In a fourteen-nation test of science achievement, US high school seniors finished dead last. And that's just the beginning of the problem.

It's Time to Worry About Technical Manpower

BY F. CLIFTON BERRY, JR.

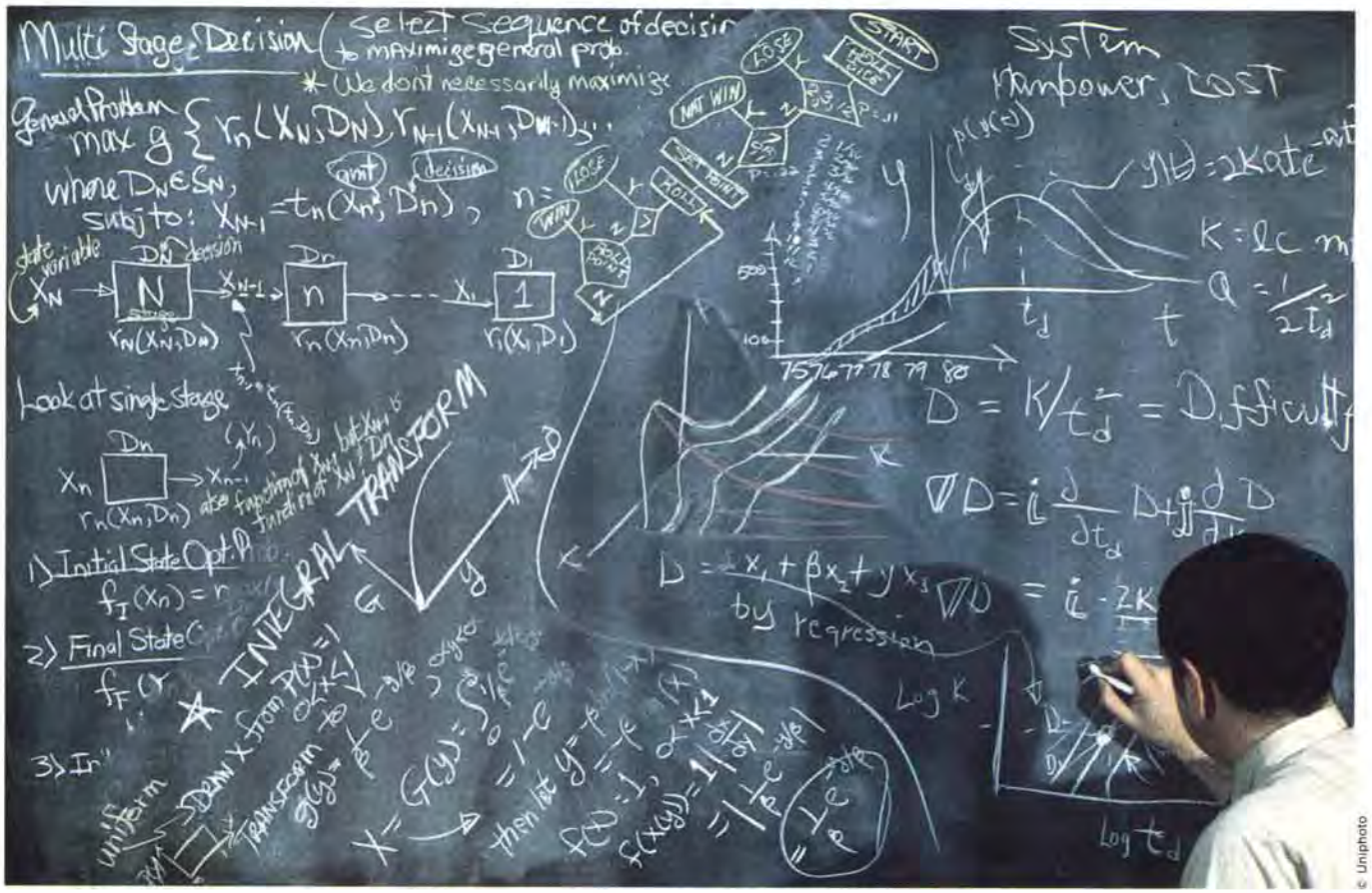
THE United States is slipping. By many criteria that count, it is no longer the world leader. The trade and budget deficits, for example, have weakened the US's position relative to its overseas partners and competitors. We are losing ground to other nations in the fielding of new technologies. Foreigners are buying and controlling US real estate, farm land, and companies. The defense industrial base is weak and getting weaker.

