



THE

CULTURES— TWENTY YEARS LATER

A SCIENCE NEWS survey of leading figures in the humanities and the sciences suggests that these two groups still generally fail to communicate but that they are finding new common ground out of necessity

BY JOHN H. DOUGLAS

Just over 20 years ago, in the October 1956 NEW STATESMAN, British writer C.P. Snow published his first essay on "The Two Cultures"—arguing that the intellectual life of Western society was being dangerously split into two warring camps, with scientists on one side and literary scholars on the other. Eventually Snow developed this theme into a formal lecture, published as a monograph by Cambridge University, where at first it promised to sink into the genteel obscurity usually reserved for such scholarly treatises.

But then, in the early 1960s—apparently much to the author's surprise—the concept of the Two Cultures struck a responsive chord in the popular imagination. Western government officials were seeking alliance with scientists in the Cold War and Western educators were fretting over how many engineers the Russians were producing. Both could find a warning and a call to action in Snow's work. More technical expertise would be needed by the governments of industrialized nations, he wrote, if they were to help the poor nations develop before the Communists did. And that would require "rethinking our education," an area in which "the Russians have a clear edge."

The problem in meeting these requirements, according to Snow, was a worsening overspecialization of the professions, resulting in a "gulf of mutual incomprehension" between their two great branches. Nonscientists "think of scientists as brash and boastful . . . shallowly optimistic, unaware of man's condition." For their part, scientists sometimes believe that literary scholars are "totally lacking in foresight, peculiarly unconcerned with their brother men, in a deep sense antiintellectual, anxious to restrict both art and thought to the existential moment."

A further elaboration of this viewpoint

was written at about the same time by Jacob Bronowski, of whom Snow wrote that he had made "the most lively of all contributions to this subject." Bronowski sets up a dialogue in which his character representing science attacks the literary intellectual:

"You cannot bear to have other people enjoy themselves in any way but yours. That is what you find distasteful, that is what outrages you about the success of technology. It makes it too easy for people to be well off, well fed, just well. Your soul is still in the age of famine; you have not come to terms with the prospect of plenty. You believe that the values of life come from denial, not acceptance. . . . The ranks of the Philistines are full of literary critics and they are not full of scientists. . . . There are no critics in science, no high priests who only expound and guard the godhead."

Beneath these rather superficial attitudes Snow found a deeper level of division. Scientists, he wrote, tend to see the human condition as tragic, but they see that social conditions can be vastly improved using the products of science and technology. "That is their real optimism, and it's an optimism that the rest of us badly need." It gives scientists a sense of "the future in their bones."

By contrast, "the traditional culture responds by wishing the future did not exist." Its adherents are "natural Lud-dites," who do not yet understand the industrial revolution or know how to manage it. Snow quoted a passage from critic Lionel Trilling as representing the goal of literary intellectuals: "The end is not just freedom from the middle class but freedom from society itself." This conception, Snow concluded, is overromantic, tantamount to "taking an optimistic view of one's individual condition and a pessimistic view of the social one."

Snow then proposed a solution for in-

creasing understanding between the Two Cultures, through education. Literary intellectuals would have to realize that the needs of the poor could only be filled by technology and that technical expertise is the greatest resource of the West. Scientists, for their part, would need to learn some lessons from traditional culture. In both cases, the present overspecialization "is leading us to interpret the past wrongly, to misjudge the present, and to deny our hopes of the future. It is making it difficult or impossible for us to take good action."

Reactions to Snow's views were mixed but were offered with such virulence that, as he later observed, it was as if "a nerve had been touched almost simultaneously in different intellectual societies, in different parts of the world." Some of the criticism was semantic—why just *two* cultures, and are these really *cultures*? Other critics noted that although Snow's own career had spanned both cultures, his work retained mainly the prejudices of a scientist. (Before becoming a novelist and essayist he was a molecular physicist and governmental science adviser.)

The arguments over Snow's work continue and may be seen as one indication of its continued relevance. When SCIENCE NEWS recently surveyed some leading figures in the sciences and the humanities to ask whether the split between the Two Cultures still exists and whether anything is being done to heal the rift, the answers were as diverse and vehement as those following first publication of Snow's essay. (Lord Snow has graciously promised to try to find time to write a short update on this subject for SCIENCE NEWS later this year.)

