LETTERS

Terminology and Science Literacy Issues Extend the Debate on Revamping Science's Relation to Society

In their "Beyond Basic and Applied" (PHYSICS TODAY, February, page 42), Roger Pielke Jr and Radford Byerly Jr get their ideas across very clearly, although a better title might be "Let's Forget Principle and Give in to the Politicians." They would like to rid us of the term "basic research," which is one that I've always kind of liked, so I hope their ideas don't spread too far. Only that's already happened—the same sentiments have been coming from high places such as grant agencies and university officials for some years now.

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I wish that P&B didn't write so well. Then the carefully embedded personal views that are presented as fact would stand out for what they are and not seem to support the authors' arguments. For example, we read that "The terminology of the social contract, and specifically the phrase 'basic research,' hinders productive debate on science policy" (page 43). My view is the opposite: Productive debate needs good terminology and "basic research" expresses a core concept very succinctly, being almost as necessary as, say, "angle" in discussions of geometry. The concepts of basic research and applied research enable us to make meaningful distinctions, and their absence definitely would make it harder to counter P&B's arguments. If we buy P&B's statement, skillfully introduced at just the right place, that basic research hinders debate, then much of their following argument does fall into line *(caveat emptor)*.

Of course, the authors have their nice four-step program to correct the situation by means of democratic debate—let the best ideas win, right? Now let's think about how that will go in the real world. The actual basic researchers (purebreds, no political genes) will be doing their research and have no time for such stuff. The debaters will be our politicians and overseers (at best we may have some politico-scientific hybrids). So the real researchers can be entirely for traditional basic research, and it just won't matter. Not that basic research ever had more than 5% of the dollars, but 95% isn't enough for some folks—they've got to have it all.

I would guess that P&B have some nice grants to come up with

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these politically correct ideas. It's just the kind of thinking that figures to have generous support these days, even if it kills the goose that's been laying the basic research egg. Now the Federal government agenda, ever more adopted by the Federal funding agencies, is right in line with P&B's article. So my follow-up guess is that it would be really hard to get a grant to support the traditional view—that the concept of basic research needs to be preserved and that the term "basic research" itself needs to be kept alive and well. It sounds like a classic conflict of interest for the agencies.

Politicians and the public may expect more practical benefits, but scientists do not have to go along meekly. How about funding science because it enlarges our worldview? After all, why else are we here—to have better home appliances?

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An important element missing from this perceptive and persuasive article is the current lamentable state of science education among nonscientists brought on to a large extent as a by-product of the old Vannevar Bush rationale for the Federal funding of science. Roger Pielke Jr and Radford Byerly Jr correctly point out that under this rationale the scientist had little incentive to communicate with nonscientists, and even less of one to educate them.

The public's negative reaction to "scientific elitism" may now be an important dynamic in our troubles over Federal funding. Nowhere is this more evident than on the university campus, where (some exciting examples to the contrary notwithstanding) scientific research has been decoupled from the teaching of nonscience majors. Science education, more often than not, sends the message that science is remote from the nonscientist—and should be.

Any new rationale for Federal support must remedy this situation. If the general public is to find basic research attractive, it will need an appreciation of the sense of wonder and serendipity that drives humans to learn more about their world.

But making society more literate (and hopefully more comfortable) in science may have its greatest impact in how science is used to inform and develop policy. Currently, its message is blunted due to either distrust or relativism. Distrust of results causes the policymaker to seek a firmer basis for decisions elsewhere. Relativism lulls the policymaker into the feeling that most scientific answers can go either way (there are as many scientific reasons for as against global warming, potential carcinogens and so forth). This situation allows scientific input to be seen as being just as politically motivated as other sources. In the global warming debate, for example, climate predictions are often viewed as value based, and the climate scientist is equated with the environmentalist.

It will prove extremely difficult to forge what Pielke and Byerly call a renegotiated social contract as long as society remains so poorly educated as to the value and place of science in the human endeavor.

