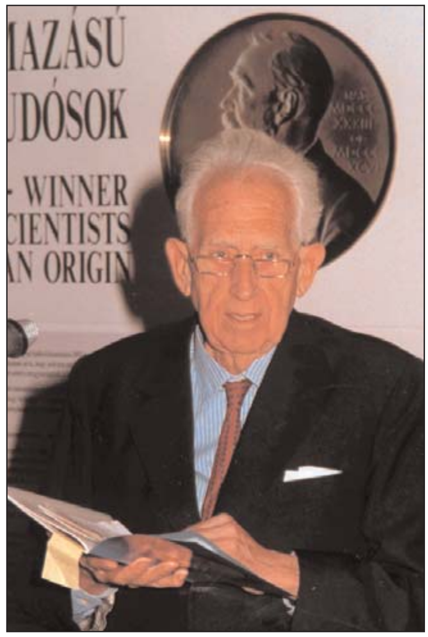
Professor Harsanyi, continuing the work of Neumann, demonstrated how to successfully analyse social games, even when the available information is incomplete. With this he founded a fast-growing research sector, namely the economics of information, which deals with strategic situations in which the participants only know each other’s intentions in part or not at all. He made good use of this knowledge to the advantage of his new home country and the world when he advised President Nixon during the American-Soviet disarmament negotiations.

The scientific activity of Professor Harsanyi was shared between the problems of philosophy - especially the philosophy of history - the theory of games, economic thinking and the improvement of ethics. “The idea is that, if society accepts the rules of ethics that, indeed, serve to benefit society, and these rules are observed by the people, society becomes not only more ethical, but it will enjoy much better economic circumstances. In fact, if people conduct themselves in an ethical manner, there will be mutual confidence and they will *not only put their trust in each other*, but they will have *good reason* to do so, and we know that a significant part of economic life centres on people being able to trust each other; otherwise they are unable to co-operate and conclude contracts, and so on. *It is best to be honest, even in economic respects!”*

The activity of John Harsanyi contributed to economics and economic thinking becoming more suitable for the accurate interpretation of the surrounding world, and to a more correct behaviour harmonised with this. In his lifework, wisdom and honour, knowledge and humanism were combined at the highest level. His example, his heritage and message are of increasing importance and increasingly topical in respect of the future knowledge-based society.

The Message of the Nobel Prizes

Essentially, science is international and a scientist can contribute to several professional fields and to the wealth of several countries by means of his/her work. The name of Robert Bárány reveals his Hungarian origin. Richard Zsigmondy originated from a famous



János Szentágothai opening the Budapest exhibition of Nobel Prize winners in 1993 on the occasion of the centenary of the birth of Albert von Szent-Györgyi

Hungarian family. Both were born in Vienna. However, Zsigmondy received the Nobel Prize in Stockholm as professor at the Göttingen University (Germany). Robert Bárány was released from captivity by the Swedish Government during the First World War, and it is Sweden that became his new home country and his final repose. In memory of Bárány, the Hungarian, Austrian and Swedish Post Offices issued a stamp. John C. Polanyi, son of the world famous chemist and philoso-

Hungarian Academy of Sciences

Nobel Prize winners in the Hungarian Academy of Sciences. From left, vice-president Pál Michelberger, John Harsanyi, George Olah, Domonkos Kosáry and Béla Halász

pher Michael Polanyi, who emigrated from Budapest after the First World War, was born in Berlin as a descendant of an intellectual family that played an important part in Hungarian cultural life. He was educated in England and received the Nobel Prize as a citizen of Canada.

"I aim at becoming a useful subject of a different country, America; and in addition, of an even larger entity, humanity, while serving the important common human objectives. However, all this does not alter the fact that I was and remain a Hungarian and my home country is Hungary, as it was in my childhood," said Albert von Szent-Györgyi Nagyrapolt, who had had to emigrate after the Second World War, on his return home after 25 years of absence. In a similar way, George Olah, who emigrated following the suppression of the revolution in 1956, said of his dual link: "My family and I found a new home country and, while being proud of that I am a Hungarian, I became American. [...] As for being Hungarian: I lived in Hungary for twenty-nine years and, as I left Hungary young, it is my best memories that remained; in fact - and this is the good thing about life - we remember the pleasant things. I am an American of Hungarian origin, and as I have said, the best of both worlds is mine."

People in Vienna, Berlin, Stockholm, Tel Aviv or even in Washington can be proud of the results of the Hungarian Nobel Prize Laureates. *The spirit of the Nobel Prize encourages us to build bridges over the borders of countries and the separating walls of science.*

Fact Sheets on Hungary, published since 1996, accessible on the Internet:

- Measures taken by the state to promote the social integration of Roma living in Hungary
- The Republic of Hungary
- Thousand years of Hungarian culture
- The national and ethnic minorities in Hungary
- History of Hungary
- The historical churches in Hungary
- The Hungarian defence forces
- The foreign policy of Hungary, a member of NATO
- On the threshold of a new millennium
- Hungary's revolution and war of independence of 1848-1849
- Relations between Hungary and the European Union
- Hungary and the Council of Europe
- The path from the Orient
- Hungary and NATO
- The 1956 Hungarian revolution
- The contribution of Hungarians to universal culture
- The Hungarian education system
- Hungary and its inhabitants
- Hungary's national days
- Hungary's national symbols
- Hungarian winners at the Olympic Games

It is an uplifting experience to view the Nobel Prize Laureates of Hungarian origin over the century. The dramatic conclusion of the 20th century - the stormiest period in human history - appears concentrated on this historic tableau: scientific-technical progress needs to be paired with moral-human progress. This relationship was emphasised by Albert von Szent-Györgyi Nagyrapolt more than half a century ago in his Nobel presentation delivered in 1937. He ended his speech - which can be rightly considered an eternally valid message from Nobel Prize Laureates - in the spirit of Alfred Nobel, linking science and humanism:

"The objective of my examinations is the same as that of modern biochemistry in general: understanding the functioning of the organism. If we eventually understand the functioning of the organism, a completely new era in medical sciences opens. However, it is apparent that until this distant objective is achieved, these examinations are not without success; in fact, we have revealed a number of things about which we can hope - or even, already know - will mitigate human suffering.

"However, there also exists another point in my research activity that I have much pleasure in and I am proud of. This is not the results of my examinations. [...] What gives me infinite pleasure is, on looking back to these examinations, that these were enabled by the wide international scientific fraternity, scientific co-operation and human solidarity, without which I would have perished and my experiments would not have led to any results. It is an imposing feeling to know that, in this inflamed world full of malice, this spirit of fraternity and human solidarity lives at the highest level of science. I can only wish for this spirit to radiate beyond the borders of science to lead mankind to a future better than the present."

Ferenc Nagy
Editor-in-chief of the Magyar Tudóslexikon

This compilation was put together on the basis of entries in the Magyar Tudóslexikon (Hungarian Encyclopaedia of Scientists) and articles published by the author. Further information is available at www.panteon.hu