letters

Perspectives and contributions over the past 75 years

For his insightful review of the changes in physics during the first 75 years of the American Institute of Physics (PHYSICS TODAY, June 2006, page 32), Spencer Weart began with a hypothetical physicist who, at age 100 now, surveys what has happened since his graduate student days in 1931. But it was not necessary to be hypothetical. There is a real example of a living physicist, John Archibald Wheeler, who was a 19-year-old physics graduate student in June 1931, two years before receiving his PhD from Johns Hopkins University. Wheeler detailed most of the changes in his 1998 autobiography, *Geons, Black Holes, and Quantum Foam: A Life in Physics*, with Kenneth Ford (Norton, 1998), and has been actively engaged in physics for the entire history of the American Institute of Physics, including a year (1966) as president of the American Physical Society.

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The physics community expends significant effort encouraging students to pursue physics as a career. Promoting physics to a broader audience was a major goal in commemorating the year 2005 as the World Year of Physics. But what are the misperceptions that discourage an enthusiastic person from joining "the club"?

One misperception comes from publications that overemphasize the fact that discoveries and innovations made by physicists often occurred early in their careers. This gives the impression that the essential factor for success in physics is to be gifted.

Take, for example, Spencer Weart's article about the advancements of physics in the past century. Weart frequently stresses the age of the physicist: "Dirac was a year short of his 30th birthday. Younger still, at 26, was Caltech student Carl Anderson." Weart says of Ernest Lawrence, "He had just turned 30; so had Robert Van de Graaff." To assure readers that physics is indeed the realm of geniuses, Weart writes, "Frederick Seitz, 20 years old in 1931 but only three years from his PhD," and "Hans Bethe, a student who turned 25 that year, found a solution of the Ising model for a one-dimensional lattice." The message that any of these phrases has for me is simple: If you turn 30 and have not yet made a significant discovery, you are in the wrong field.

True, many ideas that revolutionized the way we look at the world came from masterminds early in their careers. Nevertheless, that is not the whole story; the essential requisite for accomplishment is not how gifted you are but how passionate and hard working you are. For example, a knowledge of Albert Einstein's approach toward nature could be illuminating for students who look to him as their role model. Someone who knew Einstein during his years at the Institute for Advanced Study said of him, "What motivated him was his intense curiosity about nature."[1] In my opinion, that is what should be emphasized to the public and to students who are undecided about their future. We must infuse a passion for the beauty of nature, emphasizing its accessibility to everyone willing to put forth the effort. It is not only some genius-born elite that finds physics joyful and rewarding. Understanding natural phenomena is blissful and pleasant for any enthusiastic person at any level.

Reference

1. C. N. Yang, *AAPPS Bulletin* **15**(1), 4 (February 2005).

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Dark energy and field equations without λ

An intensive search for a presumed "dark energy" driving the acceleration of the cosmic expansion has taken place during the past decade. Adjunct to the search is the determination of the acceleration's "equation of state" if the driver is other than λ, Einstein's cosmological constant. What is remarkable and long since forgotten is that Erwin Schrödinger, shortly after Albert Einstein introduced the cosmological constant, discussed the field equations without λ but with a stress-energy tensor containing the term $p\delta^{\mu}{}_{\nu}$. Einstein objected to this as a trivial variation of his field equations. It happened as follows.

Einstein introduced λ in 1917.[1] In November of that year, Schrödinger submitted a paper[2] in which Einstein's original equations, without λ, were provided with a stress-energy tensor consisting of a uniform distribution of dust and a negative pressure term. Shortly thereafter, in a note submitted to the same journal in March 1918, Einstein responded with some acerbity:[3]

> When I wrote my description of the cosmic gravitational field I naturally noticed, as the obvious possibility, the variant Herr Schrödinger had discussed. But I must confess that I did not consider this interpretation worthy of mention.
>
> . . . . A spatially closed world is only thinkable if the lines of force of gravitation, which end in ponderable bodies (stars), begin in empty space. Therefore, a modification of the theory is required such that "empty space" takes the role of gravitating, negative masses which are distributed all over the interstellar space. Herr Schrödinger now assumes the existence of matter with negative [scalar] mass density [*negativen skalaren Massendichte*] and represents it by the scalar p. This scalar