Last year, the Aerospace Education Foundation sounded the alert about the defense industrial base in a major report, "Lifeline in Danger." A companion study, to be published by the Foundation later this year, will examine a related problem that is just as alarming, if not more so.

The US technical manpower base is in deep trouble. The problem is already apparent in the schools, in the workplace, and elsewhere. "A Nation at Risk," produced *six years ago* by the National Commission on Excellence in Education, described the situation in stark language: "The educational foundations of our society are . . . being eroded by a rising tide of mediocrity that threatens our very future as a nation and a people. What was unimaginable a generation ago has begun to occur—others are matching and surpassing our educational attainments."

The report went on: "If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves.

"History is not kind to idlers," the report continued. Pointing out that we now live among "determined, well-educated, and strongly motivated competitors," it made three quick and pertinent competition comparisons: Japanese automobiles, South Korean steel mills, and German machine tools. "These developments signify a redistribution



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of trained capability throughout the globe. Knowledge, learning, information, and skilled intelligence are the new raw materials of international commerce." The report summarized, "Learning is the indispensable investment required for success in the 'information age' we are entering."

Three years later, a 1986 study by the US Census Bureau looked at the functional illiteracy rate, which at that time stood at about thirty percent of the population. The study predicted that, if 1986 trends continued, functional illiteracy in the general population of the US would reach seventy percent by the year 2001. That means in less than twelve years, no matter what their academic records, seventy percent of the population will fall short of functioning as productive members of society.

Still at Risk

Five years after "A Nation at Risk" appeared, Secretary of Education William J. Bennett assessed America's educational progress. In 1988, he said, "We are doing better than we were in 1983 . . . but we are certainly not doing well enough, and we are not doing well enough fast enough. We are still at risk."

Current examples of educational deficiencies abound. In early 1988, the New York Telephone Co. tested 22,880 applicants for 2,000 entry-level jobs. The jobs did not require a high school diploma. Eighty-four percent of the applicants failed the examination. In July of that year, Secretary of Commerce C. William Verity wrote in "Building a Quality Workforce," a joint initiative of the Departments of Commerce, Education, and Labor: "At a time when more and more jobs require at least basic proficiency in English comprehension and mathematics, our young entrants into the labor force are proving to be disturbingly deficient in these skills, not to mention knowledge in such areas as science, geography, and foreign languages."

In March 1989, the *Wall Street Journal* looked at education in big cities. It reported that in some of Philadelphia's inner-city schools the dropout rate is as high as sixty percent. Nationwide, the *Journal* found that 3,800 teenagers drop out of school each day. Those dropouts are generally lost to the labor market. They are not competitive candidates for jobs that count; in most respects, they are incapable of entering the work force.

Louis V. Gerstner, a former president of American Express Co., commented recently on the lamentable quality of the entry-level work force. Writing in the Washington *Post* (March 20, 1989), he noted "good news and bad news." The good news, Mr. Gerstner said, is that American Express will be hiring a minimum of 75,000 people over the next five years. The bad news is that the company may not be able to find them. These are entry-level jobs; yet many applicants can barely write, are ignorant

of geography, and cannot cope with simple mathematics.

