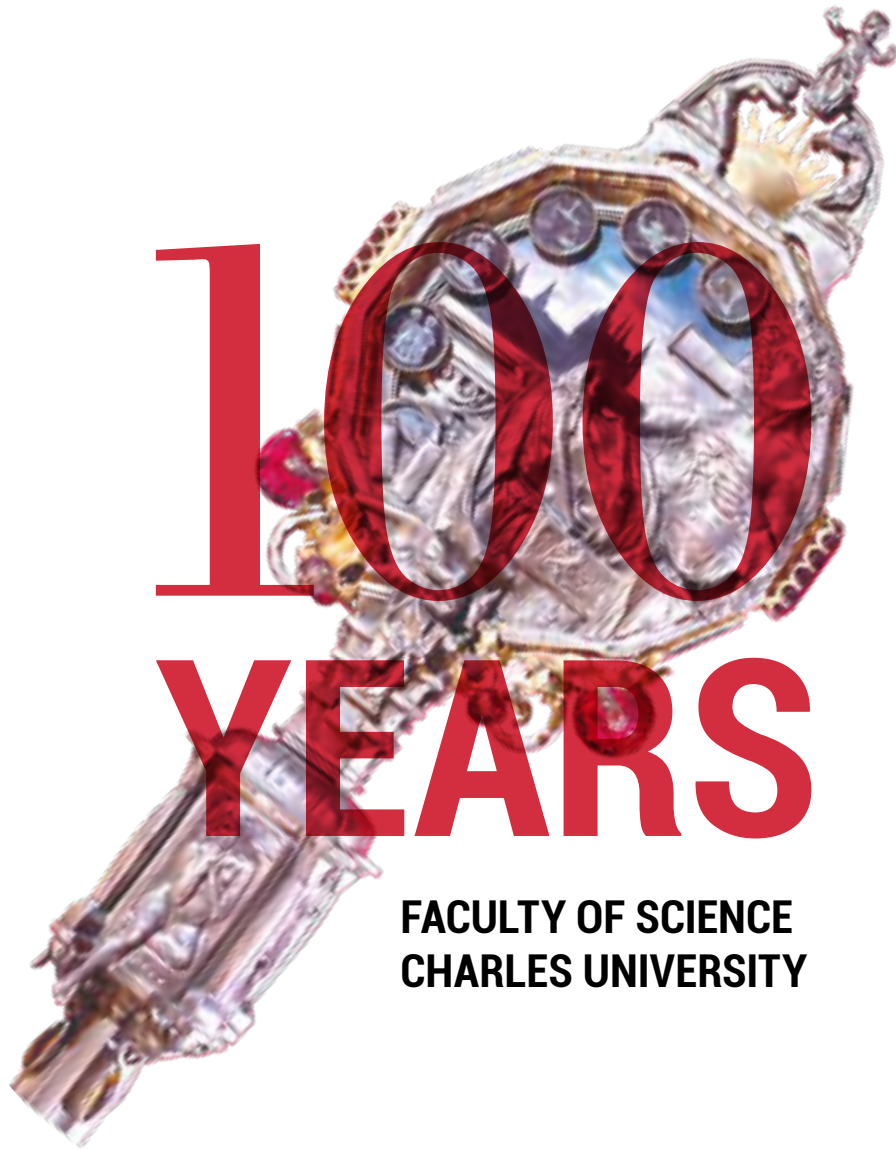




FACULTY OF SCIENCE  
Charles University

1920 – 2020



**100  
YEARS**

**FACULTY OF SCIENCE  
CHARLES UNIVERSITY**

100 YEARS OF THE FACULTY OF SCIENCE OF CHARLES UNIVERSITY













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## Foreword by the Dean

The Faculty of Science of Charles University is celebrating 100 years of existence on the 24<sup>th</sup> of June 2020. This still means a junior age compared with the anniversary of the foundation of Charles University, but compared with the duration of human life, it means the institution has already positively influenced several generations. The foundation for the Faculty of Science was the result of the rapid development in science in the preceding century and the major discoveries that changed the world and contributed to the leap development in all areas of the life of society. It was the first faculty to be added to the four founding faculties since 1348, spinning off from the Faculty of Arts. In addition to teaching the current subjects of biology, chemistry, geology and geography and the teaching of those subjects (as well as many modern subjects), the Faculty of Science also taught mathematics, physics, pharmacology and astronomy at the time. In fact, the first Dean of the faculty was a mathematician, Professor Karel Petr. The subsequent development of the university led to the foundation of other individual faculties, of which there currently are 17. Almost 850 students and 15 teachers in the first academic year 1920/1921 clearly illustrate that the teaching of science subjects was ready for independence. The faculty's development during the past 100 years was certainly not peaceful or devoid of conflict, including the World War II interruption, but it was definitely freer and more open in comparison with arts. In 2020, there are almost 5,000 students at all stages of studies, taken care of by a total of more than 1,000 employees, including 400 academic workers. Measured by the number of students, the faculty's volume has increased at least six times, but the Faculty's premises did not develop at a similar rate by far, so the majority of teaching and scientific work today takes place in historic buildings erected prior

to the Faculty's foundation that were only extended and refurbished in part at a later stage. The opening of the BIOCEV facility in Vestec near Prague, a workplace shared between Charles University and the Czech Academy of Sciences, was a major feat in recent years that addressed the great pressure for new premises to an extent, but certainly did not resolve the issue of the excessively high density of employees and students per unit of workplace area. All sections are currently focusing on the Albertov Campus project, which is being prepared to address the space issues that the Faculty of Science has been facing for a long time along with the First Faculty of Medicine and the Faculty of Mathematics and Physics. It should also provide development space allowing the university to welcome new teams.

Many teachers and scientists have worked at the Faculty over the past 100 years; they were luminaries in their field and some of them achieved international renown. To mention a few of them, we can recall Nobel Laureate Prof. Jaroslav Heyrovský, biologist Bohumil Němec, scientist, teacher and politician Vladimír Krajina, geographer and the founder of the Map Collection Václav Švambera, and geologist František Slavík. Excellent scientists work at the Faculty today and the future will assess their contributions, so their names may eventually be mentioned in honour alongside those named above.

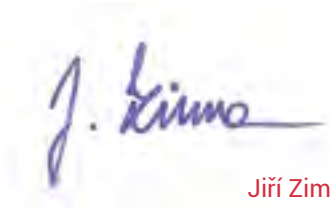
One of the areas where there is still room for improvement for the Faculty of Science is the internationalisation of studies, which is where we cannot compare ourselves with the faculties of medicine. There are objective and well-known causes for this disproportion, but they should not serve as an excuse. Even in this area, though, we can



see progress primarily in connection with Erasmus students. Many colleagues currently lecture on master's degree subjects in English, paving the way for opening study programmes in English. As a faculty, our greatest strength may be in raising doctoral students. Scientific output from doctoral theses accounts for a major part of the Faculty's scientific production and has launched successful careers for many young scientists, including international internships, and we try to make sure that the best of them return to our Faculty afterwards. Every year, our academic workers are successful in obtaining grants from the Czech Science Foundation and international grants including those provided by the European Research Council, as well as being involved in major, multi-million science projects such as the Charles University Centre for Advanced Materials and the Center for Research of Pathogenicity and Virulence of Parasites.

The Faculty's employees collaborate with their colleagues at many institutes of the Czech Academy of Sciences on a long-term basis, are in active contact with the teachers and students of the Faculty's affiliated high schools, address the general secondary school community via projects such as *Přírodovědci.cz*, participate in science and education fairs, organise open house events and fulfil the third role of universities. The Faculty's collections, museums and specialised libraries are available to both students and the general public. Several hundred people take organised professional training courses at the Faculty every year. Managed by the Faculty, the Botanical Garden of Charles University serves both teaching and relaxation purposes and is open to the public. Our employees regularly appear in the media and respond to the current developments and needs in society.

To conclude my brief introduction, I have to say that I have been extremely lucky to be able to continue the work of all Deans after 1989, namely my colleagues Vladimír Kořínek, Petr Čepěk, Karel Štulík, Pavel Kovář and Bohuslav Gaš, leading a self-confident, stable, ever – developing and successful Faculty of Science of Charles University.

A handwritten signature in blue ink, reading "J. Zima", with a horizontal line extending to the right.

**Jiří Zima**  
Dean





# Charles University

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regimo Quadragesimo octavo Indictione prima die 10 Aprilis Regnorum  
Secundo

Episcopus Johannes de alba



# Charles University

*Charles, by the Grace of God, King of the Romans, for Ever and Ever the Multiplier of the Empire and King of Bohemia. For the perpetual remembrance of the matter.*

*Among the desires of our heart and that which continuously occupies our royal mind with its weightiness, the heed, concern and attention of our mind is constantly turning to our desire that the Bohemian kingdom – which we love above all our other honourable acquisitions and possessions, be they hereditary or acquired by good fortune, with the special affection of our mind, and for whose ennoblement we strive with all our great ardour and for whose honour and good we strive with all our efforts – should, as by act of God, rejoice in the natural plenitude of the fruits of the earth, and should be adorned, by the order of our providence and our endeavour in our time, with a multitude of learned men.*

*And thus that our loyal people of the kingdom, who crave with unceasing hunger for the fruit of learning, should not need to beg for alms in foreign lands, but should find in our kingdom a table laid for feasting, and that those who are distinguished by their acuity, both innate and given from above, should become educated through the acquisition of knowledge, and should no longer be forced to wander around the world, turn to foreign nations, or to beg in alien parts in order to quench their craving, now considering such wandering useless, but that they should instead consider it their honour to be able to invite others from foreign lands and let them partake of that delectable fragrance and great gratitude.*

*Therefore, in order for such beneficial and praiseworthy intentions of our mind to bear dignified fruit and for the dignity of our kingdom to be multiplied by pleasing new deeds, on having prudently contemplated the matter we have decided to establish, elevate and newly create a Studium generale in our metropolitan and especially charming town of Prague, abounding in both a wealth of fruits of the earth and amenity of the place, so convenient and suited for such a great task.*

*At this Studium generale there will be doctors, masters and pupils of all faculties, to whom we promise excellent goods, and to those whom we consider deserving thereof, we shall grant royal gifts.*

*The doctors, masters and pupils at any faculty and beyond, all together and each one separately, no matter whence they hail, whether during the travels, during their*

*stay or on their return, we wish to keep under special protection and under the aegis of our majesty, giving to them all a solid guarantee that all privileges, prerogatives and freedoms – such as they enjoy by decree of royal power and such as are enjoyed by the doctors and pupils of both the Paris and Bologna Studia – shall be graciously granted to each and all who may wish to come here, and that we shall ensure that these freedoms be inviolably honoured by each and all.*

*As evidence thereof, and for safe assurance, we have had this charter drafted and ordered that it be confirmed by the seal of our Majesty. Done in Prague, in the first indiction, on the Seventh Day of the Month of April of the Year of Our Lord Thirteen Hundred and Forty Eight, in the second year of our rule.*

## History of the Prague University's Foundation Charters

The prevalent opinion today is that the university in Prague was founded on 7 April 1348 when King Charles IV. announced the foundation of the university at the land assembly and had its foundation charter issued. The plan for founding a university in Prague dates back to 1346 when King Charles IV. along with Arnošt of Pardubice, the Archbishop of Prague, commenced negotiations with the Papal Curia. The result was the issue by Pope Clement VI. of a university privilege for Prague dated 26 January 1347. King Charles' subsequent foundation charter of 7 April 1348 guaranteed the teachers and students the ruler's protection during study trips and while staying in the university town. King Charles also ordered that the new university follow the practice customary at the most prominent medieval universities in Bologna and Paris. The initial stage of the Prague university was concluded with King Charles IV.'s Eisenach Diploma dated 14 January 1349 whereby he granted the Prague university the same rights and privileges as his predecessors bestowed on other schools. As a result, Prague became home to the first *studium generale* in Central Europe, the first university north of the Alps and the first in the Kingdom of Bohemia, which went on to become the most important university of the Empire during the early stages of its existence. It sounds almost unbelievable to modern ears that the wording of King Charles' charter of 1348 was copied almost verbatim from the popular medieval style guide written by Peter of Vigna, with only certain parts (date, place names, etc.) altered. It was modelled after Emperor Friedrich II.'s charter for the University of Naples (1224), amended using Konrad IV.'s documents for the University of Salerno (1252–1253). The writer of



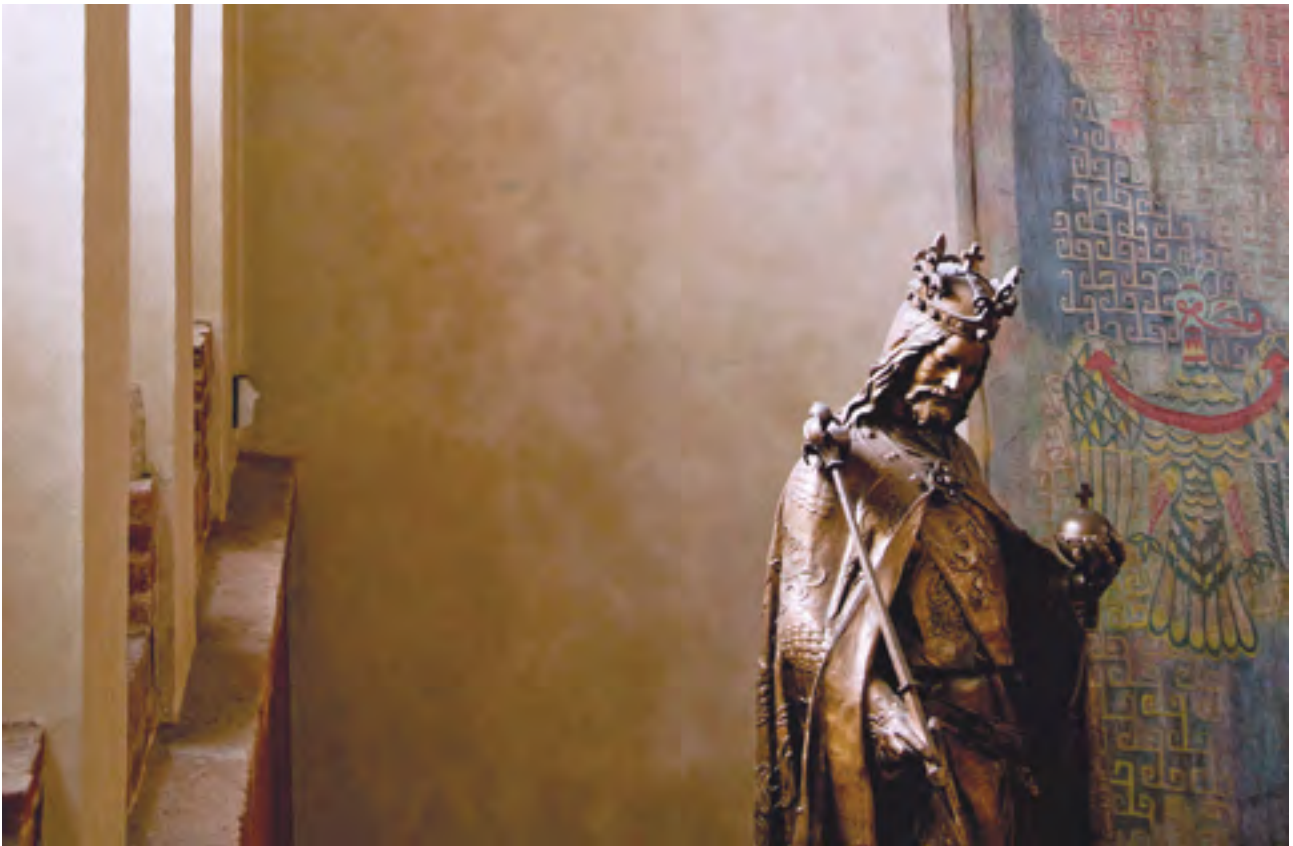
The Foundation Charter of Charles University. (photo: CU Archive)

King Charles' deed, the royal notary Nicholas Sortes, used a borrowed model, but worked without a doubt with the King's intentions in mind, so the Prague university was founded, in accordance with the customary medieval practice, using 'borrowed words', yet fully in agreement with its founders' intentions.

King Charles IV.'s office issued the charter of 1348 in two counterparts of the same wording, written in Latin on parchment. The university received the more 'solemn' counterpart and the Archbishop of Prague in his capacity as the university's chancellor received the other one. The university's specimen fitted with a golden seal was stored in Prague's Carolinum until the end of Second World War; the Nazi administrators of the university archive took it away from there along with the school's earliest insignia and records in 1945. Despite a series of painstaking investigations undertaken after the war, the documents are missing to this day. What we know with certainty is that, during the last months of the war, the most valuable part of the Prague university archive was packed in wooden boxes and prepared for shipment to Bavaria. What happened to them afterwards is the subject of mere conjectures: according to one, they were trucked across the Šumava mountains; according to another (and more viable one), they were destroyed while on a train during

an air raid of the Plzeň train station in April 1945. This was not the first time that Charles University's heritage documents were stricken with disaster. Early in the 19<sup>th</sup> century, a half of the documents from the university archive was handed over to the National Museum in Prague, only to return during Second World War. The golden seal from King Charles' foundation privilege was lost in the 19<sup>th</sup> century, though it was recovered shortly and the university regained its possession. The division of Prague's Charles-Ferdinand University into the Czech and German sections in 1882 marked the beginning of a protracted dispute over which school would hold the historical insignia and the Carolina archive. The dispute was not resolved until the enactment of the University Act in 1920, which ruled that the university's heritage should belong to the Czech-speaking Charles University. The occupation of Czechoslovakia and the subsequent closure of Czech universities on 17 November 1939 resulted in a transfer of the Carolina archive to the German University's custody, during which the university's earliest privileges, records and insignia were lost. The destiny of the second counterpart of King Charles' foundation charter of the Prague university with a majestic wax seal attached to it was not as dramatic as that of the 'university specimen', and the document is still stored in the Archive of the Prague Metropolitan Chapter in Prague Castle.





The statue of King Charles IV in the Karolinum Great Hall commemorates the founder of our University. (photo: CU Archive)

### Charles University Timeline

- 1347** Pope Clement VI.'s privilege establishes a *studium generale* in Prague.
- 1348** King of Bohemia and Roman Emperor Charles IV. founds the university with four faculties (Arts, Medicine, Law and Theology) with a charter of 7 April.
- 1366** Charles IV. founds a college for the twelve Masters of the Prague university (the Charles College).
- 1372** The Faculty of Law forms a separate University of Jurists (it lasted until 1418/19).
- 1383** Charles College is donated a building in the Old Town (the Carolinum) that has been used as the university's official headquarters since the refurbishment undertaken in 1383–1386.
- 1409** King Wenceslas IV.'s Decree of Kutná Hora (Kuttenberg) dated 18 January bestows a privileged position on the Bohemian university nation (among other things, the departing members of the other university nations are among the founders of the University in Leipzig).
- 1417** The university sides with the Hussites (the Calixtine confession) and is punished when the Pope forbids it to operate.
- 1419** Hussite wars result in a restriction of the university's activity (only the Faculty of Arts was in operation until the early 17<sup>th</sup> century).
- 1556** The Jesuit Order arrives in Prague, founding an academy in the Clementinum and teaching philosophy and theology (promoted to a university in 1616).
- 1609** The beginning of university reforms: fixed attendance regulations are introduced, the celibacy of teachers is abolished, and the university's management and economy is entrusted to the bursar.
- 1618** The university is actively involved in the rebellion against the Roman Catholic ruler.
- 1622** After the defeat of the protestant estates, Universitas Carolina is entrusted to the Jesuits.
- 1638** The secular faculties (Medicine and Law) residing in the Carolinum are subject to the direct supervision of the government.
- 1654** Emperor Ferdinand III.'s Union Decree combines the Carolinum and the Clementinum into one university ("Universitas Carolo-Ferdinandea") with four faculties.
- 1718** Architect F. M. Kaňka completes the remodelling of the Carolinum in the Baroque style.
- 1773** The Jesuit Order is abolished.
- 1781** The beginning of university reforms: non-Catholics are allowed to study from 1781; the university was nationalised in 1783 and its economic operations were taken away from it.
- 1784** The university's jurisdiction is abolished; the regulations enact German as the language of tuition.
- 1848** The university requests academic freedom and the equality of Czech and German in tuition.
- 1849** The University Organisation Act increases the power of the academic senate and teaching staff; the attendance and examination regulations of 1850 introduced rigorosum state final examination (along with the JUDr., MUDr., PhD. and ThDr. degrees).

- 1882** Emperor Franz Josef I.'s decree of 28 February divides the Charles-Ferdinand University into two separate tertiary schools with Czech and German, respectively, as the languages of tuition.
- 1920** The law on the relationships between Prague's two universities gives the Czech school the name "Charles University" and the German school the name "German University". The Faculty of Science is founded.
- 1939** During the Nazi occupation of the Lands of Bohemia, the German University (Deutsche Karlsuniversität Prag) is annexed to the Reich; Charles University and other Czech tertiary schools are closed following the student marches of 17 November.
- 1945** Charles University is reopened, with branch offices of the Faculty of Medicine formed in Plzeň (a Faculty of Medicine of Charles University officially since 1958) and in Hradec Králové (a Faculty of Medicine of Charles University officially since 1959), and the German University is closed.
- 1946** Faculty of Education opens (outside Charles University in 1959–1964).
- 1948** Student march against the onset of the totalitarian regime (followed by mass expulsions of non-communist teachers and students from the university).
- 1950** The Act on Tertiary Education abolishes the academic autonomy and subjects the schools to the Communist Party's supervision; the Faculty of Theology is separated from Charles University (and operates as a separate faculty in Litoměřice, 1950–1990).
- 1952** Faculty of Mathematics and Physics is founded.
- 1953** The Faculty of Medicine is divided into three faculties focusing on general medicine, sanitary medicine and paediatrics (renamed the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> Faculty of Medicine, respectively, in 1990).
- 1959** The Institute of Physical Education and Sport is integrated in the university (the Faculty of Physical Education and Sport since 1966).
- 1960** Foundation of the Institute of Education and Journalism (the Faculty of Education and Journalism since 1965; Faculty of Social Sciences since 1990).
- 1968** The university is involved in the Prague Spring developments and, later on, stricken by a new wave of repression targeted against non-conformist teachers and students after 1969.
- 1969** Foundation of the Faculty of Pharmacy in Hradec Králové.
- 1989** Student strike commemorating the events of 17 November 1939 triggers the demise of the communist regime.
- 1990** Act on Tertiary Education restores the autonomy of universities and the freedom of research and teaching.
- 1991** Three faculties of theology, the Catholic Theological Faculty, the Protestant Theological Faculty and the Hussite Theological Faculty are incorporated into Charles University by means of a Statute.
- 2000** Foundation of the Faculty of Humanities.
- 2020** Charles University involves 17 faculties (three located outside Prague):  
 Catholic Theological Faculty  
 Protestant Theological Faculty  
 Hussite Theological Faculty  
 Faculty of Law  
 First Faculty of Medicine  
 Second Faculty of Medicine  
 Third Faculty of Medicine  
 Faculty of Medicine in Plzeň  
 Faculty of Medicine in Hradec Králové  
 Faculty of Pharmacy in Hradec Králové  
 Faculty of Arts  
 Faculty of Science  
 Faculty of Mathematics and Physics  
 Faculty of Education  
 Faculty of Social Sciences  
 Faculty of Physical Education and Sport  
 Faculty of Humanities



The Rectorate of Charles University is still located in the Karolinum building at Ovocný trh. (photo: CU Archive)









# History of the Faculty of Science



# Faculty of Science in the Mirror of the History of Charles University and the Czech State

The beginnings of science in our lands date back to the foundation of King Charles' famous *studium generale*, the first university in Central Europe, in 1348. The lower-ranking Faculty of Arts taught arithmetic, geometry, astronomy and logic as part of the seven liberal arts, and the lessons and disputations held at the Faculties of Medicine and Theology included the traditional knowledge of man and nature. Even though the Hussite wars caused the university isolation, the results of Bohemian reformation, which sprang from the university, created a specific tolerant environment that was unusually favourable to sciences and education for a long time – until the early 17<sup>th</sup> century when Prague became one of the European centres of scientific revolution. The university was officially called Charles-Ferdinand University from 1654, following its merger with the Jesuit university that was founded in Prague's Clementinum in 1616 and the negotiations geared towards reinstating autonomy under the auspices of Emperor Ferdinand III. Latin as the language of tuition was being replaced by German as a result of the enlightenment reforms in the latter half of the 18<sup>th</sup> century, considering the purpose of the university, which was to raise teachers, priests, medical doctors and officials. Science remained part of the studies at the Faculty of Arts and certain disciplines such as chemistry and physiology were also taught at the Faculty of Medicine. Johann K. Bohatsch (1724–1768) was one of the leading initiators of science research in Bohemia in the 18<sup>th</sup> century, and Joseph G. Mikan (1742–1814), Professor of Botany and Chemistry, founded the first ever chemistry laboratory in the Carolinum in 1784.

Czech started gaining foothold as a language of tuition in 1849 when all universities in Austria were reformed following the proven German model devised by von Humboldt, resulting in free schools of science with a greater degree of autonomy (the Thun reform, named after Count Leo Thun, Minister of Education). In this era of 'language utraquism', the demand for experts with tertiary education in the fields of state administration, education and healthcare was growing during the latter half of the 19<sup>th</sup> century. University lecturers possessed great authority and made public statements on many technical and public matters. This development was fostered by the growing number of secondary schools with increasing emphasis on education in mathematics and science, and the Faculty of Arts was the only institution raising secondary school teachers. The Faculty also taught pharmacy whose students attended lectures primarily in botany and chemistry over the course of a two-year curriculum.

The division of the Charles-Ferdinand University into a Czech university and a German university in 1882 was the outcome of prolonged effort mainly on the Czech side and it provided a major stimulus for the further development of science, with the number of scientist positions in the separate science and mathematics/physics section almost doubling. Scientific work was concentrated in university institutes, seminars and proseminars whose mission was both preparation for teaching and independent scientific work. After the division, science programmes at the Faculty of Arts encompassed six institutes; there were seven full professors, one extraordinary professor and six private associate professors. Čeněk Strouhal (1850–1922) led the Institute of Physics (his tenure ended in 1920), the Institute of Chemistry was chaired by Vojtěch Šafařík (1829–1902), Ladislav Čelakovský (1834–1902) led the Institute of Botany, Antonín Frič (1832–1913) led the Institute of Zoology, Karel Vrba (1845–1922) led the Institute of Mineralogy and Jan Krejčí (1825–1887) led the Institute of Geology. Supervised by these founders, private associate professors started teaching and scientific work and went on to form a generation of extraordinarily influential personalities in the early 20<sup>th</sup> century.

The Faculty of Arts became a collective workplace for sciences, which experienced an era of truly international growth. Researchers in these fields transcended the confines of 'national' science and embraced modern laboratory and experimental methods. In chemistry, this trend is associated with the name of Bohuslav Rayman (1852–1910), the founder of experimental organic chemistry, and zoologist František Vejdovský (1849–1939), the founder of modern Czech experimental biology and the second most influential Czech biologist after J. E. Purkyně, lectured on the anatomy and systematisation of lower animals. His teaching influenced a host of excellent researchers who set the tone in Czech biology throughout the first half of the 20<sup>th</sup> century and virtually founded the Faculty of Science.

In terms of scope and quality, Czech science in the early 20<sup>th</sup> century was on a par with other university research institutions in Europe. It was obvious that the footing of the Faculty of Arts was becoming increasingly confining for the development, specific needs and diversification of the individual fields of science. Europe's leading universities, which as a rule had their own recently established faculties of science, also worked as a model in this respect. This is why, in 1908, Czech scientists submitted a proposal for the division of the Faculty of Arts, which would effectively



The sceptre as the main part of the Faculty of Science's new insignia. The photo on the left shows a figure of Nature (face side), the photo on the right shows a motif of an owl (reverse side). The sceptre was made by goldsmith Alois Tengler in 1926. (photo: CU Archive)

give rise to a new Faculty of Science. The leaders of this effort were primarily the younger professors at science institutes, botanist Bohumil Němec (1873–1966), mineralogist František Slavík (1876–1957), mathematician Karel Petr (1868–1950) and several others. World War I delayed the implementation of this proposal, but the discussions were renewed soon after the formation of Czechoslovakia as part of the reorganisation of university studies and science policy of the new state, and they eventually resulted in the establishment of two separate Faculties of Science simultaneously at both Charles University and the German University in Prague with effect from 24 June 1920. This was primarily thanks to Professors Bohumil Němec, Otakar Srdínko (1875–1930) and František Mareš (1857–1942) who pursued the effort as the MPs in the first National Assembly. In effect, the Faculty of Science became the fifth faculty of Charles University and the first of the modern age faculties added to the four classic ones later on. The Faculty taught mathematics, physics, chemistry, biology, geology and geography. It involved 13 institutes and several seminars, 15 professors and nine extraordinary professors, and mathematician Karel Petr was the Faculty's first Dean. The new Faculty opened its courses in the winter semester of 1920/21 with 719 enrolled science and mathematics students and 130 pharmacy students.

The scientific and educational work of the various institutes could continuously build on their previous achievements, the success in their fields and the international renown of their representatives, while the room for further development of science was significantly expanded. The period of twenty years between the two World Wars can easily be considered the culmination of almost a century of efforts towards establishing an adequate institutional foundation for Czech science. The individual institutes were led by renowned scientists with extensive international experience, raising the next generation of scientists. Many of them were also premier science popularisers and celebrities. We can mention Professor of Botany Bohumil Němec (1873–1966) whose public involvement led him to run as a candidate for the President in 1935; mineralogist František Slavík (1876–1957); physical chemist Jaroslav Heyrovský (1890–1967), the only Nobel Prize laureate from among the Faculty; zoologist Julius Komárek (1892–1955); philosopher Emanuel Rádl (1873–1942); Jindřich Matiegka (1862–1941) whose achievements in physical anthropology earned worldwide recognition; parasitologist Otto Jírovec (1907–1972); botanist Karel Domin (1882–1953); the first Professor of Genetics Arthur Brožek (1882–1934) and his follower Karel Hrubý (1910–1962); geologist Radim Kettner (1891–1967); geographers Václav Švambera





Prof. Jaroslav Heyrovský is receiving a Nobel Prize from Gustaf VI Adolf, King of Sweden (1882–1973), in Stockholm on 10 December 1959. (photo: Czech News Agency)

(1866–1939) and Viktor Dvorský (1882–1960); demographer Antonín Boháč (1882–1950); chemist Bohuslav Brauner (1855–1935) and many more. Despite the unfavourable impact of the great depression beginning with the late 1920s, accompanied by restrictions in government funding, the Faculty of Science with its 18 institutes and four seminars was one of the premier science institutions in Europe in terms of scientific output and the proficiency of its graduates before the universities closed in 1939. Its scientific and educational activity relied on a system of laboratories with modern equipment, collections and libraries allowing for thorough student education and successful scientific work. While some of the younger teachers embodied the continuity of university science after the war, the scientific and public reach of the Faculty was never restored again in the subsequent eras stricken with political twists that affected each subsequent generation.

Nazi occupation in March 1939 virtually destroyed tertiary education on the territory of the Protectorate. First, the German University was subjected to arization and radical Nazification, renamed German Charles University, separated from the Protectorate administration, and incorporated in the Reich university structure in September 1939. During a coordinated raid of the occupation forces, all Czech and Moravian universities were closed on 17 November 1939, some of the students were arrested

and deported to concentration camps, and the property including the collections, libraries and equipment was confiscated. The faculty were reassigned to different sectors or secondary schools, placed on leave with a waiting allowance or retired. Many employees, students and graduates of the Faculty of Science fell victims to various forms of Nazi persecution in 1939–1945. Direct casualties included anthropogeographer and a long-time President of the Czechoslovak Statistics Office Jan Auerhan (1880–1942), physicists František Závíška (1879–1945) and Václav Dolejšek (1895–1945), mineralogists Radim Nováček (1905–1942) and František Ulrich (1899–1941) and zoologist Jaroslav Štorkán (1890–1942). Botanist Vladimír Krajina (1905–1993) gained a legendary status as a member of the domestic anti-Nazi resistance and as a post-war scientific and anti-communist political exile. Professor Otakar Matoušek (1899–1994) was at the helm of the rebellious Czechoslovak Radio during the Prague Uprising in early May 1945.

A new chapter of the Faculty's life opened after the end of the war and almost six years of forced interruption of educational and research activities. Hundreds of students crowded lecture halls, and teachers rapidly restored the operation in institutions and laboratories and renewed the destroyed or stolen collections with a great deal of help from students. Teaching started in an accelerated semes-

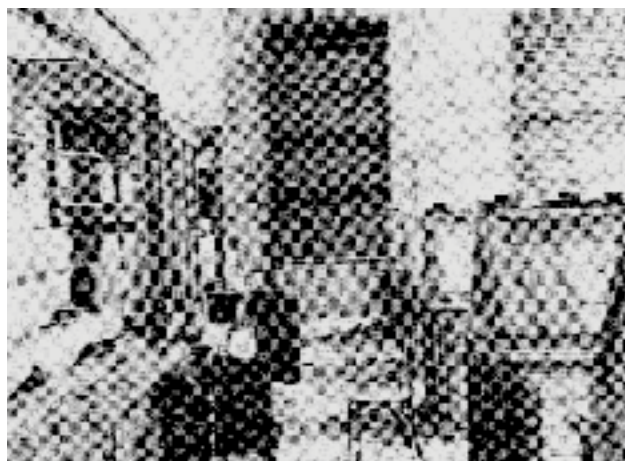
ter on 18 June 1945 and the Faculty also took over certain buildings and collections from the abolished German University. Many newly appointed professors and associate professors took vacated positions and young assistant professors started their careers. Soon afterwards, however, political developments affected the life of the Faculty, shaping the future development in Czechoslovakia for a long forty years. The coup of February 1948 and the rule of the communist party over time subjected the entire science and education sector to the soviet model of operation. Ideological supervision overseen by the communist party's power structures influenced science, from the system of its organisation to direct ideological interventions into the freedom of scientific research. Many teachers and students were forced to leave, some of them leaving the country.

A series of ill-considered organisational and administrative interventions followed soon. A new act on tertiary education of 18 May 1950 merged similar subject areas, and departments were set up instead of the existing institutes. In 1952 the single faculty was divided into three: Faculty of Mathematics and Physics (which included chemistry subjects), Faculty of Geology-Geography and Faculty of Biology. Large departments were divided into multiple departments with a narrower focus and the doctoral degrees gave way to graduated biologists, chemists, geographers and geologists (the original degrees were not restored until 1966). Constant chaos ruled during the reforms and the division of principal subjects into separate faculties proved wrong, so 1959 saw yet another restructuring when the Faculty of Biology and the Faculty of Geology-Geography was merged with the chemistry subjects, giving rise to the Faculty of Science as we know it today.

Certain modern trends in research and teaching made their way to the Faculty in the 1960s despite constant material shortage and tough international isolation. The Faculty community supported the democratisation changes



Prof. B. Němec, Rector of the University, with Deans of all CU Faculties (academic year 1921/1922). Prof. Jindřich Matiegka (second from left) was the second Dean of FSc. The other Deans, viewed from the left: Prof. M. Pěšina, Prof. J. Vais, Prof. V. Tille and Prof. V. Funk. (photo: CU Archive)



The state of the mineralogical collections in May 1945. (photo: CU Archive)

during the Prague Spring of 1968 and a rehabilitation panel was appointed to address the cases of persecuted employees and students and try to remedy the situation to a limited extent. The occupation of the Warsaw Pact armies and the subsequent period known as the normalisation froze all new hopes and trends. A wave of political loyalty tests came in 1969–1971, followed by more forced departures. Despite that, the Faculty retained a relatively high standard even amidst the machine of drastic political practices, in particular thanks to the everyday scientific and educational work of its employees. Under the difficult conditions, the Faculty continued raising excellent scientists for the Academy of Sciences institutes, experts for zoos and botanical gardens and museum curators, specialists for sectoral institutes and other expert institutions, and high school teachers.

In the late 1980s, some teachers and more students increasingly participated in semi-official and independent anti-regime activities, many of which involved criticising the devastation of the environment, and in various environmental movements. This is one of the reasons why, in November 1989, the Faculty of Science and its students were at the core of the developments during the actual demonstration on 17 November and involved in the hands-on leadership of the subsequent student strike. That was the beginning of the Faculty's modern history. Right from the outset, the Faculty was in the lead of university democratisation reforms and introducing western academic standards, which opened new routes to cooperation and competition in the field of international science. This is why, thirty years later, the Faculty of Science is an internationally renowned, top-tier scientific institution within both Charles University and Czechia as a whole. Its institutional history and even longer prehistory form an important part of the history of science in our country, and as such they witnessed the dramatic and fateful developments in the previous century. At the same time, this unique heritage obliges the Faculty to never curb its ambition or development, opening up creatively and responsibly for the purposes of science and society of the upcoming century.





# Albertov and Its Genius Loci





# Albertov and Its Genius Loci

Albertov is a peaceful part of Prague's New Town with a lot of green areas where university life, vibrant mostly in the university's medical and science sites, has been concentrated since the late 19<sup>th</sup> century. The primary driver behind the rise of a 'university quarter' in Albertov was the division of Prague's university into two new institutions – the Czech and the German Universities in 1882. Both newly established universities suffered from a lack of space from the very beginning. Most science institutes struggled within the limited premises of the Old Town's Carolinum and Clementinum. Some institutes relocated in 1880 to a newly built university facility in Viničná Street, which was assigned to the German University after the split. Medical institute buildings were opened near in Kateřinská Street in 1883 and more institutes followed in the same direction. Relocating the university's botanical garden along with both Czech and German Institutes of Botany from the original location in Smíchov to the slopes of the Slup area was a bold move. The garden officially opened in 1898.

The construction of other campus buildings was launched in the early 20<sup>th</sup> century. Albertov – a street named after prominent Czech surgeon Eduard Albert (1841–1900) – was the axis of the development. The first phase (until 1912) included the buildings for the Institute of Physics, Mathematics and Chemistry and the Institute of Science for the Czech University and the buildings for the Institutes of Hygiene and Physiology of the German University. The second phase after 1912 include the Hlava and Purkyně



The assembly of students at Albertov on 17 November 1989. (photo: Jakub Langhammer)



A general view of the students' home at Albertov, New Town, around 1905. (photo: Tomáš Vojta, AHMP)

Institute of the Czech University and the Institute of Chemistry of the German University. A number of plans and visions for the future development of the campus followed, but not all of them came to fruition. The area is still developing today and the most anticipated projects include the new compound for biology and medicine research – Bio-centre – and the Centre for the Study of Global Change – Globcentre.

The campus has always been a colourful tapestry with students spending their leisure time in it in addition to attending lectures and studying. Student fraternities (*Burschenschaft*) used to frequent the legendary ancient *Jedová chýše* (Poison Shack) pub in Apolinářská Street until its demolition in the 1930s. The Student House (today's canteen) built in the 1920s with the support from YWCA and YMCA offered accommodations as well as a library, a film screening room and clubrooms with a pi-

ano and billiards tables. This provided the students with an option of affordable lodging, which many foreign students used (students of 28 different nationalities stayed there in 1926, five years after opening). The Student Union used to meet in the German University's former summer-house after the November 1989 revolution. Another facility worth mentioning is *Mrtvá ryba* (Dead Fish), a student club opened in 1991.

Providing a mere description of the campus and institutions is not enough. The entire quarter is commemorative of the various periods and key events in our history. The university and the academic community were actively involved in social and political movements; in fact, academicians were often their prime movers. Albertov is inextricably associated with the anti-Nazi demonstration of 15 November 1939 when it was the starting point for the funeral procession for Jan Opletal, a student shot by the Nazis during the demonstrations. Initially a peaceful event, it was suppressed violently and led to the arrest of more than one thousand students, execution of nine student leaders and the closure of all Czech tertiary schools. The university premises then witnessed other feats of anti-Nazi resistance such as the radio transmissions from the building in Benátská Street 2 undertaken by the members of non-communist domestic resistance.

Another well-known event associated with Albertov is the meeting organised on the occasion of the 50<sup>th</sup> anniversary of the anti-Nazi demonstration. The meeting of 17 November 1989 was also an open protest against the communist regime of the era. The march set out from Albertov to the Slavín cemetery in Vyšehrad to poet Karel Hynek Mácha's grave where the event was officially ended with the Czechoslovak anthem. A large part of the students continued towards Opletalova Street along a route that was officially forbidden. The procession was violently dispersed in Národní třída, and that was the beginning of what is known today as the Velvet Revolution, which brought about the end of the communist rule and the final departure of Soviet occupation armies from Czechoslovakia. Of course, the students from Albertov then took part in the anti-regime student strike. A plaque to commemorate the anniversary of the event was unveiled in Albertov in 2006. Another plaque was unveiled in 2014 in the presence of President Miloš Zeman and the Presidents of Hungary, Germany, Poland and Slovakia, commemorating the 25<sup>th</sup> anniversary of the events of 1989. The ceremony turned into a protest against President Zeman's political style.

Let us wish for Albertov to retain its vibrant scientific and social life and to always offer room for the free expression of opinions and the opportunity to point out social issues and injustice.



A panoramic view of New Town, Prague. On the left Studničkova Street (formerly U botanického ústavu), with houses No. 2028 (Institute of Hygiene – in the middle), houses Nos. 2049 and 2038 (Institute of Natural Science on the left) in New Town. 2 April 1910 (photo: Jan Kříženecký, AHMP)







# The Faculty Today: Education and Teaching



# Faculty in Figures

## Numbers of Students in the Last 10 Years

	2010	2011
<b>Numbers of students in bachelor's programmes</b>		
Biology Section	803	893
Chemistry Section	556	493
Geography Section	490	547
Geology Section	272	237
Ecology and Environmental Protection	147	126
<b>Total students in bachelor's programmes</b>	<b>2,268</b>	<b>2,296</b>
<b>Numbers of students in master's programmes</b>		
Biology Section	549	569
Chemistry Section	238	241
Geography Section	374	376
Geology Section	97	137
Ecology and Environmental Protection	66	69
<b>Total students in master's programmes</b>	<b>1,324</b>	<b>1,392</b>
<b>Numbers of students in full-time doctoral programmes</b>		
Biology Section	387	404
Chemistry Section	198	203
Geography Section	142	143
Geology Section	41	42
Ecology and Environmental Protection	24	33
<b>Total students in full-time programmes</b>	<b>792</b>	<b>825</b>
<b>Numbers of students in combined doctoral programmes</b>		
Biology Section	289	273
Chemistry Section	139	143
Geography Section	113	94
Geology Section	72	61
Ecology and Environmental Protection	23	20
<b>Total students in combined programmes</b>	<b>636</b>	<b>591</b>

2012	2013	2014	2015	2016	2017	2018	2019
921	931	978	1,037	1,070	1,099	1,143	1,165
427	417	481	519	478	461	475	480
555	538	461	401	409	384	348	353
182	178	156	137	135	180	234	289
107	95	87	83	96	76	69	107
<b>2,192</b>	<b>2,159</b>	<b>2,163</b>	<b>2,177</b>	<b>2,188</b>	<b>2,200</b>	<b>2,269</b>	<b>2,394</b>
603	564	582	552	548	538	536	543
234	220	179	173	143	155	173	167
352	356	373	359	381	312	282	269
141	135	108	101	81	70	70	78
73	59	51	41	46	42	43	52
<b>1,403</b>	<b>1,334</b>	<b>1,293</b>	<b>1,226</b>	<b>1,199</b>	<b>1,117</b>	<b>1,104</b>	<b>1,109</b>
439	451	462	480	480	496	493	469
214	194	200	207	197	205	211	223
140	155	129	123	109	94	103	93
49	59	62	55	53	49	50	54
32	30	31	25	29	24	23	17
<b>874</b>	<b>889</b>	<b>884</b>	<b>890</b>	<b>868</b>	<b>868</b>	<b>880</b>	<b>856</b>
278	302	293	284	283	304	305	303
135	142	133	121	114	99	90	90
88	82	73	81	80	79	71	61
56	43	50	46	52	54	55	45
22	26	19	21	18	25	19	17
<b>579</b>	<b>595</b>	<b>568</b>	<b>553</b>	<b>547</b>	<b>561</b>	<b>540</b>	<b>516</b>



# Faculty in Figures

## Numbers of Graduates in the Last 10 Years

2010

### Numbers of graduates from **bachelor's** programmes

Biology Section	204
Chemistry Section	120
Geography Section	111
Geology Section	40
Ecology and Environmental Protection	39
<b>Total graduates from bachelor's programmes</b>	<b>514</b>

### Numbers of graduates from **master's** programmes

Biology Section	171
Chemistry Section	105
Geography Section	123
Geology Section	56
Ecology and Environmental Protection	22
<b>Total graduates from master's programmes</b>	<b>477</b>

### Numbers of graduates from **doctoral** programmes

Biology Section	63
Chemistry Section	42
Geography Section	23
Geology Section	14
Ecology and Environmental Protection	5
<b>Total graduates from doctoral programmes</b>	<b>147</b>

	2011	2012	2013	2014	2015	2016	2017	2018	2019
	188	190	207	193	198	199	210	204	214
	120	107	101	70	71	71	70	94	82
	84	76	96	108	74	70	49	63	68
	72	55	38	34	21	28	19	23	23
	31	25	21	24	19	15	17	18	22
	495	453	463	429	383	383	365	402	409
	200	194	215	185	221	208	191	174	178
	100	108	94	95	91	76	55	57	77
	97	106	101	76	99	88	98	97	85
	29	33	47	50	28	40	34	24	21
	20	19	31	20	22	13	14	10	9
	446	460	488	426	461	425	392	362	370
	85	52	57	53	67	66	60	77	87
	35	35	43	36	42	50	44	39	40
	25	26	14	12	12	12	12	11	21
	19	13	11	5	13	8	6	10	16
	4	3	6	11	4	4	2	10	4
	168	129	131	117	138	140	124	147	168



## Faculty in Figures

### Numbers of Employees in the Last 10 Years

	2010	2011
<b>Number of employees by category</b>		
Full professors	48	50
Associate professors	90	97
Assistant professors	154	166
Assistant professors + lecturers	46	58
Other	407	497

## Faculty in Figures

### Amount of Funds for Each of the Last 10 Years

	2010	2011
<b>Amount of funds in the budget (CZK thousand)</b>		
Contribution and subsidy for educational activities	440,350	555,479
<b>Subsidy for research activities:</b>		
Institutional funds	183,732	150,502
Defined purpose funds	260,590	270,824
Other sources	21,127	1,085
<b>Total funds excluding supplementary activities</b>	<b>905,799</b>	<b>977,890</b>
<b>Supplementary activities</b>	<b>9,930</b>	<b>13,676</b>
<b>Total funds including supplementary activities (CZK thousand)</b>	<b>915,729</b>	<b>991,566</b>

2012	2013	2014	2015	2016	2017	2018	2019
53	55	57	54	60	63	67	72
92	95	104	110	109	115	128	125
178	182	183	182	180	182	182	215
59	57	53	44	52	53	56	58
704	752	765	785	824	894	933	922

2012	2013	2014	2015	2016	2017	2018	2019
410,157	391,612	407,571	415,863	426,920	451,749	509,552	551,677
259,358	276,516	300,297	298,362	341,220	355,579	356,879	356,277
326,993	401,390	423,055	604,423	595,777	492,990	711,693	696,411
7,386	32,907	31,536	45,874	14,817	7,311	5,597	32,757
1,003,894	1,102,425	1,162,459	1,364,521	1,378,734	1,307,630	1,583,720	1,637,122
10,953	12,031	12,005	16,576	24,585	24,329	23,780	29,265
1,014,847	1,114,456	1,174,464	1,381,098	1,394,784	1,331,959	1,607,501	1,666,387



# Structure of Study

The Faculty of Science of Charles University provides education and teaching in the field of biological, environmental, geographical, geological and chemical sciences and raises future teachers of science subjects for secondary schools and higher stages of primary schools (biology, geography, geology, chemistry). The Faculty of Science is one of the premier educational institutions at Charles University as well as within the entire Czechia in terms of the range of its programmes, number of students and number of graduates.

The studies at the Faculty are structured. The core part of educational activities is focused on bachelor's, master's and doctoral programmes. The Faculty also pays great attention to lifelong education, organises preparatory courses for its studies, further education courses for teachers in practice and complementary studies, accredited qualification courses for non-medical healthcare professionals and, last but not least, courses as part of the University of the Third Age. As part of lifelong education, the Faculty offers motivated students the Bachelor PLUS complementary programme.

The Faculty of Science's bachelor and master programmes take the full-time form. This applies to programmes focusing on raising future scientists and experts in the various fields or disciplines (programmes with specialisation) as well as to double curriculum programmes. The latter allow for combining studies in two fields of science; these programmes are mostly focused on education and teaching. Bachelor's programmes are scheduled for three years (with the maximum permitted duration of studies of six years) and master's programmes are scheduled for two years (with the maximum duration of five years). The tuition of programmes accredited at the Faculty of Science has a long-running tradition of cooperation between the Faculty of Science and its partner faculties within Charles University (e.g., Faculties of Mathematics and Physics, Arts, Social Sciences, Education, and Physical Education and Sport), and our Faculty is often involved in preparing students matriculated in other CU faculties (such as Physical Education and Sport, and Education).

There are almost 3,500 students, studying more than twenty bachelor's and more than forty master's programmes. Hence, the Faculty of Science ranks among Charles University's 'large' faculties in terms of the number of students (only the Faculty of Arts and the Faculty of Education have more students, and the First Faculty of Medicine and the Faculty of Social Sciences have a similar number of students).

The bachelor and master programmes are taught on the basis of a credit system formulated in accordance with the European Credit Transfer System (ECTS) rules. To graduate, a student must obtain at least 180 credits in a bachelor's programme and at least 120 credits in a master's programme. The curricula include subjects taught in English to foster the internationalisation of the studies. The Faculty has an extensive network of contracts covering international study cooperation. Master programmes' students in particular choose from a wide range of study stays at international universities (mostly under the Erasmus programme), and the Faculty offers dozens of subjects for students who come to Prague for six – or twelve-month stays to Prague from abroad. The Faculty annually admits more than two hundred students from international universities.

