IMO, what you can expect from it, how to join it, past experiences, future prospects

József Pelikán

The International Mathematical Olympiad (IMO) is the oldest of the international science Olympiads. Accordingly, a great amount of experience accumulated around it over the years. Mathematical competitions on the national level have an even longer history, the oldest being the Hungarian Kürschák competition, which started back in 1894. In this paper, I talk about such international, regional, and national competitions, mainly in mathematics, but, briefly, in other sciences as well.

The International Mathematical Olympiad

József Pelikán
Hungary

In this talk, I will briefly outline the history of the International Mathematical Olympiad (IMO), then speak about mathematics competitions on the national level, and finally discuss the experience of mathematics journals for high school students. The focus will be on how these things are interconnected.

1 The IMO

It is an interesting story how the first of all science Olympiads came into existence. Originally, nobody had the idea to organize an International Mathematical Olympiad. What actually happened was that in 1959, in celebration of its 65th anniversary, the Romanian Mathematical Society invited student teams from what were at the time called socialist countries: Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, and the USSR. Together with the organizers, seven countries with eight students each (the USSR with only four) took part in a two-day competition. At the end of it, the participants said to themselves: “Hey, this is a good thing! Why don’t we repeat it next year?” So, next year there was a similar competition. And again, everybody agreed that this was a good thing. So it started to be a regular event: the IMO. This is a good example of how changes often come unintentionally.

I don’t want to go into the details of IMO history, just point out a few landmarks. The first Western European countries joined the IMO in 1967. In that year, France, Italy, Sweden, and the United Kingdom participated for the first time. Although more and more new countries joined, until 1973, with the exception of Mongolia, only European countries participated. In 1974, with the appearance of the United States and Vietnam, the IMO started to be an intercontinental event. The first IMO to be organized in a non-Socialist country took place in 1976 in Austria. In 1981, Washington, DC, was the venue of the first non-European IMO. Australia organized the 1988 IMO in Canberra, and the first Asian IMO took place in 1990 in Beijing, China. Argentina was the venue of the first South American IMO, in 1997.

It is worthwhile to have a look at the participation of the countries of the BMENA region at the IMOs. The following table lists those countries of the BMENA region which participated in at least one IMO, in the order of the year of their first participation (the number of times the country participated in IMOs up to 2010 is shown in parentheses):

Algeria	1977 (13)
Tunisia	1981 (19)
Kuwait	1982 (26)
Morocco	1983 (28)
Bahrain	1990 (3)
Saudi Arabia	2004 (6)
United Arab Emirates	2008 (2)
Syria	2009 (2)
Mauritania	2009 (1)

I sincerely hope that many more countries of the BMENA region will join the IMO family in the near future. An important first step toward doing so is to have a national-level mathematics competition for high school students, and this leads me to my second topic.

2 National competitions

How do mathematics competitions and, more generally, science competitions arise? That is another interesting question. In some countries, notably France and England, there have been exams for a long time that were competitions at the same time (i.e., the participants were ranked according to their accomplishments). But the first true competitions in mathematics that were not connected with exams and in which the aim was purely to measure problem-solving ability and find the winner, the runner-up, etc., started in Hungary in 1894. In that year, the president of the Mathematical and Physical Society of Hungary, Loránd Eötvös, a professor of physics at the university that now bears his name (and is, incidentally, my home university) was named minister of education, a rare phenomenon for a mathematician or a physicist.

To commemorate the event, the Society decided to organize a mathematics competition for high school students. The competition had just three questions—difficult ones, but that required only a knowledge of high school mathematics. Again, it was observed that this was a good thing, and the competition survives to this day, being the oldest mathematics competition in the world. For about 50 years, it was called the Eötvös competition, but after the Second World War it was renamed the Kürschák competition, because the physics competition got the name ’Eötvös’. (József Kürschák was a professor of mathematics with a keen interest in competitions; he published the first book on the problems posed at the Eötvös competition during the period 1894–1928.)

Today in Hungary, there are several mathematics competitions, nationwide and local. In the first years of the IMO, some participating countries had no mathematics competitions at home, which was a serious drawback for them: There was no way to find the best students on a national level, and even those students who were selected had no real practice in solving hard problems. But in those countries, national Olympiads were soon organized and outcomes improved accordingly. Today, we can safely say that the practice of how to start mathematics competitions in a country has been crystallized. You should not start right away with the IMO. First, you should start organizing a national Olympiad, usually with an initial local-level round

and a second, final round or even three rounds. After having gained experience over a couple of years, a country might venture to join the IMO.

To organize such a nationwide competition is quite a challenge. There is another, easier way to raise the interest of students in high-level problem solving: starting a mathematics journal. This leads me to my third topic.

3 The journal

In Hungary, a high school teacher named Dániel Arany had the idea of starting a monthly mathematics journal for high school students. Curiously, this happened in the same year, 1894, that saw the birth of the mathematics competition. That was a time of great progress socially and economically in Hungary. The journal was entitled "Középiskolai Matematikai Lapok" (today affectionately abbreviated 'KöMaL'), which simply means "Mathematical Journal for High-School Students." Problems were featured every month, the students had to send in the written solutions, and at the end of the school year there were winners in the various age groups. Each problem's solution, usually sent in by a student, was published some months later, together with the name of the student. The students took great pride in being the author of a published solution. Later, another inspiring idea in the same vein was added: At the end of the school year, not only were the results of the annual problem-solving competitions published with the names of hundreds of the best students, but also the photos of several dozens of the best solvers appeared in the journal. It was a thrill to see your own photo among those of the best students, and it was also great to see pictures of those of your fellow competitors whom you had never met personally.

Other than running this yearly competition, the journal has regularly published survey articles on interesting topics that are accessible to high school students and also has published the problems and solutions of various competitions. More recently, a physics department within the journal was established and, as an even more recent development, there are some informatics problems in the journal. This journal had such a huge impact that virtually all Hungarian mathematicians who later became internationally acknowledged, like Paul Erdős and others, claim that the journal was the starting point for their career and development.

If you have such a journal or run competitions, you will need problems to present. And this is a crucial matter: The value of a competition depends largely on the quality of the problems presented. The IMO has a great role in this, too: It sets the standard for nice, hard problems. Of course, in national and local competitions you will often use easier problems.

Today there is a huge body of mathematical problems available worldwide; you can use them for training or in smaller competitions. But in serious, big competitions, it is desirable to compose original problems. In some countries (Hungary is one of them), original problems are used in every national competition. And this is a great challenge: To come up with dozens of interesting, new problems every year is a demanding job. Luckily, in Hungary many research mathematicians contribute to competitions: If, in their research, there is some small detail that they do not want to publish and that is suitable for a high school competition, they give it to the organizers of the competition.

To conclude, I would like to underline one thing. All these national competitions, the journal, and the IMO are excellent opportunities to nurture mathematical talent. But their significance extends beyond that: They show a wide circle of students and teachers that mathematical problem solving can be both fun and a challenge, that there are lots of attractive nonroutine problems, and that the school drill is not the last word in mathematics education. If,

starting from the recognition of these three facts, we gradually increase the number of fair, good, and excellent students, some of whom reach the IMO level, then we have not worked in vain.