

## EDUCATION AND RESEARCH IN MATHEMATICS

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The purpose of this short introduction is to give a survey of the institutions in Hungary connected with research and the nurturing of young talents in mathematics, for readers who are not familiar with the subject.

### 1900–1920

After 1883, there were two kinds of secondary schools in Hungary which led to university studies: “gimnázium” and “reáliskola”. Both started after four years of elementary school and had eight grades. In the humanistic gimnázium Latin and Greek were taught, while the reáliskola (like its model, the Austrian “Realschule”) put emphasis on science, mathematics, descriptive geometry, and modern languages. Both schools ended with the “érettségi” examination (Reifeprüfung, Matura or Abitur in German, Baccalauréat in French), with written as well as oral examination. Passing the érettségi at a gimnázium gave right to enter any university, while the érettségi at a reáliskola gave right to studies at the Technical University, Faculties of Science, and to the Academies of Mining, Forestry, and Economics. The forming of secondary school teachers was directed by Teacher’s Colleges attached to the universities. The College in Budapest was created by Mór von Kármán (father of Theodore von Kármán) and had a practice school called “Mintagimnázium” (minta = model), which was one of the strongest gimnáziums of Hungary (e.g., T. Kármán, E. Teller, D. König, P. Lax studied there). Otherwise, secondary schools were either state schools or church schools. Some of the church gimnáziums were famous top-standard schools; in bringing up talents in mathematics, the Lutheran Evangelical Gimnázium in Budapest (A. Haar, J. Harsányi, J. von Neumann, E. Wigner), the Benedictine Gimnázium in Győr (J. Farkas, J. König,

J. Pál, F. Riesz, M. Riesz), and the Piarist Gimnázium in Budapest (L. Grosschmid, G. Hajós, E. Makai) were the most successful among them.

At the beginning of the century, there were two universities in Hungary: one in Budapest founded in Nagyszombat [today Trnava, Slovakia] in 1635 and another in Kolozsvár [today Cluj-Napoca, Romania] established in 1872. There was also a Technical University in Budapest active in forming engineers and specialists in economics. As research centres in mathematics, the Budapest Technical University and the University of Kolozsvár both played an important role, while the University of Budapest gained considerable influence in mathematical activities only in the first decade of the century.

In the 1910's two more universities were established, one in Pozsony [today Bratislava, Slovakia] and one in Debrecen, with very modest activity in mathematics until the end of the period.

As in other countries, future researchers in mathematics usually took the degree “Doctor of Philosophy” at a university. After having written a “Habilitation” thesis and presented an inaugural lecture, one was awarded the title of “private professor” (*magántanár*, *Privatdozent* in German, the term we shall use in the Biographies). This title gave the right to teach at the university (*venia legendi*) but involved only a minimal financial remuneration. However, secondary school teachers of state schools who became *Privatdozents* had their teaching load of 18 weekly hours reduced to 12.

The Hungarian Academy of Sciences had about a dozen members engaged in research in mathematics, grouped in the Section for Mathematics and Physics. The Mathematical and Physical Society was founded in 1894 and had about 400 members. Both the Academy and the Society organized sessions with lectures on various subjects in mathematics and physics, mostly connected with the research results of the lecturer.

There were two periodicals in which research papers in mathematics appeared in Hungarian: *Mathematikai és Természettudományi Értesítő* [Mathematical and Scientific Bulletin] published by the Academy, and *Mathematikai és Fizikai Lapok* [Mathematical and Physical Journal] published by the Society. The Academy also had a periodical containing papers in foreign languages: *Mathematische und Naturwissenschaftliche Berichte aus Ungarn*.

Beginning with 1894, the Mathematical and Physical Society organized every year a contest in mathematics for those who have just graduated from

secondary school. After the death in 1919 of the physicist Loránd Eötvös, first president of the Society, this contest was named “Eötvös Competition”. Every time, three problems were to be solved during a period of four hours, and any kind of resource was allowed to be used.

