50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 1

THE FIRST ISSUE OF CATALYZER MAGAZINE 19/07/2018

WELCOME MESSAGES

KAROL MIČIETA

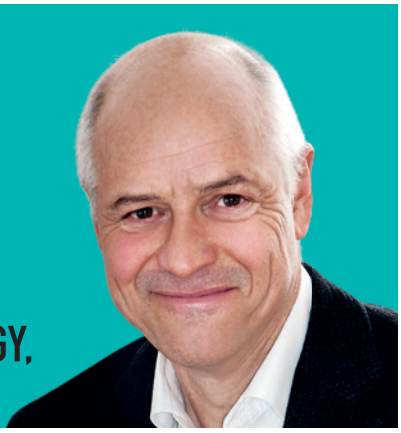
RECTOR
COMENIUS UNIVERSITY IN BRATISLAVA

I am very glad to welcome all enthusiastic fans of chemistry and scientific research on behalf of Comenius University in Bratislava, Slovakia, on the 50th anniversary of the International Chemistry Olympiad. Our university is also international, as evidenced by the fact that over 10 percent of our students are from abroad, from approximately 70 countries around the world. We provide the greatest opportunities to Slovakian students in gaining international experience abroad and, in turn, provide the same to international students in Slovakia. We are a research university and an important science center. In this regard, I also wish to praise the enthusiasm, effort, and professional input of colleagues from our Faculty of Natural Sciences, which is also my alma mater, in organizing the International Chemistry Olympiad 2018, particularly the team led by Doc. RNDr. Martin Putala, PhD.
I am delighted to cooperate with the University of Chemistry and Technology, Prague, because I am convinced that the leading scientific workplaces are significantly enriched by such collaborations; such cooperation is very important. I am even more delighted that in 2018—the year before the celebration of our first university centenary—we are commemorating together the 100th anniversary of the First Czechoslovak Republic. For, in the past, the Chemistry Olympiad in Slovakia was closely connected with the Olympiad in the former Czechoslovakia. Scientific research is an adventurous and exciting journey in its quest for advancing the frontiers of knowledge sometimes resembling the plot of a detective novel. For some participants of the International Chemistry Olympiad, the 50th anniversary of IChO could become the starting point of their research career. I wish our young apprentices of chemistry a lot of success on their path towards the joy of learning and discovery.

Prof. Karol Mičieta

KAREL MELZOCH

RECTOR
UNIVERSITY OF CHEMISTRY AND TECHNOLOGY, PRAGUE



Dear young chemists,
I am happy and honoured that, as a biotechnology professor and Rector of the only "chemistry only" university in the Czech Republic, I can greet the most talented young chemistry students here in the heart of Europe. I wish you much success and fun in the Olympic competition. The organization team has worked hard for more than a year in order to prepare interesting tasks for you, a comfortable environment, and a programme packed with exciting events.
The first part of IChO will take place in Bratislava, a beautiful city whose beauty and atmosphere you will be able to see in detail in the coming days. Then the competition moves to Prague, where fifty years ago your predecessors, young chemistry enthusiasts, met to compete in the first IChO. They had something to build upon because, during the reign of Emperor Rudolf II in the seventeenth century, Prague was the cradle of alchemy, which—with some exaggeration—we can consider the forerunner of chemistry.
Since the time of Emperor Rudolf II, but especially since the first IChO, science has undergone a tremendous journey. I can confirm this as an eyewitness, because it was exactly fifty years ago when I devoted myself to chemistry. Since then I have not left chemistry behind; it has become my lifelong love.
I wish you carry with you only the most beautiful memories from the Czech Republic and Slovakia. And perhaps develop a lifelong love.

Prof. Karel Melzoch

SLOVAKIA

An inland country in Central Europe, 5.5 million inhabitants. Not to be confused with Slovenia much further to the south. Independent since peaceful dissolution of Czechoslovakia in 1993. Member of European Union since 2004 and using Euro as currency since 2009.

BRATISLAVA

The capital of Slovakia has a very special location. It lies on the border with Austria, only an hour-long drive to Vienna. Only 20 km away, the two countries meet Hungary. Many people in the villages in this region speak all three languages daily, just as in the past times of the Austro-Hungarian Empire. Bratislava is often dubbed "The Beauty on Danube", the river is a very central element of the city. The Old Town offers monuments, old narrow streets, and the city's landmark, the Bratislava Castle. At the same time, the city is very lively, young people from all over the country come here for education and work. Great food, drinks and nightlife are taken for granted.

NATURAL WEALTH

The greatest wealth of Slovakia lies is in its incredibly beautiful nature. The country is largely mountainous, in the winter it is a paradise for winter sports, and in the summer for mountain hiking, rock climbing and other leisure activities.
Nine natural parks nurture a great diversity of plant and animal life, many precious species are found only in Slovakia. The country is very rich in mineral waters, spas, and more than 7000 caves, many open to the public. Ochtina Cave, for example, is one of just three aragonite caves in the whole world.

LEADING TECHNOLOGIES

In 2007, Slovakia became the world's largest producer of cars per capita. Several models of Peugeot, Citroen, and Kia are manufactured here, and the production of Volkswagen Bratislava also includes Audi, Bentley, and Porsche. Leadership in the field will be secured further with a new Jaguar Land Rover plant opening in 2018.
The country is particularly advanced in IT. Slovakia has one of the highest penetration rates in optic-fiber Internet, and also is the home of ESET, one of the world's leaders in IT security. The company's founders made the first antivirus software as early as in 1987. Nowadays, ESET has its branch offices on all continents.

SPORTS

The country has a tradition in skiing and ice hockey, there have been many Slovak hockey players in the NHL, nine managed to share the Stanley cup. Slovaks are truly exceptional in water sports, out of the 28 medals that Slovakia brought from 6 summer Olympics, 14 were in canoe slalom.
Our world fame in sports includes footballer Marek Hamšík, currently the captain of Italian club Napoli, and Dominika Cibulková, in 2017 ranked as the world's number 4 in women's tennis. One of the world's best road bicycle racers is Peter Sagan, a prolific winner of individual stages in stage races, as well as many European and World titles.

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CULTURAL HERITAGE AND FOLK TRADITIONS

Many places preserve their centuries-old castles, chateux, or manor houses in great condition. They frequently become shooting locations for movies, for example, the famous Nosferatu, the first Dracula movie from 1922, was actually not filmed in Transylvania, but at Orava Castle in Northern Slovakia. The people sustain a great wealth of folk traditions, and many customary festivities and rites are still alive today.

Almost every family keeps its own special recipe for the traditional Christmas sour-cabbage soup, and many people are involved in folklorist activities, maintaining their regional art and crafts, regional costumes, music, song, and dance.

© ESET

The face of the cutting-edge IT security company ESET is an android.

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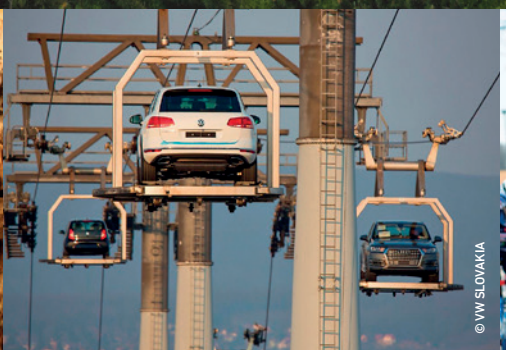

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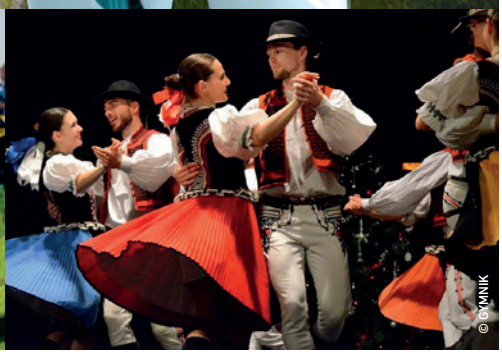

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BRATISLAVA

It straddles both banks of the Danube, a river which flows through ten European countries. Its symbol is a castle with four corner towers and an interior courtyard. There are over 400,000 permanent residents with another 130,000 visitors commuting to the city each day for work and educational purposes. Welcome to Bratislava, capital of Slovakia.

SNP Bridge (Bridge of the Slovak National Uprising) is a road bridge over the Danube in Bratislava. It is the world's longest one pylon cable-stayed bridge, spanning 430.8 meters. The evening colours of the bridge, fascinatingly, are determined by the weather forecast for the following day: yellow for sunny, blue for rainy, green for cloudy, red for strong wind and harsh weather. However, construction of the bridge in 1967 is still topic of controversy, because it involved demolition of the city's Jewish quarter, including a synagogue. The historical structure of the old town was grossly disrupted. Have you ever seen a four-lane highway crossing a historical medieval gate?

Another interesting curiosity is a **restaurant shaped like a UFO** placed on top of the bridge pylon. Visitors can access the restaurant using a lift or a staircase with 430 stairs, also placed on the pylon.

St. Martin's Cathedral is the largest church in Bratislava, but it was not always so. St. Laurence's Church, demolished in 1529 after being destroyed during the Turkish invasion, was not only larger, but it was also built behind the city walls with a strategic vantage point. After the church was demolished, the salvaged stones were used to repair the city's defenses. To this day, while taking a walk around the castle walls, one can see a pink gravestone in the facade of Michael's Gate.
St. Martin's Cathedral, consecrated in 1452, is the cathedral of the Roman Catholic Archdiocese of Bratislava. Eighty-five meters tall, the architectural design can be classified as Gothic.

From 1563 to 1830, nineteen coronations took place at St. Martin's Cathedral. That is why the coronation symbol, in the form of a gilded copy of the royal crown, is situated on top of the tower. The copy (weighing 300 kg and 1.6 meters in height) is so detailed that even a small cross on its top was bent to match the original crown, which got bent at Ferdinand III's coronation. The crown at the top of the tower also serves as a time capsule. In it, various documents from different periods of time are stored, and every time the tower undergoes reconstruction, new ones are added.

Bratislava is situated on the edge of a **vineyard region**. The city can also be proud of its wine pipe supply, used for distribution in times of high wine production. It was built to transport wine from cellars on Pražská Street to wineries in the proximity of today's Main Railway Station.

Bratislava Castle has a characteristic shape, resembling a flipped table. Its towers appear to be of the same height, but in fact, one is higher than the other three, which were only built later on the roof. Initially, the castle was situated outside the city and at one point, there was a violent conflict between the townspeople in the tower of St. Martin's Cathedral and the monarch in the castle, during which they fired at each other. Fortunately, the government's plan in 1941 to build a university campus on the site of Bratislava Castle did not pass, and the castle was renovated to its present form instead.

Janko Kráľ Park (*Sad Janka Kráľa*), located on the other side of Danube, is the oldest public park in Central Europe, founded in 1776. While stationed at this park, Napoleon tried to get across Danube and conquer Bratislava in 1809. A cannon ball placed in the facade of the Old Town Hall reminds us not only of the times when the city was under fire, but also of the creativity of citizens who walled similar shots in their facades in order to receive financial compensation for wartime damages.

Of the original four gates which were part of the medieval bastion, only **Michael's Gate** remains. If by any chance you are homesick, just look down to your feet to the "zero mile marker". It shows directions and distances to different world metropolises.

The **Universitas Istropolitana** was the first university founded in the territory of today's Slovak Republic. It was founded in 1465 at the request of King Matthias Corvinus and named after the location where it was built (from ancient Greek: Istros – Danube; polis – city). This name was also given to planet No. 11,614 (Istropolitana), discovered at a nearby observatory in Modra. The university ceased to exist around 1490, after the death of Matthias Corvinus.

Michal Chrappa

COMENIUS UNIVERSITY IN BRATISLAVA

Comenius University in Bratislava (CU) is the oldest and the largest university in Slovakia. CU has 13 faculties and offers diverse study programmes encompassing a broad range of human knowledge – from medicine, humanities, and social sciences, to natural sciences, mathematics, and theology. It is the only Slovak institution of higher education to appear in worldwide rankings among the top 2 to 15% of the best universities.

© CUB

CU draws on the tradition of Academia Istropolitana that was founded in 1465 in Bratislava by Matthias Corvinus, the King of Hungary.

Since its founding in 1919 the university has ranked among the best educational institutions on the national level and it has become an internationally recognized centre for scientific study and research.

Around 24,000 students study at CU, including almost 2,800 international students from more than 70 countries. With more than 2,500 doctoral students, CU is also a major scientific institution.

CU is the home institution of 26 top-level research teams (out of a total of 54 at all Slovak universities).

In 2015, the Science Park of CU was established. It is focused on science and research in the fields of biomedicine, biotechnology, environmental, medical, and social challenges of the 21st century.

CU covers more than 40% of the total number of scientific publications of all Slovak universities in foreign indexed journals.

CU is a leader in Slovakia in the mobility programme, ERASMUS+. Every year CU accepts the most international students (around 450) and sends the most students to universities abroad (around 600).

FACULTY OF NATURAL SCIENCES

It was founded in 1940 and presently it is one of the largest faculties of Comenius University, in both the number of staff members and students.

It has teaching staff of approximately 286, including 48 full professors, 87 associate professors, 133 researchers with the title of D.Sc. or PhD/CSc.

The chemical section of the faculty creates a diverse spectrum of research activities in many areas of analytical, inorganic, nuclear, organic, physical and theoretical chemistry as well as in biochemistry, with a strong element of intensive collaborations with leading universities and research institutes worldwide.

The student population numbers approximately 2,400, including nearly 400 PhD scholars, of whom 140 are full-time PhD students working at individual departments of the faculty.

Its scientists publish more than 300 articles per year in prestigious and highly ranked scientific journals with high impact factor.

Faculty of Natural Sciences (FNS) is the most successful Slovak faculty in terms of supporting its projects with the participation of EU funding.

Analytical chemists from FNS developed advanced microchips and micro-electroseparation devices.

New four-step instead of 13-step synthesis of oseltamivir, an antiviral medicine for flu, was invented by FNS organic chemists.

Accreditation Commission established by the Government of the Slovak Republic has identified 6 Excellent Science Teams at the FNS.

FNS has rich international relations with other universities and research institutions worldwide via ERASMUS+ exchange programme and many other frameworks and programmes.

FNS in Bratislava offers two bachelor degree study programmes in English: Environmental Studies and Biological Chemistry.

CZECH REPUBLIC

10.4 million inhabitants, historical cities, wonderful castles and chateaux, pristine countryside and legendary cuisine – that's the Czech Republic.

UNESCO

Registrations in the UNESCO cultural heritage list are not bestowed lightly; there are less than a thousand worldwide. But you can find twelve UNESCO sites in the Czech Republic. Beyond the historical centre of Prague, other sites include Český Krumlov, Kutná Hora, and Telč – and even the functionalist Villa Tugendhat in Brno designed by architect Ludwig Mies van der Rohe and the historical gardens and chateau in Kroměříž.

NATURE

Previously the saying went: Every Czech is a musician. Today one might say: Every Czech is a tourist. Czechs love nature and do not hesitate to use every moment of spare time for trips to sandstone rocks, mysterious river valleys or mountain peaks. These sites are mostly protected within national parks. The most well-known: Podyjí, Krkonoše, and Šumava.

CUISINE

Traditional Czech cuisine offers some original dishes that you will not taste anywhere else, or at least you will not enjoy such quality as you will in Bohemia. In the first place there is, of course, beer. It is not a complete meal, but as the traditional Czech saying goes: Hunger is a disguised thirst. You can be sure that beer is the national pride number one. Another specialty is the spiced liqueur, Becherovka; in Moravia, slivovitz is very popular. As far as food is concerned, sirloin with cream sauce and dumplings as well as pork, dumplings, and cabbage dominate. And don't forget potato pancakes and the delicacy known around the world: the delicious delicacy, fried cheese.

PERSONALITY

The most prominent international sports personality hailing from the Czech Republic is one of the best NHL players, Jaromír Jágr. This world champion, Olympic champion and Double Stanley Cup champion was, at the start of 2017, the second player in history to score 1,900 NHL points – and he's still going…

PRAGUE

City of a Hundred Spires and one of the most beautiful cities in the world. Home to over a million people, five public universities and countless theaters, galleries, cinemas, and pubs. It is also the sixth safest city in the world. Each of Prague's districts has its own characteristic atmosphere and unique charm. Prague presents itself to you as a changeable city which likes to alternate styles: it is romantic and successful, ancient and modern, but above all it is a city that is cosmopolitan through and through, used to welcoming visitors.

Did you know?

- In 2002 Prague was the last major city in the world to give up using a pneumatic postal system, installed in 1889. The system had 26 lines covering some 55 kilometers.
- Founded by King Charles IV in 1348, Charles University in Prague is one of the oldest universities in the world and the oldest university in Central and Eastern Europe.
- It was in Prague that Pluto was taken down a peg. The general assembly of the International Astronomical Union, which gathered August 2006 in the Czech capital, voted to redefine Pluto as a "dwarf planet".

CZECH CURIOSITIES

- Jan Jansky (1873–1921), a famous Czech medical practitioner, was first to identify the four principal blood groups – referred to today as A, B, 0, AB.
- Modern contact lenses were invented by the Czech chemist, Otto Wichterle.
- Sugar cubes were invented when a sugar factory director's wife near Prague was injured, while trying to cut some pieces of sugar. She strongly suggested finding an alternative for this tedious task.
- The international word "robot" has Czech origin. It was introduced in 1920 by the Czech writer Karel Capek in his drama R.U.R.

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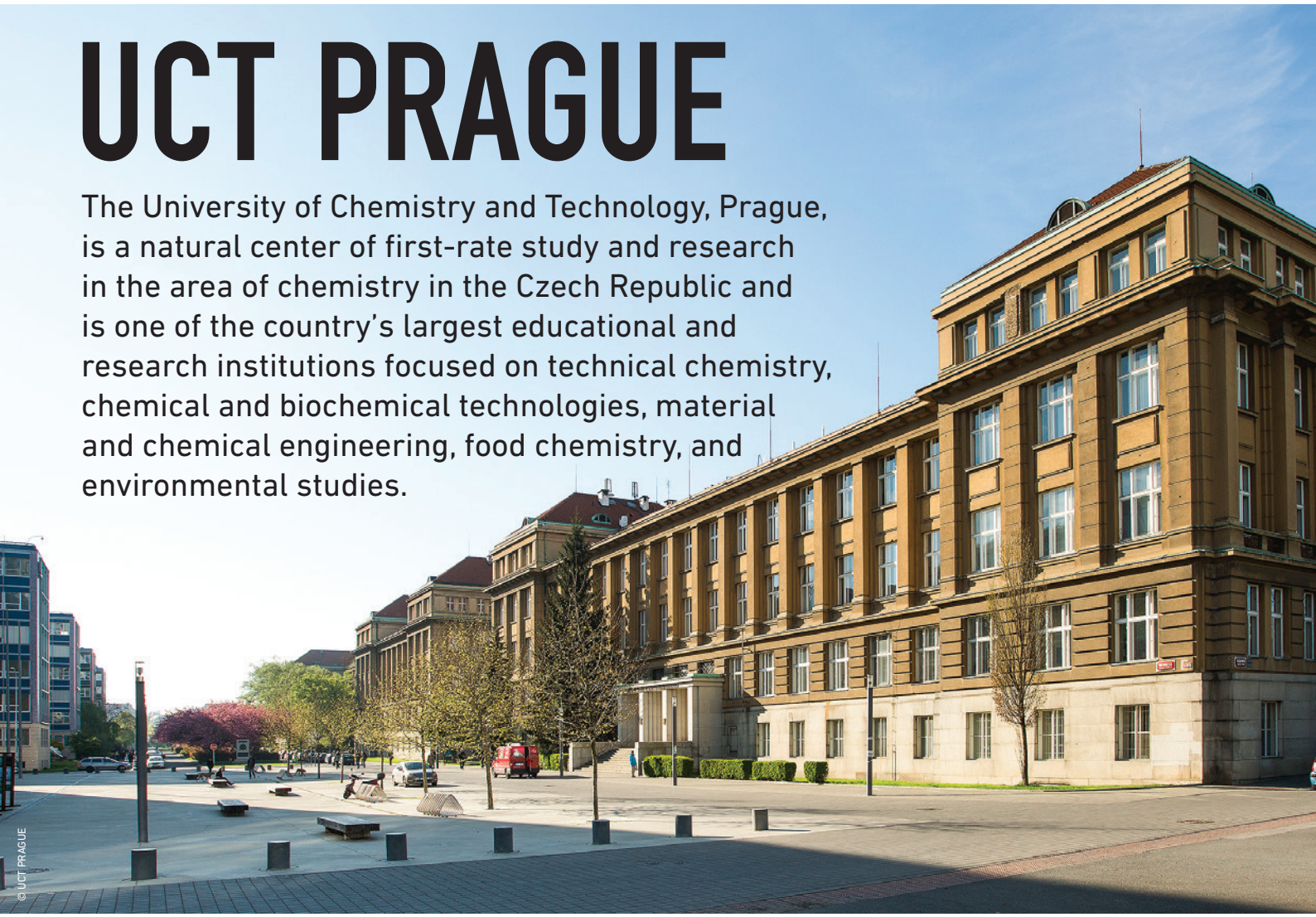
UCT PRAGUE

The University of Chemistry and Technology, Prague, is a natural center of first-rate study and research in the area of chemistry in the Czech Republic and is one of the country's largest educational and research institutions focused on technical chemistry, chemical and biochemical technologies, material and chemical engineering, food chemistry, and environmental studies.



Half of UCT Prague's income is generated from the institution's creative activities focused on science, research, and innovation. In the Czech context, this is an extraordinary accomplishment.

The institution is a member of the European University Association, the European Federation of National Engineering Associations, and the International Society for Engineering Education. It cooperates with more than 100 academic institutions not only in Europe but also in the US, Canada, Japan, Vietnam, and many other countries.

UCT Prague plays an important role in a number of international projects (FP7, Horizon) and takes an active part in the activities of European and world research infrastructures, including EATRIS and ELIXIR.

According to the prestigious Times Higher Education rankings, UCT Prague, one of five Czech universities, ranks among the 4% of the best world universities (*2017). The school has also dominated the rankings of the Education Policy Centre of Charles University in the "Emphasis on Science, Research and Creativity" category (*2016). A number of key figures in the history of chemistry have been related to UCT Prague. Among them, three figures are renowned in their fields: Vladimir Prelog, Nobel Prize winner for his work on stereochemistry; Otto Wichterle, inventor of contact lenses; and Emil Votoček, author of the Czech chemical nomenclature.

Several presidents of the Czech Academy of Sciences—František Šorm, Rudolf Zahradník, and Jiří Drahoš—are connected with the school as well.

UCT Prague is the most active Czech university in the ERASMUS+ exchange programme:
> 120 bilateral agreements
> 230 international students and scholars visit UCT Prague per year
> 100 outgoing students every year

Degree programmes in English UCT Prague offers:
- 1 Bachelor degree programme (4 specializations)
- 1 Master degree programme (5 sub-programmes)
- 13 Doctoral degree programmes

UCT Prague has more than 4,000 students with an extraordinary number of PhD students: 700, on average.

UCT Prague is exceptional in the area of collaborations with industrial partners which results in over 70 million Czech crowns per year. The list of most important partners includes Unipetrol, Zentiva, and MSD.

UCT Prague was the first Czech university authorized to provide the Eurobachelor degree. As its name indicates, this prestigious recognition certifies the quality of UCT Prague bachelor studies at the European level.

Over 40 programmes have been accredited in the areas of chemistry, chemical and biochemical technologies, material and chemical engineering, food industry, and environmental studies.

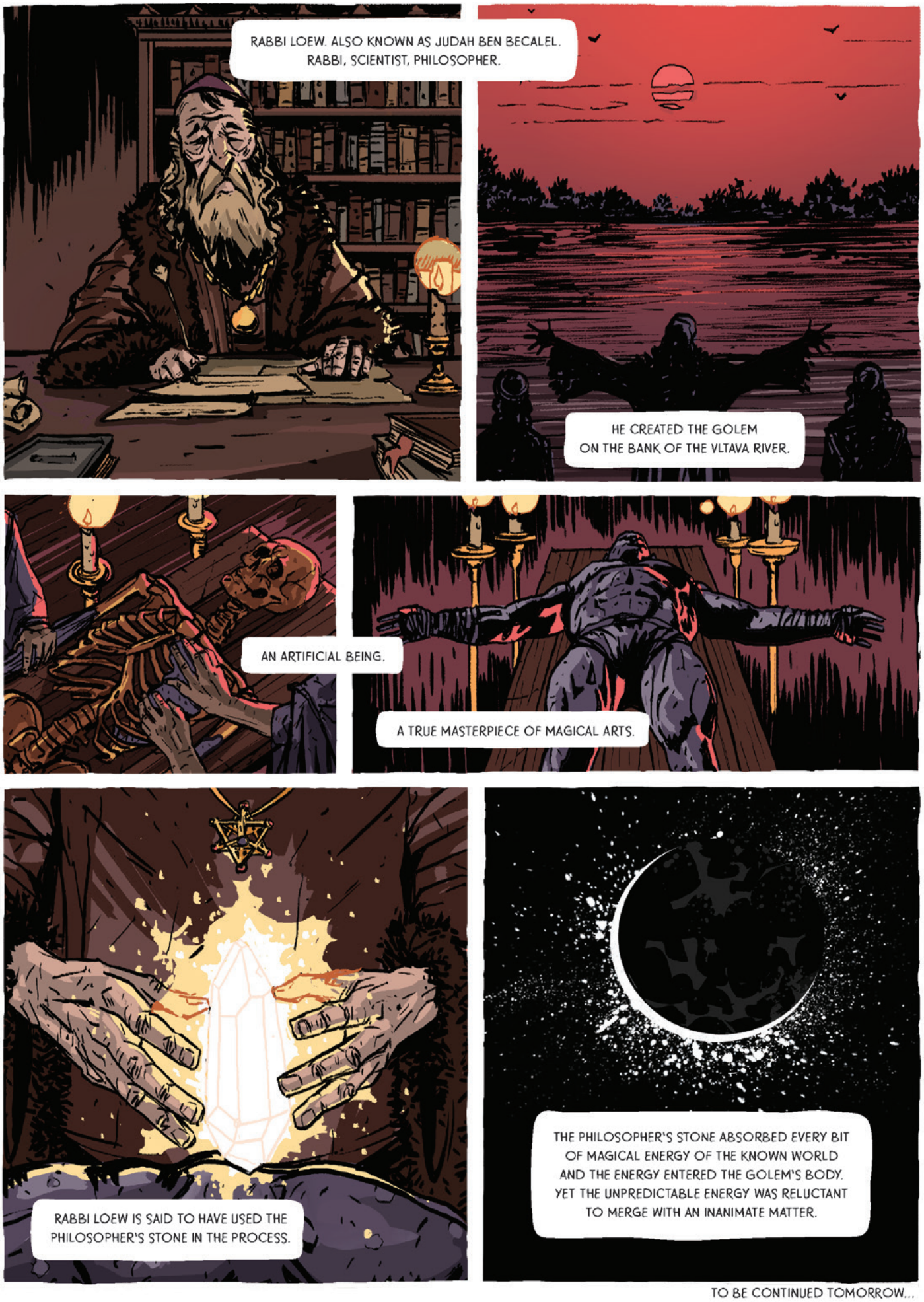
Some of the programmes are unique within the Czech Republic and essential to its future in the development of water technologies, refinery and petrochemical technologies, pharmaceutical engineering, glass and ceramics production technologies, brewery technologies, and food safety.

HISTORY

"FIRSTS" IN THE HISTORY OF IChO	YEAR	CZECH & SLOVAK HISTORY MILESTONES
	1918	Constitution of independent Czechoslovakia
	1948	Czechoslovakia becomes a communist country
1st IChO: Czechoslovakia – Prague, 3 participating countries (Czechoslovakia, Hungary, Poland), 18 competing students	1968	Warsaw Pact invasion of Czechoslovakia, beginning of the occupation by the Soviet Union
The only year when IChO was not held (for political reasons)	1971	
Preparatory tasks introduced (4th IChO: Soviet Union – Moscow)	1972	
Arbitration between authors and mentors; more than 10 countries (7th IChO: Hungary – Veszprém)	1975	
Quick translations into national languages (8th IChO: East Germany – Halle)	1976	
Medals awarded at the closing ceremony (9th IChO: Czechoslovakia – Bratislava)	1977	
IChO held in a western country (12th IChO: Austria – Linz)	1980	
English the only official language (until then, simultaneous interpretation into English, German, French, and Russian); delegation from the Americas – USA (16th IChO: West Germany – Frankfurt)	1984	
IChO flag created and handed over to the next organizer at the closing ceremony (17th IChO: Czechoslovakia – Bratislava)	1985	
More than 100 participants (19th IChO: Hungary – Veszprém)	1987	
Delegation from Asia (Singapore) and Australia (20th IChO: Finland – Espoo)	1988	
	1989	Velvet Revolution: End of communism
The Reaction Coordinate – daily chronicle of competition, predecessor of Catalyzer; computers used instead of typewriters, IChO outside Europe (24th IChO: USA – Pittsburg)	1992	
Catalyzer – IChO newspaper (25th IChO: Italy – Perugia)	1993	Velvet Divorce: Czechoslovakia peacefully splits into two separate countries: the Czech Republik and Slovakia
Competiton held in Asia (27th IChO: China – Beijing)	1995	
Competition held in the southern hemisphere (30th IChO: Australia – Melbourne)	1998	
More than 50 countries (31st IChO: Thailand – Bangkok)	1999	
More than 200 participants (32nd IChO: Denmark – Copenhagen)	2000	
Delegation from Africa (Egypt) (34th IChO: Netherlands – Groningen)	2002	
The highest number of theoretical tasks ever: 35 (35th IChO: Greece – Athens)	2003	
	2004	The Czech Republic and Slovakia join the European Union
Emergency IChO (48th IChO: Georgia – Tbilisi)	2016	
Previous IChO (49th IChO: Thailand – Nakhon Pathom)	2017	
50th IChO: Slovakia & Czech Republic, Bratislava & Prague, two co-organizing countries	2018	100th anniversary of Czechoslovakia's constitution

THE SECRET STORY OF THE GOLEM

PART 1



TO BE CONTINUED TOMORROW...

USEFUL SLOVAK AND CZECH PHRASES

Slovak	Slovak pronunciation	English	Czech	Czech pronunciation
Dobrý deň	[dobrɪ: ɟɛɲ]	Good morning/afternoon	Dobrý den	[dobri: den]
Ahoj	[ahoj]	Hello	Ahoj	[ahoj]
Pivo	[pɪvo]	Beer	Pivo	[pɪvo]
Dve/Tri/Štyri pivá	[dvɛ] /[trɪ] / [ʃtɪrɪ] [pɪva:]	Two/Three/Four beers	Dvě/Tři/Čtyři piva	[dvje] /[tr̝ɪ] / [ʧtɪr̝ɪ] [pɪva]
Malé pivo	[malɛ:] [pɪvo]	Small beer	Malé pivo	[malɛ:] [pɪvo]
Áno, prosím	[a:no] [prosɪ:m]	Yes, please	Ano, prosím	[ano] [prosi:m]
Áno	[a:no]	Yes	Ano	[ano]
Ďakujem	[ɟakujɛm]	Thank you	Děkuji	[ɟɛkujɪ]
Vďaka	[vɟaka]	Thanks	Díky	[ɟi:kɪ]
Voda	[voda]	Water	Voda	[voda]
Nie, ďakujem	[ɲɛ̯] [ɟakujɛm]	No, thanks	Ne, děkuji	[nɛ] [ɟɛkujɪ]
Nie	[ɲɛ̯]	No	Ne	[nɛ]
Zaplatím	[zaplatɪ:m]	The bill, please	Zaplatím	[zaplati:m]
Ospravedlňujem sa	[ospravɛdlʲnujɛm sa]	I am sorry	Omlouvám se	[omlou͡va:m sɛ]
Prepáč	[prepa:ʧ]	Sorry	Promiň	[promɪɲ]
Dovidenia	[dovɪɟɛɲɛ̯a]	Goodbye	Na shledanou	[na sxlɛdanou͡]
Maj sa	[maj sa]	See you	Měj se	[mɲɛj sɛ]

TONGUE TWISTERS

Slovak	Slovak pronunciation	English	Czech	Czech pronunciation
Strč prst skrz krk	[strʧ] [prst] [skrs] [krk]	Stick the finger through the throat	Strč prst skrz krk	[strʧ] [prst] [skrs] [krk]
Išiel pštros s pštrosicou a pštrosíčatkami Pštrosou ulicou	[ɪʃɛ̯el] [pʃtros] [s pʃtrosɪt͡sou] [a] [pʃtrosɪ:tʃatkamɪ] [pʃtrosou] [uʌɪt͡sou]	A He Ostrich with a She Ostrich walked down Ostrich Street with their ostrich babies	Šel pštros s pštrosicí a pštrosáčaty Pštrosí ulicí	[ʃɛl] [pʃtros] [spʃtrosɪt͡si:] [a] [pʃtrosa:ʧatɪ] [pʃtrosi:] [ulit͡si:]
Odideologizovaný deziluzionizmus	[odɪdɛologɪzovanɪ:] [dɛzɪluzɪonɪzmus]	Unideologized disillusionism	Odideologizovaný deziluzionismus	[odɪdɛologɪzovani:] [dɛzɪluzɪjonɪzmus]
Žerucha	[ʒɛruxa]	Watercress	Řeřicha	[r̝ɛr̝ɪxa]
Čučoriedka	[ʧutʃorɛ̯ɛtka]	Blueberry	Borůvka	[boru:fka]

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 2

THE SECOND ISSUE OF CATALYZER MAGAZINE 20/07/2018

BACK TO WHERE IT ALL BEGAN

The beginning
When I was born, IChO had celebrated its tenth anniversary. When I started going to school, I liked numbers. Later, we started to use letters in their place more often and sometimes even the weird, Greek, ones. Then wires came into the mix, along with everything else that spins, gives warmth, or shines. We would talk about gases and liquids, but also planets and black holes. However, when I first heard about atoms and molecules in the seventh grade, it was love at first sight! Not only would we talk about molecules, but we would also go to the lab. And that teacher's office! A magical scent of a mix of halogens and organic substances, cases and shelves with an infinite number of flasks with mysterious names on them.
The following year, my teacher suggested that I should participate in the Chemistry Olympiad. I have kept my solution till this very day; I was especially proud of the equation of thermal decomposition of potassium permanganate. I think I ranked second in the regional round. By the first day of high school, I'd already been hooked.

Contact
Another key moment occurred in the first year of high school. My classmate talked me into coming to the Chemistry Olympiad camp in Běstvina. I spent fourteen days among cabins, test tubes, and freaks like me. And I learned that the top students from the oldest age category would participate in the International Chemistry Olympiad in Perugia, Italy! I started to grow fond of it even more. Two years later, I ranked just below the threshold of participation in IChO in Beijing, but during the summer holiday before the first university year, I left for Moscow to take part in the following run of IChO. And it was a success: I won the silver medal!

A friend
During the following years, I wrote, reviewed, and tested problems; I organized summer camps enthusiastically, prepared our students and proudly watched them return with medals. I became the mentor of the Czech team for the first time 13 years ago at IChO in Taipei. And I saw the background of the whole event. How much effort, time, and money it required. Then, a fateful encounter occurred. A year later, in Gyeongsang, South Korea, I met Martin from Slovakia.

A dream
Years and years went by and we would only meet at IChO. A crazy idea came to our minds sometime around IChO in Washington. The 50th year was approaching, so why not try to host it together, both in the Czech Republic and Slovakia? At the beginning, we discussed it only between the two of us. We revealed our idea to the others and they supported us: "Go for it!" they said. So we presented the idea officially in Hanoi.

Joy
Everything gained momentum quickly. We had to find financing, enthusiasts, and time. First Baku, then a last-minute change from Karachi to Tbilisi, Bangkok, and now we're here: Bratislava and—after fifty long years—back to where it all began: Prague! Enjoy it with us.

Petr Holzhauser
President IChO 2018, Czech Republic
(On photo: Bottom row, 2nd from left)

© T. BELLOŇ

Guides eagerly awaiting the arrival of your teams. Sign up and get ready for the adventure!

Vienna International Airport, one of the gates to IChO 2018. First teams are coming.

© IChO TEAM

Welcome on board! We are delighted to meet you and ready to answer all of your questions.

© T. BELLOŇ

DAY No. 1

© IChO TEAM

Off the plane and on the bus! Just a few more days until the moment you have been preparing months for.

© IChO TEAM

Your new home for the next few days. Please make yourself comfortable. Good night.

NEVER FORGET TO HAVE FUN

Interview with President IChO 2018, Slovakia, Martin Putala

What is the difference between the Olympiad you attended as a student and the recent Olympiads?
Attending IChO myself was an exciting experience for me—I got to meet a lot of like-minded people. Even though the times have changed, the main idea remains.

Why is this year's IChO taking place in both Slovakia and Czechia?
Since the very first IChO took place in Czechoslovakia in 1968, the Czech Republic and Slovakia decided to go back to where it all began and banded together for organising the 50th anniversary of IChO in Prague and Bratislava.

What are the advantages and disadvantages of this collaboration?
By cooperating with Czechia, we have had a great chance to distribute the workload evenly and be way more efficient than we would be by ourselves. Nevertheless, there were some disadvantages. In particular, we had to travel 250km between Prague and Bratislava at least once a month.

How many people are participating in organising IChO?
There are around 200 team members: 90 guides, 60 lab assistants, and 20 authors (10 from each organising country).

Since when was the idea on the table?
To be honest, I don't remember. However, the first idea came from Anton Sirota (a former President of the Slovak Chemistry Olympiad). The whole project took more than two years of active preparation and hard work.


Martin Putala, President IChO 2018 (left)

© T. BELLON

What are the costs of IChO 2018?
Originally it was estimated to cost around 1.3 million euros. However, the reconstruction of laboratories and other unexpected expenses increased the budget to two million euros. Both countries agreed to contribute one-to-one.

What message would you like to share with the students?
Follow your dreams, work on them, and never forget to have fun.

IN YOUR WORDS

Artem Yanchak
Ukraine

How was your journey?
We flew from Kiev and the flight was supposed to take about 2 hours. The flight was amazing: no turbulence, no wind.

How long have you been preparing for IChO 2018?
The issue is what we consider preparation for the Olympiad. If we consider preparation directly for the Olympiad, it's about one year, but generally it took a lot more.

Do you have any experience or knowledge about the Czech Republic and Slovakia?
I have some memories of coming to Slovakia to ski in the High Tatras. But it was just a brief experience.

Sebastián Solís-Vargas
Costa Rica

How was your journey?
First, we took a flight to Madrid that lasted 10 hours. In Madrid we were waiting for 5 hours for the next three-hour flight to Vienna. We arrived yesterday, so we had an opportunity to enjoy the city of Vienna.

How long have you been preparing for IChO 2018?
We have been preparing for IChO 2018 since January; however, we participated in other events, so in total it has been about 2 years.

Do you have any experience or knowledge about the Czech Republic and Slovakia?
I know Prague, it is an amazing city.

Anh Duc Pham
Vietnam

How long have you been preparing for IChO 2018?
We had intensive team preparation for the last 3 months.

Do you have any experience or knowledge about the Czech Republic and Slovakia?
I admire local architecture (castles) and nature.

What are you looking forward to? Any message you would like to share?
I hope it will be a really special event and I am looking forward to meeting local people. I know you are very kind and thus you have a huge Vietnamese community.

ESTONIA

1. Illustrating here the *Kaera-Jaan* national dance.
2. Common stereotype: Very slow. National food: Sauerkraut and potatoes.

KYRGYZSTAN

1. Showing us their skills in a national dance called *Kara Jorgo*.
2. We are hosting the World Nomad Games in September.

