Letters

Cities in the Seas

In a recent editorial (4 Sept., p. 993) Athelstan Spilhaus strongly advocates the colonization of the sea, pointing to recent advances in buoy construction and underwater living that suggest to him the imminent feasibility of floating and undersea cities. In so doing Spilhaus lends his forceful pen and great personal prestige to the ever popular "enough and to spare" philosophy that has for some years now made headlines and sustained the delusions of people who like to think that if they just relax and procreate, the "fallout" of genius will solve the problems of supporting an ever-increasing population on an ever-shrinking planet.

To argue, by implication, if not directly, that human ingenuity must somehow surmount the problem of maintaining and sustaining constantly expanding numbers of people is to misidentify the problem. Even if this could be done for a while, and in reasonable physical comfort, the psychological trauma of sheer overpacking would eventually give many of us "lemming disease," not to mention the drain on nonrenewable resources. It would be far more to the point to stop reassuring the people and the politicians that Science or Engineering will find a way, and to increase emphasis on the eventual necessity of a sociological solution —a stable population capable of existing within the reasonably clement reaches and the practically attainable resources of the solid earth. Any other course amounts to playing Russian roulette with the future of mankind.

I find equally troublesome the exhortation that in the event occupation of a different realm becomes necessary, the occupants "might just as well be our men." Why not Tshombe's men if they need the space and will behave decently in it? The international community of science has done much to fortify the concept of a brotherhood of man. Let us not now encourage retrogression by differentiating between "our" scientists or "our" men and somebody else's. If it must be done, let it be done from a common pool of knowledge by or for whoever needs to do it first.

PRESTON E. CLOUD, JR.
Institute of Technology,
University of Minnesota, Minneapolis

Determinism: Bias and Complementarity

Boring's article in the issue of 14 August entitled "Cognitive dissonance: Its use in science" suggests to me that there is still something useful to be said concerning the perennial problem of freedom and determinism. In listing the antithesis between freedom and determinism as "the best known instance of cognitive dissonance that the scientist encounters," Boring implies that the simultaneous employment of these two paradigms involves an inconsistency. . . . Historically, science has resolved this problem by utilizing a different paradigm: a dichotomy of observed and observer. The paradigm of determinism is applied to the observed. The paradigm of choice is applied to the observer. This policy works well in physics and astronomy and causes little or no difficulty in chemistry, but difficulties appear on the horizon of biology and increase in psychology, approaching catastrophe in introspective psychology. Difficulties arise and increase as the distinction between the observer and the observed diminishes.

Why does Boring view the freedom paradigm as "a preference for certain kinds of ignorance"? Presumably because acknowledging a concept of freedom entails staking out an area of phenomena unamenable to scientific treatment. Does not existing scientific evidence suffice to deny the existence of any area of freedom—to assert that the area of determinism includes all phenomena? Wherever science has been sucecssful, determinism has been found. Does not this irresistibly bolster the argument? Not irresistibly, and *perhaps not at all* if scientific method involves a deterministic bias. When a scientist is given a set of data his first step is to seek some trace of order, some evidence of interrelation among the individual items. When he thinks he has found it, he constructs a hypothesis, which he then tests by examining the concurrence (or lack of it) between the deductive consequences of his hypothesis and appropriate empirical observations. What does he do if he fails to find any order in the data? He may seek more extensive data, or more precise data. But, if he continues to fail to find any order? I submit: he ultimately abandons this exasperating project and seeks a more promising one. Ergo, the scientist concentrates his efforts in the areas where causal relations appear. He prospects for determinism, and that is what he finds.

What else could he do? Well, if the data related to human action, especially human thought, he just possibly might suspect these disordered items to be in the area of freedom, to consist of prime events which wave no causalistic tails behind them. Cannot some fruitful method be developed to deal with this possibility? Is not the effort worthwhile? If no effort is made at all, is this not also an exhibition of a "preference for certain kinds of ignorance"? If this issue is explored no further, about all that has been accomplished is a comfortable rationalization of the dissonances under discussion—number iv in Festinger's list of methods for dealing with a cognitive dissonance. Accordingly let me pose a more specific problem for study.

The practical application of the concept of freedom to choose is in the making of decisions. Let us take this question from the level of the practical to that of the abstract, illustrating with the selection of strategy for utilizing computers to play games. Since the possible number of moves in a game of chess is finite, though very large, it would be possible in principle to construct and program a computer to review at each step the ultimate consequences of each possible move and select the best one (or one of the

best ones, if several were of equal value). Such a computer would be a "perfect chess player." No other player, human or mechanical, could exceed its skill. In a recent article on this subject the authors found it expedient to limit the computer's review to the consequences of a relatively small number of steps in advance. The result, as I recall, was a respectably effective mechanical chess player which could defeat most human contestants. This is clearly a practical compromise which falls short of attainable efficiency. The efficiency of the compromise could be expressed in relation to that of the "perfect chess player."

