Observations

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The 2011 IMO in the Netherlands

My friend and colleague James Cranch has written his UK leader's report for 2011, and there is no point in duplicating it. I was struck when reading his document how differently we experienced IMO 2011, even though we lived through the same events.

James Cranch, Jack Shotton and Sally Anne Huk did a disturbingly good job of leading an excellent UK team. The students were a credit to their families, their schools and themselves.

Watching all this reminded me of the time when I visited my home university in the middle of a sabbatical. It is clear that my impact on the place had been significantly less than the ripples on a pond from the dropping of a small pebble. I recommend such an experience to anyone who harbours the delusion that they play a crucial role in a large system.

Tuesday July 12 Today I am flying to Amsterdam for the 52nd IMO. I have been UK IMO leader for the past nine years, and this year will go as Observer A (Observer with Leader). This year James Cranch takes over as UK Leader. I plan no outright acts of sabotage of James's efforts, but of course I will be looking for weaknesses.

Over in Cambridge, the Australian and UK IMO teams are contesting the annual *Mathematics Ashes*. I expect to receive a text giving the score round about the time I land in Amsterdam.

I catch a taxi to my local airport, Bristol International. The plane is running slightly late, and there is a delay in announcing the gate. When the information comes through, I scuttle there as quickly as possible, for I have paid for *early boarding*, a sort of pretend business class for *arrivistes*. To my horror I discover that boarding has already started. It seems only fair that

everyone should be recalled to the gate, so that I can be allowed on first. However, survival instincts kick in, and I say nothing, but glare resentfully at the easyJet staff who have stolen my moment in the sun.

I manage to stow my hand-luggage easily, so all is well. I am met at Schipol by a member of the Dutch IMO crew. She escorts me to a leaders and observers A holding area, where I am the unique specimen in that category. There are half a dozen Dutch crew, so I am feeling well cared for. Overheating is a problem, until a kind soul pours some water into my radiator.

After a few minutes, the bus is ready. I take a short walk to discover that I have it all to myself. This seems like pretty good service. The bus driver tells me that we are waiting for the Austrian leader. I know Robert Geretschläger well, and have no objection to sharing a bus with him.

At length, a posse of Dutch crew emerge from the terminal, providing a guard of honour for Robert. The crew get on the the bus too, and we head south for a conference centre hotel called the Konigshof which is due south of Eindhoven. We are worryingly close to the Belgian border, not far from the one of the world's most successful experiments in fractal political geography, Baarle-Nassau.

The conference centre is a sky-scraper on its side. The carpet is therefore correctly placed on the wall facing the ground, and is colour coded, so you can tell which part of the complex you are in. There is an unfortunate design error in that although the building goes sideways, the lifts go up and down. This is pointless because there are only two floors. The lifts should have been installed sideways too, so that we could be dragged from the dining room to the jury hall and vice versa. Alternatively, a small train, or even Konigshof space hoppers, would have been useful.

By now the news has come through that the Ashes exam was a 66–66 tie. This means that the UK will retain the trophy, and it is a particularly pleasing result since it will generate the maximum possible frustration among the Australians.

On arrival in the hotel I meet UNK7 James Cranch. He hands me the shortlist, and I quickly discover the news that a question I submitted, C3 (the windmill), has made the shortlist. I designed the problem in May 2010. I tested it on a few trusted IMO experts in the UK, and none of them solved it, so I am amused to see that it is classified as C3, a designation appropriate for an easy or easy-medium combinatorics problem.

The problem is based on the idea of a rotating line, and was specifically designed as a windmill problem for the Dutch IMO. I must not tell anyone

that I am the author of C3 because the jury must choose the problems without such knowledge.

The evening is splendid, seeing so many good friends again. The list is far too long. Rozemarijn Schalkx from the IMO office is good value.

Wednesday July 13 Today the Advisory Board met from 9am until about 6pm, with a break for lunch. We listened to presentations from countries offering to host future IMOs in the morning. I was delighted that these presentations were all sensible, and that nobody tried to impress us with overly polished bland nonsense. Instead everyone stuck to the key issues: funding, availability of co-ordinators, accommodation, facilities, location, safety and transport.

