ASCB PROFILE

William Wood

It was Bruce Alberts who indirectly introduced Bill Wood to the revolutionary idea that the best way to improve the teaching of science is to apply a little science to teaching. "Bruce asked me in 1999 if I would join a National Research Council committee that was looking at advanced placement science courses in high schools. About half the members of the committee were educators, and quite frankly when I joined the committee I didn't have a lot of respect for people in education schools. But it was a revelation. I discovered that over the last 30 years, [educational researchers] had been systematically validating all these notions that had been flying around since the 1960s about student-centered approaches and inquiry-based learning. I didn't realize that educators were doing things that I would be interested in."

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Wood's interest in "evidence-based pedagogy" led to his chairmanship of the biology panel for that NRC committee, which produced the 2002 report, "Learning & Understanding." His new objective is nothing less than the transformation of undergraduate biology teaching at large research universities. Wood explains, "We need to learn how to do a better job of educating our undergraduates. We should approach our pedagogy the same way that we approach science, trying to get evidence for which techniques work better. Before, people teaching innovation would report anecdotally that students liked it better if you did this or that. But now in physics and to a growing extent in biology, people are trying to really assess how much students have learned and to test different pedagogical approaches on the basis of that assay."

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With major support from the Howard Hughes Medical Institute, the first National Academies Summer Institute for Undergraduate Education in Biology convened in Madison, Wisconsin, last summer. "The idea is to reach junior faculty who are under tremendous pressure to produce research and at the same time are obligated to teach these large introductory classes," says Wood. "Our model was Cold Spring Harbor or Woods Hole where you go for a week and immerse yourself in science. Here you eat and sleep science pedagogy for a week."

Bill Wood will receive the ASCB Bruce Alberts Award this month in recognition of his extraordinary contributions to science education. Alberts says that being the living namesake of a major award can be daunting. Bill Wood, says Alberts, is the perfect choice. "It honors the Award," says Alberts, "just to have Bill Wood's name associated with it. Bill has been an innovator in biology education from the time he started at Caltech [in 1965]. The book that he wrote in 1974, *Biochemistry: A Problems Approach*, was revolutionary in its day, especially in biology. Bill showed us a way to teach kids how to think instead of just memorizing. This was at a time when all of us, including myself, took it for granted that the best way to teach was the way we had been taught. Bill was way ahead of everyone then."

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Alberts continues, "Of course, we know from studies now that people learn in different ways and arrive on campus with different levels of preparation. By and large, we don't give them much of chance to catch up. As a result, we discourage a lot of people who could become good scientists and we also turn off a large number of future leaders of our society who come away from these

classes disillusioned with science in ways that will become a problem for us later."

Jim Gentile, Dean of Natural Sciences at Hope College in Michigan, served as co-chair with Wood at the first Summer Institute. Gentile says, "When you're a stellar scholar like Bill, no one is ever going to question your research credentials. So it's a critical thing for someone like Bill Wood to step to the plate and talk about the integration of research and teaching. It sets up a role model particularly for junior scientists on how to integrate what they do in the lab with what they do in the classroom without jeopardizing their careers."

Wood, who trained with Paul Berg at Stanford, brought a biochemistry perspective to his collaboration with geneticist Bob Edgar at Caltech on the development of T4 bacteriophage. Says Wood's University of Colorado colleague and former ASCB President Dick McIntosh, "Together Edgar and Wood established a new kind of union between genetics and biochemistry with a technique they invented called *in vitro* complementation." Edgar had isolated phage mutants with defects that left them unable to carry through to the production of infectious phage particles. Edgar and Wood combined extracts of cells infected with different defective alleles to see which combinations could produce complete phage. "It gave them a way of looking at the mutants that were blocking the phage's assembly of infectious particles," says McIntosh, "and as a result, they were able to put a whole series of mutants into phage formation pathways. Edgar and Wood were the first to work out the pathway for the assembly of a complex bacteriophage.

"This was a tremendous advance," McIntosh recalls. "It allowed people to understand, at least in basic terms, how a viral particle assembles as a series of protein biochemical steps. It was the reason that Bill was elected to the National Academy of Sciences as a very young man." Wood was 34.

