

able time overseas. It requires an organization of effort permitting a sustained interaction with scientists in these less-developed areas despite rotation of particular personnel. Many suggested that success could only be assured through an organization having some of the attributes of the Peace Corps but which would not demand financial sacrifice by volunteers.

Copies of the complete course of this inquiry are available. I shall welcome further comment and will attempt to make such views available to anyone concerned.

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Crackpot Scale Applied

Gruenberger's "A measure for crackpots" (25 Sept., p. 1413) has interesting possibilities. But I wonder why the author wastes his time considering those harmless believers in the dowsing rod or in ESP, who, after all, are only looking for a little water or a little insight into the muddled minds of men. If Gruenberger glanced around where he works (the Rand Corporation), he would find far more challenging subjects for his scale. I refer, of course, to the nuclear strategists, those earnest applied scientists who are regularly defended in the pages of *Science* itself.

Let's apply the Gruenberger Scale to nuclear gaming, strategic simulations, and the like:

1) *Public verifiability*—12 points. To quote Gruenberger, "The crackpot often says, 'This is revealed truth; sorry, but I and my followers are the only ones who can obtain these results.'" Compare this with testimony before Congress on projected nuclear casualties, the effect of shelters, and so on, by several experts. Score: 0.

2) *Predictability*—12 points. Refer, as an example, to Kahn's book on thermonuclear war, and compare his prediction for the 1964–65 period with the Russian-Chinese tension, the test-ban treaty, insurgency in small countries around the world—that is, with what is actually happening. Score: 0.

3) *Controlled experiments*—13 points. Clearly, the nature of hydrogen warfare makes experimentation impracticable except in a prototype (final) sense. Score: 0.

4) *Occam's razor*—5 points. The tortured intricacies of he-thinks-that-I-

think-that-he-thinks-that-I-know-where-as . . . are fun when Dr. Strangelove does it but far from the simplest way to approach conflict resolution. Score: 0.

5) *Fruitfulness*—10 points. Need I comment? Score: 0.

6) *Authority*—10 points. Nobody can argue with all those hotshot degrees. Score: 10.

7) *Ability to communicate*—8 points. There is no lack of journal space devoted to this stuff. Score: 8.

8) *Humility*—5 points. Cf. the Teller-style bluff and bluster. Score: 0.

9) *Open-mindedness*—5 points. When I recently took a writer to task because of possible downwind effects a cratering attack on the eastern missile sites might have on New England, he said my criticism was improper because I supposedly did not believe in the principle of deterrence. In other words, a technical argument is invalidated by a person's ethical beliefs. Score: 0.

10) *Fulton non sequitur* and (11) *Paranoia*—5 points each (if negative). Strategists are not being laughed at, so they need not invoke the shade of Fulton. Nor are they suffering from persecution complexes. Why should they be? Score: 10.

12) *"Earth-shaking" complex*—5 points (if negative). These prophets of doom score: 0.

13) *Statistics compulsion*—5 points (if negative). Is anybody not familiar with the megadeath games? Score: 0.

Total score: 28 points out of 100—the same score as the dowsers'. Angelologists—those who study the existence and habits of Angels—score even lower.

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Training in Microbiology

During the past 5 years I have noticed severe deficiencies in the training of undergraduate majors in microbiology. My views have been corroborated by a survey conducted by the Education Committee of the Society for Industrial Microbiology and by the discussions at an SIM symposium on training microbiologists at the bachelor's level (held at the 1964 annual meeting of the American Institute of Biological Sciences).

Gross inadequacies in five skills were repeatedly noted. Many college graduates with majors in microbiology

(i) cannot prepare, sterilize, and dispense culture media; (ii) cannot serially maintain pure cultures; (iii) cannot effectively search the literature for relevant publications on a particular subject; (iv) cannot record concisely an experimental design or clearly report the results; and (v) are not familiar with standard references such as *Bergey's Manual of Determinative Bacteriology*, *Lange's Handbook of Chemistry*, and the *Merck Index*.

A colleague said, "Does it really matter? These are things that can be learned within a few months." True, but shouldn't an undergraduate major in microbiology be able to do these things? What happens to the new graduate who does not have a qualified supervisor?

In our haste to teach all that is new, and with pressure to train more students, we must not omit the simple, basic techniques.

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On Quoting

Skinner's letter (25 Sept., p. 1385) calls attention to an error in referencing in my article "Empiricism in latter-day behavioral science" (31 July, p. 464). Let me apologize both to Skinner and to readers of *Science* in acknowledging that the reference should have been to *Cumulative Record* (Appleton-Century-Crofts, 1959) rather than to *Science and Human Behavior* (Macmillan, 1953). Page references remain unchanged.

As regards Skinner's other criticisms, to the effect that he had been quoted out of context and misrepresented, I have little really to say. Any quotation is subject to the same objection. I selected the Skinner quotes and those from Sidman's book (*Tactics of Scientific Research*, Basic Books, 1960) because they illustrated my honest understanding of the essentials in the Skinnerian position. The informed reader will have no doubt already made a judgment as to whether I have or have not represented Skinner fairly. To the interested but less informed, I would hasten to urge, indeed, a direct perusal of the references cited (as herein corrected).

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