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GEOFFREY J. BUTLER: SUMMERS ON OLYMPUS

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My first contact with Geoff Butler was by long distance telephone early in the spring of 1981. He wondered whether I would join him in taking a team of Canadian high school students to the International Mathematical Olympiad.

This would be the first of three occasions on which Geoff and I would collaborate in this way. Since these Olympiads constituted my main contact with Geoff and represented at least three intense months of both our lives, this paper will be devoted to a glimpse of this activity and what it reveals of Geoff, not as a researcher, but as a problem solver and friend of students.

By 1981, Canadian participation in the IMO had been mooted for many years. Begun in 1959 in Eastern Europe, the Olympiad gradually drew in Western countries including the U.S.A. in 1974. Murray Klamkin had been pressing the Canadian Mathematical Society to sponsor a Canadian entry, and the 1981 Washington location with the prospect of minimal travel expenses presented a not-to-be-missed opportunity.

Having been on the Alberta High School Mathematics Prize Examination Board for some years, Geoff was no stranger to competition activity. He became chairman of the Canadian Mathematical Olympiad (CMO) when it moved to the University of Alberta, and accepted the unexpected challenge of entering the IMO . His two obvious choices as allies, colleagues Murray Klamkin and Andy Liu, were already coaching the U.S. team, so he had to look elsewhere and came round to me.

Money had to be raised and a training session organized. We met our financial obligations with the help of the governments of Ontario and Alberta, as well as some private foundations. As for the training session, the University of Saskatchewan agreed to extend its seminar for winners of the CMO so we had almost two weeks to work with the fourteen students, eight of whom constituted the team. Let me introduce the members: Georges Gonthier, a Montreal student attending Galois' school Louis le Grand in Paris, and David Ash

from Thunder Bay were undoubtedly the most talented. Other strong students were Cary Timar from Sarnia, John Chew from Toronto, Julian West from Vancouver, David Bernier from Quebec City and two from Old Scona Academic High School in Edmonton, Arthur Baragar and John Bowman.

The Saskatoon training session was one of the most satisfying experiences of my career. With Roger Servranckx (department chairman) looking after general care and feeding, Geoff and I devoted our entire attention to the training sessions. Each day, the focus was on a particular topic: plane geometry and transformations, solid geometry, trigonometry, algebra, number theory, combinatorics and inequalities. Each weekday consisted of: an hour quiz to test basic background, a lecture on the topic of the day, an open discussion on contest problems, an hour test and criticism of written work. Geoff and I spotted each other. While one worked with the students, the other looked up problems, prepared tests, assignments and solutions, and marked student scripts. On the weekend, we gave them the "Sunday collection" of extra difficult challenge problems. I am amazed now at the territory we managed to cover and how well the students got along with it. Although we had noble plans for improvements in the following years, we never recaptured the sense of achievement and exhilaration of that first year.

It was not as though there was no recreation. This was in the early days of the interactive computer and "Dungeons and Dragons" was the rage. I had a forewarning of the implications of this, since I had met some of the students the previous year at the CMO seminar in Toronto. The students had pressed to be allowed access to the computer, and, once on, were essentially lost to the seminar by the allure of the games. The threat was clear in Saskatchewan. They would have access only in the evening, but in no case after midnight. The deadlines were enforced by Professor Servranckx who could tap in with his modem and punish any infraction with a permanent shutdown. In this way, the students were encouraged to get enough sleep to keep the training on track. On Dominion Day (July 1), we all went to Batoche, the decisive battlefield for the Second Riel Rebellion in 1885, with a stopoff at the home and studio of a Metis artist and a picnic supper which ended abruptly in a fast-developing prairie thunderstorm.

The students acquitted themselves with seriousness, spirit and enthusiasm. One evening, they disappeared downtown to buy specially designed team t-shirts for themselves, the coaches and Professor Servranckx, each with a Canadian flag on front and the wearer's name on back.

Finally, we had to meet our American hosts in New York. Our arrival probably caused more inconvenience than that of any other team. While other competitors managed to arrive during the day at Kennedy airport, the best we could manage from Saskatoon was to get into LaGuardia after midnight. Nevertheless, an air-conditioned bus was on hand to ferry us to Rutgers University, where the team and deputy coach would be housed before going to Washington for the examinations. As chief coach, Geoff was taken to join the jury at Fredericksburg, Virginia, to help prepare the examinations. We would not meet again until the students had finished writing. As Geoff explained to me later, the jury meeting turned out to be a fractious and chaotic affair carried on in English, generously sprinkled with French and German. From up to five problems submitted by each country, the U.S., as host, selected about two dozen for consideration. It was necessary to find three problems for each of two $4\frac{1}{2}$—hour examinations written on consecutive days. Subject matter and difficulty were matters of contention, with each coach trying to ensure at least one medal for his team. Powers of negotiation and compromise were tested by arriving at official wordings in the four official languages, English, French, German and Russian.

