Letters

Quality Education: Hanged without a Trial

Before the article by Astin on "Undergraduate achievement and institutional 'excellence'" (16 Aug., p. 661) becomes the Project Hindsight of the educational world, it may be well to bring out for public discussion some of the possible sources of error in that study. It seems to us that the use of only a single measure of undergraduate achievement in a study using 69 measures of institutional quality and 103 of student characteristics is inconsistent and exposes the whole study to any weaknesses that single measure may have. We suggest that the Graduate Record Examination Area Tests, which were that single measure, are inadequate as a measure of achievement in ways which are precisely such as to bias the study in the observed directions.

We have examined an area test in the natural sciences. *All* the informational content examined in physics, chemistry, and biology is presented in high school courses. Although the use of mathematics in physical description is a most important part of material science, there was not a single problem on the examination requiring mathematics beyond the 9th-grade level. In short, the examination measures predominantly *information* from high school and early college levels, not the level of sophistication or even of information one expects from a science major at a major university. While we are less well qualified to judge the other two sections of the area tests, we believe them to consist similarly only of survey course material.

There are two aspects to education at most colleges and universities. One is the continuance of education on a broad front through introductory and general courses, fundamentally an extension of high school education, to a slightly higher level. The area tests attempt to measure such education. The second aspect is education in depth in a field of specialization. This aspect is the major reason for the existence of colleges and universities as distinct from junior colleges or extended high school education. The area tests totally fail to examine education in depth. Astin's measure of achievement has therefore systematically ignored the unique and important feature of university education. At the same time, most of the conventional measures of university academic excellence with which "achievement" is being correlated are related to this education-in-depth aspect.

It is then to be expected that Astin finds little correlation between the cost of education and achievement. "Achievement" as measured by the area tests describes only the general and introductory aspect of education. The high cost of good university education—the need for huge libraries, good laboratory facilities, and teaching by Ph.D.'s—is chiefly due to the education-in-depth aspect of universities. If an adequate measure of achievement could be found—and we have none to suggest—a study such as Astin's could be quite informative. Astin's use of a biased measure of achievement, however, hangs quality education without a trial.

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Anderson's and Hopfield's concern that the large number of input and environmental measures "is inconsistent and exposes the whole study to any weaknesses that single measure [the Graduate Record Examination] may have" is difficult to understand. We used a large number of input variables to reduce the chances that variations among institutions in the characteristics of their entering students would result in spurious college "effects," and a large number of environmental variables to maximize our chances of detecting any true environmental effects.

Whether or not one agrees with Anderson and Hopfield that the GRE area tests measure only "survey course material" and "totally fail to examine education in depth," the important points are (i) that there was considerable variation among the students in their performance on these tests (even among students attending the "highest quality" institutions); and (ii) that little, if any, of this variation could be attributed to differences in the "quality" of the institutions attended. Of course, it may be that the higher quality institutions de-emphasize basic or introductory material in favor of "in-depth" coverage, but it is difficult to see much virtue in such a practice so long as there are still such wide variations among the students in their grasp of the fundamentals. We are currently conducting similar analyses using the advanced tests of the GRE, which presumably measure more of the "in-depth" knowledge that concerns Anderson and Hopfield.

It would be interesting to know if the area tests would have been judged to be "superficial" if our results had shown that attending a "high quality" institution enhances the student's performance on these tests. Unless such judgments about the relevance of evaluative criteria can be made independently of evidence concerning the differential effects of institutions on these criteria, there is a real danger that the folklore about institutional "excellence" will become a self-fulfilling prophecy.

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Versatile Genius: Frederick II

In view of the letters (2 Aug., 27 Sept.) concerning the accomplishments of Frederick II of Hohenstaufen in the field of ornithology, it seems unfair to his genius to pass over his feats in other branches of experimental science, as he was no narrow specialist. He was also:

1) A physiologist. He fed two men sumptuously at dinner, and then sent one to sleep, the other to take vigorous exercise. After a sufficient interval, he caused both to be opened in order to judge which had digested better (*1*).

2) An anatomist. He enclosed a man in a hermetically sealed cask. Since the cask, when opened, showed no soul, but only a corpse, he concluded that man had none (*1*).

3) A geneticist-linguist. He ordered foster mothers to care for some new-

born children but not to speak to them in order to see whether they would speak their parents' language or some older language such as Hebrew or Greek. "But he labored in vain; for the children could not live without clappings of the hands, and gestures, and gladness of countenance, and blandishments" (*1*, p. 113). Thus we see an early example of serendipity and Frederick must be credited with the discovery of the importance of tender loving care in the rearing of children almost seven centuries before its alleged discovery. Herodotus reported a similar experiment performed by the pharaoh Psammetichus, with vastly different results. The children grew up speaking Phrygian (*2*). (It is unlikely that Frederick ever read Herodotus.)

Dante placed the godless Frederick in Hell, but he also praised his ability as a poet.

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1. G. G. Coulton, *Medieval Panorama* (Meridian, New York, 1938), p. 447.
2. Herodotus, *The Histories*, A. de Selincourt, Transl. (Penguin, Baltimore, Md., 1954), p. 103.