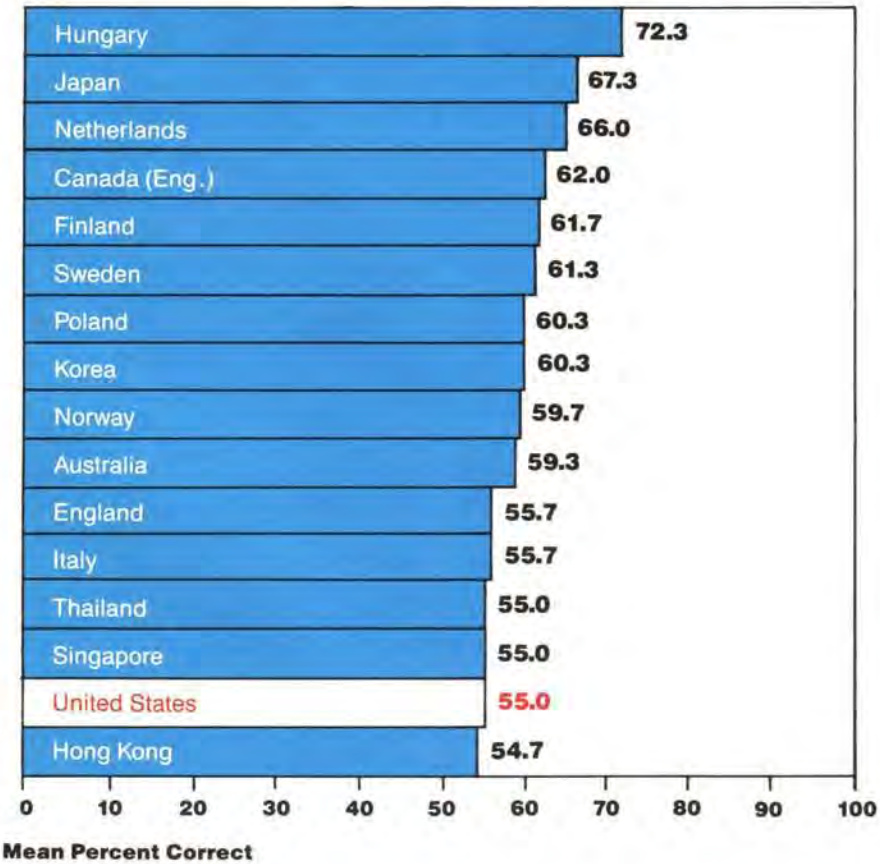
Mathematics is the key to opportunity everywhere. Phillip A. Griffiths, Chairman of the Board on Mathematical Sciences and professor of mathematics at Duke University, says, "Those who do not learn basic mathematics problem-solving skills will be left behind in the world of the future. And this is just as true for nations as it is for individuals." Mr. Griffiths made that statement at the conference releasing the report "Everybody Counts" in January 1989. The report was sponsored by the National Research Council as part of its response to the urgent national need to revitalize mathematics and science education. Frank Press, Chairman of the Research Council, stressed how crucial it is "for science, technology, and the economy of the nation that all students receive high-quality education in mathematics."

In its early paragraphs, the report says, "More than ever before, Americans need to think for a living; more than ever before, they need to think mathematically. Yet, for lack of mathematical power, many of today's students are not prepared for tomorrow's jobs. In fact, many are not even prepared for today's jobs." Then it says, "Wake up, America! Your children are at risk."

Perhaps the US experience is not unique; maybe educational achievement levels are slipping worldwide. The evidence suggests otherwise. Comparing US education levels with those in other countries adds cause for concern. Consider the "International Science Report Card," issued in 1988 by the National Science Teachers Association *(see chart below)*. The report was based on standardized tests administered to students in the United States and twenty-three other countries. Students at the fifth-, ninth-, and twelfth-grade levels were tested. By 1988, data on the US and most other countries had been analyzed and included in the report.

At the fifth-grade level, US students ranked eighth among fifteen countries. The ninth-grade students ranked lower—fifteenth place. Even worse news came from testing the twelfth-grade advanced-science students. For example, US twelfth-graders completing a second year of biology ranked fourteenth among the fourteen countries whose data were analyzed—dead last. In other sciences the US results were slightly better, but not encouraging. US twelfth-grade students with two years of chemistry ranked eleventh among thirteen countries; in physics, the comparable result was ninth of thirteen.

US Ranks Low in Science Achievement



US ninth-grade students ranked fifteenth among the sixteen countries participating in a 1986 international science achievement test. Still more alarming is the fact that US ninth-graders' average score on this test in 1986 was lower than that achieved by US ninth-graders in 1970.

Source: International Science Report Card, International Association for the Evaluation of Educational Achievement.

Jobs and Skills Mismatched

Educational shortcomings would be lamentable enough in a static situation, but the circumstances are not static. The economy and workplace are changing rapidly, and the pace of change is accelerating. As Secretary Verity commented in "Building a Quality Workforce," "The 'basic skills gap' between what business needs and the qualifications of the entry-level workers available to business is widening."

Secretary Verity and his colleagues cited examples of the pace of change. The Commerce Department noted that about ninety percent of all scientific knowledge has been generated in the last thirty years. It estimated that the pool of knowledge will double in the next ten to fifteen years. Product life cycles also shrink, requiring change and adaptability. The Commerce Department says that life cycles for electronics products "already have collapsed to three to five years" and that product life cycles rarely will exceed five to ten years in other industries.

The rapid change will demand a flexible and adaptable work force. "Building a Quality Workforce" quotes David Kearns, CEO of Xerox: "Future jobs will be restructured about every seven years, and

work and learning will be inseparable." The Bureau of Labor Statistics underscores the need for education in the future. It forecasts that more than half of all new jobs created between 1984 and 2000 will require some education beyond high school, and almost a third will be filled by college graduates. Today, only twenty-two percent of all occupations require a college degree.