Some respondents, including anthropologists Froelich Rainey and Sol Tax, believe the gap between the disciplines has narrowed. Rainey says that science has made a "breakthrough in our way of

thinking" that is spreading to the humanities. Tax believes that Snow's essays themselves have helped build new bridges between the cultures.

Others, including historian Will Durant, disagree, saying the division continues unabated. One of the strongest expressions of this viewpoint is that of National Academy of Sciences President Philip Handler: "I believe that there is a greater consciousness of this gap, but it widens, if anything. Where once there was an attempt to build bridges one now finds distrust and alienation."

Still others insist on a reformulation of the argument. Says Lewis Branscomb, vice president for research of IBM, "The big cultural gap is not between scientists and humanists but between intellectuals and pragmatists." Writer Alvin Toffler says that the "Two Cultures have become two thousand cultures. As we leave the industrial age behind us, we become more diverse. . . . The result is a fragmentation of once-neat categories."

Science fiction writer Arthur C. Clarke answered with a pun. The Two Cultures are still far apart, he says, but "I prefer to say that persons at either extreme are simply uncultured." Clarke adds that more "good" science fiction will help bridge the gap.

(Another noted science writer and science fiction writer, Isaac Asimov, demurred with characteristic modesty: "I am trying to resist the temptation of letting the world lure me into being the 'universal sage.' . . . Therefore, I will pass on this subject, except to say that I am one living bridge between the Two Cultures in my own person.")

Has Education Helped?

Since Snow had put so much emphasis on revising education as a means of bringing students of the sciences and the humanities together, we asked what progress had been made. One of the most extensive answers came from science historian Gerald Holton, who has been involved in several attempts to revise science curricula. The aim of these projects, he says, is "to show, as part of a science curriculum, that a proper understanding of science involves its sources, its effects, its dynamic relation with the rest of the culture." Some of the new courses, he concludes, have succeeded in weaving "a tapestry of crossconnections among many fields. And that seems to me the essential task of education, in contrast to that of mere training."

Philosophers Walter Kaufmann and Karl Popper are more worried about what is happening to education in the humanities. Says Kaufmann: "The humanities have become less and less humanistic. There are few 'humanists' left on our

faculties and most of our students lack even a basic literacy in the humanities." (He expands on this view in a forthcoming book, *The Future of the Humanities*.)

Popper notes that some institutions devoted chiefly to the education of scientists and engineers have made great efforts to bridge the gap by introducing departments of philosophy and literature. But "it seems that almost nothing has been done on the side of the humanities to stimulate in their students an interest in scientific problems. Besides, my impression is that the level of humane studies has declined, by and large, both in England and in the United States. This may perhaps be illustrated by the decline of clarity of writing and of historical interest."

Will Durant shifts the burden from writers to subject: "The researchers' results are too technical to be widely understood."

At least two respondents might take exception to these criticisms of writing, in as much as they apply to explaining science for lay audiences. Anthropologist Rainey says education is still much too specialized, but "interpretations of scientific research, now being done by many writers, are reaching the public in general through books, magazines, radio and TV. Those media, I think, have made the difference over the past 20 years."

Nobel laureate chemist Glenn Seaborg agrees, at least in part. "The news media should improve their performance. However, SCIENCE NEWS is doing a good job and efforts should be made for it to reach a broader audience. Television programs such as the 'Nova' series are helpful, but on the whole, the British Broadcasting Corporation with its broadcast of the Open University is doing a better job than U.S. television."

Again, some believe that a reformulation of the argument is necessary. Branscomb at IBM believes the information explosion has been more important than education to joining the two cultures: "I think that future societies will be even more information-intensive, and that is why I expect greater commonality of viewpoints among various societal groups." Philip Handler sees bridges between the disciplines coming more from mutual efforts in arms control and protection of the environment than from education, where "the sorting out appears to occur early in life."

One problem in bringing the Two Cultures together is institutional, and various campuses and U.S. government agencies have tried to stimulate work in this area. The National Science Foundation and the National Endowment for the Humanities, for example, sponsor a joint Program of Science, Technology and Human Values. This program funds scholarly and educational work on current issues in the "ethical and human-value implications of science and technology."