Just to put the record straight—and to give credit to two long-dead but gallant youths—the cover picture on the 27 September issue is not that of Frederick II of Hohenstaufen and his son Conrad. Instead it is a picture of Conrad the Young, or Conradin, Frederick's grandson, with his friend and boon companion, Frederick of Baden. In the Manesse Manuscript, over the picture, is the legend "King Conrad the Young." Conradin, born 2 years after the death of Frederick, was the last legitimate heir of the Hohenstaufens, and perished grievously at the age of 16, along with Frederick of Baden, at the order of Charles of Anjou (*1*). In the painting, Conradin is flying a gyrfalcon, the falcon reserved for royalty. Frederick of Baden, on the left, is serving as squire.

Still, it is excellent that you have called attention to that fascinating imperial scientist, Frederick II of Hohenstaufen, and to the royal sport of falconry, which itself has many elements of interest to the behavioral scientist. The falcon presents an intriguing problem in behavior modification, one with which falconers have struggled for at least two millennia. Generally speaking, birds, like other animals from completely undomesticated species, are far more satisfactorily trained if they can be acquired early, preferably in infancy. This is extremely difficult with all hawks, which, as far as I know, never breed in captivity. Thus, the hawk, as a fledgling, must be snatched from the nest, and falcons' nests are generally built in inaccessible places. Even if one captures the fledgling, one must still devise a method of rearing which will keep the animal domesticated, but at the same time develop its strength and predatory skills. Two such goals are normally incompatible, in a wide-ranging animal like a hawk. The more satisfactory method is generally considered to be that of capturing a young adult bird. The problem then is that the falconer must deal with an extremely "wild" hawk, very difficult to tame.

Obviously, the first goal in training a falcon, whether by Oriental, English, or Continental methods, is to get the hawk to return to the falconer after it has seized its prey. Most falconers have used a twofold method. First they begin training by producing a stage of marked dependency in the falcon—either by stimulus reduction, such as the Persian use of "seeling" (sewing together the eyelids of the falcon), or—according to the commoner English practice—by a sort of shock treatment in which the animal is continuously exposed to stimulation for 60 hours or more, and kept in the dark for extended periods, a kind of brainwashing. Frederick was clearly influenced by the Persians, as expected from his general interest in the Orient (*2*). The English practice is as hard on the falconer as on the falcon, since he must sit up with the hawk and stimulate it constantly to prevent its falling asleep. Latham, the 17th-century English authority, describes in detail the other part of the method. This is the use of positive reinforcement. The falconer is informed that as soon as he begins to train the hawk he must talk to her and feed her from the hand so that hand and voice become associated with feeding. Thus, soon, the falcon so trained will be "better pleased both with them (the prey) and with yourself, loving your voice and you the better for their sakes." Latham explicitly recognized the primacy of food as a reinforcement when he says that it is food only "that guides her and rules her; it is curb and bridle that holds and keeps her in subjection to man" (*3*).

There is a growing group of falconers in America today, such as the members of the American Falconry Association, who find their best guides for behavior-shaping are still the treatises of Latham, of Frederick of Hohenstaufen, or of the Persian royal authority on falconry, Taymur Mirza, who, like Frederick, wrote in the 13th century (*4*).

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1. T. Carlyle, *Frederick the Great* (Clarendon Press, Oxford, London, 1916).
2. Frederick II of Hohenstaufen, *The Art of Falconry*, C. A. Wood and F. M. Fyfe, Trans. and Eds. (Stanford Univ. Press, Stanford, Calif., 1943).
3. S. Latham, *Faulconry, or the Faulcon's Lure and Cure* (Thomas Rooks, London, 1658).
4. T. Mirza, *The Baz-Nama-Yi-Nasiri: A Persian Treatise on Falconry*, D. C. Phillott, Transl. (Bernard Quaritch, London, 1908).

Galileo's Insight: A Modern Guide

The Catholic Church's announcement of Galileo's probable rehabilitation and Father Ernan McMullin's comments ("Galileo: The case may be reexamined," 2 Aug., p. 449) ought to be considered with Pope Paul's more recent banning of artificial birth control. Galileo's name does not require rehabilitation. His *Dialogue* and other Copernican works were removed from the *Index of Prohibited Books* in 1822 when the College of Cardinals declared it permissible to teach Copernican theory in Catholic countries (*1*). By recanting and fulfilling his sentence Galileo rehabilitated himself in the eyes of the Church (*2*). Father McMullin praised him for theological concepts that Pope Paul VI seemingly chose to ignore when he considered the problem of birth control.

An abridged version of Galileo's sentence is in Wolf (*1*). The sentence is of a type that can be canceled by the Bishop without any legal proceeding according to the *Malleus Maleficarum*, a manual of procedure widely used in 17th-century ecclesiastical and secular trials of heretics (*2*). It is possible that the College of Cardinals may have rehabilitated Galileo when they permitted his theories to be taught in 1822.

Acceptance of Galileo's theological ideas is more important today than correcting the record of his trial because they touch on current problems. I find them useful in discussing evolution with