

THE 4th EUROPEAN GIRLS' MATHEMATICAL OLYMPIAD

Luxembourg Leader's Report

Ein Luxemburger'sches Fräulechen-Porträt.

In mid-April 2015, Belarus hosted the fourth European Girls' Mathematical Olympiad (or EGMO to its acolytes), following onto the previous editions of this competition in the United Kingdom in 2012, in Luxembourg in 2013, and in Turkey in 2014. Minsk welcomed 109 contestants from 30 countries, among which were 24 contestants from 7 guest nations from all over the world.

At EGMO 2015, Luxembourg was represented by one contestant. The team leader was Pierre Haas. Charles Leytem, Luxembourg's representative on the EGMO advisory board, also attended the competition. More or, in many cases, less flattering mugshots of participants can be found at the official internet side of EGMO, <http://www.egmo.org>, where the interested reader may find virtually any information on EGMO, ranging from results of past competitions to detailed explanations, cast in soporific legalistic parlance, of what constitutes "force majeure". For those whose intellect craves for something beyond sobre statistics of results, the present report aims at giving a more buoyant description of EGMO.

As its mother competition, the International Mathematical Olympiad (IMO), EGMO is a competition among individuals engaging in the chivalrous fight for shiny metal, but a ranking of nations is published and carefully scrutinised by team leaders. It has been pointed out that Luxembourg has held for many years the position of the leading Grand-Duchy at these competitions. In 2015, the Luxembourg contestant won a bronze medal:

		P1	P2	P3	P4	P5	P6		
LUX1	Tara Trauthwein	7	2	0	7	1	0	17	Bronze Medal

For each problem, a maximum mark of seven points was available. This constitutes an excellent performance for a small country such as Luxembourg: Tara beat all the contestants from much larger countries such as Belarus, Belgium, Italy and the Netherlands that, unlike Luxembourg, sent a full team of four contestants to the competition.

A Brief History of EGMO

The first question about the European Girls' Mathematical Olympiad clearly has to be: why is there such a thing? The reason is simply that, over the past years, about one in ten participants at the International Mathematical Olympiad has been female (although some of the most successful IMO contestants of all time have been female). This is clearly undesirable¹; mathematical competitions for girls therefore aim to encourage more girls to take part in mathematical olympiads. One of oldest of these competitions is the Chinese Girls' Mathematical Olympiad (CGMO). EGMO is the brainchild of Geoff Smith, the leader of the team from the United Kingdom at IMO, and its first edition was held in Cambridge (the real one, not the one in Massachusetts, and not the homonymous hamlet in Gloucestershire either) in 2012. The second edition was held in Luxembourg in 2013, followed by the third edition in Turkey in 2014. Belarus hosted the 2015 edition that is the object of the present report, and future editions will take place in Romania in 2016, and Switzerland in 2017. Ultimately, however and in the words of Ceri Fiddes, competition director at EGMO 2012, EGMO will have been a success when there is no longer any need for it.

The format of EGMO is that of IMO: contestants sit two four-and-a-half-hour papers consisting of three extremely tough mathematical problems on two consecutive days. In a process called coordination, an intense communion between the team leaders and deputy leaders on the one hand and experts from the host country on the other, an integer mark out of seven is assigned to each problem. Medals are awarded to approximately half of the contestants; half of the medals are bronze medals, one third are silver, and one sixth are gold medals. Contestants who do not receive a medal, but solve one question completely, are awarded an honourable mention.

¹A caveat applies: the Dutch leader at EGMO and chair of the EGMO advisory board, Birgit van Dalen, has related that, when she participated in mathematical olympiad training camps as a student, boys got crowded into shared dorms, whereas she, being the only female participant, had a room all to herself.

The reason why this competition is a European one is more mundane: sending teams all over the world to participate in a mathematical competition is expensive. Nonetheless, it is heartening to see so many non-European countries wishing to send guest teams to EGMO, and it is hoped that, in this way, EGMO will spawn off many daughter competitions in other parts of the world, just as EGMO itself was modelled partly on CGMO.

Leader's Diary

Mathematical competitions are best related to others in the form of a leader's diary on the events that may or may not have occurred during the competition. What distinguishes the present diary from its highly biased counterparts is the lack of the desire, on the part of the author, to represent his actions in as favourable a light as possible. Caveat lector.