Wood would change methodologies in 1978 when he left Caltech for the University of Colorado, Boulder, where he'd already learned *C. elegans* genetics during a sabbatical with David Hirsh. In recent years, Wood and his nematodes have pursued the developmental question of handedness or embryonic asymmetry. That's as basic a question as you can find, says McIntosh. "How does an organism that is developing symmetrically from a single fertilized egg develop asymmetry? What is the earliest moment when symmetry is broken? It's a very fundamental question and just the sort of thing that has always fascinated Bill Wood."

William Barry Wood grew up with a tough act to follow. His father, also William Barry Wood, was a legend in medicine, clinical research and sports. Arguably the greatest Ivy League scholar-athlete of the 20th century, his father lettered ten times at Harvard, captained the football team and was named the 1931 All-American quarterback. The eldest of five, Bill Wood shared his father's passion for science but lacked his father's build for football or his interest in clinical medicine. But the younger Wood had other passions, particularly for folk music. As a Harvard

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Wood's father had attended medical school at Johns Hopkins before joining the faculty at Washington University and then returning to Hopkins as Vice President. His father suggested that Bill talk to his old friend, Arthur Kornberg, in St. Louis about graduate school. Kornberg was delighted but he too was on the move. "Stanford had lured away Kornberg's department including Paul Berg," Wood recalls. That year, Kornberg won the Nobel Prize, as did later Wood's post-doc supervisor at the University of Geneva, Werner Arber.

Wood's European post-doc stint led to an even more important introduction, to a German graduate student living in France. Renate and Bill Wood married in 1961 and moved in 1965 to Pasadena and Caltech. After a dozen years in the US, Renate Wood became a poet in English. Wood says his wife never seriously wrote poetry in any language before she started writing in English about the nightmarish world of her WWII childhood in Germany. Renate Wood is a frequent contributor to poetry journals and the author of two published collections, *The Patience of Ice* and *Raised Underground.*

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The Woods have two sons who are both successful, professional musicians. Oliver plays lead guitar in a blues/pop band, and Chris is the bass player in the "jam band," Medeski, Martin and Wood. Says their proud father, "I may secretly have wanted to do that, but I never seriously considered it as a career. I have to laugh now because they're both doing so well, I think Chris is making more money than I do." Oliver lives in Atlanta and Chris in upstate New York with his wife Sirkka and Wood's first grandchild, Nissa.

His sons contributed to Wood's original interest in education reform. When they were little, the boys were enrolled in a Pasadena experimental nursery school that expected parents to be highly involved. Inspired by the writings of education critics such as John Holt and Jonathan Kozol, Wood challenged teaching traditions at Caltech. He inherited an 8 a.m. "Intro to Biochem" lecture course, and began by moving it to a more civilized hour. Then he tried a series of experiments to coax his glassy-eyed students out of their rote learning expectations. It was a long struggle. Along the way, Wood enlisted grad student John Wilson (who would later become his co-author on the *Problems* textbook and a professor at Baylor), one of Caltech's first women undergrads, Sharon Long (who became a noted plant physiologist and then Stanford dean), and another junior faculty member, Lee Hood. One of their most successful innovations was "Krebs Cycle Poker," based on the citric acid cycle, says Wood. Students quickly learned never to bet on an apparent straight unless they were certain about all the intermediates.

His return to the challenge of overhauling biology education hasn't slowed Wood's research. Currently he is using sabbatical time to work with Tony Hyman at the new Max Planck Institute in Dresden on the origin of handedness. Wood's Boulder lab had some success last year with a gene encoding G-alpha protein GPA-16 in *C. elegans*, whose loss disrupted asymmetry. Wood now thinks that this protein is involved downstream in maintaining asymmetry through early development, but it's not the starting point.

"I'm interested in finding the initial cue that tells the embryo to break left-right symmetry and which way to do it," says Wood. "You start with an embryo that's left-right symmetrical and it becomes left-right asymmetrical and it always does so with the same handedness. Once that cue is given, you have to maintain the handedness. We did find a gene that seemed to involved in maintaining that," says Wood. "But I'm looking for the prime mover. We've got ideas but we're not there yet." ■