Doctoral programmes take the four-year full-time form as well the combined form for a maximum period of studies of eight years. Doctoral programmes are focused on raising scientists, which means that research is the key focus.

The Faculty of Science accounts for one-fifth of Charles University's doctoral students and, in terms of the number of doctoral students, ranks first among CU's faculties. More than 1,600 students are registered across more than thirty doctoral programmes (one-quarter of those students are foreigners). Two-thirds of doctoral students study full time and one-third study in the combined mode. The Faculty provides doctoral programmes both individually and in cooperation with CU's partner faculties (all three Faculties of Medicine, Faculty of Education) and with two dozen institutes of the Czech Academy of Sciences. Doctoral students fulfil the assignments of their individual curricula under the guidance of a supervisor and a supervisor consultant. Of almost 700 supervisors, more than one half come from CU and more than one-third come from CAS institutes. Within CU, doctoral programmes are managed by coordination boards. Doctoral curricula accredited at the Faculty of Science are managed e.g. by the coordination boards for science, biomedicine and also social sciences and subject-area didactics.

Almost all of the Faculty's doctoral programmes are accredited for a standard period of study of four years, providing students with the time needed for mastering the discipline, qualified research work in preparation for their dissertation and defending the dissertation in a form acceptable in an international context. The doctoral studies follow each doctoral student's individual curriculum, ap-



A lot of laboratories for hands-on training of students have undergone reconstruction in the past 10 years. (photo: Petr Jan Juračka)

proved and assessed by the doctoral programme's subject-area board. The mandatory requirements of doctoral students' individual curricula include passing several individual exams and a state doctoral examination, and the curricula specify the subject-area boards' requirements for the number and quality of doctoral students' publications, the parameters of mandatory study stays abroad, etc. Doctoral students mostly take international study stays and practical internships as part of Erasmus.

Students receive substantial support in the form of scholarships. The Faculty grants scholarships to students for excellent academic results (marks) and for excellent scientific, research, development, artistic or other creative results that contribute towards improving knowledge; for research, development and innovation activity; in cases worthy of special consideration; in support of studying abroad; in support of studying in Czechia; full-time doctoral programme students are granted regular doctoral scholarships as well as extraordinary scholarships or bonuses for the successful defence of the dissertation within the standard period of study (four years).

The Faculty of Science purports to provide equal opportunities to all of its students. There are consultancy

services and support available to disadvantaged students at the Faculty. The support consists in modifying the study performance assessment (individual curricula) with respect to the student's special needs as well as in modifying the conditions and environments for studying with a view to enabling them to duly deliver on their study obligations (e.g., provision of sign language interpreters, writers, assistants, teaching material, and modifications of the form of examination or informing the teachers).

Every year, almost one thousand students graduate from the Faculty; two-fifths of them are the graduates from bachelors' programmes, two-fifths are the graduates of masters' programmes and one-fifth are the graduates of doctoral studies. As a result, the Faculty organises almost thirty official graduation ceremonies per year.

The Faculty offers master's and doctoral programme graduates the opportunity to participate in a rigorosum procedure. Having successfully passed the state rigorosum examination and defended a rigorosum thesis, approximately one hundred rigorosum candidates obtain the academic title of Doctor of Natural Sciences (RNDr.).

# Overview of **Bachelors'** Subject Areas, Programmes and Their Specialisations

## Biology

- Bioinformatics
- Biology
- Biology Oriented at Education  
(Biology-Chemistry, Biology-Geography, Biology-Geology, Biology-Mathematics)
- Ecological and Evolutionary Biology
- Molecular Biology and Biochemistry of Organisms

## Chemistry

- Biochemistry
- Chemistry
- Chemistry and Physics of Materials
- Chemistry Oriented at Education  
(Chemistry-Biology, Chemistry-Physics, Chemistry-Geology, Chemistry-Mathematics)
- Clinical and Toxicological Analysis
- Medicinal Chemistry

## Geography

- Applied Geography (specialisation: Physical Geography and Geoinformatics, Social Geography and Geoinformatics)
- Demography (specialisation: Demography and Social Geography, Demography and Sociology, Demography and History, Demography and Public and Social Policy, Demography and Economics)
- Geography and Cartography
- Geography Oriented at Education  
(Geography-Biology, Geography-Mathematics, Geography-Physical Education, Geography-History)
- Surface and Underground Water

## Geology

- Geology
- Geology Oriented at Education  
(Geology-Biology, Geology-Chemistry)
- Geotechnology
- Earth Sciences
- Management of Natural Resources
- Practical Geobiology

## Ecology and Environmental Protection

- Environmental Protection



# Overview of **Masters'** Subject Areas, Programmes and Their Specialisations

## Biology

- Animal Physiology
- Anthropology and Human Genetics
- Bioinformatics
- Botany
- Cellular and Developmental Biology
- Ecology
- Evolutionary Biology
- Experimental Plant Biology
- Genetics, Molecular Biology and Virology
- Immunology
- Microbiology
- Parasitology
- Protistology
- Reproduction and Developmental Biology
- Training Teachers of Biology at Higher Secondary Schools (Biology-Chemistry, Biology-Geography, Biology-Geology, Biology-Mathematics)
- Theoretical and Evolutionary Biology
- Zoology

## Chemistry

- Analytical Chemistry
- Biochemistry
- Biophysical Chemistry
- Chemistry and Physics of Materials
- Clinical and Toxicological Analysis
- Inorganic Chemistry
- Macromolecular Chemistry
- Medicinal Chemistry
- Modelling of Chemical Properties of Nano – and Biostructures
- Organic Chemistry
- Physical Chemistry
- Training Teachers of Chemistry at Higher Secondary Schools (Chemistry-Biology, Chemistry-Geology, Chemistry-Mathematics, Chemistry-Physics)

## Geography

- Cartography and Geoinformatics
- Demography
- Global Migration and Developmental Studies
- Hydrology and Hydrogeology
- Landscape and Society
- Physical Geography and Geoecology
- Regional and Political Geography
- Social Geography and Regional Development
- Social Epidemiology
- Training Teachers of Geography at Higher Secondary Schools (Geography-Biology, Geography-History, Geography-Mathematics, Geography-Physical Education)

## Geology

- Applied Geology
- Geobiology
- Geology
- Hydrology and Hydrogeology
- Training Teachers of Geology at Higher Secondary Schools (Geology-Biology, Geology-Chemistry)

## Ecology and Environmental Protection

- Environmental Protection

# Overview of **Doctoral** Programmes

- Analytical Chemistry
- Animal Physiology
- Anthropology and Human Genetics
- Applied Geology
- Biochemistry
- Botany
- Cartography, Geoinformatics and Remote Sensing
- Demography
- Developmental and Cell Biology
- Didactics of Chemistry
- Didactics of Geography
- Ecology
- Environmental Science
- Experimental Plant Biology
- General Issues in Geography
- Geology
- Immunology
- Inorganic Chemistry
- Macromolecular Chemistry
- Microbiology
- Modelling of Chemical Properties of Nano- and Biostructures
- Molecular and Cellular Biology, Genetics and Virology
- Organic Chemistry
- Parasitology
- Philosophy and History of Science
- Physical Chemistry
- Physical Geography and Geoecology
- Regional and Political Geography
- Social Geography and Regional Development
- Theoretical and Evolutionary Biology
- Zoology



Field exercises are an integral part of the practical education of most study programmes. (photo: Petr Jan Juračka)









STARS

# STARS – Supporting TAlented PhD Research Students

The internationalisation of science and a pursuit of greater mobility of academic personnel is the driver behind the effort geared towards bringing on board new talented doctoral students who earned their master's degree at other institutions, preferably abroad. In 2011, the leaders of the Faculty decided to boost the inflow of good students from other institutions while preventing the outflow of their own capable students by founding a programme for supporting talented PhD students known as STARS, an acronym for Supporting TAlented PhD Research Students.

The most interesting and promising topics from the most relevant areas of science and research pursued at the Faculty of Science are included in the STARS programme based on the research board selection. Czech and international doctoral students apply for doctoral positions in the projects in an open competition. The students who also submit an application for standard doctoral studies go through interviews with research teams at the Faculty's individual sections where the best applicants are ranked and selected.

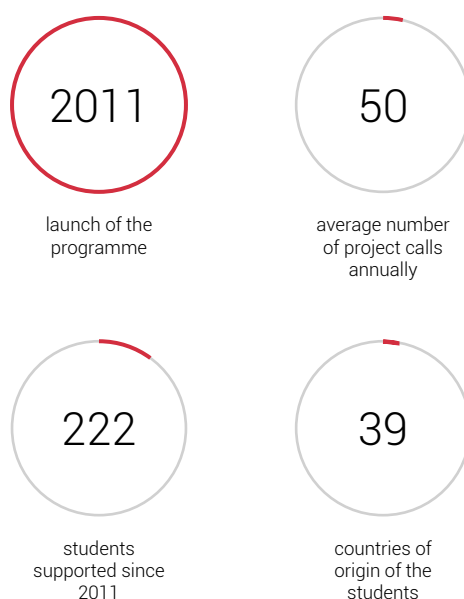
The research teams that publish STARS calls are usually international, are sponsored by prominent personalities and the project topics address current issues and are competitive in the context of the current science. In addition, it has to be said that there are not many workplaces focusing on geology or geography with such tradition and quality as ours in Czechia. The Geography Section is the only site in Central Europe to regularly rank within the top 100 facilities in a global comparison chart. The Biology Section in cooperation with the Academy of Sciences recently opened the BIOCEV cutting-edge research centre, and the Chemistry Section opened the CUCAM centre of excellence (Charles University Centre of Advanced Materials: Design, Synthesis and Applications).

The STARS programme annually makes several dozen (30–50) project calls and the additional financial support for the researchers is usually provided during the standard term of the doctoral studies (4 years). Currently, there are some 140 projects in progress. Successful candidates selected for STARS receive additional support on top of their doctoral scholarship from the research team that covers the topic and from the Faculty. Students are members of research teams from the very beginning of their studies; thanks to the support under the programme, they can focus on their research projects intensively and they usually successfully complete their doctoral studies during the standard period.

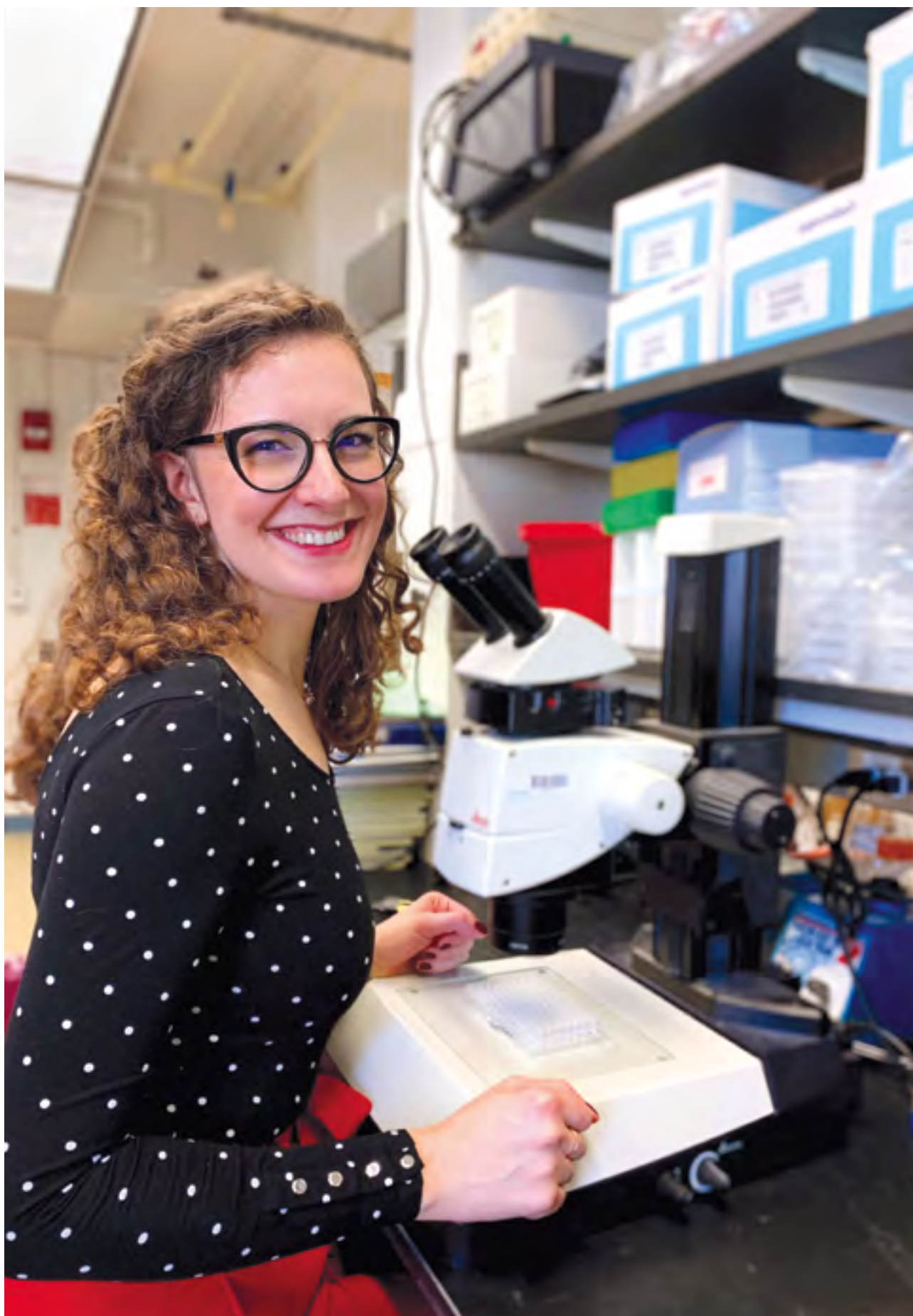
The information about the STARS projects and positions is published on a separate website at [www.stars-natur.cz](http://www.stars-natur.cz). There, the potential candidates can find detailed information on the various research projects as well as about the candidate selection process, admission for studies and life at the Faculty, and they can submit and administer their programme applications directly. The project topics are also promoted using electronic media, recruitment portals and social media in Czechia and abroad.

Student demand for involvement in STARS regularly exceeds the supply many times over. From the beginning of the programme in 2011 (until November 2019), 222 candidates from a total of 39 countries of the world were admitted to specific STARS research projects. As of November 2019, 62 of the admitted doctoral students had completed their programmes.

## STARS in Figures







Katarína Pšenáková graduated from the Department of Physical and Macromolecular Chemistry. Thanks to the STARS support for gifted students and the Endowment Fund of the FSc CU, she had an opportunity to see the National Institute of Health laboratories in Washington, D.C., during her doctoral study. Her journey to a postdoctoral internship, which she recently started, has led her to the famous Harvard University. (photo: Katarína Pšenáková's archive)





An aerial photograph of a rugged coastline, showing steep cliffs and waves crashing against the shore. The entire image is overlaid with a semi-transparent red gradient. The text is centered in the upper half of the image.

# International Contacts and Cooperation



# International Contacts and Cooperation

The Faculty of Science of Charles University has been undergoing significant changes during the last two decades as part of its internationalisation. The Faculty has been focusing on creating an international environment open to students' and academicians' mobility for a long time. The Faculty's administrative and social background is gradually improving the support for international researchers and students. Although there are still many shortcomings in this respect, the Faculty is actively trying to remedy them.

In recent years, the Faculty has been a sought-after destination for a continuously growing number of international students, welcoming a total of 261 of them in 2019. Erasmus remains the key student exchange programme, bringing approximately 230 students to Prague every year. Most of them come from France, Germany and Spain.

While the number of student trips abroad has been steadily growing over the last ten years (543 trips in 2019, including 47 long-term ones), the student mobility supply still exceeds demand on the part of students. This trend can be observed in our university as well as at other schools. International experience is a crucial asset for the students' future professional development and, in fact, has become a mandatory part of the doctoral programme for many subject areas. Student mobility is also highly desirable on pre-gradual levels of studies and it is imperative to con-

stantly improve its support and increase student awareness of its importance and the available options. Spain, Germany and the UK have been the most frequently visited countries as part of Erasmus in recent years. Student mobility is encouraged using other resources too, such as the CU Mobility Fund, funds for the support of internationalisation on the university and faculty levels, CEEPUS, Aktion and DAAD.

We expect a major change towards the internationalisation of the Faculty and the university as a result of the 4EU+ European University Alliance. This recently formed alliance of six major, renowned and research-oriented public universities includes Charles University, Universität Heidelberg, Sorbonne Université, Københavns Universitet, Università degli Studi di Milano and Uniwersytet Warszawski. The purpose of the connection is to develop intensive cooperation in education and research and the administrative background for such activities. In the long-term perspective, this grouping should proceed towards the inception of the integrated European University system.

The Faculty of Science's international cooperation includes a number of other active contacts with major international sites such as the University of Zurich, University College London, Washington University, University of Freiburg, University of California, University of Edinburgh, Uni-

## International Contacts – Students and Employees of the Faculty of Science of Charles University, 2010–2019

	2010	2011
<b>Students seconded</b>		
short-term/long-term	366/21	387/27
<b>Students admitted</b>		
short-term/long-term	9/23	3/25
<b>Employees seconded</b>	1,015	1,060
<b>Employees admitted</b>	233	268
<b>ERASMUS students – on secondment</b>	101	116
<b>ERASMUS students – arrivals</b>	89	99



Contracts of the FSc CU for Erasmus study stays, sorted by Section. (2019)

- Biology
- Chemistry
- Geography
- Geology

versity of Oxford, University Paris Diderot, Hebrew University of Jerusalem, Katholieke Universiteit Leuven, Flinders University and University of Bergen. In certain cases, the cooperation is institutionalised through contracts between the universities. However, most international contacts arise from teaching and research cooperation between the individual facilities and individuals.

The intensity of research cooperation with international entities is reflected by the steadily growing number of academicians' trips abroad (1,720 trips in 2019) and by an increase in the number of arriving experts. Last year, 388 foreign visiting professors visited our Faculty. Visiting professors' activities are a benefit too; six of them have worked at our Faculty during the last two years. They are major international experts who participated

in the teaching and research of the host facility over the course of one semester. Last but not least, we should mention the long-term activities of international workers on the Faculty's research teams. We believe this number will continue growing along with the number of Czech researchers returning to their homeland having acquired multiple years' worth of experience in major global workplaces.

The Faculty of Science of Charles University intends to continue playing its active role in international research and education, improving the conditions for international experts and students working on its premises and encouraging its students and employees to gain experience in foreign countries. We hope that those efforts will continue to be successful.

	2012	2013	2014	2015	2016	2017	2018	2019
	377/31	369/41	222/31	284/54	318/31	492/41	460/43	496/47
	5/31	33/21	77/5	7/29	14/13	43/25	20/34	15/16
	1,065	1,020	1,518	1,454	1,219	1,338	1,516	1,720
	267	259	217	251	275	290	291	385
	103	114	97	122	129	113	107	91
	133	135	144	174	192	195	229	230







# Science and Research

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# Biology



# Department of Anthropology and Human Genetics

## History of the Department

The origins of the Department of Anthropology, previously the Anthropology Institute of the FSc CU, are associated with Jindřich Matiegka, the first professor of anthropology, the second Dean of the Faculty of Science CU, Rector of Charles University and the founder of the Hrdlička Museum of Man. He was succeeded by Prof. Jiří Malý and subsequently by many others. After 2000, the workplace was renamed the Department of Anthropology and Human Genetics and was led by the distinguished figure, Prof. Zbyněk Šmahel. After his death, the Department underwent major restructuring and stabilisation under Assoc. Prof. Vladimír Sládek, and this development continues under Assoc. Prof. Jana Velemínská until today.

## Scientific Focus

The Department is engaged in the biological research of humans of the current and past populations. The research methodology is diverse, ranging from virtual anthropology to biomechanics, histology, genetics and molecular anthropology. The Bone Tissue Anthropology Laboratory focuses on research related to bone decomposition and skeletal taphonomy, as well as on analysing structural changes in dense bone tissue in relation to environmental and behavioural factors. The Laboratory of 3D Imaging and Analytical Methods focuses on forensic methods, bioarchaeology, fossil reconstruction, ancient Egypt and research on craniofacial malformations. The Biomedical Anthropology Laboratory evaluates human postnatal development in connection with lifestyle changes, and the Molecular Anthropology Laboratory studies cryptic rearrangements of the human genome, autoimmune and polygenic diseases, and population genetics of man.

## Other Activities of the Department

Teaching at all levels of study, master's and doctoral studies in the field, including excursions and field bioarchaeological research. International cooperation: Johns Hopkins University School of Medicine (USA), Duke University (USA), University of Bordeaux CNRS (France), University of Copenhagen (Denmark), Naturhistorisches Museum Wien (Austria) and many others.

## Major Achievements

Research into the field of the paleobiology of Pleistocene and Holocene populations has described, for example, the relationship between lower limbs and energy expenditure while hunting in Neanderthals and modern humans. This examination of locomotion also led to a new conclusion about the decrease of human mobility in the Neolithic period. This gradual change lasted several thousands of years and depended on the progressive intensification of agriculture. Knowledge was expanded about the migrations of African Sahel populations, where a relationship between HLA alleles and environments with a higher incidence of malaria was discovered. The methodology of forensic identification methods was also refined for use in bioarchaeology, including the development of new predictors of age and gender, both based on skeletons and the longitudinal development of the face.

## Most Important Publications in the Past Decade

Over the past decade, the Department has contributed to more than 180 professional articles with IF, 26 chapters in books and eight monographs.

**KOTĚROVÁ, Anežka, VELEMÍNSKÁ, Jana, DUPEJ, Ján, BRZOBOHATÁ, Hana, PILNÝ, Aleš and BRUŽEK, Jaroslav.** Disregarding population specificity: its influence on the sex assessment methods from the tibia. *International Journal of Legal Medicine*. 2017, **131**, 251–261. ISSN 0937-9827.

**RUFF, Christopher B., HOLT, Brigitte, NISKANEN, Markku, SLÁDEK, Vladimír, BERNER, Margit, GAROFALO, Eva, GARVIN, Heather M., HORA, Martin, JUNNO, Juho-Antti, SCHUPLEROVÁ, Eliška, VILKAMA, Rosa and WHITTEY, Erin.** Gradual decline in mobility with the adoption of food production in Europe. *Proceedings of the National Academy of Sciences*. 2015, **112**(23), 7147–7152. ISSN 0027-8424.

**SANCHEZ-MAZAS, Alicia, ČERNÝ, Viktor, DI, Da, BUHLER, Stéphane, PODGORNÁ, Eliška, CHEVALLIER, Elodie, BRUNET, Lydie, WEBER, Stephan, KERVAIRE, Barbara, TESTI, Manuela, ANDREANI, Marco, TIERCY, Jean M., VILLARD, Jean and NUNES, José M.** The HLA-B landscape of Africa: Signatures of pathogen-driven selection and molecular identification of candidate alleles to malaria protection. *Molecular Ecology*. 2017, **26**(22), 6238–6252. ISSN 1365-294X.



Vladimír Sládek and Martin Hora from the Bone Tissue Anthropology Lab research, among other things, biomechanical properties of long bones. (photo: Petr Jan Juračka)

# Department of Botany

## History of the Department

The Department of Botany continues the tradition of the Institute of Botany, which was part of the Czech branch of the University from its formation in 1882. Before 1918, some of the most distinguished figures included Professors Ladislav J. Čelakovský (1834–1902) and Josef Velenovský (1858–1949), who both excelled as experts in morphology and systematics. In the period of the First Czechoslovak Republic, the Institute was led by Prof. Karel Domin (1882–1953) who, in addition to botany, was also active in academic and parliamentary politics. In the same period, ecologist and geobotanist Vladimír Krajina (1905–1993) worked at the Institute and became one of the leaders of the Czech resistance in the ÚVOD organisation during the Protectorate. After 1948, he worked as a professor at a university in Vancouver for many years.

The Institute of Botany also existed at the German Faculty of Natural Science in the 1920s and 1930s, where it achieved outstanding results in algae research under Prof. Adolf Pascher (1881–1945). This tradition continued after 1945 with the establishment of the Czechoslovak Algological School at the Department of Botany by Prof. Bohuslav Fott (1908–1976). Prof. Karel Cejp (1900–1979) founded an equally important mycological school. One of the most important parts of the Department during the 20th century and especially after 1989 was the Geobotanical Section, where research of community and landscape ecology developed under the influence of Prof. Jaromír Klika (1858–1957) and Prof. Jan Jeník (\*1929).

## Scientific Focus

The Department of Botany consists of four sections, which include a number of research teams and sub-disciplines:

### Geobotany

History of landscape and dynamics of vegetation: relationship of vegetation to the structure of the landscape in the past using paleoecological, archaeobotanical and palynological methods (Petr Kuneš, Vojtěch Abrahám and Jan Novák).

Plant population and conservation biology: relationship between the characteristics of populations and species

and their distribution, recent threats, interactions with animals and climate change (Zuzana Münzbergová and Zdeněk Janovský).

Ecology of plant communities: research on community dynamics, plant clonality, and interaction of root structures (Tomáš Herben, Tomáš Koubek, Jitka Klimešová and Martin Weiser).

Ecophysiology of alpine plants and cold adaptation: research on frost resistance and adaptation in alpine tropical ecosystems (Petr Sklenář).

### Mycology, Lichenology and Bryology

Phylogenesis and diversity of microscopic fungi: molecular diversity of fungi on plant litter, food and in association with animals (Ondřej Koukol, Alena Kubátová and Miroslav Kolařík).

Medical mycology: microscopic fungi as pathogenic organisms in humans (Vít Hubka).

Diversity and ecology of bryophytes and lichens: bioindication of pollution by lichens, spreading of bryophytes and lichens (Jana Steinová, David Svoboda and Zdeněk Soldán).

### Algology

Phylogenesis and diversity of microscopic algae: evolutionary mechanisms of green algae, chrysomonads and diatoms, phylogenomics and genome evolution, evolution of photobionts, cryptic diversity (Pavel Škaloud and Jana Kulichová).

Biology and evolution of cellular shapes: dynamics and plasticity of cell shape in evolution and ecology, cell symmetry, geometric morphometrics (Jiří Neustupa).

Ecological physiology of microalgae: research on algae adaptation to freezing, drying stress or temperature (Yvonne Němcová and Martina Pichrtová).

### Vascular Plants

Evolutionary and ecological genomics: research of microevolutionary processes leading to the diversification of plant taxa, phylogenomics, genome and phenotype interactions (Filip Kolář, Roswitha Schmickl).





The Mycology, Lichenology and Bryology Section focuses on the phylogenesis and diversity of microscopic fungi, molecular diversity of fungi on plant litter, food and in association with animals. The picture shows the *Pilaira anomala* mycelium. (photo: Alena Kubatova)

Molecular phylogenetics and evolution of plant lines: microevolutionary processes, polyploidisation in plant evolution, phylogeography, evolution of ploidy levels, flow cytometry (Karol Marhold, Tomáš Fér, Martin Čertner and Tomáš Urfus).

Plant apomixis: group studying asexual reproduction and genome hybridisation in polyploid complexes (Patrik Mráz and Jindřich Chrtek).

Evolution of plant reproduction: research of evolutionary processes at the level of plant reproductive features, population genomics, developmental biology and embryogenesis (Clément Lafon-Placette).

#### Other Activities of the Department

Teaching and supervision of students in the master's programmes in Botany, Evolutionary Biology and Protistology. Training of PhD students in the Botany programme. Popularisation of studied fields.

Field courses throughout Europe focused on all groups of plants, algae and fungi (terrestrial, freshwater and marine).

Regular research expeditions in all areas of interest (Central Europe, Alps, Balkan Peninsula, Scandinavia, South Africa, Andes, Panama, Siberia, Baltic Sea, Mediterranean Sea).

Close cooperation with the FSc CU's Herbarium Collections; management of two registered collections of microorganisms (Culture Collection of Fungi – CCF, Culture Collection of Algae – CAUP), field station in the Central Bohemian Highlands.

Operation of plant cytometry, plant DNA research and microscopic analyses laboratories.

#### Major Achievements

Discoveries of new, previously unknown lines and revisions of known genera of fungi, protists and algae (e.g., *Bradomyces*, *Jenufa*, *Leptochlorella*, *Geosmithia*, *Hermatomyces*, *Vulcanochloris*).

Karol Marhold works as the Secretary General of the International Plant Taxonomy Association, is one of the co-authors of the botanical nomenclature code and a member





Filip Kolář from the Vascular Plant Unit won the Neuron for Young Scientists Award in 2018 and a prestigious ERC Starting Grant in 2019. (photo: Luboš Wisniewski)

of the Organizing and Editorial Committee of the Species Plantarum – Flora of the World project.

Zuzana Münzbergová is the regional coordinator of the PlantPopNet project, which creates networks for research and data exchange in plant population biology.

Tomáš Herben is one of the editors of *The Perspectives in Plant Ecology, Evolution and Systematics* journal. Department members work as editors or sit on editorial boards of other major international impact journals (e.g. *European Journal of Phycology*, *Taxon*, *Annals of Botany*, *Journal of Vegetation Science*, *Plant Systematics and Evolution*).

During the past 10 years, the Department has received and successfully carried out numerous grant projects, including a European Research Council (ERC) junior grant, an IATS company project of applied research in the EU Capacities programme focused on developing detection systems for monitoring algae growth, a Past4Future project in the 7th EU Framework programme, and a total of 42 GAČR projects.

Organisation of major scientific conferences and symposia, e.g. the 8<sup>th</sup> International Chrysophyte Symposium, co-organisation of the 58<sup>th</sup> IAVS Symposium in Large-scale Vegetation Patterns, as well as participation in organising sections at numerous world symposia.



### Most Important Publications in the Past Decade

The Department of Botany is currently one of the most productive research facilities at the Faculty, and its members have published 457 original professional articles in impact journals, 44 chapters in books and 24 books over the past ten years.

ČERTNER, Martin, SUDOVOVÁ, Radka, WEISER, Martin, SUDA, Jan and KOLÁŘ, Filip. Ploidy-altered phenotype interacts with local environment and may enhance polyploid establishment in *Knautia serpentinicola* (Caprifoliaceae). *New Phytologist*. 2019, **221**, 1117–1127. ISSN 1469-8137.

ELIÁŠOVÁ, Anežka, TRÁVNÍČEK, Pavel, MANDÁK, Bohuslav and MÜNZBERGOVÁ, Zuzana. Autotetraploids of *Vicia cracca* show a higher allelic richness in natural populations and a higher seed set after artificial selfing than diploids. *Annals of Botany*. 2014, **113**, 159–170. ISSN 1095-8290.

KOLÁŘ, Filip, ŠTECH, Milan, TRÁVNÍČEK, Pavel, RAUCHOVÁ, Jana, URFUS, Tomáš, VÍT, Petr, KUBEŠOVÁ, Magdalena and SUDA, Jan. Towards resolving the *Knautia arvensis* agg. (Dipsacaceae) puzzle: primary and secondary contact zones and ploidy segregation at landscape and microgeographic scales. *Annals of Botany*. 2009, **103**, 963–974. ISSN 1095-8290.

KOLAŘÍK, Miroslav, FREELAND, Emily, UTLEY, Curtis and TISSERAT, Ned. *Geosmithia morbida* sp. nov., a new phytopathogenic species living in symbiosis with the walnut twig beetle (*Pityophthorus juglandis*) on *Juglans* in USA. *Mycologia*. 2011, **103**, 325–332. ISSN 0027-5514.

KOUKOL, Ondřej, KOLAŘÍK, Miroslav, KOLÁŘOVÁ, Zuzana and BALDRIAN, Petr. Diversity of foliar endophytes in wind-fallen *Picea abies* trees. *Fungal Diversity*. 2012, **54**, 69–77. ISSN 1878-9129.

KUNEŠ, Petr, SVOBODOVÁ-SVITAVSKÁ, Helena, KOLÁŘ, Jan, HAJNALOVÁ, Mária, ABRAHAM, Vojtěch, MACEK, Martin, TKÁČ, Peter and SZABÓ, Péter. The origin of grasslands in the temperate forest zone of east-central Europe: long-term legacy of climate and human impact. *Quaternary Science Reviews*. 2015, **116**, 15–27. ISSN 0277-3791.

PEKSA, Ondřej and ŠKALOUD, Pavel. Do photobionts influence the ecology of lichens? A case study of environmental preferences in symbiotic green alga *Asterochloris* (Trebouxiophyceae). *Molecular Ecology*. 2011, **20**, 3936–3948. ISSN 0962-1083.

SUDA, Jan and HERBEN, Tomáš. Ploidy frequencies in plants with ploidy heterogeneity: fitting a general gametic model to empirical population data. *Proceedings of The Royal Society B*. 2013, **280**, 20122387. ISSN 1471-2954.

ŠKALOUD, Pavel, NEMJOVÁ, Katarína, VESELÁ, Jana, ČERNÁ, Kateřina and NEUSTUPA, Jiří. A multilocus phylogeny of the desmid genus *Micrasterias* (Streptophyta): evidence for the accelerated rate of morphological evolution in protists. *Molecular Phylogenetics and Evolution*. 2011, **61**, 933–943. ISSN 1055-7903.

WEISER, Martin, KOUBEK, Tomáš and HERBEN, Tomáš. Root foraging performance and life-history traits. *Frontiers in Plant Science*. 2016, **7**, 779. ISSN 1664-462X.



# Department of Cell Biology

## History of the Department

Cell biology was traditionally one of the fields at the Department of Animal Physiology and Developmental Biology. The Department of Cell Biology was established in 2007 by splitting the original highly heterogeneous Department and separating the cell physiology, immunology and developmental biology units. The history of these fields is inherently linked with their respective founders and leaders at the Faculty: Prof. Václav Kubišta, founder of cell physiology and co-discoverer of glycerophosphate metabolism; Assoc. Prof. Jiří Čerkasov, pioneer in biochemistry of cell organelles and co-discoverer of hydrogenosomes of parasitic protozoa; Prof. Alexej Romanovský and Dr. Jaroslav Mácha, founders of immunology who prepared monoclonal antibodies back in the 1980s; and last but not least, Prof. František Sládeček, founder of developmental biology. The Department is presently headed by Prof. Jan Černý.

## Scientific Focus

The majority of the Department's research teams are housed in the historic buildings at Viničná Street 5 and 7 in Prague. Since 2015, some of the teams also work at the BIOCEV centre in Vestec. Department teams cover the following spectrum of biological disciplines and areas:

- **Cellular immunology** (Prof. J. Černý)
- **Genetics of microorganisms** (Dr. M. Převorovský)
- **Immunoregulation** (Prof. V. Holář and Assoc. Prof. M. Krulová)
- **Tumour cell invasiveness** (Assoc. Prof. J. Brábek and Assoc. Prof. D. Rösel)
- **Molecular dynamics of immunity response** (Dr. K. Drbal)
- **Molecular genetics of development** (Dr. M. Šilhánková and Dr. L. Libusová)
- **Synthetic biology** (Dr. K. Hlouchová)
- **Regulation of gene expression** (Assoc. Prof. P. Folk and Assoc. Prof. F. Půta)
- **Structural bioinformatics** (Dr. M. Novotný)
- **Structural biology** (Dr. V. Veverka)
- **Developmental biology and cytogenetics** (Assoc. Prof. V. Krylov and Dr. T. Tlapáková)

## Other Activities of the Department

The Department offers courses included in its field of expertise for all levels of study and guarantees mas-

ter's programmes of Cell Biology, Developmental and Reproductive Biology, Immunology and Bioinformatics (a total of approx. 100 students). The Department harbours two Subject-area Boards for the Developmental and Cellular Biology and Immunology doctoral study programmes, where approx. 200 PhD students are currently enrolled. Students are taught and trained in cooperation with top experts in various fields at the Czech Academy of Sciences. In addition to conducting research, teaching and supervising students, Department members actively promote their fields by publishing texts and appearing in the media (Prof. J. Černý and Assoc. Prof. J. Brábek).

## Major Achievements

The most significant scientific achievements of the Department in the past 10 years include the establishment of the concept of migrastatics and generally the research into the molecular mechanisms of tumour cell migration. A series of works on this topic, describing individual key molecules, their association, cell signalling, and biophysical principles of various types of cell movement, received the Bedřich Hrozný Prize for Creative Initiative in 2018 (Assoc. Prof. J. Brábek and Assoc. Prof. D. Rösel). Moreover, Assoc. Prof. J. Brábek won twice the League against Cancer Award (2006 and 2018) and the "Czech Head – Invention" Award (2019).

Since 2018, the Tumour Cell Invasiveness team has been a key component of the Tumour Ecology Centre – research into tumour microenvironments that significantly support tumour growth and spread in the body (Assoc. Prof. J. Brábek and Assoc. Prof. D. Rösel), supported from the OP RDE, Excellent Research. In 2017, Dr. M. Převorovský obtained a CU Primus grant (New connections between lipid metabolism and centromeric heterochromatin function), and in 2019, a Primus grant was awarded to Dr. K. Hlouchová (Study of synthetic protein sequences in vivo: systematic mapping of structural and functional space). In 2019, Dr. K. Hlouchová also received a prestigious Human Frontier Science Programme Young Investigators grant. Master's graduate F. Nemčko was awarded the FSc CU Dean's Prize in 2018.

Department members actively participated in preparing and establishing the Biotechnology and Biomedicine Centre in Vestec u Prahy, with a major contribution to the project's success made by Biology Section Vice-Dean, Assoc. Prof. P. Folk.



A new teaching laboratory at the FSc CU, equipped with advanced microscopes making it possible to share imaging, was built thanks to the funding from the Research, Development and Education Operational Programme – Modernisation of Infrastructure for Master's Studies in 2019. The facility is used to teach practices in cell biology, developmental biology, histology and other fields. (photo: Petr Jan Juračka)

Department members also supervise talented secondary school students in the Biology Olympiad, including international rounds. Because of his commitment, Prof. Jan Černý received the prestigious Werner von Siemens Prize for best educator in 2013 and has been chairman of the Central Committee of the Biology Olympiad since 2014. In 2018, Dr. L. Libusová became Executive Vice-Chairwoman of the International Biology Olympiad.

#### Most Important Publications in the Past Decade

During the past ten years, the Department has published approx. 230 impact publications.

FLIEGER, Miroslav, BANDOUCHOVÁ, Hana, ČERNÝ, Jan et al. Vitamin B2 as a virulence factor in *Pseudogymnoascus destructans* skin infection. *Scientific Reports*. 2016, **6**(1), 33200. ISSN 2045-2322.

GEMPERLE, Jakub, DIBUS, Michal, KOUDELKOVÁ, Lenka, ROSEL, Daniel and BRÁBEK, Jan. The interaction of p130Cas with PKN3 promotes malignant growth. *Molecular Oncology*. 2019, **13**(2), 264–289.

GAHURA, Ondřej, HAMMANN, Christian, VALENTOVÁ, Anna, PŮTA, František and FOLK, Petr. Secondary structure is required for 3' splice site recognition in yeast. *Nucleic Acids Research*. 2011, **39**(22), 9759–9767. ISSN 1362-4962.

HÁJKOVÁ, Michaela, JAVORKOVÁ, Eliška, ZAJÍCOVÁ, Alena, TROŠAN, Peter, HOLAN, Vladimír and KRULOVÁ, Magdalena. A local application of mesenchymal stem cells and cyclosporine A attenuates immune response by a switch in macrophage phenotype. *Journal of Tissue Engineering and Regenerative Medicine*. 2017, **11**(5), 1456–1465. ISSN 19326254.

JANOŠTIK, Radoslav, BRÁBEK, Jan, AUERNHEIMER, Vera, TATÁROVÁ, Zuzana, LAUTSCHAM, Lena A., TULI, Dey, GEMPERLE, Jakub, MERKEL, Rudolf, GOLDMANN, Wolfgang H., FABRY, Ben and ROSEL, Daniel. CAS directly interacts with vinculin to control mechanosensing and focal adhesion dynamics. *Cellular and Molecular Life Sciences*. 2014, **71**(4), 727–744. ISSN 1420-682X.

KOUDELKOVÁ, Lenka, PATAKI, Andreea Csilla, TOLDE Ondřej, PAVLÍK, Vojtěch, NOBIS, Max, GEMPERLE, Jakub, ANDRESON, Kurt, BRÁBEK, Jan and ROSEL, Daniel. Novel FRET-Based Src Biosensor Reveals Mechanisms of Src Activation and Its Dynamics in Focal Adhesions. *Cell Chemical Biology*. 2019, **26**(2), 255–268. ISSN 24519456.

MÁCHA, Jaroslav, TEICHMANOVÁ, Radka, SATER, Amy K., WELLS, Dan E., TLAPÁKOVÁ, Tereza, ZIMMERMAN, Lyle B. and KRYLOV, Vladimír. Deep ancestry of mammalian X chromosome revealed by comparison with the basal tetrapod *Xenopus tropicalis*. *BMC Genomics*. 2012, **13**(1), 315. ISSN 1471-2164.

# Department of Ecology

## History of the Department

The Department was established in 2004, partially as the successor of the Hydrobiology Section, originally a part of the Department of Parasitology and Hydrobiology, and included terrestrial environmentalists of all kinds from the very beginning. The first Head of the Department, Prof. Vojtěch Jarošík, played a key role in its founding. Since then, he has been followed by Prof. Adam Petrušek and Prof. Lukáš Kratochvíl.

## Scientific Focus

The Department understands ecology as a biological discipline studying mutual relationships of organisms and between organisms and the environment, often in an evolutionary context. The following areas are traditionally studied:

- **The Biology of invasion:** focus on the analysis of the success of invasive plant, animal and pathogen species and their impact on existing communities.
- **Macroecology:** analysis of ecosystem properties on large scales and determinants of the global distribution of species diversity.
- **Microbial ecology and biogeochemistry of glacial ecosystems:** special attention is paid to the carbon and nutrient cycle.
- **Ecology of extremophiles:** focus primarily on the diversity and adaptation of cryophilic (snow) algae and algae occurring in other extreme conditions.
- **Ecology, evolution and phylogeography of aquatic animals,** especially zooplankton.
- **Ecology of birds:** primary areas of the study are diversity, conservation, functional ecology and function and variability of vocalisation.
- **Reproductive ecology of vertebrates,** especially the evolution of ways of sex determination and reproductive costs.
- **Ecology and protection of insects and interaction of insects (pollinators) with plants.**

The Department collaborates with several other Institutes of the Czech Academy of Sciences (especially the Institute of Botany, Institute of Vertebrate Biology and the Institute of Animal Physiology and Genetics), zoological gardens (mainly the Prague Zoo) and many other domes-

tic and foreign institutions. In addition to research in the CR, a number of the Department's research activities take place in the polar regions of the northern and southern hemispheres and in sub-Saharan Africa. The list of publications below is not exhaustive due to its limited scope, yet it illustrates the breadth of the Department's research activities.

## Other Activities of the Department

The Department offers courses included in its field of expertise for all levels of study and guarantees follow-up master's study in the field of Ecology with two specialisations (Hydrobiology, Terrestrial Ecology). The Department harbours the Subject-area Board for the Ecology doctoral study programme. In addition to conducting research, teaching and supervising students, Department members actively promote findings in the fields of ecology, evolutionary biology and environmental protection by publishing texts and appearing in the media.

## Major Achievements

Each year the Department publishes over 100 articles in multidisciplinary and field-specific international scientific journals, regularly in the most important ones such as *Nature*, *Science*, *Nature Communications*, *Nature Ecology and Evolution*, *Proceedings of the National Academy of Sciences of the USA*, *Current Biology*, *Ecology Letters*, *Trends in Ecology & Evolution*, *Global Change Biology*, *Biological Reviews*, and *Molecular Biology and Evolution*.

Prof. Petr Pyšek has received a number of foreign and Czech awards, one of them being the Neuron Endowment Fund and the Robert H. Whittaker Distinguished Ecologist Award. He is usually included (along with another, unfortunately deceased member of the Department, Prof. Vojtěch Jarošík) in the list of roughly four thousand most cited researchers in the world.

Prof. David Storch was a Chairman of the Czech Society for Ecology (now followed by Dr. Robert Tropek, a Department member) and among other awards Prof. Storch has received the *Donatio Universitatis Carolinae* bonus.

Department members regularly receive research grants from Czech and foreign sources.





The Petrusseks during their fieldwork. (photo: Jindřich Lacko)

Department experts often sit on editorial boards or work as reviewers for international journals, project evaluators/panel members for Czech and foreign grant agencies, members of the Learned Society of the Czech Republic, scientific boards of other institutions and expert panels of state institutions.

#### Most Important Publications in the Past Decade

**KUBELKA, Vojtěch**, ŠÁLEK, Miroslav, TOMKOVICH, Pavel, VÉGVÁRI, Zsolt, FRECKLETON, Robert P. and SZÉKELY, Tamás. Global pattern of nest predation is disrupted by climate change in shorebirds. *Science*. 2018, **362**(6415), 680–683. ISSN 0036-8075.

LAMARCHE-GAGNON, Guillaume, WADHAM, Jemma L., SHERWOOD LOLLAR, Barbara, ARNDT, Sandra, FIETZEK, Peer, BEATON, Alexander D., TEDSTONE, Andrew J., TELLING, Jon, BAGSHAW, Elizabeth A., HAWKINGS, Jon R., **KOHLER, Tyler J.**, ŽÁRSKÝ, **Jakub D.**, MOWLEM, Matthew C., ANESIO, Alexandre M. and **STIBAL, Marek**. Greenland melt drives continuous export of methane from the ice-sheet bed. *Nature*. 2019, **565**, 73–77. ISSN 1476-4687.

**ROVATSOS, Michail**, REHÁK, Ivan, VELENSKÝ, Petr and **KRATOCHVÍL, Lukáš**. Shared ancient sex chromosomes

in varanids, beaded lizards, and alligator lizards. *Molecular Biology and Evolution*. 2019, **36**, 1113–1120. ISSN 0737-4038.

**STORCH, David**, KEIL, Petr and JETZ, Walter. Universal species-area and endemics-area relationships at continental scales. *Nature*. 2012, **488**, 78. ISSN 1476-4687.

van KLEUNEN, Mark, DAWSON, Wayne, ESSL, Franz, PERGL, Jan, WINTER, Marten, WEBER, Ewald, KREFT, Holger, WEIGELT, Patrick, KARTESZ, John, NISHINO, Misako, ANTONOVA, Liubov A., BARCELONA, Julie F., CABEZAS, Francisco J., CÁRDENAS, Dairon, CÁRDENAS-TORO, Juliana, CASTAÑO, Nicolás, CHACÓN, Eduardo, CHATELAIN, Cyrille, EBEL, Aleksandr L., FIGUEIREDO, Estrela, FUENTES, Nicol, GROOM, Quentin J., HENDERSON, Lesley, INDERJIT, KUPRIYANOV, Andrey, MASCIADRI, Silvana, MEERMAN, Jan, MOROZOVA, Olga, MOSER, Dietmar, NICKRENT, Daniel L., PATZELT, Annette, PELSER, Pieter B., BAPTISTE, María P., POOPATH, Manop, SCHULZE, Maria, SEEBENS, Hanno, SHU, Wen S., THOMAS, Jacob, VELAYOS, Mauricio, WIERINGA, Jan J. and **PYŠEK, Petr**. Global exchange and accumulation of non-native plants. *Nature*. 2015, **525**, 100–103. ISSN 1476-4687.

# Department of Experimental Plant Biology

## History of the Department

The Department continues in the work of the Institute for Plant Anatomy and Physiology founded by Prof. Bohumil Němec, world-renowned plant physiologist, in 1901. His successor was Prof. Silvestr Prát who continued to head the Department into the 1960s. He was followed by Prof. J. Seifert, Prof. L. Nátr, and after 1989 by Prof. J. Pazourek, Assoc. Prof. J. Luštinec, Prof. Z. Opatrný, Assoc. Prof. L. Pavlová, Prof. J. Albrechtová and Dr. L. Fischer. The Department is currently headed by Assoc. Prof. F. Cvrčková.

## Scientific Focus

The Department's core consists of six teams focusing on the following areas:

- **Cell biology and plant biotechnology:** Dr. K. Schwarzerová's, Dr. J. Petrášek's and Dr. L. Fischer's team studies the role of cytoskeletons in cell morphogenesis and signalling, auxin transport and the regulation of gene expression through RNA interference.
- **Cellular morphogenesis:** Prof. V. Žárský's and Assoc. Prof. F. Cvrčková's team looks into molecular mechanisms of cell polarity, especially proteins and protein complexes that take part in polarised exocytosis and cytoskeletal organisation.
- **Cell growth and differentiation:** Dr. M. Fendrych's laboratory explores molecular and physiological mechanisms that govern the growth of plant organs and cells, especially at the interface between the cell and its wall.
- **Plant ecophysiology:** Prof. J. Albrechtová's team is engaged in the study of physiological and structural responses of plants to biotic and abiotic factors of the environment, and research of mycorrhiza and other fungal associations of plant roots.
- **Physiological anatomy:** Dr. A. Soukup's and Dr. E. Tylová's team deals mainly with the development and function of root systems and their interaction with the soil environment.
- **Regulatory factors of plant morphogenesis:** Assoc. Prof. H. Lipavská's team primarily studies the sugar metabolism of plants in the context of ontogenesis and plant response to stress.

The Department collaborates closely with the Institute of Experimental Botany, Institute of Botany, Institute of Mi-

crobiology and the Global Change Research Institute of the Czech Academy of Sciences, Research Institute of Crop Production and other domestic and foreign institutions. Its members have contributed to major publications produced in collaboration with external institutions (e.g. Fendrych et al., *Nat. Plants*. 2018, 4, 453–459; Kohout et al., *ISME J.* 2018, 12, 692–703) or as a result of extensive international projects (e.g. Nishiyama et al., *Cell* 2018, 174, 448–464).