IChO NATIONAL TEAMS

RUSSIA

1. We are having fun :-).
2. Three times as many bridges in St. Petersburg as in Venice.

UZBEKISTAN

1. Look at us! We are tough guys :-).
2. We have the best taxi drivers.

COSTA RICA

1. It's not just a bird, it is *Rafita.*
2. It may surprise you that we do not have an army in Costa Rica.

TURKMENISTAN

1. Throwing *tahya* caps into the air. *Tahya* caps are a head decoration in traditional Turkmen dress.
2. Gates of Hell: A natural gas field collapsed into an underground cavern.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

PORTUGAL

1. Imitating their national hero, Ronaldo.
2. Our ancestors discovered India.

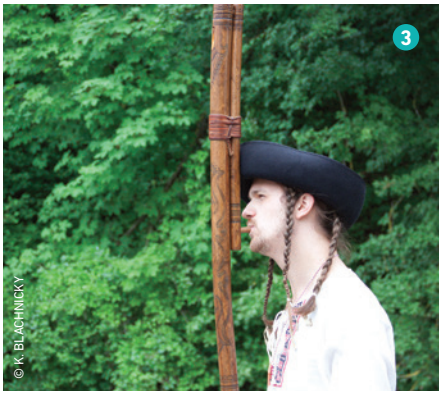
PHILIPPINES

1. Pretending to be confused.
2. The Philippines has over 7,000 islands.

The Slovak Republic was established on 1st January 1993 by peaceful dissolution of Czechoslovakia. It is a landlocked country located in the heart of Europe. After joining the European Union, the country adopted the Euro currency. Despite the small size of the country, it is rich in history, world cultural and natural heritage, and living traditions.

WHAT YOU (PROBABLY) DON'T KNOW ABOUT SLOVAKIA

GEOGRAPHIC MIDPOINT OF EUROPE
They don't say Slovakia is the heart of Europe just for nothing. Right next to the Church of St. John the Baptist near Kremnické Bane in central Slovakia, there is a stone marking the geographic midpoint of Europe.



UNIQUE NATURE
Slovakia can be characterized as a land of mountains and forests (41% of the country's area is forests), which have served as isolating barriers against modernization and centralization for centuries, thus helping to preserve regional traditions and identities. In addition, the mountains and forests are protected by nine national parks and fourteen landscape parks. Among the best known of them are High Tatras, Low Tatras, Malá Fatra, Veľká Fatra, Slovenský kras, and Slovenský raj.

LINDEN TREE OF KING MATTHIAS
The linden tree is the tree of Slavs. Linden wood was said to have magical powers, used mainly against demons and vampires. The Linden Tree of King Matthias is one of the oldest linden trees in Slovakia and in Europe. According to a legend, it was planted by "Lord of Váh and Tatras" Matúš Čák of Trenčín in c. 1301. In the fifteenth century, this place was regularly visited by Hungarian King Matthias, who organized meetings and dinner parties under this linden tree. In its best times, the tree measured 30 meters in height, 12.5 meters in circumference, and 36 meters in the diameter of its crown.

MORE THAN 1,600 MINERAL SPRINGS
Slovakia has many sources of mineral water and as well as hot springs, which are mainly used for therapeutic and recreational purposes in twenty-one spas. While they're considered a luxury in several countries, spas and water parks are easily accessible in Slovakia, thanks to their long tradition. Even Ludwig van Beethoven took to the waters in Piešťany in western Slovakia.

THE OLDEST AND LARGEST OPAL MINES IN THE WORLD
Nowhere in the world has opal been mined as long and in such an amount as in Slovakia. The largest piece of opal named Harlekýn comes from here. It weighs 607 grams and is worth half a million dollars. These gems were also worn by Napoleon's family.

CASTLE AND CHÂTEAUX SUPERPOWER
(1) With 180 castles and 425 châteaux, Slovakia is the world leader in number of castles and châteaux per capita. Each of them has a unique story. Čachtice Castle is known thanks to the "Blood Countess" Elizabeth Báthory, who allegedly killed more than 600 virgins and took baths in their blood to stay young forever. Among other known castles is Spiš Castle, the largest medieval castle site in Central Europe. **See pages 8 and 9 for infographic on medieval castles.**

THE TALLEST ALTAR IN THE WORLD
It took ten years of work and not a single nail for Master Paul of Levoča to make the gothic altar out of linden wood. You can find it in the Basilica of St. James which is, needless to say, in Levoča. It is 18.6 meters high.

RESERVATIONS OF FOLK ARCHITECTURE
(2) The picturesque village of Čičmany holds the title of the first Reservation of Folk Architecture in the world. It is known for its traditional wooden houses whose walls are hand-painted with white geometrical shapes.

ROCK DWELLINGS
Would you think they still live in "caves" in Slovakia? The village of Brhlovce is home to unique houses carved into rock. The story goes that the first such dwellings already came into existence in the sixteenth century. There was not enough money to build houses, so they carved them into nearby rocks.

FUJARA, MUSIC OF TERCHOVÁ, BAGPIPE CULTURE
(3) What do the only musical instrument of its kind, world famous Slovak regional folk music, and the tradition of playing bagpipes have in common? They're all inscribed in UNESCO's Intangible Cultural Heritage.

THE OLDEST OPERATING BUSINESS
The Kremnica Mint was founded in 1328 and has been producing the world's top minting products ever since, for almost seven centuries. Coins, or ducats, began to be minted here by coining 23-carat and 9-grain gold. All Kremnica ducats can be distinguished by their high levels of gold stability and fineness, which is why they were considered to be the strongest currency of the medieval Central Europe.

Julián Vrábel
Henrieta Stankovičová

SLOVAK CUISINE

The traditional basic components of the Slovak diet are milk, potatoes, and cabbage.

© 123RF

Due to a common past, Slovak cuisine is closely linked to Hungarian, Czech, and Austrian cuisine. Other factors have also affected it: Turkish ingredients and recipes; German, Italian, Bosnian, and Bulgarian cuisine; and the imperial court was well-known for its Spanish etiquette and food. It is not possible to circumvent Jewish cuisine or Polish Goral and Ruthenian influences. Of course, this statement has nothing to do with the food historically eaten by the poor, but can be applied to foods consumed by members of the middle and upper classes.

Our current Central European standard is expressed by our five meals a day: breakfast, lunch, dinner, with supper and snacks between them. There is usually a hot drink (tea, cocoa, coffee), yogurt, cereals, breads and pastries with a garnish, or fruit cake with butter, honey or jam at the beginning of the day. Hot cooked meals—soup, a main meal, and a dessert—are served for lunch and dinner, which can also be warm, or there can be some form of cold buffet.

Habits were once different, however. Five hundred years ago, people ate twice a day. The first meal of the day was consumed before noon, and the second meal after dark. The first meal used to be cold: people ate bread, and only those who could afford it. They also ate cheeses, sausages, meat from the previous day; vegetables, and seasonal fruit. Cold, boiled, or roasted meat was complemented with mustard, popular grated horseradish with apples, and pickles. Few could afford fresh meat. Meat was kept fresh by smoking, salting, or drying, so thirst was much stronger than today. It is said that beer is our bread, and back then, it truly was, because beer consumption was perhaps up to ten times higher than today. There were several reasons for this: water quality was poor, causing disease; oversalted meat caused a cumulative thirst; servants in the imperial court—in addition to wine—received two liters of beer per day. Moreover, beer was a Lenten drink and, unlike wine, could be consumed during times of strict fasting. Eating habits began to change over time; hard-working people, in particular, needed strength before going to work. In our environment, both adults and children consumed bread with warm beer in the morning. Beer was often flavoured, so beer soup appeared. Various pulps, thick soups with vegetables, beans and broths were added to bread and beer, which we would call a "snack soup" today.

For dinner, women prepared hot dishes, especially legume porridge, milled cereals, and various soups; the upper class also ate roast or stewed meats with sauces, poultry, fish, game, cheeses, savoury and sweet puddings (flavoured with honey or fruit jams), vegetables, fruit—and bread, of course.

From time immemorial, people have distinguished between two types of bread: dark and white. Wheat bread was light and rye bread, or bread made from other cereals, was dark. Dark bread belonged to the peasants and the poor, while white bread was consumed by the nobility. Bread was sold in the markets. Dark bread used to be stored in a dark mat on the ground; white bread and pastries were stacked on desks.

At the turn of the eighteenth and nineteenth centuries, in the context of new growing crops, a big change occurred. The expansion of potato cultivation was promoted by Maria Theresa, but the nobility constantly bumped into resistance. The reason was prosaic. People respected food closest to heaven the most: fruits and birds. What was grown underground carried with it the scent of hell. **However, hunger reached such dramatic proportions that people were forced to accept potatoes.** Hunger was a more convincing argument than the punishment of fourty blows of the cane for peasants who refused to plant potatoes. The consumption of potatoes, rice, pasta, and corn gradually increased. Potatoes are now considered to be a Slovak ethno-identifying food.

Since that time, the traditional basic components of the Slovak diet are milk, potatoes, and cabbage.

Milk is drunk fresh or sour, and all milk products such as whey, cottage cheese, *bryndza* (salted sheep curd), and sheep cheese are very popular.

The most typical Slovak national meals use *bryndza* as main ingredient: *bryndzové halušky* (dumplings made of potato dough mixed with a special kind of soft and salty sheep curd and with fried bacon chopped in tiny pieces or chives) and *bryndzové pirohy* (potato dough filled with *bryndza*). Among the traditional domestic dishes are various meals prepared with potatoes. They are mostly in the form of cooked or fried dough (*zemiakové placky, lokše*).

A good Slovak dinner starts with a soup: *kapustnica* (made from cabbage, spring mushrooms, smoked meat; some regions even use potatoes, dried plums, or pasta), garlic soup (in some places, it is served in a bread loaf), bean soup with a frankfurter, or beef or chicken consommé.

Domestic soft drinks such as Vinea (grape lemonade) and Kofola (cola-type drink), and a wide choice of fine quality mineral waters, now compete with international soft drink brands.

Julián Vrábel, Henrieta Stankovičová

THE ANATOMY OF A MEDIEVAL CASTLE

There was no standard shape and structure for a castle. The builders adapted their design to suit the site, the budget, and the military dangers of the day.

High walls and solid towers were the castle's main defense. They kept out the attacking soldiers and the parapets (the calls' jagged tops) provided the defenders with a safe view over the surrounding land. Every castle also made maximum use of the natural features of its site. By building the castle on a high point, the defenders had gravoty on their side. Attacking warriors had to struggle up a slope to reach the stronghold while facing a devasting shower of narrows from the defenders on the walls.


SIEGE ENGINE TOWER
KEEP
ARSENAL TOWER
STAIR TURRET
FOREBUILDING
UPPER BAILEY
TOWN GATE
ROCKY CLIFF
R BAILEY
CURTAIN WALL
Created with help of Ristridyn
© T. BELLON

THE SECRET STORY OF THE GOLEM

PART 2

TO BE CONTINUED TOMORROW...

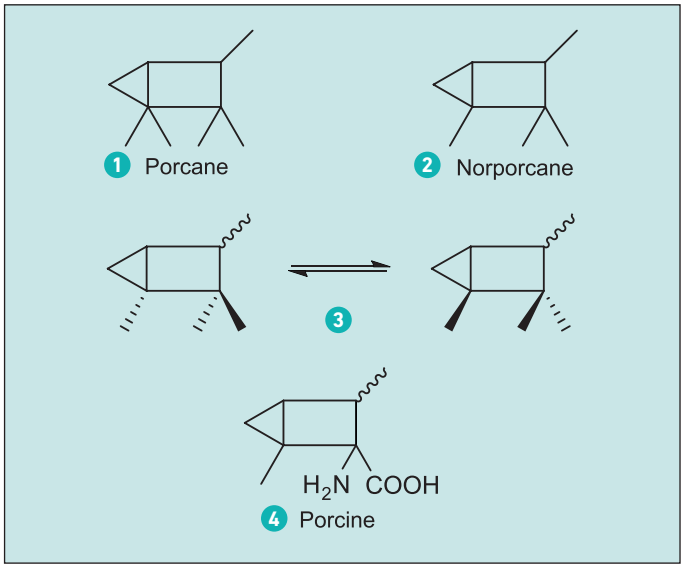
PORCANES

For decades, chemists have been fascinated by carbon's ability to form chains and create unique structures. This was proven again in 2016, when the Nobel Prize for Chemistry was awarded for the design and synthesis of molecular switches, pumps, and nanocars.

Let us have a look at a group of especially peculiar molecules: porcanes. In this field, Czechs have played a crucial role. They were the first to decode the messages of our ancestors hidden in cave paintings and written on country house walls and to bring porcanes into the daylight. By doing this, they laid the grounds of porcane chemistry. Moreover, they co-founded the World Council of Porcane Chemistry (WCPC).

It is fair to admit that the structure of porcane (1) is somewhat problematic. No doubt that the weakest point in its structure is the presence of a pentavalent carbon atom. Therefore, throughout time, even the strongest supporters came to the conclusion that the proposed structure of porcane is nonsense and that the published structure is actually norporcane (2). The authors of the porcane structure might feel ashamed that their pride limps on one leg; however, the theory with pentavalent carbon limps on both legs. The question of the absolute configuration of norporcane comes up immediately as an imminent issue. Assuming that the structure is able to move, it is far more probable that the actual structure of norporcane is described by equilibrium (3).

Aminoacid porcine (4) is also worth noting. This non-coded amino acid was given the abbreviation Por and it might be a valuable scaffold for the synthesis of series of synthetic peptides with interesting properties. Trademarks "Fivebabypigs" for linear pentapeptide Por-Por-Por-Por-Por and "Tentabypigs" for decapeptide Por-Por-Por-Por-Por-Por-Por-Por-Por-Por have been already registered. All experiments have been carefully designed and planned, and research will start as soon as some grant agency is brave enough to fund it. While it may take a while for grant agencies to recognize the importance and relevance of porcane research, you can prepare your own porcanes at home in the meantime. You simply need a sheet of paper and a set of pencils and crayons.



Petra Ménová

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 3

THE THIRD ISSUE OF CATALYZER MAGAZINE 21/07/2018

Yesterday, the jubilee 50th International Chemistry Olympiad officially kicked off in Bratislava, Slovakia. The Opening Ceremony took place in Stará Tržnica (Old Market Hall) in the centre of the city and was attended by over 600 people from 83 countries.

By gathering and having live conversations in the pleasant morning sun in front of the entrance, you could say that something was going on. Students, together with their mentors and guides, were taking pictures and enjoying the friendly atmosphere.

When everyone had been seated, the hall was ready for the show. The stage was decorated with flags and mysterious balls hovered above it all. With the audience impatiently waiting, the Copperheads came to the stage and, by touching the balls, they lit the whole space and the ceremony started.

The whole programme was hosted by two renowned TV presenters, Emma Smetana and Daniel Stach. Emma is not only a TV presenter but also a popular singer, while Daniel, a Czech Television presenter, has been popularizing science by running many science oriented programs and conducting interviews with the world's most influential and inspirational scientific figures.

Given a warm welcome by the presenters, it was the right time to take a selfie of the Copperheads with the audience. Following the formal welcome, a folk dance group performed a traditional polka dance. On behalf of Slovak president Andrej Kiska, Daniel passed a message to the audience. He greeted the incoming competitors and also shared that his mother happens to be a chemistry teacher. Other distinguished guests present also greeted the international delegations: Olga Nachtmannová, State Secretary of the Ministry of Education of the Slovak Republic; Karol Mičieta, Rector of Comenius University in Bratislava; Karel Melzoch, Rector of the University of Chemistry and Technology in Prague.

The latter welcomed all the guests to the former Czechoslovakia, which was founded in 1918. This is why both Slovakia and the Czech Republic are celebrating the 100th anniversary this year. The last contribution was given by I-Jy Chang, Chairman of the IChO Steering Committee, who officially declared IChO 2018 to be open.

The Olympiad being officially opened, presidents of the 50th IChO, Petr Holzhauser and Martin Putala, joined the stage. Daniel asked Petr Holzhauser about his feelings as a chemist. "It is the highest excited state of my life. I need to say we have been fighting against entropy to organize this event which costs a lot of energy and as you know, energy means money," said Petr Holzhauser. Both presidents attended IChO themselves and were each awarded silver medals.

(To be continued on the next page)

(Continuing from previous page)
During their speeches, they didn't forget to remind participants that the Olympiad is about gaining new relationships, discovering different cultures, and fair play, of course.

Dealing with a tight budget, it was necessary to thank sponsors. The Platinum Partner, Unipetrol, represented by Tomáš Herink, member of the Board of Directors, also greeted the students and encouraged them in their studies, and almost asked for their CVs :).

Getting to the end of the programme, all the teams were introduced one-by-one. The presenters called the country name of each team and included an interesting fact or curiosity about each country. The long presentation of delegations was combined with a cultural programme: Old School Brothers, a dance group, took over the stage and performed an original piece of art by mixing hip hop with traditional Slovak folk dance.

The programme also included the presentation of a new IChO flag, inspired by both the Olympic flag and the colours of flames. Moreover, a special IChO postage stamp was designed exclusively for the Olympiad. The structure of benzene and a silhouette are captured in the stamp design.

© IChO TEAM

The students were asked to take oaths committing themselves to respecting and abiding by the rules and the spirit of fair play. The ceremony was closed by singing the students' anthem, Gaudeamus Igitur.

Elizabeth Lenthsmith, Marek Lanč

Post scriptum: Luckily no one fainted due to a lack of O_2 :).

SUN & FUN AT ČERVENÝ KAMEŇ


© T. BELLOŇ

(1) The afternoon at the former medieval castle, Červený Kameň, was full of activities inspired by the Middle Ages. One of the activities was swordsmen showing their techniques to the students.

(2) IChO participants could try their hands at various crafts including weaving, blacksmithery, and working with leather, learning many new things about medieval craftsmanship.

(3) What a better way to end the day than being reunited with your mentors and enjoying a nice warm dinner (Slovak cuisine) with live music at the beautiful castle.


© IChO TEAM


© IChO TEAM

MENTORS IN MOTION

On Friday, mentors got to see the city of Bratislava. After a light lunch they went to the Bratislava Castle, where they started their adventure. After enjoying the spectacular view of the Danube River from the castle walls, they descended stairs to discover the streets of the Old Town and to visit a church and a square in the city centre. Finally, all the mentors got on their buses to meet the students at Červený Kameň.

IN YOUR WORDS

Elizbar Elizbarashvili
Georgia

Is it your first time in Slovakia?
I have already been to Prague, but it is actually my first time in Slovakia.

How did you like the Opening Ceremony?
I enjoyed the dancers most. I think the whole programme was nice.

Did you enjoy the Bratislava tour today?
I have been delighted by sightseeing, mainly the architecture. I like both modern and historical sights.

What are you looking forward to do or see during IChO 2018?
To all parts of the programme. I find it rich enough.

Isabel Cabello
Peru

Is it your first time in Slovakia?
Yes, I have never been to either Slovakia or the Czech Republic.

How did you like the Opening Ceremony?
The Opening Ceremony was spectacular. I really enjoyed it.

Did you enjoy the Bratislava tour today?
Since I am from South America, the sights are completely different from what I am used to. Especially, I admired the local architecture.

What are you looking forward to do or see during IChO 2018?
I am eagerly awaiting everything!

Lara Nobili
Italy

Is it your first time in Slovakia?
Some time ago I visited Prague, but Bratislava is a new experience for me.

How did you like the Opening Ceremony?
The dancing performance by the Pastels was fascinating. I was also amazed with the light balls hanging above the stage.

Did you enjoy the Bratislava tour today?
The "Czechoslovak" sights are magical. I especially enjoyed the Bratislava Castle, with its breathtaking panoramatic views.

What are you looking forward to do or see during IChO 2018?
Beer, definitely beer!

NORWAY

1. We are enjoying the welcome gathering.
2. Before final exams, we party for 40 days straight, it's called *russefeiring*.

SOUTH AFRICA

1. We are celebrating Nelson Mandela International Day by making his signature pose.
2. Did you know we have 11 official languages?

IChO NATIONAL TEAMS

SPAIN

1. Trying to make a silly pose :).
2. In Spain, it rains much more than the people think.

UKRAINE

1. We are perfoming our national dance, *Hopak*.
2. The *Hopak* dance :).

MEXICO

1. What a nice evening in UPeCe.
2. We are very family-oriented kind of people. It is common for several generations to live in the same house, and we even throw parties together.

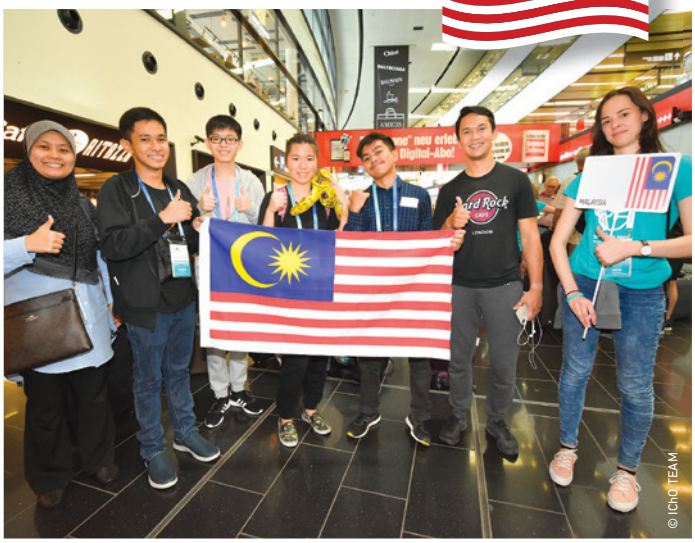
MONGOLIA

1. Showing *deel* – Mongolian traditional clothing.
2. Visit us! We are very open people and you will also see beautiful nature.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

MALAYSIA

1. Try to find our masot. Yes, it's a turtle.
2. Petronas Twin Towers, one of the highest skyscrapers in the world.



MOLDOVA

1. We are remembering our national drink, wine.
2. You will be surprised that wine is a national drink :).

© P. KÓNEC

BANSKÁ ŠTIAVNICA

Banská Štiavnica is one of the most important mining towns in the world, especially with regard to the historical and mine-technical aspects.

For centuries, the deposit was mined mainly for Au-Ag ores as well as base-metal ores. The peak of the mining was in the eighteenth century with, for example, the Banská Štiavnica district producing 25% of the world's total annual silver production in 1740. At present, there is only one productive mine near Banská Štiavnica, the Rozália mine in Hodruša-Hámre. It is currently the only active gold mine in Central Europe. The great importance of Banská Štiavnica to the world is mainly in the area of ore exploitation. In mining sciences, Banská Štiavnica was, from the late eighteenth century to the middle of the nineteenth century, the top world development center for mining. The permanent presence of prominent world experts stimulated opening of the first mining academy of its kind in the world (1762).

The greatest experts of that time (M. K. Hell, J. K. Hell, and G. A. Scopoli) were employed at this famous school. Christoph Traugott Delius wrote here the most advanced mining textbook at its time in the world. Numerous discoveries, patents, and inventions were made here by the most prominent experts, who implemented and used them for the first time, later extending their use to the rest of the globe.

The pride of the monuments are also heritable adits (entrances to underground mines), which used to take water from the mines. The Voznická adit was engineered over the course of 96 years (1782–1878) and, in the past, was the longest and the most magnificent mining work in the world (16,538.5 m long). It is now listed as a UNESCO World Cultural Heritage monument. The second Voznica heritable adit was constructed from 1980 to 1989 and today is 13,830 m long. Its construction using a Wirth machine set a world tunneling record of 812 meters in 31 days. Banská Štiavnica is unique in the field of mining water management. Near the town there are almost 60 mining water reservoirs with a total volume of about 7 mil. m^3 of water.

Today, Banská Štiavnica is home to many UNESCO World Cultural Heritage monuments. There is, for example, a unique atmospheric steam water-pumping engine preserved from the first half of the eighteenth century and a 1881 water-columnar pumping machine, driven by water pressure (the last of its kind preserved in Europe).

The area of Banská Štiavnica is rich in minerals and contains cavities with the most beautiful druse minerals in Slovakia. Nearly 200 minerals have been identified throughout the area. The best known are the varieties of quartz, with the area being the world's historically best known source for amethyst, scepter, and skeletal quartz crystals, among others.

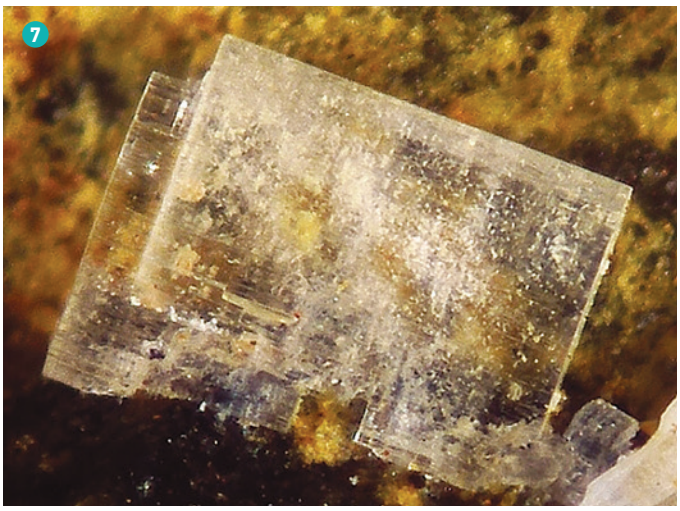
Daniel Ozdín

MANY FIRSTS IN BANSKÁ ŠTIAVNICA

- Blasting powder was used for the first time in the world in a mine (Horná Bieberová adit, 1627).
- The world's first air pneumatic pumping machine was constructed here (1755) and later used worldwide in the petroleum industry.
- In nearby Sklené Teplice, the Austrian mineralogist Ignaz von Born officially demonstrated a new silver-ore processing method called "European amalgamation of silver ores" (1786).
- Between 1825 and 1828, the first underground horse-rail line in Europe was built.
- The world's first mining cable was mass produced in Banská Štiavnica (1837).
- The first international mining society in the world, the *Societät der Bergbaukunde*, was initiated in Banská Štiavnica (1876).
- Below Štiavnica, a new type of mining ore car, the so-called Hungarian car which used wooden boards, was also developed.

In Slovakia, especially in its interior, one finds a large concentration of mineral veins. These veins have—for centuries—provided a number of wonderful mineral samples housed in many major museums and collections. Check out our list of minerals from Slovakia which have been celebrated all over the world.

UNUSUAL MINERALS IN SLOVAKIA



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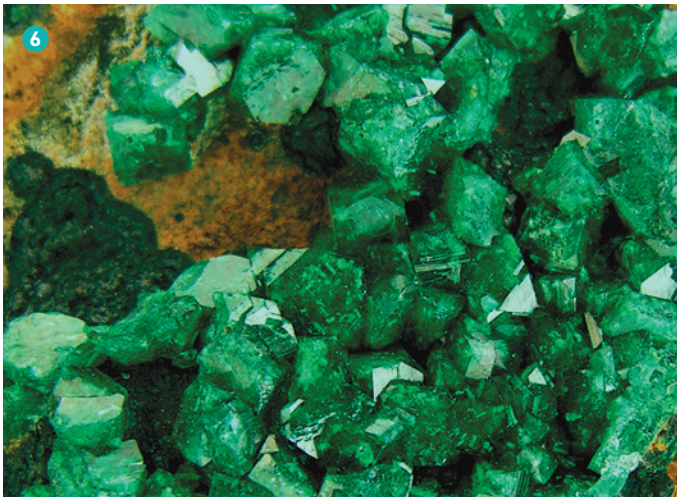


6

THE MOST STUDIED...
(1) COHENITE $(Fe, Ni, Co)_3C$ and SCHREIBERSITE $(Fe,Ni)_3P$ were discovered for the first time in the world-famous iron meteorite, Magura, which probably fell sometime between 1830–1840 in the Oravská reservoir of the flooded village of Slanica in Orava. The meteorite is famous for the fact that it was, in the nineteenth century, the most-studied iron meteorite in the world, studied by all the foremost meteorite scientists at that time.

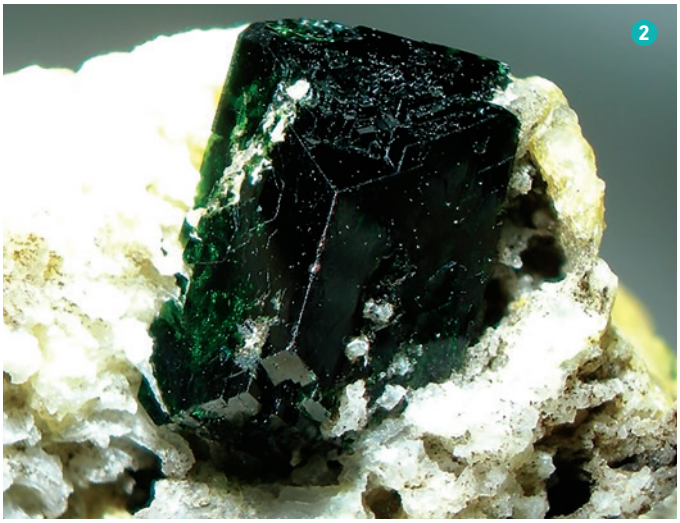
THE MOST FAMOUS...
(2) LIBETHENITE $Cu_2^{2+}(PO_4)(OH)$ is the best-known Slovak mineral. It has a beautiful black-green colour and is also featured in the logo of the Slovak Mineralogical Society, the successor to the second oldest mineralogical society in the world.

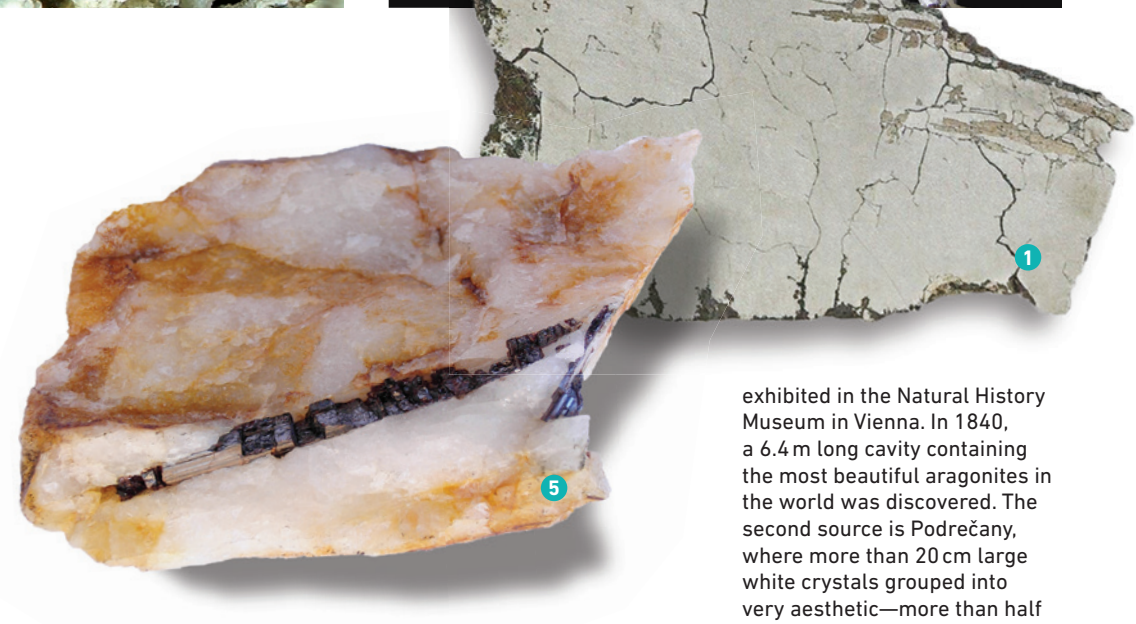
LARGEST...
(3) KERMESITE Sb_2S_2O is one of the largest Slovak minerals that forms beautiful red wine coloured, 8 cm long needles, usually grouped into fan-like or radial aggregates across several hundred cm^2. Kermesites from Pezinok and Pernek are among the most beautiful and largest in the world and can be found in most of the world's leading museum collections.

MOST VALUABLE...
(4) DEVILLIN $CaCu_4^{2+}(SO_4)_2(OH)_6 \cdot 3H_2O$ is one of the most valued Slovak minerals. It forms beautiful table crystals grouped into more than 1 cm large, globular, dark green aggregates. The largest and most aesthetic aggregates in the world come from devilline from Špania Dolina. Its crystal structure was solved using a sample from Špania Dolina.

PIONEERING...
(5) RUTILE TiO_2 is the first mineral discovered in Slovakia as a new mineral. Ignaz Born described it in Revúca in 1772 using the title "basalt ruby". Its name comes from the Latin word *rutilus* (reddish). In 1795, the world-famous German chemist M. H. Klaproth isolated titanium from Slovakian rutile for the first time.

THE MOST BEAUTIFUL...
(6) EUCHROITE $Cu_2^{2+}(AsO_4)$-$(OH) \cdot 3H_2O$ is the most beautiful mineral discovered for the first time in Slovakia. It was discovered in 1823 by F. A. Breithaupt. Euchroite got its name because of its beautiful emerald-green colour. To this day, euchroite crystals from this locality are the largest and most beautiful in the world.



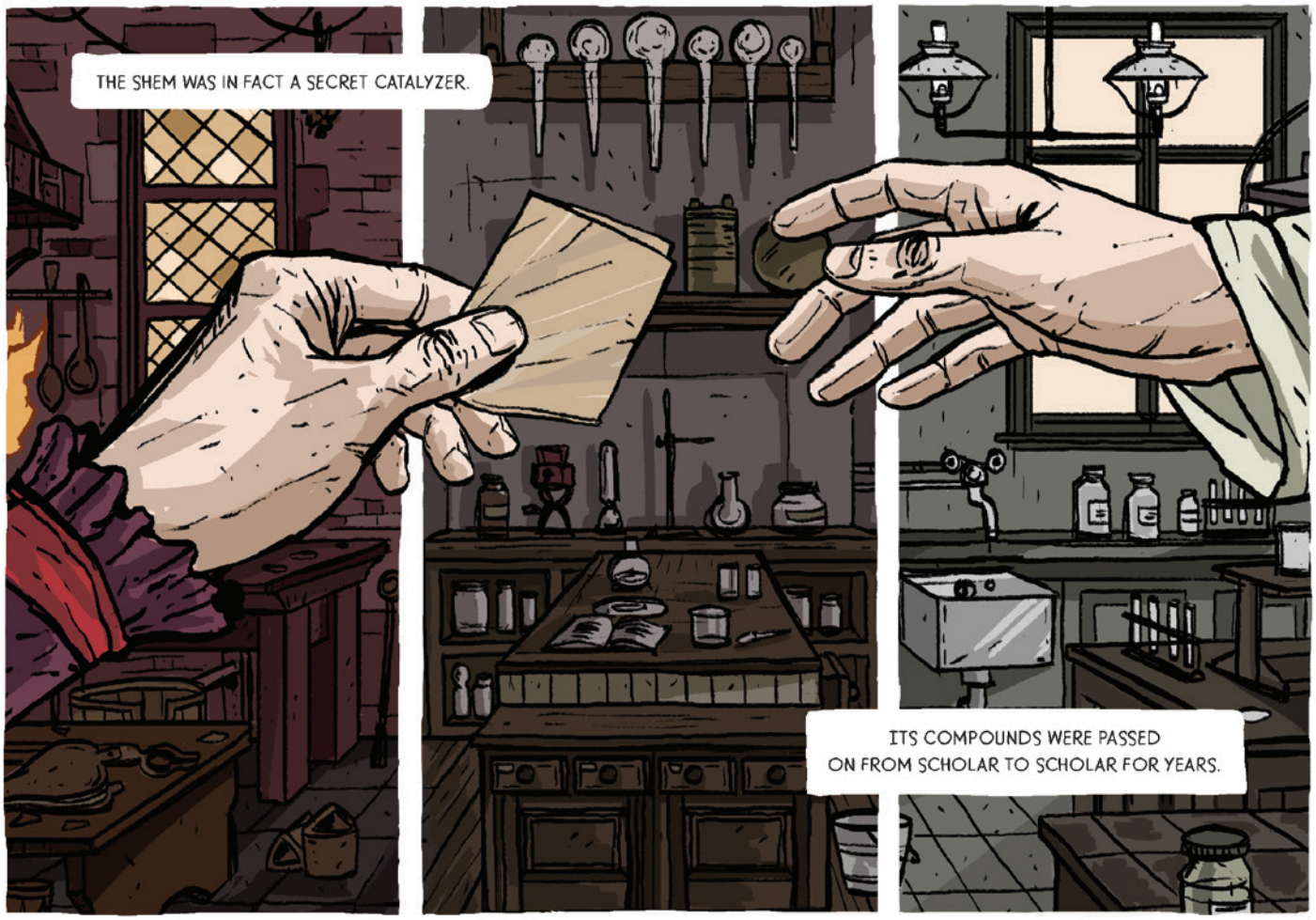


EXCEPTIONAL...
(7) BRANDHOLZITE $Mg[Sb(OH)_6]_2 \cdot 6H_2O$ from Pernek was the second find of this mineral in the world. It forms transparent, white to grey colour crystals up to 4 mm in size. It was an extraordinary, world-famous discovery from which several reference analyses have been performed. The scientific, collector, and museum sensation about the find in Pernek extended—even more significantly—to a find in the Pezinok locality. Very rich macroscopic aggregates of brandholzite (several hundred cm^2 areas with the size of tabular crystals up to 1 cm) were found in this area. The find in Pezinok is so rich that at least 85% of all the brandholzite on the globe is from there. Brandholzite is also present on mining wall surfaces and it can crystallize within a few weeks. Due to the size of the crystals and the richness of the samples, Pezinok is nowadays the dominant locality for this mineral in the world, and—from the scientific and museological points of view——the most important one.

THE BREATHTAKING...
(8) ARAGONITE $CaCO_3$ is found in two exceptional locations in Slovakia and is one of the most beautiful aragonites in the world. The historical place of origin is Špania Dolina, where six-sided and more than 10 cm large, prismatic, white or yellow crystals have been grouped in cavities, forming beautiful aggregates. One of the most beautiful samples is still exhibited in the Natural History Museum in Vienna. In 1840, a 6.4 m long cavity containing the most beautiful aragonites in the world was discovered. The second source is Podrečany, where more than 20 cm large white crystals grouped into very aesthetic—more than half a meter large—aggregates have been found. Aragonite samples from Podrečany are the pride of several important world museums such as The Smithsonian Institution (US) and the National Museum in Prague.

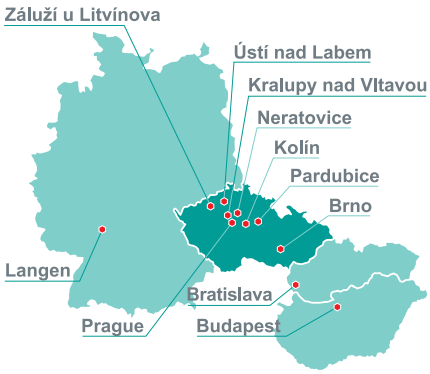
Text and photo:
Daniel Ozdín

THE SECRET STORY OF THE GOLEM



PART 3

TO BE CONTINUED TOMORROW...