Tuesday, 14th April 2015. The EGMO journey began, somewhat predictably and at an ungodly hour, at Luxembourg airport, whence the first uneventful leg of our journey took us to Vienna. At the gate for the flight to Minsk, we were greeted by a rather bleary-eyed team from the United States, and soon thereafter, the teams from Bulgaria, Switzerland and Norway turned up. This was rather reassuring: we were heading in the right direction. The landing in Minsk was of the more interesting variety: after several high-altitude manoeuvres, the pilots started a descent that involved hard braking in midair and sharp descents, followed by the plane accelerating again. Eventually, we touched down to be greeted by snowfall on the ground. I started to realise that my choice of clothing for the week had been somewhat optimistic.

One more hurdle was left to be negotiated before we could enter Belarus: the acquiring of a visa². Armed with our passports, visa forms, photographs, proof that we had acquired health insurance and an invitation letter bearing the signature of the deputy minister of education, we approached the consular office at the airport not without some trepidation. In the end, everything went smoothly, and we were issued visas. (Crossing the border itself was an entirely different matter however, for the border guards appeared unconvinced by our health insurance.) Having finally negotiated this rigmarole, we were welcomed by the guides, chosen among students studying to be interpreters. Their English was excellent.

The bus journey into the centre of Minsk took some time, and I fell asleep after we passed a monument to honour the Fallen of World War II, thus missing the chance to catch a glimpse of the National Library, an edifice the architecture of which has divided opinion (justifiably so, as far as I could judge from photos that I saw later). After lunch, we were taken to our accommodation in a student hostel. The rooms were basic, but warm and clean. (Although five star hotels on the Turkish riviera make for a nice extra at an EGMO, this kind of accommodation is perfectly adequate.) As I descended the stairs, humming, to meet up with Charles Leytem in order to go for a walk, one of the women working at the hostel gave me a rather scandalised look. I only realised later that, inspired by the post-communist feel of the place, I had been humming the anthem of the Soviet Union. No diplomatic incident was caused.

Belarusian cuisine involves lots of excellent cabbagey salads and soups (of which I am rather fond, although my digestive tract is not). At dinner, we were made to fill in a form to choose what we would eat for lunch over the coming week. Somehow, this did not surprise me. (In fact, the next day, when I tried to match dishes to their descriptions on the form to make sure I only partook of food that I had signed up for, I came to realise that not all dishes were available every day, and so people just helped themselves to whatever they felt like eating. This kind of thing is of course very upsetting for mathematicians who generally prefer to make detailed plans and stick to them.) It also transpired that the EGMO contestants are of a very much more practical disposition than their leaders: I complained about the duvet covers which I believed to be one-sided. More enterprising contestants had ascertained that they did in fact contain a small opening into

²For countries that have a Belarusian embassy, higher consular fees apply at the airport. Since Luxembourg does not however have a Belarusian embassy, we were able to acquire visas at the airport at the fees that would normally be charged at embassies abroad. (In fact, the Belgians later told us that their fees had been completely waived by the ambassador, on the grounds that the purpose of their visit to Belarus was participating in a youth competition.) A more complicated situation arose for the Norwegian team, who wanted to acquire a group visa at the airport: Norway does not have a Belarusian embassy, but their deputy leader holds a Finnish passport (and was therefore charged a more extortionate visa fee). To complicate matters further, one of their contestants holds both a Norwegian and a Russian passport, so was in fact eligible for a lower visa fee. As a result, the consular officer got confused, and was unsure what fee to charge for this nationally heterogeneous group visa.

which one could insert the duvet. When I was an undergraduate, one of my lecturers (whose research is on the dynamics of ice sheets) showed us a picture of himself on a field trip in the Arctic, carrying a gun to fend off curious polar bears. He quipped that this was not something taught in the Mathematical Tripos at Cambridge. Although the days where bedders would make students beds at Cambridge are long gone, this made me realise that dealing with recalcitrant items of bedclothing is not a skill taught in the Tripos, either.

Wednesday, 15th April 2015. The shower basins in our rooms were very much like square bathtubs, although there were railings that could in principle (but did not) hold a shower curtain. These railings appeared to be rather precariously fastened to the walls, so I decided to hold on to the washbasin while climbing out of the shower. This turned out to be a mistake, for the washbasin had a pronounced amount of horizontal leeway.

