

# Science and Its Literature

By R. A. LANDOR

What is science? It is an understanding of nature—the world accessible to the senses but existing independently of them; it is also the hypothesis (however arrived at—by hunch, chance, dreams, logic) that underlies this understanding. Science is the agreement among scientists that the results of their investigations shall be verified in accordance with certain conventional procedures; it is also the language in which these results are described. It is a looking at evidence with coldly rational mind; it is also the seeking of evidence with passionately self-centered heart. Science is what a scientist *qua* biologist, physicist, chemist, or any similarly designated person, does. Its limits are those circumscribed by man's nature, society, and history, as well as by physical reality itself.

## What Does Science Really Know?

Despite the fact (or perhaps because of it) that we know much more about that "great ocean of truth" than Newton did, it appears much more formidable to us than it did to him. To him it was "undiscovered"; to us it is, in the last analysis, undiscoverable. What Science Knows is no longer above suspicion. There is a worm in the epistemologic bud.

Even if the "facts" of science are true today, they may well be untrue tomorrow. Biologic science, it is said, now doubles its significant knowledge every ten or 15 years; the biology taught in the schools today is actually 20 years in arrears, and in some important respects a century behind. A principal value

attributed to textbooks is that they are current. But the teaching of science as a liberal art is one current into which school textbooks cannot step even once.

The history of scientific ideas is a history of changing concepts. "Thus, a theory is converted," said Joseph Schwab (1962), "not into 'fact,' but into another theory, another which is more complete, more coherent, more comprehensive. And the process of conversion is not likely to end until science finds one theory which will embrace all data about all subject matters—a termination to be sought but hardly likely to be found." If "to know" is to attain a conclusion with certainty, nothing could be more certain than the uncertainty of scientific conclusions. Compared with the longevity of philosophic and religious wisdom, scientific truth is to be classified with the ephemera of human understanding. Sufficient unto the day are the scientific observations thereof. The Nobel laureate in physics Polykarp Kusch (1966) said: "A large number of theories of science have enjoyed a considerable success because both the simple statements of the theory and the predictions of the theory were demonstrably consistent with the available body of observational data. As new observations were made or as the consequences of the theory were explored in greater depth, inconsistencies with observation were found. Either the theory had to be discarded, as was Newton's particle theory of light under the pressure of new observations; or the region of applicability of the theory had to be formally delimited, as for classical mechanics with the birth of the special theory of relativity." (However, in all fairness it should be noted that nonsense usually persists much longer in philosophy and religion than it does in scientific thought.)

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The further man extends his scientific knowledge and the more he gains upon that undiscovered ocean of scientific truth, the narrower and more alien seems the margin of the shore. "Our present relation to the world," wrote Martin Buber (1965), "resembles that told in Egyptian myth of the relation to the god whose secret names one has learned, which knowledge one may use like a bundle of powers. The basic mathematical formulae agree, a kind of symbol at once abstract and practical; experiment confirms it; but now for the first time the uncanny strangeness of the world is perceived."

### Science Among the Humanities

Science has become increasingly abstracted from human and social reality; it begins by taking thought and ends by lapsing into mindlessness. The Perfect Butler. Send a man to the moon?—Sir, at once.—Take out a city?—Sir, it is done. Simple science, ignorant of or indifferent to reality other than its own, is a form of sophisticated idiocy, the steadily increasing and uncontrolled power of which could only one day illuminate mankind explosively, in a fit of abstraction. How to rescue science from the clutches of the technology into which it has fallen has become a much more serious question than any scientific problem.

What science is and how it should be understood are questions of the greatest significance to education. That science is one of the humanities must not only be admitted; it must be insisted upon. The science that thinks its truth is the only one that is knowable or that is worth knowing begins by being ahumanistic and ends by being antihuman.

### Expression Wedded to the Thought

Science shares with its companion liberal arts the use of language as the instrument of its understanding. Works of scientific genius contribute to scientific knowledge and are exemplars of scientific thinking for exactly the same reason: science takes place at its best in the most powerful expression of its thought.

The schoolbook approach abstracts the study of science from a humanistic context; lacking art, it lacks science also. It interposes its interpretations between the student and the scientist; makes scientific thought seem cut-and-dried and divides physical reality into segregated, sterile units; obscures the perplexity of the problem; and nullifies the excitement of the search. The schoolbook performs a prefrontal lobotomy on the subject, so that its characteristic life is destroyed.

Some say that in the teaching of science (or any academic subject, for that matter) it is not important that children have the language, so long as they have the ideas. This is educational schizophrenia. The language is of the essence. "As the language of a poet rings with a truth that eludes the clumsy explanations of his commentators," said Sir

Arthur Eddington (1921), "so the geometry of relativity in its perfect harmony expresses a truth of form and type in nature, which my bowdlerized version misses." The gross misunderstanding of science resulting from the belief that the committees who write the school textbooks communicate the same science in their versions as do the classics of scientific literature in theirs is the extravagant price that the schools pay for using an inferior language.

Science is no exception to the rule that style is blood brother to substance. The language of a work of liberal art is the imprint of its artist. In the work of its great writers and thinkers the student comes to grips with science at its most scientific.

