bring that untutored public up to the standard of education that will make them able to comprehend the specialized language of the scientist. Certainly there can be no virtue in dullness or lack of clarity.

Some progress is being made. The occasional scientist who does succeed in popularizing his science is no longer a pariah. To an extent undreamed of a generation ago, he may even receive critical acclaim. Step one in improving the public appreciation of scientific achievement must be a continuing recognition of the value of this kind of writing. Its importance in the whole advancement of civilization grows greater by the day.

Further, there are now available competent science writers—men whose primary skill is communication, but whose scientific training provides them with the basic knowledge required for accurate reporting of scientific achievement. To these men should be given the wholehearted support and encouragement that can come only from those actually engaged in the research reported by the writers. Not only do they merit help in general—they should be given the opportunity to collaborate with top-flight research scientists in carrying the results of this research into the minds of the mass reading audience. Science writers have already been able to do this job in many instances. With wholehearted support, they can do much more.

There are, of course, many pitfalls in the path of successful collaboration. It is, however, one answer to the problem of making reports more palatable, and for the scientist who begrudges any time taken from his laboratory it may be the only practical one. Even the "ghost writer" of Washington and Hollywood fame may one day find his niche in science, also.

Two additional solutions were proposed. Each would involve the acceptance by the scientist of his responsibility to write clearly and interestingly, and his willingness to work at his skill as at any other necessary technique. The results should justify the effort. Magazines of relatively large circulation can provide the testing ground for the scientist willing to learn the necessary skill in communicating his ideas. By submitting articles with regularity—seeking an ever more cogent style—the research scientist can begin to compete with his less able but more dramatic colleague for popular interest. Such magazines provide one means of disseminating information to an increasingly large audience as well.

The last answer proposed by the panel was even more fundamental. Perhaps, if the scientist is to assume his full responsibility for the communication of his knowledge to a troubled world, he must be more of that world himself. His interests can no more be limited by the four laboratory walls than can the results of his tests and research. Although his forte may be science, his study of, and interest in, the humanities must never lag far behind.

Here our British colleagues offer an encouraging lead. Broader in their educational training in almost every instance, generally more catholic in their interests and tastes, almost always more skilled in their use of language, they succeed in arousing interest where we often fail. Where our own writers have combined scientific achievement with broad, humanistic interests, we, too, have achieved science and sanity at the same time.

Preoccupied as I am with the field of communication, it was a heartening experience to see this concern on the part of the scientist. Ours *is* one world in the sense that the achievement and success of each of us has its inevitable effect on the lives and fortunes of others. Only when we seek mutual understanding and progress on the highest generally popular level available can that effect be the forward movement of all things—books, civilization, and science included.

# Science and Literature

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MOST PEOPLE LIKE TO BE WRITTEN ABOUT, whether they can justify the feeling or not. Scientists are no exception. Of course, we like to see our technical papers quoted, for that helps give our own particular contribution the emphasis it deserves. We don't mind seeing our names in the newspapers, either, for no particular reason unless we believe that well known means well paid.

Next to appearing in print ourselves, we get a certain vicarious satisfaction from being associated with publicized matters. It is only human to feel that "it's my laboratory," or "my committee," or "my field of work" that is receiving so much attention. And I think it is perfectly all right to feel a little pleased, too, that people are taking such an interest in science-fiction. This seems to show that they have an interest in science and, indirectly, even in you and me. We might as well like it, for we cannot change the fact that a version of science and scientists is being presented to a growing group of readers in this way.

We may please ourselves by believing that science has a good deal to offer to the field of literature. Aren't scientists and science worth writing about? And don't people ever get tired of stale adventures, stale surprises, and stale ways of killing and of hiding

the crime? Think of the ingenious gadgets one can almost make. Or think of the wonders we could work by violating just one or two laws of science. If that isn't enough, think of the effect that new devices or new principles, possible or impossible, could have on whole civilizations, and even more strikingly, on individual people like you and me.

If it is escape that one wants, why not escape right off the world, to the planets or to the stars? It seems startlingly arbitrary that things here have turned out as they have. What other kinds of creatures would there have been under conditions just a little different? And what strange sorts of civilizations might they have worked out?

These matters have been exploited, and sometimes very effectively. In *A Slip Under the Microscope,* H. G. Wells takes us into a real school and laboratory. In *The Plattner Story* he takes his protagonist a good deal farther, into the fourth dimension, and Plattner comes back duly turned mirrorwise. In *The Time Machine* Wells takes us into a non-Utopian future; in *The First Men in the Moon,* all the way to that satellite; and in *The War of the Worlds* he brings the men of Mars here. Indeed, his scope was amazing before his message became so important to him.