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PIELKE AND BYERLY REPLY: We agree with R. E. Wilson that "productive debate needs good terminology." But unlike Wilson's, our interpretation of the recent debate on science policy parallels that of both the National Science Foundation and the American Association for the Advancement of Science:

▷ NSF: "The traditional categories of basic [and] applied research . . . are somewhat murky and, thus, not always ideal in describing the relationship between science, technology and innovation in the real world."[1]

▷ AAAS: "Advances in science and technology are so closely interlinked that policy can no longer be based on a sharp distinction between basic and applied research."[2]

Science policy debate has suffered and will continue to suffer as long as it uses the murky and indistinct terms "basic" and "applied" research. Wilson's analogy with the term "angle" is thus inappropriate, in that "angle" does have a distinct meaning. His analogy would be apt if, say, an architect and a building contractor used different definitions of "angle," because any structure that they built together using such indistinct terminology would be unsound. Such is the case with Federal science policy.

Wilson fears that our thinking could be fatal to the "goose that's been laying the basic research egg." As we have said elsewhere: "We suggest that the goose take a moment to ensure that the egg she lays is, in fact, golden, and, if it is, that her patrons realize that fact; if it is not, she should take steps necessary to make it golden, for if the egg is not golden, the goose will pay the price."[3]

Wilson notes that "politicians and the public may expect more practical benefits, but scientists do not have to go along meekly." This strikes us as symptomatic of the unnecessarily divisive nature of the Vannevar Bush social contract. One way of ensuring reduced support from the public and politicians is for us to ignore the reasons why they support our work and then take an adversarial stance. That could lead to loss of the broad public support that science now enjoys (see below). Science has much to offer the nation, in terms of both advances in knowledge, which can expand people's worldview, and advances in technology, which can lead to, say, less costly and more efficient appliances. As we wrote, science ought to be a part of society, not apart from society.

Thus, contrary to Wilson's inference, we do not suggest that scientists "go along meekly"; rather, we encourage the opposite—that they take responsibility for themselves by answering a set of hard questions and acting on the answers. Franklin Raines, the former director of the Office of Management and Budget (which plays a major role in funding science) also suggests that scientists be more, not less, engaged, and that (as detailed in PHYSICS TODAY, July, page 47) they answer a similar set of questions.[4]

We agree with much that Charles Keller says, in particular that the Vannevar Bush rationale gives scientists "little incentive to communicate with nonscientists. . . ." Nevertheless, we offer two comments. First, if the general public needs to understand basic research to be able to support it, how can we explain data that show continuing high support for science in a public that remains (relatively) scientifically illiterate?[5] Scientists ought not assume that increased science literacy on the public's part would be accompanied by an increase in support for research; in fact, the converse could well be the case. Second, we view a renegotiated social contract as a means by which to improve scientific education, and not vice versa. The high level of support that the public now shows for science should be seen by both scientists and policymakers as an opportunity to renegotiate a social contract that will sustain a healthy relationship between science and the rest of society well into the next century.

References

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4. F. D. Raines, Science **280**, 1671 (1998).
5. See National Science Foundation, *Science and Engineering Indicators*, National Science Board-96-21, US Government Printing Office, Washington, DC (1996), chap.7. Also available at http://www.nsf.gov/sbe/srs/seind96/ch7_cont.htm.

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Félix Varela Is in Line to Be Sainted Physics Teacher

A little-known aspect of Pope John Paul II's visit to Cuba early this year—and one with an unusual link to the field of physics—was that the pontiff used the occasion to speak about the case for canonizing a Havana-born priest named Félix Varela (1788–1853). The case appears to have the support not only of Catholics living on the island but also of Cuban Catholics living in exile. What makes Varela special to the physics community is that he could very possibly be the first physics teacher ever to become a saint recognized by the Roman Catholic Church.

