McGraw-Hill Encyclopedia of Science and Technology

An encyclopedia of science and technology that attempts to cover such topics as abacus, abalone, abdomen, and aberration (optical) in successive entries, and all fields of scientific information in some 14 volumes of text and one of index, is a bold venture indeed. That such a work as the 15-volume **McGraw-Hill Encyclopedia of Science and Technology** (McGraw-Hill, New York, ed. 2, 1966. 9557 pp., $295) is now in its second edition indicates that it does fill a need in libraries and schools and that it serves a useful purpose. [The first edition of the encyclopedia was reviewed in *Science* **133**, 374 (1961).]

Since we can no longer afford either the funds or shelf space for a work of the scope of the famous ninth edition of the *Britannica*, whose major entries were indeed a summary of all knowledge on the subject to that time, we have come to accept specialized encyclopedias such as this as useful, if they succeed in presenting enough information to satisfy the curiosity or needs of a nonspecialist. Of course the specialist may feel that a given article is really not detailed enough even for that purpose, and there are some articles in this encyclopedia which could have been more informative. The discussion of the abacus, for example, does not tell the reader how to use one, and the article on the abdomen never really tells the reader what an abdomen is and erroneously restricts it to vertebrates. Yet the article on aberration (optical) is four pages long and bristles with equations, diagrams, and details. These imbalances were present in the first edition and have been carried through to the second. On the whole, the encyclopedia is much stronger in its treatment of technology, instruments (but not of the typewriter, alas!), physics, geology, and experimental aspects of biology (for example, behavior, cell, endocrinology, and embryology) than in descriptive biology and natural history.

Fortunately an encyclopedia cannot be judged like a chain, by its weakest links, for by that token no encyclopedia could be considered very good. On the whole the majority of the articles are excellent and convey enough detail to satisfy ordinary needs for information; one can, for example, find enough about distillation to produce usable results, or enough about computers to build a small analog computer, and enough about physiology to pass a 1A final. It is disconcerting, however, to find such a large accumulation of weak links concentrated in the field of descriptive biology; in particular the entries on mollusks (except Cephalopods) range from the amateurish to the erroneous, in strong contrast to the detailed professional articles on orders of insects, crustacea, and echinoderms. The recent vertebrates as a whole come off rather poorly; there are no entries for orders of birds and mammals comparable to the entries devoted to insects, and the discussion of higher plants is also rather skimpy. The editors could have improved this edition considerably by removing a large number of pot-boiler items in favor of better treatment of the entries. Why should there be all of these little squibs on various animals, ranging from abalone to zebra (but not aardvark or pangolin) and including snails and slugs? Such information can be found in any natural history compendium (and perhaps better done). At the same time one has to know that the best place to look for a discussion of *Fucus* is under the Phaeophyta. Oddly enough this principal reference to *Fucus* is not indexed, although two passing mentions are. This is in spite of the obvious attention that has been paid to the preparation of a useful index; it is unfortunate that the search for *Fucus* was my first test of the index. Aardvark is buried in volume 14, under Tubulidentata and Tubulidentata fossils, incidentally.

In view of the obvious effort that was made to assemble the best possible authorities for most of the subjects, and the resulting excellent entries, it is strange that whole blocks of entries were contributed by industrious hacks. Most of these are under common names, although at the same time much the same material is included under more technical terms. Sometimes the information is directly contradictory. In volume 9, for example, there are consecutive entries for Nudibranch and Nudibranchia by different authors. The first article states that "their basic anatomy is similar to that of the mussel and the snail" and that they lack true gills. It then proceeds to refer to them as sea cucumbers, and concludes with the statement that "Sea cucumbers are sometimes incorrectly called sea slugs," whatever that is supposed to mean. While nudibranchs are called an order, the Nudibranchia are called a suborder, with gills of variable size and position, and are said to be very beautiful animals. The reader is referred to Opisthobranchia, stated to be a subclass containing, by implication, a group of suborders in which the gills when present are posterior to the heart, and so forth. Nowhere in the 14 volumes is there an adequate diagram of the basic anatomy of a mussel, snail, gastropod, pelecypod, or any mollusk at all to explain these foggy allusions. Of course, this information is available in numerous high school and college texts. Such essentially uninformative entries are much less frequent in the physical sciences and technology, and as a whole the work achieves its purpose. The new edition contains much added material (accommodated by the device of a-b pages), illustrations have been replaced, and the index has been completely overhauled.

In preparing this review I have had helpful advice from several of my colleagues.

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Waning of the "Two Cultures"

The provocative "Science and culture" number of *Daedalus* (winter 1965) is now available in hard covers. **Science and Culture: A Study of Cohesive and Disjunctive Forces** (Houghton Mifflin, Boston, Mass., 1965. 348 pp., $6), edited by Gerald Holton, is a bright collection of essays whose sum is to dismiss the C. P. Snow "Two Cultures" thesis once and for all and to leave a host of new questions.

Holton has brought together 16 distinguished authors of widely representative disciplines in a critical reformulation of the Snow thesis. The editor's introduction attempts to knit the contributions into sharp focus on this theme. Happily this attempt is befuddled by the essays themselves which tend to march off in all directions. What emerges is a new and deeper focus: science reduced to a salient but hardly central vector of current cultural change, and the "Two Cultures" concept dissolved into a melange of more significant and less manageable disjunctions than those between technical and nontechnical education.