During the winter of 2010–2011, following an initial approach from the Dutch IMO 2011 organization, Google made a gift of €1 million to the IMO to support the hosting of IMOs 2011–2015. At that stage, the IMO was starting to look a bit fragile. We had no host countries lined up beyond Argentina in 2012. Now we have hosts for all IMOs up to 2015. Of course this is a complicated business, and one cannot simply attribute any particular offer to host the IMO to the Google Gift. However, it seems clear that Google's contribution has helped the IMO through the difficult years in the wake of the global financial crisis.

After lunch the IMO AB settles down to IMO Foundation discussions. Until now, the IMO had no continuing existence between competitions. Each IMO was a completely independent entity. This has advantages: you cannot sue the IMO, the IMO cannot revisit the decisions of previous years, and any financial problems are localized to a particular year. Moreover, not having significant money means that loot does not arise as a subject for unsavoury disputes. There are disadvantages too. The lack of a continuing existence has inhibited the growth of IMO support structures, except the web presence and Matjaž Željko's technical roadshow. Any funds raised hitherto were for particular IMOs, and not for the continuing IMO movement.

The IMO Advisory Board is now setting up an IMO Foundation to administer the Google Gift and any other future donations. We have decided to appoint people who have a record of having good relations with commerce and industry, rather than respected IMO elders. This is because we hope that the Foundation will encourage other organizations to support future IMOs on the Google model. The Foundation is a permanent legal entity, with its address in the Netherlands, and is subject to Dutch law. Its role will be purely supportive, so if there is a major problem with a future IMO, the

Foundation will not be legally responsible. The IMO jury elects members of the Advisory Board. Those IMO AB members will be the *Supervisory Board* of the IMO Foundation, setting policy, and appointing the IMOF management board. The *Management Board* of the Foundation will conduct the day to day business of the Foundation. We also had discussions concerning other important issues.

In the evening I discover that other leaders and observers are purchasing beers by using circular pieces of plastic. Initially I assume that these tokens are the so-called 'euros' which dominate the financial press, and are used to mediate exchange in parts of continental Europe. In fact I am wrong, and (at the time of writing) the euro coins are made of metal. It turns out that our excellent IMO hosts have issued beer tokens, which can be exchanged for refreshments. More precisely, they have issued them to everyone except me. My welcome pack was absolutely standard, except for the absence of beer tokens. By grovelling nicely in the IMO office, I get my little circular disks, and all is well. Many thanks.

I have considerably more faith in the organizers of IMO 2011 than I do in the *European Central Bank* and, unsurprisingly, the Copernicus-Gresham law[1] applies. After a few days, the plastic coins will disappear, to be replaced by euros. People will hoard the plastic IMO 2011 coins, along with gold and platinum, as security in an uncertain world.

Thursday July 14 The first jury meeting is at 9:00am with Hans van Duijn in the Chair. Hans is the principal of the Technical University of Eindhoven. I met him before, during the jury phase of IMO 2009 in Bremerhaven. Hans is very sound, and will use his professional skills to great effect, lending gravitas to the proceedings. He is flanked on the rostrum by Tom Verhoeff and Quintijn Puite, who actually know what is going on, and more to the point, what should happen next.

We dispose of a few problems as being 'known'. There is some discussion of the shortlist, and in the afternoon the beauty contest is held. This is a secret poll which informs much of the subsequent debate. Leaders are asked to express their views as to the difficulty of the problems, and their suitability for the IMO. Dinner is at Hans's TU Eindhoven; music, wine and free food. What more could you want? The only possible answer is a late-night jury meeting.

