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International Chemistry Olympiad and Its Role in Chemical Education

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Abstract—International Chemistry Olympiad (IChQ) is the annual world competition for high school students – the winner of national olympiads. The level of this competition is very high, and its results reflected to some extent the efficiency of national systems of chemical education. We briefly present the history of IChQ and its regulations, raise some methodical issues and show the role of Russia in the world system of chemistry olympiads. The influence of IChQ on chemical education in Russia is discussed.

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The history and regulations of International Chemistry Olympiad, which is the annual world competition for secondary schoolchildren, winners of national Olympiads, were briefly overviewed, and some related methodological issues were considered. The role of Russia in the world system of chemistry Olympiads was highlighted. It was emphasized that the level of International Chemistry Olympiad is very high, and its results reflect to some extent the efficiency of national systems of chemical education. The influence of International Chemistry Olympiad on chemical education in Russia was discussed.

International Chemistry Olympiad (hereinafter, IChO) is the annual competition of secondary schoolchildren, which promotes international contacts in the field of chemistry. International Chemistry Olympiad represents the highest level of chemical competition and marks the culminating point in the worldwide system of national chemistry Olympiads. Different countries of the world hold different attitudes to science Olympiads. In Russia, Eastern Europe, and South-East Asia they play an important role and provide the basis for the chemical education system. Most of Western Europe countries treat science Olympiads as only one type of educational activities of secondary schoolchildren. Some other countries consider Olympiads to be the events that distract schoolchildren from getting quality education. Despite these differences, all countries treat the International Chemistry Olympiad as a very authoritative forum, and participation in it, as a task of national importance. Therefore, virtually all countries, where chemical education is provided and where national chemistry Olympiads are held, take part in International Chemistry Olympiad.

The International Chemistry Olympiad pursues high and noble goals. According to the regulations formulated at the very first IChO, "it is intended to stimulate the activities of students interested in chemistry by a way of independent and creative solving of chemical problems. The IChO competitions help enhance friendly relations among young people from different countries; they encourage cooperation and international understanding." The last phrase reflects the main goal and the main result of IChO. More than ten-year authors' experience of involvement in International Chemistry Olympiads suggests that IChO accomplishes this goal in full. The International Chemistry Olympiad activities have promoted the establishment in the world's chemical education system of a large and friendly community whose members are schoolchildren, teachers, students, researchers, and professors involved in IChO in some way and contribute to the development of the Olympiad movement in the world.

Preparation for IChO requires undertaking considerable efforts by each participating country, because this is a competition of a very high level, whose results are determined by the effectiveness of the national

education system and, thereby, serve as an indicator of the success of its functioning.

Here, we briefly overviewed the history and the rules of organization and conductance of IChO, as well as some methodological aspects and results, and also discussed the role of our country in the worldwide science Olympiad movement.

History of the International Chemistry Olympiad

The idea to organize the International Chemistry Olympiad was born in the former Czechoslovakia. In the spring of 1968, the political situation in Czechoslovakia was very tumultuous. Under new leaders the country was in an economic reform, known as "Prague Spring." Groups of intellectuals strove after a "socialism with a human face." There was a smell of independence in the air. The people were full of activities; they wanted more contacts with other countries. One of the new ideas was to organize an International Chemical Olympiad. The Czechoslovak National Committee for Chemical Olympiad, sup-ported by the Ministry of Education, sent letters of invitation to all friendly "socialist countries." The invitation was accepted by Poland and Hungary only, while the Soviet Union, supported by its closest allies Bulgaria and German Democratic Republic, gave no response (recall that, in May 1968, the relations between Czechoslovakia and the Soviet Union started to be "nervous").

In the years that followed, policy has repeatedly intervened into chemistry affairs, the most recent case being that of China's refusal to participate in IChO-2005 which was held in Taiwan.

The chemistry Olympiad in the Soviet Union, which was a model for all other socialist countries, was chosen as the basis for the first IChO. The competition consisted of two examinations (rounds), one theo-retical (four problems) and one experimental (prob-lems). Each team had six members. The winner (whose name, unfortunately, was lost over the time) showed a 100% result. At the first IChO, the IChO regulations (which, with minor amendments, are still valid) were formulated and approved. Thereby, the start was given for the international chemical Olympiad movement.

