Olympics in Mathematics

American students do well in international competition but their schools receive little of the credit

by Dietrick E. Thomsen

Hungary is a small country in central Europe. It has only a few million people, has never been very rich and has not enjoyed anything like great-power status since the last Hapsburg emperor. And yet little Hungary in one generation produced a statistically surprising number of people of first rank in mathematics and mathematically related sciences. Asked how this phenomenon came about, one of them replied: "In those days in Hungary the schools were so bad that anybody who wanted to learn anything had to do it himself."

Fifty years after that remark applied, Hungary is one of three countries considered perennial serious contenders for first place in the International Mathematics Olympiad, an annual competition for secondary students. (The other two top contenders are the Soviet Union and the German Democratic Republic.) The United States is a large country with over 210 million people. It has enjoyed great power status and remains—if somewhat precariously—very rich. Question: Can students from the United States compete in the math olympiad with students from little Hungary? Answer: Quite well, but they don't credit their schools with helping them much. In the United States in those days the schools were so bad. . . .

The sixteenth international math olympiad was held on July 8 and 9, 1974, in Erfurt in the GDR. It was the first time Americans had been invited to participate, and they went with some trepidation amid predictions by prominent educators that they would do badly. In fact the eight members of the American team, the late Gerhard Arenstorf of Nashville; David Barton of Berkeley; Paul Herdeg of Hamilton, Mass.; Eric Lander of New York; Stephen Modzelewski of Pittsburgh; Thomas Nisonger of Bethesda, Md.; Douglas Oman of Berkeley, and Paul Zeitz of New York, came in second in the field of 18 nations. (Last week Zeitz won the $10,000 top scholarship in the nationwide Science Talent Search competition, SN: 3/5/75, p. 153. Lander won it in 1974.) The Soviet Union was first; Hungary was third. For the record Mongolia was last.

So why the preliminary pessimism? First of all there is a great philosophical gulf between the American high school and the European lycée or gymnasium. The American school considers itself a preparation for life and spends time on skills such as driver education. The European attitude is that life prepares for life, and the gymnasium is strictly an academic institution that provides for some of its pupils a finishing liberal education and for others a preparation for the university, which they tend to enter at a much higher level than American high-school graduates. Mathematics is a most academic subject, and the Europeans were expected to be sharpshooters. What is treated as almost a miracle is that the Americans were too.

The schools don't get any credit. In preparation for the olympiad a three-week training session was led by Samuel L. Greitzer of Rutgers University, director of the U.S. national math olympiad, and Cecil Rousseau of Memphis State University, assistant director of the national olympiad. The 24 students who participated were asked where and how they obtained their mathematical competence. "Overwhelmingly," Greitzer reports, "they said they learned *in spite of the school*." Contact with other gifted students or access to a college library were among the influences cited. There was little or no guidance. The training session itself was credited by the team members with a large assist toward their red-ribbon showing in the international competition. Some said it was the first time they had come into contact with certain facets of mathematics and methods of mathematical proof.

But wait. Wasn't there a revolution in the American mathematical curriculum some years ago? The birth of a new math that was supposed to make Hilberts and von Neumanns out of first graders? Well the new math gets dumped on by the students and the professors alike. It seems to them tautologous to teach people to figure in binary or octal arithmetic when they can already do it in decimals. After all nobody balances a checkbook in binary fashion.

What do the students want in place of the octals and the binaries? More plane geometry. That's right—plane geometry. The dullsville stuff that relevant curricula were going to get rid of. One student complained of an inability to visualize problems in solid geometry; it wasn't taught in his school. Greitzer pleads for more geometrical insight, pointing out that European schools teach geometry throughout the secondary course. In general the U.S. curriculum needs more of the fundamentals of orthodox mathematics, he feels: number theory, combinatorial analysis, work with inequalities, training in problem solving. He opposes such express-train innovations as teaching calculus in the last year of high school, believing the time better spent on the theory of limits as a preparation for calculus in college.

The new math just does not make good mathematicians, Greitzer avers. He cites the Bronx High School of Sci-

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Typical questions from the International Mathematical Olympiad

In the triangle ABC, prove that there is a point D on the side AB such that CD is the geometric mean of AD and DB if and only if

$$\sin A \cdot \sin B \leqq \sin^2 \frac{C}{2}.$$

Determine all possible values of

$$S = \frac{a}{a+b+d} + \frac{b}{a+b+c} + \frac{c}{b+c+d} + \frac{d}{a+c+d}$$

when a, b, c, d are arbitrary positive numbers.

Let P be a non-constant polynomial with integer coefficients. If n(P) is the number of distinct integers k such that

$$[P(k)]^2 = 1, \text{ prove that } n(P) - \deg(P) \leqq 2,$$

where deg(P) denotes the degree of the polynomial P.

. . . Math Olympiad

ence as an example. Entry to Bronx Science is by competitive examination, and the school recruits its pupils from the best of the mathematically and scientifically minded in New York City. Surely they should do well in competitions. But, says Greitzer, Bronx Science "went wild about the new math." He blames that enthusiasm for the result that it didn't have anybody place in the first 25 in the national olympiad.

Meanwhile there have been changes in math curricula in Europe, but they tend more in the direction of the fundamentals of orthodox mathematics, and that is reflected in the kind of problems posed in the international olympiad. Still, with gifted, self-motivated students, plenty of self-study and a good training session, Greitzer believes he can field a team that can compete with the Europeans. The 1975 international olympiad will probably be held in Sofia, Bulgaria. Greitzer hopes for a "miracle" similar to 1974. □