Unipetrol
ORLEN GROUP

The Unipetrol Group is the largest refinery and petrochemical company in the Czech Republic. It focuses primarily on crude oil processing, distribution and sale of fuel and petrochemical products — particularly plastics and fertilisers. In all these fields, the group is a key player on both the Czech and Central European market. The Unipetrol Group includes refineries and production plants in Litvínov and Kralupy nad Vltavou, Paramo with the Mogul brand in Pardubice and Kolín, Spolana in Neratovice, and two research centres in Litvínov and Brno. Unipetrol also owns the Benzina network of petrol stations with 404 stations. In 2005, Unipetrol became part of the PKN Orlen Group, the largest crude oil processor in Central Europe.

www.unipetrol.cz

UNIPETROL GROUP IN 2017

CZK 122.5 billion
REVENUES

CZK 13.5 billion
OPERATING PROFIT

4600
EMPLOYEES

CZK 8.7 billion
NET PROFIT

MAIN ACTIVITIES

REFINERY
PETROCHEMISTRY
RESEARCH
WHOLESALE
RETAIL
LOGISTICS

MAIN PRODUCTS

DIESEL
PETROL
JET
BITUMENS
POLYETHYLENE
POLYPROPYLENE
BENZENE
ETHYLENE
AMMONIA
OILS

RETAIL

The widest network of petrol stations in the Czech Republic

BENZINA

404
PETROL STATIONS

21.4%
MARKET SHARE

Retail brands

efecta
verva
made in PARAMO MOGUL
stop cafe

EDUCATION & RESEARCH & DEVELOPMENT

UniCRE

POLYMER INSTITUTE BRNO

UNIVERSITY CENTER
UCT PRAGUE - UNIPETROL

UNIPETROL FOUNDATION

SCHOLARSHIP PROGRAMME FOR STUDENTS

GRANT PROGRAMME FOR SECONDARY SCHOOLS

SCIENCE PROJECTS

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 4

THE FOURTH ISSUE OF CATALYZER MAGAZINE 22/07/2018

The initial Olympic bustle has passed and hopefully everyone has fully recovered from jet lag by now, because the actual competition is finally starting.

© UCT PRAGUE

THE FUN ENDS; THE REAL FUN BEGINS

Today, you will learn about the available lab instrumentation and its safe use—a small warm-up before tomorrow, when the practical part of IChO 2018 starts in full. This is the part all those bitten by the chemistry bug like the most.

So, what can you expect tomorrow? In the first of a total of three tasks, you will need to be patient, because you are going to prepare...well, wouldn't you like to know? Unfortunately, as the famous *Smrťák*, a Czech version of the Grim Reaper, says: We can't tell you, we can't even give a hint. But what we CAN do is reveal a few interesting facts from previous Olympiads.

For example, **Taiwan in 2005.** The day before the practical exams, the competitors had to stay in their dorms due to the threat of a typhoon. When the eye of the typhoon passed Taiwan, mentors were just translating the practical exams. "It started with a drizzle, which soon turned into a strong thunderstorm. It lasted one whole day and one whole night," remembered a participant, Petra Ménová. "From the dormitory windows, we saw how a river changed within a few hours from a peaceful stream to a wild river, flooding the surrounding areas. Tree branches and banana tree leaves were carried away by the strong wind," Petra added. The accompanying programme had to be cancelled. Don't worry though, this is very unlikely to occur in Slovakia.

You will likely not be threatened by malaria, as was the case **in 2014, in Vietnam**. Although the risk in Hanoi was relatively small, it is difficult to judge how the students were feeling inside during the practical task while they were synthesizing an artemisinin derivative. Anyway, the formula of this antimalarial drug made it to the backside of the Olympic medals.

But there can be many other challenges. A particularly innovative approach to practical tasks was demonstrated by the organization committee for the **Cambridge** (UK) Olympiad **in 2009**. For one task, students did not get a full laboratory, but only a conductivity meter, a glass and a few other simple tools. They were then asked to use the provided tools to find the critical micelle concentration of a surfactant. Creative improvisation just like in the MacGyver series, isn't it? Even better, because it was completely real.

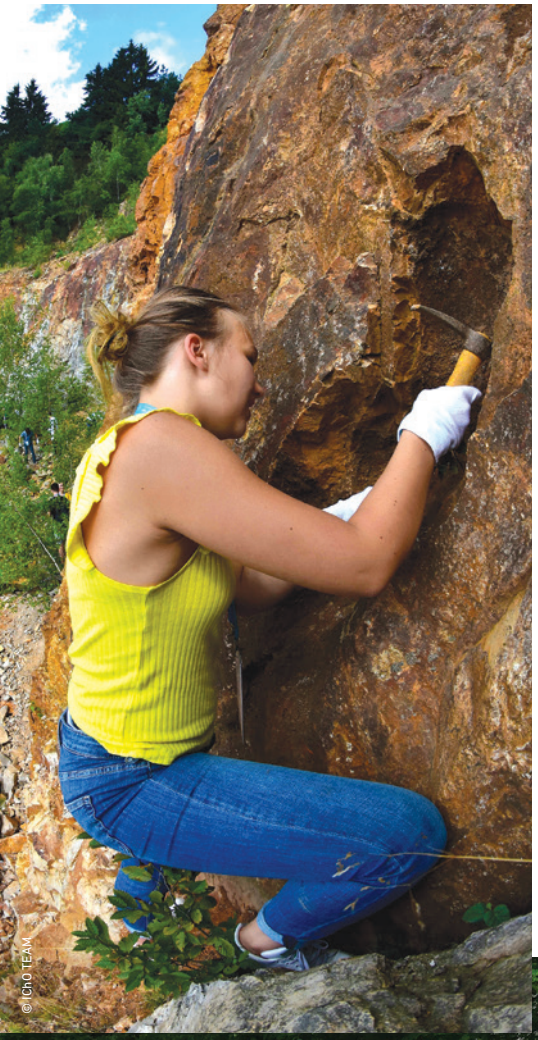
The surprises aren't only for the students, though. In January **2015**, the Steering Committee arrived **in Baku**, Azerbaijan, to check their readiness for IChO, taking place there in just a few months. When they saw that the planned laboratories were rooms with nothing but bare walls, they were starting to worry despite the assurances of the organizers. The worries turned out to be unfounded: The practical tasks that summer took part in brand new laboratories, built and furnished with amazing speed and quality.

A year later in Tbilisi, Georgia, some members of the Steering Committee wanted to try out the practical tasks themselves, to really put themselves in the shoes of soon-to-be competitors. The results weren't made public, but the rumours say they were less than stellar. As one of the committee members jokingly told the editorial staff: "Looked like some of us weren't in an actual lab for a long, long time."

As the given examples illustrate, the practical part of IChO can be full of surprises, and every year has its own unique tasks, experiences and overall flavour. We hope to continue this tradition. Wishing you all the best for tomorrow!

Michal Janovský

ABOVE GROUND AND UNDER GROUND



Short report from the trip to Banská Štiavnica

After getting on board of one of the eight buses, we had the feeling of being in a ghost town. Every single passenger fell asleep with their breakfast bags in their laps shortly after leaving the dorms. Waking up in Svätý Anton, the zombies transformed into the students we had known from before and took a guided tour of a local palace, where they learned about the life of noble families, regional history, and hunting. They also got to see an exhibition of stuffed Slovak animals and admired the collection of knives, rifles, and shotguns.

Resurrected by a short safety demonstration of emergency exits provided by a crewmember on the bus, students walked up to the top edge of Šobov Quarry. In the quarry, they were equipped with geology shovels and spread all over the area to take the chance to dig the ground for some quartz crystals. One of the Venezuelan participants was lucky to find a neat piece of crystal: "Seeking for crystals is fun, but I would not trade geology for chemistry," he said.

On the way to the Open-Air Mining Museum, the teams stopped for lunch in Banská Štiavnica to recharge their batteries, make friends, or to take a short nap. Museum staff gave the students well fitting—though out of fashion—coats and helmets. Ready for their mining mission, they continued their journey to the underground mines. The Catalyzer team never saw them again :).

Elizabeth Lensmith, Marek Lanč

© T. BELLOŇ

BYE BYE, DEAR MENTORS!

After only two days of adapting in Bratislava, your mentors have already turned on their working mode, meaning they have already inspected the IChO 2018 laboratories yesterday to ensure everything is ready for exams.

Then they took a train to Prague. And it indeed was a special train, with 16 railcars, the longest one ever to be dispatched from Bratislava Train Station!

Now they have the first night in Prague behind them and they are going to meet with the authors of the Olympiad tasks in the next few days. They will be discussing, negotiating, and translating the final problems of the theoretical and practical tasks to customize them for each team. Because the test questions remain top secret, you won't be able to get in touch with your mentors until Wednesday at the Summer IChO Party in Prague.

But not to worry, your mentors won't be working all the time. A tempting programme is prepared for them as well. During their stay in the Czech Republic, they will discover Kutná Hora, the Vltava River, and other interesting sights.

Elizabeth Lensmith, Marek Lanč

© T. BELLOŇ

SLOVENIA

1. Performing different stages of a ski jump.
2. In a small country like ours, we still have over 50 dialects. Unlike other Slavic countries, we have the word "love" in our name.

SAUDI ARABIA

1. We are wearing our traditional dress, it consists of 4 main pieces: *Ghutrah*, *Agal*, *Thawb*, *Tagia*.
2. The capital of Islam, the city of Mecca, has the largest clock in the world: Abraj Al Bait Towers Clock.

IChO NATIONAL TEAMS

GREECE

1. Showing us their national dance, *sirtaki*.
2. Every place is within 100 km of the sea and we also have the southernmost place in Europe.

THAILAND

1. Thaibox pose.
2. One of our favourite foods is a soup, *Tom Yum Kung*. It is a shrimp soup with hot and sour spices.

THE REPUBLIC OF KOREA

1. Showing Taekwondo, a Korean martial art.
2. *Soju*, a hard liquor, mixed with beer, makes a cocktail called *somaek*. We like to drink it with food...or even without :).

VIETNAM

1. Imitating a symbol from their flag, a five-pointed star.
2. Every Monday we dress more formally in our traditional clothing. *Ao dai nam* for men, *Ao dai* for women, and a flag salute.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

USA

1. Posing as an eagle.
2. The national bird was supposed to be a turkey.

AUSTRALIA

1. Quitely awaiting the Opening Ceremony.
2. Eating spaghetti on toast? Seems normal to us.

THE SYMBOLISM OF IChO

When you say the word "Olympiad", everyone imagines medals and the Olympic circles. The International Chemistry Olympiad started in 1968 and its symbolism emerged gradually throughout the following decades. IChO now has its own flag, each year has its own logo, and a slogan. Just like with sports, medals are awarded.

THE LOGO
Through the years, the main themes of the logos were different molecules, flasks, or national symbols. The logo of the 50th anniversary event represents the fact that IChO is not just about flasks and molecules, but especially about young chemists. These young chemists are full of passion for chemistry and knowledge. Their inner flame is pictured in another of the symbols used, the Olympic flame.

BACK TO WHERE IT ALL BEGAN

THE SLOGAN
This year's slogan certainly requires no explanations.

THE MEDALS
In the first ten years of IChO, no medals were awarded, only certificates with the final positions were given out. At the very beginnings, even the ranking was not announced; later it was only the first three, and since the 5th IChO in Sofia, Bulgaria, more first, second, and third places started being awarded. It was only in 1977 at the 9th IChO in Bratislava, when real bronze, silver, and gold medals were manufactured and awarded (not made of real bronze, silver, or gold, though).

THE FLAG
As a symbol of IChO, it was first presented in 1985 at the 17th IChO in Bratislava. The logo of IChO was surrounded by the words "International Chemistry Olympiad" in the four official languages of the competition: English, German, French, and Russian. At the end of the competition, it was given as a pledge to the organizers of the following year from Leiden, Netherlands. Thus, a new, unwritten tradition emerged, held till today.

On the occasion of the 40th anniversary of IChO in Budapest, Hungary, the organizers created a new flag. It fulfilled its purpose for the following ten years. The original flag was stored in the archive, where it still rests today.

The 50th anniversary of IChO was another clear milestone, which required a new flag. The new flag was presented at the opening ceremony in Bratislava and will be handed over to our French colleagues at the Closing Ceremony in Prague.

The flag features the acronym "IChO" and the five Olympic flames representing the Olympic circles, as well as the flame. A chemist will recognise the characteristic colours of the flame-tests of compounds of thallium (green), calcium (orange), sodium (yellow), copper (blue-green), and strontium (red). A closer look will also reveal a burner: a timeless symbol of the lab work of alchemists and chemists.

THE ANTHEM
At the 6th IChO in Romania, the song of university students, *Gaudeamus igitur*, was proposed to be the anthem of IChO. Even though it disappeared from IChO through the years, it was played again on the occasion of the 50th anniversary.

The first IChO medal die from 1977. On the front, there is a solid-state structure; the back depicts the Bratislava Castle. This year's medals carry the logo of the competition; the reverse depicts a linden leaf, the national tree for both Czechs and Slovaks, commemorating the 100th anniversary of the birth of independent Czechoslovakia.

IChO HAS BEEN INSTRUMENTAL FOR MY CAREER

Roman Mezencev is a Czechoslovak-born US scientist who has distinguished himself over years of productive research at the Georgia Institute of Technology. As a young student years ago, he competed in three annual IChOs (1986–1988).

What brought you to chemistry and the Chemistry Olympiad?
I began to be interested in chemistry when I was about twelve. It was then that my dad brought me a classic Russian *Yuniy khimik* ("young chemist") chemistry set. I quickly used one set of chemicals, then another, but it was still not enough, so I turned to friends and acquaintances who had access to laboratories. With their help, I built a small chemistry lab in our cellar and kept exploring.

Was the Chemistry Olympiad beneficial for your career?
It really was. My four years at a high school were like a road with milestones set-up around the Chemistry Olympiad. Every year I was moving from the school level to the county level, then to the national, and eventually to the international level–and back again. When I graduated, I faced a difficult choice regarding my higher education. I knew that I wanted to become a scientist exploring the point at which chemistry and medicine intersect. Unfortunately, however, cross-disciplinary programmes such as MD/PhD were not available at that time, so I had to choose between the two. I chose chemistry and never regretted it. Eventually, my scientific career further evolved in the United States, and I am now doing what I always wanted to do. My research combines areas of chemistry, genomics, and public health.

Do you have any personal anecdote related to IChO?
Years ago, the "evening of delegations" used to be a tradition at IChO. At that event, each delegation gave a short performance to present its country and to entertain others. For obvious reasons, the spoken part had to be in English. At the 19th IChO in Vészprém, Hungary, I was fulfilling a role of conferencier during our delegation's performance. I took and embraced this role even though my English was somewhat limited. I knew English only from self-study and not from a formal class or a language course. And right on the stage during our performance it happened: My English failed me. I suddenly could not remember how to say the word "volunteers" in English. We were going to ask for volunteers from other delegations watching our performance, but I could not remember the word "volunteer" or any usable synonym. I paused and looked at my friends, seeking their help, but they did not realize that I was in trouble. The silence was heavy and seemed endless till I produced some descriptive verbal alternatives that saved the moment.

Do you have any other memory?
Another memorable moment was from a study camp where we were rigorously trained and evaluated. We were competing to be selected to represent our country at IChO. During one laboratory session, we were asked to synthesize benzyl chloride and our instructor graded our lab work based on the yield of the product. There was a lot at stake, and I believe that at least one trainee could not resist the urge to increase his apparent yield of product by secretly adding some water to it. The instructor looked first at his product. Then he looked at the trainee hard for a long moment. Then he turned to all of us and said: "This is how it looks when benzyl chloride reacts with water in a hydrolysis reaction. The liquid turns cloudy." He did not need more to discover what the trainee had done.

Which team was your biggest competitor at that time?
It was the Soviet Union. However, this competition was not bitter in any way. Students from the Soviet Union traditionally displayed excellent performance at IChO and I felt that they set a positive example for what can be achieved with hard work. We wanted to show that we could be equally good.

Veronika Boguschová
Eva Brichtová

MEMORIES OF SOME PARTICIPANTS FROM PREVIOUS IChOs

Prof. Ivan Cibulka
1st IChO (1968), Czechoslovakia
At the first IChO, there were students from Czechoslovakia, Hungary, and Poland. However, I remember that we were speaking in Russian. We knew that the winners of the competition would not be announced. We saw IChO more like a meeting than a competition. I even kept in touch with some of the students from Poland after the end of the Olympiad.

Assoc. Prof. Petr Duchek
4th IChO (1972), The Soviet Union
Before we could go to IChO, we had to have the length of our hair checked at the Ministry of Education. Officer Nedvídek was in charge of this and he did not want to get into any troubles, definitely not political ones. (*In 1972 IChO was in Moscow and the Communist regime of that time thought that men with long hair were dangerous and were charged with "social parasitism".*) That is why we were sent to the barber and the government paid for it. When we came to IChO, we found out that the Russians had the longest hair of all.

Prof. Dalimil Dvořák
5th IChO (1973), Bulgaria
Officer Nedvídek, an elderly bald man, invited us to the Ministry of Education before departure. He told us that at the previous IChO was a guy who brought some risqué pictures to the Olympiad. He advised us not to do anything like that; that it would be inappropriate.
The second problem we faced was connected with the instructions. They were in Czech, but they were not translated very well. We did not know what we should do in the practical part. That is why we could not succeed in the Olympiad.

Prof. Petr Bouř
16th IChO (1984), West Germany
Just the trip to West Germany was an unforgettable experience. We had to cross the Iron Curtain (*the boundary between the former East and West with fences and barbed wires*) and get checked by dogs and the officers of the border service on our train. What I remember most is probably the practical part of the competition. I think it was going on in a laboratory at Hoechst AG company and we went on excursion there. They took great care of us; I vividly remember the boat cruise through the Rhine Valley and a creamy mushroom soup.

The most popular Tuzemák, with a picture of a sailing boat. © Božkov

THE CHEMICAL STORY OF CZECHOSLOVAK RUM

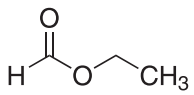
You might be very surprised if you order rum in a pub in the Czech Republic or in Slovakia. You will not get a liquor with an exotic scent but rather a brown beverage just slightly reminiscent of the exotic, with a special chemical scent. This is so-called Tuzemák (local rum), used for everything from curing the flu to baking Christmas sweets.

In 1806, the French statesman Napoleon Bonaparte implemented the so-called continental blockade so that he could strengthen French business interests. This resulted in the end of import of some of the overseas products to the Habsburg Monarchy, including the Lands of the Bohemian Crown. The blockade had a positive impact on the development of craft production and the breeding of the sugar beet. Sugar beet is the basic component used in producing ethanol. Even after the end of the blockade, the high import tariff lasted. It was just a question of time before a cheap substitute for true rums appeared.

It is believed that this rum was firstly produced by Czech sailors who were working on the overseas boats and missed rum at home. In the Habsburg Monarchy, a rum substitute began to be produced in large volumes and–thanks to its cheap price–soon became favoured over rum from Cuba and Jamaica. That is how **Tuzemák** was created.

Nowadays, well-known rum substitutes include **Innländer Spirituose** (a local distillate) in Austria, while Slovaks and Czechs share the classic **Tuzemák**. You can also drink Hungarian **Hajós** ("sailor" in Hungarian) and **čajni** or **domači rum** ("tea" or "home rum") in Croatia.

Local Rum Recipe
Ethanol produced from potatoes is diluted to typically 37.5–40% vol. and flavoured by ammonia caramel and "*rum flavour*". Rum flavour is produced by heating wood pyrolysis oil with ethanol, manganese dioxide, and sulfuric acid. It contains at least 84 proven organic substances. The most characteristic flavour compound, which also gives taste to real rum, is ethyl formate.



The European Union and rum
In fact, local rum is not rum, which is why the European Union does not allow the use of the word "rum" for this product. Since 1st January 2003, manufacturers have been using alternative creative names for locally-produced rum, including R.U.M. and **Tuzemák**.

In 2017, EU officials found that some compounds in rum flavour can be toxic and were ready to ban **Tuzemák**. Luckily, the Czech and Slovak Republics managed to negotiate a five-year exception in April 2018. Therefore, you can still enjoy **Tuzemák** during the 50th IChO in Bratislava and Prague!

Czecha Libre—definitely the most tasty Tuzemák-based long drink
A glass of Coke, a shot of Tuzemák, and a slice of lemon or lime–depending on your taste. Enjoy!

Tea with rum to fight the flu
Add a shot of Tuzemák to a cup of black tea, squeeze a lemon, sweeten with sugar or honey, and the flu cannot win!

(1) OTTO WICHTERLE
Otto Wichterle (1913–1998) is a world-renowned Czech chemist. He was one of the founders of macromolecular organic chemistry and dedicated his career to this field. Wichterle is especially famous for inventing soft contact lenses and the synthetic polyamide fiber silon. During his lifetime, Czechoslovakia was controlled by two totalitarian regimes: First, the Nazis, and later, the Communists. Wichterle defied both of them. What is more, he managed to amaze the world with his inventions.

(2) KAREL ČAPEK
Karel Čapek (1890–1938) is among the most famous Czech writers. He is the author of numerous short stories, novels, dramas, travel books, essays, and children's stories. He was nominated for the Nobel Prize in Literature seven times.
The themes of science, technology, and chemistry appear several times in his works; for example, in his novels, *The Absolute at Large* and *Krakatit*, and in his drama, *R.U.R.*, in which the word "robot" was used for the first time. In fact, it was Čapek's brother Josef who invented this word. Robot then made it into almost every world language.

(3) LITTLE MOLE
Hello! I am Little Mole, a cute cartoon character, and many children's best friend. In the Czech Republic, I am much more popular than Mickey Mouse, Tom and Jerry, and other cartoon characters. I am an all-rounder: In one of the episodes, I became a chemist. In 2011, my toy version made it into space on board the space shuttle Endeavour. As a plush toy, I live in almost all Czech children's bedrooms.


4


6


5

NATIONAL CELEBRITIES

Each country has its own heroes. So do Slovakia and the Czech Republic.


1


2


3

(4) JÁN JESENSKÝ (JESENIUS)
Ján Jesenský (1576–1621), known as **Jesenius**, was from an old Slovakian noble family. He studied medicine at Wittenberg, Leipzig, and Padua universities and obtained a doctorate of philosophy in Prague. There, he performed the first public autopsy in 1600. He was an anatomical consultant for Rudolf II, King of Bohemia and Holy Roman Emperor, and Emperor Mathias. In 1617, he was elected Rector of Charles University. Due to his sympathies with the Bohemian estates against the Habsburgs, he was arrested and executed together with other Bohemian estates leaders on the Old Town Square in 1621.

(5) JURO JÁNOŠÍK
Juro Jánošík (1688–1713) was the national Slovakian hero. Until he was eighteen, he lived an ordinary life in poverty. At that time, the revolt of poor Slovakians against the Habsburg Monarchy began, and Juro voluntarily joined the rebel army. Shortly after their defeat, he entered the Habsburg army and served as a prison guard. There, he met imprisoned highway robber leader Tomáš Uhorčík and joined Uhorčík's gang. Shortly after, Juro became their captain. They robbed nobles and gave the loot to the poor, just like Robin Hood. A formal member of his group betrayed him, and Juro was sentenced to death. His story became a legend and has inspired many movies and plays.

(6) MILAN RASTISLAV ŠTEFÁNIK
Born 1880 in the former territory of Austria-Hungary, he was a well-travelled philosopher, astronomer, and diplomat. To name a few of his achievements, he built an observatory in Tahiti, patented the first process for colour photography and film, and received the Legion of Honour from the French military court. At the age of 28, during World War I, he was already acting as a French general and as the Minister of War for Czechoslovakia. He was one of the top figures in the Czechoslovak National Council, which played a huge role in the independence of Czechoslovakia. Along with Beneš and Masaryk, he was a key person in the founding of the first Czechoslovak Republic, where he also helped to design the first draft of the flag. His life motto was "Faith, love and work". He tragically lost his life in a plane crash in 1919.

THE SECRET STORY OF THE GOLEM

PART 4

TO BE CONTINUED TOMORROW...

Did you know that the beauty of Hollywood stars comes from Prague? That's right: They've used Dermacol Czech cosmetics since 1960!

The original Czech brand Dermacol has been cherishing female beauty for over half a century. One of the first covering foundations in the world was developed in Dermacol's Czech laboratory. It began being used by Hollywood in the 1960s, and ever since, Dermacol has been synonymous with perfect skin make-up, not only in the Czech Republic, but also all over the world.

The Dermacol brand launched more than 50 years ago in the Barrandov Film Studios. Soon, film studio experts teamed up with dermatologists from the Medical Cosmetics Institute in Prague. The aim was to create a covering foundation in order to help common people with skin imperfections. The beautician, Mrs. Olga Knoblochová, today known as Lady Dermacol, was with the brand from the very beginning. She is the living legend of Czech cosmetics. Lady Darmacol celebrated her 85th birthday and she is still the ideal of natural beauty for Czech women even in that age.

Dermacol, the original producer of Czech cosmetics, is today a family company. The brand was separated from the film studios and over the years was acquired by Věra and Vladimír Komár. Thus, a new era of famous Dermacol started. The brand has become a proud Czech family business and a symbol of famous Czech women. Věra and Vladimír Komár continue in the tradition that was seeded by Lady Dermacol and they are still cooperating with one another. Věra Komárová personally oversees the development of each product and cooperation with laboratories and chemists.

And Dermacol still belongs to the film industry; it is the official beauty partner of the 53rd Karlovy Vary International Film Festival. In addition to culture, Věra and Vladimír Komár support charity in the Czech Republic and around the whole world, wherever help is necessary. This spring, Dermacol opened a school in Nepal, in the place where more than 5,000 schools were destroyed by an earthquake.

Dermacol Cosmetics is an international company; even though most of the production takes place in a factory in Brno, Czech Republic. You can buy these cosmetics in more than 60 countries in the world. Dermacol is well known in China, the USA, South America, the Middle East, Africa, and Europe.

We are very proud that the beauty of lots of women all over the world comes from the Czech Republic, from the heart of Europe, from Prague.

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 5

THE FIFTH ISSUE OF CATALYZER MAGAZINE

23/07/2018

4,000 PIPETTES READY FOR USE

Today, after the grand opening followed by a short acclimatizing excursion to notable sites of Central Europe, the first round of competition for the International Chemistry Olympiad medals is about to start for all **300** contestants.

The contestants will have to solve Practical Problems, translated the previous day into their native languages by mentors in the pleasant environment of Prague's Hotel Diplomat. The authors from Slovakia have prepared three problems which, according to IChO rules, are to be solved in five hours. The aim of the first problem is a profound examination of the competitors' skills in organic synthesis, extraction of products, and subsequent analysis of their purity by implementing thin-layer chromatography. Fans of physical chemistry will get an opportunity to exhibit their deep knowledge in chemical kinetics while working hard with pipettes, stopwatches, and calculators donated by Casio. The third Practical Problem is to identify an unknown sample of mineral water originating from the amazing nature of Slovakia.

A trade-off for the varied and imaginative assignments and tasks was high organizational complexity. More than 20 different chemical compounds and 101 types of laboratory equipment had to be prepared for each competitor. Stunning is also the total amount of used material. Over 50,000 pieces of laboratory glass and other equipment of all kinds and sizes was brought from our warehouses to the lab tables in the last five days, among other things, 700 TLC plates, 4,000 pipettes, 2,400 beakers, and 320 hotplate magnetic stirrers. The team of authors supported by 60 co-workers and students, mostly from the Comenius University and from the ranks of former Chemistry Olympians, took good care of all of it. Most of them have yet to take care of the less glorious part of the whole endeavour—cleaning, washing, and storing all the used equipment. We owe them one for that!

Upon completion of the practical part of the competition, IChO is everything but close to its end. While the contestants are relaxing (spending the afternoon with sport activities and in the movie theatre), mentors will be fully immersed in finalizing the Theoretical Problems and tests for the grand finale. But more about this in our next report.

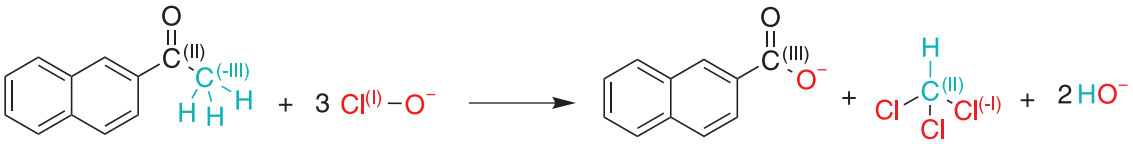
Jan Havlík, Petra Ménová

Did you notice that familiar sweet orange blossom smell of your starting material you used in organic chemistry Practical Problem 1?

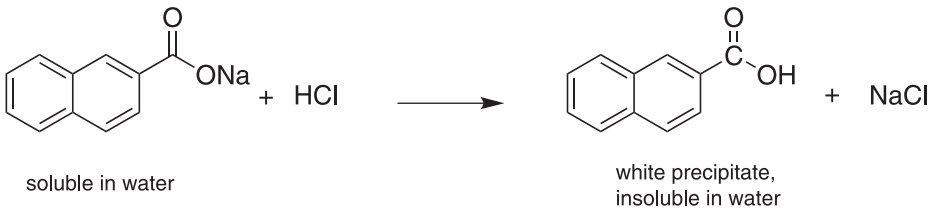
SYNTHETIC ORANGER AND SMELL OF PURITY

PRACTICAL PROBLEM 1

Methyl 2-naphthyl ketone is also known as *Synthetic Oranger* and is an artificial substance used as fragrance, cosmetics and flavour ingredient, thanks to its sweet, citrus, vanilla, fruity taste and odour. Another smell associated with purity comes from sodium hypochlorite, NaClO, which —when dissolved in water—is commonly known as *liquid bleach*. Methyl ketones can be easily converted into carboxylic acids by oxidative cleavage of C–C bond by haloform reaction. For this purpose we can also use common household chemicals; for example, the liquid bleach used for disinfection. This transformation is also known as a haloform reaction, because the methyl fragment is converted to trihalomethane (haloform). Carbonyl group is activated towards nucleophilic attack of hydroxide anion thanks to the transformation of methyl group to electron-withdrawing trihalomethyl group. In addition, trihalomethanide anion is a good leaving group (pK_a values of haloforms are 25 for iodoform, 13.7 for bromoform, and 15.5 for chloroform). The oxidation state of both carbon atoms is increasing, while the atom of chlorine from hypochlorite provides two electrons and its oxidation state is decreasing from Cl(I) to Cl(-I). The oxidation state of carbonyl carbon atom increases from C(II) of the ketone to C(III) of the carboxylic acid. The carbon of the leaving methyl group had oxidation state C(-III) and loses 5 electrons. Assuming those partial steps, we can express the stoichiometry of the reaction and it is clear that the transformation of the ketone requires consumption of 3 equivalents of hypochlorite.

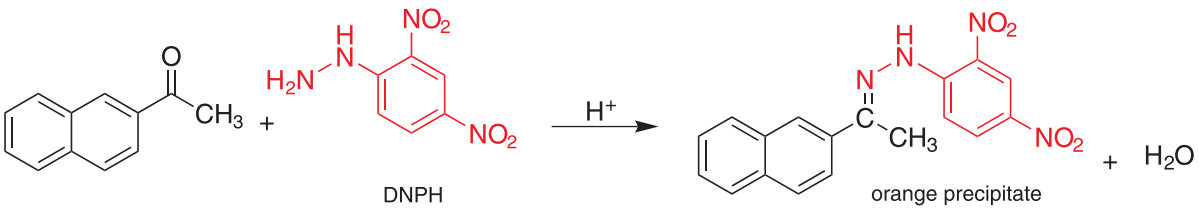


Different acidity of the starting ketone and the carboxylic acid product can be exploited for efficient separation of these two compounds by acid-base extraction. The carboxylic acid can be converted into the water-soluble carboxylate by treatment with a weak base and effectively transferred from organic to aqueous solution. After acidification of the aqueous extract, the acid is isolated as white precipitate.



Despite the irreversible oxidation proceeding with complete conversion, under the reaction conditions we used in the task, only part of the starting ketone was consumed. The unreacted ketone underwent a condensation reaction with DNPH and formed orange solid of the corresponding hydrazone and water. The reaction equilibrium is shifted in favour of the product due to its low solubility. The hydrazone can be obtained in almost quantitative yield. Hydrazones have been commonly used for the characterisation of carbonyl compounds.

Iveta Kmentová



CLOCK SYSTEM KINETICS

Many researchers from the former Eastern Bloc, including Czechoslovakia, devoted their careers to oscillating reactions.

PRACTICAL PROBLEM 2

As you already know from the preparatory problems, 2018 is not only the fiftieth year of IChO. This year, we are also celebrating the fiftieth anniversary of a landmark conference in Prague that is frequently cited as the beginning of the era of nonlinear chemical dynamics.
Around the countries of the former Eastern Bloc such as Hungary, Czechoslovakia, and Yugoslavia, the study of chemical oscillators and patterns was particularly popular.
A great number of researchers from the region devoted their entire careers to this topic.

In this context, the preparatory problems were dedicated to the Belousov-Zhabotinsky oscillating reaction; and in the end, chemical kinetics was also the focus of the competition task. The luminol-H_2O_2-Cu-cysteine system used in the exam was optimized as a clock reaction, to be spectacular but appropriately simple for exploration in the short time available. The most crucial skills for the task were pipetting and patience. In addition to waiting for the flash of chemiluminescence to appear, it was essential not to cheat on the shaking, because if not mixed properly, the reaction could be much faster and the chemiluminescence could arrive inhomogeneously, over several seconds rather than in a short flash. Interestingly, a similar luminol-based system can also exhibit oscillations. In 1986, Miklós Orbán from Hungary discovered an oscillator composed of H_2O_2, Cu^{2+} and KSCN in an alkaline solution. It was a completely new kind of system, the first homogeneous oscillator that did not contain any halogen. It is based on a competition between autocatalytic production of NC-SO_2^- and its inhibition by $HO_2^{\bullet}$ radicals, both processes being facilitated by Cu^{2+}. Finally, adding luminol, thiosemicarbazide, or even 1,10-phenantrholine can produce oscillating chemiluminescence.

Erik Szabó

MINERAL WATERS OF SLOVAKIA

PRACTICAL PROBLEM 3

It is raining. Rainwater soaks into the soil and slowly penetrates down to the lower layers of the Earth's crust. Perfect filtration occurs; it meets and dissolves minerals and is saturated by natural carbon dioxide. Then, after hundreds, sometimes thousands of years, it begins its ascent to the Earth's surface, where it bursts forth as a natural spring—producing mineral water!

Slovakia is rich in mineral water springs. All types of mineral water can be found here, except for radioactive ones.
The low mineralized waters are cold acidulous *seltzer waters* with low mineralization (< 500 mg L^{-1}) and highly saturated by CO_2 (**Budiš**). These are suitable for daily consumption. Medium carbonate mineralization waters (Ca-HCO_3 and Ca-Mg-HCO_3 types) are widespread and originate from the dissolution of limestone and dolomitic karst rocks (**Gemerka**, for example, has antistress effects and stimulates digestion).

The highly mineralized waters (> 5 g L^{-1}) are called *brines*. Very famous is Czech mineral water **Šaratica** (12.3 g L^{-1}), which has high magnesium and sulfate content and a very strong laxative effect. This is reflected in its commercial slogan: "*Drink Šaratica—it makes your step quicker*"!

One of the rare European basic (pH > 7) mineral waters is **Fatra**. It is recommended for digestive problems and, because of its balanced mineral composition, also after excessive consumption of alcoholic drinks.

HEALING BATHS
The most precious mineral waters are used for healing procedures. There are eighteen healing baths in Slovakia. People come to these natural springs for bathing as well as for drinking water. Healing waters with mineralization >5 g L^{-1} and pharmacological effective components are considered to be medicine and should be consumed in limited doses according to medical prescription.

Pavol Tarapčík
Petr Holzhauser

SLOVAKIAN RECORDS
- Highest mineralization: **Solivar Spring** (292 g L^{-1})
- Highest H_2S content: **Smrdáky** = "Stinky Springs" (292 g L^{-1})
- Highest CO_2 content: **Korytnica** (3.8 g L^{-1})

Mineral water
...is naturally occurring underground water of original purity, stable composition and properties, and containing dissolved mineral substances or carbon dioxide of at least 1 g L^{-1}. This provides physiological effects and can therefore be used as drinking water or for the production of bottled mineral waters.

Healing mineral water has to meet at least one of these criteria:

- Min. mineralisation 1 g L^{-1}
- Min. CO_2 content 1 g L^{-1}
- Min. temperature 20 °C
- Minimum radioactivity 1500 L^{-1}
- Content of chemical element important for human health

At the Action Park Čunovo, the IChO crew was split into two groups competing with each other in thrilling activities, such as a spider web, maze, and an adrenaline-fuelled spartan race.

Cheers! Can students perceive the differences among various Slovak mineral water samples according to their tastes? Four different mineral waters (Sulinka, Fatra, Mitická, and Budiš) were tasted by our bright young chemists.

AND...ACTION!

The last day before the Practical Exam was full of different activities and events.

Every young chemist is as excited as possible while having the chance to eagerly listen to the Lab Safety presentation :).

Mentors had their hands full in Prague all Sunday. All Practical Problems had to be translated into native languages. At 10 P.M., the translated and printed problems were loaded into a secret car end transported to Bratislava under cover of night.

SCIENTIFIC CURIOSITIES OF SLOVAKIA

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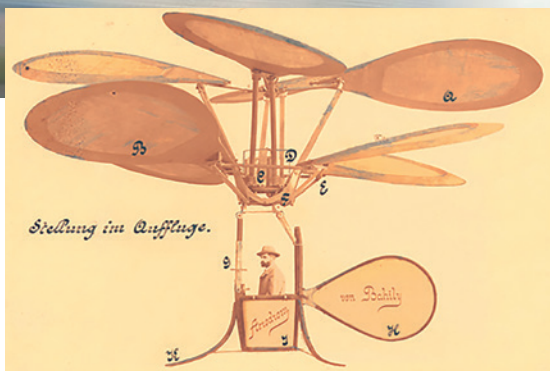


© CRAFTING PLASTICS

One of the more recent Slovak inventions is a flying car. It took twenty years to develop the concept of the flying car and it will soon be on sale.

AeroMobile is powered by a Rotax 912 four-cylinder engine with an aerospace cruise range of 700 kilometers. Conversion from automobile to aircraft takes about 80 seconds. Maximal automotive speed is 160 km/h and aerospace Vs / Vc / Vd - 112/259/360 km/h.

Predecessors

Man has always wanted to fly like a bird. Since ancient times, people have always admired birds in flight and yearned to fly like them. Thus, flying vehicles belong to the most exciting and desired discoveries of humankind. Slovaks are proud to have contributed to these discoveries.

Parachute

Slovak Štefan Banič (1870–1940) witnessed an air accident which motivated him to invent the parachute, which—in its final form—looked much like an umbrella. Its opening was provided by telescopic ribs with a spring-loaded mechanism. Very unusual was the fact that the aviator didn't hang on ropes under the surface of the umbrella, common in those times. Instead, the aviator was deeply attached to the umbrella. By jumping off the roof of a fifteen-floor building with his parachute in front of US Patent Office officials, Banič proved his invention. That's why he is considered to be the pioneer of BASE jumping by the Americans.

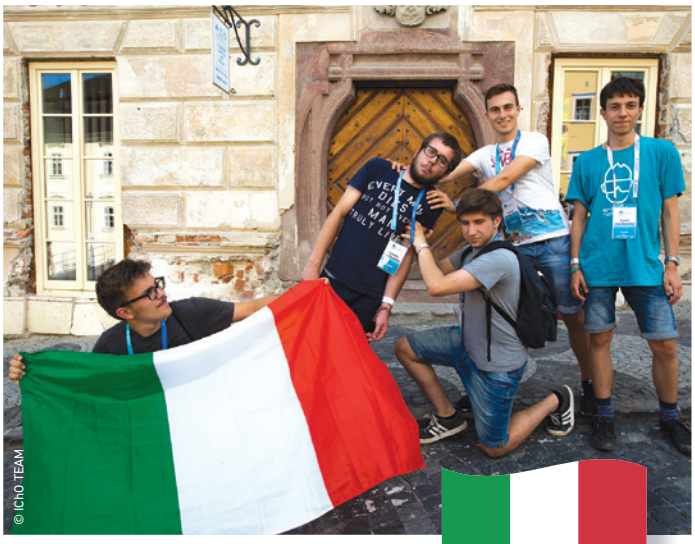
Helicopter

The first prototype of today's helicopter was invented in Slovakia. The developer of this model was Ján Bahýľ (1856–1915). In 1894, he also designed a helicopter which would be human-powered. Later he was able to patent this design and work on its realization. Unfortunately, he did not meet the set deadline for construction. Therefore, he got in touch with Anton Marshall. It was in Marshall's workshop that the model for the Bahýľ helicopter, known as the AVION, was improved and created.