Ordained as a priest at the age of 23, Varela quickly went on to become a great teacher who, as a youthful professor of philosophy, brought the level of education at the Seminario de San Carlos in Havana (a seminary and college for Cuban youth) to an all-time high. A man of wide-ranging interests and abilities, he introduced both physics and chemistry as school subjects in Cuba, taught physics at the seminary and wrote a physics textbook that was basically as current as the European textbooks of the time. In fact, his book followed the French model, being physics in the styles of Jean Baptiste Biot, Lazare Carnot, Charles Augustin de Coulomb and Jean Charles de Borda. It covered such topics as mechanics and machines, and calorimetry and gas laws, as well as geometrical optics. It also emphasized the need for conducting experiments and demonstrations. (In the 1940s, the Office of the Historian of the City of Havana published *La Fisica del Padre Varela*, written by an eminent predecessor and teacher of mine at the University of Havana, Manuel F. Gran.)

After almost a decade at the seminary, Varela was elected as one of Cuba's representatives to the Spanish parliament in Madrid. There he introduced legislation opposing slavery and limiting the central government's power in the colonies. Though soon branded a rebel, he was fundamentally a Cuban patriot who pressed the case of the colonies' independence from metropolitan Spain with such conviction that he was forced to live in exile in the US for the last 30 years of his life.

In those three decades, Varela continued to work for the freedom of the Spanish colonies. Assuming the role of activist priest in New York City, he distinguished himself as a writer, philosopher, humanitarian and social reformer with a particular concern for the poor and the downtrodden. Late in life, he was appointed vicar general of the New York diocese.

Last year, the US Postal Service issued a 32-cent stamp in Varela's honor, and his name and image finally became known to millions of Americans.

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More on Marietta Blau and the Physicists of Pre-, Postwar Vienna

I was moved by Peter Galison's article entitled "Marietta Blau: Between Nazis and Nuclei" (PHYSICS TODAY, November 1997, page 42) and would like to add a few personal footnotes.

Marietta Blau came to the University of Miami in 1956, a few months after I did, from Brookhaven National Laboratory. As soon as she arrived, she organized an emulsion research project, involving a number of faculty, graduate and undergraduate students. With support from the US Air Force Office of Scientific Research, we acquired rather good laboratory facilities, including about ten movable stage microscopes and a very high precision multiple scattering microscope. Marietta brought stacks of photographic plates exposed to 1.3 GeV/c negative pions, and I (as a faculty member of the group) later exposed plates to 620 MeV/c antiprotons, and to 450 MeV/c negative kaons. We attempted to identify the nucleon resonance, produced by the pions, but were frustrated by poor statistics.

While at Miami, Marietta complained bitterly about the mistreatment she had received from her prewar Viennese colleagues, who, as Galison points out, had been Nazis of varying degrees of persuasion. She also decried their postwar rehabilitation. In 1960, she finally returned to Vienna, in somewhat poor health.

When I saw her in Vienna two years later (I was there to finish up a paper), she was living in genteel poverty, receiving a pittance of a pension from Vienna University. She said then that, of the physicists in Vienna in the early 1960s, only Hans and Walter Thirring and Erwin Schrödinger were friendly—the rest being in sympathy with her earlier adversaries.

That she was cheated of public recognition for her lasting contribution to nuclear and particle physics, there is no question; her case is quite parallel to that of Lise Meitner. She said that she had taught Cecil F. Powell all that she knew of the emulsion technique, and had felt shortchanged by her circumstances when Powell received the Nobel Prize in Physics for having developed methods of using photographic emulsions to detect particles and for having discovered the pion (pi-meson). Surely, she was strongly entitled to share his glory. The ingratitude of Kodak and Ilford, as pointed out by Galison, was further disheartening to her.

Belying her tiny stature and gentle and self-effacing demeanor, Marietta was a tenacious scientist, strong administrator and inspiring teacher. In addition, she was an exceptionally warm and cultured person, establishing close ties with her coworkers and students. She was pivotal in my life, changing the direction of my intellectual interests, acting almost as a surrogate mother and grandmother to me and my children. Her name and the importance of her achievements ought to be perpetuated.

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Marietta Blau was a classmate of my mother's and a frequent visitor in our home in Vienna prior to