

E. F. Schumacher: Cutting Technology Down to Size

London. The late Jacob Bronowski, as *The Ascent of Man*'s many fans may not have guessed, spent much of his adult life working for the National Coal Board, the British government agency that manages the country's nationalized coal mines. This unusual alma mater boasts another alumnus, one who is not yet as well known as Bronowski but probably has an equal claim on public attention. He is Ernest Friedrich Schumacher, founder of the maverick development agency Intermediate Technology, and author of *Small Is Beautiful*,* a tract with the wry subtitle, "Economics as if people mattered." Yet whereas Bronowski saw science as a cultural peak of Western man, and maybe his salvation too, Schumacher holds that science and technology, in their present uses, have ravaged nature, degraded man, and impoverished civilization.

A central message of *Small Is Beautiful* is that man, in the infatuation with his new found technical skills, has lost his sense of values and opted for the old Faustian deal of fly now, pay later. Unfortunately the flight was short and the time for payment has arrived, says Schumacher. Large scale technology, violent both to nature and to human nature, lies at the root of the three crises that have fallen almost simultaneously upon the modern world—the industrial threat to the environment, the scarcity of natural resources, and the mounting discontent and ungovernability of populations.

It would be wrong to dismiss Schumacher as a mere doomsayer, as this overcondensed précis might suggest. His book is about economics, a trade that he practiced for 20 years as adviser to the coal board. His prediction, in 1958, of the approximate date and nature of the present energy crisis is a warning that his forecasts should not be taken too lightly.† Born in Bonn in 1911, the son of a professor of economics, Schumacher went to Oxford as a Rhodes scholar, and to Columbia University as a lecturer. He left Germany for England, and after World War II broke out found himself working as a farm laborer in Northamptonshire for \$5 a week. He then wrote an article that was noticed by Maynard Keynes, and by the end of the war had become chief economic editorial

writer on *The Times* of London. Then followed a period as adviser to the allied control commission that laid the base for Germany's economic recovery.

Now retired from the National Coal Board, Schumacher is much in demand as a speaker, and as a peripatetic consultant for Intermediate Technology. He is working on a new book, to be called "A guide to the perplexed," and is enjoying the success of *Small Is Beautiful*, which seems destined to become a countercultural cult text as well as a talking point among the more orthodox. The book is not easily summarized, being a collection of disparate essays written over the last 10 years. But the following themes illustrate some of the flavor of his thinking.

► *The problem of production.* It is an illusion that modern economies have solved the problem of production. Production depends heavily on the capital provided by nature in the form of air, water, and resources. We treat this capital as income, and value it at nothing. The modern industrial system, for all its intellectual sophistication, consumes the basis on which it has been erected, Schumacher says. We must develop a new life-style, with new modes of production and consumption, a life-style designed for permanence.

► *What scientists must do.* "Wisdom," in Schumacher's opinion, "demands a new orientation of science and technology towards the organic, the gentle, the non-vio-

lent, the elegant and beautiful. . . . We must look for a revolution in technology to give us inventions and machines which reverse the destructive trends now threatening us all.

"What is it that we really require from the scientists and technologists? I should answer: We need methods and equipment which are

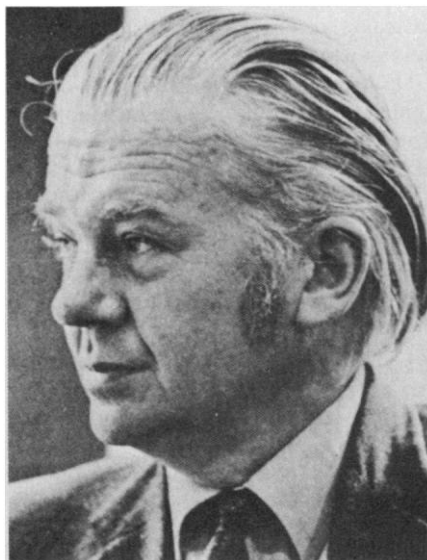
—cheap enough so that they are accessible to virtually everyone;

—suitable for small scale application; and

—compatible with man's need for creativity."

