will be discussed. Interesting contrasts with previously described organisms will be reported. Period."

Maybe there's a good story there; maybe it's just a washout. But the reporter, with no means of knowing, must barge out and buttonhole the scientist—perhaps winding up with nothing, and meanwhile losing an hour or so of time. Reporters have deadlines to meet; they can't afford many wild goose chases.

Many scientists try to cooperate with the reporters. But some of them are fuss-budgets about minor things. Some of them have sincere fears about being made to appear to be publicity seekers merely because they talk to reporters. They forget that reporters may be just seeking additional information on something the scientist has already reported at a scientific meeting or in a technical journal. If their scientific colleagues condemn them for that, scientific organizations should do something about protecting their men from such criticism.

Some of the top medical and scientific organizations have issued policy statements urging their members to cooperate fully with responsible reporters. That's all to the good; but there ought to be more of it. We sometimes have to deal with really stuffy characters among the scientists and occasionally encounter one who is just plain rude and coarse.

All in all, however, the science-writing job is nice going, and it looks like an exciting future. Who knows? Perhaps we'll someday go on a press junket to the moon!

The Impact of Science on Literature

Fred A. Dudley

Department of English, State College of Washington, Pullman

TWO THOUSAND YEARS AGO the Roman poet Lucretius wrote *On the Nature of Things,* a great poem and a serious consideration of science. He was not the first literary man to reflect the thinking of students of nature. The impact of science on literature is almost as old as science itself and has grown more pervasive with the passing generations.

Except for the work of a few scholars the study of that impact is comparatively new, unorganized, and hampered by the literary scholar's lack of specialized knowledge about science. But it exists, and for twenty years or so it has been fairly active. Among its products are works that not only illuminate history for the student of literature, but might also command the attention of the thoughtful scientist.

Curry's masterly monograph on Chaucer (*1*), for example, clarifies a major author's total knowledge and use of the science of his time. Beach (*2*) and Lovejoy (*3*) trace the manifestations of seminal ideas partly rooted in science, Lovejoy dealing with pre-Darwinian views that now sound evolutionary, and Beach with the nineteenth-century concept of nature. Nicolson (*4*) makes vivid the intellectual and literary excitement created by the work of Newton. Stevenson (*5*) does something similar for the consternation that Darwin caused. Babb on Elizabethan psychology (*6*) and Johnson on Renaissance astronomy (*7*), each examining one science at one period and seeking out its reflections in literature, demonstrate how essential to the history of culture is some awareness of the course of scientific thought.

More limited explorations are numerous. How sound are Henry Adams' literary and philosophical applications of physics? What is the proper estimate of Goethe's passionate scientific misconceptions? How did the Royal Society's program for the clarification of scientific prose affect literary style? On such questions the journals of literary scholarship are stockpiling materials for a history of science in literature.

The outburst of eager praise that celebrated the achievements of Newton is almost unique in literary history. Copernicus and Galileo were dangerous heretics and made way slowly. Lyell and Darwin were shockingly irreverent. Einstein is fascinating but incomprehensible. Science has so often angered or bewildered literary men that at almost any time in history it is possible, and at most times easy, to find poets deploring or opposing current scientific thought.

One central force in this hostility, religious antiscientism, long antedates the nineteenth century and is vigorously alive in the twentieth. Since the days when "science" meant about the same as "magic," pious obscurantism has found something evil in curiosity about the secrets of nature. The Faust legend is full of the idea of forbidden knowledge, of black magic, of secret and horrible commerce with Satan. In Elizabethan and Restoration drama scientific ideas abound; but the "virtuoso" himself, whether awesome sorcerer or contemptible quack, is often a damned soul. Milton's cosmological ambiguities reflect at least some hesitation on theological grounds. Geological impiety shocked the gentle Cowper:

> Some drill and bore
> The solid earth, and from the strata there
> Extract a register, by which we learn
> That he who made it, and reveal'd its date
> To Moses, was mistaken in its age.

Tennyson rebelled against theories he could not reject. Grieving to have lost a clear intellectual sanction to

faith, he saved it by setting emotion above reason. Wisdom, or faith, must rank higher than knowledge, or science, which was admirable but not preeminent:

> Let her know her place;
> She is the second, not the first.