The book gains coherence from the uniformly high style and logical rigor of its contents. Though disparate in attitude, the essays achieve a certain unity

in positing current problems and choices. In this, the editor has succeeded in compiling a significant commentary.

Almost two decades have been transfixed by the nuclear dimension, the self-generating strategic weapons race, and the emergence of the scientist-technologist into the center of the public cockpit. These portents provided an auspicious moment for C. P. Snow's pronouncement on the "Two Cultures," which an apocalyptic decade siezed as a cliché.

Essentially, the thesis expressed a fear (if not a prediction) that new forces "liberated by science" would be misused by nonscientifically oriented leaders unless they learned, as the scientists presumably had, the unprecedented dangers of traditional conflict. The Sir Charles *pronunciamento* tended to cloak political values (concerning disarmament, national interests, and the like) with the authority of "science" itself. Failure to accept his attitude was ascribed to a communication problem arising from the cultural schism between Science and the Humanities which only a new kind of universal science education could erase.

However, the 1960's appeared to level the strategic arms race; international pluralism confounded the assumptions of a bipolar Cold War; government developed a healthy skepticism toward the claims made (by generals, contractors, and scientists) in the name of a science-technology race with the Russians; and public responsibility in the areas of basic research and education came to be recognized (at least in principle).

These changing conditions weakened the impact of the "Two Cultures" thesis and far more subtle and complex disjunctions in domestic and international culture came to dominate the agenda. The attack on the concept, originally characterized as antiscience, softened into a critical consensus. In his essay "The established dissenters," Don K. Price expresses this trend: "The celebrated conflict between science and humanities is real enough that it takes up a lot of the time of those who prepare academic budgets or prepare foundation grants. But in the American political system, it is a phony war" (p. 109).

Throughout this volume the reservations are spelled out. The concept of "science as a culture" is rejected (for example, in the essays by Edmund R. Leach, Talcott Parsons, and Daniel Bell). Alienation between the technically trained and other people is seen as no greater and often less than that between specialists of all kinds, between social classes and regions, between the weak and the powerful, and between decision-makers and citizens. As a group, the essays reassert the ordinary perplexities and multiple disjunctions of a world in which there are no miracle cures, shortcuts, or final solutions.

There is recognition that the scientific community is a variegated social order containing as wide a range of conflicting interests and values as society at large, that this new political constituency's breakup may have marked an inevitable shattering of the myth of scientific unanimity and unique authority. The emerging pluralism of the scientists, though it may corrupt the coinage of scientific expertise, also has positive consequences. The scientists have been victims of the democratic habit of defrocking would-be priests.

Public controversy is revealed to be primarily based on cultures and values that have little to do with scientific education or knowledge. Like other specialized skill groups, today finds equally well-qualified and well-intentioned scientists on every side of every issue. The trial-and-error business of maintaining a social order besets all experts—lawyers, economists, businessmen, and labor leaders as well as scientists—with an even hand. In their attempts to define the relation between science and culture, the essays reflect the assimilation of science and scientists into the ambiguities of social change.

Several of the essays seek to clarify the nature of science and its relation to technology. Much of the mystique of science arises from the spectacular success of technology which furnishes symbols and analogies to all fields of thought. Together science and technology generate much of the metaphysical vocabulary of our time, permeating not only intellectual but work-a-day life.

Science is both a specialized activity (exploring the environmental boundaries of human life) and an abstract record of this activity embodied in theories and laws. Applied science and engineering are concerned with finding or creating the materials, sources of power, and forms by which laboratory experiences can be scaled-up to social dimensions in order to achieve practical values. Science extends its reach to new experiences because of the accretions of technology; but technology itself contains the seeds of its own elaboration even without theory. The contribution of science is essential —it provides the symbolic formulation that accompanies the advancing "state of the art." On the other hand, the creative laboratory scientist is as much a "tinkerer" and technologist as he may be a theoretician.

In his essay "The thematic imagination in science," Holton suggests that enduring scientific "truth" represents a selection from among many possible ways of representing events. Any theoretical construct can be qualified with enough variables to provide descriptive language embodying the extent of man's capability for predicting and controlling phenomena. The arbitrary aspect of scientific theory, its imagery, cultural environment, and surrounding political ideologies, and the ethos of the age can be more important than any "objective" correspondence with reality for the acceptance of a new scientific principle. Theory may suggest new experiments and ways to manipulate materials—out of which may come experiences which either fit or modify the original formulation; but it would be incorrect to suppose that theory ever has more than a formalistic and conditional correspondence to the environment.

Great theories of science come to dominate the cultural perception and definition of reality. They are poetic myths that give meaning to our acts and interpret and dramatize our relation to each other and to our physical boundaries in much the same way as do religious, literary, and political thought-systems. It is difficult to find any dichotomy between "hard science" and "the soft humanities."

This volume is refreshing for its lack of prescriptions. In its brilliant and disparate essays there is no explicit moral lesson. It offers a host of insights and issues implicit in which is the notion that science and technology, though deeply involved in the problems that beset us, offer in themselves no guidelines for the future and no magic elixir against anxiety. They cannot relieve us of traditional and ordinary hard choices. Culture, as Edmund R. Leach points out, is constantly changing; conflict is the mode of change and growth. "Functional integration" is not necessarily a "normal attribute" of either primitive or modern societies.

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