The agenda of the first jury meeting featured two items: first, approving the election procedures for the advisory board (a rather uncontroversial item, although, for lack of candidates, nothing came of the election announced for later during the week), and second, approving the papers set by the Problem Selection Committee³:

Day One

Problem 1. Let $\triangle ABC$ be an acute-angled triangle, and let D be the foot of the altitude from C . The angle bisector of $\angle ABC$ intersects CD at E and meets the circumcircle ω of triangle $\triangle ADE$ again at F . If $\angle ADF = 45^\circ$, show that CF is tangent to ω .

Problem 2. A domino is a 2×1 or 1×2 tile. Determine in how many ways exactly n^2 dominoes can be placed without overlapping on a $2n \times 2n$ chessboard so that every 2×2 square contains at least two uncovered unit squares which lie in the same row or column.

Problem 3. Let n, m be integers greater than 1, and let a_1, a_2, \dots, a_m be positive integers not greater than n^m . Prove that there exist positive integers b_1, b_2, \dots, b_m not greater than n , such that

$$\gcd(a_1 + b_1, a_2 + b_2, \dots, a_m + b_m) < n,$$

where $\gcd(x_1, x_2, \dots, x_m)$ denotes the greatest common divisor of x_1, x_2, \dots, x_m .

Day Two

Problem 4. Determine whether there exists an infinite sequence a_1, a_2, a_3, \dots of positive integers which satisfies the equality

$$a_{n+2} = a_{n+1} + \sqrt{a_{n+1} + a_n}$$

for every positive integer n .

Problem 5. Let m, n be positive integers with $m > 1$. Anastasia partitions the integers $1, 2, \dots, 2m$ into m pairs. Boris then chooses one integer from each pair and finds the sum of these chosen integers. Prove that Anastasia can select the pairs so that Boris cannot make his sum equal to n .

Problem 6. Let H be the orthocentre and G be the centroid of acute-angled triangle $\triangle ABC$ with $AB \neq AC$. The line AG intersects the circumcircle of $\triangle ABC$ at A and P . Let P' be the reflection of P in the line BC . Prove that $\angle CAB = 60^\circ$ if and only if $HG = GP'$.

³Unlike IMO, where the six problems that make up the contest papers are selected from a shortlist of thirtyish problems by the team leaders, at EGMO, the Problem Selection committee actually sets the papers (with a list of backup problems in case any problem gets rejected on the ground of being already known). While this has its advantages (for instance, at IMO, the team leaders do not have that much time to select the problems so that the final selection might not be that well balanced), the Problem Selection Committee might blunder, which happened at EGMO 2014, and set papers that are far too hard. To reiterate a point that I have raised previously, some external control of the papers before the first jury meeting (e.g. by the EGMO advisory board) might therefore be desirable in the future.

These problems were proposed by Luxembourg, Turkey, the United States, Japan, the Netherlands, and Ukraine, respectively. Approving the papers took some time: it was blatant that the jury wanted some time to have a go at the questions before approving them. This left me with enough time to convince myself that the second question was easy. I was wrong, and the question later turned out to be harder than the more approachable fifth problem. The final steps of the argument were probably even harder than the (rather more technical) third problem on the paper. The suggestion of the Hungarian leader (which was, however and predictably, shouted down) to swap the problems of the two days therefore had some merit, although he argued that the first problem was harder than the fourth problem. While, as the author of the first problem, I was of course biased in that respect, I felt that the fourth problem was much more unusual than the first one. (Concerning the fourth question, I pointed out to the jury that a simpler yet superficially similar problem had appeared in a Kazakh Olympiad a couple of years ago, but it was judged to be sufficiently different.)

The opening ceremony was rather excellent: although the pair of compères were, unsurprisingly, the kind of people who use too much hair pomade and manage to keep the corners of their mouths level with their nostrils while speaking, the speeches (including one by the Minister of Education) were appropriately short. In the intervals between the speeches, pupils from local schools did some fabulous dancing. One performance involved three people, each dancer holding two sticks connecting him to the other two. They would then jump over the stick held by the other two, and perform more contortions of that ilk. It is clear that the organisers put a lot of effort into this ceremony, and that effort was well spent.

The English Language Committee was chaired by the US leader: the British leader had not arrived yet (since the team from the United Kingdom had missed their connecting flight at Frankfurt, and thus been stuck in Frankfurt overnight), but I made sure that “orthocentre” was spelled in the British way (and I learnt later that Joseph Myers had been sending frenzied emails extolling the virtues of British spelling from Frankfurt). The discussion of the wording of the questions confirmed my earlier impression, that this year’s jury was of the more verbally incontinent variety (although, as Charles Leytem happily reminded me, my own contributions did not contribute to dispelling that impression). The translation of the papers into the different languages revealed the jury to be astonishingly polyglot, and quite a few leaders made learned contributions to the Japanese translation.