## Other Activities of the Department

The Department offers courses in its field of expertise for all levels of study and guarantees master's study programme in the field of Experimental Plant Biology with three specialisations (Plant Physiology and Anatomy, Plant Cell and Molecular Biology, Plant Ecophysiology). The Department harbours the Subject-area Board for the Plant Anatomy and Physiology doctoral programme, in which 20 doctoral candidates are currently enrolled, 13 of whom are supervised directly by Department members. In addition to conducting research, teaching and supervising students, Department members actively promote plant biology and natural sciences in general by publishing texts, appearing in the media and taking part in events intended for the general public.

## Major Achievements

The most important scientific achievement of the Department in the past 10 years is the functional characterisation of the plant exocyst protein complex. Here, Prof. V. Žárský's team is building upon its own discovery of this complex.

In 2018, Department member Dr. M. Fendrych received a prestigious ERC Starting Grant to help him put together his research team.

Prof. J. Albrechtová chairs the Czech Society for Experimental Plant Biology. In 2016, as the FESPB President, she organised the Plant Biology Europe international congress, held under the auspices of the European Plant Science Organisation.

Prof. V. Žárský sits in the editorial board of *The Plant Physiology* magazine and is the only Czech representative in the Multinational Arabidopsis Steering Committee.

Department experts are repeatedly invited as authors of review articles in prestigious journals (e.g. Petrášek and



In 2018, Department member Matyáš Fendrych was awarded a prestigious ERC Starting Grant to help him put together his research team. (photo: Petr Jan Juračka)

Schwarzerová, *Curr. Opin. Plant Biol.* 2009, 12, 728–734; Žárský et al., *Curr. Opin. Plant Biol.* 2013, 16, 726–733; Žárský, *Proc. Natl. Acad. Sci USA.* 2016, 113, 10745–10747). They also act as editorial board members and reviewers for international journals, project assessors for Czech and foreign grant agencies, science board members for other institutions and expert panels of state institutions.

#### Most Important Publications in the Past Decade

Since 2009 Department members have contributed to approximately 350 professional studies published mostly in international impact journals, co-worked on 65 chapters in books. The selected publications given below present some of the original work of the Department team.

**KUBÍNOVÁ, Zuzana, JANÁČEK, Jiří, LHOTÁKOVÁ, Zuzana, KUBÍNOVÁ, Lucie and ALBRECHTOVÁ, Jana.** Unbiased estimation of chloroplast number in mesophyll cells: advantage of a genuine three-dimensional approach. *Journal of Experimental Botany.* 2014, **65**(2), 609–620. ISSN 0022-0957.

**KULICH, Ivan, VOJTÍKOVÁ, Zdeňka, SABOL, Peter, ORTMANNOVÁ, Jitka, NEDĚLA, Vilém, TIHLAŘÍKOVÁ, Eva and ŽÁRSKÝ, Viktor.** Exocyst subunit EXO70H4 has a specific role in callose synthase secretion and silica accumulation. *Plant Physiology.* 2018, **176**(3), 2040–2051. ISSN 0032-0889.

**KULICH, Ivan, COLE, Rex, DRDOVÁ, Edita, CVRČKOVÁ, Fatima, SOUKUP, Aleš, FOWLER, John and ŽÁRSKÝ, Viktor.** Arabidopsis exocyst subunits SEC8 and EXO70A1 and exocyst interactor ROH1 are involved in the localized deposition of seed coat pectin. *New Phytologist.* 2010, **188**(2), 615–625. ISSN 0028-646X.

**LIPAVSKÁ, Helena, MAŠKOVÁ, Petra and VOJVODOVÁ, Petra.** Regulatory dephosphorylation of CDK at G2/M in plants: yeast mitotic phosphatase cdc25 induces cytokinin-like effects in transgenic tobacco morphogenesis. *Annals of Botany.* 2011, **107**(7), 1071–1086. ISSN 0305-7364.

**SCHWARZEROVÁ, Kateřina, BELLINIA, Erica, MARTINEK, Jan, SIKOROVÁ, Lenka, DOSTÁL, Vojtěch, LIBUSOVÁ, Lenka, BOKVAJ, Pavel, FISCHER, Lukáš, SCHMIT, Anne-Catherine and NICK, Peter.** Tubulin is actively exported from the nucleus through the Exportin1/CRM1 pathway. *Scientific Reports.* 2019, **9**(1), 5725. ISSN 2045-2322.

**TYLOVÁ, Edita, PECKOVÁ, Eva, BLASCHEOVÁ, Zuzana and SOUKUP, Aleš.** Casparian bands and suberin lamellae in exodermis of lateral roots: an important trait of roots system response to abiotic stress factors. *Annals of Botany.* 2017, **120**(1), 71–85. ISSN 0305-7364.



# Department of Philosophy and History of Science

## History of the Department

Philosophy and history of science represent an interdisciplinary area of research that focuses on the theoretical reflection of science, both in historical perspectives and with regard to current scientific fields and their epistemological questions.

The Department has a long-standing tradition at Charles University associated with the legacy of both Ernst Mach (1838–1916) and founder of the Department at the newly established Faculty of Science Emanuel Rádl (1873–1942). At that time, an international institutionalisation of the history of natural science had already started. In 1950, the field was suppressed for ideological reasons. The Department was renewed thanks to Zdeněk Neubauer (1942–2016) in 1990 and continued the previous work done in academic institutions outside universities and on unofficial platforms.

## Scientific Focus

The Department's profile within the Biology Section is focused on evolutionary and theoretical biology. The Department represents a unique workplace at Charles University, linking natural sciences with humanities.

Scientific focus: philosophy and science in Antiquity, in Renaissance and modern times; methodology of science; history and philosophy of biology; evolutionary biology and psychology; theoretical biology and morphology.

## Other Activities of the Department

- Teaching of mandatory and elective bachelor and master courses in the areas of philosophy, methodology and history of sciences, science and ethics, evolutionary and theoretical biology, and more.
- Master of Science in Theoretical and Evolutionary Biology.
- Two PhD programmes: in Philosophy and History of Sciences and in Theoretical and Evolutionary Biology.
- Foreign cooperation: University of Oxford and University of Leeds (UK), Slovenian Academy of Sciences and University in Ljubljana (Slovenia), Institute of Philosophy (Croatia), University of Southern Denmark, Tartu University (Estonia), Polish Academy of Sciences; University of Buea (Cameroon), Bogazici University (Turkey), University of Sao Paulo (Brazil), and others.
- Participation in organising annual *Gatherings in Biosemiotics* conferences and also in the foundation and

editorial board of the impact factor journal *Biosemiotics* (Springer, ISSN 1875-1342).

- Partnership with *Oxford Centre for History of Science, Medicine and Technology* (University of Oxford) in the *Creative Cities: Knowledge of Nature and Networks of Science* project (TORCH International Partnership Scheme).

## Major Achievements

Ig Nobel Prize ("for results that first make you laugh and then make you think"): **Jaroslav Flegr** in 2014 in the field of "public health" for his attempt to answer the question: "Is it dangerous to have a cat?".

*Amfibios*: a series of Department's publications in cooperation with the Pavel Mervart publishing house (eds. **T. Hermann, V. Hladký, K. Kleisner**). Presently there are about 30 volumes featuring excellent dissertations or results of various research projects, e.g. results of the *Early Greek Philosophy and Science* grant project: **Kratochvíl, Zdeněk**. *Between the sea and the sky. The legacy of archaic Ionic perception*. Pavel Mervart, 2011. 376 p.

## Most Important Publications in the Past Decade

Since 2009, the Department has published over 320 publications (170 of which were in impact factor journals), 70 books and over 100 chapters in books.

**Komárek, Stanislav**. *Mimikry a příbuzné jevy. Dějiny poznávání a výkladu vnějšího vzhledu živých organismů. (Mimicry and Related Phenomena. The History of Cognition and Interpretation of the External Appearances of Living Organisms)*. Prague: Academia, 2016. 368 p. Significantly expanded and modified edition.

**Markoš, Anton** and **Švorcová, Jana**. *Epigenetic Processes and the Evolution of Life*. Boca Raton: CRC Press, Taylor & Francis Group, 2019. 230 p.

**Ovčáčková, Lenka**, ed. et al. *O původu kultury. Biologické, antropologické a historické koncepce kulturní evoluce. (The Origin of Culture. Biological, Anthropological and Historical Conceptions of Cultural Evolution.)* Prague: Academia, 2017. 437 p. A representative collective monograph resulting from interdisciplinary interaction in the *Nature and Culture* project within the University Centre (UNCE).



Biologist and philosopher Zdeněk Neubauer was the driving force behind the re-establishment of the Department of Philosophy and History of Science after 1989 and acted as its first Head from 1990 to 1996. (photo: archive of Tomáš Škrdlant)

# Department of Physiology

## History of the Department

The field of animal physiology at FSc CU was established by Prof. Karel Wenig in 1945. The original Institute of Animal Physiology went through numerous organisational changes over the following decades and the current Department of Physiology, which became fully independent in 2007, continues the long tradition started by several prominent scientists who have worked here, such as Prof. František Sládeček, Prof. Václav Kubišta, Prof. Ladislav Janský, Prof. Helena Illnerová and Prof. František Vyskočil. The current Head of the Department is Assoc. Prof. Jiří Novotný.

## Scientific Focus

The Department of Physiology carries out research projects focusing primarily on the following topics:

- Cellular and molecular mechanism of receptor signalling
- Consequences and mechanisms of opioid action on cells and the entire body
- Cardioprotective mechanisms induced by cold adaptation
- Significance of the circadian system for regulating physiological processes
- Neurobiology of cognitive functions and Alzheimer's disease

In its research activity, the Department works closely with the Institute of Physiology at the Czech Academy of Sciences and the National Institute of Mental Health, as well as other domestic and foreign institutions.

## Other Activities of the Department

The Department offers courses in its field of expertise for all levels of study and guarantees master's and doctoral study programmes in Animal Physiology. Over the past 10 years, students have successfully defended more than 180 master's theses and 50 doctoral theses in this field. In addition to conducting research, teaching and supervising students, Department members actively popularise knowledge associated with the field of physiology.

## Major Achievements

The most significant scientific achievements of the Department in the past decade include the description of far-reaching consequences of morphine administration and its withdrawal on the expression profile of proteins in the heart. Considering the widespread global use of opioids, this is a very important discovery. During long-term cooperation with the Institute of Physiology of the Czech Academy of Sciences, adaptation to chronic hypoxia was found to affect the expression and activity of important enzymes for the energy metabolism in the heart. This knowledge leads to a better understanding of the complex adaptive changes underlying the development of the cardioprotective phenotype.

## Most Important Publications in the Past Decade

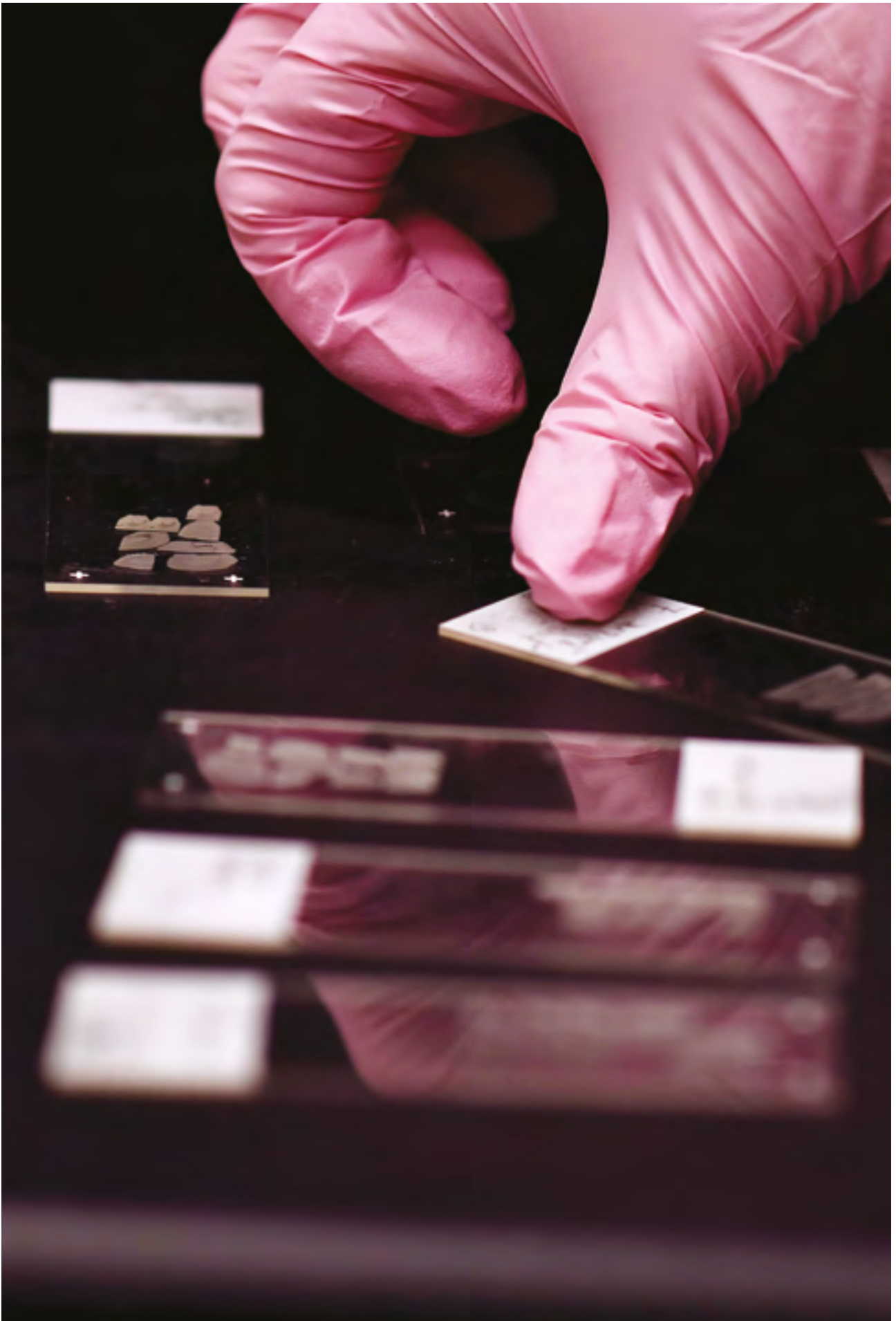
In the past decade, Department members have published over 50 professional articles in international journals.

**DRASTICHOVÁ, Zdeňka, ŠKRABALOVÁ, Jitka, JEDELSKÝ, Petr, NECKÁŘ, Jan, KOLÁŘ, František and NOVOTNÝ, Jiří.** Global changes in the rat heart proteome induced by prolonged morphine treatment and withdrawal. *PLoS One*. 2012, 7(10), e47167. ISSN 1932-6203.

**PAČESOVÁ, Dominika, VOLFOVÁ, Barbora, ČERVENÁ, Kateřina, HEJNOVÁ, Lucie, NOVOTNÝ, Jiří and BENDO VÁ, Zdeňka.** Acute morphine affects the rat circadian clock via rhythms of phosphorylated ERK1/2 and GSK3 $\beta$  kinases and Per1 expression in the rat suprachiasmatic nucleus. *British Journal of Pharmacology*. 2015, 172(14), 3638–3649. ISSN 0007-1188.

**WASKOVÁ-ARNOŠTOVÁ, Petra, KAŠPAROVÁ, Dita, EL-SNICOVÁ, Barbara, NOVOTNÝ, Jiří, NECKÁŘ, Jan, KOLÁŘ, František and ŽURMANOVÁ, Jitka.** Chronic hypoxia enhances expression and activity of mitochondrial creatine kinase and hexokinase in the rat ventricular myocardium. *Cellular Physiology and Biochemistry*. 2014, 33(2), 310–320. ISSN 1015-8987.





In addition to research, the Neurobiology of Cognitive Functions and Alzheimer's Disease group also works actively to raise public awareness of this disease. (photo: Alice Foltýnová)

# Department of Genetics and Microbiology

## History of the Department

In 2019, the Department of Genetics and Microbiology celebrated the 60<sup>th</sup> anniversary of its establishment. Although the number is not insignificant, its real history dates back to 1901 when Prof. Bohumil Němec was tasked with establishing the Institute of Plant Physiology where research and teaching in the field of genetics first began. However, Artur Brožek can be considered the true founder of genetics at CU; he became the first professor of genetics in Czechoslovakia in 1927. He was succeeded in 1934 by Karel Hrubý, today considered one of the most important Czech geneticists. The 1948 Czechoslovak coup d'état meant the beginning of Lysenkoism and the fight against genetics as a "bourgeois pseudo-science". When the FSc CU was re-established in 1959, an independent Department of Microbiology and Genetics was formed and remains to this day. Karel Hrubý, the Head of the Department, was replaced by bacteriologist Jiří Stárka, who was succeeded by geneticist Jan Nečásek and later microbiologist Olga Bendová. In 1989, the Department was headed by microbiologist and virologist Vojtěch Závada, an enthusiastic and outstanding teacher in modern molecular biology and virology, who then passed the Department leadership to Stanislav Zdražil, a biochemist and molecular biologist from the Institute of Molecular Genetics of the Czech Academy of Sciences. From 1998–2013, the Department was led by Petr Pikálek, Zdena Palková and Ivo Konopásek. In 2013, the Department was managed by Ivan Hirsch, who worked on virology, especially retroviruses at facilities here and abroad (from 1989–2013, he worked as Research Director at INSERM, Marseille, France). After his return to the Faculty, he began additional intensive research collaboration with the Czech Academy of Sciences (Institute of Molecular Genetics and the Institute of Organic Chemistry and Biochemistry). Under his leadership, some of the Department's research teams moved to the new BIOCEV research centre in Vestec u Prahy.

The Department of Genetics and Microbiology is located in the FSc CU building at Viničná Street 5 in Prague. The Department includes laboratories and greenhouses in the Brožek Genetic Garden while the research facilities were recently expanded considerably at the BIOCEV centre in Vestec u Prahy. The Department of Genetics and Microbiology is one of the four largest Departments

of the FSc CU Biology Section: its members currently include 3 professors, 5 associate professors, 15 professional assistants, 2 lecturers, 47 researchers and 20 technicians. Naturally, the Department also includes students. Each year, an average of 26 undergraduate, 29 master's and 15 doctoral students defend their theses successfully.

## Scientific Focus

The Department's scientific interest extends not only to various fields of genetics, molecular and cell biology, microbiology and virology, but also to physiology, ecology and systematics. The relatively large diversity of research projects is reflected both in the wide range of organisms examined (viruses, bacteria, yeasts and other fungi, animals and plants), and the variety of methodological approaches and techniques used. There are currently nine research groups at the Department which often collaborate with one another, other FSc CU's Departments and numerous research institutions in Czechia and abroad. They include the **Laboratory of Virology, Laboratory of Immunotherapy, Laboratory of Molecular and Tumour Virology, Laboratory of Yeast Colony Biology, Laboratory of Bacteriology and Genetics, Laboratory of RNA Biochemistry, Laboratory of Plant Genetics and Laboratory of Spider Cytogenetics**. Four of them (Laboratory of Virology, Laboratory of Immunotherapy, Laboratory of Molecular and Tumour Virology, and Laboratory of Yeast Colony Biology) are also members of research projects at BIOCEV in the *Cell Biology and Virology* programme. The research projects are supported by many domestic and foreign grants and research results are frequently published in prestigious scientific journals and monographs.

## Other Activities of the Department

The Department provides basic and specialised lectures and practical training for bachelor's, master's and doctoral students (each year approximately 80 lectures, training sessions, courses and seminars). Department members also supervise student theses at all three levels of university study, either in the three-year bachelor's programmes of Biology and Special Chemical and Biological Sciences, the two-year master's Biology programme (fields of study: Genetics, Molecular Biology and Virology with six study specialisations – Virology,

Molecular Biology and Genetics of Prokaryotes, Molecular Biology and Genetics of Eukaryotes, Cellular and Molecular Biology of Microbial Populations, Cytogenetics, Plant Genetics – and Microbiology with a single specialisation in Microbiology), and doctoral programmes/fields of Molecular and Cellular Biology, Genetics and Virology, and Microbiology.

### Major Achievements

The Department is able to effectively utilise the BIOCEV infrastructure where a total of four Department groups have moved the focus on their research activities. The **Laboratory of Yeast Colony Biology**, which is recognised as a world leader in its field, has carried out research supported by the prestigious Czech-Norwegian programme based on the study of molecular aspects of development and extracellular signalling in yeast colonies as a model of a multicellular organised structure. This model revealed an unexpected association between differentiated yeast colonies and mammalian cell tumours and elucidated the mechanisms of environmental influence on colony formation and aging. These findings are important for understanding the underlying processes in the evolution of multicellular organisms and will help reveal new aspects of tumour biology.

Research at the **Laboratory of Molecular Virology** defined the functional consequences of interactions of small DNA viruses, polyomaviruses and hepatitis B virus and their products with various host cell structures as well as mechanisms of innate immunity and restriction of viral replication.

Two virology groups have been studying papillomaviruses associated with cancer in humans: the **Laboratory of Molecular and Tumour Virology** focused on finding new diagnostic and therapeutic targets and characterising the molecular mechanisms of carcinogenesis. The **Laboratory of Immunotherapy** examined the treatment of tumours induced by human papillomaviruses based on therapeutic vaccines. Both virology groups, together with groups of the Department of Cell Biology and groups of the 1st Faculty of Medicine, are involved in the interdisciplinary OP RDE project titled *Tumour Ecology Centre – Research of Tumour Microenvironments in the Body Facilitating Tumour Growth and Spread*.

The **Laboratory of Bacterial Physiology** is involved in preparing the main direction of *Infection and Immunity* research to be conducted at the Biocentre on the Albertov Campus, which should study the biophysical characteristics of the interaction of cells with the *Bordetella pertussis* toxin (which causes pertussis). Results of this research have great application potential both for developing a vaccine and for understanding the pathogenesis of infection. A similarly high application potential is seen in research on the RNA regulation of gene expression, carried out to prepare the main areas of research (*Biochemistry and Metabolism, Genetics, Genomics and Bioinformatics*) at the RNA Biochemistry Laboratory, specifically using a hepatitis C virus model.

The application potential of virology research is also exploited to develop nanotechnologies. Research of viral nanoparticles as biological carriers for foreign proteins and their subsequent use as vaccines or diagnostic tools is carried out in the *Laboratory of Molecular Virology* in cooperation with the Department of Inorganic Chemistry. This has resulted in the registration of numerous utility models. The groups of Z. Palková, M. Pospíšek, R. Tachezy and M. Šmahel actively participated in acquiring and implementing the Faculty's *Twinning H2020 MiCoBion* programme focused on education and mutual communication.

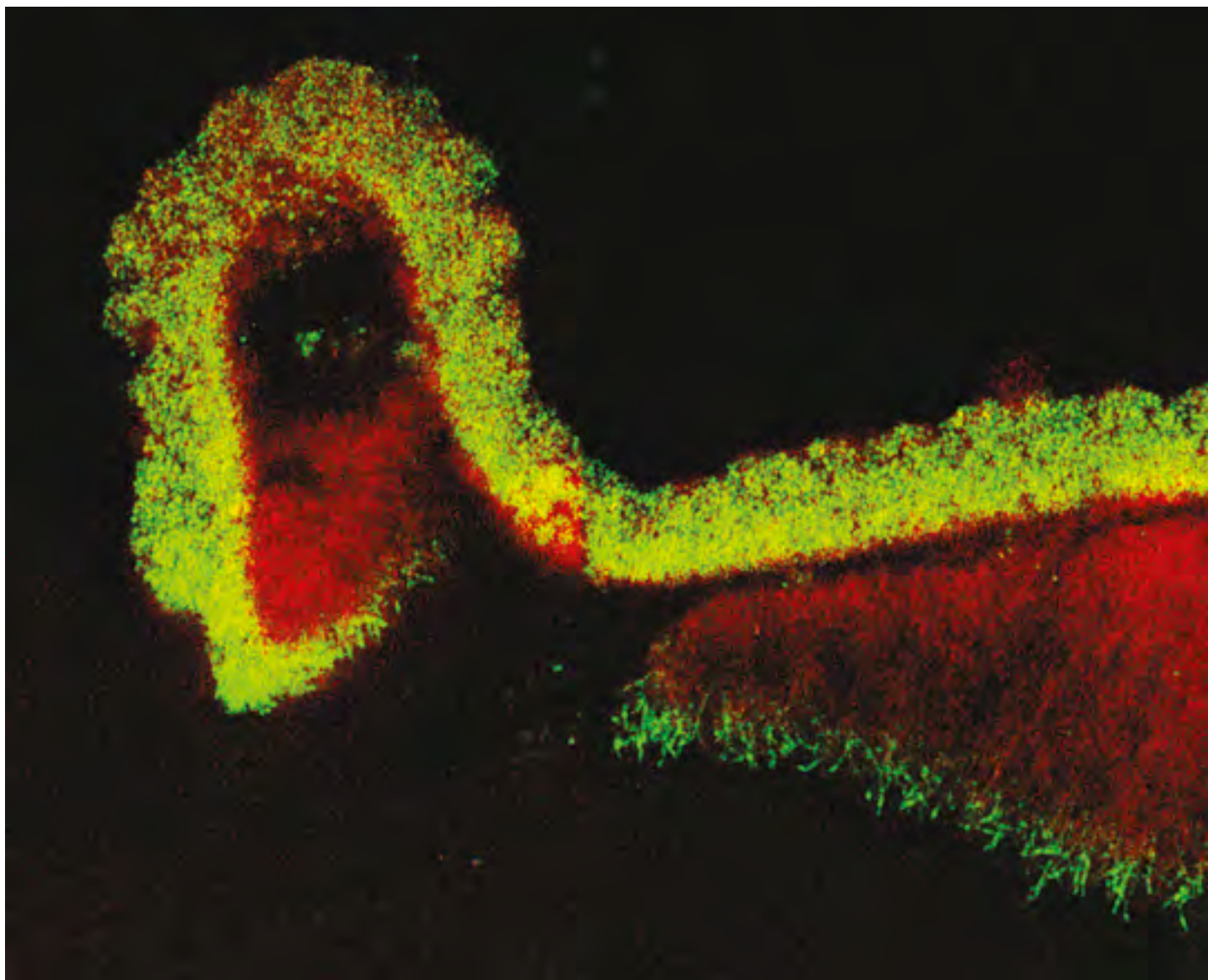
### Most Important Publications in the Past Decade

AOUACHERIA, Abdel, CUNNINGHAM, Kyle W., HARDWICK, Marie J., PALKOVÁ, Zdena, POWERS, Ted, SEVERIN, Fedor F. and VACHOVÁ, Libuše. Comment on "Sterilizing immunity in the lung relies on targeting fungal apoptosis-like programmed cell death". *Science*. 2018, **360**, 6395. ISSN 0036-8075.

ČÁP, Michal, ŠTĚPÁNEK, Luděk, HARANT, Karel, VÁCHOVÁ, Libuše and PALKOVÁ, Zdena. Cell differentiation within a yeast colony: metabolic and regulatory parallels with a tumour-affected organism. *Mol. Cell*. 2012, **46**(4), 436–448. ISSN 1097-2765.

ČEPL, Jaroslav, STEJSKAL, Jan, LHOTÁKOVÁ, Zuzana, HOLÁ, Dana, KORECKÝ, Jiří, LSTIBŮREK, Milan, TOMÁŠKOVÁ, Ivana, KOČOVÁ, Marie, ROTHOVÁ, Olga, PALOVSKÁ, Markéta, HEJTMÁNEK, Jakub, KREJZKOVÁ, Anna, GEZAN, Salvador,





Zdena Palková's group does research of yeast colonies and is internationally acclaimed in the field of the molecular biology of yeast populations. (photo: BIOCEV archive)

WHETTEN, Ross and ALBRECHTOVÁ, Jana. Heritable variation in needle spectral reflectance of Scots pine (*Pinus sylvestris* L.) peaks in red edge. *Remote Sens. Environ.* 2018, **219**, 89–98. ISSN 0034-4257.

GRZELAK, Adrianna, POLÁKOVÁ, Ingrid, ŠMAHELOVÁ, Jana, VACKOVÁ, Julie, PEKARČÍKOVÁ, Lucie, TACHEZY, Ruth and ŠMAHEL, Michal. Experimental combined immunotherapy of tumours with Major Histocompatibility Complex Class I downregulation. *Int. J. Mol. Sci.* 2018, **19**(11), E369.3. ISSN 1422-0067.

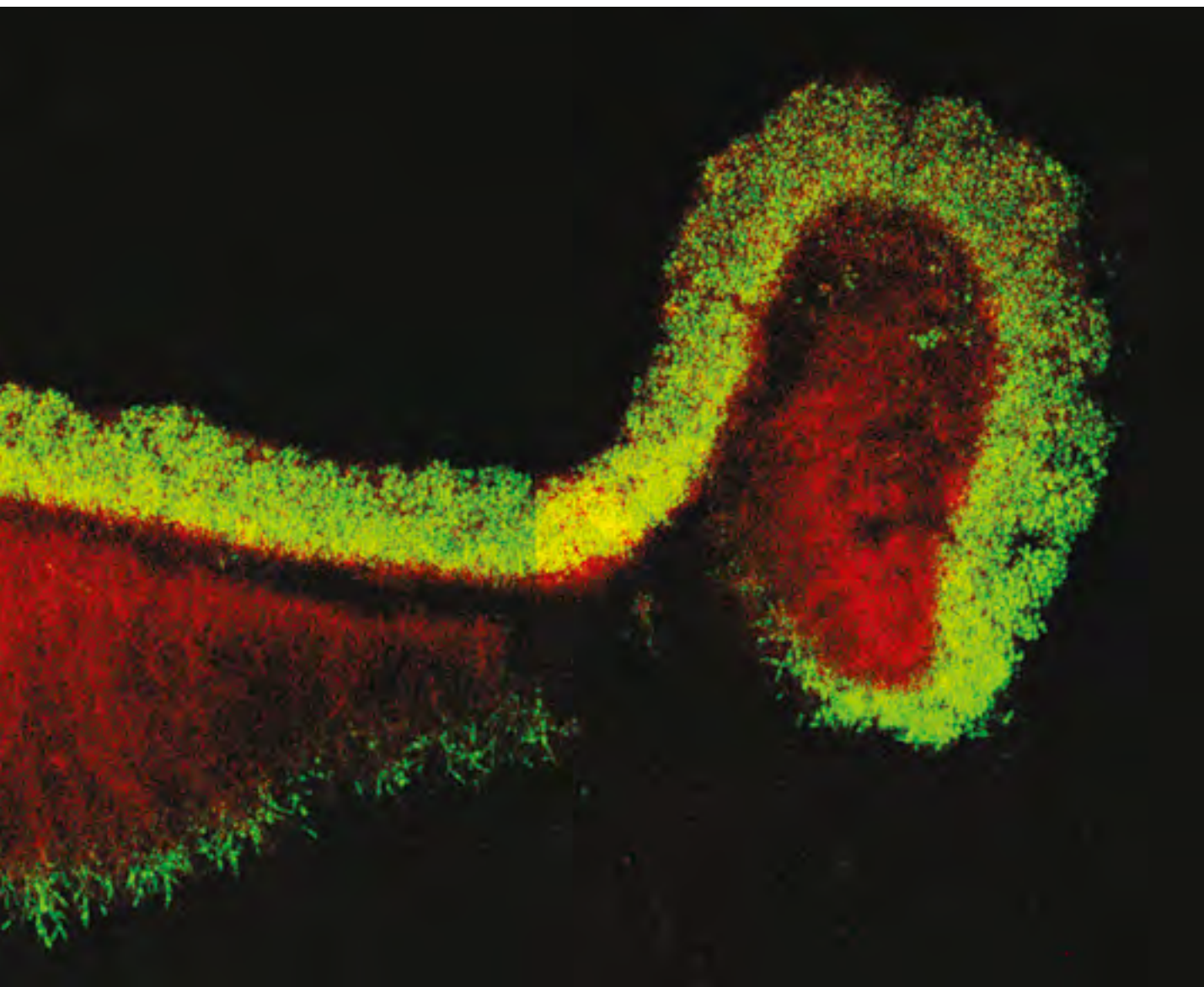
HENKE, Petr, KIRAKCI, Kaplan, KUBÁT, Pavel, FRAIBERK, Martin, FORSTOVÁ, Jitka and MOSINGER, Jiří. Antibacterial, antiviral, and oxygen-sensing nanoparticles prepared from electrospun materials. *ACS Appl. Mater. Interfaces.* 2016, **8**(38), 25127–25136. ISSN 1944-8244.

HORNÍKOVÁ, Lenka, FRAIBERK, Martin, MAN, Petr, JANOVEC, Václav and FORSTOVÁ, Jitka. VP1, the major capsid

protein of the mouse polyomavirus, binds microtubules, promotes their acetylation and blocks the host cell cycle. *FEBS J.* 2017, **284**(2), 301–323. ISSN 1742-464X.

JANOVEC, Václav, AOUAR, Besman, FONT-HARO, Albert, HOFMAN, Tomáš, TREJBALOVÁ, Kateřina, WEBER, Jan, CHAPEROT, Laurence, PLUMAS, Joel, OLIVE, Daniel, DUBREIL, Patricie, NUNÉS, Jacques A., STRÁNSKÁ, Růžena and HIRSCH, Ivan. The MEK1/2-ERK pathway inhibits Type I IFN production in plasmacytoid dendritic cells. *Front. Immunol.* 2018, **9**, 364. ISSN 1664-3224.

PARTLOVÁ, Simona, BOUČEK, Jan, KLOUDOVÁ, Kamilla, LUKEŠOVÁ, Eva, ZÁBRODSKÝ, Michal, GREGA, Marek, FUČÍKOVÁ, Jitka, TRUXOVÁ, Iva, TACHEZY, Ruth, ŠPÍŠEK, Radek and FIALOVÁ, Anna. Distinct patterns of intratumoral immune cell infiltrates in patients with HPV-associated compared to non-virally induced head and neck squamous cell carcinoma. *Oncotarget.* 2015, **4**(1), e965570. ISSN 2162-402X.



**SEYDLOVÁ, Gabriela**, POHL, Radek, ZBORNÍKOVÁ, Eva, EHN, Marcel, ŠIMÁK, Ondřej, PANOVA, Natalya, KOLÁŘ, Milan, BOGDANOVÁ, Kateřina, VEČEŘOVÁ, Renata, **FIŠER, Radovan**, ŠANDEROVÁ, Hana, VÍTOVSKÁ, Dragana, SUDZ-INOVÁ, Petra, POSPÍŠIL, Jiří, BENADA, Oldřich, KŘÍŽEK, Tomáš, SEDLÁK, David, BARTŮNĚK, Petr, KRÁSNÝ, Libor and REJMAN, Dominik. Lipophosphonoxins II: Design, synthesis, and properties of novel broad spectrum anti-bacterial agents. *J. Med. Chem.* 2017, **60**(14), 6098–6118. ISSN 0022-2623.

**SÝKORA, Michal**, POSPÍŠEK, Martin, **NOVÁK, Josef**, **MRVOVÁ, Silvia**, KRÁSNÝ, Libor and **VOPÁLENSKÝ, Václav**. Transcription apparatus of the yeast virus-like elements: Architecture, function, and evolutionary origin. *PLoS Pathogens*. 2018, **14**(10), e1007377. ISSN 1553-7366.

VERRIER, Eloi R., YIM, Seung2Ae, HEYDMANN, Laura, EL SAGHIRE, Houssein, BACH, Charlotte, TURON- 2LAGOT, Vincent, MAILLY, Laurent, DURAND, Sarah C., LUCIFO-

RA, Julie, DURANTELE, David, PESSAUX, Patrick, MANEL, Nicolas, **HIRSCH, Ivan**, ZEISEL, Mirjam B., POCHET, Nathalie, SCHUSTER, Catherine, F. BAUMERT, Thomas. Hepatitis B virus evasion from cGAS sensing in human hepatocytes. *Hepatology*. 2018, **68**(5), 16951709. ISSN 0270-9139.

**VOJTĚCHOVÁ, Zuzana**, SABOL, Ivan, **SALÁKOVÁ, Martina**, TUREK, Lubomír, GREGA, Marek, **ŠMAHELOVÁ, Jana**, VENCÁLEK, Ondřej, LUKEŠOVÁ, Eva, KLOZAR, Jan and **TACHEZY, Ruth**. Analysis of the integration of human papillomaviruses in head and neck tumours in relation to patients' prognosis. *Int. J. Cancer*. 2016, **138**(2), 386–395. ISSN 0020-7136.

# Department of Parasitology

## History of the Department

The origins of the Department date back to 1938 when Prof. Otto Jírovec (1907–1972) founded the parasitology division at Viničná Street 7 as part of the CU Zoological Institute. Considered the founder of modern Czech parasitology, he developed the field primarily in the areas of veterinary and human medicine. Prof. Jírovec achieved international recognition particularly for his discovery of the causative agent of pneumocystis pneumonia, which was named *Pneumocystis jirovecii* in his honour; he also contributed significantly to research on toxoplasmosis, vaginal trichomoniasis and other parasitic diseases. In 1961, he held the first international protozoological conference in Prague, thus establishing a tradition of regular meetings of protozoologists from all over the world. In 2017 (56 years later), this meeting, once again held in Prague, was again organised by FSc CU protistologists Assoc. Prof. Vladimír Hampl and Prof. Ivan Čepička.

Throughout its history, the parasitology division became part of the Department of Ecological Zoology, only to be later made part of the Department of Parasitology and Hydrobiology. The Department was then headed by various distinguished parasitologists: entomologist Prof. Jaroslav Kramář (1954–1976), helminthologist Prof. Bohumil Ryšavý (1976–1986) and protozoologists Prof. Jiří Vávra (1986–1990) and Prof. Jaroslav Kulda (1990–1997, 1999–2000). The Department of Parasitology became fully independent in 2004 and has been led by Assoc. Prof. Ivan Hrdý since 2015.

## Scientific Focus

The Department is traditionally divided into three basic areas: the study of parasitic protists (protistology), worms (helminthology) and arthropods (medical entomology). The Department boasts a modern insectarium with a unique collection of phlebotomine sand flies. In 2015, some of the Department's research teams relocated to the state-of-the-art BIOCEV Biotechnology and Biomedical Centre in Vestec near Prague.

In their research, Department staff study the biology of parasites, their adaptation to parasitism and interaction with the host, both on a molecular level in the laboratory and organismal level in the laboratory as well as in the field. They collaborate with other research teams from Czechia and abroad. At the same time, a significant per-

centage of students and researchers from abroad work in the Department's laboratories. Research projects primarily focus on the following topics:

- Biodiversity and taxonomy of parasites
- Phylogeny and evolution of parasites, their organelles and molecules
- Significance of parasite cellular membranes, organelles, cells and tissues for adaptation to a parasitic lifestyle
- Biogenesis and function of unusual parasite organelles
- Clarification of the mutual relationship between parasites and their hosts
- Research of parasitic epidemics and epizooties in Czechia and abroad
- Development of tools to diagnose parasitic diseases

The Department of Parasitology plays an important role in the teaching of undergraduate students, including the ERASMUS programme. Above all, it is the guarantor for master's and doctoral studies in parasitology. Over the past 10 years, more than 80 undergraduate theses and 30 dissertations of various parasitology topics have been successfully defended at the Department.

## Other Activities of the Department

The field of parasitology is characterised by its overlap with many areas of biology. During their studies, students master methods of experimental biology and can also experience field work, either as part of a scientific project or during excursions in Czechia (Ruda field station) or abroad (Norway, Romania) that primarily focus on parasites of domesticated and wild animals. The Department also supports student participation in scientific conferences and internships in scientific laboratories abroad. The multidisciplinary approach provides graduates with a broad range of job opportunities in basic and applied research or in diagnostic laboratories. Department staff activities include consulting for institutions and the public, as well as lifelong educational courses.

## Major Achievements

Discovery of the first amitochondriate eukaryotic organism; characterisation of metabolic changes associated with the adaptation of eukaryotic cells to life in an anaerobic environment; description of the mechanism of attach-





The group led by Vladimír Hampl discovered the first amitochondriate eukaryotic organism and received the prestigious ERC Consolidator Grant. (photo: Petr Jan Juračka)

ment of leishmania to the vector's intestine; epidemiologically significant classification of sand flies as specific and permissive vectors; discovery of new trichomonad species in the oral cavity of dogs and cats (*Trichomonas bixi*) and the zoonotic potential of *Trichomonas tenax*; description of phylogenetic relationships of avian trypanosomes and the discovery of a new vector-bird parasite combination.

The scientific and educational achievements of the Department have been distinguished at the national and international level. Notable awards include the World Federation of Parasitologists' Distinguished Achievement Awards (Prof. Kulda 2010; Prof. Vávra 2018), the Bedřich Hrozný Prize for Creative Initiative (Assoc. Prof. Hampl 2016) and the Learned Society of the Czech Republic Award (Prof. Tachezy 2011).

Department members have received prestigious grants, e.g. Twinning H2020 (Prof. Tachezy), OPVVV19 (Prof. Tachezy), ERC Consolidator Grant (Assoc. Prof. Hampl), H2020-MCTN (Prof. Volf), and H2020-Infraia (Prof. Volf).

Teams are involved in international projects studying parasites common to humans and non-human primates in Africa and leishmanioses in Southern Europe, Africa and South America (LeishShield, VectorNet, EuroLeish).

A Czech popular science book titled "*Of Parasite and Men*" (Votýpka et al., Triton, 2018, written in Czech), with the editorial team from the Department of Parasitology won the Magnesia Litera Award for educational literature in 2019.

### Most Important Publications in the Past Decade

Over the past decade, Department members have published over 380 professional articles (including *PNAS*, *Sci-*

*ence Advances*, *Clinical Microbiology Reviews* and *Current Biology*), 15 chapters in books and 3 books.

DOEHL, Johannes S.P., SÁDLOVÁ, Jovana, ASLAN, Hamide et al. Leishmania HASP and SHERP Genes Are Required for In Vivo Differentiation, Parasite Transmission and Virulence Attenuation in the Host. *PLoS Pathogens*. 2017, **13**(1), e1006130. ISSN 1553-7374.

DOLEŽAL, Pavel, DAGLEY, Michael J., KONO, Maya et al. The essentials of protein import in the degenerate mitochondrion of *Entamoeba histolytica*. *PLoS Pathogens*. 2010, **6**(3), e1000812. ISSN 1553-7374.

HORÁK, Petr, MIKEŠ, Libor, LICHTENBERGOVÁ, Lucie et al. Avian schistosomes and outbreaks of cercarial dermatitis. *Clinical Microbiology Reviews*. 2015, **28**(1), 165–190. ISSN 0893-8512.

KARNKOWSKA, Anna, VACEK, Vojtěch, ZUBÁČOVÁ, Zuzana et al. A eukaryote without a mitochondrial organelle. *Current Biology*. 2016, **26**(10), 1274–1284. ISSN 09609822.

KAZAMIA, Elena, ŠUŤÁK, Róbert, PAZ-YEPES, Javier et al. Endocytosis-mediated siderophore uptake as a strategy for Fe acquisition in diatoms. *Science Advances*. 2018, **4**(5), eaar4536. ISSN 2375-2548.

NÝVLTOVÁ, Eva, ŠUŤÁK, Róbert, HARANT, Karel et al. NIF-type iron-sulphur cluster assembly system is duplicated and distributed in the mitochondria and cytosol of *Mastigamoeba balamuthi*. *Proceedings of the National Academy of Sciences*. 2013, **110**(18), 7371–7376. ISSN 0027-8424.

# Department of Teaching and Didactics of Biology

## History of the Department

The Department has a long tradition and has mostly participated in the training of future secondary school teachers. It also played a part in laying the foundations of some science competitions, such as the Biology Olympiad.

## Scientific Focus

The primary mission of the Department is to prepare future biology teachers in bachelor's and master's programmes and in lifelong learning courses. An important part of this training includes guiding the students through their teaching practice at secondary schools. We also provide methodological support to current biology and science teachers at secondary and primary schools and organise continuing education courses for them. Our research activities cover several areas of biology teaching which overlap into other fields of science. We examine, for example, the issue of motivating students to study science, the use of activating teaching methods, the implementation of current biology knowledge in teaching or the influence of sibling constellations on academic success.

## Other Activities of the Department

International cooperation: University of Maribor – Faculty of Science and Mathematics (Slovenia), Matej Bel University in Banská Bystrica – Faculty of Natural Sciences of Sciences (Slovakia).

## Major Achievements

2011: Centralised Development Project of the Ministry of Education, Youth and Sports of the Czech Republic: Modern Biology at Your Fingertips: An interactive biological laboratory to develop gifted and motivated pupils and teachers in secondary schools and tertiary vocational schools. Project manager: Alena Morávková, M.A., Ph.D.

2018–2019: Project financed from the Prague municipal budget: Prague's Nature and Environment in School Teaching, No. DOT/54/12/013697/2018. Project manager: Jan Mourek, M.A., Ph.D.

2019: Kateřina Příbylová was awarded a Charles University Rector Prize – The Václav Příhoda Prize for best gradu-

ates of teacher training study programmes for her thesis on "The Influence of the Higher Education and Support of the School Environment for Beginning Teachers of Biology". The work was supervised by Jiřina Rajsiglová, Ph.D.

## Most Important Publications in the Past Decade

**DVOŘÁKOVÁ, Radka** and **ABSOLONOVÁ, Karolína**. Obsahová analýza tématu evoluce člověka v českých učebnicích přírodopisu a biologie. (*Content analysis of the topic of human evolution in Czech natural history and biology textbooks*). *Scientia in educatione*. 2017, **8**(2), 2–20. ISSN 1804-7106.

**JANŠTOVÁ, Vanda** and **ŠORGO, Andrej**. Evaluation, Validation and Modification of Science Motivation Questionnaire for Upper Secondary School. *Journal of Baltic Science Education*. 2019, **18**(4), 748–767. ISSN 1648-3898.

**KUBA, Radim**, **FLEGR, Jaroslav** and **HAVLÍČEK, Jan**. The Effect of Birth Order on the Probability of University Enrolment. *Intelligence*. 2018, **70**, 61–72. ISSN 0160-2896.

**PROCHÁZKOVÁ, Kamila**, **NOVOTNÝ, Petr** and **HANČÁROVÁ, Miroslava**. Teaching a Difficult Topic Using a Problem-based Concept Resembling a Computer Game: Development and Evaluation of an E-learning Application for Medical Molecular Genetics. *BMC Medical Education*. 2019, **19**(1), 390. ISSN 1472-6920.

**POUPOVÁ, Jana**. Výuka o vědě a jejích dějinách: Česko versus Západ (*Teaching about science and its history: Czechia versus West*). *Orbis scholae*. 2018, **12**(1), 1–17. ISSN 2336-3177.





The primary mission of the Department is to prepare future teachers in bachelor and master programmes as well as in lifelong learning courses. (photo: Petr Jan Juračka)



# Department of Zoology

## History of the Department

The Department of Zoology is directly linked to the Institute of Zoology of Charles University, founded in 1882. The first professor of zoology, Antonín Frič, headed it from the beginning. Prof. František Vejdovský, CU Rector and a world-renowned cell biologist played a key role in its further development. The Institute of Zoology joined the newly founded Faculty of Science under the guidance of Vejdovský's student, Prof. Alois Mrázek. In 1925, the Institute was divided into three separate institutes, with Prof. Julius Komárek heading the Institute for Systematic Zoology. Later, the radical post-war rebuilding of zoological disciplines took place under his leadership with the help of his assistants and students. In 1953, the Department of Systematic Zoology was founded and later renamed the Department of Zoology in the 1980s. Key figures that are worth mentioning include Assoc. Prof. Waltr Černý, Prof. Emanuel Bartoš and a host of outstanding graduates whose research and teaching efforts heralded the development of the Department and field in the following decades (Assoc. Prof. Vladimír Hanák, Prof. Ota Oliva, Prof. Zdeněk Veselovský, Prof. Karel Hůrka, Prof. Pavel Štys, Assoc. Prof. Milan Kunst, Prof. Jan Buchar and others). Assoc. Prof. Milan Kunst began his long tenure as the Head of the Department in 1955. After 1989, the Department was headed in turn by Prof. Karel Hůrka, Prof. Milan Chvála, Prof. Pavel Štys, Prof. Jaroslav Smrž, Assoc. Prof. Pavel Stopka and Assoc. Prof. Pavel Munclinger. The current head is Prof. Ivan Čepička.

## Scientific Focus

There are currently 4 professors teaching at the Department, 10 associate professors and 22 assistant professors. The Department is divided into five informal sections:

- **Invertebrate zoology** – focuses on the diversity and cytogenetics of arachnids, the ecology and paleoecology of molluscs and the evolution of anaerobic protists.
- **Entomology** – studies the diversity and evolution of recent and fossil insects, evolution of eusociality, emergence and evolution of the insect wing, study of flight adaptations, ontogenetic development of insects and succession of insect communities.
- **Vertebrate zoology** – studies the morphology, genetics, ecology, distribution, systematics and palaeontology of vertebrates.
- **Ethology and ecology** – focuses primarily on neuroethology, the study of aposematism and mimicry, cognitive and comparative ethology and human ethology.
- **Evolutionary animal biology** – the largest Section, it concentrates on the study of general evolutionary biological issues such as mechanisms of speciation, genetic basis of adaptations, evolution of immunity, nervous systems and sexual selection. Research is mainly carried out on vertebrates.

The Department of Zoology has been actively involved in the new BIOCEV centre in Vestec, where it has a team examining the genetics of behaviour and reproductive biology in mammals.

## Other Activities of the Department

The Department is part of a joint workplace shared with the Institute of Animal Physiology and Genetics and the Institute of Vertebrate Biology of the Czech Academy of Sciences. It also closely cooperates with the National Museum, the National Institute of Mental Health and other scientific research institutions. All research teams of the Department collaborate with foreign scientific institutions. The Department runs the master's and doctoral programmes in Zoology, and is also involved in organising new master's courses in Evolutionary Biology, Reproductive Biology and Bioinformatics and teaching biology to undergraduates. Over the past 10 years, more than 260 undergraduates and 60 PhD programme students have successfully defended their theses. In addition to regular lectures and practices, several excursions in Czechia and abroad are organised each year for field training, such as the Field Course in Zoology, Ichthyological Methods, Quaternary Palaeontology Methods and Interdisciplinary Botanical-Zoological Excursions (with the Department of Botany) and the Mediterranean Sea Fauna (with the Department of Ecology).