Flying is not the only thing that fascinates our inventors.

We replace plastic bags with biodegradable bags which undergo biological decomposition. Unlike plastic bags, biodegradable bags disappear a few days after being thrown into compost. This revolutionary technology was invented by Slovak scientists from the Slovak University of Technology in Bratislava under the leadership of P. Alexy.
His team produces biodegradable plastics from polylactic acid which are synthetized using common starch and polyhydroxybutyrate, a biomaterial produced by bacteria. Providing bacteria with sugar is sufficient for production. This sugar comes from sugar cane or whey, waste produced during the production of dairy products which has no other use. These bioplastic materials are already used in the manufacture of eyeglasses. Reusable plastic refill cases, used for decreasing the amount of plastic waste, are applied in the food, chemical, petrochemical, and pharmaceutical industries. Plastic bottles are "dressed" in a special foil before filling. After consuming the content, the foil is pounded and discarded into compost where it decomposes naturally, not producing any other plastic waste. Afterwards, a new recyclable film is embedded, and this process is repeated *ad infinitum*.

Henrieta Stankovičová



ITALY

1. We think you know where this is going...a human Leaning Tower of Pisa.
2. Capri Island has a volcano beneath the water surface, which makes the water so hot, you can boil fish there.

MACEDONIA

1. Making fun of a Macedonian model (Dunuvka Trifunovska) who did the hand sign shown in the picture instead of a heart.
2. We have beans for lunch every Friday. It's a rule.

IChO NATIONAL TEAMS

LITHUANIA

1. Showing us their national pride by performing their national dance, *Džiugūnas*.
2. We are the world's biggest alcohol consumers.

TURKEY

1. *Zeybek* is our traditional Turkish dance.
2. We have more than 50 types of kebabs.

POLAND

1. Replicating the Coat of Arms of Poland, the crowned eagle.
2. On Christmas lunch, we serve 12 different dishes.

URUGUAY

1. Drinking our typical drink, *mate*. *Mate* is prepared by steeping *yerba mate* in hot water.
2. We are the country with the highest number of cows per capita. 60% of our land is occupied by cattle.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

ISRAEL

1. Being proud of their Jewish heritage by remaking the Star of David.
2. Jerusalem contains holy sites for Jews, Muslims, and Christians.

INDIA

1. We are showing our welcoming gesture.
2. India uses plutonium instead of uranium to run its nuclear reactors.

JÁCHYMOV – A RICH DEPOSIT OF MINERALS

Jáchymov is a small town on the southern slopes of the Ore Mountains, just a few kilometers from the Czech-German border. Its rapid growth began at the beginning of the sixteenth century after one of the richest deposits of silver was discovered here.

Jáchymov quickly became the second most populated town in the Kingdom of Bohemia after Prague. Eventually, other ores (including Pb, Ni, As, Co, Bi, and Sn) were extracted as well. By then, Georgius Agricola—a physician, scientist, and the father of mineralogy—was active here. Towards the end of the nineteenth century, a spring rich in radium was discovered in one of the mines and quickly the first radon spa in the world was opened here.

DOLLAR

- A silver coin, minted in Jáchymov in the sixteenth century, provided the current US dollar its name
- The original German, *Taler*, passed through Dutch as *daalder* and into English as dollar

JÁCHYMOV SPA

Medieval miners noticed a beneficial effect for painful diseases when they bathed in mine water. Near Jáchymov, water containing radium, which emits alpha radiation when it decays to radon, springs up from an approximate depth of one kilometer towards the surface. The Jáchymov radon spa, focused on the treatment of locomotive organs and nervous and metabolic disorders, was founded in 1906. The deepest borehole extends seventy-seven meters below sea level. Each day, approx. 350 m^3 of water is drawn into the spa directly from the boreholes.

RADON

A colourless, odourless and tasteless gas; when solidified, it is dark orange and exhibits bright phosphorescence. It was first observed by E. Rutherford and R. B. Owens in 1899 in the form of a radioactive gas emitted by a sample of thorium. The same year, it was detected by P. and M. Curie during their experiments with radium. In 1908, W. Ramsay and R. Whytlaw-Gray measured some of its properties and determined that radon is the heaviest noble gas. It is a member of U, Th, Ac, and Pu decay chains—it is formed from radium and decays further to polonium. Radon is one of the ten least abundant elements on Earth. Yet, it can accumulate in badly ventilated spaces such as mines. The danger of inhaling higher concentrations of radon in mines has been known for centuries. Agricola recommended airing mines to prevent this "mountain sickness" (*Bergsucht*).

URANIUM

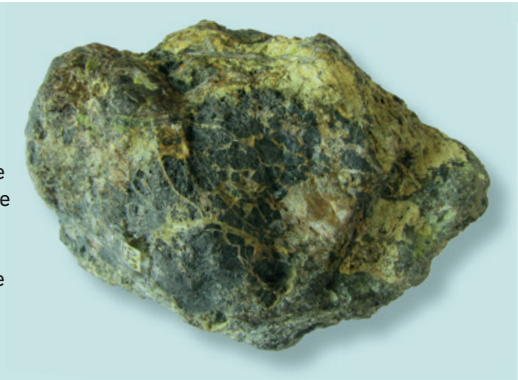
Uranium yellow has been used to dye glass and ceramics since ancient times. However, metallic uranium was discovered by M. H. Klaproth as late as the end of the eighteenth century. It was named after the then newly discovered planet, Uranus. This silvery shiny metal with a high density (19.01 g/cm^3) and strength is used, among other applications, in armour plating and gyroscopes. Uranium has three natural isotopes and several artificial ones. The ^{235}U isotope can be used as a nuclear fuel and in nuclear weapons, but its natural abundance is very low: 0.73%. To be effective in the fission process, it must be enriched. This use of uranium grew greatly at the end of WWII and had a great impact on Jáchymov and its history.

The first prison camps to mine uranium were established in Jáchymov by the Nazis. After WWII, prisoners of war were forced to work there, and this manner of uranium mining was adopted by the Communists. They ran prison camps for political prisoners until the beginning of the 1960s. Some 70,000 prisoners were forced to live in the inhumane conditions of the camps. Based on a secret pact, 98,000 tons of uranium ore were extracted and taken out of the country to the Soviet Union.

© S. DUSIK

URANINIT

- An oxidic ore of uranium in a mixed oxidation state, from UO_2 to U_3O_8
- Formerly known as pitchblende: Pitch for its black colour, and blende from the German for the metallic ore of unknown composition
- Due to radioactive instability, it contains traces of Ra, Po, Th, Pb, and He



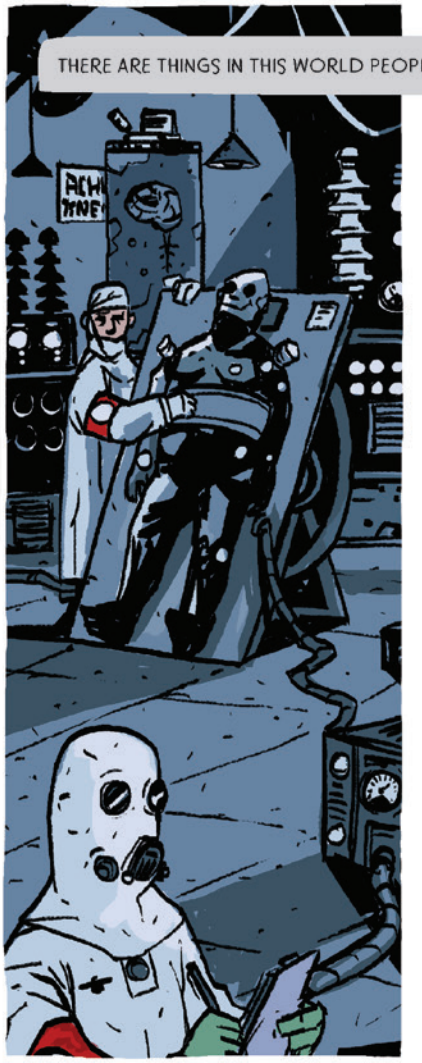
Marie Skłodowska-Curie was the first woman to be awarded the Nobel Prize in Physics. In 1903, she received the Prize together with H. Becquerel and P. Curie for the discovery of radioactivity and radioactive substances, including two previously unknown elements, polonium and radium. When she received her second Nobel Prize in Chemistry in 1911 for production of radium as a pure metal, she became the first double laureate of this prestigious award.

MARIE SKŁODOWSKA-CURIE (1849–1934)
She was born in Warsaw as Maria Skłodowska. In 1891, she left for Paris to study mathematics and physics at the Sorbonne. During her research on the magnetic properties of steel, she met Pierre Curie. They married in 1895 (later, she used her blue wedding dress as a lab coat). Her doctoral mentor was H. Becquerel and her research focused on the radiation emitted by pitchblende. She noticed correctly that this radiation was caused by the presence of uranium itself and not by its interaction with the environment, in contrast to then recently discovered X-rays. However, some samples showed stronger radiation which did not correspond to the amount of uranium contained. This led her to the discovery of polonium in 1898 and radium shortly thereafter. To obtain a few grams of the elements, she had to process tons of pitchblende from waste rocks left behind from silver mining in Jáchymov.
After Pierre's tragic death in 1906, Marie took over his professorial position at the Sorbonne and became the first female professor there. When WWI broke out, she temporarily halted her research activities and devised mobile X-ray laboratories to aid soldiers wounded on the western front. She died of aplastic anemia, most probably due to long-term exposure to radiation. To this day, her laboratory notes from the discovery of polonium and radium are stored in lead casing because of their strong radioactivity.

Katřina Rubešová, Vít Jakeš

THE SECRET STORY OF THE GOLEM

PART 5



TO BE CONTINUED TOMORROW...

REACTIONS
NAMED AFTER SLOVAK AND CZECH CHEMISTS

1 THE BELLUŠ-CLAISEN REARRANGEMENT

Among the reactions available for the construction of new C–C bonds, the Claisen rearrangement is one of the most powerful, elegant, and well-characterized methods. A genuinely new variant, the Belluš–Claisen rearrangement, came to light fourty years ago: the reaction of an allylic ether, thioether, or amine with a ketene leads through a [3,3] sigmatropic bond reorganization of a zwitterionic intermediate to an (*E*)- unsaturated ester, thioester, or amide. When applied to cyclic allylic substrates, ring enlargement by four carbon atoms in one step provides medium ring-sized unsaturated (*E*)-configured lactones, thiolactones, and lactams.

2 THE BÍLIK REACTION

In 1972, Slovak chemist Vojtech Bílik reported a remarkable carbohydrate reaction, the molybdic acid catalyzed epimerization of aldoses. Several aldoses, formerly called rare aldoses, were only available infrequently, as their preparation procedures were very demanding. An early commercialization of the Bílik reaction has made such aldoses as L-glucose, L-ribose, D- and L-lyxose, D-talose, or D-mannose easily available in one-step reactions starting from their more common respective epimers.

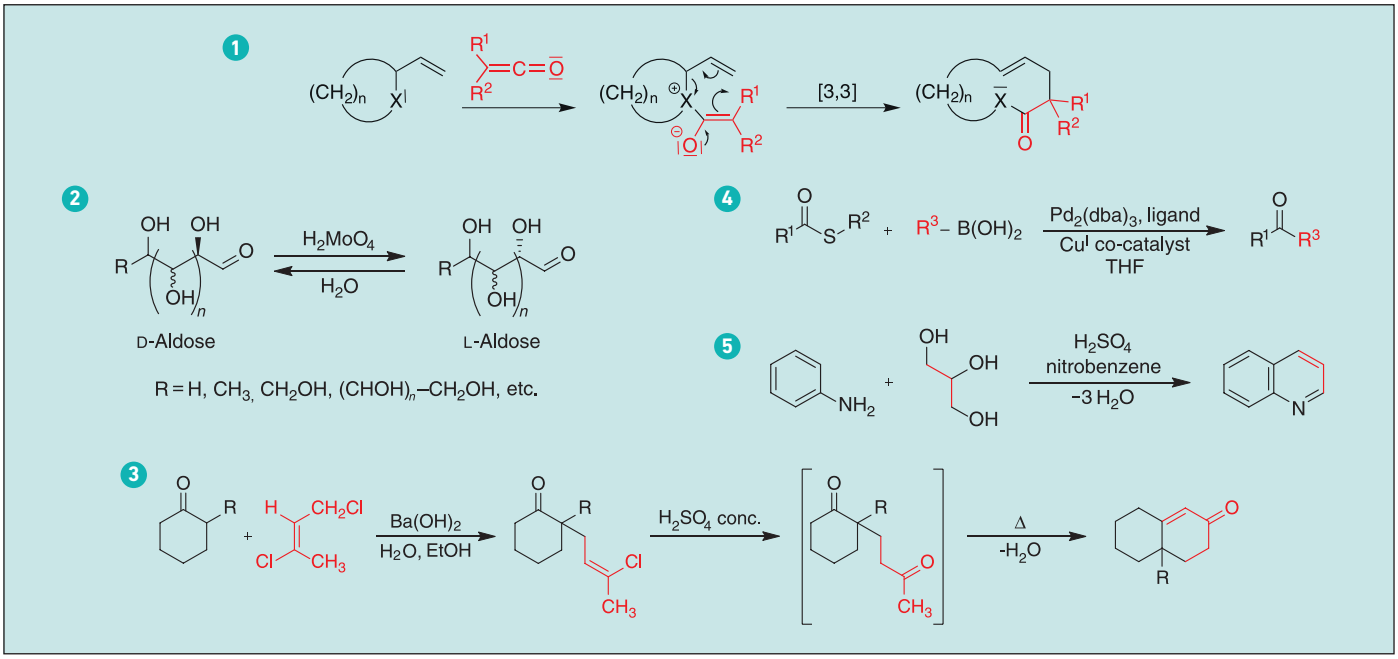
3 THE WICHTERLE REACTION

The Wichterle reaction is a variant of the Robinson annulation, in which (*E*)-1,3-dichlorobut-2-ene is used instead of the commonly used methyl vinyl ketone. In the first step, a base-catalyzed alkylation of an enolate occurs. The treatment of the obtained vinylic chloride with concentrated sulfuric acids results in the formation of a ketone, subsequent spontaneous cyclization, and water elimination. The reaction has been successfully applied in the preparation of fused cyclic compounds, which are invaluable in the synthesis of numerous natural products.

4 THE LIEBESKIND–ŠROGL REACTION enables the synthesis of an assymetric ketone from a thioester and a boronic acid, in the presence of a palladium catalyst, ligand, and copper co-catalyst. The reaction was invented and named after Jiří Šrogl (*1966) from the Academy of Sciences, Czech Republic, and Lanny S. Liebeskind from Emory University, Atlanta, Georgia, US. The reaction belongs to the family of palladium-catalyzed cross-coupling reactions and is a valuable tool for the formation of new carbon–carbon bonds.

5 Zdenko Hans Skraup (1850–1910) was a Czech-Austrian chemist who discovered the first quinoline synthesis, today known as the **SKRAUP REACTION**. In the archetypal Skraup reaction, aniline is heated with sulfuric acid and glycerol in nitrobenzene, which serves as a solvent and also as an oxidizing agent, to yield quinoline.

H. Stankovičová, P. Ménová



50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 6

THE SIXTH ISSUE OF CATALYZER MAGAZINE

24/07/2018

© IChO TEAM

ARMY OF CHEMISTS INVADED THE LABS

The first days of IChO passed by quickly. On Monday, the core students' discipline started and they suited-up for the labs.

After laboratories were prepared for Practical Problems during the night by IChO Scientific Committee members, who got just nine minutes of sleep, students were finally allowed to enter the lab rooms. Practical Problems consisting of organic synthesis, physical chemistry kinetic study, and analysis of mineral water composition were solved by IChO competitors in the labs of the Faculty of Science, Comenius University in Bratislava.

Students were divided into 19 laboratories supervised by university staff and, after skimming the Practical Exam booklet, eager students had to check the provided glassware, equipment, and chemicals and finally they were given 5 hours to solve the problems.

After entering the labs, you could smell various vapours; see trembling hands; or hear rustling paper, clinking glass condensers, flasks, pipettes, and so on. One would have also noticed nervousness was in the air. Observing the students concentrating on on-going reactions, one could see how focused the students were.

(To be continued on the next page)

(Continuing from previous page)
However, some of them happened to make mistakes such as setting up instruments poorly, breaking a burette, confusing polar and non-polar phases, or losing their products accidentally. Nevertheless, all the students seemed to be organized and to be quiet well managing their lab work.

Performing experiments can sometimes be dangerous to not just the performers themselves, but also to their colleagues. Luckily enough, no major injuries happened. "Our team was only called to take care of mild cut wounds due to broken glass. To be honest, we were a little bored at our base," one of the IChO paramedics said.

At around noon, when the Practical Part of the Olympiad was closed, students left their laboratories. If you expected them to be exhausted and tired, you would be surprised how vibrant and positive their moods were. Enthusiastically discussing the previous experience among team members, they were slowly moving to a canteen. "We really enjoyed the tasks. It was fun. But we would have appreciated more time, because the working place was too small to work efficiently," said a member of the Croatian team on the way to the canteen. Jesús David, Venezuela, said: "My favourite part was the synthesis of hydrazone precipitate due to its nice orange colour." According to New Zealand team members, the most amusing experiment was the second one, a glowing clock reaction with blue chemiluminescence, where they studied chemical kinetics.

The students' answer sheets have been sent to Prague where they will be graded, and students' brains have been slowly switching to a theoretical mode.

Elizabeth Lensmith, Marek Lanč

IN YOUR WORDS

Daan Hoogers
Netherlands

How were the problems?
There were just too many questions. Time management was really a thing. But in general, it was okay.

How did you feel during the examination?
It's 5 hours straight working on the exam, so we are all very tired. I was fully focused, so I had no time to eat anything.

How have you prepared for the Practical Exams?
We had kind of a training camp, where we tried a couple of test problems, which were similar to last year. I wouldn't change anything about the preparation.

Franco Baroffio
Uruguay

How were the problems?
I think the theoretical background wasn't that hard, however, you really needed to manage your time, which I failed a bit. I managed to do everything, but there was no time to make sure about the results.

Were these problems more difficult than the last year?
Last year, I didn't manage to complete the test, because I was much less experienced. That's why I can't answer this objectively, but I feel better after this one, mainly because last year I wasn't sure about anything.

Stefan Ivanov
New Zeland

How were the problems?
Everything what could have gone wrong, went wrong for me. But that's how it is, and I need to focus on the Theoretical Exam.

What happened?
I started with question one, but my product after refluxing was colourless, that's uncommon, and also, I saw everyone else had a yellow colour. I repeated once again, but there was no difference. Afterwards, I changed my setup and it finally worked out. I think the exam was all right; the way I reacted after complications wasn't. I had no time for question 2 at all.

At the beginning of 1968, the Czechoslovak Chemistry Olympiad committee decided to organize an international chemistry competition for high school students, later named the International Chemistry Olympiad (IChO). Its creation was inspired by the International Math and Physics Olympiads.

LONG NIGHTS AT IChO


© P. MENOVÁ

Fifty years ago, when IChO was created, only Socialist countries (i.e., Eastern Bloc countries) were expected to attend the competition. The former Czechoslovakia was then going through a very specific political situation, and some people feared the competition would not be widely accepted. Only three countries from the delegations which had originally been invited and a total of eighteen high school competitors attended the first IChO. In the following years, however, all fears about IChO's viability were dispelled. In 2017, delegations from 76 countries and 296 competing students participated in the competition.

When I look back on the myriad of experiences, the memories that resonate most strongly are especially the ones regarding creation of the final versions of competition problems. The authors introduced problem drafts to the mentors, and a long and intense discussion usually followed. It focused on both the scientific and formal aspects with the aim of correcting any problematic areas. Once the discussion was over, the problems needed to be translated into the respective mother tongues of the participants in compliance with IChO regulations.

This was quite easy for mentors at the first events because translations were handled by the organizers; mentors only had to check whether or not the translations were correct, both factually and linguistically. At the 3rd IChO (1970), it was mandated that only four languages would be used in discussions at the international jury sessions: English, French, German, and Russian. However, it was still the organizer's task to provide translations into each participant's mother tongue. This rule was changed in 1976 (the 8th IChO), when it was decided that problems would only be provided in one of the aforementioned languages. This could only be done once the discussions in the jury and final adjustments of problems were over, which meant the translations took place later in the afternoon or in the evening. Several delegations were translating till morning.

This created a strange atmosphere. Imagine a big room with many tables and typewriters. You could hear the typewriters clattering amidst a silent background. Translations had to be typed so that Xerox copies could be printed out for the competitors. Texts, numbers, and chemical formulae had to be rigorously checked. It was strenuous work, with several tools used (including scissors and glue). Since the competition officially started the following morning, the translations needed to be handed over by 5 A.M.; some delegations did not manage the deadline and their competitors got Xerox copies still "hot" off the presses. Often, such mentors finished the translations and went directly to the bus to participate in the following events prepared by organizers. For some, this was exhausting, so it comes as no surprise that doing translations in the evening or through the night was given the nickname "long nights at IChO"—or sometimes even, "the IChO nightmare".

In the following years, the organizers were trying to find ways to do away with these long nights. It was desirable, because problems were getting longer, more complex, and more difficult to translate. In 1984, English was introduced as the official IChO working language. Discussions became more effective, but since the organizers only provided problems in English, more of the participating countries had to translate problems into their mother tongues. Only countries where English was an official language profited from this, because the mentors only rewrote problems into standard English.

1992 (the 24th IChO) was groundbreaking because, for the first time ever, mentors began using computers instead of typewriters. At first sight, one might think that introducing computers would speed up the process, but in reality, it was quite the opposite. Many mentors were not yet proficient in using computers. Also, printing large numbers of copies was often a bit problematic for the organizers. So, the long nights continued.

1998 (the 30th IChO) saw a great leap forward. The organizational structure was updated and the international jury was divided into two sections, each responsible for assessing half of the problems.

Since 2002, an extra day has been added to the IChO programme. This enables mentors to translate problems during the day, not at night as before. The traditional long nights at IChO will forever remain imprinted on the memories of those who survived them—and now look back on them rather with fondness than displeasure.

Anton Sirota
IChO International Information Center, Bratislava, Slovakia

FRANCE

1. Do you recognize this? It's our world famous guillotine!
2. Our legendary creature is the *dahu*. It is a small deer in the mountains, with two short and two long legs on opposite sides. It walks in circles, only in one direction.

CANADA

1. Posing with their world-renowned animal, the beaver. A moose was too big to bring on the plane.
2. We don't live in igloos. We apologize for your disappointment :).

IChO NATIONAL TEAMS

GERMANY

1. Typical Germans...always professional.
2. Germany usually consists of 16 states, but we go to Mallorca so much, in our minds, its our 17th.

NIGERIA

1. Different stages of the trendy Nigerian *Shaku Shaku* dance.
2. In Nigeria we have over 250 dialects!

EL SALVADOR

1. Showing us their national dance, *El Carbonero*.
2. Our capital city, San Salvador, is not only situated next to an active volcano, a lake that is able to overflow, but it's even in a valley, where earthquakes are quite common.

IRAN

1. Posing as the famous Azadi Tower.
2. Our architecture dates back to at least 5,000 B.C. We encourage you to visit us, because we are very good hosts.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

ARMENIA

1. Performing their national dance, *Kochari*.
2. Our capital city, Yerevan, is 2,800 years old. It is the oldest capital city in the world!

INDONESIA

1. This is our national martial art, *Pencak Silat*.
2. Get ready for the 18th Asian Games! We are hosting them this year.

HOW TO ENJOY YOUR SUMMER BARBECUE IN A HEALTHY MANNER

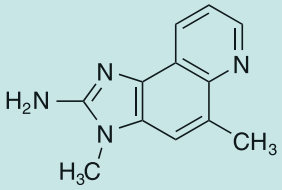
Summer parties associated with beloved grilling activities are in full swing. Doctors cautiously warn more and more often that eating poorly prepared food can cause health problems or even cancer. What chemical compounds should one avoid? Is it possible to grill in a healthy manner?

The question of proper grilling techniques often divides people into two unconquerable camps. One side is of the opinion that meat should be grilled just a short time, only slightly warming its interior. The other side loves the taste of a burnt steak. From the health point of view, neither extreme is ideal. While badly heat-treated food can be a source of unpleasant indigestion, black burnt sausages remind us of the result of an unsuccessful chemical experiment with the blame going to too high cooking temperature and dripping fat which—when grilling on an open fire—flares easily and burns meat to a crisp.

Many harmful substances, including proven carcinogens, are produced by burning fat. We can divide them into two basic groups. The first group of so-called heterocyclic amines (HCAs) with mutagenic effects already occurs at temperatures ranging from 125 to 300 °C because of thermal decomposition of sugar, amino acids, and creatine. The second group of polycyclic aromaric hydrocarbons (PAH) occurs at temperatures above 400 °C.

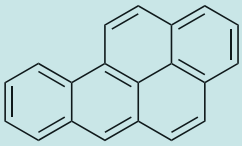
These carcinogenic substances, including benzopyrene, are found in abundance in tobacco smoke and are one of the major causes of cancer worldwide. We are not safe even if we prefer vegetarian foods. Certain risks are also present in foods containing starch such as potatoes and pastries which—when heated at high temperatures—produce damaging acrylamide.

The most dangerous heterocyclic amine formed is mutagenic 2-amino-3,4-dimethylimidazo (4,5-f) quinolone, also denoted by the abbreviation MeIq. It is more than 24 times more carcinogenic than the aflatoxin found in mouldy food.



2-Amino-3,4-dimethylimidazo-[4,5-f]quinoline MeIQ

One of the most notorious polycyclic aromatic hydrocarbons is benzo(a)pyrene. The carcinogenic effects of this compound were already described in the eighteenth century. The presence of this compound in chimneys caused a dramatic increase in cancers among chimney apprentices.



HOW TO GRILL PROPERLY?
Perhaps the most important step is to not roast the meat directly above a flame but rather over smouldering charcoal or another source of heat. The most important thing is that the meat does not burn to a crisp. Grills should be properly cleaned before use and one should rotate meat regularly while grilling. If this is not possible, scientists recommend cutting off any burned areas, since harmful substances are concentrated there. The amount of pollutants in meat grows rapidly the longer one grills. To shorten grilling time, use meat warmed to room temperature rather than meat taken straight out of the fridge.

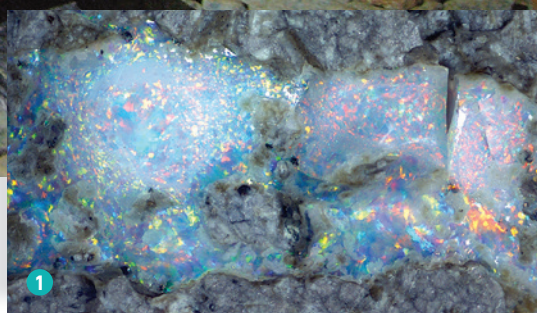
The type of grill is also very important. The most suitable grill type is one which prevents fat from being poured directly into the fire, enabling fat to move freely to a colder place. Vertical, electric, or heated stone stabs are the most appropriate types of recommended grills.

Surprisingly, scientific studies show that a very effective way to grill in a healthy manner is by using a marinade. Marinades reduce the amount of polycyclic aromatic hydrocarbons by more than half. Mixtures containing beer, onion, vinegar, oregano, basil, mint, or garlic are highly recommended. Avoid using sugar-containing marinades that multiply the amount of HCAs.

Consistent compliance with these tips should be enough to allow anyone to enjoy the pleasant atmosphere of an occasional summer barbecue with a calm conscience and no fear of later consequences.

Jan Havlík

GEOLOGICAL ATTRACTIONS IN SLOVAKIA

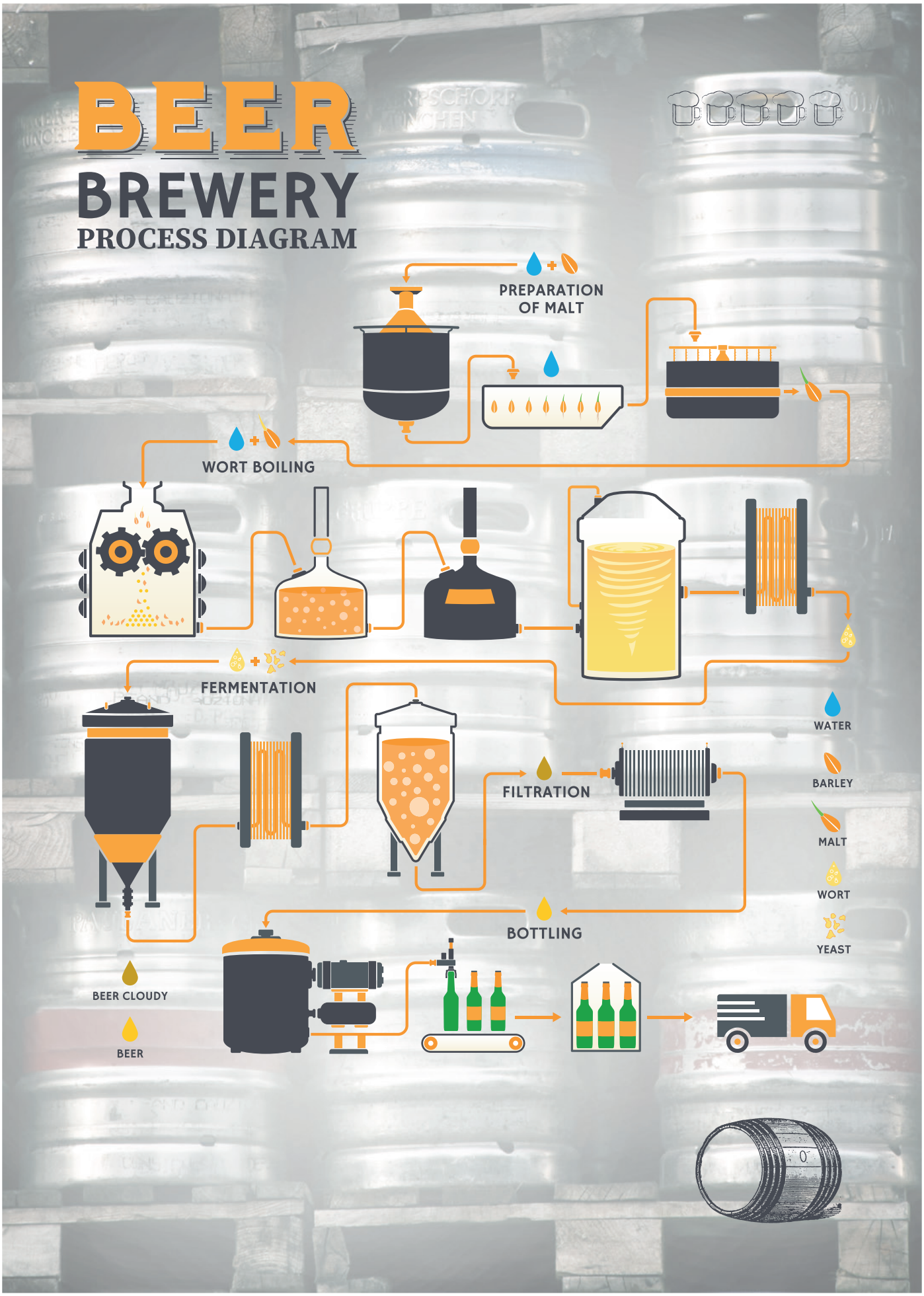


The opal mines at Dubník (*Dubnické opálové bane*) are the oldest precious opal mines in the world, with the precious opal from Dubník probably known already in Roman times. Opal **(1)** is mostly white in colour and characterized by its opalescence. The most common colours are blue, green, and red. The red colour of opalescence is the most valuable. The colour of the opal depends on the size of the balls from which the opal "structure" is composed and the orientation of the packets: opal parts with regularly ordered balls of solidified SiO_2 gel. Opal was formed in the final phase of volcanic activity with the release of silicic acid-rich hydrothermal solutions. The largest and most beautiful Slovak precious opal from Dubník belongs to the most important and most expensive gems in the world. It is called *Harlekýn* and is displayed under armoured glass in the Natural History Museum in Vienna. It was found in the seventeenth century, is 12.5 × 5.7 cm large and weighs 594 g (2970 ct). At present, the public can learn about the history and exploitation of opals during a visit to an accessible Jozef adit **(2)**.

The Ochtinská aragonite cave, unlike other caves where calcite or ice prevail, has an exceptional, grandiose aragonite decoration **(3)** with a variety of aggregates of this mineral. It was discovered by chance: Not by speleologists (as in most caves), but by miners during an ore survey and exploration of the Kapusta adit for iron ore in 1954. It is one of several aragonite caves accessible to the public in the world. It was made accessible in 1972 with a 145-meter long access adit. The length of the accessible part of the cave is 230 m. The cave itself is housed in Paleozoic marbled limestone. The aragonite was formed during three phases. The oldest aragonite was formed by botryoidal aggregates 121,000 to 138,000 years ago. The next phase resulted in needles and fruticose aggregates, very abundant and dating back 14,000 years. The youngest generation of aragonite has radial aggregates snow-white in colour and which continue to be formed to date. Since 1995, the Ochtinská Aragonite Cave has been part of a UNESCO World Natural Heritage Site.

Stone balls at the Megonky (4). Near Milošová village, close to the Czech border, lies the natural monument, Megonky. In the quarry and in the forest around the quarry, 30–40 million years old sandstone occurs in various 0.3–2.6 m large stone balls having perfectly regular to egg-like shapes. How the stone balls were formed remains a mystery, but is probably due to a unique geochemical process in the formation of sandstone sediment. The stone balls are located in a 250–500 m wide belt between the Milošová and Klokočov villages. It is the largest occurrence of stone balls in Europe.

Text and photo: Daniel Ozdín


BEER
BREWERY
PROCESS DIAGRAM
PREPARATION OF MALT
WORT BOILING
FERMENTATION
FILTRATION
BOTTLING
BEER CLOUDY
BEER
WATER
BARLEY
MALT
WORT
YEAST

BEER CHEMISTRY

Beer is a popular, well-known, and refreshing low-alcoholic beverage produced from water, malt, and hops. But not everybody knows what exactly beer contains. Where does the aroma of beer come from? How can beer affect the human body and life processes?

CHEMICAL COMPOSITION OF BEER
No doubt ethanol is the most well-known chemical compound in beer. Ethanol makes beer very popular and makes it an alcoholic beverage. The main component in barley malt is starch. During the brewing process, starch is enzymatically cleaved into simple sugars. These sugars contained in wart (liquid extracted from the mashing process) are transformed into ethanol and carbon dioxide by yeasts during the fermentation process.

Carbon dioxide is another significant component of beer. Most of this gas escapes during fermentation. Later, during the maturation process in closed over-pressured tanks, carbon dioxide is dissolved in beer. Beer carbonation is necessary for taste and mouthfeel.

Sugars and other malt components which are not transformed by yeasts represent the real remaining extract in beer, providing the body of a beer's taste. The main components of filtered beer are water (92%), ethanol (4%), carbohydrates (3%), proteins (0.5%), and carbon dioxide (0.5%). This approximate beer composition is typical for Czech lager and can differ depending on a beer's style or production technology.

SENSORIALLY ACTIVE COMPOUNDS
...are a very interesting group of beer substances. Their concentration in beer is very low, but their impact on the flavour and aroma of a beer is essential. Based on beer sensorial analysis (beer tasting), the raw materials, their quality, or technological mistakes made during the production process can be identified. For example, sulfur dioxide and hydrogen sulfide cause a sulfur odour resembling matches or boiled eggs. These smells are usually present when the beer maturation process was too short, resulting in a "still green" beer.

Dimethyl sulfide creates an odour akin to boiled or canned vegetables. Higher concentration of dimethyl sulfide is caused by an incorrect brewing process and insufficient wort boiling. Diacetyl (2,3-butanediol) is an important flavour active compound in beer and results in a buttery off-flavour. The concentration of diacetyl can be regulated by adjusting the fermentation process.

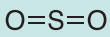
During the fermentation process, many sensorially active compounds are created and their composition and interactions constitute the final beer aroma. Ethyl acetate, for example, gives a solvent-like smell to beer; acetaldehyde, the aroma of green apples or apple peel; iso-amyl acetate, a typical banana-like aroma; ethyl hexanoate, the smell of red apples or anise; and 4-vinylguaiacol, an intense clove-like aroma, typical especially for wheat beer.

On the other hand, butyric acid has a vomit-like smell and its presence points to technological mistakes during the fermentation process. Hop addition technology and the variety of hops used affect the hoppy aroma of beer, constituted by hundreds of hop essential oils. These compounds bring also a flowery aroma to beer. The most common, geraniol, provides a rose-like aroma.

BEER AND HEALTH
Ethanol is the only unhealthy compound in beer. In low doses, it is sometimes recommended for improving digestion and cardiovascular system function. Other components make beer a balanced beverage that contains nutrients, minerals, and vitamins. Regarding the ratio of particular ions, beer is a perfect drink for organism mineralization. The magnesium concentration in beer is higher than that of conventional mineral water. In addition, beer contains up to six times more potassium than sodium, which is very positive for the human organism. From this point of view, beer is an exceptional nutritive suitable for low-sodium diets, to name one example. Apart from minerals and nutrients, beer contains many health benefiting compounds. These are especially B-group vitamins originating from malt and yeasts. Additionally, hop polyphenols have many positive biological effects.

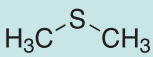
Tomáš Kinčl

Sulfur dioxide

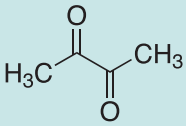


Hydrogen sulfide

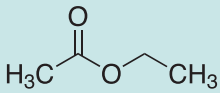
Dimethyl sulfide



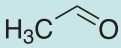
Diacetyl



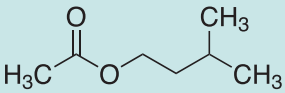
Ethyl acetate



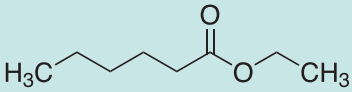
Acetaldehyde



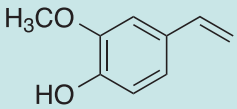
Iso-amyl acetate



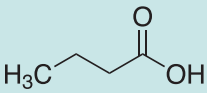
Ethyl hexanoate



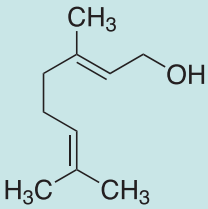
4-vinylguaiacol



Butyric acid

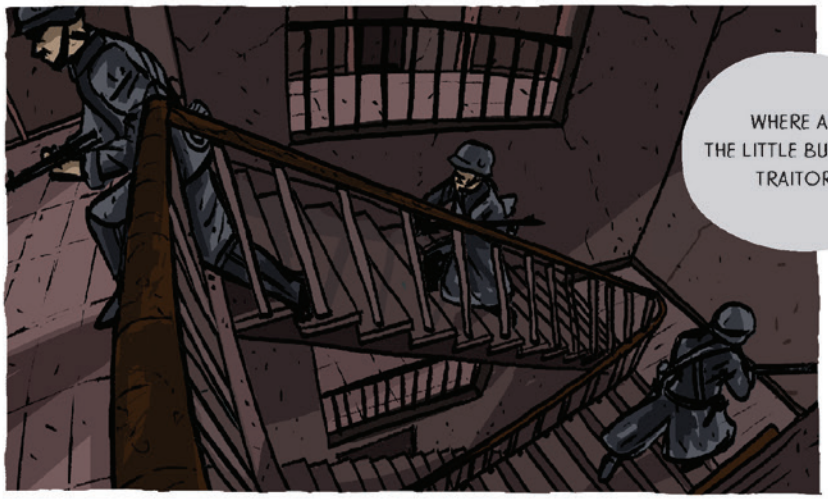


Geraniol



THE SECRET STORY OF THE GOLEM

PART 6



TO BE CONTINUED TOMORROW...