Yet while the number of new jobs is growing (16,000,000 created between 1982 and 1988, says the Labor Department), the number of new entrants is shrinking. The group of people between sixteen and twenty-four years of age has been the traditional source of new workers. But that group is dwindling as the effects of the post-baby-boom era begin to take hold; fewer mothers and fewer babies per mother translate into a smaller future labor pool. The Hudson Institute, in its "Workforce 2000" report, projected the trend in these terms:

- Decline in population growth means an older work force, with average age of workers increasing from thirty-six to thirty-nine by the year 2000.
- Workers aged sixteen to thirty-four accounted for half the work force in 1985, but will be declining to less than forty percent by 2000.
- Eighty percent of new entrants into the work force will be women, minorities, and immigrants.

Besides requiring a steady influx of entry-level workers, companies in the aerospace and defense sectors also require midlevel and senior men and women who are already qualified and productive. The ebb and flow of defense contracts and new projects often require companies to add qualified technical people to compete for new business or complete business on the books. The companies must range far afield to find and hire them.

For example, listening to the car radio while stuck in freeway traffic in Los Angeles, I heard a recruitment commercial for Westinghouse Defense: "Come to beautiful Chesapeake Bay and work on exciting projects in the land of pleasant living. Interviews being conducted at the Century Marriott on Saturday." Back home a day later in the Baltimore-Washington area, I heard a radio commercial broadcast for Rockwell Autonetics: "Join Rockwell at Newport Beach, Calif., where it's warm and pleasant, and the prospects are challenging. Interviews Saturday at Crystal City."

"The Depth of Commitment"

In March 1989, Boeing borrowed up to 670 skilled production workers from its competitor Lockheed to fill orders for its 747-400 airliners. Dean Thornton, president of Boeing Commercial Airplanes, said that borrowing workers from Lockheed and other Boeing divisions showed "the depth of the Boeing commitment to produce the 747-400s that meet all the quality and technical expectations that our airline customers have." It also demonstrated the acute shortage of skilled aircraft production workers in Seattle and a surplus in Marietta, Ga., where Lockheed's C-5B work had wound down.

Other short-term remedies taken by aerospace companies include bounties and hefty recruitment advertising. Aerospace companies in Southern California offer bounties of up to $2,000 to employees who recruit qualified people with the right skills. The mix of money spent on product and recruitment advertising is changing to be more heavily weighted for recruiting skilled people. But if a California firm hires engineers from Baltimore, there is a hefty financial cost for moving the people and their families. In addition, in more than half of working families, both spouses are employed. That makes them reluctant to move without assurance that both will be employed in the new situation.

Clearly, such actions are short-term fixes. Coordinated national reforms are required for the long term.

In 1983, the authors of "A Nation at Risk" recommended simple, straightforward, and lasting national reforms. Among them: strengthen content to stress basics; adopt more rigorous standards and expectations; devote more time to basics with better use of the school day, longer school days, and lengthened school year; improve teaching and teachers; and provide leadership and funding.

In his 1988 assessment of progress, Secretary Bennett said that reforms face serious obstacles; among them, sheer bureaucratic inertia from 100,000 school systems and determined opposition in different forms. One group of opponents denies that things are as bad as they seem. A second group admits that things are bad, but says that "society" or the "system" needs to be altered.

"Today," Secretary Bennett said, "we hear opposition by extortion: the false claim that to fix our schools will first require a fortune in new funding." Finally, he said, current opposition to school reform "is manifested in the narrow, self-interested exercise of political power in statehouse corridors and local school board meetings." Sweeping national remedies may seem obvious, but as Secretary Bennett pointed out, they are difficult to implement. Even successful national programs require local participation as an element of success. What is being done locally by industry and communities?

Local Initiatives

In many localities nationwide, industry, government, and schools are working together to create improvement. They are not waiting for national solutions. Take Cincinnati, for instance.

"Unless something is done, hundreds of children born this year [1987] in Cincinnati will grow up functionally illiterate and unemployable. Almost half will never finish high school. We must work together to stop this enormous waste of human potential in our community." In saying that, John Pepper, the President of Cincinnati-based Procter & Gamble, was emphasizing the need for business to do something about the forty percent dropout rate in Cincinnati's public schools.

A partnership between business and education was developed in January 1987. Called the "Cincinnati Youth Collaborative," it is aimed specifically at dropout prevention. The CYC links hundreds of business volunteers with scores of public and private sector organizations concerned with youth. By working together, the CYC helps the system keep young people in school and helps the schools prepare them better for the job market.

