Education

US students gain bronzes in first crack at Physics Olympiad

Ask any American about the International Physics Olympiad and the response is likely to be a vacant stare. In Europe and some Far East countries, however, the event sometimes receives the recognition usually given the Olympic games. Modeled on those venerable and venerated Olympic contests for gifted athletes from all over the world, the Physics Olympiad was first run in 1967, but until last July no American had taken part. Now, however, US high school students are considered worthy competitors, for three young Americans have taken bronze medals in the Olympiad their first time out.

It is something to celebrate. "We are right to be proud of our team," says Jack M. Wilson, executive officer of the American Association of Physics Teachers, principal sponsor of the US team. "When the idea of entering the Physics Olympiad first came up a few years ago, many were skeptical. Someone even predicted we would end up sending a US team with 20 kids of Asian descent, all from the Bronx High School of Science."

That didn't happen. By 17 June, after three run-offs, there were 20 team members from a remarkable diversity of locations and origins. Among them were Bryan Beatty of Greer, South Carolina; Golda Bernstein of Tucson, Arizona; Cathryn Carson of Chevy Chase, Maryland; Mason Ng of New York City; David Kreithen and Sanjoy Mahajan of Pittsburgh; David Norman of Bountiful, Utah; Mikael Thompson of Fort Worth and Ali Yegulalp of Teaneck, New Jersey. "When the team list came out, the critics were silenced," Wilson recalls.

The five finalists represented the US in its engaging pluralism:

▶ Paul Graham, graduate of Cherry Creek High in Englewood, Colorado, a member of the Colorado Junior Academy of Science and a National Merit Scholarship winner, possesses among his distinctions a sharp wit. Asked in his application for any thoughts on physics, he wrote: "Reality is relative. Unfortunately, relatives are often reality."

▶ Howard Haruo Fukuda, graduate of Iolani School in Honolulu, collects football cards, postage stamps and comic books, though his most prized hobby, he indicated on his application, is computer programing.

▶ Philip Daniel Mauskopf, graduate of the North Carolina School of Science and Mathematics in Durham, spent the past two summers working in semiconductor labs, mainly in uv–visible spectroscopy; he also is a violinist with the Piedmont Youth Symphony and several chamber groups. In his application he noted: "I find the most interesting facet of physics is the comparisons and examples of discrepancies. Physics diverges to the greatest extent from 'common sense' when dealing with very small or very large-scale phenomena, or very low or very high-energy phenomena, because these are not part of everyday experience. Quantum mechanics and cosmology pose problems that cause us to contemplate philosophical questions such as cause and effect (Schrödinger's cat) and our own origin (Big Bang) in a new light, with a different viewpoint. That's why I enjoy physics, expecially theoretical physics."

▶ Srinivasan Sheshan, graduate of Thomas Jefferson School for Science and Technology in Alexandria, Virginia, sent with his application a page-long list of academic honors and accomplishments, including an IBM-Watson Scholarship, a University of California Regents Scholarship and an honor's award in the 1986 Westinghouse Science Talent Search. A resident of Reston, Virginia, Seshan is working this summer at an IBM laboratory in nearby Manassas.

▶ Joshua R. Zucker, 11th year student at Palisades High in Pacific Palisades, California, placed first in California's

Members of US Physics Olympiad team pose with Education Secretary William J. Bennett. From left to right: Paul Graham, Joshua Zucker, Bennett, Srinivasan Sheshan, Howard Fukuda and Philip Mauskopf.

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Science Day physics competition earlier this year and won a National Merit Scholarship to attend Stanford University this fall. At the age of 16 he was the youngest member of the US Olympiad team. An accomplished orator, he holds a 10–2 record in high school debating contests and placed fifth in statewide competition. His other specialties include Ultimate Frisbee, flute-playing, tennis, chess and computers.

The five finalists emerged after a grueling series of tests and trials. It is somewhat astonishing that the US fielded a team for the 17th International Physics Olympiad at all, considering its late start. The idea of entering the Olympiad was first broached by Wilson in late 1984 and brought before the Governing Board of the American Institute of Physics early in 1985. To explore the proposal the AIP board decided to send Ronald D. Edge, a physicist at the University of South Carolina, and Arthur Eisenkraft, a physics teacher at Fox Lane High School, Bedford, New York, as observers to the Physics Olympiad at Portoroz, Yugoslavia, in July 1985.

On their return, Edge and Eisenkraft wrote reports urging US participation. Despite their excitement, some board members expressed caution. Anthony P. French of MIT, for instance, examined the advantages and disadvantages of taking part in the Olympiad in a letter to board members. In it he observed that "Olympiad examinations are primarily a reflection of physics as taught in most European countries to students who have probably had at least three years of physics in high school, taught in a way to develop a high level of skill in analytical problem-solving. Similar examinations . . . have traditionally been used to select students for admission to universities. I myself came up through this route," explained French, who was born in Britain. "It was a demanding program for which I have always felt intensely grateful."

