A New Contender in World Science

Science in Contemporary China. LEO A. ORLEANS, Ed. Stanford University Press, Stanford, Calif., 1980. xxxiv, 600 pp., illus. $35.

Few developments of the late 1970's have more potential significance than the renewal of intellectual interchange between China and the industrialized democracies. For the first time in decades, we enjoy the prospect of constructive Chinese involvement in the search for solutions to problems that transcend national boundaries: communicable disease, food and energy shortage, environmental pollution, nuclear proliferation, and unchecked population increase. While the inclusion of China hardly guarantees that mankind will surmount the global problems we confront, clearly these problems will not be managed well without the active participation of more than one-fifth of the world's population.

From the 1920's through the 1940's, Chinese universities and research institutes began to train thousands (but not tens of thousands) of talented, industrious teachers and researchers in the sciences and social sciences. The humanities, already well sustained by China's cultural traditions, began to enjoy a renaissance through the absorption of Western thought. In addition to these promising developments in China, thousands of Chinese students enrolled in universities in the West. But the Sino-Japanese War (1937–1945) and the communist revolution disrupted the entry of China's intellectuals into international professional communities. Following the communist victory, many stayed in the United States, subsequently joined by compatriots from Hong Kong and Taiwan, to contribute immeasurably to our scientific development.

But as ethnic Chinese residing in the West increasingly played a vital role in international scientific advance, China's own scientific community became increasingly isolated. *Sciences in Communist China*, the major 1961 survey published by the American Association for the Advancement of Science, concluded that, though China had continued its advance in some areas (mathematics, medicine) and was moving forward in some new ones (engineering sciences), the exclusive reliance on the Soviet Union, the heavy emphasis on applied rather than basic research, and the political persecution of many scientists were having an adverse effect. Soon after that assessment was completed, China entered its Cultural Revolution and its aftermath (1966–1976), which proved devastating to its intellectual community. Universities closed. Research halted. Laboratories disbanded or moved to the countryside. Intellectuals were hounded. Only a few areas in the national security realm even partially escaped the mayhem.

Toward the end of this period, from 1972 on, but even more so after the death of Mao Ze-dong (Mao Tse-tung) and the weakening of supporters of the Cultural Revolution in the Chinese bureaucracy, the political leadership exhibited a keener awareness of the importance of science and technology. Since 1976, the universities and the research academies have gradually been restored, though the legacy of the Cultural Revolution remains strong. And, since 1978, the Chinese have begun to establish meaningful ties with the West—not just exchanging superficial visits, as in 1972 to 1977, but attending international conferences alongside countrymen from Taiwan, sending scholars and students abroad for sustained periods of research, and engaging in collaborative research projects. Whereas in 1978 but a handful of People's Republic of China (PRC) citizens were in American universities, today over 6000 visiting scholars and degree candidates are on our campuses, and thousands of others have received and are receiving advanced technical training in corporations. A massive transfer of science and technology to China has begun, with China hesitatingly opening its doors to Western research in China as well. Not since the early 1930's has China's research community exhibited such vibrancy, and perhaps never have the prospects been so bright for the incorporation of China into the common effort to advance knowledge. Careful, realistic thinking is now in order as to how to take advantage of the opportunities at hand.

Three policy questions obviously merit study. First, what is China's absorptive capacity? Second, is China's scientific development likely to continue, or could the nation stagnate? And third, if the assessment is encouraging, what is the best way to enhance Sino-American cooperation in sciences, social sciences, and humanities?

In order to answer such questions, we must obviously possess a keen sense of the state of the sciences in China today. *Science in Contemporary China* is a major contribution in this regard. Twenty-eight eminent authors, cooperating under the capable editorship of Leo Orleans, have produced a volume that is encyclopedic in scope. The book opens with effective introductory chapters on science in China's past by the distinguished historian of Chinese science Nathan Sivin and on science policy and organization by Richard Suttmeier, America's leading specialist on this subject. The reader is then introduced to mathematics, physics, chemistry, astronomy, geography, the earth sciences, meteorology, and oceanography. Chapters on biomedical research, plant genetics, plant protection, and animal sciences come next, followed by chapters on engineering, energy, electronics, and environmental science. A concluding section focuses on the social sciences. A useful appendix provides tables of organization, lists of Chinese scientific journals, and texts of major speeches to the 1978 National Science Conference, at which the ambitious goals that still guide policy were set forth. The noticeable but understandable omission concerns science and technology exclusively for national defense. (Dual-purpose and gray-area technologies are covered.)

