

LETTERS

Sunday Schools versus Science?

In his recent commentary, Karl H. Puechl opines that religious education may be damaging the scientific education of American children. A few points should be made about this.

- It is noteworthy that Mr. Puechl does not even attempt to provide evidence correlating religious education with scientific literacy.
- Historically, modern science originated in a culture which accepted unchanging and objective theological and philosophical truths and which therefore was inclined to seek unchanging and objective truths in the physical world as well. This is scarcely a coincidence.
- It seems likely that parents who are concerned about their children's religious education will also be interested in their academic education. Uninvolved parents surely pose the greatest threat to a child's education.
- Widespread religious education seems not to have hindered previous generations. In fact, American dominance in the sciences came when there was more religious education – even prayer in public schools.
- As a "Sunday School graduate", I can assure Mr. Puechl that the lessons tend to be much more about the Ten Commandments and about the Golden Rule than about any scientific theory. On the other hand, "thou shalt not bear false witness against thy neighbour" is exactly what must be demanded of scientists when they are called in as expert witnesses in criminal trials or congressional hearings. Likewise, the more general principle "thou shalt not lie" is **absolutely necessary** for science; a "no-holds-barred" approach that permits fabricating data is no longer science at all. Finally, the principle of informed consent is nothing more than a specific application of the Golden Rule. Historically, of course, some researchers have felt handicapped by the principle of informed consent. These researchers have brought us such abominable "science" as the Tuskegee Experiment.
- Since Mr. Puechl wants "no-holds-barred questioning students", would he favor the policy of the Tangipahoa Parish Board of Education's policy of requiring teachers to urge students "to exercise critical thinking and gather all information possible and closely examine each alternative toward forming an opinion" regarding "the origin of life and matter"? Somehow, I suspect that he would instead side with the Fifth Circuit Court of Appeals, deciding that in *this* case, it is better for the student to be told *five* days a week that evolution is "an absolute truth that cannot be questioned".
- Finally, although the commentary targets Christian religious education, its content is no less an attack on the religious education of Jews and Muslims.

I doubt that a similar opinion piece making the absurd claim that America's poor performance in science and math is due to a supposedly too-large percentage of racial minorities would be graced by the imprimatur of the Commentary section. However, whereas bigotry against racial minorities is beyond the pale, bigotry against religious believers is clearly accepted by the editors of *Physics and Society*, their disclaimer notwithstanding. After all, *Physics and Society* is not simply a bulletin board or chatroom.

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Science and Goodness.

I wish to thank Todd Duncan for his insightful and important commentary "The Perceived Conflict between Science and Meaning". His analogy regarding the dehydrated damsel in distress was particularly helpful. Desperate people need to have their desperation, and not just because of their desperation, recognized and heard.

It occurred to me while reading Duncan's piece that scientists can do far more than just acknowledge, and/or sympathize with, religious views that owe their urgency to the need for meaning. Scientists can quite rightfully point out that science allows the realization of one of the most important components of Judeo-Christian morality, viz., the performance of deeds of goodness. If providing food to the hungry and care for the sick are deeds of goodness, then science enables such deeds to a far greater extent than any person, church, or nation has ever done. Because

of science most, if not all, of the people reading this letter will probably not worry about obtaining food for their family's next meal, nor are they likely to die of sickness prior to the age of 45 years.

It is certainly true that science is a two-edged sword, and some people (religious and otherwise) might point out that science has been used in the creation of destructive, and even genocidal, tools (e.g., Zyklon B, thermonuclear bombs). However, science has much to recommend it in the list of tools that allow for the performance of deeds of goodness. We should all be ready to recite from that very long list.

I'd like to summarize by paraphrasing both Duncan and myself: In dealing with deeply religious people we scientists need to develop far better bedside manners, and we also have to point out the efficacy of science in the performance of that which is perceived to be Divine Will.

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Depleted Uranium and Leukemia

Bernard Cohen states near the end of his April article (*Physics and Society*) that no excess leukemia has been reported among 78,000 uranium mill workers [as of 1979]. But a review by Archer in 1977 states that mill workers show excess lymphoma (Cancer 39(4)). Also, a study of several thousand US mill workers by Dupree-Ellis, et al, found various excess cancers, as well as chronic nephritis, an expected DU symptom (Am.J. Epidemiology, 2000, 152, 91-95). It seems possible the study cited by Cohen merely reflected good plant management and thus low worker exposure. Uranium miners have reported increased rates of cancer since the 19th century. Modern nonsmoking miners likewise (Gilliland, et al, Health Physics, 2000, 79, 365 -372; J. Occupational & Environmental Medicine, 2000, 42, 278 - 283). Miner lung cancer has been attributed to radon, a component of natural uranium (See <http://ccnr.org/bcma.html#lung>; also, Field, et al, Am. J. Epidemiology, 2000, 151, 1091 - 1102). Various regulatory limits are at <http://www.antenna.nl/wise/uranium/utox.html>.