The Smithsonian Institution is also

considering formation of a Council on Humanities and the Sciences. Wilton Dillon, the director of Symposia and Seminars, says the program would have two goals. First, it would provide a specific forum where specialists would meet to discuss interdisciplinary issues. At present, he says, specialists are hesitant to enter such discussions because of "the fear that they will be considered amateurish." The second goal of the Council would be to develop seminar material that could serve as the basis for curriculum changes in American universities, incorporating topics from many fields of interest.

Does It Matter?

We finally asked those surveyed what they thought were the practical consequences of the split between the Two Cultures and whether acquiring more technical expertise in government had helped mobilize the West to meet the challenges Snow foresaw. Perhaps predictably, this question raised some of the most vehement responses: Most scientists replied that more expertise was needed, but at least two humanists refused to answer at all because they professed not to like the question or to understand its significance.

Probably the most outspoken response came from Philip Abelson, president of the Carnegie Institution of Washington and editor of SCIENCE magazine. "For the most part the nations are governed by people who have little or no knowledge of science and technology. Such experts as are employed usually have little effective influence in decisions." Rather than mobilizing to aid the developing world, he says, "each country in the West seems to be preoccupied by its own internal conflicts over such matters as the environment, jobs, wages and inflation." Education isn't helping and "insofar as the humanists avoid real immersion in science they are uneducated and unfit to exert leadership in a world that in the future must necessarily be dependent on science and technology for its very existence."

Taking the opposite tack are historian Will Durant and sociologist Amitai Etzioni. Says Durant, "Government will use more and more science, not always for amiable purposes." And Etzioni (who thinks the phrase "Two Cultures" is a "gross oversimplification") says Snow was certainly no prophet for saying the West was likely to become an "enclave" in a hostile world: "The West is becoming less of an enclave by being more open to transcendental ideas. And the East is becoming Americanized."

Again Philip Handler would somewhat revise the basis of the argument. Certainly having technology and technical expertise in government has produced some successes and more such expertise will be

. . . Two Cultures

needed, he says, but the central problem is a moral one. "The world dilemma is whether or not to redistribute wealth—making the rich nations very much poorer while doing relatively little for the huge numbers of the very poor. And *that* is what may create an 'enclave.' "

A Retrospective

In the late 1960s, Snow again turned his attention to this subject, in a lecture glumly entitled "The State of Siege." He reemphasized that "The Two Cultures" had been a call for action, to marshal both great intellectual traditions of the West to meet the worldly challenges of the future. He noted the easing of Cold War tensions and said that all-out war seemed less likely. But otherwise he had grown even more pessimistic, particularly in one crucial area he had earlier failed to pursue:

"In the 'Two Cultures' lecture there was a curious and culpable omission. . . . I was talking about world crises and I made only the slightest reference to the growth of population. . . . I didn't want this major problem to dominate the discussion: Partly because it seemed to me then to make social hope even more difficult; partly because I didn't want to hurt other people's religious sensibilities." In "Siege" he no longer yielded to such

scruples. Warning about the dangers of famine and overpopulation "is the plain duty of churchmen of all kinds."

He also noted the rapid increase in global communications but he was far less sanguine about their effect than Lewis Branscomb. "Television bombards us with communication about the world outside. . . . We know so much—and we can do so little." The West is not only making itself an enclave, he wrote, but many groups of its people are making small ones of their own. Even the young: "They too have turned inwards—into their own customs and often their own language."

Once again he made a call for action, this time with little specific reference to academic disciplines of either stripe: "One hears young people asking for a cause. The cause is here. . . . Peace. Food. No more people than the earth can take. That is the cause." But then he concluded on a somber note. "I should be less than honest if I told you that I thought it was likely to succeed."

Leaving aside several specific details, Snow's original analysis and call for action have weathered the two last decades rather well. The schism between the Two Cultures is at least a matter still hotly debated, and the complex social-technical problems that must be solved in order to relieve human suffering are still with us. Some recent studies (SN: 11/13/76, p.