## Major Achievements

During the past decade, researchers at the Department of Zoology have been the lead authors or co-authors of over



At the Department of Zoology Robert Černý primarily focuses on the head formation in deep-branching lineages of fish. He is the lead author and co-author of numerous publications in prestigious scientific journals including *Nature* and *PNAS*. (photo: Petr Jan Juračka)

1,000 publications in impact journals and nearly 90 chapters in scientific monographs. Some of their discoveries were so significant that textbooks needed to be revised. That is also why they are published in the most prestigious biology journals, such as *Science*, *Nature*, *Proceedings of the National Academy of Sciences of the United States of America* and *Current Biology*. The notable discoveries include:

The discovery of the enormous colour vision potential in certain deep-sea fish (Musilová et al., *Science*, 2019, 364, 588–592). It showed that the visual system of vertebrates is capable of evolving under extreme evolutionary pressure. The editors of *Science* magazine were so impressed with the discovery that it made the front page of the issue in which the article was published.

The discovery of preoral entoderm in vertebrates (Minařík et al., *Nature*, 2017, 547, 209–212). The existence of this ancient feature was confirmed in the early phase of the ontogenetic development of the vertebrate head. This structure had been predicted theoretically in the past, but had never been found in any living creature or fossil. This discovery received the Bedřich Hrozný Prize for Creative Initiative (2017), the Charles University Rector's Special Prize (2018) and the Czech Science Foundation Chairwoman's Award (2019).

The discovery of the oldest holometabolous insect (Nel et al., *Nature*, 2013, 503, 257–261). This fundamentally shifted our understanding of the early evolution of this most diverse group of living organisms.

The explanation of the origin of insect wings (Prokop et al., *Current Biology*, 2017, 27, 263–269). The detailed study of Paleozoic Palaeodictyoptera unexpectedly supported the theory of dual insect wing formation, i.e. the fundamental innovation of the species-richest group of organisms. At the same time, it refuted the popular hypothesis that the bases of wings served for active flight in larvae.

The finding that ostracods have been reproducing with giant sperm for at least 100 million years (Matzke-Karasz et al., *Science*, 2009, 324, 1535). This work is unique because the results were obtained using a synchrotron.

The finding that the combined care of both parents for offspring and polyandria may be an alternative to eusociality in hymenopteran insects (Bures et al., *PNAS*, 2019, 116, 6238–6243). The discovery received the Jaroslav Heyrovský Prize.

The finding that certain birds (songbirds and parrots) have a much greater density of neurons in the brain than mammals, enabling them to have significant cognitive abilities



Zuzana Musilová attends to the research of fish, especially their sensory perception. For her research, she received a Swiss National Science Agency grant to support young "group leaders". In 2019, her study on the vision of deep sea fish was published by Science, and an illustration for the article even made it to the cover. (photo: Luboš Wiśniewski)



despite the small brain volume (Olkowicz et al., *PNAS*, 2016, 113, 7255–7260).

The discovery that low-frequency magnetic fields generated by high-voltage power lines disrupt the perception of the magnetic field by cattle and deer (Burda et al., *PNAS*, 2009, 106, 5708–5713). At the same time, this is an indirect evidence of the perception of the magnetic field by these animals.

Research on the evolution of toll-like receptors (an important part of innate immunity) in birds (Velová et al., *Molecular Biology and Evolution*, 2018, 35, 2170–2184), which has provided a new perspective on the evolutionary processes that diversify immunological defence.

Research on partner preferences based on genes of the major histocompatibility complex (MHC) in humans (Winternitz et al., *Molecular Ecology*, 2017, 26, 668–688), which shows that people have a tendency to choose heterozygous partners but not different MHC partners as previously thought.

### Most Important Publications in the Past Decade

BURDA, Hynek, BEGALL, Sabine, ČERVENÝ, Jaroslav, NEEF, Julia and NĚMEC, Pavel. Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants. *Proceedings of the National Academy of Sciences of the United States of America*. 2009, 106(14), 5708–5713. ISSN 0027-8424.

ČERNÝ, Robert, CATTELL, Maria, SAUKA-SPENGLER, Tatjana, BRONNER-FRASER, Marianne, YU, Feiqiao and MEULEMANS MEDEIROS, Daniel. Evidence for the prepattern/cooption model of vertebrate jaw evolution. *Proceedings of the National Academy of Sciences of the United States of America*. 2010, 107(40), 17262–17267. ISSN 0027-8424.

FARKAŠOVÁ, Helena, HRON, Tomáš, PAČES, Jan, HULVA, Pavel, BENDA, Petr, GIFFORD, Robert James and ELLEDER, Daniel. Discovery of an endogenous Deltaretrovirus in the genome of long-fingered bats (Chiroptera: Miniopteridae). *Proceedings of the National Academy of Sciences of the United States of America*. 2017, 114(12), 3145–3150. ISSN 0027-8424.

HAMPL, Vladimír, ČEPIČKA, Ivan and ELIÁŠ, Marek. Was the mitochondrion necessary to start eukaryogenesis? *Trends in Microbiology*. 2019, 27(2), 96–104. ISSN 0966842X.

MATSCHINER, Michael, MUSILOVÁ, Zuzana, BARTH, Julia M.I., STAROSTOVÁ, Zuzana, SALZBURGER, Walter, STEEL, Mike and BOUCKAERT, Remco. Bayesian phylogenetic estimation of clade ages supports trans-Atlantic dispersal of cichlid fishes. *Systematic Biology*. 2017, 66(1), 3–22. ISSN 1063-5157.

MATZKE-KARASZ, Renate, SMITH, Robin James, SYMON-OVA, Radka, MILLER, Charles Giles and TAFFOREAU, Paul.

Sexual intercourse involving giant sperm in Cretaceous ostracode. *Science*. 2009, 324(5934), 1535. ISSN 0036-8075.

MINAŘÍK, Martin, ŠTUNDL, Jan, FABIÁN, Peter et al. Pre-oral gut contributes to facial structures in non-teleost fishes. *Nature*. 2017, 547(7662), 209–212. ISSN 0028-0836.

MIKÁT, Michael, JANOŠÍK, Lukáš, ČERNÁ, Kateřina, MATOUŠKOVÁ, Eva, HADRAVA, Jiří, BUREŠ, Vít and STRAKA, Jakub. Polyandrous bee provides extended offspring care biparentally as an alternative to monandry based eusociality. *Proceedings of the National Academy of Sciences of the United States of America*. 2019, 116(13), 6238–6243. ISSN 0027-8424.

MUSILOVÁ, Zuzana, CORTESI, Fabio, MATSCHINER, Michael et al. Vision Using multiple distinct rod opsins in deep-sea fishes. *Science*. 2019, 364(6440), 588–592. ISSN 0036-8075.

NEL, André, ROQUES, Patrick, NEL, Patricia, PROKIN, Alexander A., BURGOIN, Thierry, PROKOP, Jakub et al. The earliest known holometabolous insects. *Nature*. 2013, 503(7475), 257–261. ISSN 0028-0836.

OLKOWICZ, Seweryn, KOCOUREK, Martin, LUČAN, Radek K., PORTEŠ, Michal, FITCH, W. Tecumseh, HERCULANO-HOUZEL, Suzana and NĚMEC, Pavel. Birds have primate-like numbers of neurons in the forebrain. *Proceedings of the National Academy of Sciences of the United States of America*. 2016, 113(26), 7255–7260. ISSN 0027-8424.

PROKOP, Jakub, PECHAROVÁ, Martina, NEL, André, HÖRNSCHEMEYER, Thomas, KRZEMIŃSKA, Ewa, KRZEMIŃSKI, Wiesław and ENGEL, Michael S. Paleozoic nymphal wing pads support dual model of insect wing origins. *Current Biology*. 2017, 27(2), 263–269. ISSN 09609822.

ŠIZLING, Arnošt L., POKORNÝ, Petr, JUŘIČKOVÁ, Lucie et al. Can people change the ecological rules that appear general across space? *Global Ecology and Biogeography*. 2016, 25(9), 1072–1084. ISSN 1466822X.

VELOVÁ, Hana, GUTOWSKA-DING, Maria W., BURT, David W. and VINKLER, Michal. Toll-like receptor evolution in birds: Gene duplication, pseudogenization, and diversifying selection. *Molecular Biology and Evolution*. 2018, 35(9), 2170–2184. ISSN 0737-4038.

WINTERNITZ, Jamie C., ABBATE, Jessica L., HUCHARD, Elise, HAVLÍČEK, Jan and GARAMSZEGLI, László Zsolt. Patterns of MHC-dependent mate selection in humans and nonhuman primates: a meta-analysis. *Molecular Ecology*. 2017, 26(2), 668–688. ISSN 09621083.





An aerial photograph of a large, multi-story building complex, likely a university or institutional building, viewed from a high angle. The building features a mix of architectural styles, including a prominent central tower with a gabled roof and several wings with numerous windows. The entire image is overlaid with a semi-transparent yellow filter. The word "Chemistry" is written in white, sans-serif font across the middle of the image.

# Chemistry



# Department of Analytical Chemistry

## History of the Department

The word *analysis* comes from the ancient Greek word ἀναλύω, which means to clarify, unravel, or reveal a secret, and is based on the words ἀνά (entirely) and λύω (free, liberate). The thing is that all knowledge of the world around us stems from and is conditioned by analysis. Ever since humans have used chemical processes, analytical chemistry has therefore been one of the most essential parts of chemistry. We can define it as a scientific field that develops and applies methods, tools and strategies to obtain information about the composition and nature of matter in space and time. In short, analytical chemistry answers four basic questions about the material being analysed: *what?*, *where?*, *how much?* and *what is the structure or form?* Analytical chemistry, its methods, procedures and especially results make it possible to obtain essential information necessary to address many urgent questions and problems facing human society, such as the fight against insidious diseases and saving human lives in hospitals, ensuring fair play in sports, treating infertility, improving agriculture and preventing famine, protecting consumers and the environment, catching the perpetrators of serious crimes and much more.

The tradition of research in analytical chemistry and its teaching at Charles University reaches back to general natural science research carried out at the Faculty of Medicine of Charles University as early as the 17<sup>th</sup> century. Notable work includes research on the solar spectrum carried out by Jan Marek Marci of Kronland (1595–1667), which later became the fundamentals of spectral methods of analysis. During the 18<sup>th</sup> century, analytical chemistry at Charles University was used to analyse mineral water from Czech springs or raw materials from various locations, which contributed to the development of both Czech balneology and a number of industries. Separate lectures and laboratory training in analytical chemistry was introduced by Prof. Josef Redtenbacher (1810–1870) in 1842. Notable successors include Prof. Vojtěch Šafařík (1831–1902), who worked with compounds of vanadium and similar metals. In 1892 Professor Šafařík split then the Institute of Chemistry into three more narrowly focused Institutes, one of which was the Institute for General, Inorganic and Analytical Chemistry. From the start, it was headed by world renowned chemist Prof. Bohuslav Brauner (1855–1935), a friend and colleague of D. I. Men-

delev. In addition to making major discoveries in the fields of the elements and inorganic chemistry, he also focused on analytical chemistry, as evidenced in his outstanding book *Quantitative Analysis for Students (Beginners) of the Czech University*, published in 1919.

Shortly after the founding of the Faculty of Science CU, the Institute of Analytical Chemistry was made independent in 1925. The first head was Prof. Josef Švéda (1881–1929) who primarily focused on the analysis of gases and forensic analyses. His successor, Prof. Oldřich Tomíček (1891–1953), is one of the founders of modern analytical chemistry in our country. He was primarily interested in volumetric analysis (he introduced potentiometry and numerous redox titration reagents) and pharmaceutical analysis. The work of Assoc. Prof. Rudolf Příbil (1910–1986) on complex-forming volumetric determinations, of Prof. Eva Smolková (born 1927) on gas chromatography and of Prof. Karel Štulík (1941–2013) on various areas of electroanalysis and separation methods earned international recognition.

## Scientific Focus

The scientific activity of the Department is focused on the development of all three areas of modern analytical chemistry, i.e. electroanalytical, separation and spectral methods, as well as the application of analytical chemistry methods for the broadest use. Attention is also paid to theoretical questions of analytical chemistry, such as the modelling of analytical processes or the study of relationships between the structure and physical/chemical properties of substances.

In the area of electroanalytical methods, new electrode materials are studied (boron-doped diamond electrodes, amalgam, composite and screen-printed electrodes) and new electrochemical detectors are constructed (flow detectors, contactless conductivity detection, integrated sensors). Other advances include new electroanalytical methods for the sensitive and selective determination of important biological, ecological and toxicological organic compounds. The development of electroanalytical DNA sensors enabling the study of processes related to carcinogenesis is also significant.

Separation methods being developed primarily include microcolumn liquid chromatography, multidimensional gas chromatography, post-column derivatisation methods for detection, and the miniaturisation of electropho-



At the end of 2019, Jiří Berek was awarded a silver memorial medal of the Faculty of Science of CU for his lifelong contribution to research and his teaching of analytical chemistry. (photo: Luboš Wiśniewski)



In addition to scientific and teaching activities, Karel Nesměrak is also dedicated to the popularisation of chemistry. Together with the Library of the Chemical Sciences, he prepares exhibitions on the history of chemistry not only at the Faculty, and on the history of the periodic table. (photo: Petr Jan Juracka)

resis for the on-line monitoring of biologically important substances in living organisms. Research into the application of separation methods includes chiral separation of optically active substances, methods for highly sensitive and specific assays for clinical and environmental applications, the development and validation of methods for determining active substances in medicinal products, and stability and degradation studies of these substances.

In the area of spectrometric methods, research is primarily focused on methods of atomic spectrometry suitable for highly sensitive determination of metallic elements in samples. New techniques for speciation analysis are being developed, based on combining atomic spectrometry with separation techniques. Great attention is paid to the possible uses of UV-photochemistry to generate volatile compounds.

#### Other Activities of the Department

In addition to research, the Department is currently responsible for the undergraduate and postgraduate teaching of analytical chemistry and toxicology, numerous lectures and laboratory courses, and all types of university qualification work, always in conjunction with research being carried out at the Department. The Department cooperates widely with institutions of the Czech Academy of Sciences, various industrial institutions and workplaces of other universities, both domestic and international. Department members are represented in international socie-

ties of chemistry (IUPAC, European Chemical Society) and sit on the editorial boards of many international scientific journals (e.g. *Analytical Letters*, *Analytical and Bioanalytical Chemistry*, *International Journal of Electrochemical Science*). Since 2004, the Department has organised *Modern Analytical Chemistry*, an international student conference focused on PhD students in the field of analytical chemistry and supported by the European Chemical Society.

#### Major Achievements

The Department has received a great number of grants, in particular from the Grant Agency of the Czech Republic (Centre of Excellence – *New Approaches to Bioanalysis and Molecular Diagnostics*), the Technology Agency of the Czech Republic, the Grant Agency of Charles University and many others. In addition to scientific publications, these have resulted in several patents, for example, CZ Pat. 304 176 *Electrochemical measuring cell, a system of electrochemical measuring cells and the process of its production*, or CZ Pat 305 127 *Post-column derivatization by solid derivatization agent in HPLC*.

The high level of teaching at the Department has been recognised several times with the student prize of the FSc CU for quality teaching (Prof. Opekar, Assoc. Prof. Cvacka, Assoc. Prof. Nesmerak).

Of the many Czech and foreign awards won by the Department students and staff, we must not forget to mention



the L'Oréal Woman in Science prize (Dr. Pecková, 2013) or the Travel Award for Young Electrochemist given by the International Society of Electrochemistry (Assoc. Prof. Vyskočil, 2016).

### Most Important Publications in the Past Decade

In total, the Department has published 573 articles in impact journals, 12 chapters in international monographs, and received 4 patents and 7 utility models for the last decade.

**BAUEROVÁ, Petra, VINKLEROVÁ, Jitka, HRANIČEK, Jakub, ČORBA, Vojtěch, VOJTEK, Libor, SVOBODOVÁ, Jana and VINKLER, Michal.** Associations of urban environmental pollution with health-related physiological traits in a free-living bird species. *Science of the Total Environment*. 2017, **601–602**, 1556–1565. ISSN 0048-9697.

**BAVOL, Dmytro, SCAMPICCHIO, Matteo, ZIMA, Jiří, BAREK, Jiří and DEJMKOVÁ, Hana.** Fast scanning voltammetric detector for high performance liquid chromatography. *Electrochimica Acta*. 2018, **281**, 534–539. ISSN 0013-4686.

**DUFKOVÁ, Veronika, ČABALA, Radomír and ŠEVČÍK, Václav.** Determination of C<sub>5</sub>–C<sub>12</sub> perfluoroalkyl carboxylic acids in river water samples in the Czech Republic by GC–MS after SPE preconcentration. *Chemosphere*. 2012, **87**, 463–469. ISSN 0045-6535.

**FISCHER, Jan, HÁJKOVÁ, Andrea, PEREIRA, Mariane, KŘEČEK, Matěj, VYSKOČIL, Vlastimil and BAREK, Jiří.** Investigation of voltammetric behaviour of insecticide chlorpyrifos on a mercury meniscus modified silver solid amalgam electrode. *Electrochimica Acta*. 2016, **216**, 510–516. ISSN 0013-4686.

**HÁJKOVÁ, Andrea, VYSKOČIL, Vlastimil, JOSYPČUK, Bohdan and BAREK, Jiří.** A miniaturized electrode system for voltammetric determination of electrochemically reducible environmental pollutants. *Sensors and Actuators B: Chemical*. 2016, **227**, 263–270. ISSN 0925-4005.

**KOZLÍK, Petr, BOSÁKOVÁ, Zuzana, TESAŘOVÁ, Eva, COUFAL, Pavel and ČABALA, Radomír.** Development of a solid-phase extraction with capillary liquid chromatography tandem mass spectrometry for analysis of estrogens in environmental water samples. *Journal of Chromatography A*. 2011, **1218**, 2127–2132. ISSN 0021-9673.

**KŘÍŽEK, Tomáš, DOUBNEROVÁ, Veronika, RYŠLAVÁ, Helena, COUFAL, Pavel and BOSÁKOVÁ, Zuzana.** Offline and online capillary electrophoresis enzyme assays of  $\beta$ N-acetylhexosaminidase. *Analytical and Bioanalytical Chemistry*. 2013, **405**, 2425–2434. ISSN 1618-2642.

**NÁDHERNÁ, Martina, OPEKAR, František, REITER, Jakub and ŠTULÍK, Karel.** A planar, solid-state amperometric sensor for nitrogen dioxide, employing an ionic liquid

electrolyte contained in a polymeric matrix. *Sensors and Actuators B: Chemical*. 2012, **161**, 811–817. ISSN 0925-4005.

**NESMĚRÁK, Karel, ČERVENÝ, Václav, HRANIČEK, Jakub and RYCHLOVSKÝ, Petr.** A spectrofluorimetric determination of phenothiazine derivatives after their photooxidation or chemical or electrochemical oxidation in a flow injection arrangement. *Microchemical Journal*. 2013, **106**, 226–232. ISSN 0026-265X.

**NESMĚRÁK, Karel, TOROPOV, Andrey A., TOROPOVA, Alla P., KOHOUTOVÁ, Petra and WAISSER, Karel.** SMILES-based quantitative structure property relationships for halfwave potential of N-benzylsalicylthioamides. *European Journal of Medicinal Chemistry*. 2013, **67**, 111–114. ISSN 0223-5234.

**NOVÁKOVÁ, Eliška, LINHART, Ondřej, ČERVENÝ, Václav, RYCHLOVSKÝ, Petr and HRANIČEK, Jakub.** Flow injection determination of Se in dietary supplements using TiO<sub>2</sub> mediated ultraviolet-photochemical volatile species generation. *Spectrochimica Acta Part B: Atomic Spectroscopy*. 2017, **134**, 98–104. ISSN 0584-8547.

**SCHWARZ, Dana, NODA, Yu, KLOUDA, Jan, SCHWARZOVÁ-PECKOVÁ, Karolina, TARÁBEK, Ján, RYBÁČEK, Jiří, JANOUŠEK, Jiří, SIMON, Frank, OPANASENKO, Maksym V., ČEJKA, Jiří, ACHARJYA, Amitava, SCHMIDT, Johannes, SELVE, Sören, REITER-SCHERER, Valentin, SEVERIN, Nikolai, RABE, Jürgen P., ECORCHARD, Petra, HE, Junjie, POLOZIJ, Miroslav, NACHTIGALL, Petr and BOJDYS, Michael J.** Twinned growth of metal-free, triazine-based photocatalyst films as mixed-dimensional (2D/3D) van der Waals heterostructures. *Advanced Materials*. 2017, **29**, 1703399. ISSN 0935-9648.

**SCHWARZOVÁ-PECKOVÁ, Karolina, VOSÁHLOVÁ, Jana, BAREK, Jiří, ŠLOUFOVÁ, Ivana, PAVLOVA, Ewa, PETRÁK, Václav and ZAVÁZALOVÁ, Jaroslava.** Influence of boron content on the morphological, spectral, and electroanalytical characteristics of anodically oxidized boron-doped diamond electrodes. *Electrochimica Acta*. 2017, **243**, 170–182. ISSN 0013-4686.

**SVOBODOVÁ, Adéla, KŘÍŽEK, Tomáš, ŠIRC, Jakub, ŠÁLEK, Petr, TESAŘOVÁ, Eva, COUFAL, Pavel and ŠTULÍK, Karel.** Monolithic columns based on a poly(styrene-divinylbenzene-methacrylic acid) copolymer for capillary liquid chromatography of small organic molecules. *Journal of Chromatography A*. 2011, **1218**, 1544–1547. ISSN 0021-9673.

**ŠTÍCHA, Martin, JELÍNEK, Ivan, POLÁKOVÁ, Jana and KALIBA, David.** Characterization of rhenium(V) complexes with phenols using mass spectrometry with selected soft ionization techniques. *Analytical Letters*. 2015, **48**, 2329–2342. ISSN 0003-2719.

# Department of Inorganic Chemistry

## History of the Department

Inorganic chemistry has been one of the basic chemistry disciplines ever since the very beginnings of the field. The predecessor of the Department of Inorganic Chemistry at Charles University was the Institute for General, Inorganic and Analytical Chemistry led by Professor Bohuslav Brauner, who focused his research on the chemistry of rare earths and determination of their atomic weights. Professor Brauner collaborated closely with D. I. Mendeleev and contributed to refining and promoting his periodic table of elements. In 1925, the Institute split into the Institute for Inorganic and Forensic Chemistry led by Prof. Jindřich Křepelka and the Institute of Pharmaceutical Chemistry led by Prof. Jan Stanislav Štěrba-Böhm. While Prof. Křepelka continued with the determination of atomic weights and focused on tellurium and iodine chemistry, Prof. Böhm followed the line of Brauner's rare earth research. It was not until 1952 that the Department of Inorganic Chemistry was established and led by Prof. Stanislav Škramovský, a student and co-worker of Professor Štěrba-Böhm. Prof. Škramovský concentrated on the development of thermoanalytical methods and chemistry of coordination compounds. In 1969, the chair of the head of the Department passed to Prof. Miroslav Ebert, who retained the structure of research and teaching while he naturally added modern applications of computers. In the 1990s, under the guidance of Assoc. Prof. Zdeněk Mička and Prof. Ivan Lukeš, the Department gradually introduced other modern areas of research, in particular bio-inorganic and organometallic chemistry and the chemistry of solids and functional materials. Such research continued under the leadership of Prof. Ivan Němec and is still carried out today under Prof. Petr Štěpnička.

## Scientific Focus

**The Coordinating Chemistry and Bio-inorganic Chemistry Group** (Prof. P. Hermann, Assoc. Prof. J. Kotek and Assoc. Prof. V. Kubíček) focuses on the preparation of macrocyclic ligands and coordination compounds of these highly specific donors with the aim of their subsequent use in medical diagnostics (especially as contrast agents for magnetic resonance tomography, MRI) and in nuclear medicine (chelating agents for diagnostic and therapeutically important radionuclides). This research provides a unique opportunity for a broad and fruitful cooperation with Czech and foreign research groups.

Research in the **Organoelement Chemistry and Catalysis Group** (Prof. P. Štěpnička) is aimed primarily at developing new phosphinoferrrocene ligands for coordination chemistry and catalysis of practically important reactions of organic and organometallic substrates mediated by transition metal complexes. In addition to ferrocene, which is used as a specific molecular scaffold, the ligand molecules contain phosphine donor groups which are combined with other functional groups that can be used to tune physical and chemical properties.

Probably the most diverse research at the Department is carried out in the field of chemistry of materials. The **Group of Photochemistry and Supramolecular Chemistry** (Assoc. Prof. J. Mosinger) is engaged in the study of porphyrin photosensitisers and NO-photodonors and their anchoring on nanoparticles and nanofibrous materials capable of photogenerating highly reactive singlet oxygen and NO radicals. These materials have interesting medicinal applications, especially for healing wounds and as photodisinfecting materials.

Research in the **Group of Optical Materials** (Prof. I. Němec) focuses on the preparation and characterisation of new solid optical materials that combine nitrogen base cations with inorganic acid anions, whose structures include hydrogen bonds. The aim of the group is to obtain modern materials usable in nonlinear optics, e.g., as second harmonic frequency generators.

In the field of **Solid-state Chemistry**, attention is further focused on simple and composite oxide materials that exhibit useful magnetic or optical properties or other physical phenomena, such as e.g. oxygen transport at higher temperatures that could have practical applications (Dr. V. Tyrpekl, Dr. D. Zákutná).

An integral part of the Department of Inorganic Chemistry is the **Centre of Molecular and Crystal Structures**, which emerged from the Laboratory of Structural Analysis established by Prof. Josef Loub in the 1960s. Members of the centre, (Dr. I. Císařová, Assoc. Prof. R. Gyepes and Dr. M. Zábanský) analyse roughly 450 crystal structures every year. This Centre is a modern facility for X-ray structural analysis and provides important support for other research teams of the Department of Inorganic Chemistry and other research laboratories.



Jan Blahut won the Dean's Award for the Best Student Thesis in a Doctoral Programme in 2018. (photo: Petr Jan Juračka)

### Other Activities of the Department

The Department of Inorganic Chemistry is responsible for basic education of inorganic chemistry for undergraduate students and is the guarantor of master's and doctoral studies in the entire field of inorganic chemistry. In addition, people at the Department are engaged in additional educational activities, including courses for secondary school students and teachers.

### Major Achievements

The high quality of research conducted by teams at the Department of Inorganic Chemistry is reflected not only in the numerous outstanding publications and support obtained from national and international grant agencies, but also by the awards that the Department staff and students have received. These include the Bolzano Prize for Dr. Jiří Tauchman (2012), the Miloš Hudlický Prize for the best article printed in the given year in a "European" chemistry journal that went to Zuzana Kotková et al. (2015), the CU Rector's Prize – Prof. J. Heyrovský Prize for Miroslav Soroka (2016) and Filip Horký (2017), prizes for conference presentations or invitations to give lectures at prestigious institutions and international conferences.

### Most Important Publications in the Past Decade

**BLAHUT, Jan**, BERNÁŠEK, Karel, GÁLISOVÁ, Andrea, HERYNEK, Vít, **CÍSAŘOVÁ, Ivana**, KOTEK, Jan, LANG, Jan, MATĚJKOVÁ, Stanislava and **HERMANN, Petr**. Paramagnetic  $^{19}\text{F}$  Relaxation Enhancement in Nickel(II) Complexes of *N*-trifluoroethyl Cyclam Derivatives and Cell Labeling for  $^{19}\text{F}$  MRI. *Inorganic Chemistry*. 2017, **56**(21), 13337–13348. ISSN 0020-1669.

**DAVID, Tomáš**, **HLINOVÁ, Veronika**, **KUBÍČEK, Vojtěch**, BERGMANN, Ralf, STRIESE, Franziska, BERNDT, Nicole, SZOLLOSI, David, KOVACS, Tibor, MATHE, Domokos, BACHMANN, Michael, PIETZSCH, Hans-Jürgen and **HERMANN, Petr**. Improved Conjugation,  $^{64}\text{Cu}$  Radiolabeling, in Vivo Stability, and Imaging Using Nonprotected Bifunctional Macrocyclic Ligands: Bis(Phosphinate) Cyclam (BPC) Chelators. *Journal of Medicinal Chemistry*. 2018, **61**(19), 8774–8796. ISSN 0022-2623.

**DAVID, Tomáš**, **KUBÍČEK, Vojtěch**, GUTTEN, Ondrej, LUBAL, Přemysl, **KOTEK, Jan**, PIETZSCH, Hans-Jürgen, RULÍŠEK, Lubomír and **HERMANN, Petr**. Cyclam Derivatives with a Bis(phosphinate) or a Phosphinato-Phosphonate Pendant Arm. *Inorganic Chemistry*. 2015, **54**(24), 11751–11766. ISSN 0020-1669.



DOLANSKÝ, Jiří, HENKE, Petr, MALÁ, Zuzana, ŽÁRSKÁ, Ludmila, KUBÁT, Pavel and MOSINGER, Jiří. Antibacterial nitric oxide- and singlet oxygen-releasing polystyrene nanoparticles responsive to light and temperature triggers. *Nanoscale*. 2018, **10**(5), 2639–2648. ISSN 2040-3364.

HENKE, Petr, KIRAKCI, Kaplan, KUBÁT, Pavel, FRAIBERK, Martin, FORSTOVÁ, Jitka and MOSINGER, Jiří. Antibacterial, Antiviral, and Oxygen-Sensing Nanoparticles Prepared from Electrospun Materials. *ACS Applied Materials and Interfaces*. 2016, **8**(38), 25127–25136. ISSN 1944-8244.

KUBÍČEK, Vojtěch, BÖHMOVÁ, Zuzana, ŠEVČÍKOVÁ, Romana, VAŇEK, Jakub, LUBAL, Přemysl, POLÁKOVÁ, Zuzana, MICHALICOVÁ, Romana, KOTEK, Jan and HERMANN, Petr. Complexes with Copper(II) and Divalent Metal Ions: Kinetic and Thermodynamic Studies. *Inorganic Chemistry*. 2018, **57**(6), 3061–3072. ISSN 0020-1669.

MATULKOVÁ, Irena, CÍSAŘOVÁ, Ivana, VANĚK, Přemysl, NĚMEC, Petr and NĚMEC, Ivan. Novel organic NLO material bis(*N*-phenylbiguanidium(1+)) oxalate – A combined X-ray diffraction, DSC and vibrational spectroscopic study of its unique polymorphism. *Spectrochim. Acta A* 2017, **170**, 256–266. ISSN 1386-1425.

MATULKOVÁ, Irena, CIHELKA, Jaroslav, POJAROVÁ, Michaela, FEJFAROVÁ, Karla, DUŠEK, Michal, CÍSAŘOVÁ, Ivana, VANĚK, Přemysl, KROUPA, Jan, NĚMEC, Petr, TEŠAŘOVÁ, Nada and NĚMEC, Ivan. Molecular crystals of 2-amino-1,3,4-thiadiazole with inorganic oxyacids – crystal engineering, phase transformations and NLO properties. *CrystEngComm*. 2014, **6**(9), 1763–1776. ISSN 1466-8033.

PNIOK, Miroslav, KUBÍČEK, Vojtěch, HAVLÍČKOVÁ, Jana, KOTEK, Jan, SABATIE-GOGOVI, Andrea, PLUTNAR, Jan, HUCLIER-MARKAI, Sandrine and HERMANN, Petr. Thermodynamic and Kinetic Study of Scandium(III) Complexes of DTPA and DOTA: A Step Toward Scandium Radiopharmaceuticals. *Chemistry – A European Journal*. 2014, **20**(26), 7944–7955. ISSN 0947-6539.

SCHULZ, Jiří, VOSÁHLO, Petr, UHLÍK, Filip, CÍSAŘOVÁ, Ivana and ŠTĚPNIČKA, Petr. Probing the influence of phosphine substituents on the donor and catalytic properties of phosphinoferrocene carboxamides: a combined experimental and theoretical study. *Organometallics* 2017, **36**(9), 1828–1841. ISSN 0276-7333.

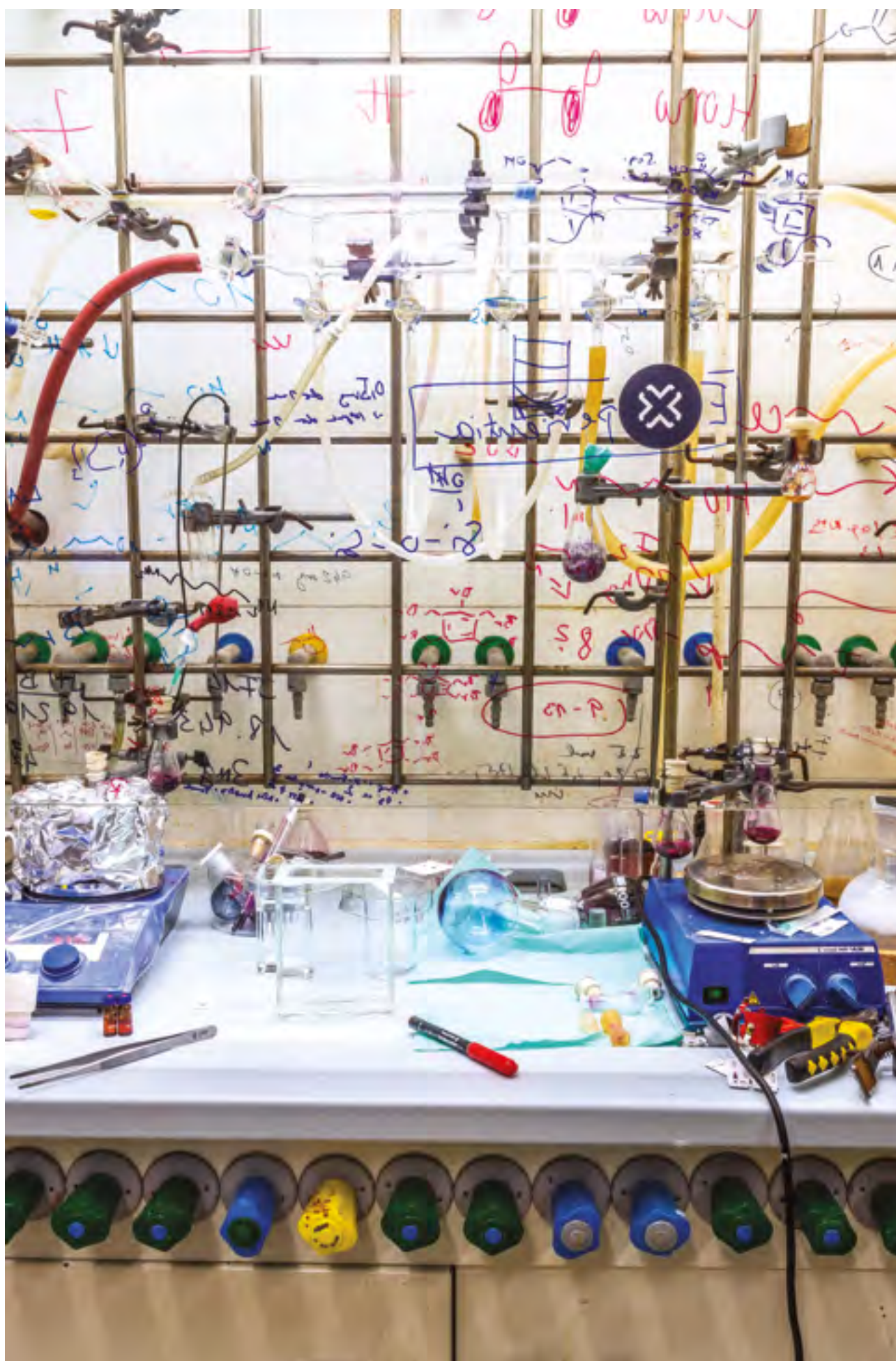
ŠKOCH, Karel, CÍSAŘOVÁ, Ivana and ŠTĚPNIČKA, Petr. Selective gold-catalysed synthesis of cyanamides and 1-substituted 1*H*-tetrazol-5-amines from isocyanides. *Chem. Eur. J.* 2018, **24**(52), 13788–13791. ISSN 0947-6593.

ŠKOCH, Karel, CÍSAŘOVÁ, Ivana and ŠTĚPNIČKA, Petr. Synthesis and catalytic use of gold(I) complexes containing a hemilabile phosphanylferrocene nitrile donor. *Chem. Eur. J.* 2015, **21**(45), 15998–16004. ISSN 0947-6593.

ŠTĚPNIČKA, Petr. Phosphino-carboxamides: the inconspicuous gems. *Chem. Soc. Rev.* 2012, **41**, 4273–4305. ISSN 0306-0012.

TYRPEKL, Václav, VEJPRAVOVÁ, Jana, ROCA, Alejandro, MURAFÁ, Natalia, SZATMARY, Lorant and NIŽŇANSKÝ, Daniel. Magnetically separable photocatalytic composite  $\gamma\text{-Fe}_2\text{O}_3\text{@TiO}_2$  synthesized by heterogeneous precipitation. *Applied Surface Science*. 2011, **257**(11), 4844–4848. ISSN 0169-4332.

ZÁBRANSKÝ, Martin, CÍSAŘOVÁ, Ivana and ŠTĚPNIČKA, Petr. Synthesis, coordination, and catalytic use of 1'-(di-phenylphosphino) ferrocene-1-sulfonate anion. *Organometallics*. 2018, **37**(10), 1615–1626. ISSN 0276-7333.



(photo: Petr Jan Juračka)



# Department of Biochemistry

## History of the Department

The name of the founder of the Biochemistry Department, Josef Koštíř, is closely associated, among other things, with the first isolation of penicillin in Czechoslovakia. After nationalisation, Koštíř worked as the head chemist at SPOFA and his biochemistry working group became the core of the first independent Department of Biochemistry here.

Distinguished graduates of the Department of Biochemistry include Helena Illnerová, Václav Pačes, Eva Zažímalová and Václav Hořejší. The Department of Biochemistry is currently a cutting-edge research and teaching facility.

## Scientific Focus

Several Department research groups have traditionally studied biotransformation enzymes (especially the mixed-function oxidase system). The primary task of these enzymes is to enable the elimination of foreign substances from the body, but they are of particular interest in the context of compounds which, during metabolism, can be converted by certain forms of enzymes to active derivatives (drugs) or harmful substances (pollutants, carcinogens, endocrine disruptors). The current research includes several interesting and promising partial goals: the development of anti-tumour drugs with targeted effect (based on nanoparticle tyrosine kinase inhibitors or fusion forms of immunocyte surface receptor ligands, especially NK cells), the recognition of the role of biotransformation enzymes in platinum chemotherapeutics and the potential use of prokaryotic heme sensors in antibacterial therapy. Intensive research of enzymes as the targets of therapeutic intervention has also long concentrated on viral proteases (development of inhibitors that overcome resistance in HIV patients), more recently on glutamate carboxypeptidase II (function in neuropathological processes and prostate tumours), and serine racemase from the human brain (potential use of inhibitors in the treatment of neurodegenerative diseases).

Another biomedical challenge is the research on cystic fibrosis, specifically the prevention of bacterial infections of the lungs that threaten the lives of patients with this illness, and gene therapy focused on restoring the function of chloride anion transport across membranes.

In plant biochemistry, research focuses on the adaptation and regulation of metabolic pathways under stress con-



With her team at the Department of Biochemistry, Markéta Martínková continues to research the properties of haemoproteins, especially those involved in sensory function. One of the goals is to develop new types of antibiotics. (photo: Petr Jan Juračka)

ditions (drought, salinization, increased temperature, and viral infection), biological protection of plants, nutritional effects on metabolism and characterisation of key plant enzymes.

In addition to classic biochemical and molecular techniques, some less common methods are available in the Department's laboratories, such as  $^{32}\text{P}$ -postlabeling, analytical ultracentrifugation, high-resolution microscopy, X-ray crystallography, surface plasmon resonance, mass spectrometry (light-induced chemical cross-linking, light-induced electron transfer in proteins, H-D exchange, radical labelling, ion mobility), theoretical modelling of biomolecules and their interactions, etc.



## Other Activities of the Department

The Department of Biochemistry offers biochemistry courses for the entire Chemistry Section of the Faculty of Science, especially in the individually accredited Biochemistry study programme at the bachelor's, master's and doctoral levels. The Biochemistry study programme is outlined as multi-disciplinary and, in addition to the profile subjects (biochemistry, molecular biology and biomedicine), incorporates other chemical, biological, mathematical and physical disciplines, especially at the undergraduate level. It combines theoretical preparation with participation in research, and not just in the laboratories of the Department of Biochemistry and Czech cooperating institutions (MBÚ, ÚOCHB, SZÚ), but also at facilities abroad (such as DKFZ and the universities in Heidelberg and Strasbourg). Thanks to this, graduates are well prepared to work in research centres or in many other biomedical-oriented professions.

## Major Achievements

- "iBodies" – synthetic antibody mimetics based on the principle of a polymeric carrier decorated with specific ligands, fluorescent markers and an affinity tag (biotin) to identify, isolate and quantify proteins (especially enzymes) with extraordinary sensitivity and selectivity in most *in vitro* applications, such as ELISA, FACS or Western blot. Patent ÚOCHB AV ČR, ÚMCH AV ČR, PřF UK Praha: *Macromolecular conjugates for isolation, immobilization and visualization of proteins*. Originators: Šácha P., Konvalinka J., Schimer J. PV 2015–19, PCT: CZ201605002, AU2016207125, US1011401.
- DIANA Method for quantifying enzymes and looking for their inhibitors by using a specific inhibitor of a given enzyme covalently linked to an oligonucleotide probe (NAVRÁTIL et al. *Nucleic Acids Research*. 2017, 45(2), e10). Werner von Siemens Prize for the best research work/innovation (2018).
- Affinity chips in combination with MALDI-TOF mass spectrometry enabling quantification of individual transferrin glycoforms (detection of alcoholism; DAREBNÁ et al., *Clin Chem*. 2018, 64(9), 1319–1326).

## Other Select Awards

- *Donatio Universitatis Carolinae* – M. Stiborová, 2018
- Datta Medal (Datta FEBS Lecture) – J. Konvalinka, 2018
- Student Giant Salamander Award for the best teachers – O. Vaněk, 2012/13; M. Martínková, 2013/14
- Grants – the Department of Biochemistry has been awarded and successfully carried out numerous grants, especially from GA ČR (Centre of Excellence – P. Hodek; J. Konvalinka), MŠMT, IGA, MPO (H. Ryšlavá), TA ČR (K. Běloňníková) and CELZA (P. Novák)

## Most Important Publications in the Past Decade

GOEKMEN, Refik M., COSYNS, Jean-Pierre, ARLT, Volker Manfred, **STIBOROVÁ, Marie**, PHILLIPS, David H., SCHMEI-

SER, Heinz H., SIMMONDS, Monique S.J., COOK, H. Terence, VAHNERWEGHEM, Jean-Lois, NORTIER, Joelle L. and LORD, Graham M. The Epidemiology, Diagnosis, and Management of Aristolochic Acid Nephropathy, A Narrative Review. *Ann Intern Med*. 2013, **158**(6), 469–77. ISSN 0003-4819.

**JEČMEN, Tomáš, PTÁČKOVÁ, Renata, ČERNÁ, Věra, DRAČÍNSKÁ, Helena, HODEK, Petr, STIBOROVÁ, Marie, HUDEČEK, Jiří** and ŠULC, Miroslav. Photo-initiated crosslinking extends mapping of the protein-protein interface to membrane-embedded portions of cytochromes P450 2B4 and b5. *Methods*. 2015, **89**, 128–37. ISSN 1046-2023.

**JEŘÁBEK, Petr, FLORIÁN, Jan** and **MARTÍNEK, Václav**. Lipid Molecules Can Induce an Opening of Membrane-Facing Tunnels in Cytochrome P450 1A2. *Phys Chem Chem Phys*. 2016, **18**(44), 30344–56. ISSN 1463-9076.

SHIMIZU, Toru, HUANG, Donyang, YAN, Fan, **STRÁŇAVA, Martin, BARTOŠOVÁ, Martina, FOJTÍKOVÁ Veronika** and **MARTÍNKOVÁ, Markéta**. Gaseous O<sub>2</sub>, NO, and CO in Signal Transduction: Structure and Function Relationships of Heme-Based Gas Sensors and Heme-Redox Sensors. *Chem Rev*. 2015, **115**(13), 6491–533. ISSN 0009-2665.

**SCHIMER, Jiří, PÁVOVÁ, Marcela, ANDERS, Maria, PACHL, Petr, ŠÁCHA, Pavel, CÍGLER, Petr, WEBER, Jan, MAJER, Pavel, ŘEZÁČOVÁ Pavlína, KRAEUSLICH, Hans-Georg, MUELLER, Barbara** and **KONVALINKA, Jan**. Triggering HIV polyprotein processing by light using rapid photodegradation of a tight-binding protease inhibitor. *Nat Commun*. 2015, **6**, 6461. ISSN 2041-1723.

SKÁLOVÁ, Tereza, **BLÁHA, Jan**, HARLOS, Karl, DUŠKOVÁ, Jarmila, KOVAL, Tomáš, STRÁNSKÝ, Jan, HAŠEK, Jindřich, **VANĚK, Ondřej** and DOHNÁLEK, Jan. Four crystal structures of human LLT1, a ligand for human NKR-P1, in varied glycosylation and oligomerization states. *Acta Crystallogr D*. 2015, **71**, 578–91. ISSN 2059-7983.

**STRÁŇAVA, Martin, MAN, Petr, SKÁLOVÁ, Tereza, KOLENKO, Petr, BLÁHA, Jan, FOJTÍKOVÁ, Veronika, MARTÍNEK, Václav, DOHNÁLEK, Jan, LENGÁLOVÁ, Alžběta, ROSŮLEK, Michal, SHIMIZU, Toru** and **MARTÍNKOVÁ, Markéta**. Coordination and redox state-dependent structural changes of the hemebased oxygen sensor AfGcHK associated with intraprotein signal transduction. *J Biol Chem*. 2017, **292**, 20921–35. ISSN 0021-9258.

# Department of Physical and Macromolecular Chemistry

## History of the Department

The Department was founded in 1921 by Professor Jaroslav Heyrovský (1890–1967), whose research work was awarded the Nobel Prize for chemistry in 1959 for the discovery and development of polarography. Heyrovský was succeeded in the position of Head of the Department by one of his students, Prof. Rudolf Brdička (1906–70), later the Director of the Institute of Physical Chemistry of the Czech Academy of Sciences who, thanks to his applications of polarography in medicine, was one of the founders of biophysical chemistry. Gradually, the Department's research focus expanded to include adsorption and catalysis, photochemistry, theoretical chemistry, chemistry and physical chemistry of polymers and chemistry of materials.

Over the past five years there has been tremendous development of the Department in conjunction with the preparation and implementation of the project titled *The Centre for the Targeted Synthesis and Application of Promising Materials* (CUCAM = Charles University Centre of Advanced Materials), funded from OP RDE 02\_15\_003 Support of Excellent Research Teams. The project initiated by Prof. P. Nachtigall made it possible for the Department to hire top physical chemists from Czechia and abroad (Prof. J. Čejka and Prof. R. E. Morris), along with a number of talented young scientists, at the same time giving the Department a markedly international character (40% of the Department staff are foreigners today). The CUCAM project also enabled the construction of state-of-the-art laboratories for the synthesis of advanced materials and catalysis and, last but not least, a rapid increase in the quality of scientific outputs, including a significant increase in the number of publications in the most prestigious scientific journals. The CUCAM project has led to the formation of a new group to research heterogeneous catalysis and new materials and significantly expanded the existing groups focusing on the modelling of (nano) materials and soft matter.

## Scientific Focus

### Modelling of (Nano)materials (Headed by Prof. P. Nachtigall)

The group primarily focuses on the theoretical study and modelling of materials with application potential, especially in the areas of catalysis, adsorption/separation

and electronics/spintronics. The primary emphasis is on the realistic combination of theoretical description with an experiment. The group cooperates with numerous experimental teams at the Department (Prof. J. Čejka, Prof. R. E. Morris) and abroad (for example with the University of St. Andrews, in Bayreuth, Leuven and Munich). The strategy and vision of the (nano)materials modelling group can be described as *operando* computer modelling (Grajciar et al. *Chem. Soc. Rev.* 2018, 47, 8307–8348 and Heard et al. *Chem. Sci.* 2019, 10, 5705–5711).