► *Buddhist economics.* Modern economics sees consumption as the sole end of activity, and the customary Western yardstick of a man's happiness—his "standard of living"—is measured exclusively in terms of material goods. In Buddhist countries, Schumacher notes, the purpose of life is considered to be liberation, not consumption, hence a different economics is called into being. The difference between Buddhist and Western economics is that the former "tries to maximize human satisfactions by the optimal pattern of consumption, while the latter tries to maximize consumption by the optimal pattern of productive effort. . . . We need not be surprised, therefore, that the pressure and strain of living is very much less in, say, Burma, than it is in the United States, in spite of the fact that the amount of labor-saving machinery used in the former country is only a minute fraction of the amount used in the latter."

► *Science and values.* There are six leading ideas, all developed in the 19th century, which dominate the minds of educated people today. These ideas (essentially the theories of Darwin, Marx, and Freud on which most rationalist philosophies are founded) claim to do away with metaphysics "but are themselves a bad, vicious, life-destroying type of metaphysics." They becloud our reason, stultify our moral awareness, and impose on us a false sense of values. It's not more education we need to restore our perspective, Schumacher opines, but more wisdom. Learning the second law of thermodynamics, as C. P. Snow would have us do to bridge the two



Ernest F. Schumacher

†At a time when most European governments were busily winding down their coal industries in preference for cheap oil, Schumacher wrote that there would arise an ever growing gap between Europe's fuel requirements and indigenous supplies, a gap which could be closed only by Middle East oil and which, he said, "would mean the end of Western European independence." His 1958 statement continues: "If present plans are carried through, the position will be irretrievable 20 years from now. Western Europe will have attained a position of maximum dependence on the oil of the Middle East precisely at the moment when the first signs of a world famine become visible. The political implications of such a situation are too obvious to require discussion." This and frequent other warnings by Schumacher were ignored, often with the *ad hominem* assertion that he was just protecting the interests of the National Coal Board.

*Harper & Row, New York, 1973. Paperback, \$3.75.

cultures, is exactly useless. "Science and engineering produce 'know-how'; but 'know-how' is nothing by itself; it is a means without an end, a mere potentiality, an unfinished sentence. 'Know-how' is no

more a culture than a piano is music." For education to finish the sentence, it would have to transmit ideas of value, of what to do with our lives. Science cannot produce the ideas by which we could live.

► *Technology with a human face.* The modern world has been shaped by technology, so we should look at technology as a possible cause of the crises that beset it. What does technology really do for us? Its primary task is to lighten the burden of work. But, says Schumacher, "the type of work which modern technology is most successful in reducing or even eliminating is skillful, productive work of human hands, in touch with real materials of one kind or another." St. Thomas Aquinas defined man as a being with brains and hands, yet to be able to use both creatively has become the rarest of privileges in a modern society, a fact which may underlie the modern neurosis.

We may say, therefore, that modern technology has deprived man of the kind of work he enjoys most, creative, useful work with hands and brains, and given him plenty of work of a fragmented kind, most of which he does not enjoy at all. . . . Taking stock, we can say that we possess a vast accumulation of new knowledge. . . . The use we have made of our knowledge is only one of its possible uses and, as is now becoming ever more apparent, often an unwise and destructive use.

The direction which modern technology has taken is the opposite of real progress, Schumacher argues. There must be a new orientation, which everybody must help decide, since it cannot be left to the experts. "Today, the main content of politics is economics, and the main content of economics is technology. If politics cannot be left to the experts, neither can economics and technology."

► *Science and the Third World.* In many countries the poor are getting poorer, and the established processes of aid and development seem unable to reverse the trend, but rather promote it. What has gone wrong, in Schumacher's analysis, is that aid givers have established new industries, mostly in the cities, and largely in imitation of Western economies. But the common criterion of success—growth in GNP—is utterly misleading. It is more important that everybody should produce something than that a few people should produce a great deal. What should be done is to create cheap workplaces, located in the countryside and based on production technologies that use local materials and easily acquired skills.

Intermediate Technology

To such small-scale, labor-intensive, cheaply created forms of production, Schumacher gives the name "intermediate technology." In the belief that the best form of aid is knowledge, he founded the Intermediate Technology Development Group (ITDG) in 1966 to make Third World countries aware of the alternatives that exist to the high technologies touted

Geological Survey Lowers Its Sights

The U.S. Geological Survey has dramatically lowered its estimates of undiscovered, recoverable oil and gas resources in the United States, and the Survey's new estimates are already having an effect on national energy policy. In a document the Energy Research and Development Administration bills as a new "national plan" for energy R & D, ERDA says the Survey's reappraisal means that extending the life of U.S. oil and gas resources has become the nation's "first technological need."