The competition was at Georgetown University in one of Washington's notorious heat waves. Geoff warned me that the papers seemed easy—he had resisted choosing some questions for this reason—and he was right. On the day of the second examination, we went an hour early to lunch to avoid the crush of students expected at 1:30. Imagine our surprise when we found half the team already in the cafeteria! They responded to our remonstrations with the assurance that they had done everything, and, on the whole, the scores bore this out. There were two perfect scores (Gonthier and Ash) and the other scores were high enough to put us seventh in a field of close to 30 countries.

In fact, Julian West had also written a perfect paper on the second day. On the first day, however, one of the problems was combinatorial. I should explain that each student script is first marked by his own

coaches and then taken before a three-man board of coordinators for verification. Geoff and I found Julian's solution to this problem thoroughly incomprehensible, despite a suspicion that he might have had something. We shared our bewilderment with the coordinators, but as no insight rewarded the combined efforts of the five of us, we had to settle for a grade of 2 out of 7. Later on, we got Julian to explain it for us; if only he had committed his ideas to paper, he would probably have gained an additional four points.

The Americans treated us royally—a dinner theatre production of "Camelot," a Netherlands Ballet performance at the fine country auditorium at Wolftrap (which unfortunately succumbed to fire not long afterwards) and an impressive closing ceremony at the National Academy of Science. Two of our boys were interviewed on an American national network morning show.

Geoff was again in charge of our team for the 1982 IMO in Hungary. Our travel expenses were considerably reduced by the fact that only four, rather than eight, students were invited. Training was combined with the CMO seminar at the University of Calgary under the supervision of the two of us, with some assistance from Robert Woodrow and Richard Guy. Because of continued uncertainty about our participation during the year, we simply took the top four scorers on the CMO which turned out not to be the best choice, as we realized when we actually met other possible contenders. By the time Geoff and I got the team for training, the members were tired out by seminars at Waterloo and Calgary, as well as all-night sessions with Dungeons and Dragons; the training was much less satisfactory.

One problem at the training session, from the 1978 IMO , caught our imagination and Geoff came up with a detailed analysis. The result was an anonymous proposal in the Canadian Mathematical Bulletin:

P. 329. *Proposed by Mary Agimo, Calmonto College, Last Spike, Alberta.* Let τ be the golden ratio; that is, τ is that positive real number for which $\tau^2 + 1$. Prove that, for $n = 1, 2, 3, \ldots$,

$$[\tau[\tau n]] + 1 = [\tau^2 n].$$

Is τ the only real number for which all these equations are valid? ($[\cdot]$ denotes the greatest integer function.)

REMARK. This problem was suggested by the following 1978 International Mathematical Olympiad problem: *The set of all positive integers is the union of two disjoint subsets* $\{f(1), f(2), \ldots, f(n), \ldots\}$. $\{g(1), g(2), \ldots, g(n), \ldots\}$, *where* $f(1) < f(2) < \cdots < f(n) < \cdots, g(1) < g(2) < \cdots < g(n) < \cdots$ *and* $g(n) = f(f(n)) + 1$ *for all* $n \geq 1$. *Determine* $f(240)$. [**1**].

While the location of the proposer is pure whimsy, the reader can get a clue to the name and institution by recalling that we were training for the Magyar IMO and that the universities in *Cal*gary, Ed*mon*ton and Toron*to* were involved.

Since Geoff was once again on the jury to select the problems, he went to Hungary a couple of days before the team and myself. As opposed to what occurred in the US, I was separated from the team on my arrival and taken to join him for the jury's final deliberations, which were more expeditious this year. A little bus conveyed myself, family and other deputies across the Hungarian plain past fields of towering sunflowers to a country town called Cegled. This town's place in history had been assured by a sixteenth century peasant revolt led by a citizen, George Dhosa, which was commemorated by a monument in the town square. We visited a local wine cellar and collective farm.

In Budapest, we were put up at Zoltan Schőnherz College, a highrise residence of the Budapest Technical University, while the students were about three or four miles away. We were issued identity cards and room keys, the latter attached to varnished wooden blocks at least an inch cube. Whenever we went out, the key had to be surrendered to a dour porter in a cage by the entrance. Geoff, with his English background, complied. When he later tried to retrieve it, he found that he needed his identity card. However, the card had been left in his room, for which, of course, he needed the key. Geoff's reaction to this situation, determined through a protracted transaction with the porter who seemed to know no language but Hungarian, was a combination of annoyance at the inconvenience and bemusement at the viciousness of the circle. Eventually, with the help of an English-speaking clerk, a happy resolution of this affliction was negotiated.