### Heterogeneous Catalysis and New Materials (Headed by Prof. J. Čejka)

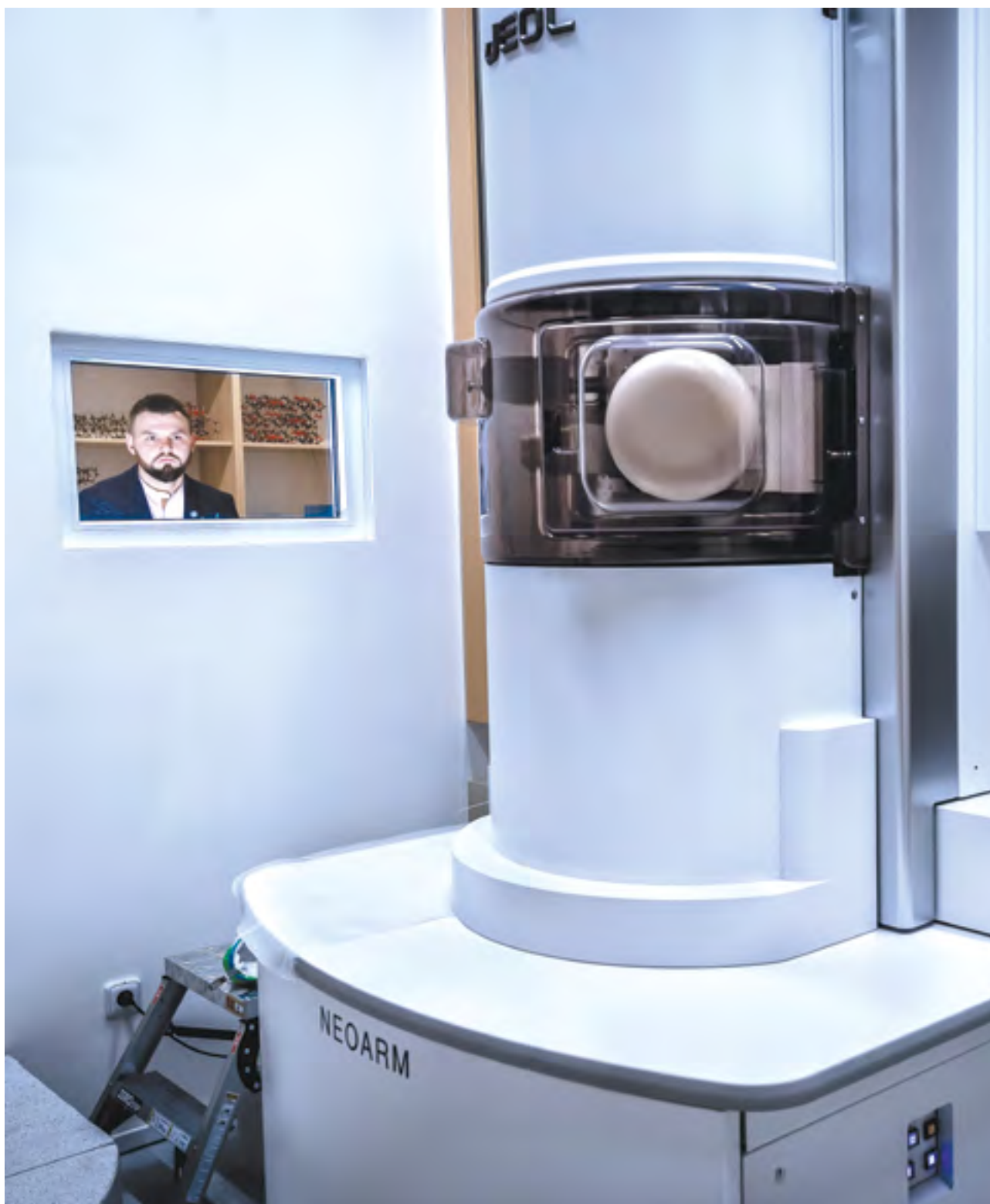
The team focuses on the synthesis of new porous materials based on zeolites and organic-inorganic hybrid materials and their use in adsorption and catalysis. In recent years, the team has developed a new method of zeolite synthesis (ADOR) that makes it possible to prepare zeolites that were thought to be unobtainable using standard methods (Henkelis et al. *Nat. Protoc.* 2019, 14, 781–794; Přeč et al. *Chem. Soc. Rev.* 2018, 47, 8263–8306). A variety of experimental techniques are used to characterise these materials, including transmission electron microscopy, nuclear magnetic resonance, adsorption techniques, X-ray diffraction, etc.

### Soft Matter (Headed by Assoc. Prof. M. Štěpánek)

The group is engaged in the interdisciplinary research of systems at the interface between physics and the chemistry of macromolecules. This includes the study of self-organising behaviour in solutions of associating block copolymers, polyelectrolytes and their mixtures with low-molecular-weight amphiphilic substances, such as surfactants or boron clusters (Uchman et al. *Angew. Chem. Int. Ed.* 2015, 54, 14113–14117; Murmiliuk et al. *ACS Macro Lett.* 2018, 7, 1243–1247). Various physical/chemical methods are used for this purpose, namely static and dynamic light scattering, neutron scattering, electron microscopy, atomic force microscopy and modelling of studied systems using molecular dynamics and the Monte Carlo method.

### Complex Polymer Systems (Headed by Prof. K. Procházka)

The group focuses on the study of conformational behaviour and spontaneous association of macromolecules, polymers and copolymers, especially polyelectrolytes in



Michal Mazur at a JEOL NeoARM high resolution electron microscope, CUCAM project. (photo: Petr Jan Juračka)

solutions and geometrically restricted environments with interacting walls (Ahn et al. *Macromolecules* 2017, 50, 8720–8730; Lisal et al. *Phys. Chem. Chem. Phys.* 2016, 18, 16127–16136). The research focuses on computer modelling of systems important for chromatographic, biomedical, and environmental and nanotechnology applications. Computer studies are usually combined with experimental studies (e.g. scattering, spectroscopic or chromatographic methods) either within the group or in

collaboration with other groups in the Department or with colleagues from the Czech Academy of Sciences and abroad.

#### **Conjugated Polymer Systems (Headed by Prof. J. Vohlídal)**

The group is dedicated to the preparation and study of the functional attributes of two types of conjugated polymer materials: microporous polymer networks with various sub-



The Department provides education in master's studies in the fields of physical chemistry, modelling of chemical properties of bio- and nano-structures, biophysical chemistry and macromolecular chemistry. (photo: Petr Jan Juračka)





groups for adsorption and catalytic applications (Sekerová et al. *Chem. Eur. J.* 2018, 24, 14742–14749) and constitutionally-dynamic metallo-supramolecular and covalent-type polymers with potential applications in photonics and electronics (Rais et al., *J. Mater. Chem. C* 2017, 5, 8041–8051). The studies are carried out in cooperation with the Plasmonics and Molecular Spectroscopy group and colleagues from the Institutes of the Czech Academy of Sciences.

#### **Protein Complexes (Headed by Prof. T. Obšil)**

The group is dedicated to the study of protein-protein interactions and their role in the regulation of protein function. Primary focus is on regulatory proteins 14-3-3 and their complexes with proteins involved in apoptosis and G-protein and calcium signalling (Alblova et al. *Proc. Natl. Acad. Sci. USA* 2017, 114, E9811–E9820 Pšenková et al., *Biochim. Biophys. Acta Gen. Subj.* 2018, 1862, 1612–1625). The main tools of study include the methods such as fluorescence spectroscopy, sedimentation analysis, light scattering, SAXS, NMR and protein crystallography.

#### **Electrophoresis and Chromatography (Headed by Prof. B. Gaš)**

The group's research focuses on a detailed understanding of the separation mechanisms of electrophoretic and chromatographic methods and on the proposing of conditions to attain the best possible separation. The group creates mathematical models of electromigration processes (Dvořák et al. *Electrophoresis* 2019, 40, 668–682) and calculates them using advanced software which it also develops and provides to the professional public for use (Simul 5 Programme). The theoretical results obtained are verified experimentally. Another important topic addressed in this group is chiral separations, which play a fundamental role in many fields of science, research and applications (Storch et al. *J. Chromatogr. A* 2016, 1476, 130–134).

#### **Plasmonics and Molecular Spectroscopy (Headed by Prof. B. Vlčková)**

The group studies the mechanisms of surface plasmon-enhanced optical processes and reactions on surfaces of plasmon nanoparticles with a view to optimising these processes and using them in molecular spectroscopy and chemical reactions. Specifically, this involves surface-enhanced Raman scattering (SERS), surface-enhanced resonance Raman scattering (SERRS), surface-enhanced luminescence (SEL), and surface-enhanced infrared absorption (SEIRA) (Sutrová et al. *J. Phys. Chem. C* 2018, 122, 20850–20860; Sloufova et al. *Langmuir*, 2019, 35, 9831–9840).

#### **Other Activities of the Department**

In accordance with its scientific focus, the Department offers master's degree courses in physical chemistry, modelling of chemical properties of bio- and nano-structures, biophysical chemistry and macromolecular chemistry and doctoral study programmes in physical chemistry, modelling of chemical properties of bio- and nano-structures and macromolecular chemistry.



# Department of Organic Chemistry

## History of the Department

The history of organic chemistry as a separate field at Charles University dates back to the end of the 19<sup>th</sup> century, when individual branches of chemistry began to be organised into separate fields. The first important figure focusing exclusively on organic chemistry was Prof. Bohuslav Raýman, who headed the department of organic chemistry from 1893 at the Institute of Chemistry led by Prof. Bohuslav Brauner. Prof. Raýman was interested in various fields of organic chemistry, especially the chemistry of carbohydrates. He helped determine the structure of one of the newly isolated saccharides, and also suggested the name rhamnose still used today. Thanks to his activity in the field of carbohydrate chemistry, he can be considered the founder of research in this area at the Department of Organic Chemistry, a tradition lasting for over 100 years. The Institute of Organic Chemistry was not established until the era of Raýman's successor, Prof. František Plzák, in 1923. In the post-war period, we should mention Prof. Jaroslav Staněk, Josef Pacák and Miloslav Černý who further developed carbohydrate chemistry and created a research facility of world renown. These laboratories were the first to synthesise 2-deoxy-2-fluoroglucose, which is used as a radiopharmaceutical in positron emission tomography. Their students, such as Prof. Trnka, successfully continued their work in the field of carbohydrate chemistry. Also worthy of note were Prof. Vystrčil and Prof. Klinot who focused their research on the field of natural substances, especially triterpenoid compounds.

During the past 30 years, the Department of Organic Chemistry has undergone relatively extensive changes, including in personnel, which resulted in research taking several new directions. This includes areas such as the **targeted delivery of biologically active substances** (Dr. Baszczyński), **cyclodextrines and supramolecular chemistry** (Assoc. Prof. Jindřich), **catalysis for organic synthesis** (Prof. Kotora), **organic synthesis of natural compounds** (Dr. E. Matoušová), **biotransformation** (Dr. Míšek), **radiopharmaceuticals and phytoremediation** (Assoc. Prof. Smrček) and **organocatalysis** (Assoc. Prof. Veselý). The Department also houses the Joint Laboratory of Bioorganic and Medicinal Chemistry of Nucleic Acids Shared by IOCB and Charles University (Prof. Hocek).

## Scientific Focus

The newly founded group of Dr. Baszczyński is focused on basic research in the field of medicinal chemistry. The development of new self-immolative couplings for the targeted drug delivery of prodrugs is a major area of activity. The study of these phosphate-based couplings involves the preparation, monitoring, and optimisation of coupling disintegration mechanisms. Optimised couplings will be used for the targeted delivery of therapeutics. A secondary goal is the development of new biologically active substances and fluorescent probes.

The group of Assoc. Prof. Jindřich works in the field of supramolecular chemistry and mainly deals with issues in two areas where non-covalent interactions are important: a) the development of new methods to synthesise cyclodextrin derivatives and their use in practical applications; b) the use of a strong electrostatic interaction to bind active ingredients to solid carriers. Some of the projects currently underway include: a) supramolecular systems based on cyclodextrin derivatives bound electrostatically to a solid surface; b) cyclodextrin-based chemosensors with fluorophore; c) a new method of solid phase peptide synthesis using electrostatic bonding; d) cyclodextrin derivatives containing covalently bonded volatiles and the study of their release; e) synthesis of cyclodextrin derivatives suitable for organocatalysis.

The group of Prof. Kotora develops various catalytic methods for use in the organic synthesis of various classes of compounds. One area of research is the development of new organocatalysts and chiral ligands and their application in the enantioselective synthesis of natural or bioactive compounds. Another area is the catalysis with complex compounds of transition metals in the transformation of alkynes and similar compounds. This portfolio includes cyclotrimerisation reactions and selective activation of low-reactive C-C bonds. The aim is to develop alternative methods to prepare various types of 2D and 3D polyaromatic compounds.

The task of Dr. Matoušová's group is to develop new methods for preparing compounds containing difficult-to-obtain structural motives, such as quaternary carbon centres, in an easier and more economical way. To increase the cost-effectiveness of the syntheses, they use tandem



reactions that allow two or more steps to be performed in one synthetic operation. The developed methods are used to synthesise alkaloids from the *Amaryllidaceae* family, characterised by antitumor, antiviral and anti-inflammatory effects, as well as structurally similar polycyclic compounds with potential biological activity.

The research in Dr. Míšek's laboratory lies at the boundary between chemistry and biology. On the one hand, synthetic chemistry is used to create new molecular tools that enable the observation of important molecular biological processes. On the other hand, the robustness of some biological systems (e.g. enzymes) is used to prepare new compounds that are difficult to create using classical synthetic chemistry methods.

The group of Assoc. Prof. Smrček studies the environmental impact of biologically active organic compounds – pharmaceuticals and engineered nanoparticles. Research is based on the experimental study of the interaction of organic compounds with plants in terms of drug uptake by plant root systems, translocation of xenobiotics to the above-ground part of plants and their possible biotransformation by the enzyme system. The results are used to assess the contamination of ecosystems and food chains as a possible source of health and developmental problems of higher organisms. Widely used drugs and their metabolites characterised by penetration into surface water such as analgesics, antidiabetics, X-ray contrast agents and antidepressants are investigated.

The group of Assoc. Prof. Veselý studies the use of organocatalytic approaches in chemical transformations, involving the formation of C-C and C-N bonds leading to the enantioselective formation of functionalised molecules. New methods have been developed to prepare chiral amines using readily available synthetic building blocks and a cascade reaction providing functionalised spirocyclic compounds. The group uses both organocatalysis and combined catalysis (catalysis by palladium complexes and secondary amines). These methods are used to prepare enantiomerically enriched compounds and have been used to synthesise biologically active compounds. In addition to studying new synthetic methods, the group also develops new organic catalysts, low-molecular-weight compounds derived from carbohydrates and amino acids.

The group of Prof. Hocek (Joint Laboratory of Bioorganic and Medicinal Chemistry of Nucleic Acids Shared by IOCB and Charles University) deals with the synthesis and medicinal chemistry of modified nucleosides, especially substituted or fused deazapurine nucleosides with cytostatic activity, and the synthesis of nucleoside triphosphates with modified bases and their use in enzymatic synthesis of modified nucleic acids with applications in diagnostics or chemical biology.

#### Other Activities of the Department

In addition to offering basic organic chemistry courses for undergraduates, the Department of Organic Chemistry is also the guarantor for the master's and doctoral programmes encompassing all areas of organic chemistry. Department members also take part in additional educational activities, such as the Chemistry Olympiad organised partly by Assoc. Prof. Veselý.

#### Major Achievements

The quality of the staff and research is evidenced not only by publications in top scientific journals and grants received from domestic or foreign sources, but also by the awards that both Department members and students have received for their scientific activity and excellence. Notable among many are: an Experientia Foundation start-up grant to Dr. Baszczyński (2019) and the scholarship of the Experientia Foundation for a postdoctoral stay at Columbia University, USA to Dr. Eva Bednářová (2019). In 2013, Prof. Kotora received the Rudolf Lukeš Award from the Czech Chemical Society (ČSCH) for results of high international significance. In the past few years, the PRIMUS university grant programme has awarded grants to Dr. Matoušová, Dr. Míšek and Dr. Rýček. We should also mention that a former Department member, Prof. Roithová, was a successful recipient of two ERC grants.

#### Most Important Publications in the Past Decade

**FREJKA, David, ULČ, Jan, KANTCHEV, Eric A.B., CÍSAŘOVÁ, Ivana and KOTORA, Martin.** Catalyst-counterion Controlled, Regioselective C–C Bond Cleavage in 1-Azabiphenylene: Synthesis of Selectively Substituted Benzoisoquinolines. *ACS Catalysis*. 2018, **8**(11), 10290–10299. ISSN 2155-5435.





**HOCEK, Michal.** Enzymatic Synthesis of Base-Functionalized Nucleic Acids for Sensing, Cross-linking, and Modulation of Protein–DNA Binding and Transcription. *Account of Chemical Research*. 2019, **52**(6), 1730–1737. ISSN 0001-4842.

**MIKUŠEK, Jiří, JANSA, Petr, JAGTAP, Pratap P., VAŠÍČEK, Tomáš, CÍSAŘOVÁ, Ivana and MATOUŠOVÁ, Eliška.** Enantioselective Synthesis of All-Carbon Quaternary Centers Structurally Related to Amaryllidaceae Alkaloids. *Chemistry – A European Journal*. 2018, **24**(40), 10069–10072. ISSN 0947-6539.

**NOSEK, Vladimír and MÍŠEK, Jiří.** Chemoenzymatic Deracemization of Chiral Sulfoxides. *Angewandte Chemie International Edition*. 2018, **57**(31), 9849–9852. ISSN 1433-7851.

**PUTATUNDA, Salil, ALEGRE-REQUENA, Juan V., MEAZZA, Marta, FRANC, Michael, ROHAL'OVÁ, Dominika, VEMURI, Pooja, CÍSAŘOVÁ, Ivana, HERRERA, Raquel P., RIOS, Ramon and VESELÝ, Jan.** Proline Bulky Substituents Consecutively Act as Steric Hindrances and Directing Groups in a Michael/Conia-Ene Cascade Reaction under Synergistic Catalysis. *Chemical Science*. 2019, **10**, 4107–4115. ISSN 2041-6539.

**SMRČEK, Stanislav, KRMELOVÁ, Tereza, PŠONDROVÁ, Šárka, NYKL, Pavel, KOZEMPEL, Ján and VLK, Martin.** Environmental Aspects of Radiopharmaceuticals: Extraction and translocation of Ra-223 in Plants. *International Journal of Environmental Engineering*. 2017, **4**(1), 50–53. ISSN 2374-1724.

**TICHÁ, Iveta C., HYBELBAUEROVÁ, Simona and JINDŘICH, Jindřich.** New  $\alpha$ - and  $\beta$ -Cyclodextrin Derivatives with Cinchona Alkaloids Used in Asymmetric Organocatalytic Reactions. *Beilstein Journal of Organic Chemistry*. 2019, **15**(1), 830–839. ISSN 1860-5397.

In 2019, Ondřej Baszczyński received an Experientia Foundation start-up grant enabling him to set up his own laboratory at the Department of Organic Chemistry. (photo: Experientia Foundation archive)



# Department of Teaching and Didactics of Chemistry

## History of the Department

The preparation of future science teachers in secondary schools has always been part of studies at the Faculty of Science. But the teaching of natural sciences as a separate scientific discipline was first introduced in the 1960s, and by 1972 the FSc CU established a department that focused on teaching in addition to the methodology and history of natural sciences, specifically the teaching of biology and chemistry. In 1988, independent departments dedicated to the teaching of natural sciences were established, one of which was the Department of Teaching and Didactics of Chemistry. It is the only department specialising in the teaching of chemistry in Czechia.

## Scientific Focus in Chemistry Education

- Analysis of educational systems and curricular documents in the CR and abroad
- Concept and preparation of study and methodological materials and their verification in practice
- Concept, creation and verification of new laboratory tasks using PC-assisted instrumentation (dataloggers, modular spectrophotometers)
- Activation and cooperative methods, project teaching, research-oriented teaching of chemistry
- Statistical assessment and analysis of questionnaire surveys at secondary schools and results of admission examinations in chemistry at the FSc CU
- Use of ICT to teach chemistry, creation and verification of multimedia teaching resources, digitisation of chemical experiments, 3D printing and imaging
- Teaching tasks in chemistry education as a means of mastering the curriculum and indicators for evaluating learning in chemistry

## Scientific Focus in Chemistry Research

- Xenobiochemistry, computer modelling of biomolecules, isolation of substances from natural materials, NMR and SE(R)RS spectroscopy
- Study of the preparation and properties of Ag nanoparticle systems

## Other Activities of the Department

- Preparation of future chemistry teachers in the bachelor's, master's and doctoral study programmes
- Guarantor of bachelor's study programmes in chemistry with the focus on education (single major and double major), follow-up master's study programmes for teaching chemistry at secondary schools (single major and double major), and the Didactics of Chemistry doctoral programme
- Organisation and implementation of additional teaching courses for graduates in various fields of chemistry, lifelong learning in chemistry, the Journey to the Depths of Chemistry Study event for secondary school teachers and students, and the organisation of preparatory courses in chemistry for secondary school students and graduates interested in enrolling at the FSc CU
- Preparation and execution of a system of courses addressing current issues of chemistry education as part of lifelong learning for chemistry teachers
- Organisation of laboratory equipment training for primary and secondary school students, long-distance education of talented secondary school students, organisation of science camps for primary school pupils
- Expert and research cooperation in chemistry education with institutions in Czechia and abroad
- Recipient of numerous grants and projects supported with ESF funds, two 7<sup>th</sup> RP EU projects – ESTABLISH and TEMI, cooperation with foreign universities and international organisations
- Use of modern equipment as a means for teaching and didactic research, e.g. 3D stereo projection equipment, set of 3D printers, eye-tracking and other tools and equipment that improve chemistry education

Some Department members are involved in research in the areas of biochemistry (xenobiochemistry, computer modelling of biomolecules), physical chemistry (SE(R)RS spectroscopy, study of Ag nanoparticle systems) and organic chemistry (NMR spectroscopy, isolation of substances from natural materials).

Department members are members of important international organisations – IUPAC, IOSTE (International Organisation for Science and Technology Education), ESERA (European Science Education Research Association) and the EuChemS Division of Chemical Education.



Experimental teaching at the FSc CU has always been part of preparing future chemistry teachers and courses for chemistry teachers at primary and secondary schools and their students. (photo: Petr Jan Juračka)

## Major Achievements

### In the Area of Chemistry Education

- Chapters in foreign monographs focused on science education
- Articles in journals and reviewed proceedings of national and international conferences
- Publications intended for primary and secondary school teachers created as part of projects supported with 7th RV EU and ESF funds
- Sets of new tasks for laboratory exercises using instrumental techniques, exploration of the possible uses of data loggers and modern measuring instruments in teaching at secondary schools
- Study texts and sets of exercises for various levels of chemistry education, including lifelong learning
- Multimedia teaching programmes, educational programmes prepared with Macromedia flash
- Distance courses and support for on-line lessons intended for chemistry teachers, students in teaching fields and secondary school students

### In the Area of Chemistry Research

- Mapping the metabolism of carcinogenic Sudan I azo dye in humans
- Confirmation of CYP1A1 expression in human liver tissue
- Proposal for implementing multistage preparation of Ag nanoparticle colloids
- Identification of suitable spacer molecules to prevent denaturation of porphyrin molecules during adsorption to Ag surfaces
- Measurement of SE(R)RS spectra

## Most Important Publications in the Past Decade

**HÁJKOVÁ, Zdeňka, FEJFAR, Antonín and ŠMEJKAL, Petr.** Two Simple Classroom Demonstrations for Scanning Probe Microscopy Based on a Macroscopic Analogy. *J. Chem. Educ.* 2013, **90**(3), 361. ISSN 0021-9584.

**JANOŠKOVÁ, Svatava, HÁK, Tomáš and MOLDAN, Bedřich.** Global SDGs Assessments: Helping or Confusing Indicators? *Sustainability.* 2018, **10**(5), 1. ISSN 2071-1050.

**MACIEJOWSKA, Iwona, BYERS, Bill, ČTRNÁCTOVÁ, Hana et al.** *A Guidebook of Good Practice for the Pre-Service Training of Chemistry Teachers.* Krakow: Jagiellonian University in Krakow (Drukarnia Scriptor), 2015. 280 s. ISBN 978-83-943754-0-9.

**STUHLÍKOVÁ, Iva, JANÍK, Tomáš, ČTRNÁCTOVÁ, Hana et al.** *Oborové didaktiky – vývoj – stav – perspektivy. (Didactics in the Fields – Development – State – Perspectives)* Brno: Masarykova univerzita, 2015. 466 pp. ISBN 978-80-210-7769-0.

**TEPLÁ, Milada and KLÍMOVÁ, Helena.** Photosynthesis in Dynamic Animations. *J. Chem. Educ.* 2014, **91**(1), 149. ISSN 0021-9584.

**TEPLÁ, Milada and KLÍMOVÁ, Helena.** Using Adobe Flash Animations of Electron Transport Chain to Teach and Learn Biochemistry. *Biochemistry and Molecular Biology Education.* 2015, **43**(4), 294. ISSN 1539-3429.





An aerial photograph of a city, likely Edinburgh, Scotland, featuring a prominent building with a large, ornate roof and a church with two tall spires in the background. The entire image is overlaid with a semi-transparent blue filter. The word "Geography" is written in a white, sans-serif font in the upper right quadrant.

# Geography

# Department of Applied Geoinformatics and Cartography

## History of the Department

In its current form, the Department of Applied Geoinformatics and Cartography was established at the Faculty of Science in 2003. Its activities continue the work of the Department of Cartography and Geoinformatics (1991–2002) and the Department of Cartography and Physical Geography (1953–1991). Major figures that contributed to the development of cartography at Charles University include Prof. Václav Švampera, Prof. Bedřich Šalamon, Prof. Karel Kuchař, and Assoc. Prof. Ludvík Mucha. Assoc. Prof. Richard Čapek, and Assoc. Prof. Dalibor Moravec who headed the Department of Cartography and Geoinformatics between 1991 and 2003. Since 2003, the Department of Applied Geoinformatics and Cartography has been led, in turn, by Assoc. Prof. Jan Kolář, Markéta Potůčková, PhD., Assoc. Prof. Přemysl Štych, and Lucie Kupková, PhD.

## Scientific Focus

The Department of Applied Geoinformatics and Cartography represents an important domestic institution for education and research in the fields of geoinformatics/GIS (including geodatabase systems and modern methods for presenting and distributing geographical information), cartography and remote sensing. It belongs to the leading Czech and international institutions in the field of remote sensing.

In its field of research, the Department has long been working with other faculty, domestic and foreign institutions, to develop and use geoinformation technologies in many research fields. The primary areas of interest are:

**Data acquisition by remote sensing** (especially by using UAV and laboratory spectroscopy), data processing and analysis with specialisation in image and laboratory spectroscopy, aerial laser scanning and digital photogrammetry.

**Application of remote sensing to assess landscape changes** (land cover change), vegetation analyses (forest ecosystems, relict Krkonoše tundra), urban environment development (suburbanisation), mapping of rock formations, monitoring of natural disasters and risks (e.g. also in connection with climate change), and surface mapping of solar system bodies.

**Thematic, historical, digital and mathematical cartography**, creation and evaluation of cartographic products, interactive cartographic products, cartographic materials on the Internet, computational geometry in cartography, mapping and large-scale mapping methodology, geodetic calculations and measurement or software development for automated cartographic generalisation.

**2D and 3D visualisation of spatial information**, creation of spatial landscape models (disappeared Czech landscapes) and 3D photorealistic models of landscapes, buildings, interiors and objects (towns or buildings that no longer exist, information systems in buildings, model of the Albertov Campus and more).

## Other Activities of the Department

The Department participates in teaching bachelor's study programmes in Geography and Cartography, Physical Geography and Geoinformatics, and Social Geography and Geoinformatics. It also provides lectures for the master's programmes in Cartography and Geoinformatics, Landscape and Society, and the doctoral programme in Cartography, Geoinformatics and Remote Sensing. The Department trains graduates to serve as geoinformatics and cartographic experts in state institutions, the private sector, as well as in research.

The Department is actively involved in major Czech and international research and educational projects. It works closely with the European Space Agency and NASA in organising international remote sensing courses (Trans-Atlantic Training – TAT, since 2013) and participates in various research projects. Department members are actively involved in the work of major international organisations, such as EuroSDR (European Spatial Data Research), SCERIN (an international group that conducts research into changes in use of landscapes and forest ecosystems in South, Central and Eastern Europe), the IGU Commission on Land Use Land Cover Change (a commission under the auspices of the International Geographical Union for the study of long-term changes in land use), and the Eurosite Remote Sensing Support Group for Conservation Practitioners (a group of experts supporting the use of remote sensing to protect the environment).

The Department has also long been cooperating with domestic organisations (especially the KRNAP, Šumava and Bohemian Switzerland national parks), and is actively involved in international and domestic activities within the Copernicus programme (a remote sensing programme coordinated and managed by the European Union, specifically the European Commission, in cooperation with the European Space Agency).

### Major Achievements

Assoc. Prof. Jan Kolář is an important figure and a very active populariser of cosmonautics and remote sensing. He has received numerous awards, and an asteroid was named 74370 KOLÁŘJAN in his honour by the International Astronomical Union for his contribution to the European space research (2014). He was named the Czech Astronautics Man of the Year by the Subcommittee on Science, Research, Aviation and Astronautics of the Chamber of Deputies of the Parliament of the Czech Republic (2011) and was also recognised at the World Aviation and Space Governance Forum (2010).

Department members have contributed to several publications that have won distinguished awards: Lucie Kupková and Přemysl Štych contributed to: Semotánová, Eva et al. *Academic Atlas of Czech History*. Prague: Academia, 2014. 590 pages. ISBN 978-80-200-2182-3.

Magnesia Litera 2015 Prize in the publishing event of the year category: Collective. *Atlas of the Czech Landscape*. Prague: Ministry of the Environment of the Czech Republic, Silva Tarouca Research Institute for Landscape and Ornamental Gardening, 2009. 332 pages. ISBN 978-80-85116-59-5.

Several awards: e.g. The Map of the Year 2010, The Winning Work in the category of regional and national atlases at the 25<sup>th</sup> World Congress of Cartography in Paris in 2011.

### Most Important Publications in the Past Decade

**BAYER, Tomáš**. Advanced methods for the estimation of an unknown projection from a map. *GeoInformatica*. 2016, **20**(2), 241–284. ISSN 1384-6175.

BIČÍK, Ivan, **KUPKOVÁ, Lucie**, JELEČEK, Leoš, KABRDA, Jan, **ŠTYCH, Přemysl**, JANOUŠEK, Zdeněk and WINKLEROVÁ, Jana. *Land Use Changes in the Czech Republic 1845–2010, Socio-Economic Driving Forces*. Cham: Springer International Publishing, 2015. 215 pages. ISBN 978-3-319-17671-0.

BRAGINA, Eugenia V., IVES, Anthony R., PIDGEON, Anna M., BALČIAUSKAS, Linas, CSÁNYI, Sándor, KHOYETSKYY, Pavlo, KYSUCKÁ, Katarina, LIESKOVSKY, Juraj, OZOLINS, Janis, RANDVEER, Tiit, **ŠTYCH, Přemysl**, VOLOKH, Anatoliy, ZHJELEV, Chavdar, ZIÓLKOWSKA, Elzbieta, RADELOFF and Volker C. Wildlife population changes across Eastern

Europe after the collapse of socialism. *Frontiers in Ecology and the Environment*. 2018, **16**(2), 77–81. ISSN 1540-9295.

HVĚZDOVÁ, Martina, KOSUBOVÁ, Petra, KOŠÍKOVÁ, Monika, BRANDSTÄTTER-SCHERR, Kerstin, ŠIMEK, Zdeněk, **BRODSKÝ, Lukáš**, ŠUDOMA, Marek, ŠKULCOVÁ, Lucia, SÁŇKA, Milan, SVOBODOVÁ, Markéta, KRKOŠKOVÁ, Lucia, VAŠÍČKOVÁ, Jana, NEUWIRTHOVÁ, Natália, BIELSKÁ, Lucie and HOFMAN, Jakub. Currently and recently used pesticides in Central European arable soils. *Science of the Total Environment*. 2018, **613**, 361–370. ISSN 0048-9697.

**KUPKOVÁ, Lucie**, **POTŮČKOVÁ, Markéta**, LHOTÁKOVÁ, Zuzana and ALBRECHTOVÁ, Jana. Forest cover and disturbance changes, and their driving forces: A case study in the Ore Mountains, Czechia, heavily affected by anthropogenic acidic pollution in the second half of the 20th century. *Environmental Research Letters*. 2018, **13**(9). ISSN 1748-9326.

MANAKOS, Ioannis, TOMASZEWSKA, Monika, GKINIS, Ioannis, BROVKINA, Olga, FILCHEV, Lachezar, GENC, Levente, GITAS, Ioannis Z., HALABUK, Andrej, INAPULAT, Melis, IRIMESCU, Anisoara, JELEV, Georgi, KARANTZALOS, Konstantinos, KATAGIS, Thomas, **KUPKOVÁ, Lucie**, LAVRENIUK, Mykola, MESARÓŠ, Minučer, MIHAILESCU, Denis, NITA, Mihai, RUSNAK, Tomas, **ŠTYCH, Přemysl**, ZEMEK, František, ALBRECHTOVÁ, Jana and CAMPBELL, Petya. Comparison of Global and Continental Land Cover Products for Selected Study Areas in South Central and Eastern European Region. *Remote Sensing*. 2018, **10**(12), 1967. ISSN 0034-4257.

**POTŮČKOVÁ, Markéta**, ČERVENÁ, Lucie, **KUPKOVÁ, Lucie**, LHOTÁKOVÁ, Zuzana, LUKEŠ, Petr, HANUŠ, Jan, NOVOTNÝ, Jan and ALBRECHTOVÁ, Jana. Comparison of Reflectance Measurements Acquired with a Contact Probe and an Integration Sphere: Implications for the Spectral Properties of Vegetation at a Leaf Level. *Sensors*. 2016, **16**(11), 1801. ISSN 1687-725X.





The Department of Applied Geoinformatics and Cartography is a major Czech educational and research institution in the fields of geoinformatics/GIS, cartography and remote sensing of the Earth. (photo: Petr Jan Juračka)



# Department of Demography and Geodemography

## History of the Department

The founder of Czech demography, a prominent Czech physician and anthropologist Prof. Jindřich Matiegka (1862–1941), the second Dean of the Faculty of Science (1922–1923) and later the Rector of the University (1929–1930) undoubtedly belongs to the most important personages in the entire existence of demography at Charles University. The development of demography at Albertov and in Czechoslovakia in the 1930s and 1940s was largely accredited to the professional and organisational efforts of Assoc. Prof. Antonín Boháč (1882–1950), a colleague of the Czech Presidents T. G. Masaryk and E. Beneš, participant in the Versailles Peace Conference (1919), main organiser of the 1921 and 1930 censuses, and acting Vice-President of the State Statistical Office (1939–1941). He taught demography at the Faculty of Science during 1929–1936 and 1946–1948. During his tenure, the Czechoslovak demography and population statistics achieved their greatest international fame and recognition. Boháč's teaching work in demography was followed by Prof. Jaromír Korčák, who began teaching demography in 1947 at the Institute founded by Prof. Matiegka. When he became the Head of the Department of Economic Geography in 1950, he started to teach demography in a two-semester course intended for geography students. In 1964, Prof. Korčák was followed by Prof. Zdeněk Pavlík (born 1931), a statistician and demographer, who later founded the Department of Demography and Geodemography. He was also one of the co-founders of the Czechoslovak (today Czech) Demographic Society and its long-term president, as well as a founding member of the European Association for Population Studies and its first vice-president. Prof. Pavlík played a key role in training an entire generation of Czech and Slovak demographers and geographers. Under his leadership, Czechoslovak demography became internationally recognized, especially in the 1980s and 1990s, when it functioned as a major link between the Eastern European and Western schools of demography. Another important Czech demographer and population statistician was Milan Kučera, who worked and taught at the Department throughout the 1990s. He was the former Head of the Section (1968–1969), Head of the Census Department and Head of the Statistical Survey Department of the Czech Statistical Office, co-founder of the internationally recognised Czechoslovak School of Population Forecasting, which significantly contributed to

the success of the Czechoslovak censuses in 1970 and 1980, as well as subsequent microcensuses and other statistical surveys of that time.

## Scientific Focus

After its founding in 1990, the Department continued in the demographic teaching and research tradition of the Institute for Anthropology and Demography. In the global context, the Institute had an entirely unique position and its founding in 1897 marks the rise of one of the oldest institutions in the field. From the academic year 1899–1900, the Institute also taught demography, which makes it one of the pioneers of education in the field. The current Demography Department at Albertov continued to develop in close association with geography.

Demographic research at the Department is currently concentrated into five research centres, i.e. **the study of survival factors and data analysis, population forecasting and applied demography, fertility study, historical demography, and development demography.**

## Other Activities of the Department

The unique international position of the Department stems from the fact that it is one of the few European educational institutions that provide courses at all three levels of tertiary education. The Department's study programmes and specialisations are fully accredited in both Czech and English, and the master's and doctoral programmes have long been taught in both of these languages. The Department is also widely known for organising international summer schools and courses in the field, both at home and abroad, which have been run in close cooperation with the UN Population Fund (UNFPA) in the past decade.

The educational and research activity of the Department continues to develop successfully. At the end of the 2018–2019 academic year, 15 faculty members taught a total of 157 demography students, including 15 foreign students from nine different countries across three continents. Courses were offered in three fields of study: a bachelor's degree in Demography with specialisations in Demography with Economics, Social Geography or Sociology, and a master's or doctoral degree in Demography.





The Department of Demography and Geodemography is one of the few European demographic educational institutions that provide teaching at all three levels of tertiary education. (photo: Petr Jan Juračka)

Two more specialisations were added to the undergraduate program of Demography with History and Public and Social Policy in the 2019–2020 academic year.

### Major Achievements

The Department maintains widespread international contacts not only in teaching, but also in basic and applied research, e.g. it has been a member of Population Europe: The European Population Partnership demographic institutions for many years. It is a UNFPA implementation partner for Eastern Europe and Central Asia and has long participated in the Erasmus+ student and teacher exchange, currently working with eleven universities and scientific institutions in nine countries in Europe and Asia.

Foreign guests, demographers and experts in other related fields regularly visit and lecture at the Department. The Department faculty are engaged in domestic and international teaching and research. They participate in national and international demographic and other professional societies, regularly attend scientific conferences and symposia,

work in professional committees at home and abroad (e.g. for pension reform, family policy, assisted reproduction), sit on editorial boards of professional journals, etc.

In October 2014, Prof. Zdeněk Pavlík received a silver medal from the City of Prague as special recognition of his scientific work and contribution to the international fame of the city.

### Most Important Publications

**BURCIN, Boris, FIALOVÁ, Ludmila, RYCHTAŘÍKOVÁ, Jitka et al.** *Demografická situace České republiky: proměny a kontexty. (Demographic Situation of the Czech Republic: Changes and Contexts)* Prague: Sociologické nakladatelství SLON, 2011. 238 pages. ISBN 978-80-7419-024-7. The publication provides a demographic analysis of population development since the establishment of an independent Czech Republic. Emphasis is put on characterising current trends, including causes and consequences.

**HULÍKOVÁ, Klára and KURTINOVÁ, Olga.** *Lexis in Demography.* Cham: Springer International Publishing. Springer Briefs in Population Studies, 2018. 89 pages. ISBN 978-3-319-67992-1. Published by a prestigious publishing house, this publication explains demographic topics to the broader professional public

**KUČERA, Milan.** *Populace České republiky 1918–1991. (Population of the Czech Republic 1918–1991)* Acta Demographica XII. Prague: Czech Demographic Society and the Sociological Institute of the Czech Academy of Sciences, 1994. 198 pages. ISBN 80-901674-7-0. The publication gives a clear and professional overview of population processes in the Czech lands from the founding of Czechoslovakia almost up to its dissolution.

**KUČERA, Tomáš, KUČEROVÁ, Olga V., OPARA, Oksana and SCHAICH, Eberhard,** eds. *New Demographic Faces of Europe.* Heidelberg: Springer Verlag, 2000. 420 pages. ISBN 3-540-67801-8. The publication summarised population development in individual countries of the region of Central and Eastern Europe, including Austria and unified Germany, after the fall of the Iron Curtain.

**KOCOURKOVÁ, Jiřina and RABUŠIC, Ladislav,** eds. *Sňatek a rodina: zájem soukromý nebo veřejný? (Marriage and Family: Private or Public Interest?)*, Prague: FSc CU, 2006. 158 pages. ISBN 80-86561-93-3. The publication gives a comprehensive description of changes in reproductive behaviour and family policy options based on the attitudes of the Czech public.

**PAVLÍK, Zdeněk, RYCHTAŘÍKOVÁ, Jitka and ŠUBRTOVÁ, Alena.** *Základy demografie (Fundamentals of Demography).* Prague: Academia, 1986. 732 pages. A basic textbook of demography as an independent scientific field.



(photo: Petr Jan Juračka)







# Department of Physical Geography and Geoecology

## History of the Department

The Department continues the legacy of Professor Václav Švambera who ran the Institute of Geography from 1908, first at the Faculty of Arts and later at Albertov from 1913, where he established a good quality geography workplace and founded the State Map Collection of Czechoslovakia. As a physical geographer, he primarily took up hydrography (wrote a monograph on the Congo River) and limnology, where he was the first to carry out the research and mapping of the glacial lakes in the Bohemian Forest. Another key figure in physical geography, Professor Jiří Viktor Daneš, specialised in karst geomorphology and acted as a Czechoslovak diplomat (a consul in Australia) and the Dean of the Faculty of Science. The most notable personage of the latter half of the 20<sup>th</sup> century was Professor Josef Kunský, who contributed to the development of modern geomorphology. Nowadays, the Department is the largest physical geography workplace in Central Europe.

## Scientific Focus

As physical geographers, we explain spatial regularities of changes in the environment, from the landscape to the global scale. The Department conducts basic and applied research in its primary specialisations, which are geomorphology, hydrology, meteorology and climatology, pedology, and landscape ecology. In its lectures and research, the Department uses three laboratories (the Laboratory of Physical Geography, Laboratory of Dendrochronology, and the Laboratory of Ecohydrology), an extensive hydrological measuring network, geophysical survey instruments and drones equipped with various sensors. It also operates two automated climate stations and a number of hydrological stations in Peru and Kyrgyzstan.

In addition to research focusing on Czechia, academics and students at the Department of Physical Geography and Geoecology also focus research on mountain regions (the Alps, Carpathians, Tien Shan, Andes, and the Himalayas) and cold climate regions (the Arctic, Scandinavia and Antarctica). Each year, results of their basic research are published in prestigious international science journals.

The research is particularly focused on the following topics:

- Natural hazards (landslides, floods, drought, hurricanes) and physical-geographical aspects of their risks to society
- Long-term development of the natural environment and interactions of its physical-geographical components (re-

lief, soil, climate, landscape, hydrological processes) –time scales from dozens to hundreds of thousands of years

- Climate change and its impacts on the natural environment and society
- The interaction of human activity with landscape development (flows of substances in the landscape, migration of organisms)

Examples of the direct application of our research include advances in the knowledge of processes of various natural hazards and risks and in the prognosis of catastrophes and phenomena. The results of our applied research are primarily used by organisations, such as river basin state-owned enterprises (hydroecological and fluvial-geomorphological studies), the Ministry of the Environment and the Ministry of Agriculture (landscaping, adaptation measures to deal with drought and water retention in landscape), insurance and reinsurance companies (prediction and impact of extreme phenomena), the Nature Conservation Agency and the National Parks Administration (species mapping, analysis of ecosystem response to climate change).

## Other Activities of the Department

The Department of Physical Geography and Geoecology provides teaching of the Physical Geography and Geoecology master's and doctoral programmes. It also plays a major role in teaching Geography and Cartography, Physical Geography and Geoinformatics (bachelor's study programmes), Geography Oriented at Education (bachelor's and master's programmes), Surface and Groundwater (bachelor's programme), Hydrology and Hydrogeology, Landscape and Society (master's programme).

In its educational activities, the Department places great emphasis on combining theoretical, applied and practical approaches. Courses are taught by both academics and experts with practical experience. Our students attend internship programmes abroad while foreign students stay and study at our Department.

The Department cooperates with the Czech Academy of Sciences (in particular, the Institute of Atmospheric Physics, Institute of Rock Structure and Mechanics and the Institute of Hydrodynamics), other specialised institutions (the Czech Hydrometeorological Institute, Czech Geological Survey, Research Institute for Landscape and Ornamental Horticulture, and the Water Research Institute) as well as a number of foreign universities.



Drones are an important tool for physical geographers to monitor landscapes and natural changes. (photo: Petr Jan Juračka)

Currently, the Department is active in the 6 EU consortium of European universities, where it has established joint field training in physical geography with the University of Heidelberg.

### Major Achievements

The *Donatio Universitatis Carolinae* Award for major contribution to the prestige of Charles University was awarded to Prof. B. Janský in 2019.

The Center of Excellence status re-awarded by the International Consortium on Landslides (ICL) for research into landslides (awardee Prof. V. Vilímek).

Discovery and evaluation of a sedimentary profile providing a record of 30,000 years of natural development in the Krkonoše Mountains (Elbe Valley profile). The profile represents one of the most detailed sedimentary records of Hercynian Central Europe (Prof. Z. Engel).

A new methodology for detecting the rate of temperature changes at different times of the year using a representative set of stations from all over Europe. We were the first to describe areas in Europe during each part of the year where temperatures did not increase between 1961 and 2000 (the "warming holes") (Prof. R. Huth).

A new methodology for evaluating the susceptibility of glacial lake dams to rupture, developed for the Cordillera Blanca Mountains (Peru), held the interest of scientists from different countries and is now used in other areas of the world (Prof. V. Vilímek).

The HEM methodology for monitoring and evaluating the hydromorphological state of watercourses. The HEM methodology represents an original methodological approach for watercourse evaluation, accepted by the Min-

istry of the Environment as a standard tool and is used in water management to monitor the state of watercourses under the Czech and EU legislation (Prof. J. Langhammer).

### Most Important Publications in the Past Decade

**EMMER, Adam** and **VILÍMEK, Vít**. New method for assessing the susceptibility of glacial lakes to outburst floods in the Cordillera Blanca, Peru. *Hydrology and Earth System Sciences*. 2014, **18**, 3461–3479. ISSN 1027-5606.

**ENGEL, Zbyněk**, **NÝVLT, Daniel**, **KŘÍŽEK, Marek**, **TREML, Václav**, **JANKOVSKÁ, Vlasta** and **LISÁ, Lenka**. Sedimentary evidence of landscape and climate history since the end of MIS 3 in the Krkonoše Mountains, Czech Republic. *Quaternary Science Reviews*. 2010, **29**(7–8), 913–927. ISSN 0277-3791.

**JENÍČEK, Michal**, **SEIBERT, Jan**, **ZAPPA, Massimiliano**, **STAUDINGER, Maria** and **JONAS, Tobias**. Importance of maximum snow accumulation for summer low flows in humid catchments. *Hydrology and Earth System Sciences*. 2016, **20**, 859–874. ISSN 1027-5606.

**STRYHAL, Jan** and **HUTH, Radan**. Classifications of winter Euro-Atlantic circulation patterns: an intercomparison of five atmospheric reanalyses. *Journal of Climate*. 2017, **30**, 7847–7861. ISSN 0894-8755.

**SU, Ye**, **LANGHAMMER, Jakub** and **JARSJÖ, Jerker**. Geochemical responses of forested catchments to bark beetle infestation: Evidence from high frequency in-stream electrical conductivity monitoring. *Journal of Hydrology*. 2017, **550**, 635–649. ISSN 0022-1694.

**TREML, Václav** and **VEBLEN, Thomas T.** Does tree growth sensitivity to warming trends vary according to treeline form? *Journal of Biogeography*. 2017, **44**, 1469–1480. ISSN 1365-2699.





(photo: Petr Jan Juračka)







# Department of Social Geography and Regional Development

## History of the Department

Although the Department of Social Geography and Regional Development did not become a separate department until 1990, the history of social geography (previously anthropogeography) at Charles University is considerably longer. Its origins are connected with the establishment of the Institute of Geography in 1891 at Charles University's Faculty of Arts, and with early geographers such as Prof. Viktor Dvorský and Ass. Prof. Julie Moscheles. Professor Václav Švambera, the head of the Institute of Geography from 1908, played a key role in the development of the Department at Albertov (where the Institute moved in 1913) both in terms of its physical construction and as a scientist and educator. He also founded the State Map Collection of Czechoslovakia.

After the division of the Department of Geography into two new departments in 1953, Professor Jaromír Korčák became the first head of the newly established Department of Economic and Regional Geography, which he gradually developed. Under the following lead of Assoc. Prof. Libor Krajiček, Prof. Martin Hampl, Assoc. Prof. Ivan Bičík, Assoc. Prof. Zdeněk Čermák, Prof. Dušan Drbohlav and Prof. Dagmar Dzúrová, the Department has developed into a globally recognised workplace of geography.

## Scientific Focus

There are currently 12 research teams working in the Department:

- Centre for Economic Geography and Regional Development (CEGARR)
- Centre for Geographical and Environmental Education (GEEN)
- Centre for Research on Cities and Regions (CVMR)
- Centre for Research on Regional and Political Geography (REGPOL)
- Centre for Research on Cultural and Historical Geography (KUHIG)
- Leisure Geography Research Centre (GeoVoČ)

- Research Centre for Health, Quality of Life and Lifestyle in Geo-Demographic and Socio-Economic Contexts (GeoQol)
- Geographical Migration Centre (GEOMIGRACE)
- Urban and Regional Laboratory (URRlab)
- Transport Geography Research Center (CeDoG)
- Research Centre for Rural Geography (RURAL)
- Research Centre for Land Use Changes (LUCC Czechia)

## Other Activities of the Department

At the beginning of the academic year 2019/20, the Department had 32 faculty members and 88 PhD students. The faculty members and PhD students regularly publish abroad, sit on editorial boards of prestigious geographic and interdisciplinary journals, participate in establishing public policies, regularly appear in the media, and are involved in popularising activities, such as the Geographical Olympiad and publication of *The Geographic Horizons* magazine. They contribute to international research on topics dealing with the post-socialist transformation and integration of Czechia and Eastern Europe into European and global structures.

The Department offers courses in six master's programmes: Social Geography and Regional Development, Political and Regional Geography, Global Migration and Development Studies, Social Epidemiology, Landscape and Society, and Secondary School Teacher Training in Geography. In addition, it offers three doctoral programmes and cooperates with the other Departments of the Geography Section at the Faculty of Science to provide four undergraduate programmes.

The Department maintains wide international contacts to carry out teaching activities:

a) since 1994 it has cooperated with Dartmouth College, New Hampshire, USA to teach American students about the post-socialist transformation in Czechia, Central and Eastern Europe and their integration into European structures;

b) since 1997 it has worked with Lomonosov Moscow State University to offer lectures in Prague and guided field trips in Czechia for undergraduates of the Moscow Department of World Economic Geography every year;

c) since 2016 it has cooperated with the University of Massachusetts, Lowell, to offer a summer course on issues of migration and immigration in Czechia and the United States;

d) other teaching activities, such as short-term summer schools.