The second IChO was held in 1969 in Katowice, Poland; new country was Bulgaria. The Soviet Union and the German Democratic Republic sent observers. For the first time, the Soviet Union sent its team to the third IChO (Hungary, 1970), and the next IChO, in 1972, was hosted by Moscow.

The IChO idea proved to be very attractive for the global educational community. The number of participating countries was growing rapidly; new socialist countries were involved, and in 1975 they were joined by representatives from the Western world: Sweden, Belgium, and Federative Republic of Germany. In 1980, IChO was for the first time organized in a non-socialist country, Austria (the Soviet Union boycotted that Olympiad). In 1991, after collapse of the Soviet Union, the number of IChO participants increased by ten countries at a single time. In the new millennium, the participating countries were joined by Portugal, Iceland, Japan, Armenia, Moldova, Israel, and Serbia. The IChO-2010, held in Japan, gathered participants from 70 countries of all continents except Africa.

Over the decades that passed since the start, the IChO underwent a lot of changes. Today, it has more complicated rules, which were formalized with a view to covering all possible situations and codes of conduct in the Olympiad. The scientific problems suggested for IChO have a strongly increased complexity level; to solve them, the knowledge of the "secondary school program" is no more sufficient. Also, much more extensive organizational efforts are required today from IChO hosts, not to mention the costs (a typical budget of IChO is several million dollars). Thus, today's IChO has gone very far from the first com-petitions, but affected was only the level of this event, while IChO preserved intact its principles. Among them, the most important are honesty, openness, cooperation, understanding, and certainly fondness for chemistry, shared by all IChO participants, both schoolchildren and adults.

Regulations and Organization of International Chemistry Olympiad

The IChO is held annually, in July, each time in a new country. Prospective hosts should apply 5–7 years ahead of the event. The IChO organizer is typically a major educational institution (usually a leading university) of the host country; the governmental funding of IChO is provided via the Ministry of Education.

Many countries hold "training camps" for their top young chemists (it is agreed that IChO training programs must not exceed a total duration of two weeks), where they receive accelerated college-level courses in chemistry with an emphasis on the topics covered in that year's preparatory problems (issued by

the host country of the IChO, half-year in advance of the Olympiad), as well as practical training.

Each delegation consists of four schoolchildren (winners of national chemistry Olympiad) and two mentors (heads of the delegation). Schoolchildren compete in solving theoretical problems and conducting chemical experiments. Mentors must be capable of translating the text of the competition tasks from English into the language used by their team members and be able to judge the kit of problems and correct the works. Also, mentors take part in the appeal ("arbitration") procedure.

The competition consists of two, a theoretical and a practical, examinations. Both have durations of up to 5 h and are held on separate days. The experimental round comprises two or three laboratory practicals, typically quantitative analysis, an organic synthesis reaction, study of first-order reaction kinetics, or qualitative analysis of organic and inorganic substances. The theoretical assignment consists of 7–10 multilevel problems covering all the main domains of chemistry. The practical examination has a value of 40 points, and theoretical examination, of 60 points (out of the total of 100 points). During the last 10 years, the highest score overall (96.75 points) was achieved by Russian participant Aleksei Zeifman (Taiwan, 2005). For comparison: a typical score of a scholary, knowledgeable university professor is 50–60 points, and that of a good secondary school pupil, who has not received special training, <30 points. This suggests a high scientific level of IChO.

The theoretical and experimental examinations are evaluated independently, and the sum of the results of both examinations determines a participant's overall result. Usually three types of medals, gold, silver, and bronze, are presented to achievers, specifically to several tens of participants. Gold medals are awarded to approximately the top 10±2%, silver medals, to 20±2%, and bronze medals, to 30±2% of participants. With the total number of IChO participants being close to 250, gold medals are awarded to up to 30 best of them. No official team classification is made, but unofficially ranks are always identified (counted as the sum of places or points). Whatever the calculation system, the best results is typically that of Chinese team; Russia is almost always among the top five (often, the top three) countries.