CASIO

Sponsored by CASIO

Science championship – International Chemistry Olympiad

Chemistry is a science that not only answers exciting questions about nature but also affects people's everyday life with many discoveries. As CASIO shows an admiration for natural sciences, we sponsor mathematics and science competitions, such as the international Chemistry Olympiad , to support exceptional students. Günter Grefen, General Division Manager at CASIO Europe GmbH: "It is our firm belief that the participants' excellent understanding of chemistry subjects will surely lead to new scientific discoveries."

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With electronic calculators, CASIO offers a tool not only for maths but also for other science subjects, such as physics, biology and chemistry, to support students in understanding sciences more deeply. By eliminating long, repetitive calculations, time is won for exhilarating new discoveries.

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Facts & figures

From the late 1970s, scientific and graphic calculators gradually made their way into classrooms, revolutionising the way mathematics and sciences were taught.

2700 –2300 BC
First appearance of the Sumerian abacus

1957
Invention of the compact all-electric calculator

1985
World's first graphing calculator by CASIO

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 7

THE SEVENTH ISSUE OF CATALYZER MAGAZINE 25/07/2018

Congratulations, now the competition is behind you! It's time to breathe a sigh of relief, calm down your over activated brain cells, and get ready for a lot of fun. The fun will start for you tonight as soon as the train arrives at its destination:

PRAGUEEEEEEEEE!

Prague, the capital of the Czech Republic, is proud to have a number of adventurous nicknames; among others, the *Mother of All Cities*, *Hundred Towers*, and *Gold One*. It is home to the President, the government, and both chambers of parliament. It was the seat of the Czech Kings and the Roman-German Emperors. It belongs to the Top 10 richest regions in Europe and provides the background to twelve universities. It is the most visited city in the Czech Republic and one of the most beautiful cities in the world. And of course: It will also host you, the participants in the International Chemistry Olympiad, for the next few days.
Prague is literally filled with curiosities, enough to fill a whole book, not just an article in *Catalyzer*. On the following pages of today's edition, you will find only a very limited selection of noteworthy stories and a small number of photos from an ocean of the city's breathtaking sights. We believe they will tune you up for the grand tour of Prague which is awaiting you in the coming days.

As we have just announced, you will already have your first date with Prague tonight. And it will be a great chemical ride: The Reunion party. At this very moment, as you are reading this, the first bands are already warming up at the University of Chemistry and Technology campus, igniting the interest of passers-by. The special chemical unit, the greatest pride of the Czech Army, is showing off its equipment to thousands of visitors. There will be plenty of good food and drinks around. In short, a great atmosphere out under the sky.
And what will the atmosphere escalate into at the moment when the visitors will spot the biggest highlight: Your massive arrival and the ceremony of delivering the Olympic Relay to Prague?

REUNION PARTY PROGRAMME

- Chemical experiments for the public
- Examples of rescue activities: Fire Department, Czech Police, Czech Army
- Photo booth
- Street food festival: 20 food and Czech beer stands
- Public demonstration by the Czech Army Special Chemical Unit
- Bands

Babies climbing the tower. Rolling Stones as a sponsor of Prague Castle. Wall as a symbol of freedom of speech. Prague is simply

A CITY FULL OF UNEXPECTED CONNECTIONS

Emperor Charles IV laid the foundation stone for **Charles Bridge** on 9th July 1357, at 5:31 A.M. This date was not selected randomly. The Emperor was an astrologer and numerologist and chose the day and time because it is possible to write it down in sequence: 1-3-5-7-9-7-5-3-1 (year/day/month/time).

The narrowest passageway in Prague leads from *U Lužického Semináře* Street to Restaurant Čertovka. It is only 50 cm (20 inches) wide, has steep stairs, and has something unique at both ends: Traffic lights for pedestrians so that they avoid colliding while moving through the passageway.

You do not have to come to Prague to see its famous **Astronomical Clock**. A faithful replica of Prague's Old Town Hall—including the clock—can be found in the center of Seoul, the capital of South Korea, where you will also find a restaurant where Czech specialties and draught beer are served.

The Prague Castle has an area of seven hectares (five football fields) and is—according to the *Guinness Book of Records*—the largest historic castle in the world.
Prague Castle is wonderfully illuminated at night thanks to The Rolling Stones. The band was invited to Prague in 1990 by then newly-elected President Václav Havel, shortly after the fall of the Communist regime. After visiting the Castle, they suggested that Prague's dominant landmark should be illuminated. And because Czechoslovakia, according to Havel, had more serious problems to solve, the band members decided to pay for Spanish Hall lights out of their own pockets. Thank you, gentlemen.

Petřín Lookout Tower is a loose copy of the famous Eiffel Tower (at a ratio of 1:5), standing 63.5 meters versus the Eiffel Tower's 324 m. It has the upper hand over the original, thanks to the fact that it stands on a hill. Thus, it boasts a higher altitude (378 m above sea level) than the peak of the Eiffel Tower (361 m). Visitors can ascend the tower using just 299 steps.

There is a **graffiti wall dedicated to John Lennon**, who never visited Prague in person. The first graffiti inspired by Lennon and the Beatles appeared on the wall shortly after Lennon's death in 1980. Today, the wall is considered not only a monument to John Lennon, but also is a symbol of freedom of speech and resistance to totalitarian regimes.

Prague is often called a town of a hundred towers. The highest tower is **Žižkov Television Tower** (216 m). Apart from offering panoramic views of Prague, it has an unusual artistic addition: **Babies**. Ten laminated toddlers (each of them 100 kg, 3.5 m long and 2.6 m high) climb the tower, up and down. After its debut in 2000, the installation was such a success that it became permanent. This year, the Babies will reach adulthood.

Prague's Jewish Quarter is one of the few in Europe not destroyed during World War II. Hitler himself made the decision to spare the Jewish Quarter from wartime destruction as he was planning to spend his retirement there.

Although the Czech Republic lies in the heart of Europe, Prague's residents do not have to go far to visit the sea. The nearest shore of the Baltic Sea is only 365 km from Prague. The Adriatic Sea is 490 km away and the North Sea is only 5 km further.

The longest street in Prague is **Strakonická Street**. It is 16 km long.

Petra Ménová

KUTNÁ HORA

Decorations made of human bones, silver fever, treasure bricked in the walls, bats in a temple. These aren't scenes from an upcoming fantasy series, but the past and present of the medieval town of Kutná Hora.

Silver! Riches! These exclamations have been heard in the area surrounding today's Kutná Hora since the tenth century. The end of the thirteenth century brought with it a true "silver fever" related to the development of mining. Soon, Kutná Hora became one of the most important towns of the Czech Kingdom and it was rightly called the treasury of Czech kings. Shortly after, a mint was established there, which coined the Prague *groschen*—the strongest currency of Central Europe of the time. It did not take long for wealth to influence the appearance of the city. The town's Stone House was built, as well as the Church of St. Jacob, the breath-taking Cathedral of St. Barbara, and the monumental Jesuit College. Kutná Hora rightfully deserves its place on the UNESCO World Heritage List.

ST. BARBARA CATHEDRAL

A major town landmark is the cathedral, founded in 1388 and dedicated to the patron of miners, St. Barbara. Its architecture is inspired by the French style and it is so monumental and decorative that it bears comparison with Prague's St. Vitus cathedral. In the interior, unique frescos have been preserved, depicting the work of miners and minting coins. In the upper part of the church, you can see demons, harpies, bats, and even an ape with an orange.

OSSUARY

Bizarre decorations made of human bones, piles of skulls, the Schwarzenberg coat of arms built from shoulder blades and hip bones—all that can be seen by the brave in the underground chapel of the cemetery church of All Saints. Those who are more faint-hearted can wait outside. After the cemetery was abolished in the fifteenth century, the remains of more than 40,000 people buried there were moved to the underground chapel of the church. During its reconstruction, architect J. B. Santini-Aichel came up with the idea of decorating it with the bones. His vision was completed by F. Rint, who used blanched bones to create these peculiar decorations.

BONE BLANCHING

Bone blanching is usually done with a solution of hydrogen peroxide. When treating old (dark to black) bones, we start with reduction whitening using sodium dithionite ($Na_2S_2O_4$) and only after that, we continue with oxidation bleaching with peroxide. If the bones are still stubbornly stained, we add phosphoric acid into the peroxide solution, which disturbs the surface of the bone and facilitates the penetration of the bleach. According to historical sources, F. Rint used chloride of lime to whiten the bones: a mixture of calcium salt of hypochlorous and hydrochloric acid, wherein the main active component is calcium hypochlorite $Ca(ClO)_2$.

LAPIS INFERNALIS

The name for the fusion of $AgNO_3$ (97%) and KNO_3 (3%) comes from Latin: *lapis* means "stone"; *infernalis* means "infernal". It possesses antiseptic effects, and therefore the "stone of hell" is used to treat skin defects. The name probably stems from the fact that if silver nitrate comes into contact with skin, it produces dark stains that are hard to remove. It is metallic grey-black silver thanks to the great willingness of silver ions to be reduced.

SILVER ORES

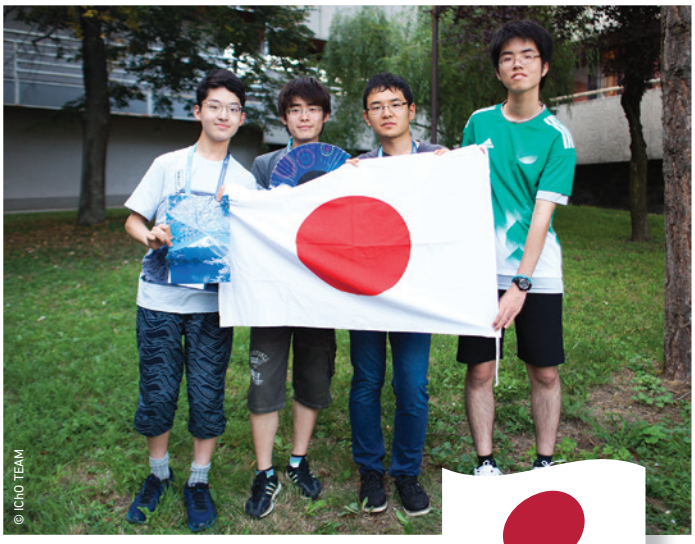
As pure metal, silver occurs in nature only very rarely; it can usually be found in compounds. It can bind directly with precious ores, the most important of them being acanthite (Ag_2S) and its modification, argentite, as well as proustite ($Ag_3[AsS_3]$) and pyrargyrite ($Ag_3[SbS_3]$). However, these are rarely found in our latitudes. Another, more significant source are the ores of other metals which contain the addition of silver such as galenite, sphalerite, and chalcopyrite. Silver content is usually in the tens of percent, and these ores have been used extensively.

CHEMISTRY AND SILVER

Its unique characteristics lend it a wide range of possible uses including the manufacture of formaldehyde, the improvement of corrosion resistance in aluminum alloys, or—together with palladium as an alloy—the production of semi-permeable membranes for hydrogen diffusion. For decades, there has been growing interest in nanoparticles of silver, used not only in medicine, pharmacology, and construction chemistry, but also in filters and electronic circuits. The cherry on top is confectionery coloured by silver (E174 colorant), which you can enjoy throughout the EU but which is banned in the US and Australia.

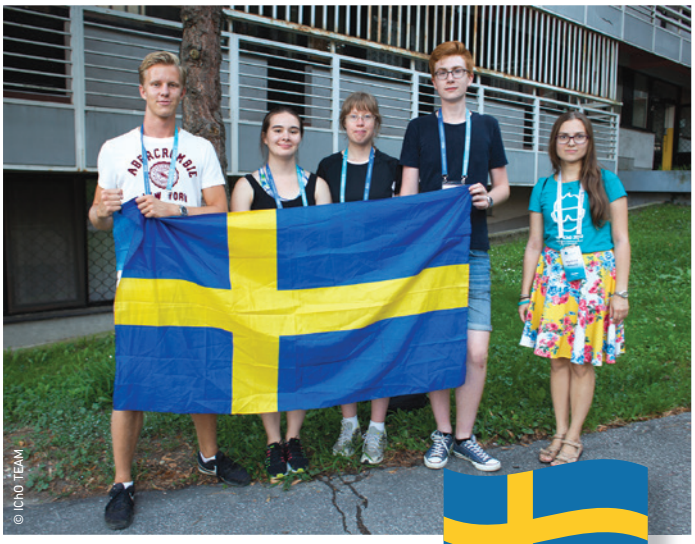
Silver compounds also have a wide spectrum of applications. $AgNO_3$ is an important laboratory agent in analytical chemistry (e.g., abstraction of soluble halides, testing for aliphatic and aromatic aldehydes) and is a key ingredient in the preparation of other compounds, such as some explosives. With the combination of Ag_2O and zinc, we get the silver-oxide cell, a battery with a good capacity-to-weight ratio. Crystals of AgI are often used in attempts to induce rain artificially.

Linda Uhlíková



JAPAN

1. We are proud of our flag, but it's just the red circle... Don't paint a face on it :).
2. Our school year usually begins in April and ends in following March.



SWEDEN

1. We are showing *lagom*. Find out what does it mean :).
2. In Sweden, there are more moose than people.

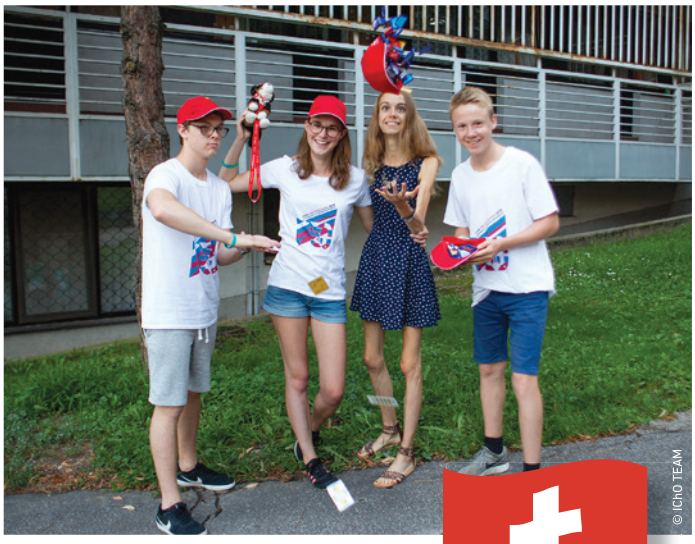
IChO NATIONAL TEAMS

DENMARK

1. Thinking about the art.
2. At Christmas time, children are given Elf Beer with 2% alcohol.

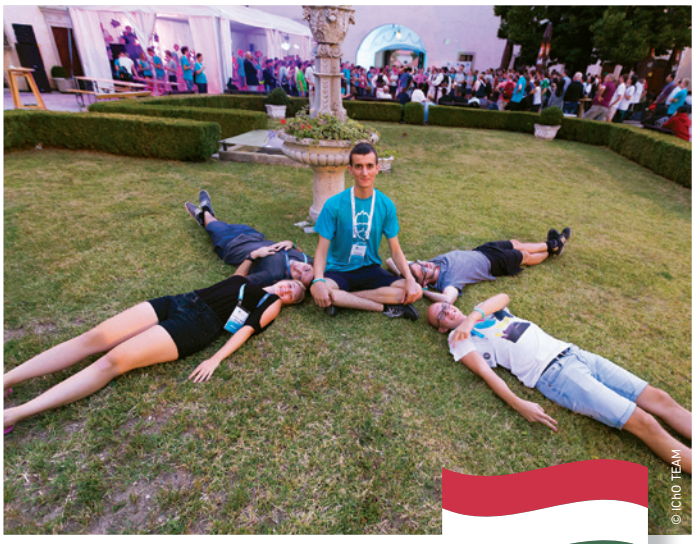
BELARUS

1. Being hungry for their guide's arm. Bon Appetit!
2. It's not only potatoes we eat.



SWITZERLAND

1. Presenting national symbols: Colors red and white, money, chocolate, and cards.
2. The popular soda, Rivella, is produced from milk whey.



HUNGARY

1. Trying to form a sausage star.
2. We have the biggest number of Nobel Prize winners when divided by precipitation/rainfall.

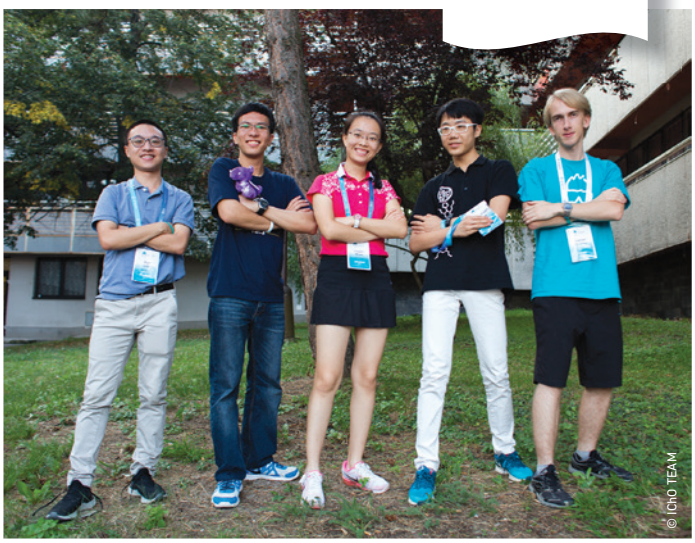
1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

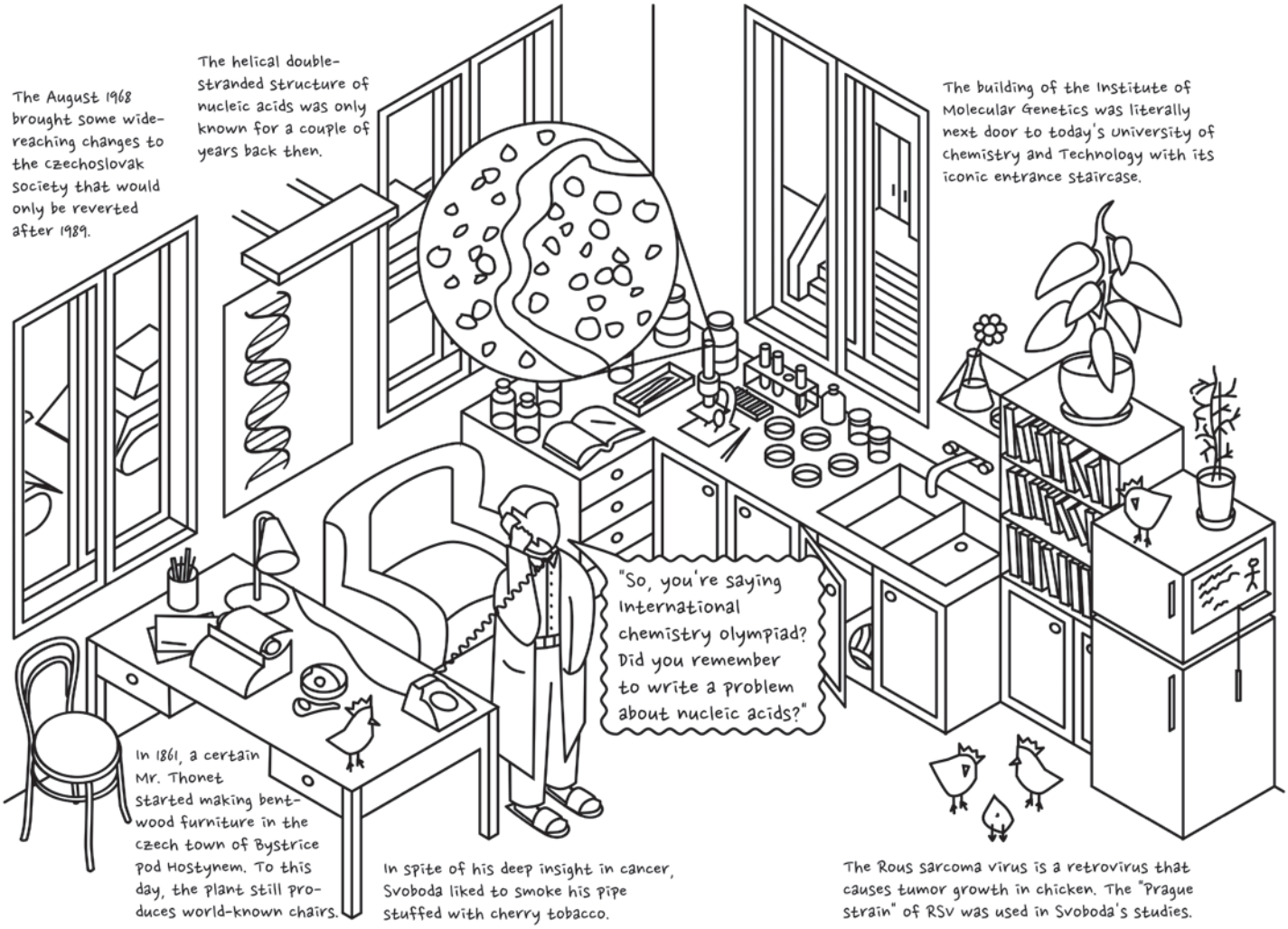
NETHERLANDS

1. We are all tall, right?
2. *Stroopwaffle* is our national candy.

SINGAPORE

1. Showing Statue of Stamford Raffles, the founding father of Singapore.
2. Chewing and selling chewing gum in public is prohibited.



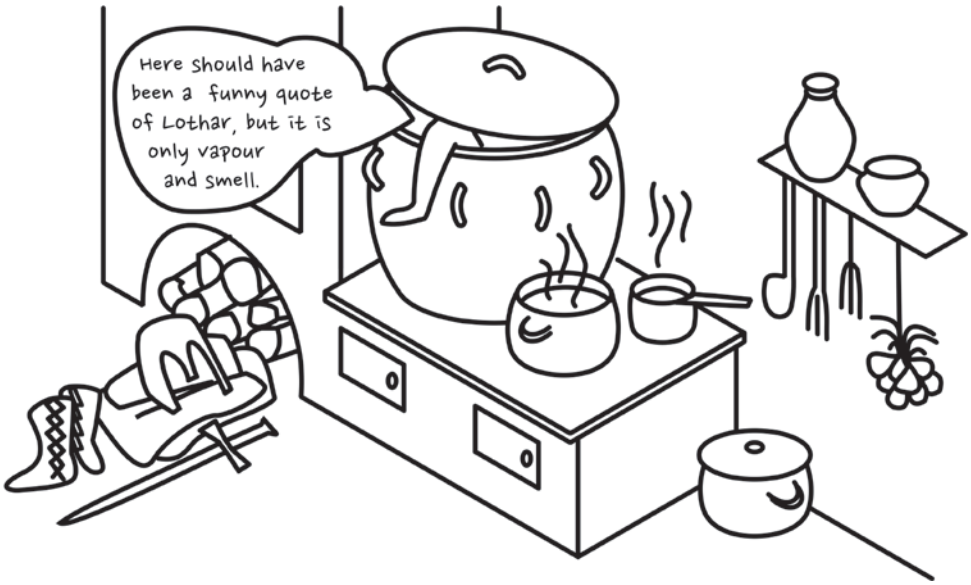


DNA

THEORETICAL PROBLEM 1

RNA, retrovirus, reverse transcriptase, hydrogen bond, nucleotide. These are a few keywords that have shaped the careers of many Slovak and Czech scientists. The schools of chemistry and virology in the former Czechoslovakia were quite strong from the 1950s onwards, despite the sub-optimal conditions under which researchers struggled. One of the leading virologists of that time was Professor Jan Svoboda (1934–2017), who pioneered the retrovirus hypothesis. It is commonly speculated that the social and political changes which coincided with IChO's first year thwarted Svoboda's chances of receiving the Nobel Prize. When the practical and theoretical problem-solving of the 50th IChO are over, grab your colour pencils and relax with a cartoon of Svoboda's lab.

Michal Kolář, Tomáš Kubař



BOILED EMPEROR: CHEMISTRY HELPS HISTORY

THEORETICAL PROBLEM 2

Historians often have rather concrete ideas about past events, but some hypotheses must be confirmed using chemistry. In the twelfth century, Europe was not a safe place to live, especially for monarchs. They faced contentious and fierce power struggles. The King of Germany and later Holy Roman, Emperor Lothar II, was no exception. He spent most of his life on the battlefield. In 1136, he was involved in a campaign against Roger of Sicily. In the south of Italy, in high summer, his troops revolted against the campaign and Lothar had to return to Germany. He died while crossing the Alps, 500 km from his castle, *Königslutter*, where he was later buried. Transport of his body to the castle took a matter of weeks due the conditions of roads at the time. Historians assumed his body was boiled to prevent decay, yet this hypothesis could only be confirmed in the twentieth century, with the help of chemical kinetics.

Dating based on the ratio of amino acids optical isomers is less common than analogical methods such as radiocarbon dating. The principle is, however, the same. In living organisms, L-amino acids vastly dominate; this situation is thermodynamically unstable. After death, racemization takes place and concentrations of D- and L-forms slowly equilibrate. The ratio between D- and L-forms then provides information regarding the age of fossils or bones from the Holocene and late Pleistocene epochs. Amino acid dating can be used for objects that are up to thirty to fourty thousand years old; the radiocarbon method is useless for such old objects because radiocarbon half-life is 5,730 years.

From the archeological perspective, Holy Roman Emperor Lothar II passed away only recently, and amino acid racemization has not yet proceeded far. Yet the rate of racemization dramatically increases with temperature and a boiled emperor should be distinguishable. And as you assured yourself in Problem 2, Lothar's body was indeed subject to such a procedure.

Amino acid racemization is a valuable tool for forensic anthropologists as well. Some tissues are not involved in metabolic reactions, and racemization takes place during a lifetime at body temperature. Dentin (which forms the majority of a tooth) is a nice example. Dentin is formed in early childhood, and amino acid racemization proceeds in dentin until death. In cold countries such as the Czech Republic, racemization after death effectively stops because of the temperature dependency of the rate constant (typical activation energies for amino acids exceed 100 kJ/mol; you can calculate yourself the rate of racemization at 10 °C, which is the average temperature in graves). The age at the time of death is then inferred from the ratio of D- and L-isomers. Obviously, the method is accurate only in countries which are cold enough, preferably for analyzing bodies buried in caves with constant temperatures.

Amino acid racemization found its use in cosmology, for meteorite analysis. Dating can be performed with all aminoacids except glycine, which is not optically active. Isoleucine is the preferred candidate because it is easily determined and has a long half-life. If we employ reverse-phase HPLC, up to nine amino acids can be measured simultaneously in one chromatograph, which significantly improves accuracy. Unfortunately, amino acid dating is not flawless. For instance, researchers must hope that temperatures did not change dramatically over time. Racemization also depends on the position of the amino acid in the chain and on the humidity of an environment. Results then require calibration in order to be trusted.

Bodies of famous people are often manipulated in various ways. Mummification is a particularly popular technique, if we recall Egypt's pharaohs or Vladimir Lenin. One of Lothar's soldiers was presumably buried peacefully at the place of his death, but poor Lothar's body was boiled for six hours and—after centuries—subjected to acidic hydrolysis by scientists.

Petr Slavíček, Eva Muchová

The Czech Republic is a country full of majestic castles, picturesque châteaux, fortresses, and ruins. Their names are often rather obscure: *Bone*, *Elbow*, *Bun*, or *Ruins*. Czechs like to visit their historic sites during weekends and on holidays. Lately, however, it is the small breweries that have begun attracting visitors. Unlike castles, they aren't situated on hills.

DEEP LOOK INTO THE CZECH SOUL

PEOPLE AND CULTURE

- Czechs are keen readers. The Czech Republic boasts the densest net of public libraries in the world.
- Beer is the national drink. Czechs are the heaviest consumers of beer in the world, drinking on average over 140 liters of beer per capita every year.
- Czechs are animal lovers: More than 40% of Czech households own a dog. That's why people recommend that you watch your step when walking in Prague ☺.
- Czechs have a great sense of humour and love to make fun of themselves. You see, in what other country could Jára Cimrman, a famous inventor and philosopher, win the "Greatest Czech" competition? You may be surprised to learn that Jára Cimrman is, in fact, a fictitious character!
- Almost all Czech secondary school students traditionally attend a dance course where they learn not only some basic dance steps, but also the basic rules of etiquette. Attending balls is a very popular activity in winter.

SPORTS

- The most popular sports are football and ice hockey. The Czech Republic boasts numerous prizes and medals, especially for ice hockey. Try mentioning the Nagano match to Czechs. Even after twenty years, you'll still be able to see a proud look in their eyes as they remember the Olympic gold medal.
- Czechs are very sporty and enjoy spending their free time outdoors. Almost every Czech child can cycle, ice skate, swim, and ski.
- Czech hikers enjoy more than 40,000 kilometers of signposted walking trails, one of the densest nets of walking trails in the world.

LANGUAGE

- Czech and Slovak languages are mutually intelligible.
- Czech is one of the most difficult languages in the world. Our language has seven cases, three genders and, notably, the unpronounceable letter "Ř". This letter can help you to distinguish Czech and Slovak, since Slovak doesn't have this letter and Slovaks often struggle to pronounce it.

THE CZECH REPUBLIC IN THE WORLD

- Until 1992, the Czech Republic and the Slovak Republic were one state, Czechoslovakia. On 1st January 1993, the countries separated in the so-called Velvet Divorce, one of the most peaceful splits of the twentieth century.
- The Global Peace Index ranks the Czech Republic as the sixth safest country in the world based on the lack of international or domestic conflicts, low crime rate, and other indicators.

CZECH INVENTION

- Sugar cubes are a Czech invention. Jacob Christoph Rad, manager of a sugar factory in the Czech town of Dačice, came up with the idea of the sugar cube after his wife cut herself when chopping sugar. His invention was patented in 1843.

FAMOUS CZECHS YOU MAY KNOW

- **Franz Kafka** – One of the greatest and most valued writers of the twentieth century. *The Metamorphosis* and *The Trial* are among his best known novels.
- Geneticist **Gregor Mendel** – Darwin's contemporary, founder of genetics, and discoverer of its basic laws.
- **Miloš Forman** – World-renowned film director, winner of two Academy Awards for *One Flew Over the Cuckoo's Nest* and *Amadeus*.
- **Dominik Hašek** and **Jaromír Jágr** – The best Czech ice hockey players.
- **Antonín Dvořák** – Music composer, whose *New World Symphony* is known around the globe. **Bohuslav Martinů** and **Bedřich Smetana** are other big names in Czech classical music.
- **Alfons Mucha** – Famous Art Nouveau painter, graphic designer, and designer.

GEOGRAPHY

- Twelve Czech monuments have made it to the UNESCO World Heritage List. You may have heard of the town Český Krumlov or the Villa Tugendhat.
- The Czech Republic is easily recognizable on satellite images, since the country is encircled by mountains. The highest mountain is Sněžka at 1,603 meters.

Martina Ménová

SUGAR SUPERPOWER

Sugar making is a trade with a long tradition in our country. At first, sugar cane was processed here. Later, it was replaced by the sugar beet, a plant widely and easily grown in our climate zone. The sugar industry flourished and our country became a significant exporter of sugar. Between the World Wars, Czechoslovakia was responsible for almost 18% of worldwide sugar production. In 1989, there were fifty-two sugar factories in Czechoslovakia. However, they gradually merged and became members of multinational companies. Nowadays, you can only find seven sugar factories in the Czech Republic, producing more than 450 tons of sugar annually.

UNDER THE LID OF CZECH CUISINE

© 123RF

Wiener schnitzel with crunchy crust, sirloin in cream sauce with sweet cranberries, juicy roast pork with dumplings and sauerkraut. If you are a real Czech, then you have begun drooling onto your *Catalyzer*. These dishes are our favourites. Come and peek under the lid of Czech cuisine.

If you do not come from Central Europe, then you probably do not know how to prepare your stomach for visiting the Czech Republic. Traditional Czech cuisine is rather meaty (especially full of pork) and greasy, yet Czechs are very fond of it. In addition to an IChO medal, you might take home a few extra pounds of fat. The most popular Czech dishes are fried Wiener pork schnitzel (fried pork coated in flour, eggs, and breadcrumbs), sirloin in cream sauce with dumplings (roasted beef in root vegetable cream sauce, served with lemon and cranberries), roast pork with dumplings and sauerkraut, fried cheese (Dutch-style cheese breaded like Wiener schnitzel), and goulash. However, some of these dishes are not entirely Czech originals but trace their roots to neighbouring countries, such as goulash, which comes from Hungary.

If your stomach is rumbling, order a typical Czech three-course lunch. The first course is soup, often very dense (for example, pea or lentil soup). Local specialties such as *kyselo* (sourdough bread soup with dried mushrooms) or *kulajda* (cream soup with dill and potatoes) can also be unusual culinary experiences. However, these specialties are so "special" that they are hard to digest, even for many Czechs. The main course follows. It consists of meat, sauce (often served flowing over the edge of the plate), and a side dish (such as potatoes or dumplings). Vegetable salad or compote comes at the end of lunch. Of course, every lunch includes a glass of well-cooled beer! If you are not yet of drinking age, then you can try Kofola. This cola drink was first produced in Czechoslovakia in 1959 as a substitute for Coca-Cola and Pepsi, which were not on the market.

What can be considered to be the real specialties of Czech cuisine? Dumplings! Dumplings are made from flour and other ingredients, such as potatoes or pieces of bread. Potato, bread, or curd cheese dumplings are served as a side dish to meats with sauces. You can also try stuffed dumplings, such as potato dumplings filled with smoked meat and fried crunchy onions, as a main course. The specialty of the cold kitchen is the open sandwich: slices of white bread topped with various salads, cheeses, sausages, vegetables, or eggs. For Czechs, no celebration or banquet is complete without open sandwiches.

What to say in conclusion? Just enjoy your meal: *Dobrou chuť*.

KOFOLA VERSUS COCA-COLA

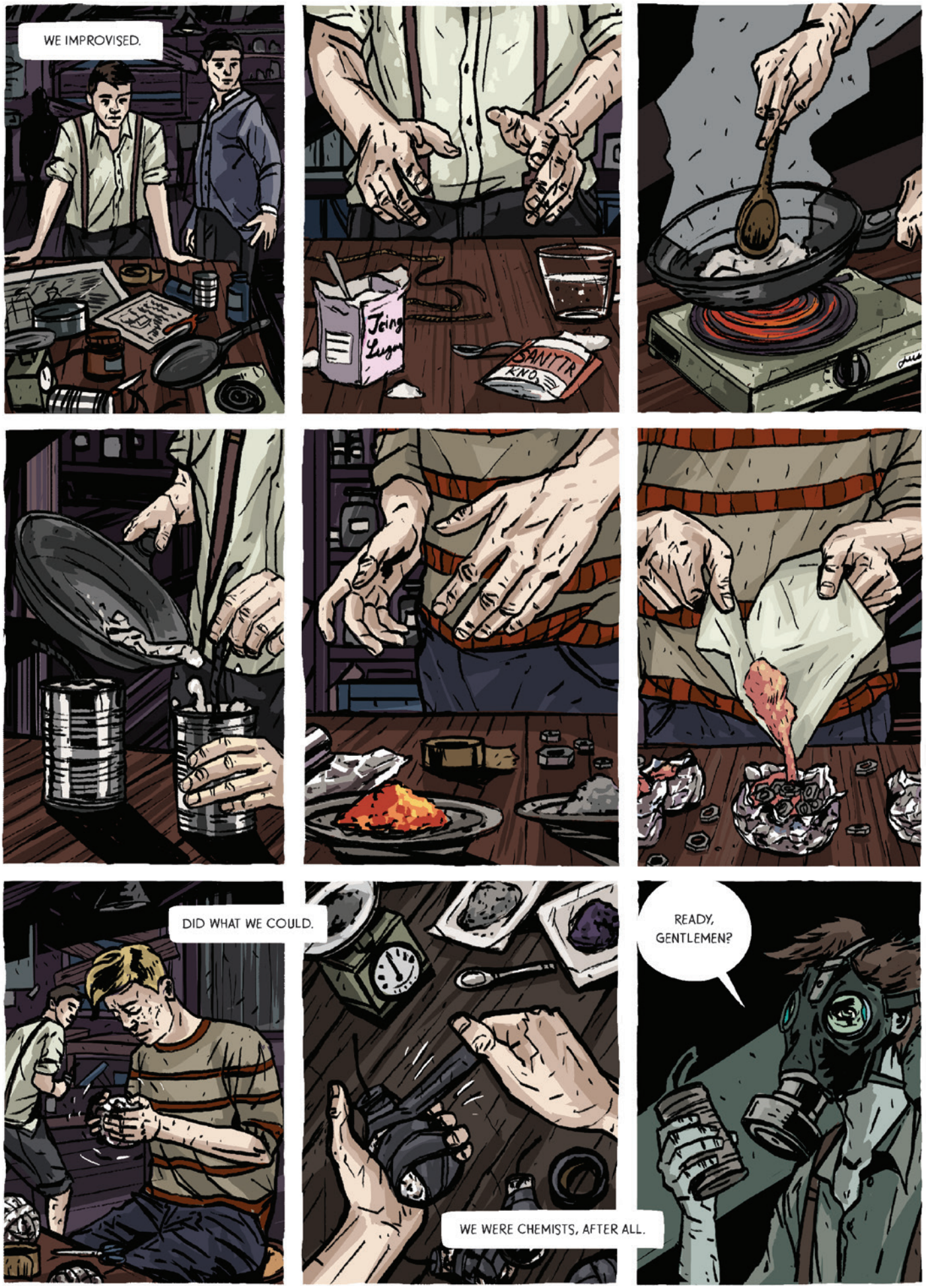
The common ingredients of these cola drinks are water, fructose-glucose syrup (Coca-Cola) and glucose-fructose syrup (Kofola), sulfite ammonia caramel (E150d), caffeine, and carbon dioxide. However, the degree of carbon dioxide saturation is very different. After the first sip of Coca-Cola, you feel as if the bubbles will come out your nose. In Kofola, you will find hardly any bubbles; in the list of ingredients by content, you will find carbon dioxide at the very end. Coca-Cola further contains only phosphoric acid and aroma. The composition of Kofola is much richer and more mysterious. It contains caramel, citric acid, sodium chloride, licorice extract, sodium benzoate preservative, KOFO fruit syrup, KOFO aroma, and an extract of 14 herbs whose detailed composition is kept as a brand secret.

SWEET LUNCH

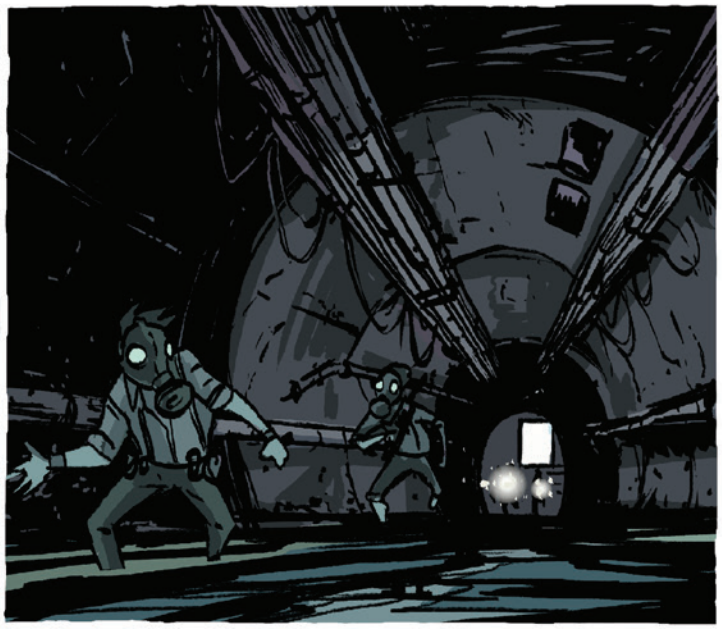
A sweet dish at the end of lunch? In the Czech Republic, you can also taste a sweet, non-meat main course—a unique, unforgettable combination dear to the hearts of meat-loving Czechs. *Buchtičky* with *šodó* (yeast buns with a pudding-like vanilla sauce, the most popular dish in school canteens for which there are always queues), fruit dumplings, bread pudding, pancakes with jam, cinnamon griddle cake, sweet millet mash, semolina porridge with cocoa, *šišky* (potato donuts made of flour and eggs) with poppy seeds, rice pudding with plums, porridge with honey—such a lunch is definitely worth the resulting high blood sugar level.