### Major Achievements

In October 2014, Prof. Martin Hampl received a silver medal from the City of Prague for his scientific work that has contributed to the international recognition of the city.

In April 2018, Assoc. Prof. Ivan Bičík was the first foreign laureate to receive a Prof. Kondracki Medal from the University of Warsaw.

Major awards received by students from the Department: Jiří-Jakub Zévl received Dr. Jaroslav Heyrovský Prize, and Dr. Lenka Havelková was awarded Dr. Václav Příhoda Prize for the best Charles University graduates from the Rector of Charles University. Luboš Fendrych won first place in the European Union Laboratory competition for the best diploma thesis on the EU, and Romana Červinková won first place in the CzechTourism contest for the best student research project.

### Most Important Publications

*Atlas krajiny České republiky (Landscape atlas of the Czech Republic, written in Czech)* 2009. Prague: Ministry of the Environment of the Czech Republic. 332 pages. ISBN 978-80-85116-59-5. A national atlas, which was the first comprehensive atlas of Czechia published after 1990, containing 906 maps, 42 in the scale of 1:500 000. The atlas, which is the work of several members of the Department, received numerous awards.

**Dzúrová, Dagmar.** Mortality differentials in the Czech Republic during the post-1989 socio-political transformation. *Health & Place*. 2000, **6**(4), 351–362. ISSN 1353-8292.

**NOVOTNÝ, Josef, HASMAN, Jiří and LEPIČ, Martin.** Contextual factors and motivations affecting rural community sanitation in low-and middle-income countries: A systematic review. *International journal of hygiene and environmental health*. 2018, **221**(2), 121–133. ISSN 1438-4639.

**OUŘEDNÍČEK, Martin.** Differential suburban development in the Prague urban region. *Geografiska Annaler: Series B, Human Geography*. 2007, **89**(2), 111–126. ISSN 0435-3684.

**PAVLÍNEK, Petr.** Global production networks, foreign direct investment, and supplier linkages in the integrated peripheries of the automotive industry. *Economic Geography*. 2018, **94**(2), 141–165. ISSN 0013-0095.

**SPILKOVÁ, Jana, PERLÍN, Radim.** Farmer markets in Czechia: Risks and possibilities. *Journal of Rural Studies*. 2013, **32**(October), 220–229. ISSN 0743-0167.

**SÝKORA, Luděk, Bouzarovski, Stefan.** Multiple transformations: Conceptualising the post-communist urban transition. *Urban Studies*. 2011, **49**(1), 43–60. ISSN 0042-0980.





The Department contributes to international academic research on the post-socialist transformation and integration of Czechia and Eastern Europe into European and global structures. (photo: Petr Jan Juračka)









# Geology

# Laboratories of the Geological Institutes

## History of LGI

The Laboratories of the Geological Institutes (LGI) officially took their present form in 1994 through the merger of the chemical laboratories of the Institute of Geological Sciences (founded in 1964 and focusing predominantly on the processing of rock samples and silicate analysis) with the laboratory of electron microanalysis and the cutting shops of the departments of petrology and mineralogy. This merger resulted in a comprehensive facility capable of adapting to current demand for the creation of data used not only in the geological sciences.

With the increasing quality of the facility's research methods and equipment, new methods of rock study have been adopted in use. In addition to the electron microanalyzer, elemental and trace analysis using spectroscopic methods (AAS, and later ICP-OES and ICP-MS) has become an important part of research, especially for studying the migration of substances in the Earth's spheres.

While the geological section still represents a major part of laboratory work at LGI, it is no longer alone. The necessary updating of modern equipment has reflected the changing needs of scientific disciplines, resulting in newly established laboratory workplaces that operate in parallel with the geological section.

## Scientific Focus

The Laboratories of the Geological Institutes provide laboratory services in the research and development of chemical analysis procedures to analyse natural and man-made materials. LGI equipment and analytical techniques can be used for a broad spectrum of inorganic analyses in geosciences. The quality of measurement and the accuracy of the results is ensured using international and internal reference materials as well as through the participation of the LGI in international laboratory tests.

**Presently, the main scientific focus at LGI includes:**

- Analytical chemistry of geological materials: development of methods and new analytical procedures
- Modern trends in the analysis of natural materials

- Preparation of polished samples and special samples for optical microscopy and SEM analysis
- Preparation of samples and special preparations for in-situ microanalysis (EPMA, LA ICP-MS)
- Application of instrumental methods in geology and the environment
- Validation of new rock reference materials for analysis in geology

## Other Activities of the Laboratory

The Laboratories of the Geological Institutes participate in the education process and are the co-investigators for numerous scientific projects. Currently, LGI participates in the teaching of several subjects: Analytical Practice in Geosciences and the Environment (MG410P06), Application of Instrumental Analysis in Geology (MG410P05), Environmental Change Dating (MG410P07), Analytical Methods in Geochemistry (MG431P99) and Environmental Geology (MO550P27).

LGI provides support for the scientific and educational activities of the Faculty of Science's Geology Section. LGI services are used primarily (but not exclusively) by the geologists of the Faculty of Science, i.e. researchers, students at all levels, and cooperating workplaces at Charles University and other universities. Furthermore, LGI cooperates with state authorities and experts in various fields of medicine, chemistry, archaeology and biology.

Since 2008, LGI has been involved in the G-probe programme, an international effort to test reference materials in geology. The coordinator of the project is Stephen Wilson of the U.S. Geological Survey and the entire programme falls under IAG (International Association of Geoanalysts). Testing includes both natural geological materials and equivalents of natural materials such as synthetic glass or pressed pellets. In recent years, basalt and gabbroid glass have been the predominant materials tested. Assoc. Prof. Ladislav Strnad cooperates in the project on behalf of the laboratories, and analytical techniques consist primarily of laser ablation in combination with ICP-MS.

## Major Achievements

- Development and validation of a detailed separation methodology for Au and PGE with subsequent ICP-MS measurement
- Chemical and isotope characteristics of soils, paleosols and biomass in relation to the study of geochemical archives
- Study of environmental contamination near industrial buildings, study of mobility and forms of metal bonds in the environment (cooperation with ÚGMNZ)
- Chemical and mineralogical characteristics of industrial waste
- Mobility of raw materials; archaeometry of metals and glass of the La Tène period (cooperation with the Czech Academy of Sciences)
- Soil archaeometry near Bronze Age human Settlements (in cooperation with Donau-Universität Krems)

## Major Grants:

- **2018–2020** Mobility of materials and life cycles of artifacts: archaeometry of metals and glass of the La Tène period; GACR 18-20096S (co-investigator; principal investigator A. Danielisová, ARUP)
- **2011–2014** Climate archives in the sedimentary record of the Upper Palaeozoic basins of the Bohemian Massif as a proxy for the reconstruction of climate change; GACR P210/11/1431 (co-investigator; principal investigator S. Opluštil)
- **2007–2010** Growth rhythms as an indicator of the Earth's rotation and climate change in the geological past; GAAV IAA 300130702 (co-investigator; principal investigator A. Galle GÚ AVČR)

## Most Important Publications in the Past Decade

ĎURIŠOVÁ, Jana, ACKERMAN, Lukáš, STRNAD, Ladislav, CHRASTNÝ, Vladislav and BOROVIČKA, Jan. Lead Isotopic Composition in Biogenic Certified Reference Materials

Determined by Different ICP-based Mass Spectrometric Techniques. *Geostandards and Geoanalytical Research*. 2015, **39**, 209–220. ISSN 1751-908X.

SKÁLA, Roman, STRNAD, Ladislav, McCAMMON, Catherine and ČADA, Martin. Moldavites from the Cheb Basin, Czech Republic. *Geochimica et Cosmochimica Acta*. 2009, **73**, 1145–1179. ISSN 0016-7037.

STRNAD, Ladislav, ŠEBEK, Ondřej, FAYADOVÁ, Marie and VRBA, Jan. Determination of Gold in e-Waste Dust Samples and Geological Matrices by ICP-MS after Extraction by an HClO<sub>4</sub>-HBr-HI-Aqua Regia Mixture. *Geostandards and Geoanalytical Research*. 2016, **40**, 257–266. ISSN 1751-908X.

STRNAD, Ladislav, GOLIÁŠ, Viktor, MIHALJEVIČ, Martin and PUDILOVÁ, Marta. The Variscan Kašperské Hory orogenic gold deposit, Bohemian Massif, Czech Republic. *Ore Geology Reviews*. 2012, **48**, 428–441. ISSN 0169-1368.

STRNAD, Ladislav, ETTLER, Vojtěch, MIHALJEVIČ, Martin, HLADIL, Jindřich and CHRASTNÝ, Vladislav. Determination of trace elements in calcite using solution and laser ablation ICP-MS: calibration to SRM NIST glass and USGS MACS carbonate and application to real landfill calcites. *Geostandards and Geoanalytical Research*. 2009, **33**, 347–355. ISSN 1751-908X.

SUCHÁ, Veronika, MIHALJEVIČ, Martin, ETTLER, Vojtěch and STRNAD, Ladislav. The pH-dependent release of platinum group elements (PGEs) from gasoline and diesel fuel catalysts: Implication for weathering in soils. *Journal of Environmental Management*. 2016, **171**, 52–59. ISSN 1095-8630.



# Institute of Geology and Palaeontology

## History of the Institute

The Institute of Geology and Palaeontology of the Faculty of Science, Charles University, is a traditional geoscience centre in Czechia that was established in 1994 by merging two initially independent departments. Its history, however, dates much farther back: the Institute of Geology, which encompassed a palaeontology section, was founded at the same time as the Faculty of Science in 1920. Since then, many globally renowned scientists were affiliated with the Institute, such as Prof. Radim Kettner (1891–1967), Prof. Josef Augusta (1903–1968), and Prof. Ivo Chlupáč (1931–2002). In general, the main research focus of the Institute is reconstructing the evolution of the biosphere and understanding global cycles and changes in the geological past of our planet, and solving the principal questions of the dynamics of geological processes on the Earth's surface and the tectonic, magmatic and metamorphic processes in the Earth's crust. The Institute is also part of the Center of Geosphere Dynamics, one of the University Centres of Excellence (UNCE), has developed a broad collaboration with a number of research institutions, has been involved in many international scientific projects, and regularly organises expeditions to China, Kazakhstan, Turkey, Morocco, the Arctic and North America, including Arctic Canada.

## Scientific Focus

The main priority of the Institute is top-level process-oriented research, carried out by three research teams:

- The Continental Tectonics Group focuses primarily on the mechanisms of magma transport and deformation in the Earth's crust, volcanic processes and magma flow on the Earth's surface, tectonometamorphic development of active continental margins and collisional orogens, mélangé formation and accretionary wedge dynamics, rock magnetism and magnetic fabric of geological bodies.
- The Sedimentary Geology and Palaeoclimatology Group focuses on reconstructing the changes in the Earth's surface in the geological past, in particular sedimentary processes, interpreting cyclicity in the stratigraphic record, evolution of continental palaeoenvironments, high-precision geochronology, interpretation of source areas and sediment geochemistry.
- The Palaeontology and Palaeobiology Group concentrates on biostratigraphy, palaeoecology, taphonomy, analysis of evolutionary changes from fossil assemblages, functional morphology, analysis of biomineralisation and ultramicrostructures of fossil organisms, mass extinctions, and climate changes from palaeopopulation analysis. It also focuses on the interactions between biological, chemical and physical processes as part of extensive synthetic studies and combines palaeontology with geochemistry, event- and eco-stratigraphy, palaeoclimatology, sequence stratigraphy, economic geology and geophysics.

The Institute's research is characterised by a combination of field work and modern quantitative methods. The Institute's laboratory facilities include a range of state-of-the-art instruments for the analysis and three-dimensional imaging of natural materials; the Institute runs four laboratories (Laboratory of Electron Microscopy, Laboratory of Palaeontology, Laboratory of Rock Magnetism, Laboratory of Experimental Tectonics) and manages the Ivo Chlupáč Museum of Earth History.

## Other Activities of the Institute

In the field of education, the Institute offers a full spectrum of geoscience courses at all levels of study from undergraduate to graduate. Subjects range from major classes in Earth Sciences (Physical Geology, Palaeontology, Historical Geology and Stratigraphy, Regional Geology) to advanced classes for higher grades, Physical Geology and Palaeontology laboratory classes, field trips, and specialised courses. The Institute also plays an important role in organising the PhD. study of Geology and the interdisciplinary Geobiology programme.

## Major Achievements

Major awards: the Faculty of Science Dean's Prize for best dissertation (J. Hájna 2013, F. Tomek 2015, L. Laibl 2017), the student's Giant Salamander Award for the best teacher at the Faculty of Science (J. Žák 2010, P. Kraft 2015, P. Čepěk 2017) and the Charles University Rector's Prize (J. Pešek for his book *Tertiary Basins and Lignite Deposits of the Czech Republic*, 2015).

Major grant projects: (i) Late Archean granites: markers of modern-style plate tectonics? (2019–2021; GACR 19-08066S, principal investigator J. Žák); (ii) Benthic ptero-



An ammonite from the Lower Cretaceous of Madagascar from the collections of the Institute of Geology and Palaeontology, Charles University, Prague. (photo: Department of Geology and Palaeontology, Faculty of Science, Charles University)

branches: undervalued indicators of paleoenvironment (2019–2021; GACR 19-06856S, principal investigator P. Kraft); (iii) From past to present: fossil vs. recent marine shelled organisms as a substrate for colonization and bioerosion (2018–2020; GACR 18-05935S, principal investigator K. Holcová); (iv) Fossil assemblages of the Libeň and Letná Formations (Upper Ordovician) (2018–2020; GACR 19-08066S, principal investigator O. Fatka); (v) Sedimentary cyclicity in Upper Palaeozoic basins: understanding the influence of continental processes on cyclic sedimentation (2016–2018; GACR 16-24062S, principal investigator S. Opluštil); (vi) The Pennsylvanian terrestrial habitats and biotas in south-eastern Europe and northern Asia and their relation to tectonics and climate (2010–2014; International Geological Correlation Programme 575, co-investigator: S. Opluštil).

#### Most Important Publications in the Past Decade

The Institute of Geology and Palaeontology is one of the most productive geoscience departments in Czechia, regularly publishing research results in highly-ranked international journals.

**HAJNÁ, Jaroslava, ŽÁK, Jiří** and **DÖRR, Wolfgang**. Time scales and mechanisms of growth of active margins of Gondwana: a model based on detrital zircon ages from the Neoproterozoic to Cambrian Blovice accretionary complex, Bohemian Massif. *Gondwana Research*. 2017, **42**(2), 63–83. ISSN 1342-937X.

**HYŽNÝ, Matúš, KROH, Andreas, ZIEGLER, Alexander, ANKER, Arthur, KOŠŤÁK, Martin, SCHLÖGL, Ján, CULKA,**

**Adam, JAGT, John, FRAAIJE, René, HARZHAUSER, Matthias, VAN BAKEL, Barry and RUMAN, Andrej**. Comprehensive analysis and reinterpretation of Cenozoic mesofossils reveals ancient origin of the snapping claw of alpheid shrimps. *Scientific Reports*. 2017, **7**, 4076. ISSN 2045-2322.

**KRAFT, Petr and KVAČEK, Zlatko**. Where the lycophytes come from? – A piece of the story from the Silurian of peri-Gondwana. *Gondwana Research*. 2017, **45**(5), 180–190. ISSN 1342-937X.

**LAIBL, Lukáš, ESTEVE, Jorge and FATKA, Oldřich**. Giant postembryonic stages of *Hydrocephalus* and *Eccaparaoxides* and the origin of lecithotrophy in Cambrian trilobites. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 2017, **470**(3), 109–115. ISSN 0031-0182.

**OPLUŠTIL, Stanislav, SCHMITZ, Mark, CLEAL, Christopher and MARTÍNEK, Karel**. A review of the Middle-Late Pennsylvanian west European regional substages and floral biozones, and their correlation to the Global Time Scale based on new U–Pb ages. *Earth-Science Reviews*. 2016, **154**(3), 301–335. ISSN 0012-8252.

**SCHEINER, Filip, HOLCOVÁ, Katarína, MILOVSKÝ, Rastislava, KUHNERT, Henning**. Temperature and isotopic composition of seawater in the epicontinental sea (Central Paratethys) during the Middle Miocene Climate Transition based on Mg/Ca,  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  from foraminiferal tests. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 2018, **495**(4), 60–71. ISSN 0031-0182.

# Institute of Geochemistry, Mineralogy and Mineral Resources

## History of the Institute

The Institute was established in 1994 with the merger of the Department of Mineralogy, Geochemistry and Crystallography and the greater part of the Department of Economic Geology. The Department of Mineralogy, Geochemistry and Crystallography was established in 1952 by renaming the Institute of Mineralogy, the origins of which date back to 1846 when three separate institutes were set up at the Prague Faculty of Arts to study mineralogy, botany and zoology. Major personages that were involved in developing the Institute include Professor of Mineralogy František Slavík (1876–1957), Dean of Faculty of Science (1924–1925) and Rector of Charles University (1937–1938), who restored the Institute after the Second World War when it had lost staff members and was damaged, and Professor Vladimír Bouška (1933–2000) who established Geochemistry as a separate discipline (since 1974/75).

The Department of Economic Geology was also founded in 1952. However, this act was merely an official confirmation of the situation that arose upon the arrival of Professor Jaromír Koutek (1902–1983) and the development of his teaching activities in applied geological disciplines. Charles University was the first to establish a Department of Mining Geology thanks to J. T. A. Peithner (1727–1792). Peithner's "*Academia Metallurgica*", established at Charles University in 1762, was the historical forerunner of the idea of creating a modern Department of Economic Geology.

## Scientific Focus

- Biogeochemical cycles of elements focusing on pollutants emitted from anthropogenic and natural sources of contamination
- Isotopic geochemistry (Ag, C, Cu, H, Hg, N, O, Pb, S, Tl, U, Zn) and contamination tracking
- Carbon geochemistry (spectroscopy, structural properties, mineralogy, geochemistry)
- Application of Raman spectroscopy in microbiology and exobiology
- Metallogenesis of deposits (especially gold deposits)
- Fluid inclusions, paleofluids, hydrothermal geochemistry
- Geology of industrial minerals and rocks including building materials

- Provenance, properties and durability of natural stone and other building materials from historical buildings
- Study of natural radioactivity – research into radioactive minerals and water
- Geochemistry of HPT mineral associations in basic and ultrabasic rocks

## Other Activities of the Institute

The Institute provides instruction in the areas of geochemistry, mineralogy and mineral resources and organises regular field courses (in geochemistry and economic geology) and excursions. In addition to regular lectures and training, there is also the Mineralogy and Mineral Resource Seminar and the Geochemical Seminar which feature leading Czech and foreign researchers. The Institute runs several laboratories (e.g. Laboratory of Stable and Radiogenic Isotopes, Laboratory of X-ray Powder Diffraction, Raman Spectrometry Laboratory and the Mortar and Concrete Body Testing Laboratory) and maintains the quite extensive mineralogical collection of the Mineralogy Museum (more than 22,000 items).

The staff and students carry out research work in various parts of Czechia and, increasingly, abroad as well (in more than 15 countries over the past 5 years, including Germany, Macedonia, Israel, Namibia, Botswana, Zambia and Brazil). Scientific cooperation of the Institute with foreign institutions (ETH Zurich, University of Vienna, Friedrich Schiller University of Jena, Hebrew University of Jerusalem, Paris University and many others) is therefore extensive. The Institute also coordinates the Centre for Geosphere Dynamics within the University Centres of Excellence (UNCE) programme.

## Major Achievements

### New Type of Arsenic Biomineralization In Reducing Soil Environments

Our study of wetland soils with naturally increased arsenic concentration by X-ray absorption spectroscopy using synchrotron radiation showed that in a reducing environment, arsenic is only bound to sulphides that correspond to realgar ( $\alpha\text{-As}_4\text{S}_4$ ). This mineral forms nanocrystalline aggregates which, particularly in the vicinity of fragmented organic matter, generate considerable accumulations of up to several millimetres in thickness. Isotopic frac-



tionation of sulphur in realgar has shown that this mineral is produced by a biogenic process, namely by microbial reduction of sulphate anions in groundwater. This finding was confirmed by an analysis of microbial communities, which showed the dominance of sulphate reduction and fermentation metabolisms only in domains where realgar was formed. By using a combination of geochemical modelling, speciation analysis and microbial community analysis, it was possible to characterise, for the first time, the mechanisms and quantify the emergence of this phase under low temperature conditions. The results of this study have refuted the myth that arsenic sulphides are only formed under hydrothermal conditions, and in particular indicate the potential that the arsenic sulphide precipitation process may have in remediation technologies. The study was published in 2017 in the prestigious *Geochimica et Cosmochimica Acta* periodical.

#### Isotopic Record of Copper In Soil and Tree Rings Close to Copper Processing Industry

In areas intensively affected by the smelting of copper (Cu), we tested the possibility of using its isotopes ( $^{63}\text{Cu}$  and  $^{65}\text{Cu}$ ) to demonstrate processes that determine its mobility in soil and also its transfer between soil and plants. Significant differences in individual processes affecting the fractionation of Cu isotopes were observed between contaminated and non-contaminated sites. The influence of contamination with dust containing Cu ores that accumulate on the soil surface is evident in the soil on both sites. During the oxidation of Cu(I) contained in the ore to Cu(II), isotopically heavy Cu is mobilised, moving away from the surface and accumulating by intensive sorption in the central part of the profiles. Subsequently, the light Cu isotope moves and accumulates in the deeper part of the soil profile. The fractionation of Cu isotopes is much more pronounced at the contaminated site whose surface contains up to 4% of copper by weight. The isotopic composition of tree rings reflects the way Cu enters the biomass. In the contaminated profile, Cu from the dust enters plant tissues through the entire surface of the plant and thus does not fractionate. In contrast, at the less contaminated site, biomass contains more of the light Cu isotope, which accumulates in the plant due to the uptake by the root system. The paper is the first in the world to describe the behaviour of Cu isotopes in tree rings and was published in 2018 in the prestigious *Science of the Total Environment* journal.

#### Most Important Publications in the Past Decade

**DRAHOTA, Petr**, MIKUTTA, Christian, **FALTEISEK, Lukáš**, **DUCHOSLAV, Vojtěch** and **KLEMENTOVÁ, Mariana**. Biologically induced formation of realgar deposits in soil. *Geochimica et Cosmochimica Acta*. 2017, **218**, 237–256. ISSN 0016-7037.

**ETTLER, Vojtěch**, **CIHLOVÁ, Markéta**, **JAROŠÍKOVÁ, Alice** et al. Oral bioaccessibility of metal(loid)s in dust materials from mining areas of northern Namibia. *Environment International*. 2019, **124**, 205–215. ISSN 0160-4120.

**ETTLER, Vojtěch**, **MIHALJEVIČ, Martin**, **ŠEBEK, Ondřej**, **GRYGAR, Tomáš** Matys and **KLEMENTOVÁ, Mariana**. Experimental in Situ Transformation of Pb Smelter Fly Ash in Acidic Soils. *Environmental Science and Technology*. 2012, **46**, 10539–10548. ISSN 0013- 936X.

**JEHLIČKA, Jan**, EDWARDS, Howell G.M. and OREN, Aharon. Raman spectroscopy of microbial pigments: archaeometry, geosciences, and forensics. *Applied and Environmental Microbiology*. 2014, **80**(11), 3286–3295. ISSN 0099-2240.

MAJZLAN, Juraj, **DRAHOTA, Petr** and FILIPPI, Michal. Parageneses and crystal chemistry of arsenic minerals. *Reviews in Mineralogy and Geochemistry*. 2014, **79**(1), 17–184. ISSN 1529-6466.

**MIHALJEVIČ, Martin**, **JAROŠÍKOVÁ, Alice**, **ETTLER, Vojtěch** et al. Copper isotopic record in soils and tree rings near a copper smelter, Copperbelt, Zambia. *Science of The Total Environment*. 2018, **621**, 9–17. ISSN 0048-9697.

ŠVANDOVÁ, Jana, VIDENSKÁ Kateřina and **PŘIKRYL, Richard**. Experimental evaluation of the influence of saturation media on the mineralogical and physicochemical stability of bentonites. *Applied Clay Science*. 2013, **86**, 1–10. ISSN 0169-1317.

VANDENABEELE, Peter, EDWARDS, Howell G.M. and **JEHLIČKA, Jan**. The role of mobile instrumentation in novel applications of Raman spectroscopy: archaeometry, geosciences, and forensics. *Chemical Society Reviews*. 2014, **43**, 2628–2649. ISSN 1460-4744.

**ZACHARIÁŠ, Jiří**. Structural evolution of the Mokrsko -West, Mokrsko-East and Čelina gold deposits, Bohemian Massif, Czech Republic: Role of fluid overpressure. *Ore Geology Reviews*. 2016, **74**, 170–195. ISSN 0169-1368.



Jakub Trubač guiding a tour of the laboratory at the Research Centre of Stable and Radiogenic Isotopes during an event for the general public. (photo: David Hereš)







# Institute of Petrology and Structural Geology

## History of the Institute

The Institute of Petrography of Charles University's Faculty of Science was founded during 1869–1881 by Emanuel Bořický, the founder of Czech petrography and geochemistry and the leading global petrographer of his era. The official establishment of the Institute of Petrography took place under the leadership of Prof. Josef Kratochvíl (1920–1951). Significant progress in the study of igneous and metamorphic rocks at the Department was achieved during the tenure of Prof. Bohuslav Hejtmán in 1954–1975. After 1975, the teaching on and research into sedimentary rocks was added to these disciplines and the Institute of Petrography was transformed into the Department of Petrology. The Institute of Petrology and Structural Geology acquired its current form in the early 1990s under the leadership of Prof. Karel Schulmann. Further progress in Petrology and Structural Geology has been made thanks to the efforts of a number of scientists who have been renowned abroad, such as Prof. Jiří Koutný (1945–1991), a long-time member of the editorial board of *Clay Minerals*, Assoc. Prof. František Holub (1949–2016) who specialised in the ultra-potassium rocks of the Bohemian Massif, and Prof. Karel Schulmann (1991–2004) who contributed towards a major shift in our understanding of the geodynamic development of the Bohemian Massif.

## Scientific Focus

The Institute is traditionally organised into three basic scientific directions that study the origins and evolution of igneous rocks, metamorphic processes in the Earth's crust and mantle, and the records of rock deformation during their formation and transport to the Earth's surface. Since these processes take place along the convergent and divergent interfaces of lithospheric blocks and often lead to large-scale collisional orogens across the continents, our research takes us to different regions of the world. During recent years, our staff and students have been working in Europe as well as in Central Africa, the Middle and Far East, Central Asia, North America and Antarctica. Our research teams focus on crystalline rocks of the Earth's crust, magma formation and metamorphic reactions between minerals that take place under extreme temperature and pressure in the mantle or at the boundary between the mantle and the Earth's crust along subduction or rift zones. In addition to studying the development of orogens and model-

ling their formation, our research also focuses on the behaviour of elements in minerals, including trace elements and isotopes, during the changes in temperature and pressure. The diffusion of elements within the crystal lattices of minerals and microscale deformations are also the subject of our study. Our Institute has had great success in obtaining grants from the Czech Science Foundation and international foundations for Earth and space science.

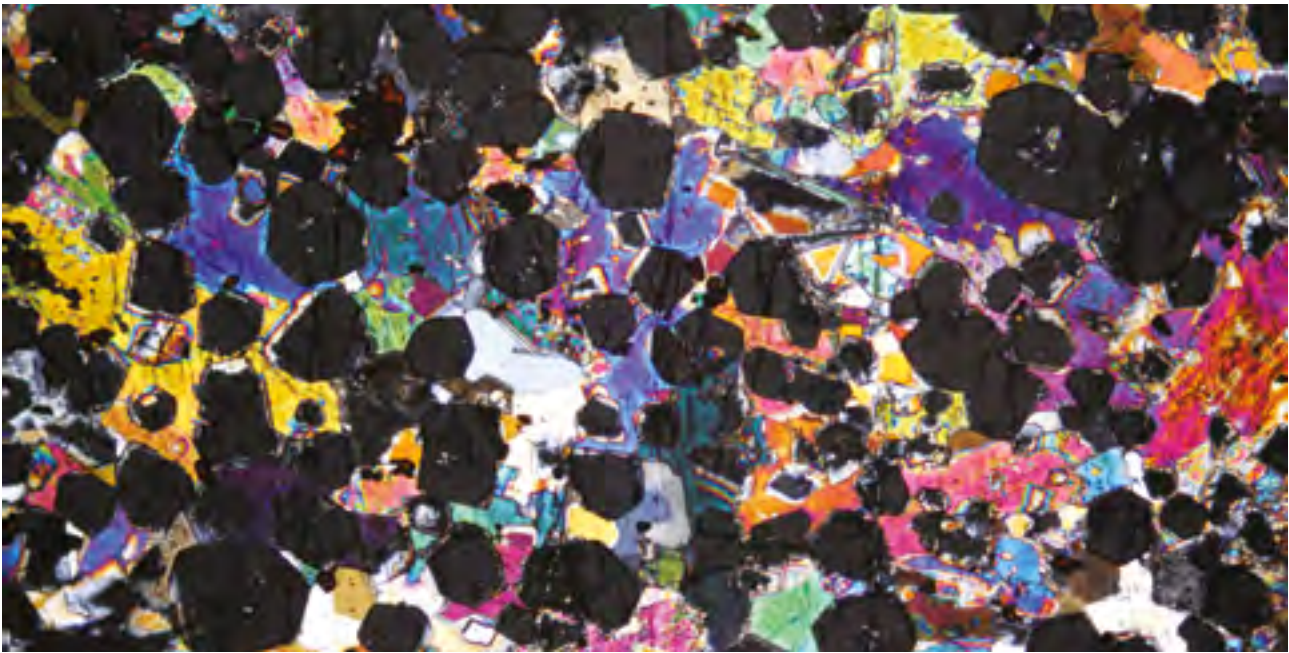
The students and staff of the Institute pursue their research activities using modern laboratory equipment including optical polarising microscopes and a microscope for analysing crystallographic orientation. State-of-the-art equipment also includes a Jeol electron microanalyzer (EPMA) with field emission gun electron source and a TESCAN Vega scanning electron microscope with BSE, SE and CL detectors installed. The Institute of Petrology and Structural Geology also has an experimental laboratory to study the formation and behaviour of magma and its crystallisation under various temperature and pressure conditions. The results of this research also have wide applications in material production.

## Other Activities of the Institute

The Institute staff play a major role in teaching bachelor's and master's students, including the ERASMUS programme, where we offer a great number of courses in English. In addition to master's programmes, the Institute is also the guarantor of doctoral studies in Petrology and Structural Geology, which is also an attractive field for graduates from foreign universities who currently make up nearly half of our post-graduate students.

## Major Achievements

During recent years, our researchers have made significant advances in understanding the geodynamic development of orogenic zones, which includes a wide range of magmatic processes, metamorphic events and deformation processes. The current geodynamic concept of hot orogenic domain evolution, formulated on the example of the Bohemian Massif, is gradually becoming the standard for studying and reconstructing geodynamic evolutions in a number of orogenic zones around the world. This concept involves several development stages in time and space: 1) deep subduction of the Earth's crust and mantle to the stability field of diamond, 2) slab breakoff of the



Amphibolised eclogite with relics of garnet from Měděnec in the Ore Mountains. (photo: Jan Kulhánek)

subducted lithospheric plate and mantle upwelling leading to extremely high temperature overprint of partially exhumed high-pressure rocks in the orogenic wedge, 3) re-lamination of the overlying plate-based material and formation of a felsic lower crust in the orogenic root, and 4) specific mass and heat exchange between the middle and lower crusts resulting in vertical extrusion of the orogenic lower crust. The suggested concept is unique and innovative in that it presumes an important contribution of volumetric forces in the thickened part of the crust, which outweigh the convergent forces of the plate tectonics at a certain point of hot orogen development and can cause horizontal redistribution of the orogenic infrastructure along with lateral shortening. In contrast to conventional tectonics, this concept explains the formation of younger structures below older ones during progressive convergence and the interaction of the contrasting structural and metamorphic record between the shallow and deep parts of the orogen.

The members of our Institute cooperate with researchers home and abroad and, as has become a tradition, organise international conferences and are invited to lecture at conferences and universities. Our employees often receive student awards for outstanding teaching. At the same time, our students are regularly recognised by the Dean of the Faculty of Science for their professional work. The graduates of our Institute are in demand at foreign universities where they take doctoral and post-doctoral positions. The high standard of research and reputation of our Institute is evidenced by the fact that our graduates currently hold professorships at several European universities.

#### Most Important Publications in the Past Decade

**FABBRIZIO, Alessandro**, BOUHIFD, Mohamed A., ANDRAULT, Denis, BOLFAN-CASANOVA, Nathalie, MANTHILAKE, Geeth

and LAPORTE, Didier. Argon behavior in basaltic melts in presence of a mixed H<sub>2</sub>O-CO<sub>2</sub> fluid at upper mantle conditions. *Chemical Geology*. 2017, **448**, 100–109. ISSN 0009-2541.

**FARYAD, Shah W.**, COLLETT, Stephen, FINGER, Fritz, SERGEEV, Sergey A., ČOPJAKOVÁ, Renata and SIMAN, Pavol. The Kabul Block (Afghanistan), a segment of the Columbia Supercontinent, with a Neoproterozoic metamorphic overprint. *Gondwana Research*. 2016, **34**, 221–240. ISSN 1342-937X.

**JEDLIČKA, Radim**, FARYAD, Shah W. and HAUZENBERGER, Christoph. Prograde Metamorphic History of UHP Granulites from the Moldanubian Zone (Bohemian Massif) Revealed by Major Element and Y + REE Zoning in Garnets. *Journal of Petrology*. 2015, **56**(10), 2069–2088. ISSN 0022-3530.

**JERÁBEK, Petr**, KONOPÁSEK, Jiří and ŽÁČKOVÁ, Eliška. Two-stage exhumation of subducted Saxothuringian continental crust records underplating in the subduction channel and collisional forced folding (Krkonoše-Jizera Mts., Bohemian Massif). *Journal of Structural Geology*. 2016, **89**, 214–229. ISSN 0191-8141.

**LEXA, Ondřej**, SCHULMANN, Karel, JANOUŠEK, Vojtěch, ŠTÍPSKÁ, Pavla, GUY, Alexandra and RACEK, Martin. Heat sources and trigger mechanisms of exhumation of HP granulites in Variscan orogenic root. *Journal of Metamorphic Geology*. 2011, **29**, 53–78. ISSN 1525-1314.

**ŠPILLAR, Václav** and DOLEJŠ, David. Heterogeneous nucleation as the predominant mode of crystallisation in natural magmas: numerical model and implications for crystal-melt interaction. *Contributions of Mineralogy and Petrology*. 2015, **169**, 1–16. ISSN 0010-7999.

# Institute of Hydrology, Engineering Geology and Applied Geophysics

## History of the Institute

The Departments of Hydrology, Engineering Geology and Applied Geophysics were founded in 1952. In 1994, the three departments were merged into a single Institute. Important figures of the Department have included Prof. Rudolf Běhounek, Prof. Ota Hynie, Prof. Jan Šilar and Prof. Jiří Škopek. Currently, the Institute is a leading university workplace for applied geology in Czechia and is part of the Faculty of Science's Geology Section. The Institute has over 22 researchers and teachers engaged in hydrogeology, engineering geology, geotechnology, applied geophysics and environmental protection. It has trained more than 600 experts over the course of the 50 plus years that applied geology has been taught at Charles University.

## Scientific Focus

The research activity of the Institute is broad and includes numerous projects that focus on groundwater, construction, environmental protection, use of natural resources and structure of the Earth's crust. Students participate in research through independent work in laboratories and in the field. The Institute possesses the best equipped soil mechanics laboratory in Czechia and an internationally registered radioisotope laboratory for determining the age of rocks, water and natural and archaeological samples using carbon and tritium dating. We cooperate with numerous institutions and companies.

Hydrogeology is a scientific discipline that examines the occurrence, origin, movement and properties of groundwater, its use and protection. Hydrogeologists investigate environmental pollution, design and implement subsequent remediation measures, search for and protect sources of drinking and mineral water, and address other environmental issues.

Engineering geology applies knowledge from other geological disciplines in fulfilling practical tasks, especially in construction and zoning planning. It is a field of science that straddles the line between nature- and technology-oriented sciences. Engineering geologists provide surveys for specific, in particular more difficult, types of construction projects (buildings, tunnels, dams, highways, etc.), they assess slope stability and design remedies for unstable slopes. They also provide documentation for land use planning and participate in assessing the environmental impact of buildings.

Applied geophysics is an applied field of science that uses measurements of natural and artificial physical fields to determine the structure, composition and inhomogeneities of rock environments for the purposes of basic geological research, geological mapping, mineral exploration and monitoring and assessment of the environment. Activities in the field of applied geophysics include primarily field and laboratory measurements using geophysical instruments, data processing and interpretation, as well as theoretical research.

Our researchers are among the best in their fields on an international level. They are involved in a broad range of research projects supported by national and European grants as well as by the private sector. Examples of research topics include mathematical modelling of groundwater flow and mechanical behaviour of soils and rocks, study of seismically active areas and groundwater contamination. We explore the use of alternative methods of energy generation such as geothermal and wind energy, and we design environmental protections for hazardous waste repositories, including permanent repositories for waste from nuclear power plants. Our top students are involved in research as part of their doctoral studies and their work is recognised by the international professional community.

## Other Activities of the Institute

Our Institute trains experts in the fields of Hydrogeology, Engineering Geology and Applied Geophysics, the specialisations of the Applied Geology master's programme. The study of all geological fields begins with a three-year bachelor's degree in General Geology or Natural Resources Management, and from the second year on, students choose specific subjects according to their chosen specialisation. It is also possible to obtain a three-year bachelor's degree in Geotechnology that, from the very first year, emphasises methods and technologies used in geology and is thus an ideal starting point for a master's degree in Applied Geology. The two-year master's programme focuses fully on the selected specialisation. Subjects at all levels of study are taught in modern classrooms and laboratories equipped with state-of-the-art laboratory instruments. All students also have the opportunity to complete part of their studies abroad, typically at universities in EU countries.



## International Cooperation:

University of Alaska-Fairbanks (USA), University of New South Wales (Australia), Hong-Kong University of Science and Technology (Hong-Kong), Institute of Earth Physics (IPGP) (France), Shizuoka University (Japan), University of Honolulu (USA), University of Western Australia (Australia), National Institute of Standards (USA), Berkeley Lawrence National Laboratory (USA), Wiseman Institute (Israel)

## Major Achievements

Fischer, Tomáš (investigator), Research Infrastructure for Geothermal Energy RINGEN, MŠMT, LM2015084, 2016–2019, 8,548,000 / 29,752,000 CZK. Recipient: FSc CU, Partners: GFÚ AVČR, ÚSMH AVČR, ÚGN AVČR, TUL, ČGS, ČVUT.

Fischer, Tomáš (investigator), Modernization of Research Infrastructure RINGEN, OPVVV, CZ.02.1.01/0.0/0.0/16\_013/0001792, 2017–2020, 72,676,000 / 102,779,000 CZK. Recipient: FSc CU, Partners: GFÚ AVČR, ÚSMH AVČR, ÚGN AVČR, TUL, ČGS, ČVUT.

Fischer, Tomáš (co-investigator), Distributed System of Observatories and Field Measurement of Geophysical Fields, CzechGeo/EPOS-Sci, OPVVV, CZ.02.1.01/0.0/0.0/16\_013/0001800. 2017–2020, 12,852,000 / 64,230,000 CZK. Recipient: GFÚ AVČR, Partners: ÚSMH AVČR, ÚGN AVČR, VÚTGTK, ČGS, PŘF MU, PŘF UK.

Mašín, David (co-investigator), Engineering Barrier 200C, TAČR TK01030031, 2018–2025, 4,994,000 / 41,269,000 CZK. Recipient: ČVUT. Partners: Česká geologická služba, TERAMED, s.r.o.

Mašín, David (co-investigator), Bentonite Mechanical Evolution BEACON, Horizon 2020, Call: NFRP-2016-2017 (Euratom fission 2016-2017), Topic: NFRP-6, Type of action: RIA (Research and Innovation action), Proposal number: 745942, 2017–2021, 3,513,000 / 103,326,000 CZK. Recipient: SKB, Partners: SKB, SURAO, POSIVA, ANDRA, NAGRA, ENRESA, RWM, MKG, UPC, GRS, CTU, CEA, VTT, ULg, BGR, KIT INE, LEI, CIEMAT, Clay Tech, EPFL, ICL, Quintessa, NERC, JY.

## Most Important Publications in the Past Decade

**BACHURA, Martin** and **FISCHER, Tomáš**. Detailed velocity ratio mapping during the aftershock sequence as a tool to monitor the fluid activity within the fault plane. *Earth and Planetary Science Letters*. 2016, **453**, 215–222. ISSN 0012-821X.

**BRUTHANS, Jiří**, **FILIPPI, Michal**, **SCHWEIGSTILLOVÁ, Jana** and **ŘIHOŠEK, Jaroslav**. Quantitative study of a rapidly weathering overhang developed in an artificially wetted sandstone cliff. *Earth Surface Processes and Landforms*. 2016, **42**, 711–723. ISSN 0197-9337.

**BRUTHANS, Jiří**, **SOUKUP, Jan**, **VACULÍKOVÁ, Jana**, **FILIPPI, Michal**, **SCHWEIGSTILLOVÁ, Jana**, **MAYO, Alan L.**, **MAŠÍN, David**, **KLETETSCHKA, Gunther** and **ŘIHOŠEK, Jaroslav**. Sandstone landforms shaped by negative feedback between stress and erosion. *Nature Geoscience*. 2014, **7**(8), 598–602. ISSN 1752-0894.

**FILIPPI, Michal**, **BRUTHANS, Jiří**, **ŘIHOŠEK, Jaroslav**, **SLAVÍK, Martin**, **ADAMOVIČ, Jiří** and **MAŠÍN, David**. Arcades: Products of stress-controlled and discontinuity-related weathering. *Earth-Science Reviews*. 2018, **180**, 159–184. ISSN 0012-8252.

**FISCHER, Tomáš**, **MATYSKA, Ctirad** and **HEINICKE, Jens**. Earthquake-enhanced permeability – evidence from carbon dioxide release following the ML 3.5 earthquake in West Bohemia. *Earth and Planetary Science Letters*. 2017, **460**, 60–67. ISSN 0012-821X.

**KLIMEŠ, Jan**, **NOVOTNÝ, Jan**, **NOVOTNÁ, Ivona**, **de URIES, Jordán B.**, **VILÍMEK, Vít**, **EMMER, Adam**, **STROZZI, Tazio**, **KUSÁK, Michal**, **RAPRE, Alejo C.**, **HARTVICH, Filip** and **FREY, Holger**. Landslides in moraines as triggers of glacial lake outburst floods: example from Palcacocha Lake (Cordillera Blanca, Peru). *Landslides*. 2016, **13**(6), 1461–1477. ISSN 1612-510X.

**KLETETSCHKA, Gunther**. Magnetization of Extraterrestrial Allende material may relate to terrestrial descend. *Earth and Planetary Science Letters*. 2018, **487**, 1–8. ISSN 0012-821X.

**NG, Charles W. W.**, **BOONYARAK, Thayanan** and **MAŠÍN, David**. Effects of Pillar Depth and Shielding on the Interaction of Crossing Multitunnels. *Journal of Geotechnical and Geoenvironmental Engineering – ASCE*. 2015, **141**(6), not paginated. ISSN 1090-0241.

**KLETETSCHKA, Gunther**, **HOOKE, Roger LeB.**, **RYAN, Andrew**, **FERCANA, George**, **McKYNNEY, Emerald** and **SCHWEBLER, Kristopher P.** Sliding stones of Racetrack Playa, Death Valley, USA: The roles of rock thermal conductivity and fluctuating water levels. *Geomorphology*. 2013, **195**, 110–117. ISSN 0169-555X.

**KLETETSCHKA, Gunther**, **FISCHER, Tomáš**, **MLS, Jiří** and **DĚDEČEK, Petr**. Temperature fluctuations underneath the ice in Diamond Lake, Hennepin County, Minnesota. *Water Resources Research*. 2013, **49**(6), 3306–3313. ISSN 0043-1397.



Jiří Bruthans' team has explained the origins of rock arches and towers. The picture shows the rock formations of Český ráj, eroded from a 100-meter thick layer of weakly cemented quartz sandstone. (photo: Petr Jan Juračka)











An aerial photograph of a building with a gabled roof and several windows, situated in a lush, green forest. The entire image is overlaid with a semi-transparent green filter. The text 'Institute for Environmental Studies' is centered in white, sans-serif font.

# Institute for Environmental Studies

# Institute for Environmental Studies

## History of the Institute

Prof. Jaroslav Číhalík, originally from the FS Department of Analytical Chemistry, designed and founded a programme focusing on environmental protection in the late 1970s. The programme was accredited by the Ministry of Education as the first five-year environmental education programme in what was then Czechoslovakia.

The Institute for Environmental Studies (IES) was originally called the Department of Environmental Protection and Landscape Ecology and was established in 1981 as the guarantor of the new field of study, which was led by Prof. Jan Čabart. In 1990, the name and structure of the Department was changed and the Institute was established. Past heads of the Department and directors of the Institute include Assoc. Prof. Karel Pivnička, 1988–1989; Prof. Milan Král, 1990–1991; Assoc. Prof. Martin Braniš, 1991–1997; Prof. Karel Pivnička, 1997–2003; Prof. Martin Braniš, 2003–2008; Prof. Jan Frouz, 2008–2014; Prof. Tomáš Cajthaml, 2014 to the present.

The Institute currently offers bachelor's, master's and doctoral programmes. The bachelor's and master's Environmental Protection programmes are accredited under Ecology and Environmental Protection. The doctoral study is accredited under the Environmental Sciences programme.

## Scientific Focus

The Institute's research focuses on similar thematic areas. The members of the Institute focus on the following topics:

Birds as a model group reflecting the impacts of global changes and landscape exploitation (Assoc. Prof. Reif), where certain species are mostly at the top of the food chain and their populations reflect the synergetic impacts of different types of pollutants, land use changes, climatic conditions, etc.

Contamination and decontamination of the environment (Prof. Cajthaml), where new remediation technologies are being developed, ecotoxicological aspects are studied (monitoring the effects of current pollutants, especially organic, on the environment) and new unknown types of pollution are searched for.

The destiny of pollutants in the environment is another important topic that is probably the most widely studied issue at our Institute. This research is also related to the development of decontamination procedures.

The impact of changing land use and climate on soil-water interactions (Prof. Frouz), which includes the study of stress on both soil and aquatic ecosystems that are under ever-increasing anthropogenic pressure. The research is focused on understanding the key physico-chemical and biological processes responsible for providing ecosystem services such as runoff, water self-purification processes and nutrient cycling in the landscape, especially nitrogen and phosphorus, with an emphasis on the decomposition of organic matter and releasing nutrients.

Other research is carried out at specialised workplaces: Laboratory of Environmental Chemistry and Soil Analysis; Air Quality Laboratory; Water Protection Laboratory; Limnological laboratory; Hydrobiological Station at the Velký Pálenec pond near Blatná and the GIS Laboratory.

## Other Activities of the Institute

The teaching at the Institute is approached synthetically and covers many areas of science and other disciplines related to environmental protection issues. More specifically, these areas include the protection of air, water and nature, waste management, applied ecology, protection of biodiversity, issues of reclamation and revitalisation or decontamination, ecotoxicology, environmental component analysis and GIS applications. The Institute cooperates with a number of university workplaces, institutes of the Czech Academy of Sciences and international institutions, especially through joint projects, theses and dissertations.

## Major Achievements

The Institute's major successes include a significant increase in scientific performance in terms of scientometric indicators. There were 63 citations on the Web of Science from publications containing original scientific articles in impact factor journals, review articles and book chapters from 1999 to 2009. From 2010 to 2019 there were 332 citations, representing more than a five-fold increase.



The Institute's Air Quality Laboratory received accreditation to measure air pollution in connection with aerosol pollution in 2017.

In 2016, the Institute became part of the newly created SoWa (Soil-Water) National Infrastructure for Soil and Water Research. The aim of the SoWa research infrastructure is to foster cooperation between the Czech and international research communities in the comprehensive study of soil-water interactions on various spatiotemporal scales. The unique combination of laboratory microcosms, mesocosms and an artificial catchment area along with a set of areas monitored in a long-term perspective will make it possible to determine the key biogeochemical processes on all relevant scales.

In 2016, IES was awarded a utility model for a device monitoring the toxicity of rock environment (PUV2016-32615), which makes it possible to monitor the clean-up of contaminated sites in situ.

IES worked on the prestigious Norwegian Fund grant no. 7F14045 as the main grant coordinator from 2015 to 2017. The project focused on developing new principles for passive samplers, which are particularly useful in developing and applying measures to remediate contaminated groundwater. Passive samplers have also been developed to sample autochthonous microbial communities.

In 2013, CRC Press published a book entitled *Soil Biota and Ecosystem Development in Post Mining Sites* (ISBN 9781466599314), edited by Prof. Frouz.

In 2012, Assoc. Prof. Jiří Reif managed to publish a work he co-authored in the prestigious *Nature Climate Change* journal. The research fundamentally documents the negative impact of global changes on bird populations and has been cited 291 times so far. (DEVICTOR et al. *Nature Climate Change*. 2012, 2(2), 121–124).

1987 marked the first year of publication of *Acta Universitatis Carolinae – Environmentalica*, a themed series that was transformed and renamed the *European Journal of Environmental Sciences* (ISSN 1805-0174) in 2011. The journal is currently included in the Scopus and Web of Science databases and is expected to be awarded an impact factor.