A few more interesting aspects deserve mentioning. All problems (theoretical and experimental) are suggested by organizers. At the Olympiad, these problems are discussed by the International Jury consisting of the heads of all the delegations (mentors). It is not a rare occasion when, after these discussions (sometimes, heated), problems undergo significant modifications, typically toward simplification. Because the mentors review the examinations before they are given to participants, any communication between the mentors and their team members prior to the completion of both exams is strictly forbidden. The schoolchildren are taken care of by organizers. In this respect, the credit is due to team guides, young persons who are well aware of the specifics of the IChO host country and who accompany their "charges" throughout the competition and help them to adapt to the life in a foreign country and overcome cultural differences.

The official language of the IChO is English[1], but the participants receive and complete the assignments in their mother tongue. As noted above, translation from English into their mother tongue is provided by mentors who, simultaneously with organizers, check the solutions presented by their team members and assign points. These points are compared with those assigned by the organizers during the appeal ("arbitration") procedure. The final official score is assigned to each participant only by mutual consent of the parties. This complicated procedure enables an open and democratic evaluation to be provided.

The competition itself is the main but not the only part of the IChO. This is a ten-day event in which only two days are dedicated to the competition proper. The rest of the time goes for the social program which aims to make the schoolchildren familiar with the host country, its traditions, cultural values, and scientific achievements (for mentors, who are hard at their work to achieve their specific goal, the social program fell by the wayside). National features and scientific achievements of host counties can be seen even in the problems suggested at IChO. For example, the kit of preparatory problems suggested for the Moscow IChO-2007 contained some questions about the Periodic Law and other discoveries made by D.I. Mendeleev, and some of the main theoretical round assignment were concerned with oscillating reactions which became widely known owing to the discoveries made by Russian chemists.

[1] Two unofficial languages, Russian and Spanish, are also widely spoken at IChO.

Much significance is attached to the IChO opening and closing ceremonies which are attended by famous persons, including Nobel Prize winners. Among them, Dr. Harry Croto, one of the discoverers of fullerene, attended the IChO-2009 at Cambridge, and Dr. Ahmed H. Zewail, the man behind femtochemistry, patronized the IChO-2012 in the United States. Thus, the humanitarian and chemical components of IChO are of equal importance.

Russia's Role in International Chemistry Olympiad

Our country (the former Soviet Union and, subsequently, Russia) has consistently played a significant role and enjoyed high prestige with IChO system. Russian team has always been one of the favorites at IChO, from whom great achievements are always expected. These expectations have been typically met. Over the last ten years, Russian participants won 21 gold, 16 silver, and 3 bronze medals from IChOs. Among them, Aleksei Zeifman, at the present time a postgraduate student at the Institute of Organic Chemistry, Russian Academy of Sciences, demonstrated a unique achievement: He was twice in a succession (in 2004 and 2005) the absolute winner of IChO. Another Russian participant Daniil Khokhlov, at the present time a student at the Chemistry Department, Moscow State University (MSU), is the only winner in the history of IChO, who was awarded gold medals by two Nobel Prize winners, Dr. Harry Croto (England) in 2009 and Dr. Ryoji Noyori **(**Japan) in 2010. At different times, Russian participants registered victories in experimental and theoretical rounds; there were cases when they were awarded four gold medals out of four; only unofficial team victory has not yet been gained.

All these achievements were made possible through the fundamental system of science Olympiads, created and carefully preserved in our country. They reflect high efficiency of Russia's IChO training system, which will be discussed below in more detail. The top Russia's young chemists, winners and prize-winners of the final stage of the All-Russia Chemistry Olympiad, take part in two ca. 2-week training camps during the year (in winter and in summer). Winter camps are not associated with a specific Olympiad; these are general education events intended only to ensure that the young chemists are in good scientific form. By contrast, the summer training camp involves couching for the upcoming Olympiad; it is culminated by two (one theoretical and one experimental) training Olympiads, whose results allow selecting Russia's team members. The complexity level of the problems suggested for the training Olympiad is often higher than that of IChO problems, which allows the team to be completed with only the top, at the moment, young chemists, "the best of the best." All the IChO training activities are organized by the MSU on the basis of the Chemistry Department. It is remarkable that not only professors and researchers, but also students and postgraduate students (former winners and prize-winners of IChOs) are involved in these activities. They share with young Russian chemists their extensive experience in IChO training instruction and participation, thereby ensuring the intergenerational continuity in the Olympiad system.