That such an ambitious volume could be produced is a tribute to the Committee on Scholarly Communications with the People's Republic of China (CSCPRC), an organization housed in the National Academy of Sciences and led as well by the Social Science Research Council and the American Council of Learned Societies. Under the capable direction of Anne Keatley until 1976 and Mary Bullock since 1977, CSCPRC has coordinated, initiated, and advanced science exchanges with China. Among its many activities has been production of over 15 detailed monographs assessing a wide range of sciences, from solid state physics to paleoanthropology to vegetable farming. These monographs, extensive CSCPRC files, PRC publications, and visits to China provide the basis for the chapters in this book.

It is impossible to summarize the book. Each chapter is readable, informed, and interesting. The chapters are uneven, reflecting in part the uneven development of the various fields of China. The Chinese emphasis on applied

rather than basic research is a pervasive theme. At least to this reader, the sections on insect pest control, infectious and parasitic diseases, plant breeding, and earthquake forecasting were particularly interesting. These areas exhibit Chinese ingenuity and offer immediate promise for mutually rewarding collaborative research. The descriptions of mathematics and physics are more sobering, reflecting the ravages of the Cultural Revolution.

The broad overview this book provides necessarily yields its major deficiency. It does not convey a fine-grained sense of the research process in China: the heroic bureaucratic battles which younger, innovative individual scientists or research teams encounter to obtain the funds, manpower, and equipment to carry out research in a system that rewards seniority and political reliability; the mundane but enormous constraints on research, such as unreliable electric supply, inadequate space, antiquated equipment, chronic shortage of necessary supplies, and so on; the complicated patterns of interaction between research institutes and university departments, their supervisory bodies, and government consumers; the personal rivalries and animosities that inhibit cooperation and spark competition in each field; the political games and favoritism in government allocation of foreign travel and external research opportunities, and the harmful effects of excessive secrecy. The book masterfully surveys science in China but does not greatly advance our understanding of the scientific craft or the sociology of science in the People's Republic. Now that CSCPRC has assessed the various disciplines in China, it would be well advised to sponsor studies on the various aspects of science policy in China. Without the intimate feel for how research projects are actually organized and carried out, outside observers will only imperfectly be able to assess China's absorptive capacity, its ability to sustain scientific and technological advance, or ways to enhance Sino-American cooperation.

Nonetheless, taken as a whole, *Science in Contemporary China* does illuminate the key issues. Prior to reading this volume I sensed that China faced considerable limitations in its ability to absorb foreign technology. The volume suggests that a highly differentiated analysis is appropriate. Much depends on the technology in question. In certain areas, such as the biological sciences, medicine, and certain divisions of engineering, the Western impact seems likely to be swift and extensive. Advances in metallurgy

Reviewed in This Issue

or electronics may be somewhat slower. Variation in available manpower among disciplines, the sophistication of the equipment involved, and the utility of the knowledge are among the principal factors determining absorptive capacity. Provided political interference is minimal, the volume suggests China is poised to take advantage of much more foreign technology than is ordinarily appreciated. A major challenge will be to integrate and use effectively the thousands of Chinese who will soon be returning to China from abroad.

The overall impression also is that China has a stronger scientific base than the poor-mouthing over the very real disruptions of the Cultural Revolution would suggest. In area after area, the conclusion is that the Chinese are at most 20 to 30 years behind, or approximate the Soviets and Japanese 20 years ago. Is the glass half full or half empty? After all, the 1950's and 1960's were not the dark ages, but rather provided a launching pad for the impressive advances of the past two decades. The issue boils down to politics: whether the governmental and social order will provide an environment conducive to research and training. This book does not probe this broader question, but it is hard to believe China's nurturing of knowledge during the coming 25 years can be more mismanaged than during the past 25. Since scientific advance tends to be more exponential than linear, the best guess based on this volume is that China will have a substantial scientific community within a generation—with or without American involvement.