By contrast, French stated in his letter, "the high-school preparation that most students get in the US is not likely to equip them to compete successfully in such a contest. That is the main reason why, initially, I myself was quite opposed to the suggestion that the US might field a team; I could see them being clobbered. . . . Also, some people would say that the approach to physics represented by traditional European syllabuses inhibits curiosity and creative spirit, that it has little to do with learning about nature and is not the sort of example that the US should follow. So far as the *general* teaching of physics is concerned, I would tend to agree with that position" (see article, page 30).

But the question is not whether pre-college physics in Europe is different or better than in the US," wrote French, "but simply . . . whether a group of five or six bright students can be found who, with the help of some extra training, can make a good showing in the competition." The performance of US students in the 1984 Chemistry Olympiad and the Canadian team in its first Physics Olympiad last year, French asserted, convinced him that an American group "would acquit itself creditably." There are plenty of competent physics students in the US, if only they can be identified. "And such youngsters, exceptionally talented to begin with, would, I believe, revel in such competitions," noted French.

A catalyst? US participation in the Olympiads was unlikely to influence pre-college physics teaching programs in the US in any major way, French claimed, "except perhaps as a stimulus to improve their quality and quantity. So far as I am concerned, the chief consideration is what I now see as a great opportunity to increase the visibility of physics in the public eye. . . . We physicists generally do a miserable selling job on the merits of our profession and the rewards that it can bring. The public understands competitive success. We talk a lot about role models; what better role model for a teenager interested in science than someone only a year or two older who has made the headlines on that basis? We shouldn't be relinquishing all such kudos to the athletes!"

At the AIP board meeting last March, Edge and Eisenkraft gave persuasive oral accounts of the Olympiad they monitored in Yugoslavia. French remembers that "Eisenkraft's enthusiasm for the Olympiad was so contagious, we were infected there and then." A report by a special committee of The American Physical Society also recommended support for US participation. The committee, headed by Neal Lane of Rice University, suggested that AIP should take the lead in gaining wide support for the event, which already had the backing of APS and AAPT (PHYSICS TODAY, March, page 107).

In the end those three organizations were joined in sponsoring US activities for the Olympiad by the American Astronomical Society, the Optical Society of America, the American Association of Physicists in Medicine, Ford Motor Co, IBM, Exxon Corp, Duracell Inc, John Wiley and Sons, Worth Publishers and the University of Maryland.

In late March Wilson sent 20 000 letters to high school teachers and administrators urging them to nominate at least one physics student for the first round of tests. He suggested that they refrain from just going ahead and nominating their best student currently in class, but rather choose only those they regarded as best compared against the best in the past decade or so. Some schools submitted two names. The Bronx High School of Science named three.

A month later the schools administered a multiple-choice test of 40 physics questions and 2 open-response problems drawn up by AAPT to nearly 200 students in their 11th and 12th years. The 50 top scorers took another written test. From these, AAPT found 23 who qualified for the special training session leading to the Olympiad.

Of those, three were already committed to the Chemistry or the Mathematics Olympiad and therefore could not participate in the physics meet. The remaining 20 attended a ten-day training session in the physics building on the University of Maryland campus. They spent most of their days working over questions from prior Olympiads. There were also crash courses, such as a 2½-hour session on optics, which was the first time most of them had encountered the subject. "I never learned optics in school. It proved to be crucial in the Olympiad test," says Mauskopf. "I amazed myself by how much I remembered from the cram course." Zucker and Sheshan would have liked a longer training session to bone up for the Olympiad. "We felt queasy about not having more experience in the lab. We expected the Europeans to be better trained at lab work than we were," Zucker observes, "and that put us at a disadvantage." Recognizing a gap in his knowledge, Graham taught himself thermodynamics before going to Maryland.

While the group wanted to do well, perhaps even take home some medals, Eisenkraft advised the students not to worry about winning. "He told us the first year was basically a throwaway," recalls Graham. "But in our hearts we really wanted to win."

Camaraderie. When the Americans met the 100 young contestants from 20 other countries at the Harrow School, north of London, England, on 13 July, any thoughts of an intense rivalry fled. "We were among like-minded people, despite the different languages and cultures," says Sheshan. They debated Bell's inequality and the significance of the Einstein–Podolsky–Rosen paradox. Mauskopf played basketball with a youth from Poland who had been to the Olympiad in Yugoslavia the year before. The Cubans kept beating the US team members at pool. Zucker taught Bulgarians, Chinese, Cubans and Turks to play Ultimate Frisbee, resulting in one broken arm. They visited museums and historic places in London, saw the Cavendish Lab in Cambridge and ate fish and chips as part of their British experience.

After the fun and games came the tests at Harrow. The tests took five hours on each of two days. The first test consisted of three lengthy questions drawn up by the British hosts and the second was administered under lab conditions. Mauskopf wrote the answer to one theoretical question over 20 pages, setting the record for length in this year's Olympiad. He also solved one problem with an elegant use of Lagrangian equations—the only contestant to employ this technique. In one lab test requiring rainbow angles to be detected by spectroscopy in a water droplet, Mauskopf was awarded a zero for measuring the supplements of the angles rather than the angles themselves. Eisenkraft and Edge argued that the answer was absolutely correct for the supplemental angles, and the judges finally gave Mauskopf 25% for the answer.

