Student Skeptics Study UFO's

The recent demonstrations in Washington and Wolfle's editorial, "Student unrest" (27 Oct., p. 443), as well as Tom Lehrer's records, show that young people "gotta have a cause," opposing U.S. government policy, or university faculty, or "the Establishment." It seems to me that this tendency to opposition can be effectively exploited in teaching science and other subjects. As an example, I am now teaching a course on "Flying Saucers," capitalizing on student interest in UFO reports that discredit the scientific establishment. The 50 students who signed up (for a class "limited to 20") will get the fundamentals of astronomy and physics that apply to UFO sightings. By the end of one semester, they should at least understand what is involved between the flying-saucer hypothesis and the laws of mechanics, radiation, and physics of the upper atmosphere (see Markowitz, "The physics and metaphysics of unidentified flying objects," 15 Sept., p. 1274). The only trouble is that I don't know enough social psychology to capitalize fully on this broad topic.

In the realm of physical science, it would help if E. U. Condon and his panel in Boulder, Colorado, would publish some statistics on the UFO reports, estimate the labor necessary to analyze one, and give interpretations of a few typical cases. Students will read such materials avidly (looking for loopholes) and will certainly learn some astronomy and physics in the process.

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Are Dental X-Rays Dangerous?

During Senate hearings on S. 2067, the bill which would set standards governing radiation hazards (15 Sept., p. 1292), Albert Richards, speaking for the American Dental Association, pointed out that dentists live an average of 1.4 years longer than the rest of the white male population and that dentists who die of diseases of the blood and blood-forming organs, including leukemia, live to an average age of 71.2 years while the parallel figure for the general population for death from these diseases is 68. His arguments are invalid for the following reasons:

1) The blood-forming organs, the bone marrow and the spleen, are deep within the body. A dentist is exposed only to scattered radiation which has a kilovolt-peak far lower than that of the primary beam. Therefore, only a very small percentage of this radiation would ever reach the blood-forming organs as most of it would be shielded out by the bones and overlying tissues.

2) There are less than 15,000 cases of leukemia in the United States per year. Therefore, the data may be statistically invalid, as there are less than 100,000 dentists practicing in a population of 200 million. If dentists were to get leukemia at the same rate as the general population, they would have roughly 7 to 7½ cases per year, and certainly in a group of 100,000, it is hard to see this as a statistically significant figure.

3) The universal use of x-ray in dentistry is an event of the last 20 years so that many of the older dentists have not had x-ray machines during their whole practice experience. Also, many have delegated this technique to assistants and hygienists.

Richards' figures comparing death rates from blood diseases of dentists with that of the general population are not realistic because virtually no dentists are under the age of 20, while many leukemia deaths occur among children. The incidence of skin cancer which could result from low kilovolt radiation would provide a more significant comparison. If the number of dentists having skin cancer were compared with another professional group not exposed to such radiation reliable data could be obtained. Most every dentist knows of a colleague who has contracted skin cancer from his x-ray machine.

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Age-at-death figures referred to by Medwedeff are from the study entitled *Mortality of Dentists, 1955–1960*, by the American Dental Association's Bureau of Economic Research and Statistics. The study, based on death certificates of dentists received from a majority of the state health departments, covered a period of 6 years. In accord with the *International Classification of Diseases, Injuries, and Causes of Death* (World Health Organization, Geneva, ed. 7, 1957), leukemia and aleukemia were included under "neoplasms," not under "diseases of the

blood and blood-forming organs." The mean age at death of dentists dying from neoplasms was 67.5, compared to 66.3 for nondentists. These figures are for white males, and are age-adjusted to take into account age differences in the populations at risk (the number of living dentists 25 and older, and white male population 25 and older). No death occurring at age less than 25 was included for either dentists or nondentists, so Medwedeff's assertion that "virtually no dentists are under 20" is irrelevant and misleading.

Death from cancer was studied also in an earlier investigation conducted by the Bureau of Economic Research and Statistics, *Mortality of Dentists, 1951–1954*. The mean age at death caused by neoplasms was 67.7 for white male dentists 25 and older, and 65.2 for white male nondentists 25 and older. In this study, too, the difference in age distribution of the populations at risk was taken into account.

Therefore, over a period of 10 years, dentists dying from neoplasms were older than the comparable general population group dying from neoplasms.

In a national survey of dentists conducted by the Bureau in 1950, 92.4 percent reported having x-ray equipment in their offices. This would indicate that x-ray machines have been in wide use in dentistry for considerably longer than 20 years as indicated by Medwedeff. Certainly earlier equipment and procedures caused greater dentist exposure than current usage.

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Symbols and Symbolic Codes

The recent issue of *Science* (13 Oct.) was distressing for one interested in the development of symbols and symbolic codes for diagrams.

The new symbol for "biohazards" (*1*) was chosen on the basis of two criteria, one of which was "uniqueness," interpreted as lack of prior meaningful associations. A good deal of research has indicated that symbols capitalizing on appropriate prior associations and meaningful stimulus structure are often superior to arbitrary "signs" (*2*). When new symbols utilize arbitrary stimuli, it is not uncommon for lapses of meaning to occur, even with trained persons. Although the symbol chosen for biohazards may *become* meaningful for persons engaged in constant work on such projects, it would not seem to provide any strong avoidance associations for nonlaboratory personnel who might come across such materials accidentally. I cannot help wondering why previously learned avoidance meanings were not considered (apparently). Offhand, one might think a skull and crossed test tubes would convey the desired meaning to both laboratory and lay persons better than the symbol chosen.

Second, Walsh's article was marred by a map (p. 243) which violated rather well-established principles of "S-R compatibility" (*3*) and standard coding techniques. Looking at the map, one would think that Massachusetts, Maryland, New York, Pennsylvania, and Texas received the lion's share. The confusion obligations. Only in reading the fine print does one discover that California received the lions' share. The confusion is compounded by the fact that up until the final division, increased shading is more or less correlated with increased funding.

Whether one is dealing with a life-and-death matter (biohazards) or simply with graphic communication, it is unfortunate that both research findings and common sense are overlooked in the development of so many symbolic displays.

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Reactions from Reed

Nelson's provocative and interesting article on Reed College (15 Sept., p. 1282) provided me with somewhat mixed emotions; one cannot help but cringe upon seeing one's beloved so exposed to public examination. In general, his facts seem to be both accurate and clearly presented, though somewhat more pessimistically interpreted than we feel is representative of our view. However, three points I believe should be clarified:

1) "Students here note a high sui-