Many eminent Hungarian mathematicians began their mathematical careers by winning a prize at this competition. A few names of these famous winners are: L. Fejér (1897), Th. von Kármán (1898), D. König (1902), A. Haar (1903), M. Riesz (1904), F. Lukács (1909), G. Szegő (1912), T. Radó (1913), L. Rédei (1918), L. Kalmár (1922), E. Teller (1925). The solutions of the problems of the Eötvös Competitions were collected in the two volumes of the Hungarian Problem Book, first edited 1929 in Hungarian by J. Kürschák, and later published in English translation.

Every year, the Ministry of Education organized a competition, similar to the “Concours Général” in France, in every subject.

There was also a periodical (*Középiskolai Matematikai és Fizikai Lapok* [Mathematical and Physical Journal for Secondary Schools]), founded in 1894 by D. Arany, that published educational papers in mathematics and physics and, primarily, mathematical and physical problems for readers aged between 14 and 18. Solutions submitted by the readers constituted the major part of the content. Many future mathematicians started as authors of one or more solutions in this journal. The photos of the most successful problem solvers were published in the last issue of each year; therefore the best solvers had often known one another from these photos before they personally met at the university.

In order to train high level *gimnázium* teachers, the Eötvös Collegium (Eötvös College) was founded as early as 1895, following the example of the *Ecole Normale Supérieure*; it was a boarding-school for university students preparing themselves for the vocation of teacher. There were first class researchers in mathematics who had been members of this College (e.g. M. Riesz).

## 1920–1945

Beginning with 1924, a third kind of secondary schools was established, the so-called “*reálgimnázium*”, a hybrid of *gimnázium* and *reáliskola*: beside mathematics and sciences, it had eight years of German, six years of Latin, four of a second modern language (French, English or Italian), and no Greek. And then, in 1934, the secondary school system was again reformed and

made more uniform, by establishing theory-oriented gimnáziums, practice-oriented “liceum”-s and specific practice-oriented schools.

The peace treaty of Versailles that ended the first world war contained seriously damaging decisions for Hungary; about 2/3 of the territory of the country was detached in favour of other countries. Also three and a half million ethnic Hungarians became citizens of other countries.

In particular, Kolozsvár was annexed by Romania under the name Cluj, and the former University of Kolozsvár continued its activity in Szeged from 1921. Similarly, the city of Pozsony went to Czecho-Slovakia with the name Bratislava; the former University of Pozsony worked in Pécs from 1921, but, for lack of a faculty of science, it did not influence research in mathematics.

On the other hand, the universities in Budapest and Szeged and, to a certain extent, the University of Debrecen and the Budapest Technical University continued to be research centres in mathematics.

The list of periodicals publishing research papers in mathematics was enriched with an important new journal, the *Acta Scientiarum Mathematicarum*, published by the University of Szeged from 1922, containing papers written in foreign languages. Due to the activity of the editors, in the first place F. Riesz, A. Haar and B. Kerékjártó, it reached very soon the rank of an important periodical in mathematics. Its name was often changed: *Acta Literarum ac Scientiarum Regiae Universitatis Hungariae Francisco-Josephinae, Sectio Scientiarum Mathematicarum*; later: *Acta Universitatis Szegediensis, Sectio Scientiarum Mathematicarum*; after the second world war: *Acta Scientiarum Mathematicarum (Szeged)*; now: *Acta Universitatis Szegediensis, Acta Scientiarum Mathematicarum*.

During the second world war from 1939 to 1945, Hungary regained a part of the territories lost in the Versailles treaty; therefore the University of Kolozsvár continued its activity for a few years as a Hungarian university, while the University of Szeged remained intact with about the same faculty as between 1921 and 1940.

The Academy, the Mathematical and Physical Society, and the earlier periodicals connected with mathematics continued their activity roughly in the same way as before 1920.

**1945–2000**

In 1948–49 the school system underwent a major change. The compulsory primary school was extended to eight years. A unified gimnázium had four years, with specialization within the school. Most of the church schools were taken over by state. Beside the gimnáziums, secondary technical schools in specific directions were also established; they also ended with a specialized “érettségi” examination. However, the érettségi no longer gave right to register at university. For that, entrance examinations had to be passed, in their oral part (which included also questions on political issues and the student’s opinion on them) favouring students from worker or peasant families.