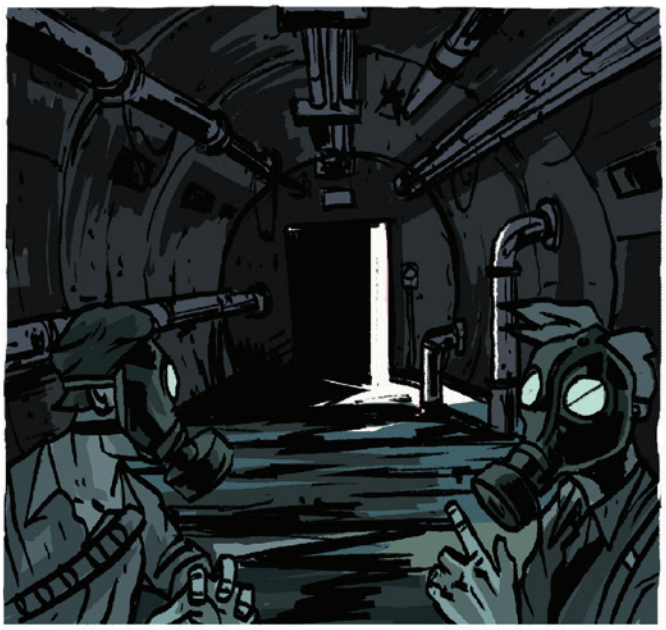
Jitka Kopecká

THE SECRET STORY OF THE GOLEM



PART 7





TO BE CONTINUED TOMORROW...

COMPETITION TASKS OF THE 1ST IChO EVER

Show your skills and try to solve the competition tasks that beat your predecessors' brains 50 years ago.

PROBLEM 1

A mixture of hydrogen and chlorine kept in a closed flask at a constant temperature was irradiated by scattered light. After a certain time, the chlorine content decreased by 20% compared with that of the starting mixture, and the resulting mixture had the composition as follows: 60 volume % chlorine, 10 volume % hydrogen, and 30 volume % hydrogen chloride.

1.1 What is the composition of the initial gaseous mixture?

1.2 How are chlorine, hydrogen, and hydrogen chloride produced?

PROBLEM 2

Write down equations for the following reactions:

2.1 Oxidation of chromium(III) chloride with bromine in alkaline solution (KOH).

2.2 Oxidation of potassium nitrite with potassium permanganate in acid solution (H_2SO_4).

2.3 Action of chlorine on lime water ($Ca(OH)_2$) in a cold reaction mixture.

PROBLEM 3

The gaseous mixture escaping from a blast furnace has the following composition: 12.0 volume % CO_2, 28.0 volume % CO, 3.0 volume % H_2, 0.6 volume % CH_4, 0.2 volume % C_2H_4, 56.2 volume % N_2.

3.1 Calculate the theoretical consumption of air (in m^3) which is necessary for total combustion of 200 m^3 of the above gaseous mixture if both gas and air are measured at the same temperature. (Oxygen content in the air is about 20% by volume.)

3.2 Determine the composition of combustion products if the gaseous mixture is burned in a 20% excess of air.

PROBLEM 4

A volume of 31.7 cm^3 of 0.1-normal NaOH is required for the neutralization of 0.19 g of an organic acid whose vapour is thirty times as dense as gaseous hydrogen.

4.1 Give the name and structural formula of the acid. (The acid concerned is a common organic acid.)

SOLUTIONS

1.1 $H_2 + Cl_2 \rightarrow 2\,HCl$

30 volume parts of hydrogen chloride could only be formed by the reaction of 15 volume parts of hydrogen and 15 volume parts of chlorine. Hence, the initial composition of the mixture must be:

Cl_2: 60 + 15 = 75%

H_2: 10 + 15 = 25%

1.2 Chlorine and hydrogen are produced by electrolysis of aqueous solutions of NaCl:

$NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

anode: $2\,Cl^- - 2\,e^- \rightarrow Cl_2$

cathode: $2\,Na^+ + 2\,e^- \rightarrow 2\,Na$

$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$

Hydrogen chloride is produced by the reaction of hydrogen with chlorine.

2.1 $2\,CrCl_3 + 3\,Br_2 + 16\,KOH \rightarrow 2\,K_2CrO_4 + 6\,KBr + 6\,KCl + 8\,H_2O$

2.2 $5\,KNO_2 + 2\,KMnO_4 + 3\,H_2SO_4 \rightarrow 2\,MnSO_4 + K_2SO_4 + 5\,KNO_3 + 3\,H_2O$

2.3 $Cl_2 + Ca(OH)_2 \rightarrow CaOCl_2 + H_2O$

3.1

		O_2
$2\,CO + O_2 \rightarrow 2\,CO_2$		14.0
$2\,H_2 + O_2 \rightarrow 2\,H_2O$		1.5
$CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O$		1.2
$C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + H_2O$		0.6
		17.3 parts

17.3 parts × 5 = 86.5 parts of the air

200 m^3 of the gas... 2 × 86.5 = 173.0 m^3 of the air

+20% 34.6 m^3

207.6 m^3 of the air

3.2 207.6 : 5 = 41.52 parts O_2 : 2 = 20.76 parts O_2 for 100 m^3 of gas

20.76 × 4 = 83.04 parts of N_2 for 100 m^3 of gas

Balance: (volume parts)	CO_2	H_2O	N_2	O_2
	12.00	3.00	56.20	20.76
	28.00	1.20	83.04	-17.30
	0.60	0.40		
	0.40			
	41.00	4.60	139.24	3.46

Total: 41.00 + 4.60 + 139.24 + 3.46 = 188.30 of volume parts of the gaseous componenets.

$\% H_2O = \frac{4.60}{188.30} \times 100 = 2.44$

$\% H_2 = \frac{139.24}{188.30} \times 100 = 73.95$

$\% O_2 = \frac{3.46}{188.30} \times 100 = 1.84$

4.1 **a)** The supposed acid may be: HA, H_2A, H_3A, etc.

$n(NaOH) = c \times V = 0.1\ mol\ dm^{-3} \times 0.0317\ dm^3 = 3.17 \times 10^{-3}\ mol$

$n(acid) = \frac{3.17 \times 10^{-3}}{\nu}\ mol$

where $\nu = 1, 2, 3 \ldots$

$n(acid) = \frac{m(acid)}{M(acid)}$

$M(acid) = \nu \times \frac{0.19\ g}{3.17 \times 10^{-3}} = \nu \times 60\ g\ mol^{-1}$ (1)

b) From the ideal gas law we can obtain:

$\frac{p_1}{p_2} = \frac{M_1}{M_2}$

$M(H_2) = 2\ g\ mol^{-1}$

$M(acid) = 30 \times 2 = 60\ g\ mol^{-1}$

By comparing with (1): $\nu = 1$

The acid concerned is a monoprotic acid and its molar mass is 60 g mol^{-1}.

The acid is **acetic acid**: $CH_3–COOH$.

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
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CATALYZER 8

THE EIGHTH ISSUE OF CATALYZER MAGAZINE 26/07/2018

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BONDING WITH THEORY

We know you have been through a lot during the last couple of days, but this was the final step and the main purpose of your visit. The Theoretical Exam was on Wednesday, but the tension could already be felt the evening before.

"Today is the day", one could probably tell by all the moving parts and working people you saw around you. Although at 7 A.M. guides started to gather their students, preparation had begun even before you woke up. Our Slovak staff had another sleepless night trying to make everything as perfect as possible.

The translated English exam sheets prepared by your mentors were shipped to IChO organisers in Slovakia and delivered to your exam room. All 300 of you used together over 400 pens, 800 pencils and 2,000 sheets of paper while being watched over by 30 supervisors along with other organisers waiting in a room nearby, all working together towards the common goal: Coming up with the best and most fair experience for you.

The test consisted of 8 main problems with many sub-questions covering different fields of chemistry such as physical, inorganic, analytic and organic chemistry. One member of the Organizing Committee said: "I think the exams required a lot of multitasking and the questions definitely weren't easy, but were well-made, examining many different areas of chemistry and the ability of a student to work among these multiple areas."

You were only allowed to bring a few essential accessories: An official IChO Casio calculator and an analogue watch (digital watch was forbidden). Any other required accessory was provided for you by our staff. The rules are strict, but this is the only way to ensure no one cheats and that everyone is on the same playing ground.

It wasn't just you the students who were working hard. Behind the scenes, the guides were busy packing everything up and preparing your suitcases to be delivered on time to Prague, which is the next stop of your journey.

Matej Šemelák, Žofia Váryová

I FEEL LIKE FERDA THE ANT

Interview with Petra Ménová, head of the Scientific Committee and one of the busiest people at the International Chemistry Olympiad.

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Can you share more about your job at IChO 2018 with our readers?
I sometimes feel like my childhood favourite hero: Ferda the Ant, Jack of All Trades. My first and most important IChO job is to head the Czech Scientific Committee, which prepares the Theoretical Problems. I also help the Slovak Scientific Committee with the Practical Problems. Within the Local Organization Committee, I help with whatever is necessary, from hiring the guides to counting how much toilet paper will be needed. One of my favourite jobs is the work on *Catalyzer*. I really enjoy writing and taking pictures and hope our readers enjoy reading the magazine.

That's quite a lot. As the Scientific Committee head, what is your role?
It all started with setting up the author team, then discussing the topics, writing, and reviewing both the preparatory and competition problems and editing the problem booklets. During the competition, it continued with co-chairing the jury meetings, finalizing the tasks, and answering countless questions during the translations. In the upcoming days, I will be busy grading exam papers and finalizing the results.

How were the topics of each problem chosen? Were there any battles within your team?
One and half years ago (wow, I have just realized how time has flown since then!), we met for the first time and started discussing the topics. We wanted to relate them to our countries because we believe we have a lot to offer and people from all over the world do not know much about us. In the problems, you could learn about organic compounds contained in our national tree, minerals found in both countries, composition of our mineral waters, and about the famous anti-HIV drugs synthesized in the former Czechoslovakia.

How long did it take to finalize the problems?
As I have already mentioned, about one and a half years. After initial brainstorming, we started outlining the competition problems and then continued with the preparatory problems in order to cover all the advanced topics. After the publication of the preparatory problems at the end of January, we got back to the competition problems to polish them up. There were about twelve iterations for each problem. The record is held by Problem 8 (Caryophyllene), which had almost 30 iterations.

When presenting the problems to mentors, did you have to deal with any difficult ones?
The mentors were really nice and provided us with mostly positive feedback. In some cases, the mentors helped us to rephrase and finalize the problems.

IN YOUR WORDS

Tom Lacoma
France

How do you feel about the Theoretical Problems?
I found them quite difficult and long. Nevertheless, the problems were really interesting. Especially the organic chemistry task about mushrooms.

What was the trickiest part of the exam?
In my opinion, it was designing the right mechanisms and predicting the final product structures.

Was there anything surprising in the test?
I didn't expect the DNA task to be so long; there were about ten questions about DNA.

Filippo Bigi
Italy

How were the Theoretical Problems compared to the practical ones?
Both parts were too long and I didn't manage to finish either one. The Theoretical Exam was slightly more difficult. The problems were hard but were not impossible.

What was the trickiest part of the exam?
Surprisingly, it was the inorganic part dealing with complexes and their colours, because inorganic chemistry is my favourite discipline in chemistry.

Any lucky charm during the test?
We have a team mascot. It's a wolf reminding us of the founders of Rome.

Roan Behrends
Germany

How were Theoretical Problems compared to the practical ones?
I feel better about the theoretical part. There were really nice and interesting problems to be solved. Luckily, I finished almost all the tasks.

What was the trickiest part of the exam?
Organic chemistry was probably the most difficult part, but it was still manageable.

Was there anything surprising in the test?
There was a nice physical chemistry task in which we were supposed to calculate how long it would have taken to boil an emperor's dead body.

Students and guides left Bratislava and joined their mentors at the Reunion Party in Prague.

IChO ON THE MOVE

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ELECTROMOBILITY

THEORETICAL PROBLEM 3

Lithium spontaneously reacts with atmospheric N_2 to form Li_3N, which gives the element its greyish colour.

The transportation of people and goods is one of the most crucial sectors of the worldwide economy. However, transportation also consumes one quarter of the energy produced in the world today because of its reliance on fossil fuels. Thus, transportation is also responsible for one third of total global environmental pollution (especially solid dust particles, volatile organic compounds, CO_2, and NO_x).

The effectiveness of energy utilization from fuel in combustion engines is considerably low and does not exceed 40%. The development of combustion engines is limited by current levels of technology, because increasing the working temperature and pressure of engines further would inevitably lead to lower engine lifetimes and to higher emission of environmentally unfriendly NO_x. The future of transportation thus should be based on more ecological and effective means of creating the motive force of the engine. However, more massive spread of **electromobiles** is limited by their "childhood illnesses". Despite this, the major automotive manufacturers are now offering fully electrical cars. Current technology does not offer the possibility of using heavier oil products directly in **fuel cells**. Car fuel cells must use smaller molecules such as hydrogen or hydrazine as fuels.

SIMPLE-MOLECULE FUELS

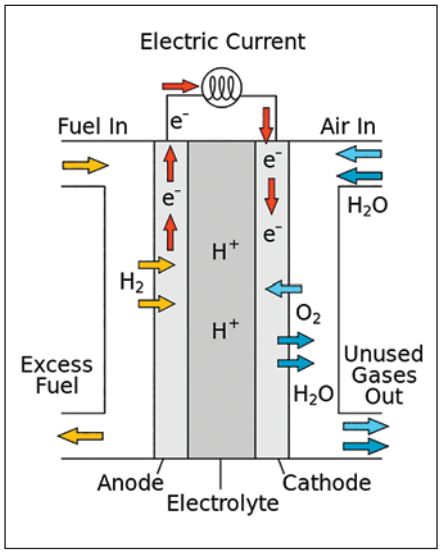
H_2 – Hydrogen gas
- Extremely high specific energy density
- Burning produces harmless water
- Storage safety risk
- Low effectivity of production by water splitting

N_2H_4 – Hydrazine
- Liquid state
- Burning produces harmless water and nitrogen gas
- Highly toxic

The above-mentioned facts lead to the domination of electrical drives over fuel cells. Current progress in the technology of batteries allows us to overcome limitations such as low capacity, high mass, and slow recharging. **Lithium-ion batteries** usually combine a graphite anode with cathodes made of a mixture of lithium oxides and cobalt (more expensive, higher capacity) or manganese (cheaper, less dangerous). Lithium ions migrate between the electrodes during the charging/discharging of the battery and incorporate themselves reversibly into the crystal structure of the electrodes. The key point is to use non-aqueous electrolytes, because lithium reacts with water quite vigorously.

Lithium and cobalt are both quite rare elements (20–30 ppm in the Earth's crust). That is the reason for searching for different battery platforms based on more readily available elements such as sulfur, silicon, and sodium. Such batteries are, however, limited at present by low conductivity of sulfur and reasonably high volume changes of silicon during the intercalation of charge carriers into its structure. Such factors should be eliminated via suitable nanostructure of electrodes (e.g., using graphene) or modifying the electrolyte (ionic liquids) to perfectly fit a battery design. Such hypothetical batteries should have significantly higher capacity and also considerably lower prices.

Radek Matuška
Ctirad Červinka

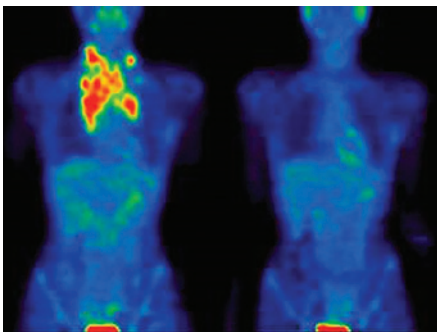


LITHIUM
- Silvery, soft, reactive, the lightest member of alkali metals family
- Name from Greek λίθος, translit. *lithos*, meaning "stone"
- Earth's crust content: 20 to 70 ppm by weight
- Manufacturing of lithium and lithium-ion batteries consumes more than three-quarters of the world's lithium production.
- Important reserves of Li (8,400 tons of pure metal) have recently been discovered in the Czech Republic.

POSITRON EMISSION TOMOGRAPHY

Ninety years ago, Paul Dirac predicted the existence of the positron. Four years later, in 1932, Carl D. Anderson used high-energy γ-radiation on various materials, creating an electron–positron pair. In 1936, he was awarded the Nobel Prize for this discovery.

Before examination, a patient is treated with a compound containing a positron-emitting radioisotope. The system detects a pair of photons which are formed by the annihilation of these positrons. The most commonly used compound is 2-deoxy-2-[^{18}F]fluorodeoxyglucose, which was the subject of Preparatory Problem No. 21. The advantage of the isotope ^{18}F is that the radioactive decay of the administered compound produces a non-radioactive product, ^{18}O-glucose. Most commonly, positron emission tomography (PET) is used to diagnose cancer. Cancer cells have high metabolic activity and they therefore take up more glucose and its fluoro derivative than healthy cells.



PET images of a patient with a cancer (left) compared to a healthy individual (right). (www.mudrvincent.cz/p-e-t-2)

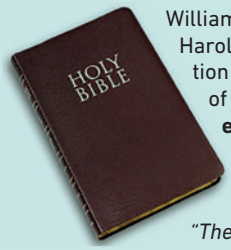
In addition to common radioisotopes such as ^{18}F and ^{11}C, some less common ones can also be used. A typical example of such a radioisotope is ^{64}Cu, which was set for use in PET already in 1951. Theoretical Problem 4 dealt with its preparation and separation. After that, the radioactive isotope is complexated with a strong chelating agent and the resulting complex is given to the patient. The basis of the experiment is the same as described above. Positron-emitting copper complexes can be used to diagnose diseases associated with copper metabolism.

THEORETICAL PROBLEM 4

ION-EXCHANGE MATERIALS

The first reports of research on ion exchange were the works of Englishmen H. S. Thompson (1850) and T. J. Way (1850). Way published a monograph describing ninety-six experiments, including some suggestions regarding the constituent of the soil that was responsible for ion exchange. After a period of experiments with clays, zeolites, and other inorganic ion exchangers, the first syntheses of ion-exchange resins were published in the first half of the twentieth century. Synthetic resins became much more popular than inorganic materials because of their numerous advantages (e.g., increased mechanical stability, uniform size, and enhanced exchange capacity). The most popular resins are styrene- and divinylbenzene-based crosslinked polymers, which can be further derivatized to get anion or cation exchange resins.

Pavel Řezanka
Kamil Záruba



William Rieman III and Harold F. Walton mention in the introduction of their book, **Ion exchange in analytical chemistry (1970)**, a different story:

"The earliest recorded application of ion exchange may have been the 'miracle' by which Moses rendered the saline water of the spring of Marah potable about 3,000 years B. C. (Exodus, 15, 24, and 25).
If the tree that Yahweh pointed out to Moses was dead and if part of its cellulose had been oxidized so as to form carboxyl groups, it is possible that the 'bitter' Epsom salt was removed by an ion-exchange reaction

$$Mg^{2+} + SO_4^{2-} + 2\ RCOOH \rightarrow (RCOO)_2Mg + H^+ + HSO_4^-$$

followed by a neutralization of the resulting sulfuric acid by deposits of limestone

$$H^+ + HSO_4^- + CaCO_3 \rightarrow CaSO_4 + H_2O + CO_2$$"

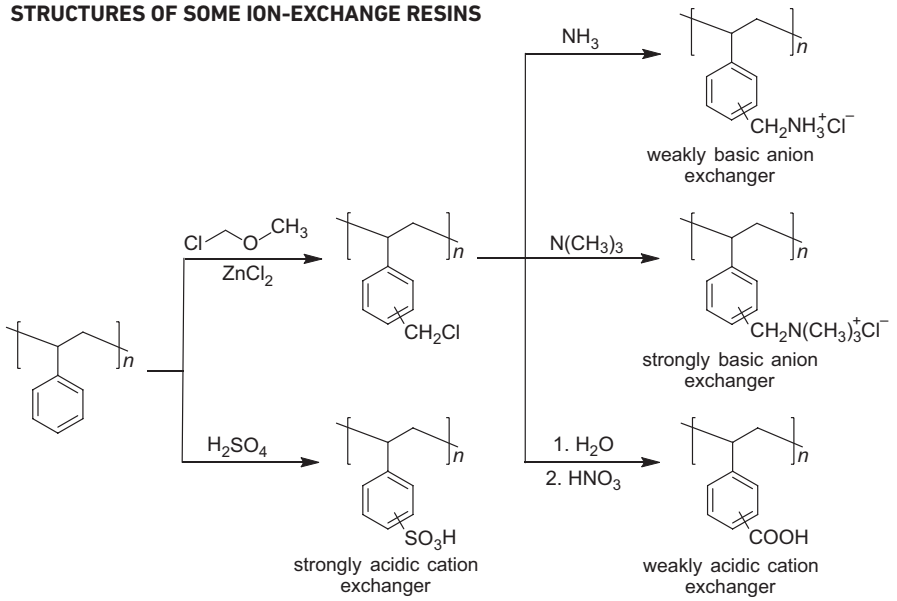
Industrial applications of ion exchange process

- Water softening (removing scale-forming calcium and magnesium ions)
- Deionization (both cation exchange resin and anion exchange resin are employed)
- Ion interchange (conversion of a product from one ionic form to another)
- Extraction of metals from ores

Analytical chemistry applications

- Ion exchange chromatographic separation of ions
- Removal of an interfering ion
- Glass pH-electrodes (ion exchange on the surface of a glass membrane)

STRUCTURES OF SOME ION-EXCHANGE RESINS



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ARGENTINA

1. We are proud of our great athlete: Messi, you rock!
2. The southernmost city in the world is Ushuaia. It's in a province named "The Land of Fire", but it's actually very cold (and cool).

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UNITED KINGDOM

1. The famous British thinkers, who played a crucial role in the development, not just of their nation.
2. Running was invented by Mr. Running, when he tried to walk twice as fast at the same time.

IChO NATIONAL TEAMS

TAJIKISTAN

1. Showing us their team spirit!
2. We used to be part of one of the greatest empires of all times, the Persian Empire.

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AUSTRIA

1. Performing their beautiful Viennese waltz. Cue the music!
2. We have a nuclear power plant which has never been used.

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BRAZIL

1. Football, the no. 1 sport in Brazil. Therefore, this is the way we save the day :).
2. J. Kubitschek de Oliveira, the driving figure behind the construction of a capital, Brasília, had Czech ancestors.

FINLAND

1. Practicing ski jumping while being observed by fans.
2. Even though the consumption of coffee per capita is the highest in Finland, none of us drink it.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

CZECH REPUBLIC

1. A typical Czech hobby: Stealing flags, for example.
2. What is cheaper in our country than water? Beer, of course :).

VENEZUELA

1. Hitting a home run using our mascot.
2. We have *arepa*! It's like a bread but different, because we use corn flour.

BULGARIA

1. Performing *Rachenica*, our national dance.
2. Our country has the oldest name among European countries.

CHINA

1. Teaching us their traditional way of showing respect.
2. Our most complicated character has 56 strokes. It's the name of a noodle called *biangbiang*.

IChO NATIONAL TEAMS

BELGIUM

1. *Manneken Pis*, a famous landmark found in Brussels, the capital city.
2. French fries are from Belgium, not France.

CROATIA

1. A traditional Croatian way of exiting Parliament.
2. Croatia has the highest number of *N*-benzyl-m-nitroaniline syntheses per capita.

SOLVAY'S QUARRY

For decades, Solvay's quarry was a significant supplier of quality limestone for chemical production. Limestone was mined regardless of political developments, continuing even during World War II. Since limestone was in high demand, mining technologies underwent many more modifications than some older mines had over several centuries. The transport of limestone also underwent interesting changes since limestone was not only transported by train or on hardened roads, but also underground and partially in the air, high above the crowns of the trees. The rich history of limestone mining and transport is presented in an open-air quarry museum. The quarry was opened to supply a factory in Neštěmice near Ústí nad Labem where soda was manufactured using the so-called Solvay process.

Solvay's method of soda production
Many people associate the word soda with baking soda, which is known for its soothing effects on stomach acid, or gastric reflux. However, soda has many more significant applications such as the manufacturing of glass, soap, paper, and textiles. The development of efficient soda manufacturing practices has had a substantial impact on the availability of numerous products. Thus, it is no surprise that chemists needed practically an entire century in order to identify the best production methods. The Solvay process was one of the most progressive methods and has been used up until the present.

The Solvay process (the ammonia-soda process) used for the production of sodium carbonate (Na_2CO_3) is based on the low solubility of sodium hydrogen carbonate ($NaHCO_3$) in water. The whole process is divided into several phases:

1. The solution of sodium chloride in water (brine) is saturated with ammonia (NH_3) in a so-called absorber.

2. The brine and ammonia mixture is carbonated with carbon dioxide (CO_2) in a carbonating tower to form poorly soluble sodium hydrogen carbonate and ammonium chloride (NH_4Cl) as its major byproduct:

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

3. The solution is cooled, which results in the crystallization of the less soluble sodium hydrogen carbonate which is then filtered, while the better soluble ammonia chloride remains in the solution.

APPLICATIONS OF SODA
Soda has a broad range of applications in both organic and inorganic chemical technologies. Soda is a basic raw material used in the production of glass, where it is used as a glass batch component; it plays an important role in the production of soap and chemical cleansers or cosmetic products. It is also used for softening hard water; this property was exploited in the design of steam furnaces and engines to prevent the formation of scale and corrosion. It has further applications in the textile industry, namely in spinning mills; bleaching plants and textile printing shops; in paper mills; during the manufacturing of viscose and nitrocellulose, sodium salts, ultramarine, and dyes; and in tanneries and other production shops. Similarly, its use is common in the food processing industry. In the Czech language, soda gave its name to carbonated water, known as *sodovka*, because carbon dioxide is produced together with other products by the decomposition of soda with the use of acids.

4. The produced sodium hydrogen carbonate is calcined (thermal decomposition at 150 °C) and transformed into sodium carbonate. Carbon dioxide and water are generated as byproducts. Simultaneously, 50% of the original amount of carbon dioxide is recovered and recycled back into the carbonating tower:

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

5. The ammonia chloride generated during the second phase reacts with calcium hydroxide ($Ca(OH)_2$), or slaked lime, is transformed back into ammonia, which returns to the production phase:

$$2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + CaCl_2 + 2\,H_2O$$

What is the role of limestone?
Limestone consists of calcium carbonate which, when heated, breaks down to form carbon dioxide used during phase 2, and calcium oxide, commonly known as quicklime, which is used to obtain slaked lime for the regeneration of ammonia. First, limestone is heated in lime kilns (thermally insulated ovens) at high temperatures to undergo decomposition and form calcium oxide and carbon dioxide:

$$CaCO_3 \rightarrow CaO + CO_2$$

Calcium oxide reacts with water to form calcium hydroxide (slaked lime):

$$CaO + H_2O \rightarrow Ca(OH)_2.$$

Lucie Pražáková

THE SECRET STORY OF THE GOLEM

PART 8

TO BE CONTINUED TOMORROW...

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SEMTEX

A CZECH EXPLOSIVE WITH A CONTROVERSIAL PAST AND PROMISING FUTURE

There are legends about its properties and its name. Thanks to Hollywood blockbusters, Semtex is synonymous with plastic explosives. Since the 1950s, newsworthy Semtex has been developed and manufactured at a single location in the world: The Czech factory Explosia, in Semtín.

At the beginning of the history of Semtex in 1954 there were two researchers, Stanislav Brebera and Radim Fukátko, tasked with developing an efficient and safe explosive which could be manufactured cheaply from domestic sources. The result of their work was a brick-red, plasticine-like, waterproof substance whose properties were preserved at temperatures ranging from –40 to +60 °C. Its detonation speed of over 7 km/s was impressive, as was its ability to resist impacts, fire, and even submachine gun penetration. Thanks to its unique properties, Semtex rapidly became a very demanded commodity in other Eastern Bloc countries. A very similar explosive, called C4, appeared at the same time in the United States. However, we´ll probably never know for sure if it was the result of successful espionage during the Cold War or just a lucky coincidence.

The increased popularity of Semtex—together with its uncontrolled export to several countries—began to take its toll. Another remarkable property of Semtex became apparent: It was virtually undetectable by security devices at the time. This resulted in a Boeing 747 explosion over the Scottish town called Lockerbie in 1988, probably the most infamous terrorist attack associated with Semtex. This and other events damaged its reputation, resulting in a temporary, complete international sales ban in 1989. Volatile nitrate esters were added to the explosive as a detection taggant (marker). Even though the destiny of Semtex was uncertain for a long time, its reliability and versatility eventually carried it through troubled waters into the twenty-first century.

Semtex is currently manufactured in many designs developed for different applications. One of them is a "sheet Semtex", resembling a thick sheet of paper, used as an explosive for hardening metallic materials. The shockwave produced can make particularly stressed parts of steel products such as railroad crossings up to four times more durable. Other versions of Semtex have found their application in explosion welding, precise cutting of steel girders, and in underwater blasting works. Its reputation has also rectified thanks to police bomb squads and rescue workers, in whose hands Semtex products can even save lives. Very popular, for example, is a portable breakthrough frame that allows for an instantaneous "cut" or opening through a ten-inch concrete wall, behind which the victims of a catastrophe may be. Finally, it truly seems that there are no a priori good or bad inventions, but it always depends primarily on us and how we utilize them.

Jan Havlík

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CATALYZER 9

THE NINTH ISSUE OF CATALYZER MAGAZINE 27/07/2018

PRAGUE IN THE REIGN OF RUDOLF II

Let's go back in time and visit the city of Prague during the second half of the 16th century. The Czech Lands were ruled by Emperor Rudolf II, a member of the House of Habsburg. During his reign, Prague became Europe's cultural and artistic center.

The emperor himself was an ardent lover of art. Known for his collecting mania, he gathered everything from pictures, statues, to clocks as well as various other curiosities. In his day, his grand art collections were truly unique and incomparable in size to any others. They became the corner stone of many present day European galleries. Emperor Rudolf II even rebuilt part of the Prague Castle to create more space for his ever growing collections. He invited painters and sculptors to Prague as well as goldsmiths, who were ordered to create his own crown jewels.

Rudolf II was not just renowned as a passionate art collector, but he also an enthusiast in alchemy, astrology, and occult sciences. The Imperial Court attracted scientists and fraudsters from all around the world. The alchemists were looking for the philosopher's stone, the elixir of eternal youth, and a way to turn non-precious metals into gold. The most famous conman was the English alchemist Edward Kelley, who was said to have turned mercury into gold right in front of the emperor's eyes. Some contemporary historians argue that Kelley was actually an agent for Queen Elizabeth I. As Rudolf's weakness for alchemy and sorcery was universally known, Kelley's task was to sneak into the emperor's favour.

It is important to mention that alchemists, though often swindlers, were also mostly renowned as healers. They mixed herbal elixirs and potions which sometimes had real healing powers. They are rightfully considered the predecessors of today's pharmacists.

Astronomers and astrologists Tycho Brahe and Johannes Kepler were also significant members of the Imperial Court. Brahe thought that the Earth was the centre of the universe, orbited by the Moon and the Sun, with other planets orbiting the Sun. Kepler, in contrast, was an advocate of Copernicus's heliocentric theory. He is most renowned for creating the laws of planetary motion.
While we are introducing important personalities from Emperor Rudolf's court, we mustn't forget Jan Jesenius, a physician and anatomist who, in 1600, was the first person ever to perform a public autopsy.

At the end of our journey through Prague during the rule of Rudolf II, we leave the Imperial Court behind and visit the Jewish ghetto. The end of the sixteenth century was marked by frequent attacks on local Jews, so Rabbi Loew created the Golem, an artificial human fashioned out of clay, brought to life by a small piece of paper (*shem*) with mysterious writing inserted into his mouth. The Golem helped protect Jews against all enemies. He was growing stronger and stronger and eventually, people got scared of him. The wise Rabbi saw that the Golem was doing more harm than good and pulled the shem out of his mouth. Legend says that the Golem is still hidden in an attic in the Old New Synagogue.

In 2002, Prague was hit by hard floods which caused the collapse of the basement ceilings in the Rabbi Loew House in the Old Town. By complete accident, a secret alchemist's workshop dating back to Rudolf's era was discovered. The room contained original equipment, old recipes for potions, and even one small bottle with its original contents. The discovered alchemist's workshop was restored and is now open to the public as part of the Museum of Alchemy.

Petra Ménová


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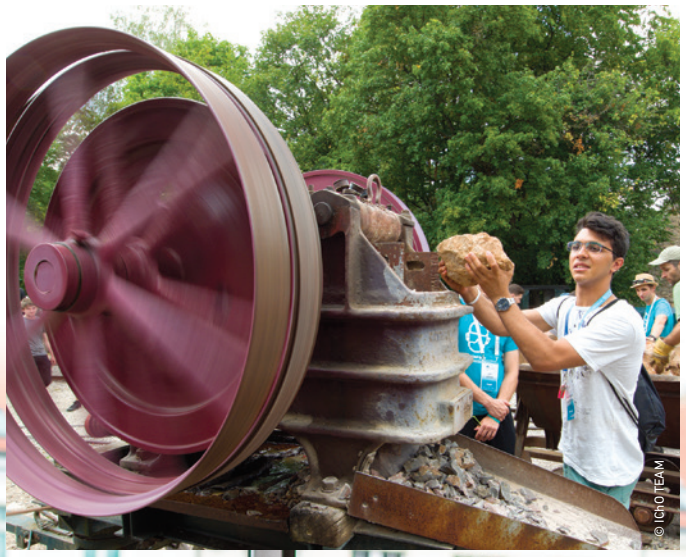
MARKING VS. EXPLORING

While students were enjoying sunny weather in Solvay's Quarry, their mentors and the authors of problems were working hard at their hotel in Prague marking all exam sheets shipped from Slovakia. Each sheet was double-checked by a collective of authors and the sheets were given two sets of marks, red and green. Guessing from their thoughtful facial expressions, it was not always easy to grade the partial answers fairly. Let's hope markings will be arbitrated smoothly among the authors and mentors today.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Any scientific nomenclature is a language, although to some extent artificial. The priority is to make the terms specific, even if this means that their forms are not entirely natural.

100 YEARS OF THE MOST ARTICULATE CHEMICAL NOMENCLATURE

The naming of inorganic compounds relies on expressing atomic ratios and oxidation numbers. Numeric prefixes (such as in *dinitrogen pentoxide*) or explicit numerals (such as in *dilead(II) lead(IV) oxide*) seem inevitable. However, even in English, we find examples that a different approach is also possible. In the old days, *copper(I)* ions were called *cuprous* and *copper(II)* ions were *cupric*. In other words, oxidation numbers were expressed indirectly, encoded in a proper suffix. Unfortunately, *-ous* and *-ic* had to be recycled for various oxidation numbers. While *cupric* meant *copper(II)*, *ferric* was *iron(III)* and *ceric* was *cerium(IV)*. Finally, this limited approach was obviously inadequate for elements that have more than two oxidation states.

The Czech and Slovak advantage

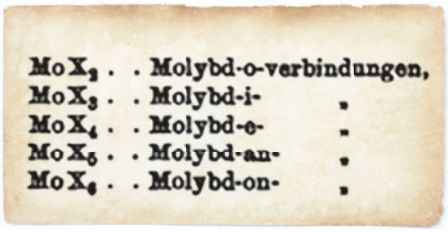
Compared to English, our languages are much richer in word inflection, but also in the formation of new words through morphological derivation. For instance, we can take the word "wood" and add different suffixes to form several distinct adjectives meaning *made of wood, made from wood, resembling wood*, and so on.
Indeed, this is a perfect linguistic environment for sustaining a suffix-based nomenclature that could not be sustained in English. Our languages are used to giving many flavours to the same word, and we also have enough adjectival suffixes to support a suffix system that is not limited to differentiating just two oxidation states of an element.

Linguistically seamless and chemically precise

In our nomenclature for inorganic chemistry, we have one suffix firmly assigned to each oxidation state. From the suffixes for cations, we also derive the suffixes for the anions of oxidoacids. Numeric prefixes are only used when it is necessary to explicitly state how many atoms of a certain element are present.
The names are usually very simple, yet informative. In English, to write a formula for *calcium nitrate*, you must know that *calcium* implies *calcium(II)* and *nitrate* is *nitrate(V)*. In our system, both oxidation numbers are understood from the suffixes in the two words of the name.
Importantly, our approach is not incompatible with IUPAC recommendations. Even though the core of our nomenclatures remains traditional, it has been continuously extended in line with the most up-to-date international rules; we simply omit the tools that others need to specify oxidation numbers.

The German version that never took off

We rarely think about it, but the unique suffix-based system of Czech and Slovak nomenclatures for inorganic chemistry is the only one of its kind in the entire world today. The system is so efficient and so firmly established that it has resisted all pressures to replace it with more international versions.
Interestingly, in 1913, a system similar to ours was also proposed in Germany. Each oxidation state was assigned a morpheme, e.g. VCl_3 and PCl_3 would be called *vandichlorid* and *fosfichlorid*, whereas VCl_5 and PCl_5 would be *vanadanchlorid* and *fosfanchlorid*. However, the proposal never gained traction; in 1913, it was already too late for such a dramatic reconstruction of the existing nomenclature.

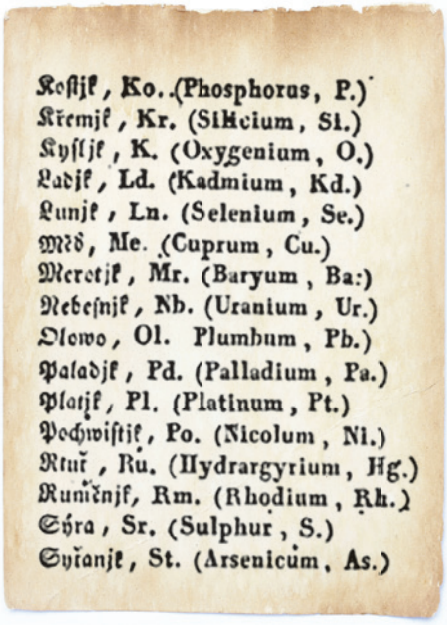

MoX₂ . . Molybd-o-verbindungen,
MoX₃ . . Molybd-i- "
MoX₄ . . Molybd-e- "
MoX₅ . . Molybd-an- "
MoX₆ . . Molybd-on- "

How the nomenclature got its suffixes

Our first system distinguishing various ratios of elements in compounds through suffixes dates back to the 1820s, when our scientific language was born. In chemistry, many essential domestic terms are mostly attributed to Jan Svatopluk Presl. He established our words for *acid*, *solution*, *compound*, and *analysis*. He also created our own domestic names for several elements.

Presl also established the first suffix-based nomenclature. Luckily, the system also survived the dramatic changes that happened in writing chemical formulae. When symbols of elements started denoting atoms rather than equivalents, water became H_2O instead HO; NO_3 was reformulated as N_2O_3, and so on. Finally, Alexandr Sommer Batěk and Emil Votoček proposed the final revision of the suffix system, sorting out all the mess that has accumulated over the years. Their suffix system became normative exactly 100 years ago, and it has been used almost unchanged until today.