We return to the Konigshof and initiate the said meeting. The jury starts

[1] Bad money drives out good.

to choose problems for positions 1 and 4, but there is a difficulty. The powerful geometry lobby would love to put an 'easy' geometry problem on the paper. There are only two possible candidates, G1 and G2. However, G1 contains an elephant trap into which at least half the IMO is likely to fall: it is a very easy matter to look at the diagram, write down some attractive algebraic consequences, work with the algebra to make it look even better, massaging and manipulating to make the formulas progressively more attractive, until you get stuck. You can then spend a happy but fruitless hour burrowing around, trying to negotiate an algebraic way forward. Read what is says on the tin: this is a geometry problem, and algebra is not enough. Instead you have to make an interesting and unusual geometric observation which will unlock the problem. If this goes on the paper in an 'easy' position, there will be blood, sweat and tears, but not necessarily in that order. There would be zeros stretching from Eindhoven to Amsterdam.

On the other hand, G2 is not quite classical geometry. You have a configuration involving a lot of symmetry, and a wonderful algebraic consequence which is an expression of that symmetry. I really like this result, but it seems that it has only moderate support. It is a genuine theorem, not a result about an artificially constructed configuration. It seems quite likely that it has appeared somewhere, but finding it proves difficult. The reason is that all forms of plane geometry have become very unfashionable, and few mathematics journals will publish such results. As you go back in time, however, there was greater interest. Indeed, in the 19th century, it seems that both Euclidean and projective geometry were popular leisure pursuits among the educated classes. Both old and recent results are therefore hard to track-down. You might find geometry results in *The New England Journal of Wedding Cake Decoration* or *The Bohemian Geometer, 1873*.

Eventually G2 is excluded by an exocet from the French Observer, Johan Yebbou, who discovered G2 published as a theorem in a French journal dated 1918. Now, a few years ago, an IMO jury decided that one could be a little bit relaxed about the originality of problems 1 and 4, because of the difficulty of finding completely new 'easy' problems. However, the geometry lobby clearly does not regard this is a proper geometry question, and few leaders rally to its defence.

Finally, someone suggests that both A1 and C1 may be too easy properly to belong on the shortlist. You can guess what happened next.

Friday July 15 Today we first address the hard problems, and then the mediums. The geometry lobby is in a frenzy, and must be satisfied. The

jury selects the wonderful G8 and A6, a demanding algebra problem. If you were going to be left alone for a week on a desert island, with geometric instruments and a plentiful supply of paper, then G8 would be an ideal companion. It is a very classy result, but I doubt that many people will solve it in four and a half hours.

Next the jury addresses the medium problems. No number theory problem is on the paper yet (unless you count A1, which is quite plausibly also N0). The jury selects N5 as a medium problem.

Now the jury has a dilemma. All those delicious combinatorics problems are waiting there on the shelf, dripping in cream with side-orders of strawberries. At the same time, so far there is only one geometry problem on the paper, and there are plenty of jurors who view the selection of at least two geometry problems as a human rights issue. The geometry support eventually coalesces behind G4, an attractive and demanding problem. The combinatorics support rallies behind C3, the windmill.

I have let it be known to friends that I have a problem in contention, but of course did not reveal which one. After many rounds of voting, and tactical switching of support, the final result is 47–46 in favour of C3. The jury, guided by wise words from experienced leaders, decides which problems will be set on which days. Then the chair reveals that the six selected problems have been donated by: Mexico, UK, Belarus, Iran, Iran and Japan. The word gets around some of my friends that I am the author of C3, and there is much shaking of hands.

The geometry lobby is most dangerous when wounded, and it seems perfectly possible that we will have three geometry problems in 2012. Of course, other people will be arguing that it is now a new IMO tradition that we have two combinatorics problems on the exams.

To be serious, it is clear that some people were very disappointed that only one geometry problem appeared on the papers. Many countries put a big effort into geometric training. In the UK the task of pushing geometric reasoning had been delegated to me! I know that the Colombians, the Saudis and many others had made a significant effort to develop their students' geometric skills.

A Modest Proposal In the past, the unwritten and non-guaranteed covenant between the jury and the candidates has been: at least one problem of each of the four main types, and two geometry problems. The jury usually selects

problems as, two easy, two hard, and finally two medium. The process has become rather swift, and perhaps a little too efficient.

I wonder if the jury might consider varying the covenant as follows: problems 1,2,4 and 5 will be one each of the four main types, with the selection of 3 and 6 based simply on the quality of the available submissions. The advantage is that everyone is guaranteed an accessible problem to suit their tastes.

