

PHYSICS COMMUNITY

Do Single-Sex Classes Help Girls Succeed in Physics?

Concerned about the low enrollment of girls in his classes, Thomas D. Miner, a physics teacher at Garden City Senior High School on New York's Long Island, began offering an all-girls section of physics, as an alternative to the usual coed class. "Perhaps when the male competition and its social menace [are] removed, a girl's fears subside, her interests can be alerted, she is more willing to expose her ignorance, and the intellectual rewards are not tarnished by real or fancied social losses. Perhaps even the presentation of physics can be adjusted to the fact that she is a girl, and physics is a 'man's world,'" Miner suggested in an article published in *The Physics Teacher*.

The new section's curriculum, assignments, lab sessions and tests were identical to those of the regular physics course; what differed was Miner's presentation of the material, to reflect the girls' backgrounds and learning styles. And the effort paid off: The female fraction of the physics enrollment rose from 18% prior to the creation of the special section to 37% in the second year after the section was set up.

That was in 1963. Some things have changed since then. For one, girls now account for 43% of all high school physics students, according to Michael Neuschatz of the American Institute of Physics. "The presence of girls in classes is rising, and so the portion of disadvantage [experienced by girls] that can be attributed to low numbers is shrinking," he says. "But the disadvantages arising out of the traditional culture in physics are much slower to change." This statement is borne out by the continued low representation of US women—about 15%—among physics bachelors degree recipients.

The persistence of the problem has led a handful of schools in the US to revisit Miner's approach. (Garden City no longer offers the girls-only section.) In the 1992–93 school year the Illinois Mathematics and Science Academy, a public magnet school in Aurora, experimented with an all-girls, calculus-based physics class. Even at IMSA, where only students with a high aptitude in math and science are admitted, there

were far fewer girls than boys taking the upper-level physics courses.

When the new section was offered, enrollment of girls in physics doubled. Those in the all-girls class also seemed more self-confident and did better on quizzes, homework and exams than the girls in the coed sections.

"One thing we saw was that the girls [in the special section] wouldn't let each other fail, they wouldn't let the teacher move on until everyone got it," says Catherine Veal, the school's director of communications. "Now the task is, Can we build that same kind of community spirit and camaraderie into the coed class?"

Bernard Khoury, executive officer of the American Association of Physics Teachers, agrees that the environment in the typical physics class can be very competitive. "Based on my own experience as a student and as a professor, there is a lot of one-upsmanship and intellectual jousting that goes on in class and in the lab. Some find that environment invigorating, others find it intimidating."

Although IMSA is not offering an all-girls section of physics this year, Veal says it has not been ruled out for the future. "We don't think single-gender classes are the best long-term solution for everyone. But it seems to be a good short-term strategy for some students, especially the girls who are less confident and have less experience with building things and working with their hands."

Better grades

When Marsteller Middle School in Manassas, Virginia, began separating about one-third of its eighth graders by sex last year, the girls participated more in science class and their grades improved. "Especially at the middle-school age, the kids can really hold each other back," says assistant principal Jo Fitzgerald. This year the program has been expanded to the sixth and seventh grades as well, and there is a waiting list of at least ten children whose parents want them in the separated classes.

Eugenia O'Brien, a seventh-grade science teacher at Freeport Middle School in Freeport, Maine, would love to see that happen where she works. A committee studying gender equity

in her school district recently issued a report in which girls-only classes were mentioned as a possible "intervention." Among the report's other recommendations, based on a survey of parents conducted last year, are to set up a mentoring program in which girls could meet women scientists and to create teacher workshops on sex bias.

According to Pamela Leone, a psychology professor at the University of New England who headed the equity committee, researchers who study classroom behavior note that boys raise their hands more quickly than do girls and try to dominate discussions. "When a student gives a wrong answer, the others will snicker or joke about it," Leone says. "Girls don't seem to shrug off those comments as easily." At the same time, she says, they may hesitate to speak up even when they know the right answer, because they don't want to appear "too smart."

In O'Brien's classroom, students work in small groups, to encourage interaction and downplay competition. She makes sure to call on everyone equally, and she never accepts "I hate this stuff" as an excuse. Even subtle things can send a message, O'Brien says. "I always wear a skirt or a dress in class, because I want the students to remember that I'm a woman and a scientist."

The Freeport school committee is now considering the report's findings. If it does decide to adopt single-sex classes, Leone says, it would hope to duplicate the success of Presque Isle, Maine, where for the past seven years girls in ninth and tenth grade have had their own math class. As a result, girls' enrollments in both advanced math and science courses have jumped.

In most of these efforts, the choice of enrolling in a girls-only class has been left to the students and parents. But when Choate Rosemary Hall, a private high school in Wallingford, Connecticut, divided up its entire introductory physics class into all-boy and all-girl sections with no prior warning, the students resented it. The single-sex classes also tended to be rowdier, recalls Lawrence Stowe, a

physics teacher at Choate. "My girls' section was probably the roughest I've ever taught here." Even so, as the year progressed, Stowe and his colleagues saw a rise in the girls' interest in physics careers.

As might be expected, all-girls schools also seem to do a better job in getting girls interested in physics. According to figures from the National Coalition of Girls' Schools, about two-thirds of the students at girls schools take physics, compared to about one-fifth of girls elsewhere.