Erik Szabó


Koſtjk, Ko. (Phosphorus, P.)
Křemjk, Kr. (Silicium, Si.)
Kyſljk, K. (Oxygenium, O.)
Ladjk, Ld. (Kadmium, Kd.)
Lunjk, Ln. (Selenium, Se.)
Měd, Me. (Cuprum, Cu.)
Meretjk, Mr. (Baryum, Ba:)
Nebeſnjk, Nb. (Uranium, Ur.)
Olowo, Ol. Plumbum, Pb.)
Paladjk, Pd. (Palladium, Pa.)
Platjk, Pl. (Platinum, Pt.)
Pochwiſtjk, Po. (Nicolum, Ni.)
Rtuť, Ru. (Hydrargyrium, Hg.)
Rumčnjk, Rm. (Rhodium, Rh.)
Sýra, Sr. (Sulphur, S.)
Syřanjk, St. (Arsenicum, As.)

TRY IT YOURSELF

1. As an example, take one of the salts $CsMnO_4$, Na_2CrO_4, $Ce(NO_3)_4$, $CoCO_3$. (These were chosen to minimize secondary grammatical phenomena.)
2. Identify the oxidation numbers of the atom that is the cation and the central atom of the anion.
3. From the Czech names of the elements (Cs *cesium*, Mn *mangan*, Na *sodík*, Cr *chrom*, Ce *cer*, N *dusík*, Co *kobalt*, C *uhlík*), find their word-forming root by removing any *-ium* or *-ík* suffixes.
4. Combine the roots with appropriate adjectival suffixes, according to the oxidation number: I *-ný*, II *-natý*, III *-itý*, IV *-ičitý*, V *-ičný*, VI *-ový*, VII *-istý*, VIII *-ičelý*.
5. To derive the noun for the anion, replace *-ý* or *-ový* with *-an*.
6. Put the noun of the anion first and the adjective of the cation second.

manganistan cesný, chroman sodný, dusičnan ceričitý, uhličitan kobaltatý

LATVIA

1. Many young people prefer communicating through memes rather than using a traditional lexicon.
2. Our national food is grey peas with pork fat. We know it sounds awful, but we also eat bread with cabbage.

GEORGIA

1. Drinking imaginary Georgian wine at an imaginary Georgian feast called *supra*.
2. Every time *Tamada* (the host) drinks, you have to drink as well.

IChO NATIONAL TEAMS

ROMANIA

1. Playing a popular game of cards, *Război Egiptean*.
2. The biggest building in Europe is called *Casa Poporului*, located in Bucharest.

CHINESE TAIPEI

1. We are playing baseball, our national sport.
2. We encourage you to come to Taiwan and try some stinky tofu.

PAKISTAN

1. Playing cricket, our favourite sport in Pakistan.
2. There's a common stereotype that we speak Arabic, but we don't. We speak Urdu. We also have the second tallest mountain in the world, K2.

SLOVAKIA

1. Showing us the world famous Slavic squat.
2. There is a high school in Slovakia where they have already collected over 20 IChO medals.

1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

KAZAKHSTAN

1. Imitating our national bird, the berkut.
2. The first man in space was launched from Baikonur, situated in our country.

SYRIA

1. At every wedding, we dance *dabke.*
2. Our ancestors invented the first musical notation as well as the first alphabet.

Deformed dodecahedral symmetry of the crystal structure is manifested in the habit (characteristic external shape) of garnet crystals.

BOHEMIAN GARNET

Bohemian garnets are among the most favourite gemstones; their fiery red colour is caused by chromium impurity and is highly appreciated. In mineralogical terms, Bohemian garnet is classified as pyrope (from Greek "πῦρ + ὤψ" – "fiery eye").

THEORETICAL PROBLEM 5

Garnet was described by Pliny and is also mentioned in the Bible: Noah used a garnet lamp in his Ark. As early as the fifth century, garnets in our territory were collected and traded by the Celts. Garnets were given their name "Bohemian" – **granatus bohemus** – by Anselm Boetius de Boot, the personal physician to Emperor Rudolf II. In that period, garnets also became more frequently used in jewelry.

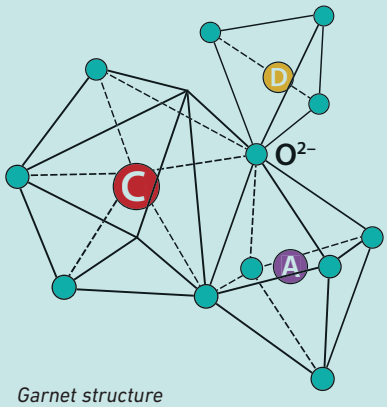
Before this time, garnets were collected on the surface and shipped to Germany for processing, but during the reign of Rudolf II, their mining and processing in the Bohemian Kingdom began. Underground mining of garnets was first described by Georgius Agricola. Industrial processing of garnets got a significant boost with edicts given by the Empress Maria Theresia and her son Josef II. In the second half of the eighteenth century, they forbade the export of extracted garnets for processing in foreign countries. Gem cutting workshops were established near the garnet mines. In the nineteenth century, garnet deposits began to be depleted and the size of extracted stones decreased to 1–5 mm. In jewelry, garnets were accompanied with almandines and, by the end of the nineteenth century, glass imitations of garnets and bijouterie appeared. In the Middle Ages, garnets were used chiefly to adorn liturgical objects (e.g., the coronation cross of the Bohemian King Otakar II). Since the eighteenth century, the popularity of Bohemian garnet jewellery **(1)** began to rise, especially after 1815, when the Russian Grand Duchess Elizabeth Alexeievna wore Bohemian garnet jewels at the Vienna Congress.
During the Czech National Revival movement in the nineteenth century, Bohemian garnet became a symbolic national gemstone. The then newly-founded National Museum collected the world's greatest collection of raw garnets and objects decorated with them.
The typical colours of garnets are the results of transition metals cation impurities, e.g. Fe^{II} and Cr^{III} in red pyrope and Ti^{IV} and Fe^{III} in reddish brown almandine.

Synthetic garnets are used in various fields of optical applications. Their chemical composition is different than natural silicate garnets. The crystal structure is the same, but the fundamental composition only contains two cations—e.g., $Y_3Al_5O_{12}$ (abbreviated as **YAG**). This garnet was one of the first to be prepared as a monocrystal by growth from the melt. It was also used as a diamond substitute in jewelry, before it was replaced by zirconia.
In the 1960s, after having been doped with various ions, YAG began to be used in optics. The first was $[Y, Nd^{III}]_3Al_5O_{12}$, used in laser technology. Other lasing garnets appeared quickly afterwards including $[Y, Er^{III}]_3Al_5O_{12}$ and $Gd_3[Ga, Cr^{III}]_5O_{12}$, among others.
An important group of synthetic garnets consists of Ce^{III}- or Nd^{III}-doped $Y_3Al_5O_{12}$ or $Lu_3Al_5O_{12}$ that are used as outstanding scintillating materials: They manifest luminescence after having absorbed electrons or high energy photons. Ce^{III}-doped garnets are also used in phosphor-based white LEDs (blue InGaN LED combined with yellow-green $[Y, Ce]_3Al_5O_{12}$ luminophore). These materials have been prepared in the form of transparent ceramics in recent times. This kind of ceramics is polycrystalline, but the grain boundaries are so perfect that they do not disperse light. When seeing this kind of material, it is hard to believe that it is not glass, but ceramics instead **(2)**.

Kateřina Rubešová, Vít Jakeš

GARNET MEANS...

The word "**garnet**" is used to name a group of minerals with a similar chemical composition ($X^{III}{}_3Z^{III}{}_2(SiO_4)_3$; X = Ca^{II}, Fe^{II}, Mn^{II} or Mg^{II}; Z = Al^{III}, Cr^{III} or Fe^{III}). All of them have the same crystal structure and, consequently, minerals of intermediate composition occur naturally as well. The well-known members of this group are **pyrope** (**Bohemian garnet**, $Mg_3Al_2Si_3O_{12}$) and **almandine** ($Fe_3Al_2Si_3O_{12}$); others are: **spessartine**, **uvarovite**, **grossular**, and **andradite**.
The typical colours of garnets are the results of transition metals cation impurities, e.g. Fe^{II} and Cr^{III} in red pyrope and Ti^{IV} and Fe^{III} in reddish brown almandine.



Garnet structure

Mushrooming is heartily embraced by Czechs and Slovaks (in contrast to many other countries), as was already stated in the introduction to Theoretical Problem 6. The species mushroomers mostly pick are boletes, parasol mushrooms, brittegills, chanterelles, and milkcaps. However, among chemists, inedible–or even poisonous–mushrooms are much more popular due to the content of many interesting biologically active compounds.

LET'S GO MUSHROOMING!

THEORETICAL PROBLEM 6

In the Problem, you already became acquainted with the inky cap and false morel. You learnt that the **inky cap** (*Coprinus atramentarius*) **(1)** is, on one hand, edible and delicious; but, on the other hand, the metabolites of the compounds contained in it are capable of inhibiting the enzyme alcohol dehydrogenase. Thanks to this, when alcohol is consumed along with inky caps, it usually results in a severe sickness.

False morel (*Gyromitra esculenta*) **(2)** is classified as inedible in our country. By contrast, in Scandinavia, this mushroom is commonly sold in marketplaces accompanied by a warning that it needs to be cooked properly (otherwise, it remains toxic).

During cooking, gyromitrin is hydrolyzed to *N*-methylhydrazine, which boils away thanks to its relatively low boiling point (87.5 °C), and the mushroom becomes non-toxic. When false morels are cooked in a poorly ventilated space, *N*-methylhydrazine vapours can accumulate in the room, and false morel poisoning may manifest itself even without having eaten the mushroom.

The most poisonous mushroom in Central Europe, commonly found also in North America, is called the **death cap** (*Amanita phalloides*). This mushroom contains hepatotoxic oligopeptides named phallotoxins and amatoxins. Amatoxins are absorbed particularly easily into the bloodstream, from where they get to the liver. However, the initial symptoms of intoxication do not manifest themselves until a larger number of liver cells are damaged, which can occur up to 48 hours after mushroom consumption. The most common antidote for intoxication is silibinin, a hepatoprotective flavonoid isolated from milk thistle (*Silybum marianum*).

Fools webcap (*Cortinarius orellanus*) is a very interesting mushroom as well. Despite being deadly poisonous, it was considered edible until 1958. Intoxications have a long latent period though, from two days to three weeks. Therefore, it took quite a long time to find the causal link between the symptoms of the fools webcap intoxication and mushroom consumption. The active compound of this mushroom is pyridine alkaloid orellanine, which is nephrotoxic and causes kidney failure. It is noteworthy that this alkaloid contains *N*-oxide moiety in its structure, owing to which it is explosive in pure form.

Clathrus is a genus of fungi into which many interesting mushroom species fall. Most of them produce a slime with the typical revolting smell of spoiled meat. It is caused primarily by sulfur compounds (sulfane, methanethiol, sulfides, and polysulfides), phenylacetaldehyde, or by monoterpenes linalool and *trans*-ocimene. A representative of this genus is **devil's fingers** (*Clathrus archeri*), a mushroom that resembles a red flower or an octopus and which is very rare here (its homeland is Australia, from where it was brought into Europe). Another representative is the **common stinkhorn** (*Phallus impudicus*). This mushroom, as its Latin name indicates (its literal translation is "a shameless penis"), resembles an erect penis in appearance.

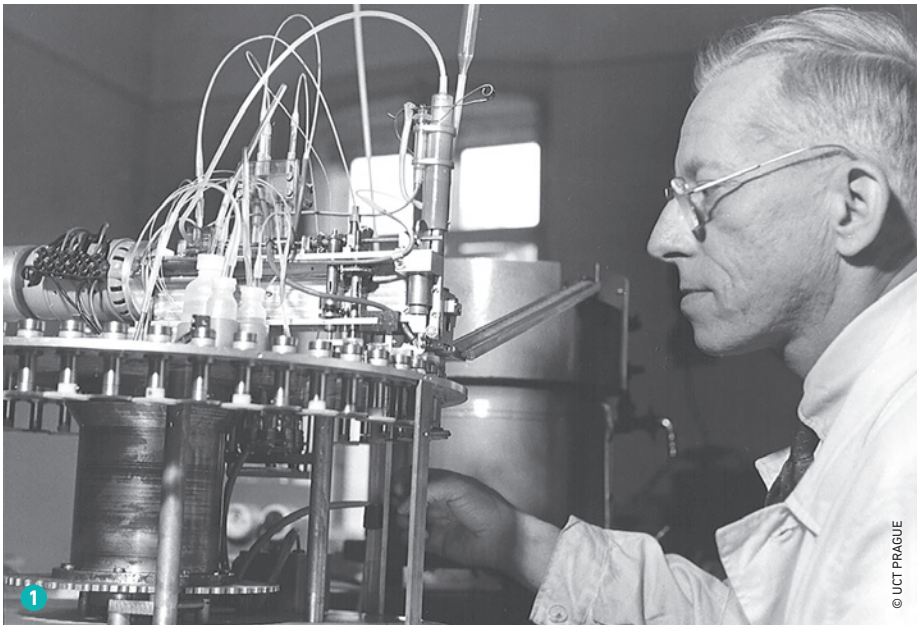
Unfortunately, there is no more space left for any other remarkable mushrooms in our Problem or in this essay. Therefore, there is nothing left to do now but to set out for the woods!

Ondřej Šimůnek

Creative improvisation is a bit of a Czech national sport, as evidenced by the incredible popularity of "how to" shows. However, this handyperson spirit isn't limited to mundane gardening and home improvement; it permeates even scientific endeavours all the way up to nuclear physics.

WHO IS BEHIND THE BIG

Perhaps the most famous Czech scientist, acclaimed for his novel ideas, was **Otto Wichterle** (1). This macromolecular chemist, together with many innovations in developing artificial fibers, became famous as the inventor of soft contact lenses, now used by millions around the world. The lesser-known part of this success story is that he made his first contact lens centrifugal caster prototypes at home in the kitchen during the Christmas holidays. For these, he used a Merkur children's construction set (think metallic LEGO with little screws instead of pegs) and a dynamo from his son's bicycle. When the dynamo started to be too weak to power the ever upscaling lens caster, Otto switched to a stronger motor scavenged from a gramophone. This machine made over 5,000 contact lenses.



Another open thinker was physical chemist **Jaroslav Heyrovský**, interested in the electrochemical analysis of solutions. As he was attempting to determine the trace amounts of ions in a solution, he was often annoyed by the contemporary solid electrodes, which were prone to rapid degradation in the analyzed solutions. Not only did that affect the readings, also polishing them was a chore. If only there was an electrode with a self-renewing surface! And he created just that, in the form of a glass capillary filled with slow-dripping mercury. When he and his Japanese colleague, Masuzo Shikata, made an improvised automatic and highly sensitive analyzer—the polarograph—a new analytical method was born, resulting later in the Nobel Prize for Chemistry (1959).

Even Czech religious figures were in love with scientific experimentation. A Catholic priest, **Prokop Diviš**, who experimented with electricity in many fields ranging from electric musical instrument to medicine, made several not yet fully recognized discoveries. Six years before Benjamin Franklin, in 1754, he erected the first functional lightening rod in his backyard. Unfortunately, Central Europe was experiencing an unusually dry summer, and the superstitious villagers in his town ended up destroying the "machine that had dispersed the clouds". Lightning rods, strange weather, and a mob of angry villagers...doesn't that evoke some well-known movie scenes?

The Augustinian abbot, **Johann Gregor Mendel**, was also not recognized in his lifetime. Behind the walls of his monastery—after reading Darwin's *Origin of the Species* and allegedly proclaiming "That's not all; something's still missing!"—Mendel patiently devoted himself to crossing pea varieties and observing their offspring. Based on his observations, he formulated the concepts of Mendelian inheritance. Perhaps because of his use of mathematics and statistics in biology or because the chromosome had not yet been discovered, Mendel's contributions were not recognized until years after his death.

The resourceful Czechs learned to crossbreed more than just pea plants. They also experimented with dog breeds—not for their love of experimenting or the desire to create a sabre-toothed bruiser with the nature of a dove, but for laboratory purposes. The scientist behind the idea was František Horák, a Czech cynologist who crossbred two mongrel dogs of unknown origin, both of which were property of the Institute of Physiology at the Czechoslovak Academy of Sciences in Prague. The wolf grey Riga and the three-coloured Míša begot 9 puppies, two of which were selected for further crossbreeding. The new breed was named the Bohemian Spotted Dog or **Horák Laboratory Dog** as it was first intended only to serve medical and genetic research purposes. The second focal point of their research was to monitor the heredity of missing teeth. This dog was also the first live being to receive a kidney transplant in a test surgery in Czechoslovakia. Later on, the breed became popular among the public, although it has not been accepted by the international cynology authorities.

Two Czech contributions to medicine are textbook examples of serendipity. Psychiatrist **Jan Jánský**, for example, played a leading role in investigating possible connections between mental diseases and blood types. After many years of demanding research with 3,160 patients, he came to the conclusion that there is no correlation between mental diseases and blood type, but noted, in a 1907, report the existence of four blood groups. While Jánský himself did not conduct further research into blood types as he was more interested in psychiatry, his classification was later confirmed and remains in use to this day, enabling effective blood transfusions and saving countless lives.

Another case of an experiment showing surprising, unanticipated benefits is 2-deoxy-2-fluoroglucose (^{18}F-FDG). This molecule, synthesized for the first time by a group of Czech chemists, was originally intended as a treatment for tumours. However, it was deemed unsuitable for this original purpose and has since, as ^{18}F-FDG, been used in PET imaging.

Jan Havlík, Petra Ménová

Only a handful of people know that many inventors have their roots in Slovakia. Even though some of the inventors had to face difficulties and naysayers in the course of their work, they succeeded in the end and helped shape our world into what it is today.

INVENTIONS IN HISTORY

DISCOVERY OF THE PRINCIPLE OF REACTIVE FORCE

Johann Andreas Segner's greatest discovery, which entered the history of physics forever, is referred to as the Segner Wheel (1735), a type of water turbine. In principle, water is delivered to the top of a cylinder, at the bottom of which is a rotor with pipes bent in the same direction. The ejected water causes the rotor to rotate in the opposite direction with the use of the reactive force of water. This discovery laid the foundation for today's designs of water turbines, rockets, and sprinklers.

OIL MAGNATES WOULDN'T MAKE DO WITHOUT HELL'S INVENTION

Jozef Karol Hell, a Slovak mining engineer, invented the water-pillar, a kind of a water pumping machine used today for oil extraction. When only twenty-five years old, he built his first wooden water pumping machine. It could extract 200 litres of water per minute from depths of around 80 meters. This marvelous invention revolutionized the mining industry, being the first pumping machine to use compressed air as its power source. The first recorded use of this machine was in Pennsylvania, where it was used to pump oil from great depths. The same principles are still used today in oil fields all around the world. Nowadays, these pumping machines do not use compressed air, but instead use compressed natural gas as their power source.

A PIONEER IN ELECTRICAL ENGINEERING

Štefan Anián Jedlík, an inventor, physicist, engineer, and Benedictine priest, brought circa seventy-six inventions to the world. To name a few of his accomplishments, he invented an electromagnetic rotating device, which he called "lightning-magnetic self-rotors", and the first electric motor, comprised of three main components: A stator, a rotor, and the world's first mercury commutator. In the prototype, both stationary and revolving parts were electromagnetic, which was another first. In the 1850s, he invented his most brilliant creation, the dynamo (3), four years before Werner Siemens, its so-called inventor. Because Jedlík did not patent his creation, Siemens was given credit for this invention.
Another of his inventions was a soda making machine, which was later used in 1841 to serve soda drinks in the very first soda fountain. Jedlík foolishly did not publish or spread the results of his research and only built machines for regional demonstrations. Because of this, the soda making machine was sadly the only of his inventions to have industrial application during his lifetime. He is the author of a physics book, *Tentamen publicum a physica* (1845).

A MAN WE CAN THANK FOR SELFIES

Jozef Maximilián Petzval (3), a physicist, mathematician, and inventor, is the father of modern photography. In 1840, he invented a lens used in photography which enabled a picture to be taken in less than a minute compared to the usual waiting times of fifteen to thirty minutes. His work didn't end there: He made an optical mechanism used to this day in astronomy and cinematography. Parts of his inventions are still used in today's digital cameras.

3

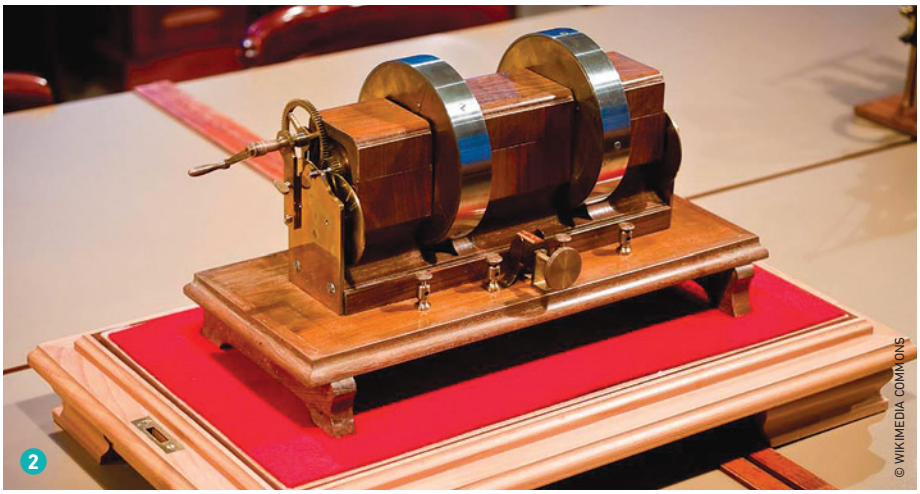
ADMIRED EVEN BY ALBERT EINSTEIN HIMSELF

Aurel Stodola, a university professor, Einstein's teacher, engineer, and inventor, was a pioneer in the area of technical thermodynamics and its applications. He is most well-known for his book, *Die Dampf-turbine* (The Steam Turbine), released in 1903. Another of his inventions is the world's first electric driven vapour recompression plant. It heats the Geneva City Hall to this day by extracting and heating water from a nearby lake.
With the help of German surgeon F. Sauerbruch, Stodola was able to design and build a prosthetic hand capable of motion. The principle was later widely used in the creation of prosthetic legs and feet, later replaced only with the advent of 3D printing and microelectronics.

THE FIRST RADIO WAS MADE BY A SLOVAK

Jozef Murgaš was an inventor, architect, botanist, painter, and Roman Catholic priest. Shortly after migrating to the United States in 1896, he received his first two patents: *Apparatus for wireless telegraphy* and *The way of transmitted messages by wireless telegraphy*. In 1907, he built two radio antennas in Wilkes-Barre and Scranton which were later used in a huge experiment testing the ability to transfer spoken words over twenty miles between towers. This accomplishment was noticed by both T. Edison and T. Roosevelt, who later visited him in his lab.
In his other hobby, fishing, he received another patent, *Spinning reel for fishing rod*. He was known as the "Radio Priest."

Henrieta Stankovičová, Jana Chrappová



2


WHAT A FOOLISH THING TO DO, BOYS. BUT SO BRAVE. THANK YOU.


COME ON! LET'S GET IN!


PROFESSOR! WE DID IT!

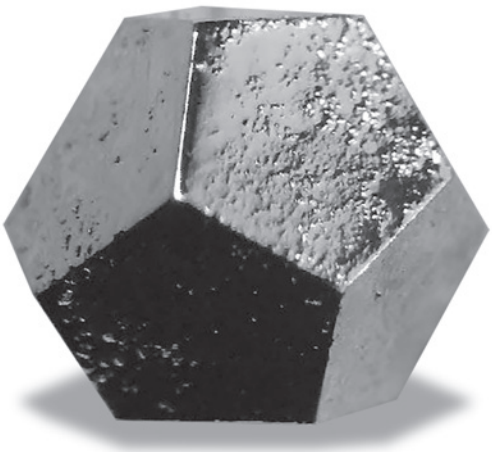

GOODBYE PROFESSOR. I LIKED YOU A LOT.

PART 9

TO BE CONTINUED TOMORROW...

For a long time, scientists did not believe that they could exist: Structures which are regularly ordered but are not periodic. 2D-tiling (with similar properties) was first discovered by mathematicians. After that, quasiperiodic crystals were predicted to exist. In 1982, they were discovered by **Daniel Shechtmann**, whose scientific career was almost ruined as a result. Quasicrystals represent an incredible connection between mathematics, physics, chemistry, art, and scientific stamina; their discovery earned a Nobel Prize in 2011.

QUASICRYSTALS



Due to a 5-fold inner symmetry, a Ho-Mg-Zn material forms quasicrystals in a regular dodecahedron shape. This is impossible for common crystals such as pyrites or garnets, which form crystals of only approximate dodecahedron symmetry.
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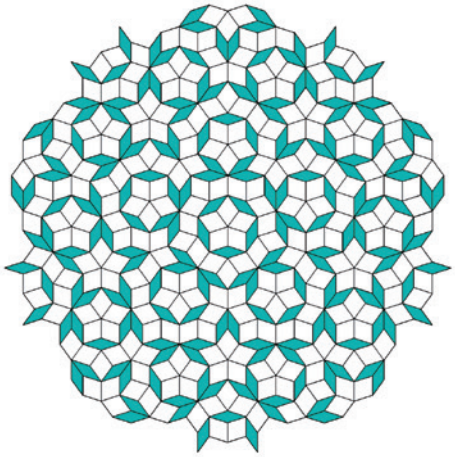
CRYSTALS
- Exhibit translational symmetry in all three dimensions
- Symmetry defined by a unit cell
- Possess only 2-, 3-, 4- and 6-fold rotational symmetries

QUASICRYSTALS
- Do not exhibit translational symmetry at least in one dimension
- No unit cell exists
- Possess "forbidden" 5-, 8- or 10-fold rotational symmetries

Daniel Shechtman (left) explains the atomic structure of a quasicrystal (1985).

WAY TO THE NOBEL PRIZE
1963 – Scientists discover it is possible to tile a surface with aperiodic tiling in an organized way. However, they do not come up with the best solution, because they need more than 20,000 different tiles.
1974 – Roger Penrose discovers a set of just two tiles enabling the non-periodic tiling of a plane. Penrose tiling, the tiling named after him, was made of two different rhombic tiles. It exhibits 5-fold symmetry.



1975 – Alan Mackay proves experimentally that Penrose tiling provides a diffraction pattern with the "forbidden" 5-fold symmetry.
1982 – Daniel Shechtmann observes a 10-fold diffraction pattern during a routine investigation of a rapidly cooled Al-Mn alloy. He hesitates to share his results for two years. He gets a basic textbook of crystallography from his colleagues, who remind him that 10-fold symmetry is not possible.
Since 1984 – Hundreds of quasicrystals with various compositions and different symmetries have been reported, thus proving Shechtmann's discovery. Quasicrystals conquer the world.
1992 – The definition of the crystal changes, accepting the possibility of an aperiodic arrangement.
2009 – The first natural quasicrystal, icosahedrite, is observed in a meteorite from the Khatyrka River in eastern Russia.
2011 – D. Shechtmann is awarded the **Nobel Prize** for the discovery of quasicrystals.

PROPERTIES AND USE
The first observed quasicrystalline materials were thermodynamically unstable, rapidly cooled alloys (natural quasicrystals of a meteoritic origin belong to this class). After heating, they formed regular crystals. Later, in 1987, the first of many stable quasicrystals was discovered and it opened the door to possible applications. Due to their electronic structure, most quasicrystals have ceramic-like properties: low thermal and electric conductivity, hardness and brittleness, resistance to corrosion, and non-stick properties.
Low friction Al-Cu-Fe-Cr quasicrystalline material has been used as a coating for non-stick frying pans. The surface is ten times harder than stainless steel and can withstand temperatures up to 1,000 °C. However, cooking with plenty of salt causes etching of the coating. Dan Shechtman himself has one of these pans.

DNA
Already in 1944, Erwin Schrödinger thought of how information could be stored at the molecular level. A periodic crystal can be encoded with a small piece of information. Amorphous solids are too chaotic. Thus, a crystal should have an aperiodic structure bearing information. In 1953, the structure of DNA was discovered by Watson and Crick. Although not crystalline, it met Schrödinger's prediction, being both regular and aperiodic.

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 10

THE TENTH ISSUE OF CATALYZER MAGAZINE 28/07/2018

THIS YEAR'S IChO IS VERY CREATIVE

Interviewing I-Jy Shang, the President of Steering Committee, and discussing her point of view on the Olympiad slowly coming to its end.

© T. BELLON

From what you have seen so far, how do you feel about IChO 2018?
The atmosphere has been very nice. Having two hosting countries together with the cooperation of the universities in Prague and Bratislava was an excellent idea. This idea had been developing for a couple of years, and thanks to Petr Holzhauser (CZ) and Martin Putala (SK), it has all come into being.

Have you noticed any major difference between this IChO and previous events?
The European style differs from the Asian one quite a lot. Actually, I like it this way. To me, it is very creative. For example, for the first time, the Reunion Party became a public event, making it a festival.
Also, it was smart to engage science enthusiasts from not only the previous years of IChO. They all know the process and understand the philosophy of IChO, which makes them perfect guides, authors, and organizers. The jubilee year also brought with it many innovations such as the new IChO flag; the original logo; and Copperhead, the mascot.
You know, if the jubilee 50th IChO was held in any Asian country, I would expect it to be more formal; more distinguished guests would come to the Opening Ceremony, for example. Instead, it was managed and celebrated in a more relaxed way; at the Opening Ceremony, we were shown the history of IChO.

How do you find the level and sophistication of the Practical and Theoretical Problems? Can one say the difficulty remains stable?
Oh, it varies a lot! IChO difficulty always goes up and down, depending on the host country. The limit points in the table of results usually tell you about the level of the exams. Neither a too low or too high score is good. For example, in the case of Russia, the cut-off to win the gold medal was about 56 percent in contrast to the result of over 90 percent obtained in a different organizing country where the problems appeared to be easier. This year I'm guessing it will be a golden mean, about 80 to 85. Although the problems were not too demanding, they were very long and the students were short on time.

How would you evaluate the work of the Scientific Committee? Were there any problems you had to deal with during the preparation period?
As I already mentioned, most of the authors had participated personally as students, thus they understand how the jury rules. You see, at some Olympiads, we were discussing the problems throughout the whole night, even until 6 A.M.; in Prague, however, we were lucky to reach the final decision by midnight. Once an author is too stubborn and the jury overrules his or her demands, there is nothing to be done about it and it is difficult to go on, because the person is offended.

Which part of this year's itinerary impressed you the most? It was a reasonably good programme. I particularly enjoyed the Wednesday trip to Kutná Hora.

(To be continued on the next page)

(Continuing from previous page)
I love food and here we tasted traditional Czech cuisine. Delicious roast duck was served. Usually it comes with beer, but I am not a beer person. Actually, I like the Czech herbal liquor, Becherovka.

Would you like to pass any message to the students, their guides, and their mentors?
Students, enjoy yourselves! Build new friendships from across the world. You never know who or where you are going to meet again. I would be happy if this experience persists in your memory. I know the students' schedule is tight, but I would like to encourage the guides to show the students some local treats. For example, in Taiwan, guides would take the students to a night market.
It is important to remind the mentors that many rules based on previous experience had been summarized in the IChO Regulations and Guidelines. We highly encourage the mentors to go through the materials to avoid unnecessary discussions. Last but not least, I would like to remind mentors that medals aren't the main goal. They're just one of the many stops on the students' journeys.

What's your vision for the future of IChO?
I had already been thinking about this while preparing for the Opening Ceremony. I believe we can improve by implying modern technology. The next generation is bringing up more new ideas and we should involve them in the preparations.
Also, I have the idea of starting a new extra concept of a competition of mixed nation teams which would deal with complex problems, preparing the students for their research careers. It's due to the fact that nowadays, IChO is mostly didactic and is not oriented enough towards research practice.

One could notice a majority of male participants. How can we possibly increase the number of young female scientists?
That's a wonderful question! In Taiwan, about seven or eight years ago, we encouraged girls to participate in science competitions. Some countries claim there should be a girl on each team. I believe it is a matter of encouragement. The more we support the girls, the more they study, the more interested they are, and gradually they become very good.

Did you expect any fights?
Unfortunately, mentors sometimes do not understand the concept right. They fight about issues which should not be even discussed. It is very tiring. I believe this is not going to happen this time.

How do you deal with simultaneous work on IChO and your research?
It took me time to learn to divide my time between IChO and research. I try to manage both; nevertheless, sometimes I have to focus more on one and then catch up on the other one.

You mentioned early that one of the purposes of IChO is playing fair and making new friendships. Can you say your expectations were fulfilled?
According to their busy itinerary, I believe students had plenty of opportunities to make new friends and discover new cultures. These are also the main principles of our Olympiad.

Elizabeth Lensmith, Marek Lanč

GENTLE WAR OF WORDS

Since the students' sheets had already been marked by authors (Scientific Committee) and mentors on Thursday, Friday was the day reserved for arbitration.

Here mentors had a unique opportunity to fight and negotiate for their students in case they doubted the authors' markings. By entering the room where the arbitration took place, one could see a turquoise army of authors defending the amount of points they had given to the students against the mentors. Delegations were invited to discuss the problems one-by-one at separate bases for each problem with soldiers in blue. There are two possible scenarios. In the first, mentors agree with the results and sign a special protocol with the committee. In the second, mentors disagree with the results, thus a passionate discussion is unavoidable. Even though the discussion was sometimes quite heated, with some people using their voices and others gesticulating trying to win the fight, most issues were resolved tactfully.

IN THE ARMS OF PRAGUE

The hard work is over. Students had free time to enjoy beautiful historic landscapes and sightseeing in Prague while resting before the Closing Ceremony.

© IChO TEAM

AZERBAIJAN

1. Showing us their fun dance, *yalli*.
2. In Azerbaijan, the "Land of Fire", we have mud volcanoes that shoot out mud instead of molten lava. Azerbaijan actually has 60% of the world's mud.

© IChO TEAM

CYPRUS

1. We are sleeping in the photo because we sleep a lot indeed.
2. According to the picture, would you believe that Cyprus has the best nightlife in Europe :)?

IChO NATIONAL TEAMS

IRELAND

1. One of our national symbols is a clover.
2. Something special? We've won Eurovision the most times!

© IChO TEAM

NEW ZEALAND

1. Showing the traditional *Haka* dance.
2. Because of time zones, we are the first to greet the New Year.

© IChO TEAM

ICELAND

1. Doing VÍKINGAKLAPPIÐ (Húh!)
2. We have the highest number of Nobel Prizes per capita. But guess what...we have just one!

MONTENEGRO

1. Being lazy is a common stereotype about our country.
2. You can swim in the south of Montenegro, then travel north, which takes around 2 hours, and ski on our mountains.

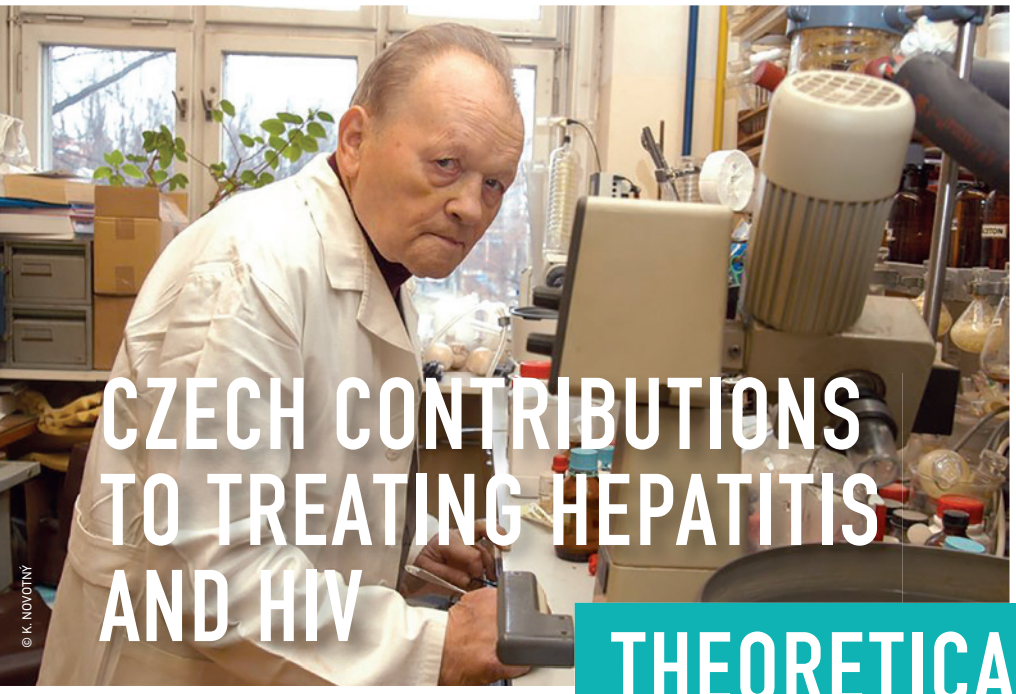
1. We asked teams to snap an original, fun photo and explain it.
2. We also asked: What's something about your country others usually do not know?

PERU

1. Posing with our mascot and popular animal, a guinea pig.
2. Guess what? We also eat them :).

SERBIA

1. Posing like Novak Djokovic, celebrating.
2. During the 14th century, the Serbian Empire was the strongest and biggest in Europe.



© K. NOVOTNY

CZECH CONTRIBUTIONS TO TREATING HEPATITIS AND HIV

Antonín Holý (1936–2012)
Professor Antonín Holý was one of the most successful Czech scientists. With more than 80 patents, more than 750 co-authored papers, and over 12,000 citations, he is one of the most successful chemists in the world. He was nominated for the Nobel Prize in Physiology or Medicine. His greatest achievements include the development of Duviragel (to combat herpes), Hepsera (to treat chronic hepatitis B), and Viread, which significantly slows the progression of AIDS.

THEORETICAL PROBLEM 7

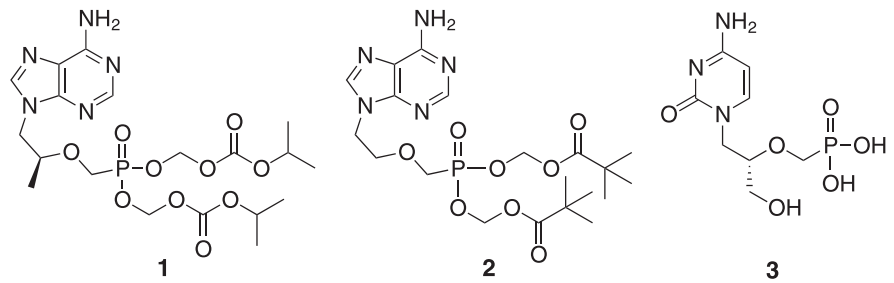
Viral infections are today one of the greatest threats to human health. More than 250 million people are infected with the hepatitis B virus and over 36 million people worldwide have HIV. Together, the viruses kill 2 million people each year.

More than half of the patients infected with HIV or hepatitis B around the world are treated with medications developed by Czech chemist Antonín Holý. At the Czech Academy of Sciences' Institute of Organic Chemistry and Biochemistry (IOCB), Holý synthesized analogues of nucleic acids that fight viral infections.

Holý was a committed scientist whose motto was "stay in the lab and work". He did not like to attend conferences and did not recommend them to his students either. Despite this, he met Belgian physician and biologist Erik De Clercq at a conference in Göttingen, Germany. The two scientists began a collaboration, with De Clercq testing the antiviral compounds Holý had developed. The results showed that the antiretroviral drugs were almost miraculous.

Despite the excellent results of biological testing, bringing the drugs to the world's markets was not easy. In the 1980s, it was not possible in the then Czechoslovakia or across Europe to find investors in the over half a billion dollar drug development project. In the end, licensing was acquired by Bristol-Meyers. After two intensive years of testing, Bristol-Meyers merged with a competitor who was not interested in continuing the project. However, an American Holý trusted—John C. Martin (former Bristol-Meyers director of antiviral chemistry)—was, and moved the project to the biotechnology company Gilead Sciences. Today, Gilead Sciences is one of the ten most profitable pharmaceutical companies in the world, and John C. Martin is one of its most profitable managers. Holý's institute in Prague received a substantial contribution from the patents and it is now one of the wealthiest institutes in the world. Its resources are devoted primarily to basic research and modernization of its facilities.