In order to accommodate this new covenant, the jury might first select the problems for 1,2,4 and 5 as a single choice. This could be done by selecting two problems of each type (one easy and one medium), giving rise to $\binom{4}{2} = 6$ menus for the four relatively accessible problems on the paper. I propose that the jury study these 6 menus at length, and eventually make a choice by elimination (informed by the knowledge of which hard problems are attractive and popular).

The purpose of this proposal is to stop the jury digging itself into a hole as I think it did in 2011. However, it would be wise to be flexible in the choice of protocols, because in some years there are both few easy and few hard problems, and we have very many medium problem proposals. In such circumstances, our current procedures seem well suited to deal with the selection process. **End of proposal**

Next the jury gets stuck into notation. It is impossible to satisfy everyone, since notation differs so widely around the world, but Hans tries. When that matter is finally settled, it is time for the official language versions to be produced in English, French, German, Russian and Spanish. In some years the notation is sorted out first at the ELC, but not this time.

James Cranch, UNK7 will be the chair of the English Language Committee. I am looking forward to the entertainment. In an act of uncharacteristic compassion, I have given him some good advice: find the most pedantic English speaker, and make that person the secretary of the meeting. This neutralizes the character most likely to disrupt proceedings. Quite often, the leader of New Zealand fills this important post, and with Chris Tuffley here, there is no question.

On reflection, I can see that there is scope for the creation of other positions to neutralize a few more eloquent nuisances. Computer liaison officer, microphone holder, projector monitor, bar manager and laundry officer. These leaders are very clever people, and if you do not give them things

to do, they will dream up absurd ways to misinterpret the wordings of the questions, forcing everyone to revisit text which is already perfectly good.

James makes a very good job of getting the ELC to agree sound wordings for the English language versions of the questions. I can see that he can do all aspects of the job of UK leader at least as well as me. I pretend to be pleased about this.

Saturday July 16 We approve official language versions, and revisit Problem 4 because Chris Tuffley has spotted a plausible way to misread it. We make a big fuss about this, but clearly not all leaders will get the message, because a lot of students will query their own language versions of Problem 4.

This circus continues for much of the day, but at 2pm I escape to a private meeting called by IMO 2011 supremo Wim Berkelmans to do the final pieces of paperwork to construct the IMO Foundation. The elected members of the IMO AB are there, together with a Dutch lawyer from the well-known company Stibbe. He is wearing a suit which looks as if it costs about a month of my salary, and I daresay he bills at €500 per hour. Anyway, this nice lawyer is donating his services to us, so we are getting excellent value for money. We sign the documents, and Wim produces Champagne and desserts. I am particularly grateful, having forgotten to eat lunch.

In the evening we start to hear presentations from problem captains concerning the marking schemes. Many leaders are feeling quite frisky, so there are lots of interventions and suggestions from the floor.

Sunday July 17 Overnight, the co-ordinators have clearly worked out how to manage the jury. The marking schemes are presented in relentless narcoleptic detail in a dull monotone. It begins after breakfast, and proceeds at uniform pace until lunchtime. It is not designed to put the jury to sleep, but rather the jury is never actually given the chance to wake up. This is no bad thing, because the marking schemes seem to be very well thought-out, and the important thing for the jury to do in this situation is to shut up.

Hans van Duijn is in his element. As a vice-chancellor, he has almost limitless experience of sitting through tedious meetings, giving the illusion that his mind is engaged in the matters under discussion. No doubt he is really musing on the things which vice-chancellors really think about: sports complexes, new libraries and how to get rid of the most irritating members of his professoriate.

In the afternoon we get on buses and go to Amsterdam for the opening ceremony. It is a pleasure to exchange waves with the UK team, to see our Observer C, Sally Anne Huk. Ceri Fiddes is making a flying visit to the

IMO to drum up business for the European Girls' Mathematical Olympiad http://www.egmo2012.org.uk/ which will be held in April 2012. Countries which want to send teams but which have not yet registered should contact info@egmo2012.org.uk as soon as possible. I can see Ceri upstairs, she has already switched delegations and is with UNK7 James Cranch on the balcony. I now have the ultimate IMO AB privilege and sit in the front row. The teams parade, escorted by some remarkable dancers called ISH.