In March 1974 the Survey estimated that between 200 billion and 400 billion barrels of oil and 1000 trillion to 2000 trillion cubic feet of natural gas remained to be found and produced by conventional technology on- and offshore in the United States. The Survey's latest estimates, which follow an extended controversy over the validity of the 1974 figures (*Science*, 28 February 1975), place undiscovered recoverable oil at 50 billion to 130 billion barrels and gas at 320 trillion to 655 trillion cubic feet. The lower figures are said to have a 95 percent probability of being correct and the higher figures, 5 percent.

Estimates of offshore oil and gas alone fell even more sharply than the overall figures. Whereas the USGS previously predicted 65 to 130 billion barrels of oil would be found on the continental shelves to a depth of 200 meters, the Survey now estimated 10 to 49 billion barrels, with the lower figure having a 75 percent chance of being right and the higher one a 25 percent chance.

According to ERDA's R & D plan, released on 28 June, the new estimates imply that current rates of oil and gas production will be "difficult to maintain" even after oil and gas begin flowing from the continental shelf and Alaska's North Slope. Without the application of enhanced recovery technology, the plan's 8-page summary declares, "the estimates indicate that production of domestic oil will drop rapidly in the mid-1980's, as will the production of domestic natural gas. It is unlikely that major new energy resources could be ready by that time."

Advanced recovery technology would, the plan continues, buy roughly 10 years of added time. This decade is said to be "crucially important," for it would effectively double the time available for developing major new sources of energy.

Oil industry analysts and some of the U.S. Geological Survey's own experts have long regarded the USGS estimates as far too high, but it was not until last summer, when the National Academy of Sciences' resource committee agreed to arbitrate the disagreement, that a resolution seemed in sight. Last February, the academy committee concluded that USGS had used some misleading math in its estimates and that something like 113 billion barrels of oil and 530 trillion cubic feet of gas remained to be found. This was close to most industry estimates and to those propounded for many years by M. King Hubbert, a senior geophysicist at USGS.

In the meantime, the Survey was working on its revised estimates using a more sophisticated approach that resembles those of major oil companies. Regional specialists analyzed more than 100 distinct petroleum provinces, plugged in what the Survey called "large quantities of new geologic and geophysical data" and, for the first time, assigned probability limits to the new estimates. All of this has been greeted with praise by Hubbert, one of the Survey's most persistent critics.

"It's revolutionary," Hubbert exulted in a recent conversation. "For the first time in 15 years the USGS has got down to dealing with facts, not fancy . . . they worked the hell out of all the information they could get."

As for the controversy that had clouded relations between the Survey and Hubbert, one of its more distinguished employees, Hubbert said, "The air has been cleared almost completely. This situation has come to an end."—R.G.

by aid givers. Based in London with a staff of about 40, including 3 research officers, the ITDG is a nonprofit company that provides consultancy services to less developed countries. It publishes a journal, *Appropriate Technology*, and through a system of expert panels develops its own examples of intermediate or appropriate technologies. In cooperation with other centers, the ITDG has assembled more than 200 such items of equipment. One ITDG product is a hand operated, multi-purpose, metal bending machine which can be built for about \$16. The cheapest machine available commercially requires mechanical power and costs \$1750.

Another product of the group's research and development is a machine for making egg trays, designed at the request of the Zambian government. The smallest existing machine cost \$390,000 and had a far greater capacity than Zambia required. The ITDG version costs \$19,500 and can make other sorts of packaging besides egg trays.

"Development begins with people, not the production of things," says George McRobie, a director of ITDG and former colleague of Schumacher's at the National Coal Board. McRobie, a Scotsman who regards himself as a citizen of a less developed country, speaks of the inhumanity of large scale technology and its disutility for the poor and powerless. The choice of technology, he says in a recent article, "is the most critical collective decision facing any

poor country (and perhaps rich countries too). The choice of technology determines who gets work . . . it determines the kind of [industrial] infrastructure required, patterns of education and training, the extent of national self-reliance or dependence on others. . . . It was, and still is, the virtual denial of such choices to the developing world that brought the Group into existence."