IES members were involved in the research, development and optimisation of a new remediation process for decontaminating groundwater, which combines the use of nano-iron with the existing microbial microflora. The bacteria are able to recycle the used nanoiron, with side effects including the geostabilisation of Cr(VI) and the dehalogenation of chlorinated ethenes (Němeček et al. *Sci Total Environ*. 2014, 485, 739–747; Němeček et al. *J Hazard Mater*. 2015, 300, 670–679; Němeček et al. *Sci Total Environ*. 2016, 563, 822–834).

Over the past 10 years, the Institute's researchers have worked on revealing the endocrine-disrupting properties of a number of commonly used chemical compounds,

such as antimicrobial preparations in toothpastes, common medicines and frequently used flame retardants (Michalíková et al. *Chemosphere*. 2019, 217, 534–541; Ezechiáš et al. *Chemosphere*. 2016, 152, 284–291; Ezechiáš et al. *Chemosphere*. 2012, 87, 820–824).

### Most Important Publications in the Past Decade

**CAJTHAML, Tomáš.** Biodegradation of endocrine-disrupting compounds by ligninolytic fungi: mechanisms involved in the degradation. *Environmental Microbiology*. 2015, 17(12), 4822–4834. ISSN 1462-2912.

ČVANČAROVÁ, Monika, MOEDER, Monika, **FILIPOVÁ, Alena** et al. Biotransformation of the Antibiotic Agent Flumequine by Ligninolytic Fungi and Residual Antibacterial Activity of the Transformation Mixtures. *Environmental Science & Technology*. 2013, 47(24), 14128–14136. ISSN 0013-936X.

DEVICTOR, Vincent, VAN SWAAY, Chris, BRERETON, Tom et al. Uncertainty in thermal tolerances and climatic debt reply. *Nature Climate Change*. 2012, 2(9), 638–639. ISSN 1758-678X.

**FROUZ, Jan.** Effects of Soil Development Time and Litter Quality on Soil Carbon Sequestration: Assessing Soil Carbon Saturation with a Field Transplant Experiment along a Post-Mining Chronosequence: Carbon Sequestration and Saturation in Post-Mining Sites. *Land Degradation & Development*. 2017, 28(2), 664–672. ISSN 1099-145X.

**FROUZ, Jan**, TOYOTA, Ayu, **MUDRÁK, Ondřej** et al. Effects of soil substrate quality, microbial diversity and community composition on the plant community during primary succession. *Soil Biology & Biochemistry*. 2016, 99, 75–84. ISSN 0038-0717.

JÍLKOVÁ, Veronika, **CAJTHAML, Tomáš** and **FROUZ, Jan.** Relative importance of honeydew and resin for the microbial activity in wood ant nest and forest floor substrate – a laboratory study. *Soil Biology & Biochemistry*. 2018, 117, 1–4. ISSN 0038-0717.

LEONI, Cecilia, **HOVORKA, Jan**, DOČEKALOVÁ, Veronika, **CAJTHAML, Tomáš** et al. Source Impact Determination using Airborne and Ground Measurements of Industrial Plumes. *Environmental Science & Technology*. 2016, 50(18), 9881–9888. ISSN 0013-936X.

**LHOTSKÝ, Ondřej**, KRÁKOROVÁ, Eva, MAŠÍN, Pavel, ŽEBRÁK, Radim et al. Pharmaceuticals, benzene, toluene and chlorobenzene removal from contaminated groundwater by combined UV/H<sub>2</sub>O<sub>2</sub> photo-oxidation and aeration. *Water Research*. 2017, 120, 245–255. ISSN 0043-1354.

**NAČERADSKÁ Jana**, **PIVOKONSKÝ, Martin**, PIVOKONSKÁ, Lenka et al. The impact of pre-oxidation with potassium

permanganate on cyanobacterial organic matter removal by coagulation. *Water Research*. 2017, **114**, 42–49. ISSN 0043-1354.

**REIF, Jiří** and VERMOUZEK, Zdeněk. Collapse of farmland bird populations in an Eastern European country following its EU accession. *Conservation Letters*. 2019, **12**(1), e12585. ISSN 1755-263.

TEDERSOO, Leho, BAHRAM, Mohammad, **CAJTHAML, Tomáš** et al. Tree diversity and species identity effects on soil fungi, protists and animals are context dependent. *Isme Journal*. 2016, **10**(2), 346–362. ISSN 1751- 7370.

TRAXMANDLOVÁ, Iva, ACKERMAN, James, D., TREMBLAY, Raymond, L. et al. Determinants of orchid species diversity in world islands. *New Phytologist*. 2018, **217**(1), 12–15. ISSN 1469-8137.

**VESELÁ, Hana**, **MUDRÁK, Ondřej** and **FROUZ, Jan**. The role of dead standing biomass of *Calamagrostis epigejos* in nutrient turnover during spontaneous succession. *Science of the Total Environment*. 2018, **644**, 717–724. ISSN 0048-9697.

VOŘÍŠKOVÁ, Jana, BRABCOVÁ, Vendula, **CAJTHAML, Tomáš** and BALDRIAN, Petr. Seasonal dynamics of fungal communities in a temperate oak forest soil. *New Phytologist*. 2014, **201**(1), 269–278. ISSN 1469-8137.

WU, Songlin, **CAJTHAML, Tomáš**, **SEMERÁD, Jaroslav**, **FILIPOVÁ, Alena** et al. Nano zero-valent iron aging interacts with the soil microbial community: a microcosm study. *Environmental Science-Nano*. 2019, **6**(4), 1189–1206. ISSN 2051-8153.





A student from Jan Hovorka's team launches a balloon to measure atmospheric pollution. (photo: Petr Jan Juračka)











# Faculty-Wide Institutions

# Institute of Applied Mathematics and Information Technologies

## History of the Institute

The Institute was founded in 1990 with the merger of the Department of Mathematics and Informatics and the Laboratory of Computer Science, and was intended as a Faculty-wide research, education and coordination workplace to teach and apply mathematics, informatics and computer science in natural science. Professor Eduard Stehlík became the first director of the Institute. In addition to teaching, the Institute was entrusted with the task of building and managing the Faculty's computer network and computer classrooms. As the scope of the computer network and related activities grew, this technical group was split off in 2002 as an independent workplace under the name of the Information Technology Center. The Institute also focused on teaching mathematical subjects.

The Institute of Applied Mathematics and Information Technologies has been directed by: Prof. Eduard Stehlík (1990–1995), Assoc. Prof. Josef Ježek (1995–2001), Václav Kotvalt, Ph.D. (2001–2002), Milan Štědrý, Ph.D. (2002–2003), Assoc. Prof. Josef Ježek (2003–2009), Václav Kotvalt, Ph.D. (2009–2016), Prof. Josef Ježek (2016–2019) and Václav Kotvalt, Ph.D. (since 2019).

## Activities of the Institute

The Institute of Applied Mathematics and Information Technologies provides basic courses in mathematics, data processing, statistics and computer science for the Faculty's areas of study. Other elective courses are offered by the Institute staff according to their specialisation and student interest. The Institute also cooperates with external experts from the CU Faculty of Mathematics and Physics in the teaching of these subjects.

While much of the work of a scientist today is based on mathematical models, it is not easy to teach mathematics and related subjects. Not all students come from secondary schools with a sufficient knowledge, and mathematics can be very difficult for them. The Institute faculty strive to overcome these shortcomings with personal commitment and by offering a wide range of individualised consultations, ad hoc lectures and teaching secondary school subjects. Mathematics need not necessarily be the bane of student existence, as evidenced by the fact that two Institute instructors (Nada Krylová and Milan Štědrý) have won the students' Giant Salamander Award for the best teacher.

Considering the large volume of teaching, other activities are complementary only. They include in particular tutoring in mathematics, statistics and programming, assistance with master's and doctoral theses, research cooperation with Faculty departments and institutes, and cooperation with both domestic and international institutions outside the Faculty. This includes creating mathematical models for science, solving problems with ordinary and partial differential equations, applying more sophisticated statistical methods, programming and computer modelling.

## Most Important Publications in the Past Decade

The Institute's publications include textbooks and articles on mathematics and statistics, such as:

**JEŽEK, Josef** and **HROUDA, František**. Eddy currents in the measurement of magnetic susceptibility of rocks. *Physics of the Earth and Planetary Interiors*. 2018, **274**, 138–147. ISSN 0031-9201.

**GREGOROVIČOVÁ, Martina** and **ČERNÍKOVÁ, Alena**. Reactions of leopard geckos (*Eublepharis macularius*) to defensive secretion of *Graphosoma lineatum* (Heteroptera Pentatomidae): an experimental approach. *Ethology Ecology & Evolution*. 2016, **28**(4), 367–384. ISSN 0394-9370.

**TKADLEC, Jan**, **PECKOVÁ, Monika**, **ŠRÁMKOVÁ, Lucie** et al. The use of broad-range bacterial PCR in the diagnosis of infectious diseases: a prospective cohort study. *Clinical Microbiology and Infection*. 2019, **25**, 747–752. ISSN 1198-743X.

**KOTVALT, Václav**. *Základy matematiky pro přírodovědné obory (Basics of Mathematics for Science Studies)*. Praha: Karolinum, 2008. 226 pages. ISBN 978-80-246-1572-1.

**MAKOVIČKA, Jiří**. *Excel pro přírodovědce (MS Excel for Scientists)*. Praha: Karolinum, 2016. 174 pages. ISBN 978-80-246-3139-4.

**ZVÁRA, Karel**. *Základy statistiky v prostředí R (Basics of Statistics in the R Environment)*. Praha: Karolinum, 2013. 226 pages. ISBN 978-80-246-2245-3.





Naďa Krylová, a popular teacher with students, has been teaching mathematics at the Faculty of Science her entire life. (photo: Karolína Kotvaltová Sezemská)

# Department of Physical Education

## History of the Department

Physical education and sports have a long tradition at the Faculty of Science. The Department of Physical Education was founded at our Faculty in 1959. Thanks to the support of the Faculty management, sports became an integral part of student life and remain to this day. It is worth mentioning that the founder of university sports was František Smotlacha (1884–1956), an important figure closely connected with Charles University's Faculty of Science. Through his tireless work in the field of physical education and sports, he established physical education as a subject at universities in Bohemia. After completing his science studies at the Charles-Ferdinand University in Prague, where he also studied teaching physical education for secondary schools, he worked as a secondary school teacher. He became a PE and sports teacher at Charles-Ferdinand University in 1910. In the same year, he founded the first university sports association, the University Association for Physical Education and Sport, Games, Hiking and Scouting. In 1919 he was awarded a lectureship for physical education at the University of Special Sciences in Prague (today's CTU). Under his leadership, institutes of physical education were established at both of these schools, which later became the headquarters for University Sports in Prague. Its successor is today's Czech University Sport Association, which inspired the establishment of other sports centres in Brno and Bratislava.

František Smotlacha focused on the systematic and methodological development of physical education and published a number of papers. In 1930 he habilitated at the Charles University Faculty of Science, thus becoming the first associate professor of physical education in our country. His idea that physical activity is necessary for modern people who do less physical work remains as relevant today as it ever was. The goal of physical education should be to contribute to the healthy and satisfied lives of individuals, in which regular physical activity plays an indispensable role. He also promoted outdoor education (without success, unfortunately). His ideas are aligned with our notion of a healthy lifestyle and the prevention of "civilisation diseases". Smotlacha's work in the field of university physical education and sport ended with the Nazi occupation and the closure of universities. After that he focused on his second field of expertise – mycology.

## Main Activities of the Department

The current activity of the Department is guided by the above principles. It has a similar view of the role of physical educa-

tion and sport in student life. In an environment where the demands on individuals are constantly increasing along with the growing number of roles in both professional and private life, physical education can relieve mental stress and provide an active form of relaxation and regeneration. As the pace of life changes, so does the way we spend our leisure time, and sports and physical activity play an important role in this. The aim of the Department is to provide students with a wide range of modern sports activities that are appealing to them and help create positive habits of regular exercise and a lifelong relationship to physical activity in general.

External specialists are also invited to help teach the wide array of sports offered by the Department. This guarantees a diverse range of physical activity options based on the latest trends. Every student will find a sport to their liking within the course offerings.

Mandatory and elective semester classes offer traditional and less traditional team sports (volleyball, basketball, softball, floorball, futsal, football, football tennis, hockey, curling), individual sports (tennis, table tennis, badminton), aquatic sports and fitness activities (aerobics, strength training, Pilates, power yoga, bosu, body balance, distance running). In addition to this, we also offer other sports like orienteering, biathlon, sport gymnastics, health and relaxation exercises, track and field, canoeing, sea kayaking, paddleboarding, diving sports (scuba and free-diving), sport climbing, non-traditional sport games and combat sports. The sports offered are constantly innovated to reflect current sport trends and the popularity of individual sports, which changes over time.

In the summer, the Department offers both general and specialised sport courses (canoeing, cycling, windsurfing, sport games). In the winter, students improve their skills in downhill and cross-country skiing, snowboarding and can even try biathlon or learn the basics of ski mountaineering. Physically impaired students have the opportunity to attend health and physical education classes.

## Other Activities and Publications of the Department

Students are given both practical and theoretical instruction. The Department holds numerous professional seminars and training sessions (yoga seminars, health and physical education seminars focused on certain forms and ways of compensating for movement and muscle imbalances, training in modern movement forms using various exercise aids, tools, etc.).



During the course of the academic year, the Department organises various social and sporting events. The mixed-couple night orienteering, swimming relay race, geography sports day and the Dean's sports day all have a long tradition. (photo: Vladimír Šigut)

Students can obtain professional licenses after completing the required course load and training sessions and then passing the examinations. Currently, training is available to obtain a fitness instructor license, a scuba diving license, and students can also obtain a ski school instructor license indirectly. Authored by colleague Klára Kovaříková, *Aerobics and Fitness* (KOVAŘÍKOVÁ, Klára. *Aerobics and Fitness*. Prague: Karolinum, 2017, written in Czech) is an extensive compendium published in connection with the accreditation for granting fitness instructor licenses and represents a unique feat for university sports. Other similar publications include BUZKOVÁ, Klára. *Fitness Yoga*. Prague: Grada, 2006 (written in Czech); and BUZKOVÁ, Klára. *Stretching*. Prague: Grada, 2006 (written in Czech).

In addition to the activities mentioned above, the Department organises various social sporting events during the academic year (one-time competitions, regular leagues, sport days, weekend and Christmas tournaments, etc.). Events such as the mixed-couple night orienteering, the Dr. M. Bubník memorial swimming relay race, the geography sports day and the Dean's sports day all have a long tradition. These events bring together students and staff from various professional disciplines. Sports thus perform an important social role.

In recent years, the Department has been successful in putting together sport teams to represent our Faculty. Since 2012 we have fielded a floorball team that regularly plays the university floorball league (we even won the

league in 2015) and there is also a Faculty ice hockey team (originally the Geography Section team) that plays the Prague hockey league. It has to be said that without generous support from Faculty management, participation in these competitions would not be possible. The Přírodoliga volleyball league also has its traditional place in the academic year's sports schedule.

Department activities focus on students as well as on Faculty staff. The staff have the opportunity each semester to take part in various sports activities under the guidance of individual Department members. The Faculty of Science University Sports Club has been a part of the Department from the very beginning. Membership consists of students and Faculty graduates who want to pursue various sports either more intensively or at a higher level. Today, this club has 10 divisions (basketball, floorball, futsal, climbing, swimming, diving, recreational sports, softball, tennis and volleyball) with almost 500 members. In addition to regular training sessions, the club arranges trips abroad and one-time events organised by individual divisions. The annual sports camp at the Charles University training centre in Albeř is another regular event with a great tradition broadly attended by students, graduates and employees of the Faculty of Science.





A photograph of a museum exhibit featuring several bird skeletons displayed in glass cases. The skeletons are arranged on shelves, with some showing the full body and others focusing on specific parts like the skull or wing bones. The entire image is overlaid with a semi-transparent red filter. The text 'Museums, Collections and Libraries' is centered in white.

# Museums, Collections and Libraries

Columbiformes

# Botanical Gardens

The botanical gardens were opened as part of the Prague University in 1775. When the Faculty of Science was founded in 1920, the botanical gardens became a part of it. The gardens serve several purposes. They are used for teaching, research and cultural and promotional events. They also represent a significant portion of Prague's freely accessible green areas. Thanks to their multi-disciplinary concept, they are among the Faculty's most cherished resources.

From a teaching perspective, they are used in the practical training of students at Charles University's Faculty of Science (providing thousands of samples for lectures and practical instruction each year). The ecological and systematic arrangement of flora is useful for teaching diverse biological disciplines. The gardens are also visited by students from other universities (the Czech University of Life Sciences in Prague and the University of South Bohemia in České Budějovice). The gardens are regularly frequented as part of the practical instruction of many Prague elementary and secondary schools, especially during the spring. The gardens are also inspiring for art schools, providing them with the perfect location for plein air drawing sessions. Cooperation with the horticulture faculties of Czech universities takes place primarily through summer internships of students in these fields.

The gardens participate in the Faculty's research. In areas closed to the public, numerous specimens are cultivated for the undergraduate and doctoral work of the Department of Botany. Multiple biotic and abiotic projects of the Institute for Environmental Studies have been carried out here, and the gardens' collections have also been the subject of several theses in the field of teaching. Currently, projects are underway to assess some of the gardens' exceptional collections (certain groups of succulents, for example).

The gardens' most important collection consists of plants from rare locations of Central Europe. The collections of

cacti and succulents, South African bulbs and plants from the *Oxalis* genus are also of global importance. The collection includes the oldest Indian cycads in Europe, a unique form of the ginkgo tree, and many interesting tropical and sub-tropical plants.

The gardens' collections are also important with respect to environmental protection. Dozens of environmentally threatened species of native flora have long been cultivated here, collected before the rapid decline of their natural habitats.

The botanical gardens are active in maintaining national and international contacts: they are a founding member of the Union of Czech Botanical Gardens and actively take part in international conferences and other professional gatherings in the field. As part of the international *Index Seminum* seed exchange, they cooperate with more than 300 botanical gardens all over the world.

Since 1997, the gardens have been an appointed rescue centre for confiscated plants protected by the CITES convention. In 2009, the gardens were registered as a scientific institution authorised to receive specimens of wild plants protected by the CITES convention.

The greenhouses are used to host various exhibitions throughout the year. In the summer months, the sub-tropical greenhouse becomes available (with exotic plants and animals, birds and succulents), while the upper exhibition greenhouse built during the reconstruction in 1998 is used for art exhibitions (photography, painting and ceramics) or exhibitions presenting the various disciplines of the faculty. The grounds of the gardens are also used to exhibit sculptures and other works of art, and art courses are held here. Information about all upcoming events at the botanical gardens is posted on their website ([www.bz-uk.cz](http://www.bz-uk.cz)), on Facebook ([bz.prf.uk](https://www.facebook.com/bz.prf.uk)) and Instagram ([botanaslupi](https://www.instagram.com/botanaslupi)). Also, a botanical consultation centre is open to the public every Tuesday.



An exhibition of cacti is held in the garden twice a year. (photo: Petr Jan Juračka)



In the tropical greenhouse, plants are reorganised by continent. (photo: Petr Jan Juračka)





The garden exteriors have open access. (photo: Petr Jan Juračka)



# Herbarium Collections

The herbarium collections of Charles University (*Herbarium Universitatis Carolinae Pragensis*, international herbarium acronym: PRC) are a scientific department of Charles University's Faculty of Science housing more than 2,200,000 specimens of algae, bryophytes, fungi, lichens and vascular plants. A seed and fruit collection consisting of more than 20,000 samples and representing some 11,000 taxa of vascular plants is also a part of PRC. In addition, the herbarium collections include a spirit collection. Comparative collections of phytoliths, plant macrofossil remnants and pollen have been built recently. Due to its size, age (founded in 1775), geographical coverage and importance (tens of thousands of type specimens), the PRC collections belong to the 25 biggest and oldest herbaria in the world and the collections within which they are kept by the university institutions are ranked in the top 10 (*Index Herbariorum*, the 8th printed edition, 1990). The most important are nomenclatural types, i.e. specimens on which the scientific names are based. The PRC collections contain tens of thousands of type specimens of taxa described mostly from the Pacific coast of Americas and the Philippines (T. Haenke's collection from the Malaspina Expedition (1789–1794) processed by K. B. and J. S. Presl), the Balkans (J. Velenovský, G. Beck, J. Rohlena, K. Vandas, F. A. Novák) and Central Europe (F. W. Schmidt, K. B. Presl, I. F. Tausch, K. Domin, Z. Černohorský, K. Cejp and others). The collection of liverworts (J. Váňa) is one of the most comprehensive in the world, both geographically and taxonomically.

The university herbarium was founded together with the botanical garden in 1775 by Professor J. G. Mikan. The botanical garden and the herbarium's depositories were originally placed in the Smíchov ward. In 1882, Charles University, including the botanical institute, was divided into two parts, Czech and German, but the entire herbarium belonged to the German institution. Therefore, after relocating the two botanical institutions into two new, almost identical buildings built on the slopes of the right bank of the river of Vltava, the new herbarium collections of the Czech University have been created mainly as a result of the efforts of Professors J. Velenovský and K. Domin and their students. During World War II, both Czech and German collections were evacuated and temporarily stored in the provisional depository at chateau Kout in the Šumava Mountains (Böhmerwald). Unfortunately, a part of the collection was damaged due to unsuitable storage conditions. After the war, the German University was closed and both herbaria were merged and moved to the present-day depositories in Benátská Street.

In 2013–2018, the herbarium collections received nearly 400 visits ("researcher-days", excluding the employees of the Department of Botany and Charles University students) and handled 129 requests coming from 33 countries of all continents. For these reasons, the PRC collections are frequently cited in scientific literature and from a scientific perspective, they represent the most important institutional collection at Charles University.

The herbarium collections are part of the Global Plants Initiative, which is the world's largest project aimed at digitalising plant type specimens. They can be accessed through JSTOR Global Plants and also through the JACQ Virtual Herbaria web interface – a consortium of herbarium collections primarily from Central Europe that is managed by the University of Vienna. In the JACQ, there are currently over 30,000 herbarium entries from the PRC collections, of which 5,000 include freely accessible high-resolution scans. The herbarium collections, alongside other faculty institutions, are a member of the European Consortium of Taxonomic Facilities (CETAF), which is a taxonomic research network formed by institutions of reference in Europe holding 80% of the world's described biodiversity as specimens, collections and the related data.

The Charles University Herbarium collections support scientific research and educational activities of various departments at the Faculty of Science as well as a number of other national and international institutions by providing material for study and enabling professional permanent storage of specimens for studies carried out on all groups of plants and fungi, and by facilitating international exchange of plant study material. The scientific research activities of the herbarium collections encompass the areas of systematics, ecology and paleoecology, evolutionary biology, global change, phyto – and phylogeography and phylogenesis of select groups of plants and fungi. The Herbarium collections staff are involved in various educational and tutoring activities at the Department of Botany and provide methodological assistance related to the herbarisation and preservation of voucher specimens representing an indispensable research tool for a reproducible science focused on the diversity of plants and fungi in space and time.



(photo: Petr Jan Juračka)



(photo: Petr Jan Juračka)



# Hrdlička Museum of Man

The Hrdlička Museum of Man is a university museum that has been part of the Faculty of Science ever since its inception. The museum's permanent exhibits present the evolution of humans and our relative species, the development of individuals (ontogenesis) and human variability, and the final exhibit focuses on pathology and death. This arrangement is based on the original concept of the museum's founder, Aleš Hrdlička.

The Hrdlička Museum of Man is the culmination of many years of work of renowned Czech anthropologist Aleš Hrdlička (1869–1943), in cooperation with distinguished scientists Jindřich Matiegka and Lubor Niederle and also with the support of the first Czechoslovak president Tomáš Garrigue Masaryk. From the very beginning, the project was fraught with complications that prevented the Museum of Man from being realised to its full extent. The first mention of the idea of founding a museum dedicated solely to man can be found in Aleš Hrdlička's correspondence as early as in 1922. With the support of leading Czech anthropologists Jindřich Matiegka and Lubor Niederle, he officially presented the idea of establishing a Museum of Man to the first Czechoslovak president.

Below is an excerpt from a letter addressed to Tomáš Garrigue Masaryk:

*"It is an irony of fate that each country has its own museums of animals and everything that man has done, but not a single one, due to the influence of deep-rooted dogmas, has yet produced a museum of human phylogeny, ontogeny, variation and physical development. And in the meantime, entire interesting human generations are lost by extinction, mixing and change under the influence of new conditions."* 22 March 1929

Aleš Hrdlička was also the main financial donor. In 1922 he had established funds (the Aleš and Marie Hrdlička Fund) to support Slavic/Czechoslovak anthropology. Hrdlička and his two greatest colleagues, J. Matiegka and L. Niederle, supervised the allocation of funding for young scientists and financing publications and research. For the Museum of Man project alone, Aleš Hrdlička donated one million crowns, primarily in the form of securities. Due to financial problems caused by the Great Depression in the 1930s, the institution never took the form Hrdlička intended. It was not able to secure its own building, and therefore the exhibition was provisionally housed in the Anthropology Institute of Hrdlička's friend Jindřich Matiegka. Despite the space constraints, the exhibition faithfully retained Hrdlička's concept. The museum, as proposed by Hrdlička, was conceived to reflect humanity in every way. It was composed of four sections: phylogenetic and ontological development, race variability

and a section called Pathology and Death. Hrdlička also played a major role in financing the museum's operation (Hrdlička's funds), as well as acquiring exhibits, many of which he brought from his expeditions. Other exhibits were obtained during the expeditions of researchers J. Šebesta, V. Suk and J. Malý. Extensive skeletal material was obtained by J. Matiegka.

The Museum of Man was first opened to the public on the occasion of the 4<sup>th</sup> International Congress for the History of Real and Technical Sciences on 22 October 1937. The festive event was clouded by the death of T. G. Masaryk, who was a patron of the project and was to take part in the opening ceremony. As an expression of respect and mourning, the museum was opened to congress participants in complete silence without any fanfare. In December of the same year, the museum was renamed the Hrdlička Museum of Man.

The museum remained open to the public until 17 November 1939 when it was closed along with Czech universities. Later on, during the 1940s, it became part of the Institute for Racial Biology (*Institut für Rassenbiologie*) and the exhibition was modified according to the Nazi ideology. The schematics and descriptions of the exhibits were translated into German. Fortunately, the Second World War did not affect the museum collections severely.

After 1945, the museum reopened thanks to Jiří Malý and Vojtěch Fetter. Its operation was significantly limited due to a lack of funding. The original funding from Hrdlička's funds disappeared during the Second World War. In 1953, the museum was moved from the building in Prague's Albertov quarter to an empty space originally belonging to the German University Institute of Natural Sciences in Viničná Street.

The museum currently has just two exhibition rooms measuring a total of 130 m<sup>2</sup>, but despite the limited space, it retains the original concept designed by Aleš Hrdlička. For decades, a visit to the museum has been part of the standard biology and anthropology instruction at elementary and secondary schools and universities. Guided tours are given regularly, along with themed workshops. Artists are also invited to let their works interact with the museum's permanent exhibition, providing a bridge between science and art for today's visitors.

The Hrdlička Museum of Man is a cultural landmark of a unique character. It is important for its historic tradition and continuity, as well as its direct ties to the academic environment, which enables the involvement of scientific research. The mission of the museum is to educate and engage the public, students, scientists and artists and provide a place where they can meet.



# Chlupáč Museum of Earth History

## History

The Chlupáč Museum of Earth History (CMEH) is a university museum created as part of the reorganisation of the original collections of the Institute of Geology and Palaeontology of Charles University's Faculty of Science. It serves primarily for teaching and research in the fields of historical geology, stratigraphy, palaeontology, general geology, regional geology and other associated fields.

CMEH opened to the public in its current form on 1 January 2009. However, its geological and palaeontological collections have been part of the Faculty of Science since its founding in 1920. Prior to that, they were kept at the various departments of the Faculty of Arts of Charles-Ferdinand University, under which natural sciences were originally organised (both the Czech and the German parts). A presidential decree in 1945 abolished the German university and its property was transferred to the Czech-speaking Charles University and other institutions. This brought many new exhibits to our collections. Given the increase in the number of items in the collections, the capacity of the original collection premises was no longer sufficient and the east courtyard of the building at Alber-

tov Street 6 was enclosed in the 1950s, creating space for exhibits and the storage of new collections. However, the collections continued to only be accessible to staff, Faculty of Science students and experts. During this period, the collection premises deteriorated, which is why it was decided to renovate them. The space was renovated between 2004 and 2007 when the exhibition was separated from the storage. After the installation of the exhibition in 2008, it was decided to open the space to the public, albeit on a limited basis only. In conjunction with this, the collection was renamed the Chlupáč Museum of Earth History.

CMEH was named in honour of Professor Ivo Chlupáč, an important Czech geologist and palaeontologist who worked at Charles University's Faculty of Science in the 1950s and 1990s. This world-renowned scientist strongly advocated the renovation of the geological-palaeontological collections which, after years of inadequate maintenance, were in a dilapidated state. Unfortunately, the renovation did not take place until after his death in 2002, which is why we wanted to honour him by naming the museum after him.



A view of the central part of the museum, dominated by a replica of the skeleton of an Upper Cretaceous dinosaur of the *Carnotaurus* genus. (photo: Petr Jan Juračka)





A diorama dedicated to models of Carboniferous arthropods, reaching enormous size due to specific conditions. The photo shows a life-size model of the genus *Arthropleura*. (photo: Petr Jan Juračka)



A view of a showcase dedicated to Prof. Chlupáč. Detailed notes in the field diary of the then grammar student Ivo Chlupáč (the pages listed are from May 1948). (photo: Petr Jan Juračka)



Lower Cretaceous diorama with a fossil shell of the Madagascar ammonite of the genus *Kranosphinctes* and a replica of the skeleton of a South American pterosaur of the genus *Anhanguera*. (photo: Petr Jan Juračka)

The exhibition consists of approximately 1,000 exhibits, genuine fossils, fossil replicas, models and pictorial reconstructions that document the development of the Earth with respect to living and inanimate nature. Everything is accompanied by information boards. The exhibition includes a notional timeline as well as examples of uniquely preserved fossils (including imprints of soft tissues). All this is supplemented with dioramas showing palaeo-ecological examples of select periods. The gallery is used for temporary themed exhibitions. The CMEH depository contains hundreds of thousands of samples of fossil material

that is available to researchers from Czechia and abroad. The museum collection includes original paintings reconstructing prehistoric life, painted during the late 1930s and 40s by Zdeněk Burian under the guidance of Professor Josef Augusta.

Since its opening ten years ago, CMEH has become very popular among elementary and secondary school teachers who use the museum to supplement their instruction in the fields of geology and biology. Despite the limited hours that the museum is open to the public, it has hosted several hundred tours for thousands of visitors.

# Library of the Biological Sciences



The Library of the Biological Sciences located on two galleries offers its users over 30 PCs with full internet access. (photo: Petr Jan Juračka)

The Library of the Biological Sciences is a modern information and library facility that serves primarily the needs of the staff and students of the Biology Section as well as the entire professional community. Along with the libraries of other Faculty sections, it is a part of the information system covering all the fields of instruction and research at the Faculty of Science.

The Library of the Biological Sciences consists of three separate libraries: the main Biology Library (Viničná Street 7, 1<sup>st</sup> floor, the centre for most library services) and two department libraries – the Botanical Library (Benátská Street 2) and the Library of Department of Philosophy and History of Science (Viničná Street 7, ground floor).

The library's stock consists of both standard paper documents (books, printed series, textbooks, theses) and electronic information resources (electronic magazines, e-books, databases). The electronic resources are accessible either directly (based on authorised IP addresses) or remotely (EZproxy or Shibboleth services, where authorised users are verified based on an account in Charles University's Central Authorisation Service).

To satisfy the information needs of its users, the Biology Library offers modern library services such as:

- Loan services for printed documents. The rules for borrowing are uniform throughout Charles University. The basic principle is that a status is assigned to every reader and library item in the system. Based on the status, the system determines loan parameters (the duration of the loan, number of possible extensions, etc.).
- The library also regularly offers interlibrary loan services ("MVS"), including loans from foreign libraries ("MMVS"). From the reader's perspective, the loans are always arranged directly at the library; a document not available in Charles University's catalogue is requested (in person or by e-mail) from another library, then delivered to the Biology Library and the reader can pick it up. MMVS can also be arranged through the National Library, but there is no difference from the reader's perspective. Again, everything takes place at the Biology Library.
- Access to electronic information resources ("EIZ"). As mentioned above, the right to direct access is controlled based on IP addresses. All computers in the libraries can be used to access licensed EIZ, and the Eduroam network can also be used for the same purpose (there is a WiFi connection available throughout the library).
- Graphic reproduction services – the Biology Library offers self-service copying on multi-functional equipment (with payments through the MyQ system) and free scanning; similar services are also available at the Botanical Library (with cash payments).

Library items (mostly paper documents and also certain EIZ) are catalogued in the Aleph automated library system designed by ExLibris of Israel. Documents are processed in MARC 21 format using the RDA standard for cataloguing rules. The complete catalogue of the library (OPAC) is accessible online and serves as a common catalogue for all libraries of Charles University (at [ckis.cuni.cz](http://ckis.cuni.cz)). The overarching discovery system, including the catalogue as well as related information resources, can be found at [ukaz.cuni.cz](http://ukaz.cuni.cz).

In addition to the latest publications in the fields taught within the Biology Section, the Biology Library buys access to roughly twenty trade journals not included in the large university-wide packages. These titles are then accessible to the entire Faculty of Science. On the other hand, the extensive collection of library material reaches back into the relatively deep past, built upon the collections of important researchers at the turn of the 20<sup>th</sup> century (e.g. A. Mrázek, J. Matiegka and others). The Biology Library seeks to collect a broad base of knowledge in diverse biological disciplines and offers useful tools for all those who study them.

# Library of the Chemical Sciences



(photo: Petr Jan Juračka)

The library, originally called the Central Library of the Chemistry Departments, then the Professional Library of Chemistry and now the Library of the Chemical Sciences, is the library of the Chemistry Section of Charles University's Faculty of Science. Its stock contains books, textbooks, magazines and theses focusing on disciplines studied in the chemistry section, i.e., primarily on chemistry. The book stock also covers other related fields such as medicine, mathematics, physics, didactics, linguistics and much more.

The Institute of Chemistry invests considerable resources into procuring trade journals and databases; all are accessible online both on the premises of the Library and remotely. The library obtains documents that are not part of its collection through the interlibrary loan service, which is available to all readers, from both Czech and international libraries. In recent years, the library has undergone tremendous development and modernisation, both in terms of its book stock and premises, as well as services and its general functioning within the Faculty.

The library has retro-catalogued its entire stock. Separate department libraries were closed and their stock incorporated into the main library. Duplicate entries were eliminated, records unified, and the general clarity of the stock improved.

The stock has collected theses from the entire Institute of Chemistry, catalogued them and made them ready for perusal in the library reading room. RFID protection for the stock has been installed. Great attention has been paid to acquisitions and the entire stock has been modernised. Old and degraded prints have been repaired or

replaced. A great deal of professional literature in Czech and English has been purchased on an ongoing basis. Since 1 June 2017 the library has been located in a new building built in the courtyard of the Institute of Chemistry in Hlavova Street in Albertov. Its construction took two years and the library actively cooperated with the architect. The building is fully adapted to the needs of a modern library. Thanks to the new premises, the number of seats increased to the current fifty. The library also has a terrace with sunshades and surrounded by greenery, creating a lovely environment for students, academicians and the general public to study or relax. The terrace provides an additional 30 seats for studying.

A great number of educational events are held at the library such as workshops and lectures for students of the Institute of Chemistry, for doctoral students of the entire Faculty, and popular educational lectures for the general public. Librarians read lectures on information literacy as part of the new subject, Chemical Information Resources. They are also invited to give one-time lectures.

At its own cost, the library published the General Chemistry textbook (*Obecná chemie*) by Jiří Vacík. The entire press run sold out in 2018, so the first reprint was ordered in 2019.

In cooperation with the departments, the library organises an Open House, three grade levels of all-day workshops for secondary schools (Heyrovský, alchemy, periodic table), it opens to the public during Prague's Museum Night and Science Night, and organises two or three public exhibitions every year. The library also serves as a place for informal meetings such as art openings, concerts, important anniversaries and more.



# Geographical Library



A view of the original library and study room in the Geographical Library. (photo: Geographical Library FSc CU archive)

The origins of the Geographical Library date back to 1885 in Spálená Street. With the establishment of the Geographical Institute in 1891, the library moved to new premises on Charles Square. The passion of the founding fathers of this field is evidenced by the fact that Professor Václav Švambera volunteered as a librarian. Core acquisitions consisted of gifts and swaps since financial support from Vienna was rather low. Professor Švambera also played a major role in the construction of the building for science programmes at Albertov Street 6, into which the Geographical Institute moved in 1914. Here, the library was given a hall with an area of 133 m<sup>2</sup>. With the construction of the east wing, the Geographical Institute expanded the library, adding another room of 105 m<sup>2</sup>. Professor Švambera paid great attention to the bibliography in the field, which he also published himself. Czech universities were closed during the Second World War. The post-war period was associated with acquisitions from the Geographical Institute of the abolished German University. Little information is available on the period from 1950 to 1990. It is known that the unique collection was named the Basic Geographic Library. In 1993 it took over the library-collection of the abolished Geographical Institute of the Czechoslovak Academy of Sciences. The library underwent major reconstruction in 2005, when it was expanded to include a second study room. This was followed by the construction of a depository and the relocation of collections to the university storage facility at Lešetice near Příbram. With a collection numbering 105,000 volumes and 800 titles of printed periodicals, it is among the largest Czech

specialised libraries. The collection covers subjects such as physical geography, cartography, demography and social geography, and regional geography of Bohemia as well as foreign countries.

The library houses a picture gallery of the founding fathers of geography made by painter Zdenka Landová (2005) as a permanent exhibition on its premises.

There are more than 35,000 documents in the open shelf collection of the collection. Regular library activities are associated with acquisitions, loan services and organisation of the library collection, but there are a lot of other activities as well. Traditionally, this involves swaps with global geographical institutions for the *AUC Geographica* trade journal. Annually, the Geography section spends roughly one million crowns on acquisitions. In the electronic catalogue, 44,000 bibliographic records are available with 77,000 physical items. A significant portion of the documents are found in electronic databases. Nevertheless, the library remains heavily frequented. Items can be checked out 42 hours a week. Each year, 17,000 readers are served. The reading room can accommodate 50 people and the 14 computers are constantly occupied.

With the support of the Ministry of Culture of the Czech Republic, the library has been able to amass the largest non-commercial geographical bibliography online with 223,000 records and 55,000 full texts. The library has organised 10 of its own exhibitions, 27 section exhibitions and arranged the loaning of 72 exhibitions throughout Czechia. Exhibitions are also available in digital form.

# Library of the Geological Sciences



Free selection. (photo: Petr Jan Juračka)

The Library of the Geological Sciences is one of the five specialised libraries of Charles University's Faculty of Science. With a stock of almost 191,000 tomes, it is one of the largest geology-oriented libraries in Czechia. It provides information support to a prestigious interdisciplinary activity that integrates science on living and inanimate nature.

The library resides on the elevated ground floor of a heritage building at Albertov Street 6. It serves primarily students and academics of the Faculty of Sciences' Geology Section and other experts. The historical core of the library is the book stock from the former Geology-Paleontology Institute of the German University from 1877–1944 and the book stock of the Institute of Geology of the Czech-speaking Charles University built since its inception in 1920.

The book stock is updated on an ongoing basis with new acquisitions and revisions. Aside from printed documents, the library also provides access to electronic resources through licenced databases as well as to individual narrowly specialised periodicals. The library underwent a major overhaul in 2015, resulting in a new reading room with open-shelf access and renewed computers and copiers. As part of the overhaul, the library purchased a multi-purpose device for self-service copying, scanning and printing including a MyQ terminal for cashless payments and a station for topping up the credits on students' cards.

A RFID system and a video surveillance system were deployed for stock identification and security. In addition to open-shelf reading room equipment, a new computer table was procured and old computers were replaced by eight virtual terminals. The overhaul also resulted in a new librarian workplace, material storage room and lockable cabinets for library users. The newly furnished library was officially opened on 28 January 2016.

The library underwent additional modifications in subsequent years. The book stock available in open shelves was sorted into individual collections based on the various divisions of geology and related areas. The formerly closed open-shelf gallery was refurbished and opened for readers in 2018. Basic library services were enhanced with the addition of complementary services such as self-service wire binding, telescopic tube loaning and on-site loans of USB chargers. The library also provides space for trips, exhibits, traveller slide shows and concerts. One of the most successful events, the exhibit *Radim Kettner, the Founder of Modern Czech Geology* marked the 50<sup>th</sup> anniversary of the death of Professor Radim Kettner, a premier geologist who significantly enhanced the library with the generous legacy of his lifelong collection of monographs and excerpts. In 2019, the library joined a series of events held to honour the legacy of palaeontologist Joachim Barrande on the occasion of 220 years since his birth and prepared an exhibit on his life and work in cooperation with the Institute of Geology and Paleontology. The exhibit was a huge success with both experts and the general public.

The Library of the Geological Sciences is very popular with filmmakers for its ancient atmosphere. Films shot there include *Green Horse Rustlers* about Moldavite seekers, the *Neviditelní (The Invisibles)* show and Czech TV's documentary about the first Czech dinosaur find, *Smrt na kutnohorské pláži (Death on the Kutná Hora Beach)* from the series *Záhady přírodovědy (Science's Mysteries)*.

The library continues work on revising and retro-cataloguing collections in depositories, mainly rare early prints from the 18<sup>th</sup> and 19<sup>th</sup> centuries, and also on enriching its current book stock.





Prof. Kettner Study Room after its reconstruction, which The Library of the Geological Sciences underwent in 2015. (photo: Petr Jan Juračka)





# Map Collection

The Map Collection of the Faculty of Science is significant both in terms of its well-preserved historical interior and content. It contains around 130,000 map sheets, 3,500 large-format atlases, 97 globes, 4,000 glass negatives and 10,000 monographs and magazines. A third of this collection consists of rare cartographic prints pre-dating 1850. The Map Collection brings together the most important Bohemian and global cartographic artefacts of the last 500 years and is one of the most important university collections in Central Europe. This is further underscored by the entry of the Czech-Maltese nomination of G. F. Camocio's news maps of the Siege of Malta (1565) in the UNESCO world heritage register in 2017.

## History of the Map Collection

Professor Václav Švambera founded the Map Collection. He intended to amass a collection of European significance. The Ministry of Education honoured his application and approved the establishment of the State Map Collection of the Czechoslovak Republic on 29 November 1920. In 1953, it was incorporated in the reorganised Czechoslovak Academy of Sciences (ČSAV). Following the dissolution of the ČSAV Geography Institute in 1993, the collection returned to its original owner, Charles University.

The collection was placed in a hall measuring 21 × 6.5 m where it has been continuously to this day. The actual original historical premises are one of the most sought-after curiosities of the Collection.

## Contents of the Map Collection

The atlases from the Renaissance period of cartography are very valuable, spanning from the Dutch school all the way to modern thematic, national and regional atlases. The Ptolemy edition from 1520 is one of the oldest atlases in the collection. The first modern Ortelius' atlas, *Theatrum Orbis Terrarum* published in Antwerp in 1570, is also included in the collection. Furthermore, there are maps by Mercator-Hondius (1633) and Janssonius-Blaeu's eleven-volume *Atlas maior* published in Amsterdam (1658). The oldest dated maps of the collection depict the layout of Rome, whether it is Tramezzine's *Urbis Romae* from 1552 or Lafréri's *Rome* from 1557. Experts did not discover certain unique maps until their digitalisation. These include Gijsbertsz's map of Europe (1598), De Wit's *Germania* (1648) and the aforementioned Camocio's map of the Battle of Malta. Maps of the Czechoslovak territory include the derivatives of Klaudyán's and Criginger's works as well as originals by



Individuals and groups can always visit the historical hall of the map Collection and Kuchař Gallery of Cartography on Wednesdays. However, it also opens on the Prague Museum Night, Days of Geography and other special occasions. (photo: Petr Jan Juračka)





The research room of the Map Collection is always open on Tuesdays and Thursdays during the school year. Old maps can only be viewed under special conditions. (photo: Petr Jan Juračka)

Aretin, Vogt, Stich, Müller, Fabricio, Komenský, Lazar, Lazius and Mikoviny up to the era of military mapping. The manuscript originals of the 3<sup>rd</sup> military mapping (1876–1879) are very valuable.

The maps of Prague and other European cities also form an extensive collection. The collection of globes is fairly comprehensive. The most valuable ones come from the publishing house of Willem Janszoon-Blaeu (1599) and from Jodocus Hondius (1613). The pneumatic globe by Philipp Cella from 1831 is also unique; it rests inconspicuously folded in a 9 × 21 cm box, but inflates to 113 cm in diameter. The oldest preserved monograph is Münster's *Cosmography* (1578).

### New Development of the Map Collection

A new concept for the revival of the closed Map Collection was approved in 2010.

The Geography Section of the Faculty of Science began an extensive reconstruction that took three years. On 26 March 2013, the Collection and the Kuchař Gallery of Cartography were inaugurated to the public. The exhibition presents reproductions of works from the Collection and the main European schools of cartography.

The Map Collection manages its stock and provides acquisition, cataloguing, loaning and consultation services. In addition, it offers the opportunity to research and study the collected documents.

### Science and Research

Although the collection was previously described in card catalogues, the records were not accurate. In 2010, work began on entering descriptions of items into Charles University's Central Catalogue. Thanks to grant support from the Ministry of Culture of the Czech Republic, catalogu-

ing methodologies were created and 60,000 bibliography entries made, generating metadata for online access to 65,000 digitalised maps.

Users can access them through the University's Digital Repository, which displays up to 650,000 maps annually. The Digital Map Collection provides higher quality of images that allows for zooming and downloads. Maps have also been incorporated into e-Sbirky, the EUROPEANA European digital library and the global portal for digital map collections, Oldmapsonline.org.

The mapovasbirka.cz interface offers additional content such as a globe collection, a set of models, and links to Czech cartographers' websites with full texts and maps.

### Exhibitions

The Collection has organised several separate touring exhibits presenting the newest research into historical cartography. Among the most notable are *Poklady Mapové sbírky (Treasures of the Map Collection)*, *Jan Felkl a syn (Jan Felkl and Son)*, *Mapy obležení (Siege Maps)* and *Mikuláš Klaudyán: první mapa Čech 1518 (Mikuláš Klaudyán: The First Map of Bohemia 1518)*. These activities are accompanied by publications and lectures.

### International Cooperation

The Map Collection staff cooperate with foreign partners at universities, in the academia and in the media. Numerous assets have been obtained as gifts and swaps. E. Novotná is a national correspondent for the prestigious international periodical for historical cartography, *Imago Mundi*, chairwoman of the UNESCO open platform for cartography documents, a member of the Map & Geoinformation Curators Group and scientific council of the International Cartographic Association: Commission on Cartographic Heritage into the Digital.



# Mineralogy Museum

The origins of the collection of today's Mineralogy Museum of the Faculty of Science can be traced back to 1775 when a royal cabinet of natural specimens was established at the university in Prague (then Charles-Ferdinand University) at the insistence of Lieutenant General Franz Joseph, Count Kinsky (1739–1805) and expert and mineral collector Ignaz von Born (1742–1791). Its core was the collection of minerals dedicated to Kinsky and then to other nobles, such as Prince Charles Egon Fürstenberg, the Highest Burgrave of Bohemia. Famous Czech naturalist Jan Svatopluk Presl (1791–1849) and well-known mineralogist August Emanuel Reuss (1811–1873) also took part in organising and expanding the collection.

The royal cabinet of natural specimens (*K. k. öffentliche Naturalien-Cabinet*), also referred to as the Czech Museum, was initially located on the ground floor of the Klementinum below the university library, where it remained for a century and was even open to the public. In 1880, the Mineralogical Institute, led by Prof. Victor L. von Zepharovich (1830–1890) at the time, relocated with its collections to a new building at Viničná Street 7 (the headquarters of the Biology Section of the faculty today). After the division of the university into the Czech and German sections (1882), the entire collection became part of the German University in Viničná.

The collection of the Czech University was then started from scratch by Prof. Karel Vrba (1845–1922). It was based on the large collection of minerals purchased from the heirs of Prague brewery owner J. M. Šáry. Later on, Vrba purchased a collection from the estate of Count J. F. A. Buquoy; it was purchased for the National Museum, but a part was given to the university collection, which continued to expand through collection, gifts and purchases.

Vrba's work was continued by his successor at the Mineralogical Institute, Professor František Slavík (1876–1957). The collection was originally housed in the Kaulich building on Karlovo náměstí that no longer exists. In 1914, it was moved to a newly constructed building in Albertov where it remains today. After the Second World War, the German University was closed and its collection was divided between the Mineralogy Museum and the National Museum, but many specimens from both collections were damaged or lost as a result of relocation and improper storage during the war and immediately after it. Following Professor Slavík's tenure, the merged collection was managed by Faculty of Science professors Josef Kratochvíl (1878–1958), Jiří Novák (1902–1971), Rudolf Rost (1912–1999) and František Čech (1929–1995). A great deal of cataloguing work was carried out by Dr. Karel Tuček (1906–1990). After the death of Professor Čech, the collection was managed by Pavel Kašpar (\*1942) and Marek Chvátal (\*1972).

The collection currently contains over 22,000 items. It is housed in two rooms on the first floor of the building at Albertov Street 6, known as the Mineralogy Museum. More than 2,000 specimens are exhibited in display cases and, with a few alterations, the exhibition has been maintained in its original and extremely pleasing aesthetic layout. The collection is used primarily for research and teaching purposes. In addition to researchers and students of geological sciences, the museum is a popular destination for elementary and secondary school students whose teachers appreciate particularly the clarity and breadth of exhibits on display.

The Mineralogy Museum can be toured and is open to the public by prior arrangement.



