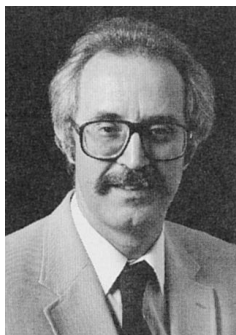


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## EDITORIAL



**Edward R. Dougherty**  
Editor

There has been quite a bit of discussion lately regarding the worth of research universities and their value to education and society in general. I would like to enter the fray with some down-home logic.

My grandfather was a shoemaker and he learned his trade from a shoemaker. My father was a mechanic and he learned his trade from a mechanic. I am a mathematician and I learned my trade from a mathematician. This is my personal family history but its educational logic has been understood since the dawn of civilization (which requires the passing down of knowledge and technique). Yet, if I say that my son wishes to be a physicist, there are some who would question his need to learn his trade from a physicist. But let me make the matter clearer: He says he wants to do research in physics. Can there then be any question regarding his mentor's profession?

I'm getting at a fundamental question concerning education in the sciences and engineering: Which provides the future researcher a better education, the research university or

the teaching university? I believe the answer is clear: the research university. Research is a trade and it is a full-time job, like a shoemaker or an automobile mechanic. Education for research, be it academic or industrial, is not only about facts, algorithms, or theorems; it is also about contemplation, open-mindedness, intuition, cleverness, method, rigorous thinking, and stubbornness in the presence of nay-sayers. These are abilities and attitudes of one who has pursued research, who has failed on many occasions, and succeeded on a few. A student who is to be educated for such a life needs to be immersed in that life's fire. I use this metaphor because I am thinking about a welder I used to work with. His education was burned into the scars that marked his hands, arms, and face.

Am I agreeing with those who demand a more "practical" education involving less theory? Absolutely not! Top-quality research requires a rigorous scientific education, as well as exposure to active research. This is true for both the industrial and academic researcher. Most students get one opportunity for an education that is preparation for a lifelong scientific career. The research university can best serve this need because its faculty are at the front of the evolving science and the applications of that science. They can incorporate the latest thinking into the basic scientific education as an enhancement of that education, not a dilution. By this I mean that a course on statistics should not become a collection of methods for pattern recognition; rather, that the mathematical content of the course should remain at a high level with the usual "examples" replaced by serious applications involving pattern recognition. I believe that faculty with strong educations who are active in research can best direct and provide this kind of academic training.

I have heard the objections: many undergraduate courses are taught by teaching assistants; professors are dedicated to their own narrow disciplines. I agree with these observations. Nevertheless, if any of my children think they might want a career in scientific or engineering research, then I will

advise them to be educated in a research university. No doubt I would like them to be taught in all their courses by full-time faculty, but I know this is financially impossible if faculty are busy contributing to their fields and maintaining a currency beyond what is being published in the journals. True, faculty are concentrating on their own narrow disciplines, but this is the nature of scientific research and (to be realistic) it will continue to get even more splintered in the future. One need only think of electronic imaging to recognize the inexorable drive to specialization.

My support of the research university is in no way meant to denigrate a liberal education. In fact, the creative mind is sharpened and deepened by encountering the great writers and philosophers. I cannot imagine my own thinking in the absence of Kant, nor coming to Kant without Leibniz and Hume. Can one really understand the implications of our scientific, democratic society in the absence of Locke and Rousseau? But there is no contradiction between simultaneous support of the research university and of a liberal education. The young men and women who will take our places in the scientific community as they surpass our discoveries and place our work onto the back of the stacks need an education that prepares them for both scientific and educational leadership.

And what of the teaching universities? Am I advocating their demise? On the contrary: the need for teaching universities will continue to grow as the economic well-being of society becomes increasingly dependent on the technical skills of its work force. My preceding arguments are addressed to the needs of students who are potentially scientific and engineering researchers. Certainly, a large majority of students do not fit into that category, nor should we try to force them to. There are many young people who wish to go into careers that probably do not require rigorous courses in mathematics or quantum theory. For them, the decision whether to attend a research or teaching university depends on factors other than research apprenticeship.