### Science-Writing That Endures

Has an acknowledged masterpiece of scientific thought anything of importance to communicate once its findings have been superseded? This is the crucial test of science as a liberal art. "What was a masterpiece in 1939 [Linus Pauling's *The Nature of the Chemical Bond*]," declared an article about scientific textbooks, "is just another book on the subject in 1960. So even here the importance of content is overriding and the history of the literature of science must be considered as a qualitatively different study from the history of literature, in that the value of a scientific work is sharply dependent on time" (Cottrell, 1962). But apparently it is not all that different; in fact, it is hardly different at all. The writer of this article went on to describe the quality of writing in Pauling's book as "pedestrian." A pedestrian style is indeed "sharply dependent on time," regardless of its subject; it lives only as long as its ideas and information are new and of practical interest. As Gay Wilson Allen (1967) observed: "When he published his massive *Principles of Psychology* in 1892, after twelve years of labor on it, James himself predicted that as a contribution to science the book would soon be out of date. He was right; but the *Principles* is still almost universally considered the fullest and best work on the subject published before the twentieth century and has survived as literature though its science has long since become archaic."

But, furthermore, how could the literature of science be "qualitatively different" from any other kind of literature? The integrity of language is no respecter of subjects. Science is under the same dispensation as any other subject that the language of discourse expresses; therefore it has the same capability of enduring beyond its conclusions as any other. Science too exists in the integrity of its language, and in that integrity it shares a timeless element with all the other forms of literature and of language.

In his foreword to Darwin's *The Voyage of the Beagle*, Leonard Engel (1962) wrote: "It is not only one of the great classics of natural history and a key work in the evolution of modern thought; it is also first-rate as literature." These are three good criteria

for the selection of writings in scientific literature at any level of education.

The individual work of art is the form of the subject that matters. In its essence the "subject" is the precise way in which its best thought is expressed. The form is the manner of its power. Change it and you make of the subject something else.

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### THE LEAD IN THE AIR

Air-pollution officials in New York City fear that lead from automobile exhausts may be causing the high lead levels showing up in the blood of city residents. Though no federal safety standards have been set on lead in the air, city officials are alarmed at amounts indicated by sampling stations in traffic-clogged Manhattan. The city health department has found high lead levels in the blood of urban children, which could not have been caused from eating old lead-based paints. Such paints, until recently, were blamed for abnormally high lead levels in children's blood.

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### SYSTEMATICS-AND-EVOLUTION CONGRESS

The First International Congress of Systematic and Evolutionary Biology will meet at the University of Colorado, Boulder, Aug. 4 to 11, 1973. The direct sponsors are the Society of Systematic Zoology and the International Association for Plant Taxonomy.

The general theme "Evolution of Biologic Diversity" covers the following symposia at the congress: evolution of biotic communities, species diversity as related to habitat, ecologic substructure of natural communities, biology of feral species, coevolution of animals and plants, continental drift and its evolutionary consequences, evolutionary development of form and symmetry, evolutionary significance of proteins, the computer revolution in systematics, phylogeny of protists, origin and evolution of the eucaryotic cell, and ultrastructure, biochemistry, and genetics of fungi. Other symposia may be added.

Those who wish to receive the congress's circular, to be mailed in spring 1972, should write to Robert W. Pennak, Biology Dept., University of Colorado, Boulder 80302.

### WHAT IS ENVIRONMENTAL EDUCATION?

Not all educators and planners agree on a definition of environmental education, but they know what environmental education is and what it is not.

*Environmental education is—*

A new approach to teaching about man's relationship to his environment—how he affects and is affected by the world around him;

An integrated process dealing with man's natural and man-made surroundings;

Experience-based learning, using the total human, natural, and physical resources of the school and surrounding community as an educational laboratory;

An interdisciplinary approach that relates all subjects to a whole-earth "oneness of purpose";

Directed toward survival in an urban society;

Life-centered and oriented toward community development;

An approach for developing self-reliance in responsible, motivated members of society;

A rational process to improve the quality of life;

G geared toward developing behavior patterns that will endure throughout life.

*The consensus is that environmental education is not—*

Conservation, outdoor resource management, or nature study (although these may be included in an environmental-education program);

A cumbersome new program requiring vast outlays of capital and operating funds;

A self-contained course to be added to the already over-crowded curriculum;

Merely getting out of the classroom.

*Places for Environmental Education*, a report issued by Educational Facilities Laboratories

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### GROWTH OF SECONDARY-SCHOOL SCIENCE

Secondary-school enrollments in selected science and mathematics courses increased sharply during the 20-year period from 1948-49 to 1969-70. Enrollments in introductory algebra and introductory geometry, sociology, advanced mathematics, and chemistry were over 2.5 times larger in 1969 than they were in 1948. Enrollments in biology and economics more than tripled, and psychology enrollments increased almost sevenfold. Among the selected courses, only physics failed to keep pace with total enrollment, increasing only 66%. (Total enrollment in grades nine to 12 increased 2.3 times during the period.)

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