The team, as anticipated, did not do as well and came in seventeenth. Since I had my family with me, I did not see Geoff much apart from

marking and coordinating. He enjoyed himself, exploring the streets, parks and cafés of Budapest. On Sunday, students and delegates were taken to visit a town of Young Pioneers, a camp for Communist Youth from around the world on the shore of Lake Balaton. There was a lot of weekend traffic and, on the way back, our bus was held up inordinately long at one intersection while a cop gave the right of way to cars entering from a side road. The bus driver was doing a slow burn. Eventually, when we were allowed to proceed, he drew up next to the cop, opened his window, and delivered a broadside of evidently deeply-felt invective. The cop merely looked sheepish and registered some relief when we went on our way. I do not think a Canadian cop would have been so passive, but, as Geoff and I agreed, perhaps there are cultural differences between East and West in dealing with the police.

My final collaboration with Geoff was with the 1983 Olympiad in Paris. This time, we tried to select the team on the basis of more evidence, and so we sent out a regular set of problems to about two dozen students during the year. Of course, we had our usual problems with funding, but this time there was a most singular occurrence. Up to this point, repeated approaches to the Canadian federal government had been entirely fruitless. However, in Paris, an official of the French government had casually remarked to a Canadian diplomat how pleased he was that Canada was sending a team to the IMO . The diplomat was caught by surprise and contacted Ottawa for clarification. Eventually, some bureaucrat found Geoff and heatedly asked why the Canadian government had not been informed. Geoff, restraining the annoyance which was later evident to his Edmonton colleagues, managed to make clear that we had been trying to get through to the government for the better part of a decade. The bureaucrat softened. "How much money are you short?" After a quick calculation, Geoff mentioned $3400. Sure enough, it came through! Geoff and I were delighted to have penetrated a wall! But the following year, the government returned to its adamant refusal. On the grapevine, we discovered that the key to this extraordinary offer of assistance was the location—France. It seems that the federal government was afraid that its rival in Canadian-French affairs, the Province of Quebec, might provide a grant and they would be out in the cold. However, their fears about Quebec were groundless.

We had quite a good team this year. However, it was not possible to extend the CMO seminar at Queen's University into a training session, since the IMO was earlier then usual. We had a couple of days in Toronto, and then, to counter jetlag, arrived in Paris a few days early for a bit more training. The six-member team we took was more broadly representative of Canada than the previous year when it was all from Ontario. Since I kept a diary in 1983, I will quote a few passages to give a flavor of the experience:

June 29, *Wednesday.* Arrived on time in Paris CDG [Charles de Gaulle airport] after good flight. M [a student] left passport in suitcase which I had to retrieve for him so he could get through passport control, which meant going wrong way on moving passageways. We realized how lucky we were when we found out that M's suitcase had arrived; S's and C's didn't make it and we had to fill out a claim form. Off to hotels—very satisfactory next to Invalides: Hôtel du Grand Palais and Hôtel de l'Empéreur, both pension-type places with ≥ 5 storeys each and quite narrow. Visit to Eiffel tower in evening for break; could only go to second storey because of repairs, but it afforded a very good view of Paris.

Geoff graciously volunteered to give up his position as chief delegate so I could experience the process of making up the examination. Accordingly, he was ensconsed with the students at the site of the competition at Louis le Grand school, while I went to the Pedagogical Institute at Sèvres, which had been built as a residence for Louis XIV with the garden designed by Mme. de Pompadour. Finally, on July 6, the opening ceremonies occurred in the Grand Amphitheatre in the Sorbonne and the students wrote the first examination. In the evening, there was a treat.

July 6, *Wednesday.* Ballet at the Opéra in the evening—absolutely magnificent building with impressionist painting on ceiling offering contrast to more formal and detailed carving of boxes. Paid franc to lady who found seats—"service!"—a new wrinkle for me and so was surprised not to have to pay attendant in washroom. Programme consisted of Capriccio and Agon by Stravinski and the Prodigal Son by Prokoviev, in homage to Ballanchine. The dancing was marvellously fluid and light, almost playful at times, but also deeply moving as in

the depiction of the degradation of the Prodigal Son and his enfolding by his father in the final scene. Agon seemed mixed, but pas de deux in middle sequence was most effective.

At the performance, since the second examination had yet to be written, the jury sat in a separate section of the hall from the students and deputy coaches.

July 7, *Thursday.* Removal from Sèvres and installation at Louis le Grand. Had a look over students' performance on first two problems and did not find them encouraging. Later, all problem sets were available and Geoff and I spent the evening on them. All students performed badly—they had ideas but did not pull them together or were careless. .... As Geoff put it, "I know how a politician feels when his party has just lost an election." It is hard to explain. We had a better team than in Hungary; the problems are meant to be easier, but we may well end up doing worse.