But in quantity if not in quality today is the day of science-fiction, though Wells remains as an admirable and exasperating standard of comparison. Many ingenious authors have written much that is amusing and some things that are instructive. The atom bomb had been thoroughly explored before it fell. Time travel, which Wells himself thought up as a parascientific project, has had its paradoxes raveled (certainly not unraveled!) in such stories as Robert Heinlein's *By his Bootstraps.* Heinlein also had an entertaining whirl at the fourth dimension in *He Built a Crooked House.* Later he wrote the story on which *Destination Moon* was based and he was connected with the production of that admirable, almost documentary, film.

Then there was Stanley G. Weinbaum, who wrote that amusing tale of exploration, *A Martian Odyssey,* with its silicon-based life and its other creatures, thinking and unthinking, who seem at once so plausible and so beyond our understanding.

In the field of technology, science-fiction writers have explored the space suit (how does one make the arms flex without changing the volume, and does the man inside freeze or swelter?), rocketry and space navigation, including the problem of meteors, interplanetary communication, and, in other fields than space travel, a host of matters including, of course, large-scale computing machines and robots (cybernetics to you?).

In what some have taken for its maturity, science-fiction has tended more and more to go beyond isolated ideas and gadgets and to speculate on the effect of science on human beings and on social organization. Don A. Stewart, who is John W. Campbell, Jr., the editor of *Astounding Science Fiction,* wrote some pioneering stories about the very remote future. Isaac Asimov, a chemist, has constructed some amusing societies, and Heinlein wrote a whole history of the future, period by period.

All in all, science-fiction has brought a great deal to writing besides a recognition of the importance and popularity of science. In some measure, it has brought science itself. Further, it has brought a new dimension of escape, and an unfettered mind to explore it. Cut off (would you say?) from reality, or at any rate from the limitations of time and place, prejudices, taboos, social forms, and revealed religion lose some of their sanctity, and the large body of readers is not shocked by a Negro chief executive, a socialist economy, or an entirely unorthodox church.

All this seems to the good, and, in my enthusiasm to convey something of it, I went through three of the latest anthologies of science-fiction, *The Big Book of Science Fiction* (Crown Publishers), *The Best Science-Fiction Stories—1950* (Frederick Fell), and *Journey to Infinity* (Gnome Press), thinking to recommend them to readers of SCIENCE. I'm not sure that I want to.

These stories are mostly recent, and the older ones presumably represent the taste of today. They are well written. Indeed, science-fiction writing (disregarding content) has never been more professional than it is here. Some of the stories were slick enough to appear in the *Saturday Evening Post.* Ray Bradbury's writing can move one with practically nothing.

What bothers me is that few of the stories have any scientific ideas in them, and, in fact, not many have ideas other than those of the most obvious sort: the atom bomb is dangerous, empires must fall and dark ages come, dictators will be destroyed. Of course, there are exceptions, but even some of the best stories by the best writers suffer from maladies of the times.

In an amateur way, I think I know something of what is wrong. In the beginning, science-fiction was written by odd people here and there. If they were odd geniuses like H. G. Wells, the stories were acceptable by any standards. If they were just odd and thoughtful people, the stories would suit only an odd and thoughtful audience. Such were the contributions of the early days of *Amazing Stories,* which Hugo Gernsback founded in 1926.

Later, science-fiction caught on with the juveniles, and high-speed pulp writers took over the field. From this state, sorrier even than that of the present, John Campbell rescued science-fiction when he became editor of *Astounding Science Fiction* in 1937. Campbell got stories from a variety of amateur or part-time writers, many of them scientists or engineers, and from writers with a natural technical bent (Will Jenkens, for example). A great many ingenious and acceptably written stories have been published in *Science Fiction.*

A view that Campbell holds dear is that the important matter is not the gadget but its effects on human beings and, even more, on human society, and that these effects must be revealed through a story with a snappy plot. This doctrine can have evil consequences

if applied rashly, and perhaps it has served as an excuse for a progressive deterioration of the hard scientific and technological core in much of science-fiction. Many present stories are built, not around science and technology, but around a bag of standard magic tricks. Time travel—a convenient hyperspace to outwit relativity and to enable one to travel faster than light—robots and thinking machines that have arbitrary limitations or no limitations whatever, are standard but overworked ingredients. Like an old-style whodunit fan who feels that ingenuity and clues are as necessary as sex and blows, I can't go along with this. I like to escape, but I'd rather escape into something clever and amusing.

