How Our Schools Fail Industry and Society*

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What are the effects on both industry and society of the decline in our nation's system of learning, especially in science and mathematics?

High-tech industrial companies like Unocal, which has always placed a premium on the value of research, will be hurt substantially! Unocal holds more than 1,400 active patents and many more trade secrets. A company like mine, with its emphasis on development of new technology, depends greatly on an assured supply of bright, well-educated young scientists and engineers. Yet their availability is threatened by American schools that are turning out scientific and technical ignoramuses.

In our society those who will lead our nation in another generation or less will lack the basic scientific knowledge necessary to make crucial policy judgments in such areas as environment, space, biotechnology, and my own field, energy. Equally important—and perhaps equally alarming—so will their constituents.

How pervasive is scientific ignorance in our country today? Copernicus proved more than 450 years ago that the earth revolves around the sun. Yet today, millions of Americans seem to think the sun circles the earth. Asked in a survey which goes around which, 21% replied incorrectly, and 7% said they didn't know. Less than half those who got it right knew it takes a year for the earth to orbit the sun; 17% thought it took only a day.

That's far from the only example. In another survey, only 31% of those sampled reported what they considered a clear understanding of radiation. Twenty-seven percent professed a grasp of the GNP, or gross national product. Twenty-four percent said they knew what computer software was. And a mere 19% thought they knew how their telephones worked.

For whatever reasons, Americans have been turning away from science since the 1960s. Back then, the United States was the world leader in the number of scientists and engineers per capita. Today, only 7 out of every 1,000 American collegians study engineering. In Japan, the ratio is 40 per 1,000. More than half of our doctoral degrees in engineering go these days to students from outside the United States. The same applies to doctorates in mathematics and physics. In our colleges and universities, 1,600 faculty positions in engineering are vacant. Half of these jobs have gone begging since 1984.

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Recent tests ranked U.S. fifth graders eighth overall among those from 15 countries, and U.S. ninth graders 14th among peers from 17 nations. At the secondary level, results were even more dismal. Among students from 13 countries, the U.S. contingent in advanced physics ranked ninth; advanced chemistry students placed 11th; and advanced biology students were dead last.

From my vantage point as president of the Science and Technology Division of Unocal, a three-word assessment of the situation comes to mind: *threatening, inexcusable, unacceptable!* Change must be rapid and radical. Scientific and technological innovation is required for my company and industry in general to maintain productivity and competitiveness. The way things are going, precious little of it will come from our own country a generation or so down the road—and that is a serious concern. My own company's experience serves to emphasizes the large degree to which industry relies on research. (See sidebar.)

As I have indicated, a shrinking talent pool from which to draw in the future is not the only problem that educational decline poses for American industry today. This deficiency contributes tremendously to the unhealthy regulatory climate in which we must operate and with which we must cope. As more and more Americans leave school without even knowing what a molecule is (and as surveys show, they do not know) more and more Americans forfeit the ability to make rational judgments about public issues. The result is bad law—bad for industry and bad for society at large.

A California ballot proposition (65), the so-called toxics initiative, is a sterling example. It's what happens when certain groups use the public's misunderstanding of toxicology to their own advantage. One misconception associated with Proposition 65 is that naturally occurring chemicals are somehow safer than synthetic chemicals. In fact, the whole world consists of chemicals. Human bodies do not distinguish between the synthetic and natural kinds.

Actually, some chemicals that occur naturally may be more carcinogenic than some synthetic agents that cause cancer. An example is aflatoxin. Found in peanuts, it may be a greater cancer danger to humans than some manmade carcinogens like ethylene dibromide, a pesticide now banned by the Environmental Protection Agency.

So we have a paradox. Parents fix peanut butter sandwiches for their kids' lunches, then vote for Proposition 65 to make sure no amount of potential manmade carcinogens (no matter how infinitesimal) could possibly enter our drinking water. Now, I'm not saying that peanut butter sandwiches threaten public health. I do say, however, that public fear of carcinogens is out of all proportion to reality. A lot of that groundless fear could be prevented if our schools placed greater emphasis on science at all levels.

So far, I've painted our schools and colleges as the villains of the piece. However, they bear only a share of the blame. If you take the view that our schools reflect our society, then all of us must accept responsibility for the educational mess in which we find ourselves.

As I see it, America has become a shortsighted society. Too many of us are too interested in the quick buck, the easy way. Too few are willing to foreswear living off the productive gains of the past. Today's American all too often wants to consume

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Research at Unocal

In 1890, Unocal established the first petroleum laboratory in the West. Its mission—find a way to make a clean-burning, colorless form of kerosene from California's thick crude oil. Since those early days, the importance of research at Unocal has increased.