We transfer back to Eindhoven, this time with Ceri. There is much excitement in the bar that night. The final of the women's soccer world cup is on the television: Japan versus USA. We do not seem to have any Americans in the bar. No doubt Zuming Feng and Steve Dunbar are in their rooms, munching peanut and jello sandwiches, and cheering on their team. However, we do have Yuji Ito, Observer A from Japan. When the Japanese women win the match on penalties, Yuji acquires the status of Japanese mascot, team coach and personal representative of the Emperor. Everybody wants to buy Yuji a drink, and with characteristic generosity, Yuji wants to buy one back for everyone he can find.

Monday July 18 This is the day of the first exam. There are only a few questions. In the afternoon there are outings, but I am uninterested in learning about my colleagues' appetites in that degree of detail, and so I go to sleep.

In the early evening, Ceri gives a short presentation on EGMO attended by quite a few leaders. It seems that EGMO will be a success. The student experience side of IMO 2011 is under the direction of the excellent Birgit van Dalen. Birgit has also agreed to join the EGMO board

`http://www.egmo2012.org.uk/organisation/`

which bodes well.

The scripts arrive in the evening. James Cranch seems pleased with the performance of the British team. I invite you to look at the national results sorted by the performances on the various problems.

Tuesday July 19 This is the day of the second exam. There are 189 questions of clarification from students. Most questions concern Problem 4. Are you counting the final configurations (no), or the ways of achieving final final configurations (yes)? The electronic hook-up works well, and the jury clears the questions in about 90 minutes.

We transfer to Amsterdam and move into the Novotel with the students. This is a classy joint, and arranged in the usual vertical posture appropriate

for a city centre hotel. It is delightful to meet the British students, the excellent UK deputy leader Jack Shotton, and Sally Anne Huk our pastoral Observer. I am introduced to the UK guide, Vicky Simon-Akerboom. Good name that. I am pressed as to what I think the cut-offs will be for the various medal boundaries. Fortunately my guesses will prove fairly accurate.

Only Andrew Carlotti has managed problem 2. None of my geometry training sessions had contained anything about rotating lines. Can nobody take a hint?

Wednesday July 20 First day of co-ordination. James and Jack go to work. We have no lunatic scripts, so the marking is straightforward, and they have no need of me. We get marks which match our expectations very closely. This shows the advantage of having detailed and specific mark schemes.

Thursday July 21 Second day of co-ordination. More of the same.

Friday July 22 The final jury begins with the sad news that no fewer than five friends of the IMO have left this year, including Jacqui Lewis from the UK. We stand in silence to remember.

The chief invigilator and chief co-ordinator give presentations, but this has been a brilliantly organized IMO and there are no serious issues to discuss.

The jury agrees the medal boundaries, and text messages start to fly.

In the afternoon, we have the IMO excursion. The Dutch organizers clearly do not have my personal needs in mind when the outing to the *Nemo* Science Exhibition was planned. I go for linen tablecloths, string quartets, heavy cutlery, good claret and strong cheeses. No luck this time.

It begins with a bus ride into central Amsterdam, which is all very satisfactory. After that, the game is to walk around Amsterdam for 90 minutes. I find a congenial pub, and nursing a beer, snatch some welcome naps in a comfortable armchair. A man with tatooed legs sits on the sofa opposite, and I pass this observation to the staff after he leaves his camera behind.

The rest of the UK group return, and we take a boat tour of the canals of Amsterdam. At least four of the team are asleep for most of the trip, slumped in a heap like baby hamsters, in recovery from late night card games no doubt.

The plan is now to walk to the party at Nemo across Amsterdam. There are plenty of people who seem to think I am not capable of such a major hike (including me, but don't let on). I send the main party off to make the journey via the interesting central square. I have a map, there is plenty of time, and I need some exercise rather badly. I plan a geodesic route, and gently amble to the Nemo Science Centre which seems an excellent venue

for a party for teenage mathematicians. There is good food on paper plates (shudder), seating if you are alert, and what passes for music if you have a generous spirit.