Questions

Apart from the educational advantages they may offer, single-sex classes also raise some legal, developmental and ethical questions, and groups such as the National Organization for Women and the American Civil Liberties Union have argued against their presence in public schools. Under title IX of the Education Amendment of 1972, which bans sexual and racial discrimination in federally funded programs, single-sex classes in public schools would seem illegal. Schools have been getting around this by theoretically allowing boys to enroll.

Another nontrivial consideration in creating a girls-only class is the scheduling difficulty it presents, especially in smaller schools. For that reason, Yvette Van Hise, a physics teacher at the 200-student High Technology High School in Lincroft, New Jersey, doesn't see her school offering single-sex classes. But at her previous job, teaching at a large public high school elsewhere in Monmouth County, where the students weren't particularly science oriented, Van Hise believes an all-girl physics class might have been useful.

"When you start people off in this artificial environment, what happens when they leave and go out into the real world?" AIP's Michael Neuschatz asks. "And what is the impact on boys?" But the real issue, he believes, is that "single-sex classrooms cannot substitute for confronting head-on gender prejudice in physics education."

Carole Greene, a science teacher at Bronx High School of Science in New York City, agrees. She and her colleagues met last spring with members of the school's Student Pugwash chapter to discuss gender issues. "There was a general consensus that if all teachers were sensitive to the concerns of young women, then it wouldn't matter if the class were coed or single-sex, or if a man or a woman were teaching."

JEAN KUMAGAI

Dirac To Be Given an Honored Place Beside Newton in Westminster Abbey

London's Westminster Abbey, where kings and queens from William the Conqueror to Elizabeth II were crowned and where other royals and distinguished Britons are buried or commemorated with stone plaques, will get its newest memorial this month honoring Paul Adrien Maurice Dirac. Implanted in the abbey's floor and touching the top edge of Sir Isaac Newton's gravestone, the two-foot-square tablet will be dedicated on 13 November—the same day the Royal Society will conduct a daylong evocation of Dirac's contributions to physics.

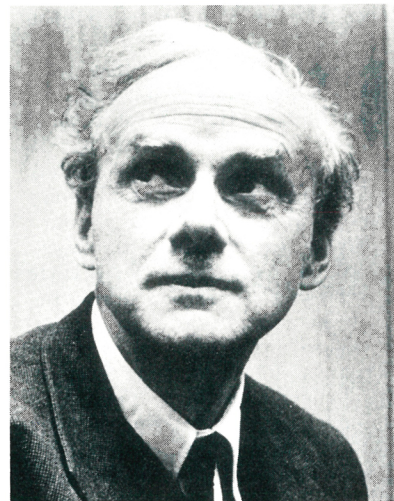
In its place in the abbey, which bears the official name of the College Church of St. Peter at Westminster, Dirac's memorial joins those of other preeminent British scientists—namely, Michael Faraday, George Green, James Clerk Maxwell, William Thomson (Lord Kelvin), J. J. Thomson and New Zealand-born Ernest Rutherford. Their tablets, all the same size as Dirac's, surround Newton's marble plaque, immediately in front of a large monument showing Newton lounging in a chair with the obligatory cherubim hovering around him. Newton's statue and gravesite are behind the main altar of the nave and roped off to keep out visitors, parishioners and clerics. Even the choirboys avoid treading on Newton's grave and the nearby markers as they take their places for religious services.

Dirac's immortalization in the abbey was initiated by physicists at Cambridge and Oxford, the Institute of Physics and the Royal Society. Dirac was Lucasian Professor of Physics at Cambridge (the chair once occupied by Newton and currently held by Stephen Hawking) from 1932 until his retirement in 1968. Dirac later became a physics research professor at Florida State University, remaining there until his death in 1984 in Tallahassee, where his remains are buried.

Born in Bristol, England, in 1902, the son of a Swiss teacher of French at a private school and his English wife, Dirac earned his PhD in 1926 from Cambridge University with a thesis on the newly devised and mathematically baffling physics of quantum mechanics. Only two years later Dirac invented his elegant yet simple relativistic equation for the electron, which predicted such properties as spin and magnetic moment.

The equation also suggested what many at the time thought to be a far-fetched concept: that an electron could have two different charge states—one negative, the other positive. Dirac's theory of oppositely charged antiparticles was confirmed in 1932 by Carl Anderson's discovery of the antielectron, named the positron. The next year Dirac shared the Nobel Prize in physics with Erwin Schrödinger. Dirac's prediction that other particles, particularly the proton, would have antimatter counterparts was eventually confirmed experimentally in 1955 by Owen Chamberlain and Emilio Segrè, who were awarded the Nobel Prize for this work in 1959.

Dirac's memorial day will commemorate his genius. The program



PAUL ADRIEN MAURICE DIRAC

at the Royal Society building in London will begin with a talk by Sir Michael Atiyah, president of the society and master of Trinity College, Cambridge, on Dirac's equation, followed by David Olive of the University of Wales discussing monopoles. After lunch Maurice Jacob of CERN will speak about antimatter, and Abraham Pais of Rockefeller University will examine Dirac's life and work. After tea at the Royal Society, the participants will proceed to the abbey for the evensong service and the unveiling of Dirac's memorial plaque. This will be followed by brief remarks on the occasion from several physicists, including Hawking.

IRWIN GOODWIN