In Chicago, fifty companies have

How Many Engineers?

If your laboratory or your project has enough engineers for the work at hand, there is no engineer shortage. However, if you don't have the engineers you need, the shortage is acute. For the best national use of technology and engineering talent, it is useful to know how many engineers of which disciplines are available.

Unfortunately, the numbers vary. That is the conclusion of John Alden of the American Association of Engineering Societies (AAES). Reporting in *Engineering Manpower Bulletin 92* (January 1989), Mr. Alden found that the National Science Foundation (NSF) counted 2,634,900 engineers in the US in 1986 (most recently compiled figures). However, the Bureau of Labor Statistics counted 1,331,747—only about half as many.

Mr. Alden adjusted the NSF figures downward by deducting the numbers of engineers unemployed or out of the labor force, employed but not in engineering, primarily in management jobs, and in other categories. With those adjustments, he squeezed the NSF total to 1,217,600. By Mr. Alden's calculations, the actual number of practicing engineers is somewhere between 1,200,000 and 1,300,000.

pooled resources to found their own school, the *Wall Street Journal* reported in March 1989. The companies hope their school will demonstrate that children in poverty can learn as well as suburban children can. The tuition-free Corporate-Community School holds classes year-round and tailors progress to the children's needs.

"Magnet schools" are another way for communities to address two social needs at the same time, desegregation and educational innovation. These schools have educational innovations that attract students and parents. Their spaces are filled by racial quotas to ensure desegregation. Prince George's County, Md., adjacent to Washington, D. C., has thirteen programs in forty-seven schools, offering 1,500 openings. Parents form lines a week before the openings are allotted, camping out on the spot to ensure their children have a shot at a magnet slot.

Mr. Kearns of Xerox advocates reorganizing every public school district with more than 2,500 children into a year-round universal magnet system. In his restructuring, advocated in *Winning the Brain Race* (coauthored with Denis P. Doyle), Mr. Kearns says the magnet schools "would be free to implement new teaching strategies and learning methods. . . . Principals and teachers would run their schools with complete academic and administrative autonomy."

School magnets, like all magnets, are attracting forces. Magnet schools attract controversy and criticism along with their appeal to parents and students. Mary H. Metz, professor of education at the University of Wisconsin, is an expert on magnet schools. She says they draw controversy because they are different, and "they challenge a pervasive myth—that the only way to achieve educational equality is through standardization." She says that magnet schools draw political fire because they bring this tacit contradiction (between standardization and diversity) to public consciousness.

Building Better Employees

Increasingly, industry is forced to make, rather than buy, productive employees. In its report, "Workplace Basics, the Skills Employers Want," the American Society for Training and Development stated the basic lesson: "Employer interest in improving basic skills is driven by economic concerns. When deficiencies affect the bottom line, employers respond with training or replacement." But the replacement course is less feasible, because the entry-worker pool is shallow and less trainable. Consequently, employers' interest in providing training in basic workplace skills is growing.

In Southern California, aerospace companies banded together with community colleges nearly four years ago to develop curriculum guides for seven occupations critical to their manufacturing operations: manufacturing planner, tool designer, machine operator, machine maintenance worker, quality control inspector, composites fabrication technician, and numerical controlled programmer. Curriculum writers from more than twenty community colleges worked in teams to convert industry requirements and input into workable instruction units.

Within eight months, the guides were ready for use in classrooms across the region. In the process, industry and the colleges both learned more about each others' needs. The project has proved successful in practice. Students qualified for jobs the aerospace companies needed to fill, and the colleges built a core of practical instructional experience usable for other aerospace manufacturing jobs, as well as in other industries. Companies involved (all members of the Southern California Aerospace Industry Education Council) were McDonnell Douglas, Hughes Helicopters (now part of McDonnell Douglas), Northrop, and Rockwell International.

Looking ahead, what can be done to arrest the decline in America's intellectual capital? What can be done to preserve and improve its technical manpower resources? Clearly, individual companies, school systems, unions, and workers should not await magical national solutions. Those will be a long time coming, if ever. Local initiatives show the most promise for addressing local problems. The Cincinnati and Southern California cases are examples of hundreds and perhaps thousands of local groups combining to address the problems.

Whichever solutions are sought, unless effective action is taken, the US will have a third strike to add to the trade and budget deficit woes: the technical-manpower deficit. The time is late; the problem, already critical, worsens daily. ■

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