In 1966, the Fazekas Mihály Gimnázium in Budapest opened a class specialized in mathematics. In subsequent years, several other gimnáziums followed the example, still the Fazekas Gimnázium could maintain its leading position, many of the present leaders of Hungarian mathematics are its alumni.

The fall of the communist system in 1989 resulted also in major changes in schooling. The school landscape became rather chaotic, with four-year, six-year, and eight-year gimnázium curricula, sometimes even in the same school. Several church schools have been returned gradually to their previous owners.

After the second world war, Hungary was restricted again to the territory possessed in the 1920’s.

The universities influencing mathematical research were, a few years after 1945, the same as before (University of Budapest, University of Szeged, University of Debrecen, Budapest Technical University). Beside them, in Cluj (Kolozsvár, Romania), the newly founded Bolyai University offered curricula in Hungarian until 1959 when it was unified with the Romanian Babeş University; after this, the number of courses in Hungarian was strongly reduced at the Babeş–Bolyai University.

Rather soon new technical universities were established in Miskolc and Veszprém, and the teaching of specialists in economics was split off from the Budapest Technical University and the Budapest University of Economics was founded. A number of colleges were also founded in order to train specialists in various fields (e.g. teachers or engineers); a part of these colleges had some contact with research in mathematics.

In 1950, scientific titles were reorganized following the Soviet system. The doctoral degree granted by universities was abolished (and reintroduced in the mid-sixties). The title Privatdozent was also abolished (but many more paid posts created at universities.) Two new degrees were created, granted by the Committee for Scientific Qualification, with members from universities and academical institutes. Requirements for the Candidate degree (“Candidate of Science”) were higher than for a university doctorate. The highest degree was “Doctor of Science”, for which usually a very substantial thesis was required, as well as taking active part in the life of the scientific community. In the mid-nineties issuing new Candidate degrees was stopped and, instead of the earlier “doctorates”, Ph. D. became the official name of the degree granted by universities. The “Doctor of Science” degree was changed into the title “Doctor of the Hungarian Academy of Sciences”, awarded by the Academy under conditions similar to the requirements for the earlier Doctor of Science degree.

The Hungarian Academy of Sciences founded a new research institute of applied mathematics in 1948 attached to the Budapest Technical University. In 1950 this institute became an independent Research Institute of Applied Mathematics, later renamed Mathematical Research Institute and, since 1999, Alfréd Rényi Institute of Mathematics.

In 1973, the Hungarian Academy of Sciences founded the Computer and Automation Research Institute, containing sections working in mathematical research.

The Section for Mathematics and Physics of the Academy was split in 1993 into a Section for Mathematics and another for Physics. The number of ordinary and corresponding members belonging to the Section for Mathematics is about 25; there are also external members, i.e. Hungarian scientists living abroad, and honorary members, i.e. foreign scientists having a sort of connection to Hungarian science. External members living in neighbouring countries have the option to spend longer periods of time in Hungary in the house of the foundation *Domus Hungarica* to carry out research.

The Mathematical and Physical Society split, and continued its activity from 1947 as János Bolyai Mathematical Society and Loránd Eötvös Physical Society, respectively. As to the former, it began in the 1960’s to organize international conferences on various domains of mathematics and to publish proceedings of many of these conferences. The series *Colloquia Mathematica Societatis János Bolyai*, started in 1969 (from 1993 *Bolyai Society Mathematical Studies*), is a very important contribution to the publication

of research papers in Hungary. Until 2000 more than 70 volumes appeared in these series.

The Academy and the Bolyai Society organized jointly two Hungarian Mathematical Congresses in 1950 and in 1960, with a number of foreign participants. The Proceedings of the first one was published in 1952.

The Hungarian Academy of Sciences started in 1974 a series of monographs with the title *Disquisitiones Mathematicae Hungaricae* (partly in Hungarian, but mostly in foreign languages).