July 9, *Saturday.* Compared to other countries, we came out better than we expected—fourteenth, one point behind the Finns and one ahead of the Poles, with the West Germans a remarkable first with 212. Lost my 10 F bet with Klamkin that some American would get 42 [Murray had been complaining about what he regarded as a less than sterling performance of his team], also the 10 F pool on number of 42s [perfect score]—I bet 3 and there were 4. After a rowdy jury meeting which lasted over 6 hours with break for dinner, settled on award of medals. They stuck to tradition by giving medals to half the students—15 points or more [out of 42]—but stiffened up on the gold (≥ 38) and silver (≥ 26), which unfortunately cut Piotte [a Canadian team member from Montreal] from silver .... Had some Constitution dollars left over after giving to delegates, so gave one to each of perfect scorers.

In the morning, Geoff and I had a chance to walk along the Seine by stalls of magazines, books and prints. Opposite were several pet stores selling such things as swans, peacocks and chickens. I cannot imagine the market for these can be very large. We visited St. Germain and St. Eustache, walked around the Bourse du Commerce and lingered

at the Forum development which is replacing les Halles. Quite a striking addition to the landscape. Was not so impressed with Georges Pompidou Centre, which looked like dry-cleaning establishment. Both places admirably suited to impromptu performances—a mime at the Forum and a demonstration of Turkish dissidents at the Centre.

The reference to the Constitution dollars is to the special dollar coin issued by the Canadian government that year. It was customary for each delegate to provide a small gift to each of the other coaches. In Washington, we gave maple sugar; in Budapest, prints of Group of Seven paintings from the McMichael Gallery near Toronto, and in Paris, the silver dollars; the organizers in each country got Canadian Broadcasting Corporation records. In return, we received contest books, records and small pieces of ethnic art.

Finally, the prizes were awarded in the Grand Amphitheatre, to be followed by a reception.

July 11, *Monday.* Reception at the Hôtel de Ville—somewhat disappointing. The mayor was not present, so a representative gave a decent brief address and then turned the crowd loose on the refreshments—all on a single long table—open-face sandwiches, champaigne and orange juice. Geoff and I took Gonthier [who by now was studying at the Sorbonne and was a member of one of the coordinating panels] and Christine [each team was assigned a counsellor, and she was ours] off to a sidewalk café for a snack. We each had a "formidable"—an enormous mug of beer which seemed to offer the only promise of relief on a stinking hot day.

July 12, *Tuesday.* Since only a few countries were going to Charles de Gaulle airport, we had to get a bus at 7 a.m. to accommodate the East Germans with a 9:45 flight (ours was at 11:50). Problems rounding up G. who had not packed, and C. . . . , so by 7:20 with a busful of people waiting, I eventually went up and gave both hell. More problems at the airport when M. and S. went off to do shopping and I had to go through passport control to retrieve them. A little hard on the nerves and I made a few more intemperate remarks. Perhaps it is really time to pass the torch to someone else.

As it happens, I had one more International Mathematical Olympiad and it was Geoff who passed the torch. By this time the University of Alberta had run the Canadian Mathematical Olympiad for three years and the University of Western Ontario was to take over. Geoff did remain on the IMO committee and helped with the correspondence programme during the following year.

During these summers on Olympus, I attained a solid appreciation of the greatness of Geoff Butler. There was a consistency between his approach to mathematics and to life generally. A man of temperate and tolerant disposition, he maintained a strong curiosity, a zest for incongruity and persistence to understand what puzzled him. As an administrator—and the IMO did generate a fair bit of administration—he was quietly effective at bringing pieces into place. While he could distance himself from whatever chaos swirled around him, he cared about and acted on what was important. He accepted people as he found them. In particular, he took personal interest in the students on our teams, knew them one by one, and encouraged them with quiet humor.

He was sometimes childlike in his mathematics. A problem catching his fancy would be taken away to explore. Later on—and I can still see the expression on his face—he would have seen through it and report with delight on some aspect found particularly surprising or enlightening. As I was later to discover when I visited his department shortly before he died, it was this same enthusiasm which informed his more significant work and seemed to sustain him in a remarkable variety of research interests and mathematical contacts, and which inspired those he worked with.

When he died, Geoff was attaining the full stride of his career, which promised in fullness of time to carry him into the ranks of Canada's greatest mathematicians. Yet, in honoring Geoff, we honor also Karen for her faith and support, the children who meant so much to him, and the department whose friendship and vitality nourished his mathematical achievements. As the conference in his memory demonstrated so well, Geoff was an active part of a mathematical community, and it is through this community that his work and influence shall live on.

I dedicate this article to Geoff Butler, a great man and a great mathematician.

REFERENCE

1. Problem **P. 329**, Canad. Math. Bull. **26** (1983), 507.

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