Science-fiction these days runs to more parsecs and longer eons. As an ultimate absurdity, one writer tells about a dynamic intergalactic culture which is forced to abandon its expanding way of life when it finds that the universe is finite.

In quick-paced writing on such a scale, the distinctive features of persons and cultures are lost. There is no time to describe strange societies, strange beings, or strange individuals, and all become standardized, a part of the bag of magic tricks. Personally, I'd rather have pure fantasy and go with L. Sprague de Camp and Fletcher Pratt into worlds of magic in *The Incomplete Enchanter* (Faery Queen) and *The Castle of Iron* (Orlando Furioso), because there's something to see and something to think about. The inflating universe of science-fiction is far less astonishing than what anthropologists find in the South Pacific, or among our own Indians, for that matter.

No doubt a good deal of this inflation is a result of increased popularity and increased demand, for not only are standard publishers jumping into this newly profitable field (yes, and the *New York Times Book Review,* the *Saturday Review of Literature,* SCIENCE, and other respectable publications have reviewed science-fiction), but two new magazines, good of their kind (*Galaxy* and *Fantasy and Science Fiction*), have been founded. Such markets are attractive to professional writers. A professional writer new to the field naturally tends to pick up the magic words without much concern for the sense. Good writing does a great deal to make up for a lack of ideas.

We may be pleased that science is more and more invoked in popular writing, but perhaps it is invoked with diminishing reason. What will the outcome be? Aside from H. G. Wells, I have written largely of science-fiction as represented in such magazines as *Astounding Science Fiction, Galaxy,* and *Fantasy and Science Fiction,* and by authors who first published in such magazines. If we look for something better, perhaps we should look elsewhere. Certainly, the stories reprinted from the *Saturday Evening Post* have not been encouraging in content. In the few in the *New Yorker* there is less than meets the eye. One really choice tale, "The No-Sided Professor," appeared in *Esquire.* In general, however, scientists have no reason to be happy over the short stories published in unspecialized magazines.

Of course, there have been novels with a scientific element or background, a good many if one goes back far enough. In reasonably contemporary times, Karel Capek (of *R.U.R.*) wrote three: *The Absolute at Large, Krakatit,* and *War with the Newts.* These were ingenious and well written, if scientifically a little weak. Ward Moore's *Greener than You Think* has a certain sweep and plausibility. G. R. Stewart's careful novels are closely related to science and technology. To me, Max Ehrlich's popular *The Big Eye* was disappointing, for all its Palomar background, and Vincent McHugh's *I Am Thinking of my Darling* rather dull and full of double-talk. One doesn't know what to make of Philip Wylie's self-assumed and bewildering advocacy of science. One could scarcely better Huxley's cleverness and good writing in *Brave New World* and *Ape and Essence,* nor Orwell's in *1984*; in these books, however, there is so much of an ax to grind that the science is incidental and rather distorted.

Indeed, in looking back, *Arrowsmith* seems an amazing achievement, for it presents through convincing people something of research and research laboratories. In this it stands almost alone, though there have been many good stories of medical practice. In writing *Arrowsmith* a fine and conscientious writer sought competent advice, a rare and commendable occurrence.

Perhaps the fundamental difficulty of finding science in a novel is the difficulty of finding anything of the world's daily work in a novel. About writers, artists, actors, publishers, advertising men, bullfighters, and politicians we can learn something by reading novels, but most occupations are carried on outside the pages of fiction. Maybe we don't like to read about anything that seems like work. Perhaps, however, it is merely that writers don't know much about how the world's work is done. Perhaps science and the complicated social and technological structure in which it is enmeshed are foreign to writers.

If other people don't write well about science and scientists, perhaps scientists will. Almost anyone has, at some idle moment or another, thought of an amusing aspect of science, either as it is, or as one might change it. What, for instance, of a suspension of inertia? A man jumping from a height is instantly and joltlessly at the bottom. One can walk but not leap. A thrown ball disappears from the hand and appears on the ground below. Of course there is no air pressure; the world rapidly collapses before one's mind, but not too swiftly for amusement. Biology must offer wonderful possibilities of truly strange creatures and strange ways of life. Surely not all of them have been exploited. And could not anthropology help in creating cultures more surprising than those repetitiously dull ones we find in typical stories?

