Book Reviews

Is Science To Be Man's Servant or His Idol?

Science and the New Nations. Ruth Gruber, Ed. Basic Books, New York, 1961. 314 pp. $6.50.

Science in the Cause of Man. Gerard Piel. Knopf, New York, 1961. 300 pp. $5.

These two books do much to strip away the delusive trappings of the Cult of Science, revealing the problems and limitations that confront the pursuit of science in both developed and underdeveloped countries. The almost insuperable difficulties of putting modern science to work in the new nations is the theme of one; the tensions within Western science, mobilized to the work of the Cold War, the other.

"Do not be dazzled by modern science," Ernst D. Bergmann, chairman of the Israeli AEC, warned the delegates at the 1960 Rehovoth Conference on Science and the Advancement of New States. The conference, summoned by Israel, brought together 120 political leaders and men of science from 40 new nations on five continents. The meeting sought to create, in the words of Abba Eban, "a point of contact between the two most decisive movements of our times—scientific progress and national liberation."

Science and the New Nations is a conscientious sampling of the 5-day proceedings, presenting a clear picture of both the general and the specific problems of the new nations—and the role of science. Problems of food and water, population, medicine and health, politics and education—all are given immediacy and concreteness in the voices of delegates whose nations span the globe from Tanganyika to Australia.

The message that emerges is sober and realistic, dwelling less on what might be done with large sums of money, and more on what must be done with the small and inadequate funds actually available.

In every context the theme recurs that the new nations must avoid undue emphasis on glamorous research, in favor of far simpler and more urgent needs. "Civilization is running a race with famine," said a U.S. expert on soil conservation, "and the outcome is still in doubt." This is the present challenge. For the new nations, milk and meat are of far greater importance than nuclear power reactors or electronics.

The new nations must begin from where they are. Introduction of the plow may prove a wiser investment than the tractor in areas where the people lack even a basic understanding of "physical relationships between cause and effect," and where the supporting economy could not long keep a tractor operating. Primary and secondary education is a universal first step, aimed at creating, not scientists, but mechanics and technicians who can, in Bergmann's words, "absorb, adapt, and use the technical know-how brought to them" from the advanced nations.

Foreign aid, in the form of money, men, and machines, was recognized at Rehovoth as indispensable if the backward nations are to break out of a vicious circle of poverty, ignorance, and political instability. The Rehovoth meeting thus issued a challenge not only to the new nations, but also to the industrialized third of the world, in the name of enlightened self-interest and international stability.

"America represents science and democracy in their hour of triumph," writes Gerard Piel in *Science in the Cause of Man*. (Piel's volume is a collection of 19 addresses delivered before various groups.) It is the example of America that "moves the colonial regions . . . with unrest and revolution." But all is not well in American science. As national power has become ever more dependent on science, science itself is being increasingly nationalized. This trend runs counter to the traditional freedom and internationalism by which science has grown, and threatens to distort and arrest that growth.

In a series of occasional pieces, the editor-publisher of the *Scientific American* focuses a sensitive intelligence upon the ethical, esthetic, political, economic, and social implications of science and technology in America. The unifying theme is the problem of preserving the creative values of science at a time when nations count it a primary resource and instrument of military power and national prestige.

"At the outbreak of the Second World War, science was a kind of world republic," he writes. "It was the only truly international community in an epoch that was to see . . . the narrower concerns of national power rise again to ascendency." As a result, there has been a disruption of creative science. Scientists have been among "the most notable victims of the invasion and abuse of personal privacy and dignity." Communication between scientists, both nationally and internationally, has been broken off by military secrecy, often enforced by those unable to grasp that greater risks to progress may be contained in such policies. There is, he writes, "a dangerous diversion of resources and talent from the really significant long-range concerns of science to the narrower short-range objectives of practical results." Too many of our scientists, already in short supply, populate industrial and governmental laboratories, while the fundamental work of the university suffers. "In our eagerness to exploit its past, . . . we have mortgaged the future of science."

Test oaths and security clearances symbolize the popular Cult of Science, which seeks to regiment science, as if it held a magic key which can banish national anxiety, but cannot itself be trusted. Rather than narrowing the ground held by fear and superstition, "science itself seems to have fallen heir to the legacy of frightened awe."

The reverse side of the Cult is the willingness of many scientists themselves to serve as the high priests. Their entry into high councils of government, where their special competence is now essential, gives them an unparalleled opportunity to impose their own value judgements in policy decisions. Such questions as nuclear strategy and disarmament may contain basic policy components which any nonscientific citizen is capable of evaluating; however, secrecy and the technical components of the issues may leave the decision in the hands of a scientific elite. To bring modern technology and science under democratic control, Piel asserts, is the

central issue of our time. Public judgments arrived at through traditional democratic processes are as pertinent as ever. While "science does broaden and secure the ground on which men can make their choice," he says, it "offers no absolutes and no blueprints . . . to tell us what we want to live for."