Similarly, according to the deterministic postulate it would be possible, in principle, to construct a "perfect decision maker" if we could include in its programming all the relevant data and their interrelations. Following its advice, we would be in a position to make infallibly the best choice of action concerning every decision which confronts us. (An element of futility enters here because in such a deterministic world our choices would always be predetermined, but this would have to be accepted as an unavoidable cognitive dissonance.) The lesser efficiency of any practically attainable decision-making device or process would be measured in relation to that of the "perfect decision maker" and would, I fear, be very low indeed.

On the other hand, the postulate of freedom could lead to a different standard of decision-making efficiency. An appropriate analogy might be the construction and programming of a computer to play a game against a contestant who had the privilege of changing the rules at any move, provided each new rule were (i) clearly specified and remained permanently in effect for the duration of the game; (ii) not inconsistent with previous rules; and (iii) open-ended, that is, did not by its consequences terminate the rule-making privilege. It might be impossible to construct a "perfect player" for such a game, since the possible number of moves is no longer necessarily finite. A very effective player could possibly be devised by providing for the anticipation of a suitable number of moves. Perhaps there would be an optimum number of anticipated moves that would define a "most efficient player." I offer no answer to this problem. I offer the problem as an example of one which is suggested by consideration of the postulate of freedom, which can be specified with sufficient definition to invite intelligent attack, and which would appear to lead, if soluble, to interesting and important results.

CHARLES B. WOOSTER
State University College,
New Paltz, New York

Some of Boring's examples of cognitive dissonance may be reclassified as *real* and *virtual*. The virtual beliefs or attitudes are subject to experiment and are therefore trivial in an inspection of the human journey: these include the geocentric system of Ptolemy versus the heliocentric system of Copernicus and mysticism versus accurate observation. His real incompatibilities include, for example, "Accept tutelage from the wise *but* maintain your own independence" and the antithesis between freedom and determinism. Such dissonances have been harmonized by the principle of complementarity formulated by Niels Bohr (*1*).

Bohr pointed out frequently that if one probes for the wave-nature of light with equipment designed to study this property, one gets a wavelike answer; if the experiment is designed to test the corpuscular nature of light, one gets a particle-like answer. Further, "if we prove the corpuscular character of an experiment, then it is impossible at the same time to prove its wave character, and conversely" (*2*). By analogy, if one tests for determinism by holding a lighted match near an unsuspecting man's foot one gets a mechanistic response, but if one asks, "Will you see *Murder in the Cathedral* on Tuesday or Thursday or not at all?", one encounters uniqueness. In the words of Bohr, "In an objective description of our situation use of the word volition corresponds closely to that of words like hope and responsibility, which are equally indispensable to human communication," and "any apparent disharmony can be removed only by an appropriate widening of the conceptual framework."

One does not live in spite of the dissonances of the real type but, rather, in keeping with them. Paradoxically, these dissonances are intensive manifestations or attributes of every personality. To contradict Boring, freedom is not a preference for ignorance, but rather an acceptance of ignorance.

A. D. MCLAREN
University of California, Berkeley

References

1. N. Bohr, *Atomic Physics and Human Knowledge* (Wiley, New York, 1958).
2. M. Born, *Atomic Physics* (Hafner, New York, 1962), p. 103.

The Cultures on the Campus

Lafore's discussion of the "cultures" on each campus (21 Aug., p. 790) is most disturbing, not because I question the authenticity of his observations but rather because I suspect he is quite right. On every campus there are many men trained in the sciences who are not scientists but capable technicians, and there are a like number trained in nonscientific disciplines who should be classified as the equivalents of technicians.

The average person from one so-called culture cannot communicate with the average person from the other. But it is hard for me to believe that the outstanding people in one would have difficulty communicating with members either of their own or of the other culture. In fact, I believe that among such outstanding people there is only one culture, encompassing the entire field of knowledge.

Historians often characterize the culture of a particular time and place in terms of its best elements. Shouldn't we apply this same perspective to our colleges and universities?

HAROLD E. YOUNG
School of Forestry,
University of Maine, Orono

Laurence Lafore's article "One Campus, Two Cultures" is delightful and persuasive. I have, however, a minor point of argument. I think that scientists have a "sense of unity" not merely because they remember the "day when the several sciences were in fact one," but because each has been trained in the use of scientific method, the tool essential to all the specialties in science.

Once having learned and used the principles of scientific method, a person ought to think differently from someone who has never encountered them. I think that most scientists at least intuitively understand that this tool is the most valuable possession they have. Perhaps that is the main reason why, to use Lafore's words, scientists "insist that a knowledge of science is indispensable to the good life."

JANET JEPPSON
985 Fifth Avenue, New York 10021