Human love, not "eagle's wing, or insect's eye," was the convincing evidence of divine love:

> A warmth within the breast would melt
> The freezing reason's colder part,
> And like a man in wrath the heart
> Stood up and answer'd "I have felt."

To Coventry Patmore, a devout Victorian poet, the worlds of telescope and microscope were "two deserts." In our own day, T. S. Eliot's poetry is partly a religious protest against scientific materialism.

A second major objection among literary writers has been that science is incompatible with beauty or truth. Keats complains that science would

> Conquer all mysteries by rule and line;

that Newton has unwoven the rainbow and placed it

> In the dull catalogue of common things.

Poe has a similar lament that science is exterminating the lovely beings of mythology and robbing the poet of

> The summer dream beneath the tamarind tree.

Others go far beyond this romantic nostalgia for lost illusions and hold that science deals in half-truths which misrepresent the deep realities of experience. Wordsworth distrusts science as a distorter of truth:

> Our meddling intellect
> Misshapes the beauteous forms of things:—
> We murder to dissect.

Browning suggests that the scientist's devotion to fact insulates him from the joy and beauty of living and thus from vital or total truth. Whitman records how, after listening to "the learn'd astronomer" until his patience was exhausted, he went out

> In the mystical moist night-air, and from time to time
> Look'd up in perfect silence at the stars

—which may be good science after all.

Poets and other writers are by no means unanimous, nor always individually consistent, in rejecting science. Through the centuries hospitality parallels hostility. Dante and Chaucer have each an astonishing range of scientific lore. Later, as a cleavage between this and other interests becomes more apparent, literary men continue to borrow from the world of science. It is a rich source of allusion and metaphor, though for such uses the discredited is quite as acceptable as the up to date. As Stefansson has observed, the ostrich that hides its head in the sand is for literary purposes a more useful creature than any factual *Struthio*. Our weeping crocodiles, death-singing swans, and resurrected phoenixes are survivals from the "unnatural natural history" of long ago. Other images come from scientific developments of the writer's own day, developments sometimes understood and sometimes not. Tennyson affords examples of both. Whitman, Lanier, Melville, and many others draw freely from astronomy, chemistry, geology, not so much for main subject matter as for figure and symbol.

When literary men have been receptive to the ideas as well as to the factual details of contemporary science, it has often been with deep disquiet, with profound regret, or with reservations concerning the parallel validity of the spiritual and the metaphysical. Tennyson is once again a case in point, as we have seen. Matthew Arnold's friend Clough tried to persuade himself that, if the achievements even of the poets rest upon

> Nothing more, nothing less,
> Than a peculiar conformation,
> Constitution, and condition
> Of the brain and of the belly,

then the disillusioned humanist, convinced against his will, could hope that

> It may be, and yet be not.

In contrast, others have accepted science with exultation. Swinburne saw in the growth of science one cause of the death of religion and, in the death of religion, the liberation of man. Meredith, feeling in the stars "that frigidity of brainless ray" called by someone else "the cosmic chill," looked for comfort not to heaven but to earth, and there found inspiration in an evolutionary ladder, which he symbolized by the words Earth, Blood, Brain, and Spirit, each ascending term being strictly a function of those below it.

To turn to a less philosophical sort of borrowing, sensational exploitation of science produces one of the lower forms of literary art—or of subliterary craft. Poe, whose romantic protest was noted above, was a deliberate and often clever practitioner of science fiction. Whether the strange farrago called *Eureka* is a startling cosmological forecast or a sign of incipient madness, Poe certainly kept a calculating eye open for scraps of science and pseudo science to exploit in "tales." Mesmerism, a sort of bogus entomology, the hollow-earth theory, balloon ascensions, the transmutation of metals—all these and more were played up in stories, some good, some pathetically bad. Poe is one progenitor of those "astounding" yarns of today that maintain an ostensible contact with advanced technology.