316) have indicated that world population may not be growing as quickly as most feared a few years ago, but the gap between rich and poor nations is demanding even more attention as terrorism and resource embargoes threaten the West.

While some educators still strive for what Gerald Holton calls "double literacy" in the sciences and the humanities, most recent attention has been focused on whether schools are even training children to be literate enough to function in day-to-day life. To Snow's concern for teaching professionals enough about each others' work that they can serve well in government must now be added a concern for educating the public enough to preserve democracy in an increasingly technical age.

Each of the Two Cultures thus faces a growing set of challenges that may make more cooperation a necessity. Both social problems at home and economic ones abroad call for solutions that go beyond the reach of any single family of disciplines. Partly as a result, a Third Culture—the social sciences—which Snow only briefly mentioned, may now mature. But if society's intellectual framework has any practical significance for the preservation of civilization—as Snow passionately believed—a fundamental new paradigm must emerge, built on a more holistic view than that of either the traditional scientific disciplines or the humanities. □

. . . Quasars

hole and coming under the influence of its gravitational field, but in this case the feeding methods are more spectacular than those for a pulsar.

"Stars of solar mass could be swallowed whole," Rees says. Larger stars might be disrupted by tidal forces or collisions with other stars and swallowed piecemeal. Rees estimates it would take a feeding rate of one solar mass per year to produce an energy radiation rate of 10^{40} ergs per second, which is about par for a quasar.

The accretion sphere forms a kind of photosphere around the black hole, similar to the light-producing layers of stars. How the object looks depends a good deal on how efficient the mechanisms are that cool this photosphere and dissipate the energy generated by collisions in it. If the cooling mechanisms are efficient, one would not be able to see very far down into the photosphere. It may be, Rees says, that the BL Lacertae objects, which have some resemblances to quasars but don't look quite as condensed and energetic, have inefficient cooling mechanisms in their photospheres so that one sees closer to their central black holes.

Rees finds that he can begin to explain various features of quasar spectra by reference to such accretion spheres. First, there is much nonthermal radiation in the background spectrum of a quasar, and this

requires particles accelerated to relativistic speeds for its production. Instead of relying on gravitation (falling), which is unlikely to produce such speeds, Rees invokes electromagnetic phenomena. If the object or objects that originally formed the black hole possessed a magnetic field, that field would not only be preserved during collapse to a black hole, it would be strengthened. The ultimate result would be electric and magnetic fields that could produce the necessary acceleration. Thus the energy for the nonthermal parts of the spectrum would come ultimately from the energy associated with the black hole's rotation (stars rotate, and that too is not lost in black-hole collapse) mediated by its magnetic field.

The narrow absorption lines seen in quasar spectra could come from particles rather far from the black hole, Rees suggests. The broad emission lines that are seen in some quasars and Seyfert galaxies probably come from high-density regions of the accretion sphere. The radio qualities of quasars would come from electrons very near the black hole. These would be part of collimated beams of relativistic plasma that would form near the hole and blast outward in two jets, thus producing the two-lobed shape of radio sources associated with quasars and many galaxies. If the black hole formed initially from an object (stellar cluster or aggregation) of ten billion or so solar masses it could also

emit gravitational radiation, although for the moment there are no data of that sort.

Beyond such oddities as quasars, BL Lacertae objects and Seyfert galaxies is the general question that extends to more "normally" behaved galaxies. "It may be that black holes lurk in the centers of little galaxies that are not big radiators," Rees proposes. It may be that the famous radio source Centaurus A once had such an active center, but has by now radiated away most of its energy and is only slowly accreting more matter. There is now no general, comprehensive theory of all these things.

Rees concludes by saying that perhaps quasars were discovered too soon. In 1963 everybody thought they were something qualitatively different. In the intervening time pulsars and X-ray sources have been found, and the accretion models developed. Astrophysicists now see that gravitation (acting in the infall of matter and in the enhancement of electromagnetic effects produced in the black-hole collapse) can be "an energy source that is relatively efficient. Had quasars been discovered later, this would have seemed a natural mechanism." Rees proposes that "now the time has come for an investigation," for the gathering of "a much larger body of high-quality systematic data." The ultimate hope then is the elaboration of a comprehensive and detailed theory along the lines of this hypothesis. □