Thursday, 16th April 2015. The walk from the hostel to the nearby school where the contest papers were to be sat involved crossing a couple of major traffic axes, but there was a seemingly endless supply of pioneers from said school, fetchingly clad in their uniforms, to take us to the school and help us negotiate the vagaries of the Belarusian rush hour. For the first half hour of the contest, the jury was crammed in a classroom to answer any questions that contestants might have about the contest problems: in most cases, this is an opportunity to learn about innovative ways in which one might misunderstand one of the problems. One of the more amusing questions concerned the first problem: a contestant submitted a diagram of the setup, and asked whether her diagram was right. The only possible answer was “No comment.” Back in the jury room, the team leaders approved the mark schemes for the problems of the first day. The experienced coordinators are those who know that the best way of getting the jury to approve their mark schemes is to come up with long mark schemes and talk through in painstaking detail.

Tara emerged from the contest room wearing more layers of clothing than she had taken into the unheated exam room at the beginning⁴. More importantly, she had solved the first problem, combining geometric reasoning with trigonometry to such devastating effectiveness that I immediately forgave her this unwonted foray into non-synthetic geometry.

Since the first problem had been submitted by Luxembourg, I also had to mark the scripts of the host country. I prepared for this task by joining Tara and the Swiss team on a trip to the city centre, and trying to decipher as many Cyrillic street signs as possible. Clearly, the olympiad was making a big splash in Belarus: a large banner advertising EGMO had been spanned across the проспект next to the central post

⁴Many mathematical olympiads get the temperature in the exam room wrong: casting my mind back to my own days as a contestant, I am reminded of the astonishing prowess of the air conditioning system at IMO 2007 in Vietnam. Most people made repeated trips to the toilets because they were slightly warmer. Of course, there is a certain romantic appeal to the rougher exam conditions of yesteryear: in the nineteenth century, the mathematics exams in Cambridge took place in January in the unheated Senate House. In some years, it was so cold that the ink froze in the inkwells.

office, whither we had been conveyed after buying postcards and a detour to a stunningly beautiful Orthodox Church and a predictably tawdry souvenir shop. Talking to Stephanie Zbinden, the veteran on the Swiss team, I was faced with something of a language barrier: what I believed to be *Schwyzerdütsch* (and therefore could not understand a word of) was high German in her book. (Later, some other members of the Swiss team confessed to me that they had trouble understanding her, too.)

Back in the jury room, the scripts of the first day were waiting for us. Of course, reading geometry scripts in a foreign language is, by far, easier than trying to understand combinatorial essays, say. There were some excellent solutions from the Belarusian teams that involved spotting an external angle bisector; thus, the one word of Belarusian that I had to look out for was *бісектрыса*. Rather more surprisingly, some of the scripts were successful at bashing the problem in Cartesian coordinates. Checking such calculations is about as painful as coming up with them, which is why I had to decline an invitation by Mark Saul, the US observer, who was going round the jury room, inviting the leaders to sample locally distilled beverages.

Friday, 17th April 2014. Many contestants were nervous about the phrasing of the fifth problem, and sought reassurance from the jury (some of this confusion might have been avoided if the jury had not decided to recast the problem as a game between two players – I opposed that change because I felt that players in a game should do similar things, which Anastasia and Boris do not). One contestant asked for the definition of the orthocentre of a triangle. My suggestion (“the isogonal conjugate of circumcentre”) received polite laughter, and a more sensible definition, in terms of the intersection of the altitudes of the triangle, was sent out. (After the first day of the contest, some contestants had complained about the toilets at the contest facility; apparently, there were some doors missing, or something of that ilk. Fortunately, none of them took up my suggestion of wreaking havoc by sending a query about these issues to the jury.)