"Popularization" may not be a popular word among scientists, but it names accurately the sort of writing it stands for. For centuries now the research of scientists has been exciting work. For many decades the public has been increasingly curious and, in a crude way, increasingly informed about the wonders of the laboratory. We all intend to know something about science, and for most of us it is popularizations or nothing. As the complexities of discovery grow more abstruse, interpretation demands more competence. Such names as Jeans, Whitehead, and Bertrand Russell, or Beebe, Sears, and Carson, remind us that among works on science intelligible to laymen, some of the best are written by scientists.

A few scientists, as spare-time explorers of belles-lettres, amuse themselves by noting literary references to their specialties. This hobby occasionally bears fruit in articles on such topics as Shakespeare on geology, botanical allusions in Arnold, or insects in poetry—articles of unequal merit but sometimes of considerable popular interest.

In a broad sense every publishing scientist is a literary man. Luckily, Phineas Fletcher's versified physiology (*The Purple Island* [1633]) and Erasmus Darwin's rhyming botany (*The Botanic Garden* [1789]) have set no lasting fashion. But sometimes a work of science has literary merit more integral than mere poetic ornament. Lyell, Tyndall, and even Charles Darwin can be read by nonspecialists with some pleasure, and the popularizer T. H. Huxley, with delight.

Personal feeling, the lifeblood of imaginative literature, has no proper place in modern scientific writing. Yet emotionless research kindles emotion. Science gratifies and renews curiosity, answers questions and stirs the sense of mystery, arouses petty complacency or cosmic terror. Science is admired, emulated, misunderstood, feared, resented. The science-fiction addict gasping over space-ships, the fundamentalist defending Genesis, the moralist evaluating atomic war, even the scientist contemplating frustration or achievement—all feel while they think, or think at least a little while they feel. Inevitably such responses carry over into literature.

No doubt the science in literature is often outdated, distorted, or misapprehended; but so great a factor in the pattern of modern life must find imaginative as well as theoretical and technological expression. It would be surprising if there were no cultural lag. Modern laymen are pretty well adjusted to a Copernican solar system; we are beginning to feel at home with evolutionary biology and with geologic time; but we are baffled by space-time and the quantum theory. We struggle along behind the advance of science, lugging a burden of mythology, prejudice, sensory limitations, and vestiges of animism. But the burden is inescapable and even indispensable. It consists partly of previous cultural assimilation of science, partly of the very structure of mind and emotion to which the newer science must somehow become related. And literature is one of the vital means by which that relationship is developed. Through poem, novel, drama, essay, we experiment with science until at last we know what to do with it—and are of course confronted with still newer science.

A century and a half ago, early in his career, Wordsworth wrote a prose preface to his and Coleridge's most famous book (*Lyrical Ballads,* 2nd ed. [1800]). In a passage about science, he recognized clearly enough the satisfaction it gave to the scientist. For validity to the layman, he believed that it must find emotional as well as informational significance for daily life:

> If the labors of men of science should ever create any material revolution . . . in our condition . . , the poet will sleep then no more than at present. . . . The remotest discoveries of the chemist, the botanist, or mineralogist, will be . . . proper objects of the poet's art . . . if the time should ever come when these things shall be . . . material to us as enjoying and suffering beings. If . . . science . . . shall be ready to put on, as it were, a form of flesh and blood, the poet will lend his divine spirit to aid the transfiguration, and will welcome the being thus produced, as a dear and genuine inmate of the household of man.

This emotional validity, this dear genuineness, is what many a thoughtful writer considers utterly alien to science—not merely to scientific procedure but to the meanings of science for man as man. Assimilation continues, but so does protest. The "value" problem is perennial.

For three or four centuries science has been affecting profoundly all areas of Western culture. The Renaissance is commonly said to mark a shift of dominant interest from the next world to this. If that shift is the key to modern thought, then the study of this world would seem to be the characteristic modern study. On such an assumption the time doubtfully foreseen by Wordsworth is here. The problem of poet and scholar, however, is not what Wordsworth expected; it is one of adjustment to naturalistic ethics. The possibility to be faced is that what we call value is a judgment of consciousness upon events in consciousness; that, whether science can deal adequately with values or not, they are conceivable as material phenomena. But if from the non-valued procedures of the laboratory the necessary inference is that science has nothing to do with values, or even destroys them, then science is culturally and ethically delusive; such critics as Bush (*8*) and Waggoner (*9*) are right, and the problem of the humanist is to maintain and reinstate spiritual values in the face of, not in terms of, naturalism and positivism. The two views seem incompatible, but neither is likely to disappear. Their clash complicates the literary study of science. It also emphasizes that such study cannot stop with the tracing of superficial influences but must face profound philosophical issues.