An important role is played by Russia in the organizational structure of IChO: Russia's official is almost always among the International Chemistry Olympiad Steering Committee members who develop the IChO strategy. Also, our country hosted four IChOs (in this respect it is second to Hungary only), of which two IChOs were held in the Soviet Union: in 1972 (Moscow) and 1979 (Leningrad), and two IChOs, in Russia: in 1996 and 2007, both times in Moscow, at the Chemistry Department, MSU. The Moscow IChO-2007 was very successful [1]: The Steering Committee was headed by the RF Minister of Education A. A. Fursenko, and Academician V.V. Lunin, Dean of the Chemistry Department, MSU, was the Olympiad Chairman. Over 250 top young chemists from 67 countries competed in solving theoretical problems and performing chemical experiments. All the Russian participants won gold medals, and at the closing ceremony they were congratulated by Deputy Prime Minister (future President and, currently, Prime Minister of Russia) D. A. Medvedev. The highest score overall was achieved by a Chinese team member.

The Moscow Olympiad's slogan was "Chemistry: art, science, and fun," which emphasized the diversity of chemistry with all its creativity and relationships with other sciences and ways of cognizing the world. The IChO problems were developed mostly by the staff of the Chemistry Department, MSU, who made their best to suggest for IChO truly creative problems, incorporating all the most interesting aspects of modern chemistry, such that the search for their solution would bring them a great intellectual pleasure. The Olympiad participants "interpenetrated" the world of quantum effects and oscillating reactions, investigated nanocatalysts, solved organic "guessings,"

examined the geometric structures of silicates, and analyzed the molecular mechanisms of atherosclerosis. (The specific features of IChO problems will be discussed below).

The next IChO in Russia will be held in 2013, which idea was supported by D.A. Medvedev (at that time the President of Russia) during his meeting with Russian winners of science Olympiads on March 18, 2010 [2]. Like all the previous Moscow IChOs, the IChO-2013 will be organized on the basis of the MSU.

Methodological Aspects and Results of International Chemistry Olympiad

The above-said might create the impression that everything goes smoothly with IChOs. However, this is not always the case. There exists a whole range of problems: political, economic, and scientific. Below, we will discuss the latter problems, mainly those related to the tasks suggested for IChO.

The tasks suggested for today's and for the very first IChO differ from each other to the extent to which, e.g., Formula 1 race cars differ from scooters [3–5]. For example, one of the assignment at the very first IChO was to write only three reaction equations:

Today, such assignments are considered simple even for entrance examinations at high education institutions.

$$CrCl_3 + Br_2 + KOH \rightarrow$$

$$KNO_2 + KMnO_4 + H_2SO_4 \rightarrow$$

$$Cl_2 + Ca(OH)_2 \rightarrow$$

The texts of modern IChO problems rarely occupy less than one page (with pictures, up to three pages). It takes nearly one hour for participants to carefully read the entire kit of problems only. All problems are formulated in exclusively politically correct way, i.e., they (a) take into account the interests of poorly prepared participants by suggesting nearly trivial questions and (b) are divided into numerous smaller problems so as to ensure fair evaluation, and the procedures of deducting points for wrong decisions is described in detail. With this procedure, participant who gave a completely wrong, nonsensical answer to a computational problem still may get up to 90% of the maximal number of points. Not surprisingly, in this situation the preliminary coaching sessions focused on the ability to quickly give the right answers to simple questions are gaining increased importance, and the largest number of points is awarded to the most reliable and hard-working, rather than to the smartest participants. This situation resembles that with the Unified State Examination in Russia, though of a much higher level. It turns out that, to get their points at IChO, the participants should provide solutions that match the answers suggested by the developers of the problems, rather than beautiful and interesting solutions. In fact, this is a "karaoke" with chemical, rather than, music themes.

The approaches taken in development of IChO problems can be conditionally subdivided into those belonging to either "western" (European) or "eastern" (Asian) philosophy (school). The "western philosophy" problems are characterized by a fairly high level of complexity; solving them requires taking nonstandard approaches and being able to think and invent, find solutions, and make decisions independently. As regards the ways to search and find solution, the accomplishment of such assignments is "quite a science" ("quite" because the Olympiad problems have a known answer, while science seeks unknown solutions and approaches).