Unocal is a world leader in the development of technology for the petroleum refining industry. We use hydrogen and special catalysts to convert high sulfur petroleum oils into clean high-grade transportation fuels.

We have developed a number of liquid and gas desulfurization processes, and several have been recognized as the best available demonstrated technologies to control sulfur oxide emissions.

Unocal leads in the development of geothermal energy, and today, we are the world's largest producer of geothermal power. Unocal harnesses enough hot steam or water beneath the Earth's surface to generate 24 million kilowatt-hours of electricity per day. That's enough power to meet the needs of 1.2 million people and is the equivalent energy found in 13 million barrels of crude oil per year. It's a clean, efficient alternate energy for America.

For more than 40 years, Unocal has been seeking an efficient way to make oil from shale. Two years ago, we reached a milestone in this quest. Now, high-quality synthetic crude oil is being produced from our shale project in western Colorado at approximately 6,000 barrels per day and shipped to our Chicago refinery. This is a major long-term project for Unocal, occupying the time and effort of research scientists and engineers over many years.

We've developed new agricultural products to take advantage of bans on certain herbicides and pesticides. We foresaw this pattern a number of years ago, and developed products specifically to pose no threat to the environment. They break down into material that occurs naturally in the soil, causing no harm whatever to groundwater.

My purpose in reciting some of our technological achievements has not been to glorify Unocal. Rather, I've used them to show you just how much a company like mine relies on research. And that reliance must continue if we are to survive.

without creating, spend but not save, win but not work. These values—if you can call them that—filter down to our children. They're deluded into believing that what they've been provided will continue when they become adults, without much effort on their part. Consequently, they coast through such difficult subjects as high school trigonometry and calculus, unwilling or unable to grasp that these courses don't come easily, that they must work if they are to succeed.

What can we do to stem this unfortunate tide? At Unocal, we're taking several steps. My own division, Science and Technology, is a sponsor of the Summer Science Institute at the University of California, Irvine campus. This program aims to make better teachers out of pre-college science instructors. A $1,500 grant pays the tuition and living expenses of a teacher for the four-week course. Each summer, we support this program from our immediate area of Orange County. I'm happy to report that the impact of this program, launched in the early 1980s, is being felt.

At the corporate level, Unocal donated more than $1 million directly to education last year. Some of the money went toward scholarships in geology and petroleum engineering. Some went toward grants for graduate study, enabling selected students to proceed beyond the undergraduate level in disciplines related to the petroleum industry. We contributed a sizable amount to supplement the salaries of chosen professors at many schools in such fields as mechanical and petroleum engineering, geophysics and geology. We want to encourage them to continue their teaching careers.

Unfortunately, all this help, though welcome and necessary, amounts to no more than a drop in the bucket if we are to save our schools and secure our future. Fortunately, there is an awakening, throughout industry, throughout the country, and throughout society. The White House Council *Report on the Health of U.S. Colleges and Universities* makes several sound recommendations. It calls for a sharp increase in federal support for basic research in colleges and universities. It would broaden federal aid for scholarships and other programs to influence bright students toward careers in science. It urges more emphasis on science and math curricula in all schools, colleges and universities. And most important, in my opinion, it suggests raising minimum standards of education. This would ensure that all students master the basic literacy and mathematics needed to function in a technologically evolving, highly competitive world.

It is encouraging that some state and local governments seem to be getting the message. In 1984, South Carolina passed its Education Improvement Act, financed by a penny increase in the sales tax. Today, the state's average combined math and verbal SAT scores have risen 35 points to 838, the largest increase in the nation. Teachers' salaries have grown 48% to an average of more than $24,000. They're now in line with those in other states. South Carolina has established a public Division of Accountability to monitor progress.

Minnesota now allows parents to decide which public school their children attend. Advocates say that if all else fails to reform the schools, free-market forces will. Last May, after four years of lobbying by the governor and the Minnesota Business Partnership, the legislature authorized parents to send their children to any public school in the state. Each child who changes schools takes along $3,600 in state tuition.

These are heartening signs. They indicate we are beginning to conquer some of the serious ills that infect not only our schools but our society. To achieve a complete cure will take time. We'll have to be patient. This crisis has been years, if not two or three decades, in the making. We can draw strength, however, from the assurance that the challenge is not insurmountable.

I believe industry must work closely with educational institutions and state and federal agencies every step of the way. Only by working together as a team will we be able to make timely and significant progress.

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