The list of periodicals intended to publish new results in mathematics has been enriched by a large number of new journals. So from 1946 to 1949, four issues of *Hungarica Acta Mathematica* were edited, and the Hungarian Academy of Sciences started *Acta Mathematica Academiae Scientiarum Hungaricae* in 1950, since 1983 called *Acta Mathematica Hungarica*. The Mathematical Research Institute launched *Studia Scientiarum Mathematicarum Hungarica* in 1966. The János Bolyai Mathematical Society has been publishing *Periodica Mathematica Hungarica* since 1971. The University of Debrecen started *Publicationes Mathematicae* in 1949 and the University of Budapest the *Annales Universitatis Scientiarum Budapestinensis de Lorando Eötvös Nominatae, Sectio Mathematica*, in 1958, and *Sectio Computatorica*, in 1978. There are also two periodicals published in international cooperation: *Analysis Mathematica* (Hungarian Academy of Sciences and Academy of the USSR, from 1975 to 1991, Hungarian Academy and Russian Academy from 1992) and *Mathematica Pannonica* (Technical University of Miskolc till 1996, then University of Pécs [Hungary], Montanuniversität Leoben [Austria], University of Trieste [Italy]), started in 1990, and two journals with international Editorial Boards: *Acta Cybernetica*, launched by the University of Szeged in 1969, and *Combinatorica*, a journal of the Bolyai Society started in 1981.

All these journals publish articles in foreign languages. There are also a number of periodicals containing research and expository papers in Hungarian. The Academy published *A Magyar Tudományos Akadémia Matematikai és Fizikai Tudományok Osztályának Közleményei* [Communications of the Section for Mathematical and Physical Sciences of the Hungarian Academy of Sciences] between 1955 and 1977. The Academy launched also *Alkalmazott Matematikai Lapok* [Journal for Applied Mathematics] in 1975, which was taken over by the Bolyai Society in 1997. The Mathematical Research Institute published *A Magyar Tudományos Akadémia Matematikai Kutatóintézetének Közleményei* [Communications of the Research Institute for Mathematics of the Hungarian Academy of Sciences] from 1952 to 1964;

its continuation is *Studia Scientiarum Mathematicarum Hungarica* in foreign languages. The János Bolyai Mathematical Society publishes, as a continuation of *Mathematikai és Fizikai Lapok*, from 1950 *Matematikai Lapok* [Mathematical Journal]. Mathematical research papers also appear in general (not specialized mathematical) journals of several universities.

The publication of *Középiskolai Matematikai és Fizikai Lapok* [Mathematical and Physical Journal for Secondary Schools] has been continued by the two societies (János Bolyai Mathematical Society and Loránd Eötvös Physical Society). After some issues published in English at special occasions, the journal has a regular English version since 2002. On the website [www.komal.hu](http://www.komal.hu) of the journal, much is accessible also in English.

The number of mathematical competitions was essentially increased. The former Eötvös Competition is called, since 1949, Kürschák Competition. (The Eötvös Competition is since that time the name of a similar competition in physics, organized by the Eötvös Society.)

There is, since 1949, a Miklós Schweitzer Competition, organized for university students; this is a homework competition in which ten (or more) problems are to be solved during ten days. The solutions of the problems from the competitions between 1949 and 1961 were published in 1968 in the book *Contests in Higher Mathematics*.

Since 1947, there is a Dániel Arany Competition, organized in several series for secondary school students of lower grades.

All of these competitions are organized by the Bolyai Society. Beside them, the Ministry still organizes the yearly competitions for the students of the last grades. There are also local competitions in mathematics, organized in several cities by the local section of the Bolyai Society.

Since 1992, secondary school students in Hungary and in neighbouring countries have an International Hungarian Mathematical Competition, organized more or less similarly to the International Mathematical Olympiads. As to the latter, Hungarian students always achieve impressive results.

Finally, it is worth mentioning that the *Középiskolai Matematikai és Fizikai Lapok* still runs its yearly problem-solving competitions, and continues to publish the photos of the best solvers. Hopefully, this competition will bring a rich supply of researchers in mathematics in the future generations as well.