The "eastern philosophy" gives priority to precise execution and good work skills. "Eastern" type problems usually contain many questions among which only few are original. Solving such problems does not provide the competitors with new knowledge; they are only tested for their ability to quickly and accurately apply standard techniques. The accomplishment of such assignments is a necessary (for training purposes) but boring occupation; it gives a result but does not add interest in chemistry. Thus, solving "western" problems implies cognition and science, and solving "eastern" problems, technology and reproduction. The above-said is equally true of theoretical and experimental problems. (It should be understood that these conclusions, based on ten years of authors' experience, describe only the averaged situation: Some "European" IChOs suggested numerous primitive questions, and some "Asian" Olympiads, by contrast, wonderful, "smart" problems).

The All-Russia Chemistry Olympiad and International Mendeleev Olympiad (these are events of nearly the same level) suggest problems of only "western" type at their theoretical rounds [6], in full correspondence with the Russian mentality: Russian people feel it is much easier to solve one complicated problem than one hundred simple problems. That is why Russian participants, selected by a rigorous

procedure (initially at the All-Russia Chemistry Olympiad and subsequently in the training camps), easily handle difficult tasks though are often baffled by trivial questions. Moreover, sometimes they even give (subconsciously) a creative form to a standard question and solve the problem in their own, rather than in "author's," statement. Solving such problems, invented by them, is a much more interesting occupation which, however, does not bring points. This leads to a kind of "split in consciousness" sensed by many Russian participants of IChO, whose subconscious requires extracting pleasure, and conscious mind, getting points. During the five hours of the competition, the creativity in them is continuously fighting the desire to achieve a high result. However, this is true of "eastern" Olympiads only, e.g., the Olympiad which was held in Tokyo in 2010. Often, brains win in this fight, and Russian (high-class) participants get a lot of points, but overall, participants from South-East Asia (China, Taiwan, Korea) have distinctly advantageous opportunities at "eastern" IChOs.

These qualitative considerations can be complemented by some statistical data. As mentioned above, "eastern" IChOs typically suggest very simple problems; the participants gain a lot of points, whereby the boundary separating the gold and silver medals passes near the level of 90 points (out of 100), as clearly demonstrated by the table. In "western" IChOs, the boundary separating the gold and silver passes at a much lower, compared to "eastern," level, and the difference in the results between the overall winner and the last of the gold medal winners is close to 20 points against less than 10 points in "eastern" IChOs. Using the jargon adopted in the IChO community, it can be said that, in Asia, the winners are determined based on "fleas," i.e., on subtle differences in the solutions provided.

Problems were at record-high level at Moscow Chemistry IChO-2007. The staff and faculty of the Chemistry Department, MSU, supported by colleagues from other chemistry-oriented higher education and research institutions, made every effort to organize a truly creative contest. Its overall winner gained a little more than 76 points, which result would allow a participant of the Tokyo IChO to take only the 95th place and won the bronze medal. Figure 1 clearly demonstrates the difference in the scores gained by the gold medal winners in three different Olympiads.

Statistical data concerning the IChO winners of different years

Host country, year	Boundary separating gold and silver medals, points	Scores gained by overall winner
Europe		
Germany, 2004	72.1	88.7
Russia, 2007	57.4	76.1
Hungary, 2008	66.7	87.0
Asia		
Taiwan, 2005	90.6	96.8
Japan, 2010	88.8	96.6

These are the general statistical data for IChOs on the whole.

Another type of data characterizes the distribution of IChO participants according to the percentage by which a specific problem was solved. In the case of a perfectly formulated problem, this distribution has a Gaussian shape with a peak around 40–60%, and the number of participants who solved the problem completely or, by contrast, did not solve it at all, is small [7]. Such a problem will allow not only all the participants to show their worth, but also well-prepared participants to be discriminated from more poorly prepared participants. By way of example, Figure 2a provides statistical data concerning solution of a "good" analytical chemistry problem, suggested at IChO-2007.