We can easily picture the hobby-loving and enthusiastic scientist first reading a few anthologies to orient himself and to disclose too-well-trodden ground (Frankenstein's monster, the last man and woman on earth, worlds in collision, and the like) and then

plunging ahead to reform the field. There is a difficulty, however. Paint is cheap, and to construct a masterpiece one has merely to arrange paint properly on a flat surface. Stories are made partly of ideas, partly of characters, partly of an interesting sequence of events (plot), and wholly of the right words in the right order. It is pleasant to talk or to write about clever, well-thought-out and well-written stories which scientists might write around sound or diverting ideas, but it is much more difficult to write such stories than to talk or to write about them. How many will spend real effort in this dubious direction?

There is another possible remedy for the state of science in fiction. The lack of science in science-fiction merely reflects the lack of science in the public mind. One gets the impression elsewhere, as well, that the general knowledge of science—and in fairly respectable circles, too—is a mystical wash of relativity and uncertainty over a lack of pre-Newtonian physics. It is hard to explain the success of Velikovsky's *Worlds in Collision* in any other manner. Perhaps the easiest way to get good writers to write sensibly about science, and to get readers to ask something sensible of writers is to teach people about science.

Perhaps scientists should write popular articles rather than science-fiction. But here, too, the way is difficult. It is no good for men to be told about the new if they do not understand the old. And who will read an article about Newton's laws of motion, when an article about unified field theory seems fresher and more glamorous? Some humanists recommend old books for teaching old matter. But there is something ephemeral about the best of science writing, fact or fiction, for science continually sheds new light on old truths and continually binds old truths together. I think that most scientists would shudder at the idea of learning science from old books, beautifully petrified though they may be. Science is live and growing; the solid trunk, as well as the fresh shoots, is a part of today.

In the present, we know merely that people are increasingly interested in science. Science-fiction, science in stories and novels, show this, but they also show people's ignorance. The interest is flattering and good. Although there are many happy instances to the contrary, the ignorance is sometimes appalling. We wish people were better informed, but who will make them so?

# The Cosmic Cinema[1]

**Herbert W. Rand**

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WILLIAM K. GREGORY is generally known as a paleontologist. A dictionary defines paleontology as "the science dealing with . . . the fossil remains of animals and plants." Nothing is more dead than a fossil. It is thrice dead. An animal that lived perhaps a hundred million years ago ceased to exist as a going concern. Its carcass suffered complete dissolution. The materials handled by a paleontologist are the more or less distorted mineral replicas of fragments of the carcass. But any fossils that have the good fortune to come into Dr. Gregory's possession do not long stay dead. At his hands they experience the miracle of the resurrection of the body. He assembles the skeletal fragments and restores the complete skeleton. Viewing the skeleton as a three-dimensional diagram of the mechanical stresses sustained by its several parts, he restores the animal's motor mechanism, the musculature, in its proper relation to the skeletal structures. Peculiarities of the teeth and jaws and of the locomotor appendages reveal the nature of the animal's food, the manner of getting it, and the animal's general mode of living. The relative size and the form of the cranial cavity tell something about the nervous mechanism. All available data having been evaluated, the animal, even if not alive "in the flesh," confronts us with a scientific reality not possessed by any mere ghost.

Gregory's *Evolution Emerging* is as far as possible from being a dull description of fossils. It is a story of Life in process of creation. It presents to the reader a marvelous pageant of ever-changing, living creatures ranging upward from the earliest, smallest, and simplest and culminating (in orthodox anthropocentric fashion!) in the human mammal. The pageant is presented not in words only, but by use of a lavish profusion of remarkably fine illustrations.

In *Who's Who in America* William K. Gregory is described as "paleontologist, morphologist." But in course of his story of "emerging evolution" he discusses the essential unity of the astronomic cosmos, the structure of the atom, the nature of time, and other subjects that are indefinitely remote from fossils and biological morphology. The behavior of animals leads him into psychology. The first paragraph of his Introduction, beginning with a reference to the philosopher Hobbes and his concept of a "leviathan state," concludes with these words: "The present work . . . deals with a complex pattern made up of innumerable pieces, the whole, nevertheless, being greater than the sum of its parts." The description in *Who's Who* is obviously a glaring understatement of

[1] *Evolution Emerging.* 2 vols. William K. Gregory. New York: Macmillan, 1951. 1,748 pp. Illus. $20.00. (Reviewed in galley.)