(photo: Petr Jan Juračka)



(photo: Petr Jan Juračka)



(photo: David Herel)



(photo: Petr Jan Juračka)

# Periodic Table of Elements

UNESCO declared the 2019 to be the International Year of the Periodic Table of Chemical Elements in honour of the 150<sup>th</sup> anniversary of the discovery of the periodic system of elements by Dmitri Ivanovich Mendeleev, which laid the foundations for the periodic table of elements as we know it today. Mendeleev's discovery has special significance for the Faculty of Science because of his close cooperation with one of the founders of the Chemistry Section of the Faculty of Science – Professor Bohuslav Brauner.

Professor Mendeleev published his table, or more precisely, the periodic law upon which it is based, in 1869, first in Russian and soon after in a leading German chemistry journal. He arranged the elements according to the increasing relative atomic weight and also with respect to similarities in their chemical reactivity. By obtaining seven periods of chemical elements he postulated the law that "the properties of elements are a periodic function of their atomic weight". As is often the case with great discoveries, the same relationship was also discovered in the same year by German chemist Julius Lothar Meyer.

Several contributions to the periodic table were also made by Czechs, the most significant of which is that of renowned Czech chemist and professor at the Faculty of Science, Bohuslav Brauner. He was introduced to Mendeleev in 1881 and they remained lifelong friends. Brauner wrote over 30 papers related to the periodic table, determining the exact atomic weights of a number of elements, thus confirming Mendeleev's conclusions. Mendeleev visited Brauner in Prague in 1900 and in 1902, he proposed an important modification of the periodic table by including the lanthanide group. Today, the largest auditorium of the Chemistry Institute of the Faculty of Science bears Brauner's name. Another Czech connection to the periodic system is the fact that the uraninite used by Marie and Pierre Curie to isolate two new elements (radium and polonium) originated from mines near the town of Jáchymov in Bohemia.

We are happy to have been able to make our dream reality by building a nearly 3 by 2 metres large exhibit of the actual samples of the chemical elements, arranged consistently with the contemporary version of the periodic table of elements as presented by the International Union of Pure and Applied Chemistry. Thanks to the support from the Chemistry Section and the tireless work of many people, the unique interactive Periodic Table of the Elements was finally created. The table contains samples of all the elements with non-radioactive nuclides from hydrogen to bismuth (with the exception of extremely reactive fluorine).

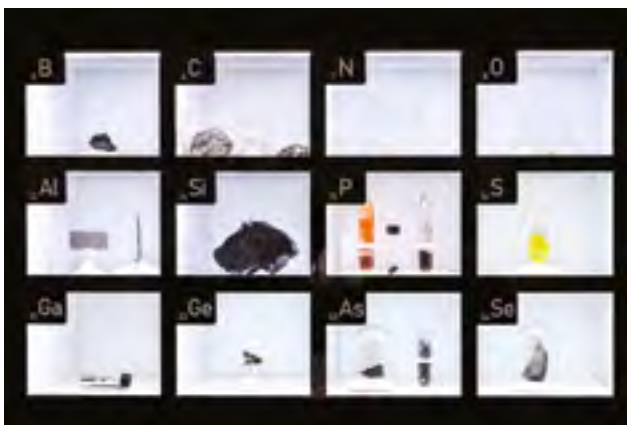


Chromium, which is visually one of the most attractive samples, was paradoxically created by chance during industrial chrome plating. (photo: Petr Jan Juračka)





A view of the Periodic System of Elements interactive exhibition, placed in front of Prof. Brauner's lecture room at the FSc CU's Institute of Chemistry. (photo: Petr Jan Juračka)



A detailed view of the periodic table, showing a part of the samples of elements in various exhibited forms. From gases in discharge tubes (N, O), freely exposed elements (B, C, Si, Ge) to more reactive or toxic elements closed in an inert environment (Al, As, P). (photo: Petr Jan Juračka)



A discharge generated in a tube filled with krypton emits the violet light that is characteristic of it. (photo: Petr Jan Juračka)

Highly reactive elements such as caesium are kept under an inert atmosphere of argon. The samples displayed in the table were selected to provide a good representation of the individual elements, and in some cases also their allotropic modifications.

The elements in the periodic table are arranged into seven periods based on their increasing atomic number (number of protons in the nucleus) and into eighteen groups according to their similarities in chemical reactivity. For example, the elements lithium, sodium, potassium, rubidium and caesium, which exclusively appear in compounds with an oxidation number of +1, are in the first group.

Interactivity is provided by a touch screen with intuitive controls that give users more detailed information about the individual elements, as well as variable colour highlights in the individual element cells to help visualise important trends in element properties throughout the entire table, such as differences in electronegativity, density, melting point and even the year of discovery.

By combining the interactive interface with visually appealing samples of the elements, we use the periodic table to not only instruct future chemistry teachers, but also to motivate students. The exhibition has also become popular destination of elementary and secondary school field trips.





A red-tinted photograph of a grand ballroom. In the foreground, a large, ornate chandelier hangs from the ceiling. The room features high ceilings with decorative panels and large arched windows. In the background, a group of people, including men in suits and women in formal dresses, are dancing. The overall atmosphere is elegant and formal.

# Student and Faculty Life



# Student Life

The Faculty of Science of CU has long supported various activities in student life that range from official faculty-wide events, specific student activities, creating conditions for meetings to the activities of student associations. Throughout the year, students take part in a wide range of activities in various roles, whether as active organisers, co-organisers or participants in individual events. The Faculty systematically provides organisational and financial support to student activities, and at the same time allows students to actively participate in work on the content and form of the individual events, following the principle 'You've made your bed, now lie in it'. Since students of the FSc CU are traditionally active, the student life of the Faculty is varied. Some activities and events have been taking place for many years, others are constantly developing and changing.

The representative ball of the Faculty of Science traditionally belongs to the most popular events shaped by students themselves. One of its traditional highlights is the *Studentský velemlok* (Giant Salamander) Award for the best teachers. Other new events organised under the auspices of the Student Chamber of the Academic Senate (SKAS), which have proved very popular, include the vol-

untary spring cleaning on Albertov slopes, focused on the care and maintenance of the landscape around the stairway at Albertov, as well as the Naturalists to Themselves event in which participants have the opportunity to learn about student associations and ask about anything they want to know about the study or operation of the Faculty. The *Věda je krásná* (Science is Beautiful) competition, in which students hand in their works of scientific photography and illustrations, gains more and more popularity and is, like many other PR activities, organised by the Public Relations Department.

The things that have definitely undergone the greatest changes in the last ten years are the venues for informal meetings of students, such as *Mrtvá ryba* (Benátská Street 4), a student club and bar which, since its reconstruction in 2012, has been a very popular meeting point for students and teachers. Other places for informal meetings and some food or a bunch of drinks include *Bistro Živina* and the adjacent student club (Albertov Street 6, ground floor), which have been open since 2014, and last but not least, *Chladič*, a cool venue for students situated in the basement of the Institute of Chemistry in Hlavova Street 8. In addition to the student clubs, faculty museums or col-



A hydrobiological excursion led by Martin Černý. Field excursions make a nice change to students' curricula. (photo: Petr Jan Juračka)



Sdružení Arachne, z.s. is an association that organises various trainings for high school students under the auspices of the Biology Section of the Faculty of Science of CU. (photo: Vojtěch Duchoslav)

lections are also worth visiting. On presentation of a student ID card, admission to the institutions, such as the greenhouses of the Botanical Garden of the Faculty of Science, the Chlupáč Museum of the History of the Earth or the Hrdlička Museum of Man, is free of charge for the FSc CU students.

### Student Associations

Student associations, covering both the areas of professional life and sport and cultural activities, represent the authentic platform for the development of FSc CU students' activities.

Professional associations are a traditional part of the life of each section of the Faculty and their activities are primarily focused on science and popularisation of individual disciplines cultivated at the FSc CU. For example, the Biology Section runs the *Biozvěst* Correspondence Seminar, the Biological Club for High School Students, *Arachne* Association and the Fluorescence Night. The Chemistry Section offers the KSICHT, a correspondence seminar inspired by chemistry issues. Students of the Geography Section meet in EGEA, the European Association of Students of Geography and Young Geographers. Demographers are associated in the Student Demographic Club. Geology students get together in several associations, such as the SGA Student Chapter Prague, GAL (Geology Academic League), or Charles University in Prague Geophysical Association (CUPGS) and participate in their activities.

Sport-loving students are traditionally involved in a number of Faculty sport clubs. The *HC Přírodověda UK* ice-hockey

team is unique in that it was formed thanks to a spontaneous interest of the students themselves. It has quickly become popular and gained support across all sections of the Faculty. Both the *Přírodní vědy Praha* softball team and the FSc CU floorball team have a long tradition. The students have a choice from other University's sports clubs (VSK), e.g. the *VSK Přírodověda Praha* walking club, the *VSK Přírodní vědy UK Praha* volleyball club, and the *VSK Přírodní vědy UK Praha* mountaineering club. The Department of Physical Education at the Faculty of Science, which provides the teams with professional guidance and facilities, plays a key role in the life of all sports teams. There are also two amateur student theatre companies at the Faculty of Science in which several generations of students have played: the Theatre Company *Hamba*, established in 2006, with its performances mostly shown in the great auditorium of the Institute of Chemistry, and *Viníci* Theatre, established in 2014.

Two student associations focus on community life: the *Přírodověda* Student Union and the FSc CU Erasmus Club, which mediates contact between foreign and domestic students.

The possibilities of student activities are not, however, limited by the imaginary boundaries of the Faculty, as evidenced, e.g., by the great popularity of the Charles University Film Seminar or, e.g., the *Majáles*, a non-commercial student festival. Simply, there are no limits to the involvement in student life at the Faculty or University, and all other activities, ideas or new associations are welcome here.



## Rybička Kindergarten at the FSc CU

The *Rybička* Kindergarten is situated in the botanical garden at Na Slupi, Benátská Street 4, in Prague 2 and intended for children of the Faculty of Science's employees and students.

The basic philosophy of the kindergarten is, "Creating and deepening a loving relationship of children to nature, to other people and to themselves, and their protection".

The kindergarten provides children with a fully-fledged educational programme according to the Framework Educational Programme for Pre-school Education, fully equal to state kindergartens, but upgraded with its unique focus on natural sciences. In addition to science "experiments and discoveries" in the science workshop, children can regularly take care of animals in the small zoo and monitor their behaviour, way of life and eating habits, effectively learning to understand the animals and form a relationship with them. Thanks to regular walks to the botanical garden, the children experience changes in nature throughout the year, participate in the process of growing various plants and trees, help with garden works, sow their own plants and crops in the kindergarten garden and experience what the plants need for their successful growth and what conditions they thrive in. The kindergarten is also focused on environmental protection and sustainable development.

With the total capacity of the kindergarten being 24 children, the kindergarten is intended for children from 2.5 years of age until the start of school. It has been in operation all year round since March 2013, with the exception of a month-long break during summer holidays.

The kindergarten premises consist of two classrooms, each for 12 children, a science workshop, a small zoo with about 10 kinds of animals, a pottery workshop with a furnace, two smaller connected gardens designed in the natural style with recreational equipment, herbal and fruit garden and an aviary with chickens. Since 2016, the garden has been bestowed with a "Model Natural Garden" plaque. The children frequently visit botanical gardens and greenhouses.

The lower number of children in each classroom where two teachers look after twelve children, makes it possible to have a very individual approach as well as to differentiate the educational process with regard to potentially gifted and exceptionally gifted children.

The *Rybička* Kindergarten is not, however, an exclusive club and welcomes other children from among the general public. During the school year, the kindergarten organises hobby groups and activities for children and adults, science clubs for children of pre-school and younger school age and four weeks of summer city kindergarten with various activities focused primarily on science.



Thanks to regular walks to the botanical garden, the children have an opportunity to experience changes in nature throughout the year. (photo: *Rybička* Kindergarten archive)



# Events for the People at the Faculty

The Faculty of Science of CU mainly consists of academics, scientists, teachers and students. Therefore, it is undoubtable the most important events organised throughout the year are international scientific conferences. Nevertheless, the Faculty can also be viewed from another angle, as a community of people who like to meet outside classrooms and laboratories. From this point of view, events that provide some room not only to the academics, but also to other employees, graduates of the Faculty, its supporters or aspiring students are of equal importance. The Faculty responds to modern trends in society and this is why there are more and more events for the faculty and the general public every year.

The Scientific Conference, already organised seven times directly by the FSc CU (the last one in 2015), is an example of an event in the borderland of both layers of the Faculty, with an inter-sectional overlap. During the conference, the Dean of the FSc CU awards prizes for the best theses, dissertations and young scholars and researchers under 35 years of age from the individual sections and from the Institute for Environmental Studies. Since 2016, the prize has been awarded in Karolinum during Christmas concerts.

A large number of faculty-wide events is organised by the Public Relations Department. Its responsibilities range from organisation and coordination of the Open Day in January, faculty balls, which are traditionally held in the early months of the year, Alumni Club meetings and Christmas concerts. Since 2015, the Department has organised the Career Day, a meeting of potential employers who try to attract undergraduates. The Department also takes part in organising most of the major fairs for aspiring students, e.g. Gaudeamus in Brno, Prague and Nitra, or Akademia Vapac in Bratislava, and Gaudeamus in Bratislava since 2019, and the Charles University Information Day, traditionally held in the FSc CU buildings in the Albertov Campus.

The Public Relations Department also coordinates organisation of various events during which individual workplaces, research achievements or scientific goals of the Faculty are presented, e.g. the international events such as the Fascination of Plants Day, Scientists' Night, the City Nature Challenge, all-Prague event Prague Museum Night, and the Festival of Science. Close cooperation with the Czech Academy of Sciences also shows in the presentation of the Faculty at exhibitions held by the Academy – the Science Fair in Letňany and the Week of Science



Traditionally attended by a great number of dance-loving Faculty students and teachers, the Faculty of Science Ball represents one of the highlights of the social life at the Faculty of Science. (photo: Vojtěch Duchoslav)

Technology. We must not forget to mention a very popular public event, the Great Exhibition of Invertebrates in the FSc CU Botanical Garden. Last but not least, concerts (Albertov Open Air), festivals (Slackline Festival, Albertov Fair), and other cultural events, such as the *Kinomol* film screenings held at Albertov, and other events organised for schools, including a meeting of faculty representatives, and popularisation presentations under the auspices of the *Přírodovědci.cz* project.

The individual institutes, departments and sections organise more or less regular lectures and events for the Faculty as well as for the public. Courses of lectures, such as Biology Thursdays and Chemistry Tuesdays, events such as the Geography Week or the Journey to the Depths of Chemistry, predominantly intended for teachers and future students, belong to the most popular ones. Aspiring students can join the faculty in summer training camps, usually organised by Olympiad coordinators, i.e. associations such as *Arachne*, *Kamenožrout* or others, and held in places like Běstvína or others.

# Věda je krásná Competition

Since 2009, ten autumns at the Faculty of Science of CU have witnessed the *Věda je krásná* (Science is Beautiful) photography and art competition. The competition originated from the idea that the general public should also witness the unthought-of beauty and aesthetics that scientists often come across during their research, and the competition has put students, teachers and specialists from various disciplines side by side within such a diverse institution as the Faculty of Science of CU undoubtedly is. The project has grown over the years as to the number of registered authors and entered works, its concept and topics have expanded and opened to the general public as well. This is how the *Věda je krásná* has shifted from the space of the Faculty among young and adult naturalists.

From the very beginning, entries in the competition were divided into three academic categories, i.e. categories for FSc CU's employees and students and ranged from the "Scientific Photography", i.e. objects captured with an ordinary camera, from macrophotography up to satellite or space photos, "Scientific Microphotography", i.e. photos taken with optical and electronic microscopes, and the "Scientific Illustration and Virtual Nature", i.e. science conveyed with a pencil or paintbrush and computer visualisations of physical and chemical phenomena. A category for the general public, called Discoverers, was later added and has been attended by the entrants registered on [www.prirodovedci.cz](http://www.prirodovedci.cz), a popularisation project of the FSc CU.

Even though the entries in all competition categories are evaluated by an expert jury, the general public can also participate via social networks. The winners of the academic categories, annually announced in Karolinum in Prague, receive a money prize, and the winner of the Discoverer category receives a gift from the sponsor of the competition.

The works highly valued by the jury are eventually converted into large-format photographic prints. The panels with photographs and illustrations are then exhibited at the annual opening after the ceremonial announcement of the competition in Karolinum as well as at traveling exhibitions throughout Czechia where the works are lent thanks to the services provided to the general public by the *Přírodovědci.cz* project.

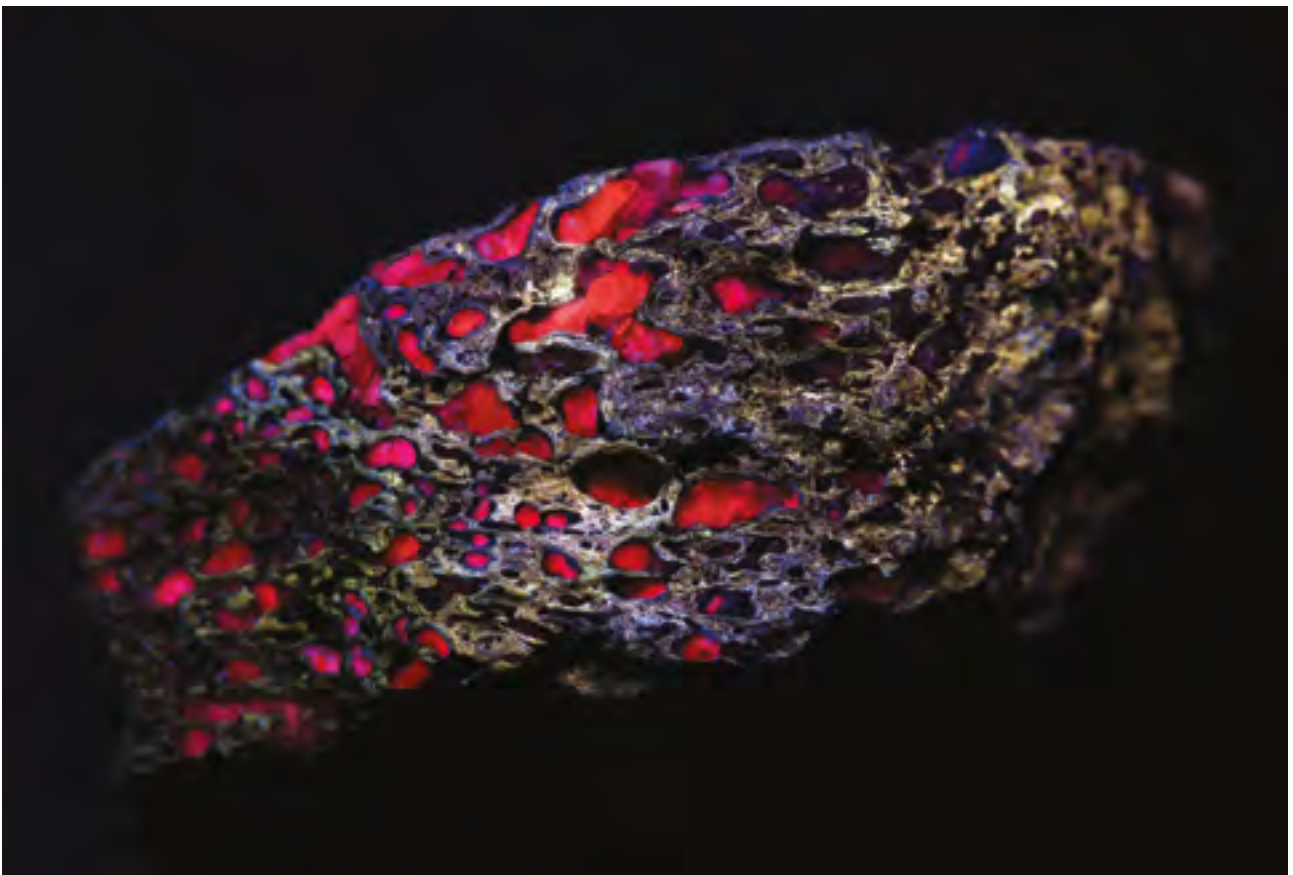
The competition has become very popular not only with the academics but also with the general public and it will surely continue in the future. It has shown us how many Renaissance personages live among natural scientists and that we often have no idea of their works that straddle the line between science and art. And it does not matter if the photographs show yeast, birds of prey, a nebula, a precisely captured 3D interaction of biomolecules, or the bending of light waves in nanostructures. The important thing is that Science is Beautiful.



*Drosera peltata* is a representative of Australian sundews, has shield-like leaves and numerous tentacles on them, is, in contrast to our local *Drosera*, able to thrive through periods of drought, when it uses energy reserves hidden underground in its tubers. (photo: Jana Pilátová)



The *Evarcha falcata* site at Na Plachtě. Their vision of two large and six small eyes is the best of all arthropods. (photo: Michal Štulpa)



The dark side of minerals. In the presence of visible light, we can often admire the incredible shapes and colours of minerals. However, the use of "black light" opens the way to their dark side. Some minerals are capable of luminescence (fluorescence and phosphorescence) and after excitation. The picture shows a dinosaur bone. (photo: Miloslav Macháček)







# Alumni and Graduates



# Alumni of the Faculty of Science of CU

By completing any of the courses of study offered at the Faculty of Science of CU, each student gains a high degree of expertise in their specialisation. Apart from this, however, they also leave the Faculty equipped with another capital – contacts to soulmates, their teachers and colleagues. Preventing these contacts from extinguishing and giving their graduates the advantage of a wide network of professionals bound to one another by studies at our Faculty is the main goal and meaning of the existence of various alumni programmes of universities throughout the world. Not only Charles University as a whole, but the Faculty of Science of CU itself has joined these activities in the last decade.

The first official activity that built the firm ground for the meetings of the faculty and its graduates was laid by the Alumni Albertov, o.s. Association, which was an association of graduates, employees and supporters of the Faculty of Science of CU in Prague, founded on the initiative of Dean Pavel Kovář and Dr. Karolína Houžvičková-Šolcová in 2007. Activities of the Association were primarily focused on supporting and strengthening the sense of community among the Faculty graduates and keeping awareness of their fellowship with the FSc CU. In its final phase, the Association had 314 members and organised a number of smaller events that strengthened the vibrant relationship between the Faculty and its graduates. The Association was formed as a civic association, formally independent of the organisational structure and funding from the FSc CU.

Thanks to the initiative of Dean Bohuslav Gaš, the FSc CU took over the care of its graduates in 2014. Subsequently, the agenda was delegated to the FSc CU Public Relations Department, and the Alumni Albertov Association gradually extinguished. The Faculty of Science created several online platforms for communication with its graduates, such as a separate Graduate tab on its website which informs about the benefits of club membership and current news at the Faculty that might be of interest to the graduates. Other online communication platforms of the FSc CU Alumni Club include a Facebook page, a profile on LinkedIn as well as newsletter communication. A special web application, accessible from the FSc CU website, was created for the members to sign up for the Club, which is done simply by entering personal details, but the profile can be deleted at any time, and thus the Club membership terminates as well. The PR Department participates regularly in coordination of meetings of the Alumni Board at the Rectorate of Charles University which coordinates the activities of individual faculties in caring for graduates at the university-wide level.

The Alumni programme takes care of several interconnected affairs, the first of them being the above communication and organisation of social events, whether unique ones for members of the Club or ones intended for a wider target group. The first category includes Alumni reunions, which took place directly at the FSc CU (2014) as well as in Karolinum (2015, 2016). In collaboration with the Alumni Club of the FSc CU, a Golden Graduation event is organised for all UK graduates (including FSc CU graduates) upon the lapse of fifty years from their original graduation ceremony. The first Golden Graduation event took place thanks to the initiative of the FSc CU (and especially thanks to its own graduate, Associate Professor Pavel Bláha) in 2016 and has been held regularly since then.

In 2017, the Endowment Fund of the FSc CU was established in connection with the activities of the Alumni Club. Its contributors include noted graduates and academic officials of the FSc CU, such as world-renowned chemist Professor Josef Michl, Professor Bohuslav Gaš, Professor Jiří Zima and Associate Professor Jan Konvalinka. The contributions are primarily used to improve the quality of learning and to support study trips of gifted students abroad.

A lot of further activities are linked to the Alumni Club activity. Contacts between the Faculty and extra-faculty entities as to the offer of and demand for job vacancies are arranged by the PR Department. Through the channels at the Faculty, job vacancies, internships and, last but not least, a popular mentoring programme for undergraduates are offered regularly. Employers who seek professions among the graduates from the FSc CU present themselves at the Career Day, held for the Faculty students annually since 2015.





The alumni reunion accompanied with tours of museums and another programme in 2014. (photo: Petr Jan Juračka)





A person wearing a white lab coat is shown from the side, holding a large, glowing red heart. The heart is the central focus, emitting a bright red light. The background is dark and textured, possibly a wall or a large piece of fabric. The overall scene is dimly lit, with the primary light source being the heart itself. The text 'Third Role of the Faculty' is overlaid on the right side of the image in a white, sans-serif font.

# Third Role of the Faculty



# Lifelong Learning

Within the third role of Charles University, lifelong learning (LL) plays a key role at the Faculty of Science of CU, stands outside the accredited programmes of study and serves to complement, deepen or expand knowledge and skills. The programmes are focused on virtually all ages, from aspiring students, undergraduates and teachers to the general public.

The LL programmes at the Faculty of Science of CU have been organised for almost 30 years and their menu as well as the number of participants has been growing. Above all, the University of the Third Age has recorded a big increase in participants and a growth of the Faculty's popularity in recent years. Departments and institutes across the entire Faculty participate in organisation of the LL programmes.

Organisation of preparatory courses for applicants who wish to study at the Faculty of Science is one of the most important activities in lifelong learning at the Faculty. They are usually designed as semester courses that take place before entrance exams and their aim is to prepare applicants for entrance exams in the subjects that are part of the admission procedure at the Faculty of Science (see the next chapter for more information).

Lifelong learning, designed as follow-up and advanced courses, presents an opportunity for undergraduates to expand their education as well. The Faculty of Science of CU launched a brand-new educational platform called *Bakalář Plus* in the academic year 2012/2013. This advanced programme offers its students an attractive way of expanding professional curriculum by means of multidisciplinary and specialised courses, done outside the existing curricula. The Scientific Photography Seminar, led by Petr Juračka, Ph.D., a well-known hydrobiologist and populariser of science, has been greeted with great interest not only among bachelor students. The Landmarks/Milestones of Cell Biology lectures, taught by Professor Jan Černý, also belong to the popular and regularly opened subject.

Many participants attend the Complementary Pedagogical Studies, intended for future teachers, and programmes for further education of pedagogical staff thanks to which current teachers deepen their professional qualifications. Over the last 10 years, seventy courses, excursions and seminars have been accredited or re-accredited within the further education pedagogical staff system. Yet, more and more are added every year.

The Professional Medical Laboratory Methods Qualification course has been an extremely successful achieve-



Lifelong learning courses are attended by people who wish to complete, deepen or expand their knowledge and skills. E.g., there is great interest in complementary pedagogical studies. (photo: Jakub Hrab)

ment for which the Faculty, in collaboration with the University, received accreditation from the Ministry of Health of the Czech Republic in the academic year 2018/2019. The lessons are taught by professionals across all medical specialisations as well as by colleagues from our Faculty and its graduates acquire professional competence to perform medical professions, such as specialists in laboratory methods, and in the preparation of medicinal products.

The Institute for Environmental Studies programmes have also gained a great popularity, namely the Waste Management for Waste Generators, which informs participants of the fundamental as well as more complex issues waste generators must deal with, and the Current Trends in Protection of the Environment programme, aimed at filling the gap in lifelong professional education in nature and landscape protection, emphasizing the current trends and discussions of people with practical experience with researchers. Almost two hundred participants, mostly employees of Czech national parks, the Czech Environmental Inspectorate and the Ministry of the Environment of the Czech Republic, completed the two-year programme.

# University of the Third Age



The University of the Third Age is very popular and has recently recorded a growing number of participants. (photo: Vladimír Šigut)

With its basic mission of fulfilling its social role towards participants mainly in the post-productive age and supporting intergenerational learning, the University of the Third Age (U3A) belongs to the most important activities among the special-interest programmes of the Lifelong Learning (LL) programme at the Faculty of Science.

The University of the Third Age has a long tradition at the Faculty and its popularity has been growing. To give you a rough idea, 5 programmes with 64 graduates were opened in the academic year 2001/2002 while it was 13 programmes with 254 graduates in the academic year 2018/2019. The first programmes included Physiology of Plants, Chemistry around Us, Human Ontogeny and Phylogeny, as well as Mycology, and Geography and Demography, which are still offered and still very popular at the U3A.

All Sections of the Faculty participate in teaching the U3A programmes, the greatest deal being done by the Biology Section, which offered six, mostly one-semester, programmes in the academic year 2019/2020, and by the Geology Section, which provided five two-semester programmes.

For five consecutive years, we have managed to open one new programme in each academic year because most of the seniors have been attending the U3A for many years and constantly demand new programmes. Some attendants have been attending the U3A courses at the Faculty of Sci-

ence for more than ten years, and it is no exception that one person attends two or more programmes at the same time.

One of the new, warmly welcomed programmes was one-semester Parasitology. The lectures are read by experts virtually from the entire Department of Parasitology and, during 11 weeks, provide seniors with an insight into the issue from multiple angles. Its success is also evidenced by the number of graduates. Fifty-four out of fifty-five enrolled students successfully completed the first year, opened in the academic year 2017/2018.

This number of participants in one programme, by then the highest, was overcome in the academic year 2019/2020 when sixty-nine students enrolled in the Underground and Mineral Waters two-semester programme, lectured by the colleagues from the Institute of Hydrogeology, Engineering Geology and Applied Geophysics.

Not only is the offer of U3A programmes varied – the age structure of the U3A participants has become varied thanks to the already mentioned Professor Černý. His one-semester programme called the World of Cell allows seniors to attend the lectures together with their grandchildren. By doing so, the professor has smartly combined the University of the Third Age with the University of the First Age. This is a way how seniors can spend more time with their grandchildren and at the same time learn something new about the origins of life or about the functioning of cells.

# Preparatory Courses and Competitions

The Faculty of Science of CU strives to care for talented students, develop their knowledge and motivate them to study science. Accordingly, besides its undergraduates, the Faculty actively works with potential and aspiring students. In addition to the preparatory courses, specialised Olympiads and other competitions intended for primary school pupils and high school students play a key role in this respect. The FSc CU staff traditionally participate in organisation of the majority of competitions.

The Geography and Biology Sections organise on-campus preparatory courses for entrance exams. Since the academic year 2016/2017, the Biology Section has prepared a group of lectures called Advances in Biology from various areas of biology, united by a certain topic. These series of lectures have found their attendants not only among applicants, but also among current undergraduates and the general public. The courses usually take place at the Faculty in one- or two-week intervals from January to April. Aspiring students can also try to sit mock entrance tests in biology, chemistry or geography.

In addition to the on-campus courses, the Section also offers correspondence seminars free of charge. KSICHT – the Correspondence Seminar Inspired by Chemistry Issues is designed for high school students who receive five chemistry tasks to be solved. In total, four series of tasks are published every year, and at the same time, trips are organised and our Faculty is prepared to organise a final camp for the best solvers. Furthermore, there is a correspondence geological seminar called *Kamenožrout*, whose participants receive ten quiz questions each month, must solve them and send back. We must not forget to mention the Geography Is Fun correspondence course in geography and demography. In addition, successful solvers of these seminars are then admitted to the relevant programmes of study without having to take entrance examinations. This, however, does not apply to the *Biozvěst* course, which is a correspondence seminar in biology for primary school pupils and high school students. Here, the reward for the successful solvers of a series of tasks is the possibility take part in a field expedition. The Biology Section organises regular meetings with high school students who consider studies at the Faculty during the Fluorescence



The 50<sup>th</sup> round of the Biology Olympiad in 2016. Faculty of Science's staff participate in organisation of nature science Olympiads, including the Chemistry Olympiad and Geographical Olympiad. (photo: Petr Jan Juračka)





The chemistry course called "In the Footsteps of Elements" for high school students in 2019. One of the goals of the Faculty of Science is to care for talented students and develop their knowledge in the field of natural sciences. (photo: Petr Jan Juračka)

Night programme. Not only do the students become familiar with various microscope techniques and modern laboratory methods, but they also learn about the latest developments in the various fields of biology at accompanying lectures. During the Fluorescence Night, field excursions to interesting destinations abroad also take place. Under the auspices of the Biology Section, the *Arachne* Association also organises field camps.

In 2018, the Faculty of Science launched a project of scientific internships for high school students called *Začni (si) s Přírodovědou* (Start (an Affair) with Science). During the internships, high school students join the work of research teams and laboratories and solve their own research tasks under the guidance of the FSc CU academic staff. This way, they have an opportunity to get to know how university environment works and what working in a research team is like, and they can also try to solve their own projects, often resulting in writing their own papers as part of the High School Professional Activity project.

The Faculty of Science is greatly engaged in organisation of science Olympiads, namely the Biology Olympiad, Chemistry Olympiad and Geographical Olympiad. In collaboration with other Czech universities, our students and teachers play a key role in the preparation of tasks for science Olympiads and in organisation of the individual rounds of the competition. The work team called Biology Olympiads, which mostly includes former participants and undergraduates, graduates and university teachers, prepares tasks and preparatory texts for

participants of the Olympiads every year. Based on the results of the national round of the Biology Olympiad, preparatory and selective training camps of the national team are held at our Faculty in order to prepare the participants for the international round. The team also prepares for the international round of the Chemistry Olympiad in close collaboration of our Faculty with the University of Chemistry and Technology in Prague. Our Faculty usually organises a selective training that prepares participants for the practical (laboratory) part of the competition. The national round of the Geographical Olympiad, the oldest category of the competition, is traditionally held at the Geography Section of our Faculty. The Biology and Chemistry Olympiads celebrated their 50th anniversaries by organising their national rounds at our Faculty; the 50th national round of the Chemistry Olympiad was organised in collaboration with the University of Chemistry and Technology in Prague in 2014 and the 50th national round of the Biology Olympiad was hosted at our Faculty two years later.

In addition to the preparatory training camps for the international rounds of the Olympiads, our Faculty also takes part in preparation of participants for the European Union Science Olympiad (EUSO) and other competitions. Successful solvers of the regional rounds of the Biology and Chemistry Olympiads are then invited to join a summer training camp, which traditionally takes place at the University of Chemistry and Technology in Prague training camp in Běstvina, where the students and staff of our Faculty, especially the Biology Section, take part in preparation of the students for the next year of the competitions.

# Přírodovědci.cz (Scientists.cz) Project

The Faculty of Science introduced the *Přírodovědci.cz* popularisation and communication project at the beginning of November 2011. Its goal is to address primary school pupils and high school students and teachers, the media, teaching professionals as well as the general public, arouse the interest of the above target groups in natural sciences and to introduce them to the areas of research in which the Faculty of Science participates. The main communication bases of the entire project are provided on the [www.prirodovedci.cz](http://www.prirodovedci.cz) website and the *Přírodovědci.cz* quarterly magazine.

The *Přírodovědci.cz* platform provides the FSc with a unique opportunity to build a network of those interested, supporters and engaged teachers who can motivate their students and form their approach to science. To be honest, motivation of students is one of the most vital factors that influence their success in study and interest in science and nature in general.

The *Přírodovědci.cz* website includes several sections focused on science and research pursued at the Faculty, e.g. the popular Ask the Naturalists section, thanks to which the public eager for knowledge have the opportunity to ask the Faculty experts. There is also a calendar of popularisation events organised by the *Přírodovědci.cz* project staff as well as by other organisational subsections of the Faculty. The Faculty e-shop, which offers books, posters, items of clothing and other merchandise with naturalist topics and is used to promote, represent and identify with the Faculty brand, runs on the website too.

The *Katalog pro učitele* (Catalogue for Teachers), where signed-up teachers can find a database of lectures and workshops conducted by experts or faculty students in the area of biology, chemistry, geography, geology as well as environmental protection, represents another important part of the platform. This is an opportunity for the signed-up teachers to choose an educational activity di-



Junior Conferences for Young Talented Male and Female Researchers are also organised under the auspices of the *Přírodovědci.cz* project. (photo: Jakub Hrab)



The Přírodovědci.cz popularisation and communication project at the Festival of Science in Prague, Dejvice, in 2018. (photo: Luboš Wiśniewski)

rectly tailored to their current curriculum or the topic being discussed. The teachers and their students can either arrive at the Faculty, e.g. for a visit to the faculty museums or laboratory exercises, or order an activity to be done directly at their school free of charge twice a year. The Faculty of Science of CU is the only university in Czechia that offers such a database to teachers.

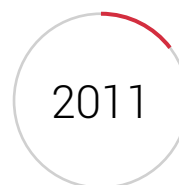
Not only teachers, but also individual naturalists among students, those eager for knowledge in natural sciences, supporters and the public are allowed to sign up for the project. In addition to information about scientific news in the form of e-letters, they also get a number of other benefits, such as a possibility to take part in a two-day Junior Scientific Conference for students from 10 to 19 years of age, which was held for the ninth time in 2019.

Apart from the above, the project has launched a large marketing campaign in schools as well on social networks (Facebook, Youtube). The *Přírodovědci.cz* magazine focuses both on the scientific areas studied at the Faculty and on the news from Faculty events and activities. It is currently published quarterly, with a circulation of 14,000 copies, and distributed at the FSc CU and 15 other places all over Czechia (science centres, museums, observatories, etc.).

The *Přírodovědci.cz* project is very popular with teachers, students and the general public, as evidenced by the fact that it has won several awards for the popularisation of

science, including the annual award of the Czech Academy of Sciences. Over 1,150 individual Czech teachers, 1,350 schools and 6,550 individual naturalists are currently signed up for *Přírodovědci.cz*.

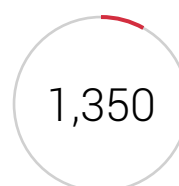
## Přírodovědci.cz in Numbers



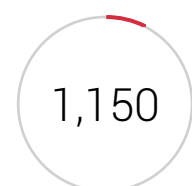
the project was  
launched



quarterly  
circulation



schools signed  
up for the project



teachers signed  
up for the project



# Teacher Training Schools

Partnerships between universities and high schools are a prerequisite for the effective transfer of knowledge and experience between the two types of institutions. Cooperation between the secondary and tertiary education sectors is particularly important in the training of future teachers, support of exceptionally talented students and the implementation of lifelong learning projects for experienced teachers. The Faculty of Science of CU is well aware of the need for close cooperation between the Faculty and schools. It therefore grants the teacher training school status to selected, exceptionally high-quality high schools.

Teacher training schools become a partner of the Faculty in ensuring quality education of students in bachelor's, master's and doctoral study programmes, especially teaching programmes accredited at the Faculty. Through the partnership between high schools and the Faculty, teachers and pupils of teacher training schools get the possibility of superior access to information and educational programmes implemented by the Faculty. With their experience, teachers thus become partners of the departments and research teams involved both in the training of future teachers and in carrying out research in education and didactics of natural science subjects. In addition, cooperation with the Faculty allows a teacher training school to acquire new quality teachers for the teaching of science subjects.

For the title of a teacher training school to be granted, the high school has to meet several criteria. It must provide quality teaching of at least two natural science subjects, taught by qualified and creative teachers. The teaching of natural science subjects must be of good quality in terms of content, application of modern forms and methods of teaching and the material and technical equipment of the school. The quality of teaching at such a school is manifested with e.g. achievements of students of the school in natural science competitions and admission of the school graduates to universities. At the same time, the school management and individual teachers should be eager to communicate well with the units of the Faculty and also with the Faculty students doing their teacher training, actively participate in the training of future teachers, facilitate teacher training (classroom observations, training lessons), cooperate with the units of the Faculty in the preparation and execution of seminars for teacher trainees, arrange consultations, create teaching materials and allow the Faculty departments and research teams to carry out their research activities in the school.



The status of a teacher training school is awarded by the Dean of the Faculty, based on a joint proposal of the Vice-Dean and of the Faculty workplace which guarantees the teaching of the fields of study focused on education and training of future teachers. The title is awarded for a period of five years and is handed over to school representatives at a ceremonial meeting which takes place once a year, as part of the Faculty

Open Day. In total, 78 schools from various regions of Czechia were holders of the Teacher Training School of the Faculty of Science of Charles University title at the beginning of 2020.



The Dean of the Faculty grants the "Teacher Training School of the Faculty of Science of Charles University" title for a period of five years on the occasion of the Faculty Open Day. (photo: Vojtěch Duchoslav)







An aerial photograph of a university campus, overlaid with a semi-transparent red filter. The image shows a large, modern building with a curved facade on the left, a paved walkway with several people walking, and a large, leafy tree in the foreground. The text "Development and Future of the Faculty of Science" is centered in white, sans-serif font.

# Development and Future of the Faculty of Science

# BIOCEV

The Biotechnology and Biomedical Centre of the Czech Academy of Sciences and Charles University (BIOCEV) was established with a significant EU subsidy. The grant application consisted of 1,600 pages and the costs of the project amounted to CZK 2.3 billion. The highest achieved evaluation among other five large projects submitted within the Operational Programme Research and Development for Innovation also evidences the well-established scientific model. BIOCEV, a joint project of six institutes of the Czech Academy of Sciences (Institute of Molecular Genetics, Institute of Microbiology, Institute of Physiology, Institute of Experimental Medicine, Institute of Biotechnology, and the Institute of Macromolecular Chemistry) and of two Charles University faculties (the Faculty of Science and the First Faculty of Medicine), was approved by the European Commission on 31 October 2011. The implementation started a year later. The foundation stone was tapped ceremonially in October 2013 and the project was officially completed on 18 December 2015.

Its research activities, however, started already in 2012, at the time when the project only existed on paper and the teams of researchers were still working in their original workplaces. More than 500 researchers and technical staff, of which almost one third comes from foreign countries, such as Australia, Great Britain, India, Canada, France, Ukraine, Poland or Germany, are currently working in BIOCEV.

Its results are directed in applied research and development of new treatment methods of serious health problems, e.g. medicaments aimed directly at an exact place of damaged metabolism, polymeric vaccines, new antibiotics or protein and tissue engineering: these are all examples of the final results of BIOCEV's research work.

*Mitotam*, an anti-tumour medicinal substance which was developed by the Institute of Biotechnology of the Czech Academy of Sciences laboratories in BIOCEV and is directed at mitochondria of tumour cells, has already been tested on people for several months. The results of the first phase of the clinical study show that the treatment is safe for patients. It has a very positive effect in patients with kidney cancer. The study included patients whose previous treatment methods had failed. *"This unique scientific centre makes a vital contribution to improving the quality of science and research in Czechia, and I believe that our researchers and students will do well here. I wish for all of us that BIOCEV belongs to top quality scientific centres in biomedicine and brings new insights to the mosaic of human knowledge,"* said Tomáš Zima, Rector of Charles University, at the opening ceremony of BIOCEV in June 2016. BIOCEV research teams have already published more than

700 scientific papers, including articles in prestigious foreign journals (e.g. *Cell*, *Molecular Cell*, *Nature Communication*, *Gastroenterology*, and others). The BIOCEV scientific programme is supported by six top research infrastructures and service laboratories, such as the Czech Centre for Phenogenomics, Medical Imaging, Centre of Molecular Structure, Gene Core, OMICS – Genomics and Proteomics, and the Cryobank.

The Czech Centre for Phenogenomics (CCP) is the biggest institution of this kind in Central Europe and also includes a laboratory of transgenic models that produces specialised, genetically modified mouse models for research of the functions of genes for the Czech and international scientific community. Together with foreign colleagues, Radislav Sedláček, CCP Head, and his team take part in the Encyclopaedia of Mammalian Gene Functions international programme, focused on the primary description of functions of all genes in the next ten years. The results of their research can positively affect the treatment of serious diseases.

## Faculty of Science in BIOCEV

The third BIOCEV research programme, called Cell Biology and Virology, includes four complementary sub-programmes: Eukaryotic Microbiology, Tumour Cell Biology, Virology and Mammalian Cell Structure and Differentiation. Together, they cover research into cellular functions in the spectrum of eukaryotic cells, both single-celled eukaryotes with an emphasis on pathogens (parasitic protists), eukaryotic microbes forming organised multicellular structures (yeast) or mammalian tissue cells, and interactions between eukaryotic cell structures and simple intracellular parasites (viruses). For their work, the researchers involved in the research programme can take advantage of the state-of-the-art Imaging Methods service laboratory, incorporated in the Czech and European research infrastructure called CzechBioImaging and EuroBioImaging. The Genomics of Eukaryotes and Lateral Transfer of Genes team, led by Associated Professor Vladimír Hampl, also takes part in the programme and stands behind the successful publication of their paper in *The Current Biology* magazine. Their article brought evidence that *Monocercomonoides* lost their mitochondrion secondarily during evolution.

The FSc CU is also the holder of three important subsidy titles in BIOCEV: the prestigious ERC grant (V. Hampl), Horizon 2020-Twinnig (the MICOBION project led by Professor Jan Tachezy), and the Centre for Research of Pathogenicity and Virulence of Parasites (OP VVV).





"BIOCEV provides a space for innovative research, stimulates conditions for excellent scientific work and supports the national and European development of the biotech industry."



BIOCEV puts emphasis on cooperation and creation of new partnerships with notable foreign science and research institutes as well as with commercial entities that are necessary partners for the transfer of the results of research into practice. (photo: BIOCEV archive)



# Albertov Campus

Albertov Campus is a project that will come into existence in the area of the incomplete university campus that dates back to the beginning of the last century where only temporary buildings are located now. The Faculty of Science, the First Faculty of Medicine and the Faculty of Mathematics and Physics of Charles University have allied to work on its development.

The plan is to erect two new buildings in the current campus in Albertov where most of the existing university buildings do not meet today's technical and capacity standards. For Charles University and the involved Faculties, the project represents an extraordinary challenge and the biggest investment project in decades.

Several years of considering the concept of Albertov Campus resulted in more specific outlines in 2008, when the preliminary study was made. It was a rough design of both centres in their maximum options, taking into account their location in the existing urban development and related aspects, such as conservation of the historical buildings, geological bedrock, utilities, etc. The total floor area of both buildings considered for this study was 47,000 m<sup>2</sup>, including underground parking spaces and technical facilities. In 2011, the Albertov Campus project was included in Investment Programme No. 133 210 of the Czech Ministry of Education, Youth and Sports. The Albertov university campus should not only concentrate state-of-the-art research, but also create an environment attractive for students, their studies and community life. In cooperation with the Albertov Campus Research Board and other bodies of the three Charles University Faculties involved, a detailed plan of activities and tasks for both centres was elaborated, reviewed and updated in 2013–2014. The plan includes in particular a key schedule for the research programme as well as the layout of classrooms and community spaces, which certainly behave to be included in this type of modern buildings.

At the same time, the organisational structure of the project was clarified and its individual bodies were formally established. The Rector of Charles University and the Deans of the Faculties involved signed a partnership agreement for the period of preparation and execution of the project. The bodies involved decided on the procedure that would lead to project documents as well as that the architectural design, due to the location and significance of the project, would be selected in a tender. The tender documentation was prepared in the summer of 2015 and the tender for the design was officially opened on 1 Sep-

tember 2016. Thirty-three applicants registered for the first round, and the winner of the second and final round, the *Znamení čtyř* Studio, including architects Juraj Matula, Richard Sidej, Martin Tycar, in collaboration with Kateřina Šebestová, Tomáš Hanus, Kristina Beranová and Jan Stoklas, was announced on 1 August 2016.

The larger building, Biocentrum, will include laboratories and research rooms for 730 employees, several auditoriums of various sizes, a study room, a café, a zoo, and a large stepped assembly hall with a glazed roof and partially glazed walls to all four corners of the world. The Biocentrum will have two underground floors and five above-ground floors, but since the rear of the building extends into a slope, which represents about the two-storey difference, the rear side of the building will appear to have as many as seven floors when viewed from outside. It is the height of the building that worries not only the architects but also the investor – the new building will undoubtedly protrude above the existing, at most five-storey Albertov buildings. On the contrary, the highlight of the new building will be its large assembly hall with a plenty of light which promises to provide a pleasant space full of tables and chairs for relaxing, meeting friends and spending a few minutes between the lectures.

Even though the Globcentrum is supposed to be smaller, its design is similar, i.e. it will have two underground floors and seven above-ground floors, this time along the entire area. However, since the Globcentrum will not be situated in Albertov Street, i.e. on the main artery of the campus, the difference in heights will not be so apparent. The windows of the new canteen, a part of the Globcentrum, will overlook a small green area, a small park or possibly a geopark, situated to the west. In addition to these, the Globcentrum will also include a small gym and a bouldering wall. The Globcentrum will also provide its users with a glazed, albeit a much smaller assembly hall, a study room, dozens of laboratories, and map and herbarium collections.



General view: on the left is the building of the future Biocentrum in place of the existing canteen, on the right behind the Purkyně Institute is the Globcentrum building. (photo: Rectorate of CU Archive)



Biocentrum building. (photo: Rectorate of CU Archive)



Globcentrum building. (photo: Rectorate of CU Archive)



Park on the campus. (photo: Rectorate of CU Archive)



Park on the campus. (photo: Rectorate of CU Archive)





## FACULTY OF SCIENCE Charles University

<b>Title</b>	100 Years of the Faculty of Science of CU
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<b>Supervision by</b>	Jana Švorcová, Jana Fryzelková, Petra Vaňharová, Michal Andrlé
<b>Published by</b>	Faculty of Science of Charles University
<b>ISBN</b>	978-80-7444-080-9
<b>Photographs by</b>	Petr Jan Juračka, CU Archive, Czech News Agency, BIOCEV archive, René Volfík, Luboš Wiśniewski, Vojtěch Duchoslav and other photographers
<b>Graphic design by</b>	Honza Havránek, Štěpán Bartošek
<b>Published (place/year)</b>	Prague, 2020
<b>Printed by</b>	Tisk Horák, a. s.



UNISTAV CONSTRUCTION a.s., the main sponsor of the 100th anniversary of the Faculty of Science of CU celebrations.

















**100 YEARS**  
**FACULTY OF SCIENCE**  
**CHARLES UNIVERSITY**



FACULTY OF SCIENCE  
Charles University