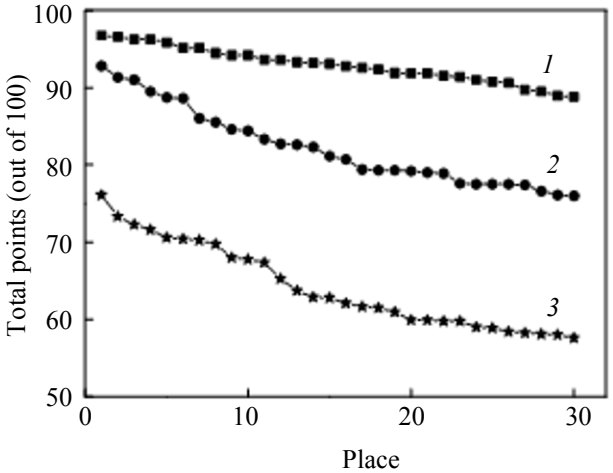

Fig. 1. Comparison of the scores gained by the 30 top participants of IChO in 2005, 2007, and 2009. (*1*) 2005 (Taipei), (*2*) 2009 (Cambridge), and (*3*) 2007 (Moscow).

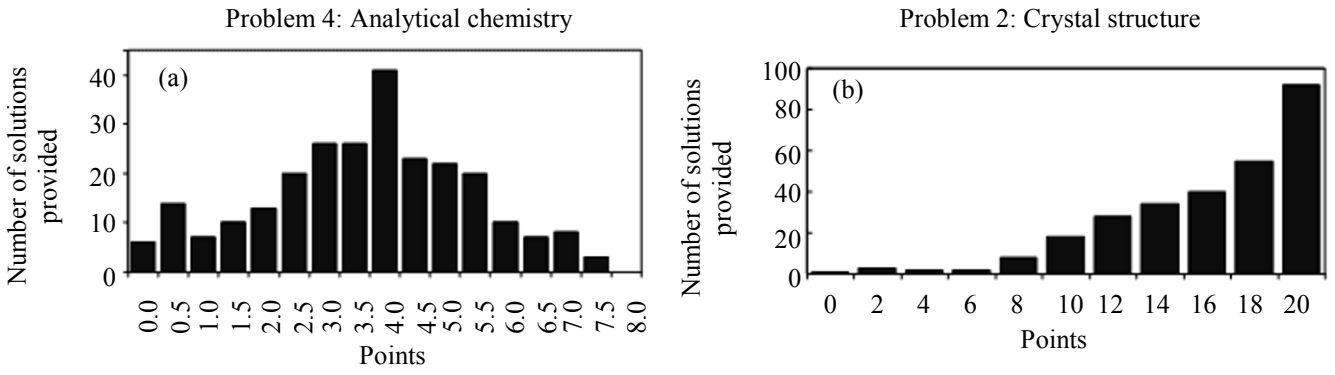

Fig. 2. Distribution of the IChO problem solutions over the scores gained for (a) "good" (Moscow-2007) and (b) "bad" (Tokyo-2010) problem.

If IChO problems are formulated less accurately, without different abilities of participants for solving them taken into account, the distribution over scores can exhibit different patterns, with several peaks or with a single peak, though shifted to the start or end point of the score scale (see Fig. 2a). In the case of "eastern" IChO problems, there is no peak at all, and the distribution pattern continuously ascends from low to high points (see Fig. 2b). Such problems possess a poor discriminating power, i.e., solving them does not allow the most capable participants to be distinguished.

Current trends are toward ever increasing primitivation of IChO problems (with rare exceptions of IChO-2007 in Moscow and IChO-2008 in Budapest). A long formulation of the problem is getting even longer, and its content even more boring; as a result, the problem resembles detailed bureaucratic regulations, where each step is described in detail, and no deviations from the developed route of problem solving is permitted. This means that any nonstandard solution, even a minor digression from the author's intention (often very primitive) may be punished by complete or partial deduction of points, with the result being the lost medal. In fact, the IChO problem developers act from good motives; they strive to ensure getting a fair score for solution of the problem and unbiased assessment of each correct part of the solution. However, the creative spirit of this contest gets lost!

Is it possible to do anything about this situation? As regards the Jury activities, nothing can be done, since all the matters are decided there by majority, but IChO organizers have a voice. The International Chemistry Olympiad-2013 will be held again in Moscow, on the basis of the MSU, and its organizers will do their best to develop a kit of problems that will be completely different from those currently suggested. At the present time, formulation of IChO problems follows predominantly the "given… – calculate… – find… – go to..., etc." scheme, in which the entire path to solution is described in detail. The Moscow Olympiad-2013 organizers will give more freedom to the participants in solving the problems. Specifically, the participants will be provided with initial information (in abundance), and the start and end points for the solution will be identified, while the choices of a specific route to the correct solution and relevant techniques will be up to the participants. For the first time, a problem of this type was suggested at the experimental round of IChO-2009 in Cambridge: The task was to empirically determine the critical micelle concentration in a solution of a surfactant by measuring the electrical conductivity of a series of solutions. How many solutions, and by which technique are to be prepared for this series was to be decided by the participants.