The cultural highlight of the day was a trip to the Minsk Bolshoi theatre. The standard of the dancing, was, unsurprisingly, fantastic. (The same could not be said of the dancing of the Belgian contestants, who, tremendously overexcited by the contortions of the prima ballerina, pirouetted through the foyer during the intervals. Fortunately, the non-EGMO theatre-goers were either far too polite to frown at this kind of behaviour, or had been warned about the presence of a large number of mathematicians.) The programme consisted of three parts, starting (as far as I could judge without the help of a programme) with a story about some princess who welcomed Prince Charming to her castle. Their (premarital) bliss came however to an abrupt end when some unsavoury characters threw him from the battlements, while of course dancing to the tune of the music⁵. In the second part, the dancers did their thing to the tune of some music from the German Romantic era and against a foresty backdrop, and the third part was a rather militaristic ballet to the tune of Ravel’s *Bolero*, set against the backdrop of Picasso’s *Guernica*: culture galore, although the connection between these elements is not entirely obvious to me. Leaving the theatre, Jo Harbour, the UK leader (who had obtained a programme brochure) confirmed my interpretation of the first part of the ballet. Jo lives in Cambridge, and, a couple of weeks before the EGMO, we met by chance in Sainsbury’s. A rather surreal conversation ensued: “Are you going to Minsk?” — “I am indeed, are you?” — “Yes I am, see you there!”.

Returning from the trip to the theatre, I read through Tara’s work (and reflected on the luxury of having a one-contestant team). I was struck again by how neat her work was, despite the fact that it was very much written in the stream-of-consciousness style. I wonder what Sigmund Freud would make of her work (or indeed of my own, very much more doodly, mathematical scribblings).

Saturday, 18th April 2015. Coordinating Tara’s work went very smoothly (a welcome change from my last, rather painful and confrontational coordination at EGMO 2014), and I found the coordinators to be well prepared. Those leaders who spend several hours discussing the scripts of their contestants on Problem 2 (and were welcomed to the jury room by a round of applause when they finally agreed on marks) probably do not share that opinion, however.

⁵I am not, generally, overly fond of ballet – give me a good opera any day. The one saving grace of ballet is, however, that its characters generally look the part. For instance, as pointed out by the great comedian Anna Russell, sopranos playing Mimi, or Violetta, or other consumptive maidens do not look the least bit consumptive (and are not often maidens anymore by the time they are vocally equipped to sing the parts), and the right bodily shape to produce tenor sounds is rarely visually pleasing. Prima ballerinas, on the other hand, do tend to look suitably consumptive.

The final jury meeting, at which the medal boundaries were decided, was rather embarrassing: the regulations state that approximately half of the contestants (from the “official” teams) should be awarded medals. Applying the rule would have put the cutoffs at eleven or twelve points. Some team leaders, who happened to have contestants with ten marks, immediately spoke in favour of choosing an even lower cutoff, at ten points. This kind of behaviour (incidentally an almost perfect replica of what happened at EGMO 2014) is not very helpful, and my inner turmoil at this hullabaloo is best described by the German neologism “fremdschämen”, which lacks an English equivalent. (It is worth pointing out that, despite having a contestant with ten marks, the UK leadership abstained in the final vote. Charles Leytem called them the “last honest people on Earth”.) After dinner, the Belgian contestants convinced me to take part in a game of ninja; this involves standing in a circle, and, everyone at their turn, lunging at the others and trying to touch their arms. I extricated myself from the game as, predictably, the injury toll started to rise. The US observer Mark Saul had organised another of his soirées, and a small group of leaders and deputy leaders philosophised into the wee hours of the morning.

Sunday, 19th April 2015. The buses that were to take us to the castle of Mir, a remnant of the olden days when part of Belarus belonged to the Grand Duchy of Lithuania, departed at a rather early hour. In common with IMO 2007 in Vietnam, our bus convoy had a police escort, but the Belarusian drivers actually heeded the orders that the police gave them. I slept soundly for most of the journey, enabling Tara to take several inappropriate pictures of me displaying the full range of awkward facial expressions that result from sleeping in a sitting position.

After a guided tour of the interior of the castle, we explored the ramparts and the towers, which allowed us to make an interesting physiological observation: the steps leading up to the top of the tower were rather high. Charles Leytem and I are tall enough to climb them as one would climb normal steps, but Tara had to almost pull herself up the stairs. The next day, both Charles Leytem and I suffered from sore vasti (they are thigh muscles — believe me, I looked up them up), while Tara was fine. There are of course two possible conclusions: either it is just better to pull yourself up high stairs rather than to try and climb them, or Tara is simply in better physical shape than Charles Leytem and me.