I sit outside for a while, both to escape the cacophony, and to savour the secondary cigarette smoke which can always be found close to Balkan leaders. It has been 20 years, but those neural pathways of pleasure are still there. When it starts to rain, I board a bus in the hope that it will go somewhere quiet with a bar. It does. What an excellent place is Amsterdam!

Saturday July 23 The day begins with an extra joint meeting of the IMO AB and the jury.

The meeting gets under way with the splendid news that locations for three future IMOs are now settled: IMO 2013 will be in Colombia, very likely on the Caribbean coast; IMO 2014 will be in South Africa, most probably in Cape Town, and IMO 2015 will be in Thailand, provisionally arranged close to Bangkok.

At the request of our chair Nazar Agakhanov I give a short presentation on the structure of the new IMO Foundation, and introduce its management board, Wim Berkelmans and Steve Dunbar. This proves uncontroversial.

We continue of discussions about IMO structures. Compared with the Olympiads in other subjects, the IMO is exceptionally dependent on mutual trust, and the honesty of both participants and leaders. Any time that there is a suggestion of an irregularity, these issues will surface. It is apparent that leaders are divided over what should be done in the long term.

The jury decided to set up an Ethics Committee, a proposal first put forward in 2006.

The meeting finishes late in the morning, just in time for me to meet my old friend Vin Luthra. We were students together in the mid 70s, and he has spent most of the time since then living in the Netherlands. We have about 15 years of catching up to do, so we slip into the fancy part of the restaurant for a private lunch. We had some excellent adventures in the distant past, creating modest havoc both in Australia and India. We are politely interrupted by a German film-maker who is making a documentary on the celebrated IMO star Lisa Sauermann. I agree to give an interview after lunch.

In the afternoon we have an excellent medal ceremony. All the British students have at least an honourable mention, and we have two gold medals.

There are lots of key people there from behind the scenes and also from TV. Lambert van der Bruggen was there from ORTEC, a company which

was helpful to IMO 2011 in more ways than can be acknowledged in public. Robbert Dijkgraaf, the media specialist for maths and science in the Netherlands seemed to be at all our events. Mark Jansen was there from Google, along with the Mayor of Amsterdam.

The handing out of gongs goes smoothly, and *victor ludorum* Lisa Sauermann receives a laurel crown, and gets a hug from Christian Reiher. One wonders how long Lisa's amazing IMO record (one silver and four golds) will last as the supreme performance. Peru's Raúl Arturo Chávez Sarmiento already has bronze, silver, gold, and he is young enough to snatch Lisa's crown if he can perform reliably.

After the ceremony, there was a party outside, with a BBQ and music. The *Golden Microphone* was won by the leader of Brazil, Nicolau Corção Saldanha. This award is for the leader with the most prolific verbal incontinence, and this year the prize was richly deserved.

The students eventually return to the hotel. It is the final evening of the IMO, and as I board a lift to go to my room, it is invaded by students. The lifts are large and the students are small, so you can get plenty in. Individually IMO students are relatively harmless, but they are nearly at critical mass.

The doors close. One of the students points at me and says "Do you know who this guy is? He is the author of *the windmill*". They swivel as one, pairs of resentful eyes staring intently. I once visited a crocodile farm near Darwin, Australia. At feeding time a dead chicken would be banged against the bank, and all the crocs in the pond would rotate, aligning towards the chicken. For some reason, this memory flashes through my mind.

I back away, pressing myself against the rear of the lift. I disarm them by affecting humanity, and ask if any of them had solved Problem 2. They shake their heads in unison, locked in sychronized left-right rotation, characters from a 50s B movie called *Revenge of the Teenage Zombies*. I pretend sympathy for a few seconds until the lift doors open, and I plunge through them at speed.

Sunday July 24 The brilliant organizers have laid on buses to the airport every half-hour. I take one, and have a relaxed flight back to the UK. Happily this time the early boarding system works, and I am able to stow baggage and get a seat before the chaos begins.