In our opinion, the future of chemical Olympiads (not only international) will be determined by specifically such problems which, though so far uncommon and difficult both to deal with and to check, are very interesting, which fact is of prime importance for prospective scientists.

Role of the International Chemistry Olympiad in the Chemical Education System

A more than 40-year history of the International Chemistry Olympiad evidences a beneficial effect it exerts on the world chemical education system as a whole. It allows different education systems to be compared so that all the best features possessed by

each of them can be used to everybody's advantage. Fairly large costs borne by IChO host countries are "reimbursed" by the benefits brought by IChO: promotion of public interest in chemistry and natural science education and enhancement of the role of chemical science and industry in the life of society. Good performance of the team, or successful organization of an IChO, cause enhancement of a country's prestige in the world education space. The involvement of various chemistry-oriented institutions in preparation for IChO has a stimulating effect on their research and educational activities.

As to IChO participants, along with knowledge augmentation during preparation for IChO, they receive increased attention from the world chemical community, which promotes their future academic success. Also, an important role belongs to contacts established during IChOs by participants from different countries.

In this connection, it would be appropriate to make a few remarks concerning the scientific fate of IChO winners of past years. Virtually all of them enter universities and, after the Olympiad life, need to undergo a process of psychological adaptation to the student's and scientific life. The success achieved at the Olympiad does not automatically lead to success in science, because the Olympiad life and the life in science represent two different approaches to chemistry. In the Olympiad life, everything is plain and simple: There is a problem which certainly has its solution. By contrast, in science, the problem should be formulated, and it is unknown a priori whether it has a solution or not. Most of the former IChO winners were able to quickly understand this; now, these are good young scientists who successfully defend their theses and continue their work in science. Many of the Russian team members at IChOs of 2001–2003 are now Candidates of Sciences (chemical or physical-mathematical); virtually all of them have been working in Russia. They continue their Olympiad life, now as teachers. For example, at the Moscow IChO-2007, three of the former IChO winners of recent years coached the Russian team, and another two were engaged as the IChO Scientific Committee members. Thus, the community of highly qualified chemistry teachers in Russia recruits its new members after each International Chemistry Olympiad.

Today, it cannot be predicted how long this prosperity will last. Gradual degradation of the system of chemical and natural-sciences education, inevitable in the "age of USE," will sooner or later affect the top-level Olympiads. The flexible system of training of creative personalities, being spoilt by directive measures, will fail some day. Still, we prefer to be optimistic about future and expect that chemical Olympiads will become specifically the "locomotive" that will push forward Russia's education system via identifying talented young people and stimulating their strive to creativity and cognition of the world.

CONCLUSIONS

(1) The International Chemistry Olympiad is the event that marks the culminating point in the worldwide system of national chemistry Olympiads. It helps enhance friendly relations among young people from different countries and encourages cooperation and international understanding.

(2) The International Chemistry Olympiad was established by socialist countries and, over its more than 40-year history, has become a prominent and prestigious event of global significance.

(3) The International Chemistry Olympiad is a complex multilevel event having its clearly defined rules, goals, objectives, and strategies. The IChO organization and holding require combined efforts to be undertaken by major governmental agencies and top-level research and educational centers.

(4) Russia holds one of the leading positions in the International Chemistry Olympiad system due to many years of successful performance of its national team members at IChOs and excellent organization of IChOs in 1996 and 2007.

(5) The International Chemistry Olympiad, with its intrinsic scientific creativity, undergoes today a crisis associated with excessive formalization of IChO problems. This situation calls for new approaches, which goal is expected to be achieved at the IChO-2013 in Moscow.

(6) The International Chemistry Olympiad produces a major stimulating effect on the national chemical education systems. The IChO preparation activities, as well as participation in, and particularly conductance of an International Chemistry Olympiad, are helpful in training top-quality scientific and pedagogic staff.

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