The restaurant where we had lunch was too small for the entire EGMO crowd, and so we were shepherded to the centre of Mir, to look at the remnants of the yeshiva of Mir (a centre of Jewish learning that was famous enough to have its own Wikipedia article). Most people were, however, rather more interested in the offerings of the farmers’ market that was taking place in the central square. The Belgian team purchased a somewhat large amount of radishes. Perhaps this explains why, when our turn to lunch finally came, the Belgian contestants did not want to eat their salads. I thought they looked rather nice, so, ill-advisedly, I wolfed down three of them. (I am talking about the salads, mind you!)

The closing ceremony featured a novel twist: not only were the medal winners and awardees of honourable mentions invited onto the stage to receive their gongs and certificates, but also the leaders and coordinators got to parade across the stage and receive certificates of participation and a round of applause. (This reminds me, probably rather inappropriately, of the movie “Comrade Don Camillo” with Fernandel, where the narrator points to the virtues of getting people to clap their hands all the time: that way, everyone knows what to do with their hands.) The highlight of the ceremony was the speech by Birgit van Dalen. When the compères announced that the chair of the EGMO advisory board was about to deliver her speech, a look of surprise stole over her face. Fortunately, she had to pause to allow her speech to be translated into Belarusian, which left her with enough time to make it up as she went along. Everyone stood while the Belarussian anthem was played. The closing ceremony then ended with a performance by some girlie band who waggled contraptions that reminded me of oversized Aida trumpets. Given that they had been selected to represent Belarus at the Eurovision contest, their singing was surprisingly pleasant.

The buffet dinner was excellent. Although the traditional food was slightly on the greasy side, there was ample opportunity to dance afterwards (yet another striking parallel to the movie “Comrade Don Camillo”). I even took off my jumper. A last look at the posters with some (very) random facts about the countries that participated in this year’s EGMO, and we retreated to the hostel. I ended up playing a board game with Tara and assorted members of the Dutch and Finnish teams. As often happens with these kinds of

games, it came with a complicated set of rules and tactics that everyone else was very familiar with, and they relished telling me at the end of the game that I had committed a crucial mistake in the first round, and thereby given the game away.

Monday, 20th April 2015. If one stays in Belarus for more than five days or so, one has to register with the local police station. We did not, but the organisers had issued us with official-looking letters bearing (yet again) the signature of the Deputy Minister of Education. Again, we approached the border guards with some trepidation, but we did not need the letter in the end. We thought that was about as exciting as returning from Belarus could become. We were of course mistaken. As the plane started its descent towards Frankfurt, the landing gear was deployed, and suddenly, the engines roared and the plane took off again. The cabin crew's message ("As you may have noticed, we had to abort our landing. Please wait until the pilot has time to explain to you what happened") was not exactly reassuring. The whole thing would of course have been even more exciting if the landing strip had already moved into view, but there was nevertheless a certain amount of *frisson*, although Charles Leytem did his best to lighten the mood by regaling us with stories of rough or emergency landings he had experienced. In the end, it turned out that the previous plane had not cleared the runway in time. We landed in Frankfurt with little time to spare. Thanks to Murphy's Law, the metal detectors beeped when Tara and I went through the security control (yes, they made us pass another security check). I was told that I had walked through them too fast; in Tara's case, it was the medal in her bag that the machine was not happy about. But then again, I am sure it could cause a lot of damage if dropped onto someone from a height.

Fortunately, Luxair waited for us. The flight to Luxembourg was extremely short, leaving barely enough time for the cabin crew to serve a bottle of water and a chocolate bar. Once arrived in Luxembourg, I ceremoniously handed Tara's scripts back to her, and we parted ways. To paraphrase Tolkien: "Well, here at last, dear friends, in the arrivals hall of Luxembourg airport, comes the end of our fellowship."

I am left to thank the organisers of EGMO 2015 and all those who, notwithstanding those minor hiccups that I have highlighted or made up for comic effect, contributed to making the olympiad such a terrific success. Last but not least, I would also like to thank Tara, for being very pleasant company, and for defending our national colours so valiantly.

A couple of weeks after EGMO 2015 finished, Dan Schwarz died. He has been a stalwart of the mathematical olympiad community, and contributed scores of problems to various olympiads; in fact, several of the problems that Luxembourg submitted to EGMO 2015 were by Dan Schwarz. His approach to mathematical olympiads and his unfailingly sensible contributions at jury meetings were a great inspiration for inexperienced young team leaders such as myself. I think that Geoff Smith's valedictory comment was perfectly appropriate: "If there is an afterlife, the conversation there just improved."

Cambridge, 16th July 2015.