ITDG is still small—the annual budget is about \$130,000—and dependent on grants to balance its books. Nevertheless, it has survived, its approach is gradually percolating into development theory, and it remains a tangible proof that its founder's ideas about the beauty of smallness have some marketplace appeal in the practical world.

Such proof is by no means unnecessary: perhaps the chief lacuna of *Small Is Beautiful* is that it describes a number of maybe utopian ideals without offering many signposts as to how they may be attained. Schumacher is not particularly helpful in elucidating the questions left hanging in his book. How can one reverse the trend that he deplores toward technological bigness, complexity, and violence? "People are sleepwalkers," Schumacher replies, "you must hope that if you shout hard enough they will wake up." He is not interested in issuing precise instructions for reform; what is important is that people sort out their own convictions. "We are suffering from a metaphysical, not a technical defi-

ciency—technical brilliance will only drive us deeper into the mire. When we say Concorde [the Anglo-French SST] is a marvelous thing, that is a metaphysical statement. Unless we sort out our deepest convictions we will never get the answer."

Schumacher complains that people "have allowed themselves to be persuaded by Darwin that there is no purpose to anything." Is he then advocating a return to religion or religious values? "I don't advocate anything. What we most urgently need is to find the truth."

Schumacher declines to say whether he is optimistic or pessimistic about the current state of things. But in a recent speech to a London borough council, he explained that the two developments which make big cities (and suburbs) possible are fast transport, which is based on oil, and high agricultural productivity, which is also based on oil. As the era of cheap oil comes to an end, "then it would follow that the task will be to decentralize . . . into small, organic, meaningful structures. Also, it will mean that many more people will have to be engaged in agriculture." The oil crisis, in other words, may be forcing us in the direction Schumacher advocates. His vision of the death of cities may not console those who prefer urban civilization to what Marx called the idiocy of rural life. But it is a vision worth bearing in mind as a corrective to those who say that the cure for all the ills caused by technology is more of the same technology.—NICHOLAS WADE

NSF Science Development Program: "Centers of Excellence" Revisited

In the middle 1960's the National Science Foundation (NSF) launched a major program of grants designed to upgrade science in selected "second tier" universities. An evaluation study* of the program has been released and, because the Nixon Administration in 1971 decided to end the program, the study has something of the quality of a postmortem, not only of the

program but of an era in which attitudes and assumptions about federal science were very different from those which prevail today.

The study's findings are not startling. As the report notes, "it is difficult to give \$230 million to universities and do them much harm." And the grants carried into the early 1970's—when the financial crunch hit most universities—so that longer-term effects of the program are hard to identify. By the indices devised for it, however, the study does provide evidence that the grants did, in most cases, help—there was, for example, an increase in faculty publications attributed to the program. But the major

value of the study may well be that a serious attempt was made to evaluate a major program by an outside group.

The study of the Science Development (SD) program was carried out for NSF by the National Board of Graduate Education.† The project director was David E. Drew, a sociologist who worked in the research office of the American Council on Education before heading the SD study and is now at the Rand Corporation. The cost of the study was \$270,000, but NSF hopes the investment will be figuratively amortized over a fairly long period be-

*The study is published in two parts. Copies of a summary report, *Science Development, University Development and the Federal Government* may be obtained free from the National Board of Graduate Education, 2101 Constitution Avenue, NW, Washington, D.C. 20418; a technical report, *Science Development: An Evaluation Study*, is available for \$5.75 from the Publication Sales Office of the National Academy of Sciences at the same address.

†NSF asked the National Academy of Sciences to undertake the study, and the academy, through its operating arm, the National Research Council (NRC), delegated the job to the National Board of Graduate Education (NBGE), with which the NRC has a slightly complicated relationship. The NRC, the Social Science Research Council, the American Council on Education, and the American Council of Learned Societies form the Associated Research Councils which established the NBGE to carry out studies in graduate education. The NBGE is administratively housed within the NRC, and the board's staff are NRC employees. The board was set up on a temporary basis and is due to expire when three reports which the staff is still working on are complete. While certainly not hostile to federal grants to universities, the NBGE had no particular axe to grind for the SD program.