- **Tenofovir disoproxil fumarate (Viread™)** (1) was launched in 2001 and is one of the most effective anti-AIDS drugs employed across the globe.
- **Truvada™** is a combination of tenofovir and emtricitabine. With it, patients take one tablet daily instead of 13. Another combination drug is **Atripla™**, which contains Efavirenz™ in addition to tenofovir and emtricitabine.
- **Adefovir dipivoxil (Hepsera™)** (2) was originally developed as an anti-HIV drug but large doses can cause significant damage to the kidneys. Instead, the drug has proven itself in the treatment of hepatitis B, which requires significantly lower doses than for anti-HIV therapy.
- **Cidofovir (Vistide™)** (3) was also originally developed for anti-HIV therapy, but today is used to treat cytomegalovirus infections.



1 Tenofovir disoproxil

2 Adefovir dipivoxil

3 Cidofovir

Holý's antiviral agents are inhibitors of reverse transcriptase, an enzyme that transcribes viral RNA into double-stranded DNA, which is subsequently integrated into a host cell chromosome. Reverse transcriptase inhibitors are nucleotide analogues which compete with natural nucleotides for a site in newly synthesized DNA. Unlike the natural nucleotides, the antiviral agents don't allow further phosphodiester binding, thus stopping the assembly of the DNA strand. Once the nucleotide analogue gets incorporated into the newly synthesized DNA (either of viral or host origin), the synthesis will immediately stop. Without the ability to retrosynthesize DNA, the retrovirus can't add its genetic material into host cell chromozome.

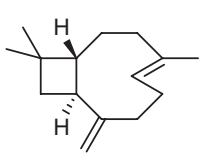
Petra Ménová

THEORETICAL PROBLEM 8

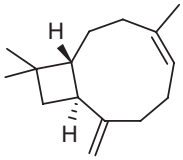
CARYOPHYLLENE

© 123RF

You have already met β-caryophyllene (1) in Theoretical Problem 8. This naturally occurring sesquiterpene has a unique structure: it contains a cyclobutane ring fused in a *trans* manner as well as an endocyclic *trans* double bond. In nature, this compound is almost always accompanied by its isomer, isocaryophyllene (2).



β-Caryophyllene
(1)



Isocaryophyllene
(2)

These two isomers are very difficult to separate and thus, the total synthesis represents one of the reasonable approaches to obtaining pure β-caryophyllene.

In 1964, Corey introduced the first total synthesis of β-caryophyllene starting from cyclohex-2-en-1-one.
In Problem 8, you became familiar with a more general synthetic route, published by Corey in 2008.

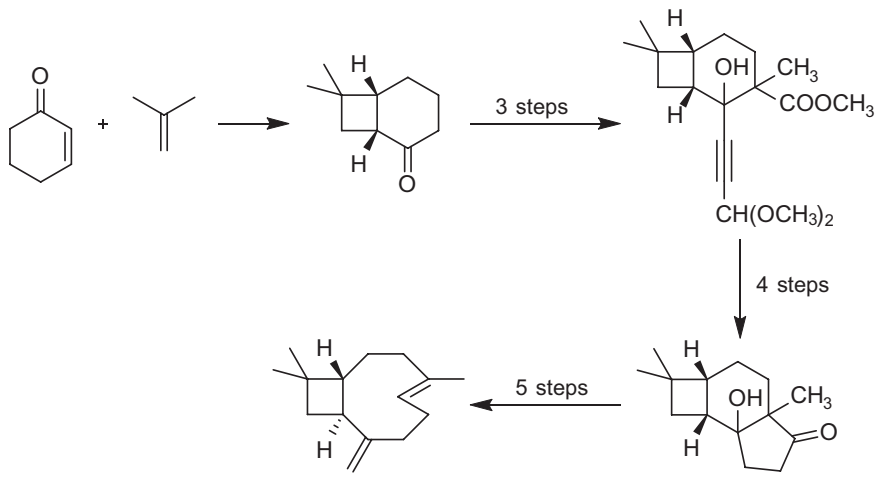
The most abundant source of β-caryophyllene is the clove tree, but you can find it in many other herbs such as cannabis, basil, rosemary, and oregano. Alongside with piperine, β-caryophyllene is also responsible for the spiciness of black pepper. Last but not least, it occurs in some traditional Czech and Slovak plants, such as hops and small-leaved linden.

Linden – Czech & Slovak national tree
Since time immemorial, linden and oak trees have been worshipped for their longevity and sturdiness by the Indo-Europeans as sacred trees. In the region of Central Europe, the oak tree was traditionally linked with the Germans, while the linden tree was linked to the Slavs. This distinction became apparent at the Prague Slavic Congress in 1848, where both Czechs and Slovaks chose the linden as their national tree.

Hops – Czech "green gold"
The **common hop** (*Humulus lupulus*) is a perennial, dioecious climbing plant which only climbs clockwise. Hops, listed in the same family as cannabis, are among the oldest cultural plants and were first cultivated in the region of the Czech Republic already in the ninth century. The extract of hops, female flower clusters, is used in brewing because it provides beer its characteristic bitter flavour and aroma. Czech hops as well as Czech beers are considered to be the best in the world. Thus, hops are often considered by Czechs to be "green gold".

Ivana Gergelitsová

Total synthesis of β-caryophyllene starting from cyclohex-2-en-1-one.



β-Caryophyllene (**1**)

Small-leaved linden (*Tilia cordata*) is a leaved deciduous tree with distinctively heart-shaped leaves. It is native to European deciduous forests, to central Russia, and to the Caucasus. Linden is widely grown as an ornamental, shade, and melliferous tree and is also planted for its wood. The oldest small-leaved linden in the Czech Republic is approximately 850 years old. Linden-blossom herbal tea contains a number of active substances and is widely used in traditional medicine. It promotes sweating and thus acts as an antipyretic. It is also used to aid cold and cough sufferers. The leaves, scalded with boiling water and mixed with wine, are used as poultice for burns and muscle spasms.

The motive of a linden leaf decorates the back side of the 50th IChO medals.

Artistic show or a sequence of exothermic chemical reactions? Whether you are watching these beautiful effects from one side or the other, they warm you up, in either case.

CHEMISTRY OF FIREWORKS

Fireworks, invented in China, are traditionally associated with rituals and celebrations. Praguers celebrated this New Year's official fireworks with more than two thousand pyrotechnics effects and special effects in the national colours manufactured in Italy, a country where the European sky was illuminated by fireworks for the first time. It was a spectacular show. However, it was incomparable with the world record from 2016. That New Year, the Philippines presented a fireworks show with more than 800,000 effects.

The beginnings of fireworks were enabled by the invention of gunpowder (black powder), a mixture of potassium nitrate, sulfur, and charcoal. Black powder was the core substance of fireworks till modern times, and nowadays it is still used for fuse cords, propellants, and fuel. What is the status of pyrotechnics in the 21st century? Efficient burning requires a minimum dependency of the reaction on air oxygen. Inspired by the unique composition of black powder, the pyrotechnic mixture contains fuel, mostly powder metals (e.g., magnesium, aluminum, magnalium, iron, or zirconium), and an oxidant. The proper choice of an oxidant can optimize the intensity of expected effects. The traditional decoration of the Czech Christmas tree, the sparkler, is oxidized by barium nitrate, bonded together by organic glue (e.g., dextrin) with powder aluminum and iron. More efficient oxidants, such as perchlorates, in combination with powder metals, result in an intensive flash followed by an enormous sound effect.
It happens due to a pressure wave created from depression after cooling and condensation of flue gas from the explosion. Chlorine-based oxidants are beneficial for colour effects because these oxidants decompose to chlorides of flame colouring metals. Flame colour is related to the emission spectrum of atomized elements in the flame, and chlorides are one of the most volatile among the substances of used metals. When working with fireworks, one must be aware of many more specifics about the materials used, such as their grain size, stability, catalytic behaviour (e.g., copper or lead), and burning rate or pH (chlorates or permanganates can self-ignite during storage due to acid in the flowers of sulfur).

Fireworks are a fascinating discipline combining chemistry, technique, empiricism, and aesthetics. Nevertheless, as an audience, no matter if chemist or not, we should think about where the boundaries between the aesthetic benefit and the number of toxic particles that we have to put into our air should lie.

Jan Havlík

STRONTIUM

CALCIUM

COPPER

BARIUM

SODIUM

VÁCLAV HAVEL (1936–2011)

Václav Havel is one of the best known Czechs abroad. He was an author, a playwright, an opponent of Communist oppression, and a political prisoner who became President of Czechoslovakia after the fall of the Iron Curtain.

BEGINNINGS AS AN AUTHOR
Václav Havel grew up in a family of intellectuals and entrepreneurs. He wasn't allowed to study for political reasons, so he received a vocational training as a lab technician and graduated from high school via correspondence classes. He was fond of literature, especially poetry, from a young age. Influenced by his family tradition (his uncle was a famous film producer), he originally wanted to work in film. After his army service, he began working in the Prague experimental theatre *Na zábradlí* as a stagehand. In the 1960s, he was one of the influential authors of Czech absurd theatre. After becoming a successful playwright, he was able to study at the Academy of Performing Arts. The central theme of his early plays was the study of human identity in an environment of totalitarian regime mechanisms.

DISSIDENT, DEFENDER OF HUMAN RIGHTS, AND WORLD-FAMOUS AUTHOR
After the Warsaw Pact invasion of Czechoslovakia in 1968, the already renowned writer was pushed out of the cultural scene as well as public life. But he did not give up creating. For a short period, he was employed in a brewery, which inspired him to create his one-act play, *Audience*, where he presented his most popular character, Ferdinand Vaněk, to the world for the first time. He had introduced himself as an outstanding publicist and essay-writer already in the early '60s, but he developed this genre in his social criticism pieces of the '70s and '80s. In his 1975 *Open Letter to Gustav Husák* (the then President of Czechoslovakia), he analyzed the state of a society governed by fear, resignation, and hopelessness under the pressure of impending totalitarianism. The pinnacle of Havel's essayist creation is *The Power of the Powerless* (1978) in which he analyzed the all-powerful regime with no democracy even more poignantly. All his works from this era were banned–and paradoxically, Václav Havel's art became well-known abroad sooner than at home.

The activities of the opposition in which he participated culminated in the publication of the Charter 77 initiative. All it demanded from the Communist government was to comply with the international agreements on human and civil rights it had signed. As one of the founders of the Charter, Václav Havel became public enemy number one in his home country. In 1979, he was sentenced to prison for his convictions and anti-regime opinions. He was released from prison after four years, in 1983, with severe pneumonia. Health issues plagued him the rest of his life. Under the tough conditions of Communist prison, he wrote his most important book, *Letters to Olga*. The apparently private letters addressed to his wife evolved into still deeper reflections on hope, art, faith, and philosophical meditations on the essence of being and the meaning of life.

In the 1980s, Václav Havel was perceived as the non-formal leader of the Czechoslovak opposition at home and abroad, and as such, he was under constant surveillance by the secret police. Regardless of this, he managed to bring to the attention of the West the violation of human and civil rights in our country with his essays.

LEADER OF THE VELVET REVOLUTION
In early 1989, Václav Havel was imprisoned once more. After his release, he initiated the petition, *A Few Sentences*, with a group of friends. The list of demands by the public to respect civil rights was signed by thousands of people. The Communist regime escalated its repression, and tension in society grew even more. After the armed forces intervened brutally against a peaceful student march on 17th November 1989, Havel


© O. ŠKÁCHA

became leader of the political movement Civic Forum, which called for democratic changes without violence, with wide support from the public. The events of the "Velvet Revolution" led to the collapse of the Communist regime in Czechoslovakia and, at the end of 1989, they elevated Václav Havel into the position of President.

PRESIDENT OF THE REPUBLIC
The first priority of the new President was to get Czechoslovakia back on the political map of the world, which he managed perfectly. However, it wasn't possible to maintain the shared state of Czechs and Slovaks–their differing ideas about the constitutional arrangement culminated in 1993 with the peaceful dissolution of Czechoslovakia into two independent states, the Czech Republic and the Slovak Republic.

The Czech President's priority then became the integration of the newly emerged state into Western security and political institutions. Václav Havel contributed greatly to the membership of the Czech (and even Slovak) Republic in the North Atlantic Alliance and later, the European Union. His presidency was marked by a continuous interest in culture, human rights, and the support of political prisoners and persecuted minorities in the world. Even while he held the highest office, Václav Havel never stopped being a writer. He wrote all his unusual, often philosophical speeches himself–in total, about 230 of them.

DEFENDER OF HUMAN RIGHTS AND AUTHOR UNTIL THE END
When his presidential mandate ended, he did not leave for any international organization, but returned to his original profession of playwright and author, and he dedicated himself fully to the defence of human and civil rights, especially in those countries that shared a similar historical experience with totalitarianism in his own country. He concluded his artistic career in 2007 with a play, *Leaving*.

The story of Václav Havel is unique on the global scale. He received hundreds of international and Czech awards for his dramatic, literary, and political works as well as approximately fourty honorary doctorates from prestigious universities around the world.

The Parliament of the Czech Republic passed a law in 2012 stating: "Václav Havel served freedom and democracy".

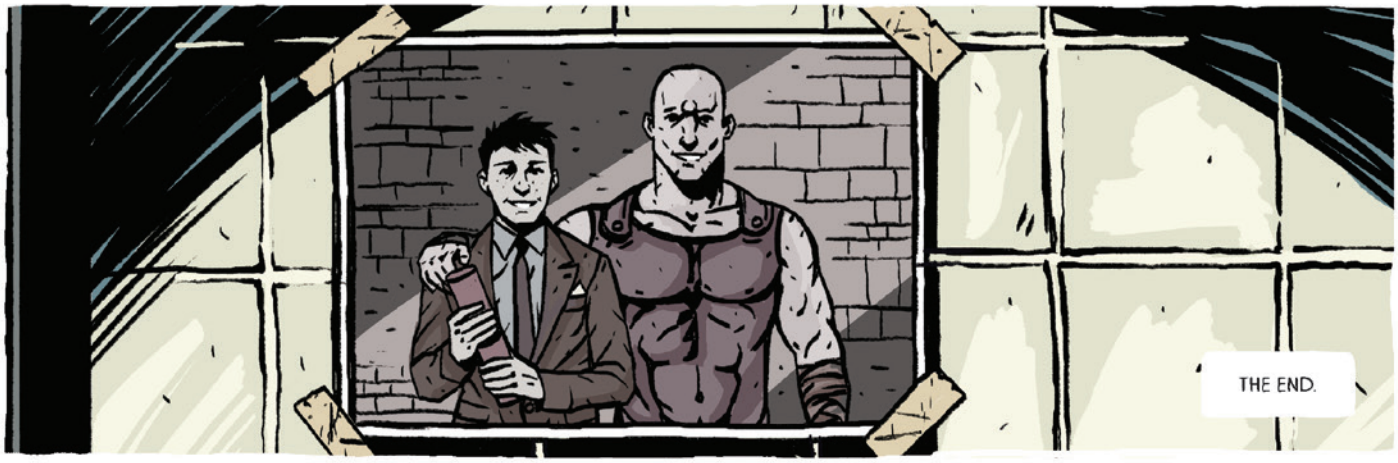
Vaclav Havel Library

THE SECRET STORY OF THE GOLEM

PART 10


AND THAT'S ABOUT IT, REALLY...
LACHOUT


LET'S GO ON WITH THE TOUR, ALL RIGHT?


THE END.

WE INVEST NOT ONLY IN THE FUTURE OF THE CHEMICAL INDUSTRY

Interview with Mr. Tomáš Herink, a member of Unipetrol's Board of Directors

Where is the refining industry heading? Isn't it endangered by efforts to restrict the use of fossil fuels?
The refining industry, which includes oil refining and the subsequent manufacture of oil-based products, is far from being just about fuels. Its important component includes petrochemistry that particularly involves producing monomers, which are used to manufacture most plastics. In light of the growing plastic consumption trend, petrochemistry will continue to develop for at least several decades without any significant changes.

Recently a lot has been written about the investment in and the construction of a new polyethylene unit (PE3). What are its advantages and benefits?
The latest production technology of the new unit will use two reactors to produce polyethylene with bimodal molecular distribution, so-called bimodal polyethylene, which will help us to improve product quality, e.g., its tenacity and flexibility. Compared to current technologies, this will give us many more options to modify the properties of the final product so we will be able to provide a better product designed according to the needs of our customers.

What can the manufactured polyethylene be used for?
Any manufactured polyethylene either high- or low-density has many applications. In fact it is the base material for manufacturing plastic products such as packaging, bottles, canisters, pipes, composters, and transport boxes. The properties of polyethylene vary significantly according to its particular use and production method, e.g., injecting, blowing, or press moulding.

What are the advantages of the newly introduced manufacturing technology?
Because we have our own petrochemical research institute—the Polymer Institute Brno—we can develop and implement new manufacturing procedures in a way that is most convenient for our customers (e.g., a combination of various types of catalysts, production conditions, and additives). So we don't develop new types of plastics but rather we develop various product modifications to best suit our customers' needs according to their manufacturing technologies and expected features of their final products. Therefore, we have already been quality-oriented for many years. With the new polyethylene manufacturing technology, we will intensify this focus even more.

Let's restrict my original question to fossil fuels. Do they still have a future?
Because of the enormous amount of consumed fossil fuels their use in the next several decades is obvious but even now there are many alternatives. The most well-known are 1st generation biofuels. Today they are called conventional biofuels and they include fuels made of rapeseed oil and palm oil such as biodiesel and bioethanol manufactured by fermenting sugars from cane, maize, potatoes, grain, etc. Other alternatives are 2nd generation biofuels, which are now called advanced biofuels, manufactured from non-food biomass or types of waste. Used cooking oil is probably the best example. We systematically research and test all available alternative fuel admixtures, including even using waste plastics and tyres.
But back to your question. If you review a list of all the alternatives and their availability, you will find that even with a combination of all current sources there is no complete alternative to fossil fuels today. Try to count how much biomass you need to produce a litre of fuel or what is the production of used cooking oil that can be relatively easily and efficiently converted to fuel. It clearly follows that even if you combine all the currently available sources conventional fuels will play a major role for at least the next 20–30 years. A full-value replacement is not yet available, and even electromobility is not a substitute. And as with any alternative, it requires an analysis of the amount of manufacturing and the source at which it will be meaningful. With electromobility, the question is how many batteries need to be produced to have all cars with electric drive. If we omit the fact that they include precious metals, the sources of which are not unlimited, and even if we leave out the environmental aspects of disposing of so many used batteries, we cannot ignore the fact that the power energy structure is not ready for everyone to recharge his or her car every day. Fossil fuels are still far from being a thing of the past.

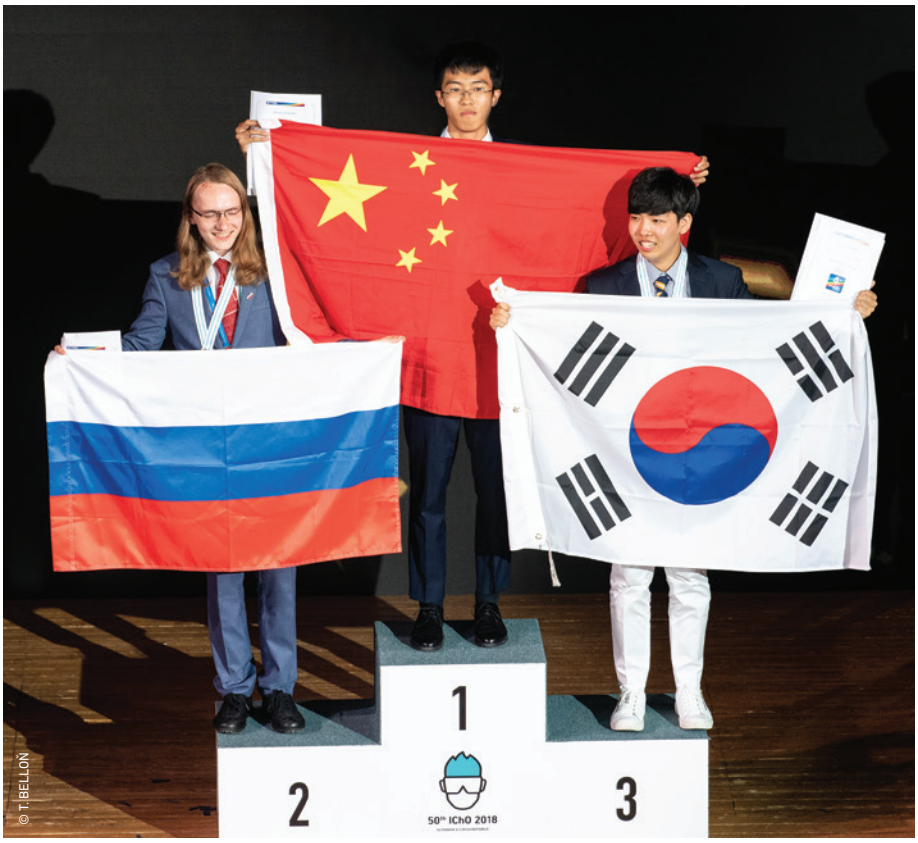
So the future of conventional fuels is not yet endangered?
Alternatives will increase, but not at a rate that could endanger conventional fuels in the next decades.
We do not rely exclusively on fuel production, the already mentioned petrochemical production is equally important. We are a refinery-petro-chemical complex where the raw material goes from the refinery to petrochemistry to manufacture monomers, and we are also prepared for when more raw materials will go from petroleum to petrochemistry in the future as the importance of this segment grows. For example, today more than one third of petroleum-based raw materials go to petrochemical production.

We have mentioned the issue of research that closely relates to education. How do you rate the Czech educational system and how do you work with schools?
All technical universities see fewer students because the entry of many private universities has resulted in a university education in other, mainly non-technical areas. Moreover, technical studies are not very attractive to the current generation of students. Heavy industry where we belong has failed to present itself to young people in an attractive way. We are trying to change this. We have established cooperation with the University of Chemistry and Technology, Prague (UCT). Together we have decided to carry out several projects to support chemistry study programmes.
For example, we have opened the UCT-Unipetrol University Centre as a branch of UCT in the Litvínov Chempark. The goal is to get an ideal interaction between theoretical and practical studies. It is the only state university in the Czech Republic that is located directly in a production enterprise.
Another example of our joint activities is education and popularizing chemistry at high schools. We try to present chemistry as an attractive discipline for students. We visit schools and deliver lectures there and, at the same time, we organize tours to our plants. Almost 500 students visit our Litvínov plant per year!

50th IChO 2018
INTERNATIONAL CHEMISTRY OLYMPIAD
SLOVAKIA & CZECH REPUBLIC

CATALYZER 11

THE ELEVENTH ISSUE OF CATALYZER MAGAZINE 29/07/2018



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ALL OF YOU ARE WINNERS!

On Saturday, 28th July, the Prague Rudolfinum witnessed the official closing of the 50th International Chemistry Olympiad 2018.

In the very heart of Prague, in this majestic neo-renaissance building, the world's top young chemists gathered for the gala Closing Ceremony. The Rudolfinum is not only a sanctuary of art and music, it also used to be the seat of the Czechoslovak Parliament.

As the students and their mentors were seated, one could see how impatiently they were awaiting the official announcement of final results. Together with their new friends, they were discussing their feelings and experiences and giggling while observing a large screen on the stage where pictures of every single team were being displayed. Some of the present competitors were focused just on themselves; others were nervously squeezing team mascots or national flags in their hands. An intro, "The Element Song", played while presenters Daniel Stach and Emma Smetana warmly welcomed the entire audience from the stage. After large applause by 300 students, 256 mentors, 84 guides, 27 ambassadors, and other distinguished guests, making it a total of 731 people, Dvořák Hall was carried away by the tones of the symphonic poem, "Vltava" by Bedřich Smetana, performed live by the Nostitz Quartet, with the Vltava River flowing in front of them on the screen.

A few minutes later, Martin Putala and Petr Holzhauser, Presidents of the 50th IChO, went on stage. Putala asked audience members if they were happy about the Olympiad. The audience answered with loud applause, nodding their heads. Referring to his Opening Ceremony speech in Bratislava, Holzhauser described how his feelings have evolved during the past few days: "My right hand has been shaking due to signing over 700 certificates and diplomas. Now I am in the process of relaxation and slowly gaining back a degree of freedom," Holzhauser said.

As the medal ceremony was about to begin, nervousness was gradually increasing. Firstly, 10 Honorable Mentions were awarded, then it was time to award the students with the medals. In total, students were awarded 95, 65, and 35 bronze, silver, and gold medals, respectively. The best students in the Theoretical and Practical Parts were announced: Yichen Nie (China) and Qingyu Chen (China) were given prizes by IUPAC and DuPont representatives. Finally, the students who absolutely ruled the competition, gold Qingyu Chen (China), silver Aleksei Konoplev (Russian Federation), and bronze Raymond Eugene Bahng (Republic of Korea), were given medals by Katarzyna Woś of platinum partner, Unipetrol.

At the very end of the Closing Ceremony, both the Czech and Slovak presidents of IChO 2018 met Anne Szymczak, French Chair of the Educational Committee for the 51st IChO, on the stage. With this, the relay baton was passed to France. Bonne chance!

Elizabeth Lensmith, Marek Lanč

IChO 2018 RESULTS

Absolute Winners

1	Qingyu Chen	CHN
2	Aleksei Konoplev	RUS
3	Raymond Eugene Bahng	KOR

Best Practical Exam

Qingyu Chen CHN

Best Theoretical Exam

Yichen Nie CHN

GOLD MEDAL

1	Qingyu Chen	CHN
2	Aleksei Konoplev	RUS
3	Raymond Eugene Bahng	KOR
4	Jeffrey Shullen Shi	USA
5	Marvin Dragon Choo	SGP
6	Chenyu Wang	CHN
7	Junlong Qin	CHN
8	Jan Obořil	CZE
9	Chae Rin Kim	KOR
10	Michelle Lu	USA
11	Vinicius Figueira Armelin	BRA
12	Andrew Shucheng Wu	USA
13	Yutong Dai	USA
14	Jonathan David Bostock	GBR
15	Yichen Nie	CHN
16	Kyrylo Danyleiko	UKR
17	Anh Duc Pham	VNM
18	Mikhail Matveev	RUS
19	Khi Yung Fong	SGP
20	Phuritat Sookananchai	THA
21	Ceylan Ceylan	TUR
22	Yu-Che Chien	TWN
23	Mátyás Sajgó	HUN
24	Jinyeong Kim	KOR
25	Josef Tomeček	CZE
26	Dhyey Gandhi	IND
27	Ong Christoper Ivan Wijaya	IDN
28	Takanao Ishii	JPN
29	Ivna de Lima F. Gomes	BRA
30	Alexandra Andrea Geim	GBR
31	Jishnu Basavaraju	IND
32	Petar Petkov Hristov	BGR
33	Matteo S. Elie J. Stockinger	FRA
34	Miroslava Novoveská	CZE
35	Joonsuk Ryan Dan Kang	GBR

SILVER MEDAL

36	Daniil Bardonov	RUS
37	Sanchit Agrawal	IND
38	Junhwan Won	KOR
39	Jiapei Miao	SGP
40	Ilija Srpak	HRV
41	Stefan Schmid	AUT
42	Hur Lim	SGP
43	Ramil Terlan Babazade	AZE
44	Evgeni Mihaylov Statelov	BGR
45	Filippo Bigi	ITA
46	Richard Veselý	CZE
47	Daniel Maksymilian Golec	POL
48	Po-Wen Chen	TWN
49	Mahdi Jafarzadehbedostani	IRN
50	Kai-Cheng Hsu	TWN
51	Teodora Stan	ROU
52	Tudor Cristian Cozma	ROU
53	Paweł Franciszek Tyrna	POL
54	Alexandre Polo	FRA
55	Sanprem Taechawichian	THA
56	Jun Hao Tan	MYS
57	Run Lin Wang	CAN
58	Hakan Calila	ROU
59	Behrad Saeedian	IRN
60	Bence Béla Botlik	HUN
61	Artem Yanchak	UKR
62	Rukovanský Peter	SVK
63	Nguyen Van Chi Nguyen	VNM
64	Raymond Li	AUS
65	Andrei Kobelev	RUS
66	John Andrew Hayton	GBR
67	Vid Kermelj	SVN
68	Kieran Connor	AUS
69	Tung Thanh Hoang	VNM
70	Wojciech Jan Jankowski	POL
71	Abdullah Muqaddam	IDN
72	Richard Huang	AUS
73	Zhanibek Bekkhozhin	KAZ
74	Taichi Nishiguchi	JPN
75	Gustavs Jānis Mežciems	LVA
76	Wei Chung	TWN
77	Renzo Mattos	PER
78	Aayush Kadam	IND
79	Martin Orságh	SVK
80	Florian Kluibenschedl	AUT
81	Raz Lotan	ISR
82	Olavs Rāciņš	LVA
83	Hanna-Riia Allas	EST
84	João Victor M. Pimentel	BRA
85	Arshia Khademi	IRN
86	Olha Vashchenko	UKR
87	Māris Koniševs	LVA
88	Bader Sulman Almulhim	SAU
89	Dmytro Tsarenko	UKR
90	Pichamon Assawaphadungsit	THA
91	Janko Civic	HRV
92	Mohammadhossein Sharifnia	IRN
93	Cristóbal Manuel Cortés	ARG
94	Martin Rihtaršič	SVN
95	Palina Bulauskaya	BLR
96	Yuta Masunaga	JPN
97	Sietse Dijt	NLD
98	Franco Héctor C. Baroffio	URY
99	Pakaphol Thadawasin	THA
100	Ignacio Román Battagliese	ARG

BRONZE MEDAL

101	Sebastian Witte	DEU
102	Ruoh Wen Cheong	MYS
103	Antoni Artur Prus	POL
104	Batuhan Apa	TUR
105	Dzianis Novash	BLR
106	Alejandro Munguia-Aldapa	MEX
107	Duat Nhat Phan	VNM
108	Mees Hendriks	NLD
109	Eszter Sára Arany	HUN
110	George Petriashvili	GEO
111	Yusa Can Dinc	TUR
112	Thomas Bro Falkenberg	DNK
113	Davit Rizhinashvili	GEO
114	Titouan Gadeyne	FRA
115	Áron Czakó	HUN
116	Daniel Cristian Ungureanu	ROU
117	Abdulrahman F. Aledrees	SAU
118	Luca Spagnoletti	ITA

119	Nicolás Adriel Manno	ARG
120	Nikita Žoglo	EST
121	Hector Rodriguez	PER
122	Suvdanchimeg Sunderiya	MNG
123	Nariman Irahid Mirishov	AZE
124	Rizki Kurniawan	IDN
125	Gregor Drelichowska	AUT
126	Russell Scott Boey	NZL
127	Brecht Guido M Pierreux	BEL
128	Callan Maurice Loomes	NZL
129	Osama Mohammed Alali	SAU
130	Kamen Pavlinov Petrov	BGR
131	Ali Mohammed Alasmari	SAU
132	Michal Chovanec	SVK
133	Muhammad Syaiful Islam	IDN
134	Phillip Liang	AUS
135	Yuto Fukumoto	JPN
136	Magdalena Lederbauer	AUT
137	Sebastián Solís-Vargas	CRI
138	Oliver Ovsée Laub Solow	DNK
139	Alexandros Terzopoulos	GRC
140	Jože Gašperlin	SVN
141	Marko Beslać	SRB
142	Bruno Diaz	PER
143	Jaloliddin S. ogli Alavitdinov	UZB
144	Emre Kilic	TUR
145	Chiril Solovei	MDA
146	Olzhas Nurpeisov	KAZ
147	Siim Kaukver	EST
148	Alejandro Valderrama-Celestino	MEX
149	Aliaksei Harakhouski	BLR
150	Neyci E. Gutierrez-Valencia	MEX
151	Saba Gogichaishvili	GEO
152	Galymzhan Moldagulov	KAZ
153	Sean Hikaru Wang	CAN
154	Dildora I. qizi Khakimboeva	UZB
155	Inomjon Majidov	TJK
156	Matko Petrovic	HRV
157	Borna Simic	HRV
158	Justas Terentjevas	LTU
159	Vladislav Ghies	MDA
160	Aaron Yuxiang Dou	CAN
161	Rokas Vilnius Sidlauskas	LTU
162	Aleh Karatkou	BLR
163	Daniele Furlanetto	ITA
164	Thomas Froitzheim	DEU
165	Ahror Ismoili	TJK
166	Akmuhammet Karayev	TKM
167	Emmanouil Kokkinis	GRC
168	Jorge Martín Álvarez	ESP
169	Antonio Andonovski	MKD
170	Daan Hoogers	NLD
171	Siiri Susanna Kuoppala	FIN
172	Peter Gonda	SVK
173	Khas-Anand Sandagdorj	MNG
174	Andrej Kovačević	SRB
175	Mihaela Magdei	MDA
176	Tom Gaëtan F. A. A. Lacoma	FRA
177	Lukas Supragonas	LTU
178	Björn Axel Rudolf Diemer	SWE
179	Julius Dela Rosa Macling	PHL
180	Anna Marija Sumrova	LVA
181	Leo Stoll	NOR
182	Giovanni Pellegrino	ITA
183	Roi Peer	ISR
184	Orisvaldo Salviano Neto	BRA
185	Muhammed S. S. Thaniana	PAK
186	Roman Herbert Behrends	DEU
187	Steven Yunfei Ma	NZL
188	Turan Babek Mammadli	AZE
189	Alec Elías Sigurðarson	ISL
190	Stefan Damchevski	MKD
191	Israel Mina Aguba	PHL
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193	Lennart Horn	CHE
194	Athanasios Fokaidis-Psyllas	GRC
195	Bayrammuhammet Annageldyyev	TKM

HONORABLE MENTION

196	Pieter S. Vanslambrouck	BEL
197	Mindaugas Dzenkaitis	LTU
198	Vladislav Cherdantsev	KAZ
199	Nikola Knežević	SRB
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210	Alexa S. Garcia-Rendon	MEX
211	Modar Monzer Al Ali	SYR
212	Narek Petrosyan	ARM
213	Tomi Patrik Termonen	FIN
214	Nanna Lærke Baun	DNK
215	Arthur R. Ventura De Belen	PHL
216	Hovhannes Matevosyan	ARM
217	João Francisco Paulo Morais	PRT
218	Erling Syversveen Lie	NOR
219	Juri Volodin	EST
220	Victor Crasco	MDA
221	William E. M. Hernández	SLV
222	Jere Erik Niemi	FIN
223	Ziting Xia	CAN
224	Erin Fleur Fitzsimons-West	IRL
225	Munkhnaran Bulgan	MNG
226	Akbar Gafur ogli Bazarbaev	UZB
227	Fernando Alvarez	PER
228	Johan E. Linnestad Larsson	NOR
229	Bakri Yahia Roumi Jamal	SYR
230	Eddie K. Efimenco	URY
231	Eshret Atanyyazov	TKM
232	Komai Osama Mhana	SYR
233	Manuel Iglesias Alonso	ESP
234	Lukas Lettmann	DEU
235	Jesús David Zambrano	VEN
236	Stefan Stojkovikj	MKD
237	David Joseph McSharry	IRL
238	Árni Tómas Sveinbjörnsson	ISL
239	Gohar Saqib Fazal	PAK
240	Nastja Medle	SVN
241	Mikaella Ty Ngo	DNK
242	Jafeth Méndez-Gomez	CRI
243	Alexandre Lebailly	BEL
244	Armando Luís M. G. Teixeira	PRT
245	Muhammad H. M. Adzrill	MYS
246	Paulo Miguel T. Cortesão	PRT
247	Eskil Vik	NOR
248	Eldar Máni Gíslason	ISL
249	Daniel Alejandro R. Aparicio	SLV
250	Hen Gelshtein	ISR
251	Muhamad Lutfir R. Hamzam	MYS
252	Marieke Visscher	NLD
253	Galen Noel Galan Nifas	PHL
254	Luis José Parra Molina	VEN
255	Renaud Gourmand	BEL
256	Nizaar Adnan Aloqla	SYR
257	Noa Crassac	ISR
258	Nicholas William Pochinkov	IRL
259	Magdalena Zlatanova	MKD
260	Carole Zermatten	CHE
261	Alicia S. Thorborg van Hees	SWE
262	Rodrigo A. M. Fernández	URY
263	Ebba Sofia Matic	SWE
264	Chantal Sandra Balmer	CHE
265	Kevin Chinchilla-Mora	CRI
266	Philip David Krause	IRL
267	Demetris Tikkis	CYP
268	Stefan Ivanov	NZL
269	Fabian Hollinger	CHE
270	Beatriz Maria Silva Lisboa	PRT
271	Konstantinos Ntounis	GRC
272	Ioannis Michalis Kestoras	CYP
273	Mirkhad Chekirbaev	KGZ
274	Atabay Allamyradov	TKM
275	Ægir Örn Kristjánsson	ISL
276	Carl Åke Aron Enliden	SWE
277	José Pablo Vásquez-Rojas	CRI
278	Movses Aghekyan	ARM
279	Ilias Batyrbekov	KGZ
280	Tomer Melnik	ZAF
281	José Gabriel Rosa Rivero	VEN
282	Yeshan Sugie Naidoo	ZAF
283	Andrés Rafael De Sousa	VEN
284	Hrachuhi Harutyunyan	ARM
285	Saida U. qizi Ortikboeva	UZB
286	Andreas Dramiotis	CYP
287	Pipololaoluwa Adeayo Alao	NGA
288	Pablo Real Baeza	ESP
289	Glory Chisom Okoli	NGA
290	Judah O. Oladipo-Joseph	NGA
291	Pavle Vulanovic	MNE
292	Abhishek Rahul Budhram	ZAF
293	Muhammadiqboli Musozoda	TJK
294	Daniel Petrus Marais	ZAF
295	Qurbonali Komili	TJK
296	Masa Colakovic	MNE
297	Anna Maria Loukaidou	CYP
298	Aidar Kamalov	KGZ
299	Mila Veselinovic	MNE
300	Sara Saric	MNE

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INTERNATIONAL CHEM

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SUMMER
IChO PARTY
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NOVÝ CAS
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YES
YES
YES
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MANY THANKS TO YOU ALL

This is the end. The end of the Olympiad and the final Catalyzer. But it's only the end of this year's event. We spent two years preparing for it. As the start of the Olympiad was coming closer, the number of people who participated in its organization began to grow, together with the excitement and nervousness that everything would turn out well. We would like to extend our gratitude to all who took part in the preparations or who in any way contributed to making the crazy dream of two friends become a reality! We would like to thank all the authors, guides, partners, VIPs, editors, proofreaders, photographers, graphic designers, assistants, specialists, consultants, all kinds of managers, event specialists, health personnel, artists, helpers, and all those we may have forgotten to mention, simply everybody! Because everyone put 100% into it and everyone had her or his share in everything turning out well. And also thanks to our Copperheads, because they were simply amazing!

It's said that the Czech and Slovak Republics are situated in the heart of Europe. So we, throughout the organization of this anniversary Olympiad, put our hearts into it. We believe that we succeeded in delivering a memorable event that you will carry home with you in your hearts and share with the whole world. Many thanks to you all!

Petr Holzhauser, Martin Putala

CATALYZER TEAM

- **Tatiana Nemirovich**, photographer ▪ **Jiří Suchan**, photographer ▪ **Peter Horváth**, photographer ▪ **Tomáš Belloň**, photographer
- **Elizabeth Lensmith**, reporter ▪ **Žofia Váryová**, reporter ▪ **Matej Šemelák**, reporter ▪ **Marek Lanč**, chief reporter
- **Stephanie Krueger**, proofreader ▪ **Dana Husníková**, designer ▪ **Michal Janovský**, editor-in-chief ▪ and many others...

50th IChO 2018
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