The policy issues that confront the United States therefore are whether to remain aloof or to be constructively involved in China's advance, and if so how. In fact, with the signing of 14 cooperative accords in the sciences since 1978, Washington has already decided to be involved. These accords range from high energy physics to hydroelectric energy to atmospheric research. The NSF has recently signed an accord for encouraging collaborative research in astronomy, archeology, linguistics, natural products chemistry, materials science, and systems science. For the past two years, the CSCPRC has secured funding from the Department of Education, the International Communications Agency, and the NSF to fund a national program for approximately 60 American researchers in China. Even under the new situation of budget stringency, foreign policy interests dictate that these programs be sustained at current levels. *Science in Contemporary China* suggests that the United States will greatly benefit by playing a constructive rather than inhibiting role in China's inevitable development.

MICHEL OKSENBERG
Center for Chinese Studies, University of Michigan, Ann Arbor 48109

Antinuclear Forces in Europe

The Atom Besieged. Extraparliamentary Dissent in France and Germany. DOROTHY NELKIN and MICHAEL POLLAK. MIT Press, Cambridge, Mass., 1981. xvi, 235 pp., illus. $17.50.

Nuclear power is the technological issue of our time. Yet until recently governments in North America and Western Europe have uniformly been pronuclear. The important antinuclear movement emerged in the middle and late '70s from outside political orthodoxy, unable to find strong roots in established opposition parties, except in such rare cases as that of the Center party in Sweden. In Europe, the ecology greens were added to the Marxist reds and the other colors of the political spectrum.

In *The Atom Besieged*, Dorothy Nelkin and Michael Pollak document the development of these extraparliamentary forces in the two key Continental nations, France and West Germany. As in the United States, the antinuclear movement in these countries has employed civil disobedience and occupied or demonstrated at nuclear power plant sites. But also as in the United States, the success or failure of the antinuclears has rested with the established court system. France, in the absence of a judiciary independent of the strong presidential regime, has been proceeding full tilt with a nuclear program designed to provide over half its energy needs by the year 2000. In Germany, though as of the end of 1979 there were actually more nuclear megawatts being produced than in France, there is a virtual moratorium on further nuclear development, based on court interpretations of a 1976 atom law amendment "providing that a nuclear facility may be licensed only after all safety precautions have been taken to the limit of science and technology."

The German atom law amendment is symptomatic of the legislative tendency to deal with technology in absolutes, as evidenced in the United States by the Delaney amendment banning all cancer-causing substances and the 1972 water quality bill prohibiting the discharge of any polluting effluent by 1985. Unfortunately Nelkin and Pollak omit any background on the development of the stringent German atom law.

This omission is offset by the authors' generally capable presentation of the details of the French and German political, legal, and administrative structures in a way that is useful to readers lacking background information on European politics. The volume also usefully documents the licensing procedures in both countries, the history and organization of the antinuclear groups, and the development of legal proceedings. The status of other European nuclear programs is summarized in one of the concluding chapters. Appendixes present information on nuclear power plant installations and major court cases.

Nelkin and Pollak serve to inform pronuclear forces that the antinuclears are as absolutist as the German atom law. Technological improvements in the safety of plant operations or in waste disposal are unlikely to quiet the core of dissent. Indeed, the opposition, speaking in terms of nuclear societies run by nucleocrats, are using the nuclear issue to attack the interlocking power of government bureaucracies, private industry, and, in some cases, organized labor.

The antigrowth dissenters as portrayed by Nelkin and Pollak appear not to be deeply concerned with alternatives to nuclear power. There is an element of romantic illusion that individual liberties either were better protected before the advent of large political and economic organizations or might be better protected in some non-nuclear future. Yet nonnuclear futures will not likely involve the social transformations desired by many dissenters. While solar power may not engender the apocalyptic possibilities of nuclear, the gear on your roof, like the car in your garage, will probably be mass-produced by an organization with some degree of monopoly power. Modern technologies apparently imply economies of scale that make large organizations inevitable. It is disappointing, therefore, that the information in *The Atom Besieged* suggests that neither side in the nuclear debate is seriously interested in investigating how the incentives to and within large organizations might be structured to avoid the Three Mile Islands, Ford Pintos, and thalidomides. This key scientific and political problem will remain, with or without nuclear power.

Though Nelkin and Pollak are quite successful as chroniclers of the antinuclear movement, their attempts at analysis are flawed. For example, according