Piel offers a provocative theory on the success of Russian science under the rigid monolith of a Marxist totalitarian society. The creative intellect craves freedom and dies without it. The nationalization of science in America since World War II has increasingly restricted the freedom of American science. On the other hand, the intellectual tradition of Russia, bred for generations in an atmosphere of repression and terrorism, has developed some immunity and "is perhaps . . . more cunning and clever in the way it resists and eludes the inquisitor." He is quick, however, to point out that "the things that are wrong with American science are the same things that are wrong with Soviet science."

In a sense, the basic issue raised by Piel and by the delegates of the emerging nations may be the same: Whether men will pursue the illusory symbols of scientific progress, or its real substance: the service of man. Both of these volumes are absorbing and disquieting. In place of the false optimism fostered by the Cult of Science, they point back to the inescapable hard problems of contemporary life. For the solution of these problems, science can do much, but it offers no quick and easy way.

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Students and Teachers

The American High School and the Talented Student. Frank O. Copley. University of Michigan Press, Ann Arbor, 1961. $3.95.

Here are two essays of interest to those who work with superior students in secondary schools. The first essay begins with and justifies general statements such as these: "Knowledge must precede criticism" and "conversation is not education." It then enumerates types of acceleration and enrichment and gives examples of each. The second essay describes (and praises) the advanced placement program, its meaning and organization, and various ways for schools to provide this program for students.

The tone of the whole discussion is practical but not detailed. On the other hand, a detailed treatment might have lost the clear thread of the argument. A reader must bring a background of teaching to this book; he will then find the generalizations very rewarding. The author shows a complete understanding of the problems that actually appear in schools.

One point will be debated by many: English study is for all, but mathematics only for those with special aptitude. It must be noted that the author, Frank Copley, teaches Latin. Also, one might question his statement: "There are few schools, public or independent, large or small, urban or rural, that could not institute Advanced Placement in one form or another and in at least one subject."

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A Historical Puzzle

Lavoisier. The crucial year. The background and origin of his first experiments on combustion in 1772. Henry Guerlac. Cornell University Press, Ithaca, N.Y., 1961. xix + 240 pp. Illus. $4.50.

Lavoisier belongs to that small and lucky band of scientists who effected a revolution in science by the introduction of new concepts. Small wonder, then, that he has attracted so much attention from scholars. Yet hitherto there has been no general agreement about what started Lavoisier on that important series of experiments on combustion, which led to his appreciation of Priestley's discovery of oxygen and to his own totally new idea that a gaseous constituent of air entered into chemical reactions. Here a distinguished historian of science undertakes to unravel what he rightly calls "this important historical puzzle." Henry Guerlac is a master at recounting a scholarly detective story in a manner at once entertaining and profound. One does not need to be a Lavoisier expert to enjoy this elegantly written book. Lavoisier scholars will find the documentation impeccable and the reasoning cogent.

Why did Lavoisier undertake the critical experiments which determined his career? It has been assumed that he was influenced by the work of Black on "fixed air" (CO_2), of Priestley on gases, of Cigna on sulfur and phosphorus, and of French chemists on the combustion of diamonds. It is here shown that the work of Black, Priestley, and Cigna was little known in France, especially to Lavoisier, and that the experiments on the diamond did not strike Lavoisier as combustion. Rather, he saw these experiments as examples of effervescence, a phenomenon with which he busied himself in connection with the reduction of metallic calxes, a phenomenon perhaps connected with the production of "fixed air" as described by Stephen Hales. Guerlac believes that Lavoisier's announced intention of studying the calcination of metals stemmed from Guyton de Morveau's elaborate experiments which showed that all metals gained weight on calcination in air. (But his argument that this was not generally known is weak, as his quotations show: the fact was known to Lavoisier's colleagues; it was the *explanation* that remained in doubt.) In 1772 Lavoisier actually undertook, instead, brilliantly revealing experiments on sulfur and phosphorus; he did so as the result of a series of accidents, skillfully detailed here. And, as a useful appendix, the relevant documents, many previously unpublished, are given in full.

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Scheele's Fluoric Acid Today

Advances in Fluorine Chemistry. vol. 2. M. Stacey, J. C. Tatlow, and A. G. Sharpe, Eds. Butterworth, Washington, D.C., 1961. 220 pp. Illus. $8.

This, the second volume of the series, consists of six reviews covering a very wide range of subject matter. The introductory essay by C. R. Patrick surveys the thermochemistry of organic fluorine compounds; an extensive compilation of the heats of formation is used to deduce bond dissociation energies of various organo-fluorine compounds. C. C. Finger, the American authority, provides a readable description of fluorine resources and utilization. The rapidly increasing application of precision mass spectrometry in organic chemistry makes J. R. Majer's review of the mass spectrometry of