In 1939 there was organized within the Modern Language Association of America a group to study the relations of literature and science. At each convention since then, a full program of papers has been read, and a mimeographed bibliography of literature-and-science studies has been distributed. Such lists being ephemeral, some demand arose for their publication. Two or three efforts proved abortive. Then, with the assistance of the State College of Washington, a formal issue became possible. About half the 1300 accumulated items were selected and arranged by four active members of the MLA group's bibliography committee: Francis R. Johnson, of Stanford; Hyatt H. Waggoner, of the University of Kansas City; Norbert Fuerst, of Indiana; and Fred A. Dudley of Washington State. The choice of items was simplified by a careful redefinition of scope, for which the main credit belongs to Mr. Waggoner. Many titles dropped were general, not

literary, discussions of science and ethics. Others dealt with the history or philosophy of science or of particular sciences, which are better covered in other bibliographies. To quote the foreword:

> Part I includes not all kinds of studies pertinent to the relations of literature and science, but almost exclusively studies in which those relations are directly discussed. Part II includes not philosophers who have discussed science nor scientists who have influenced literature, but almost exclusively literary figures whose relations to science have been more or less seriously studied. In this area the bibliography is not rigorously selective, but—though doubtless far from exhaustive—is intended to be reasonably complete.

As finally released at the Stanford convention in September 1949, the list is a neat multilithed pamphlet (*10*) of 59 pages. The small edition was sold out within a year, and no reprinting is in prospect. Many of the purchasers, however, were libraries. Copies are available on nearly a hundred campuses and in about a dozen public and half a dozen research libraries.

From the shorter annual list for 1950, a selection (*11*) edited by Fuerst (Indiana) and Williams (Illinois Institute of Technology) was published in *Symposium* for November 1951. General studies are listed first; studies on individual authors or particular periods follow in three chronological groups. In 1952 and thereafter, the list for the preceding year is to come out in May. *Symposium* will thus provide annual selected lists of published works on the relations of literature and science.

No doubt the main users will be literary scholars. But if among our scientific colleagues there are persons curious about such matters, these lists may help them to locate publications of interest. Should such exploration bring about a closer understanding between the two areas of study, the literary scholar may be aided in reducing his ignorance of science.

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Books and Scientific Meetings

R. E. Blackwelder

Society of Systematic Zoology

MOST SCIENTISTS who have attended conventions of the AAAS are familiar with the exhibits of the book publishing houses at the Exposition of Science and Industry, an annual event of large proportions and considerable popularity. Usually about 25 publishers engage separate booths, each displaying his technical publications. Some of these publishers and about 20 to 30 others combine their books in the Science Library, in which books are arranged by subject rather than by publisher. Probably more than 1000 different books are exhibited; the Science Library alone contains 500–800.

It is not claimed that these exhibits contain all the available scientific books. They usually include only the publishers' most recent productions—new books and reprints. Large publishers of technical works generally take advantage of this opportunity to display their current items.

The Science Exposition has proved to be well worth while for both the exhibitors and the delegates. Nevertheless, it is not an ideal place to increase one's knowledge of the available current books in any particular field. For persons who do not know just what books they wish to see, the arrangement by publishers is not always satisfactory. Even after browsing through all the booths, one has no assurance that he has seen all the current books, and except in the Science Library direct comparisons of volumes are difficult or impossible.

In some phases of scientific work, especially in teaching, books are of great interest and importance. In certain fields of science, such as systematic biology, books are produced in considerable numbers, with a wide range of approach, including advanced works of reference, texts for all levels, technical books for the nonprofessional, popular books for the general reading public, and books for children. A scien-