"We didn't have any notion of how we came out until the winners were announced on the last day," says Sheshan. That ceremony took place in Harrow's New Speech Room, a semicircular hall with stained-glass windows and a pipe organ. It came as no surprise that the USSR took three of the four gold medals, while the fourth went to a student from Romania. The team from China won a silver and bronze. England and both Germanys took silver medals. Graham, Mauskopf and Zucker were awarded bronze medals, while Fukuda and Sheshan missed getting honorable mentions by less than two points overall.

"It was a satisfying, difficult competition," says Mauskopf. "If we had more experience and more training, we might have done a little better. Even so, we were happy to have done so well. To hear the other contestants tell it, in most of Europe, the Olympiad serves as a basis for a rigorous series of physics courses and exams. In our country we do things differently." "I'm glad I went and did so well," asserts Graham. He and Zucker will be attending Stanford this fall; Mauskopf is going to Harvard, Sheshan to the University of California at Berkeley and Fukuda to Carnegie-Mellon University.

Wilson, Eisenkraft and Edge are thrilled by the showing of the US team and preparing for next year's Physics Olympiad, to be held in Jena, East Germany. Says Eisenkraft: "I'm convinced the Physics Olympiad will excite both students and the system to aspire to greater achievements in much the same way that the Olympic games stimulate athletes to compete. In my mind's eye, I see physics becoming as glamorous as any competitive sport."

—Irwin Goodwin

Despite Superphénix startup, outlook for breeders is poor

Back to the Future, last summer's surprise hit science fiction movie, opens with a teenaged boy being carried back three decades in a plutonium-powered time machine built by an amateur physicist. The scientist has obtained the first plutonium fuel load for his machine by working with and hoodwinking international terrorists, who now are in hot pursuit. The boy, finding himself an awkward contemporary of his teenaged parents, plaintively asks the scientist to resupply him with plutonium so that he can be powered back to his own era. "Look kid," the scientist says, "this is 1955 not 1985 when you can buy plutonium in any corner drugstore."

The scene nicely captures a couple of stereotypes about the 1980s that became current in the 1970s—the notions that plutonium would be circulating in very large quantities by now and that it would be increasingly easy for a terrorist gang or wayward government to get its hands on enough to build more or less sophisticated atomic bombs. The realities are turning out to be somewhat different.

It is true, as anticipated, that plutonium has been piling up in alarming quantities. By the beginning of 1985 about 300 metric tons of plutonium had been discharged in spent fuel from conventional reactors in the non-communist world alone, according to calculations by David Albright, a physicist who does research for the Federation of American Scientists in Washington. Of that amount, about 60 metric tons had been separated from the spent fuel at major reprocessing facilities, enough plutonium to build 7500 Hiroshima-size atomic bombs.

Nevertheless, contrary to predictions confidently made in the immediate aftermath of the 1973–74 oil shock, plutonium is not coming into commercial use at anything like the rate expected. A number of major countries already have decided to forgo fuel reprocessing and plutonium recycling altogether, and in a number of other countries that have been firmly committed to the commercial use of plutonium, commitments are increasingly controversial. The case for using plutonium has lost force partly because world uranium prices are currently very low and are expected to remain low for many years, and partly because the technologies that employ plutonium are proving to be more expensive than their promoters had hoped they would be.

The possibility now exists that the use of plutonium will level off at a rather low plateau for several decades, rather than increase geometrically as expected, and that has important implications for energy policy and the international nonproliferation regime.

For those who have been concerned that the growing use of plutonium would undermine the international safeguards system, which is designed to provide the world with timely detection when plutonium or U^{235} is stolen or "diverted" from peaceful uses, it is good news that the plutonium economy is growing much more slowly than expected. For those, on the other hand, who have staked their careers on the expectation that plutonium would soon become the dominant source of cheap electricity, the current situation is a bitter disappointment.

Ironically, the changed prospects for the commercial use of plutonium have become apparent just as the French are commissioning the most advanced piece of equipment based on plutonium, the 1200-MW Superphénix fast breeder reactor, the world's first full-scale commercial breeder. When construction began on the Superphénix ten years ago, its builders thought that it would be the prototype for a series of breeders that would be deployed throughout the European community by the end of the century. As the situation looks now, the Superphénix seems much more likely to stand isolated for some decades, a unique and brilliant feat of

Isotopic composition of plutonium discharges

Reactor type	Plutonium discharged Net kg Pu/GW_e-year	Typical isotopic composition % by weight in spent fuel				
		Pu^{238}	Pu^{239}	Pu^{240}	Pu^{241}	Pu^{242}
Light-water reactor	330	2.5	58.5	24	11	4
Heavy-water reactor	650	—	68	24.5	6	1.6
Fast-breeder blanket*	365	—	97	3	—	—

From D. Albright, "World inventories of plutonium," in *Nuclear Terrorism: Defining the Threat*, P. Leventhal, Y. Alexander, eds., Pergamon–Brassey's, McLean, Virginia (1986).

*The numbers do not reflect the burnup of plutonium in the core; taking that into account, a breeder produces about 220 tons of plutonium, net, per GW_e per year.