The logical conclusion would seem to be that depleted uranium (DU) dust is less effective in causing leukemia than other cancers. Thus, in my opinion, Cohen's analysis should have passed off leukemia at once and focussed on, say, lung cancer. In the lab, we find that DU and tungsten both are carcinogenic in cultured human osteoblast tissue (Miller, et al, Radiation Research, 2001, 155, 163 - 170; Carcinogenesis, 2001, 22, 115 - 125); that skin contact with soluble DU salt can be acutely fatal (Lopez, et al, Health Physics, 2000, 78, 434 - 437); and, that alpha radiation seems to damage cells neighboring those absorbing the radiation (Little, 2001, http://www.med.harvard.edu/publications/Focus/2001/Feb9_2001/radiobiology.html).

Looking at the physical form of a dose of DU, the expected harm from a macroscopic fragment of alpha-emitter, even one merely held close to the skin, is far greater than that from the same number of U-238 atoms dispersed widely in the body (e. g., Giannardi & Dominici, physics/0103047; Fetter & von Hippel, <http://www.princeton.edu/~cees/arms/vonhippe.pdf>). DU has been reported to cause cancer when implanted as small fragments in the muscles of living rats (F.Hahn at <http://www.medscape.com/reuters/prof/2001/01/01.25/20010124scie002.html>; free registration with MedScape required).

As for Cohen's calculations, he claims that, according to Health Physicists (sic), "inhalation of 1000 mg of any dust causes death by choking." This is absurd. Here is some regular physics: A bottle of instant coffee contains 340 g and about 180 1-teaspoon servings. So, there is about 1000 mg = 1 g in half a teaspoon of powdered instant coffee. Should we trust any calculation starting from a premise off by at least two orders of magnitude?

Cohen says that Health Physics would expect no more than 1 surplus death from leukemia in all the NATO troops sent to the Balkans. However, correcting his calculation by two orders of magnitude would suggest actually 1 such surplus death in each 1000 troops, a level above the casualty rate from direct combat. "Health Physicists have procedures for calculating exposures", Cohen claims, soon endorsing a UNEP assertion that "picked up pieces of DU, carried in pocket for weeks, would cause no skin burns [or] important health problems". He then recites NATO press conference figures showing that no one in service in the Balkans provably has gotten sick from DU. To ensure that the point has been thoroughly missed, Cohen adds that no excess of leukemia has been reported in Russia or the Ukraine as a result of Chernobyl: But, Chernobyl caused clouds of neutron-activated beta and gamma emitters and little or none of the alpha of DU. Why not mention thyroid cancer?

We have, then, a few dozen wounded veterans and 78,000 mill workers free of excess leukemia. My question is, is this enough justification for Cohen to add the P&S voice to the "We Don't Worry About DU" NATO chorus?

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Depleted Uranium and Leukemia -a Rejoinder to Williams

The very title of my article in the April P&S was Leukemia from military use of DU. It dealt with leukemia only because:

- (1) Reports of supposed excess leukemias was the driving issue
- (2) Leukemia was the subject of all the media publicity, and of the various international and national investigations
- (3) Other types of cancer than leukemia are not expected to develop so soon after exposure in the Balkan wars; they develop only after about 10 years.

If one is concerned about other cancers, the universally accepted scientific approach is to estimate the dose to various body organs, and use the risk vs dose data for those organs. That is the procedure accepted and used by the National Academy of Sciences BEIR Committees, by the United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP), the U.S. National Council on Radiation Protection (NCRP), and similar groups in every technologically advanced country. All of these groups are composed of very distinguished scientists. This procedure is illustrated for radiation exposure of bone marrow to induce leukemia in my April *Physics and Society* paper, and it is straightforward to extend it to exposure to other organs to induce other types of cancer. The principal difference is in the risk vs dose information; gathering such data is a major endeavor of the BEIR and UNSCEAR Committees. They evaluate thousands of research reports, including those cited by Williams, to reach their conclusions. The rat study referred to by Williams will be considered if and when it is published in a scientific journal (as of now it is a newspaper story), but it will be just one of numerous papers and given less weight than studies on humans.

Given sufficient space here, I would be happy to provide a calculation for lung cancer as Williams suggests. This would have to include models for dispersal developed by ICRP. My quick calculation indicates that the risk would be trivial.

I must confess that I have no experience with deriving dose estimates from implanted fragments of DU (although that was treated by the UNEP and other investigations I cited), but that is a trivial part of the problem. Anyone close enough to an exploding shell to be hit by fragments would have a much greater risk of being killed by other aspects of the explosion. Surely the problems much more worthy of consideration are (1) inhalation of finely dispersed dust which can travel many miles and after settling down can be resuspended by the wind, and (2) ingestion with food or water contaminated with DU thus transported. These are the problems I am experienced in treating and they predict trivial effects from DU used in the Balkan wars.

As for Williams remarks about powdered coffee, my statement about "1000 mg" is derived from medical experience, not from Health Physics. (The "100 mg" is from the United Nations Environmental Program report as was the "20 mg" that I used in the calculation.) Of course the dust must be fine enough and well enough suspended in air to be inhaled, get past the filtration in the nose and pharynx (from which deposited dust is rapidly cleared) and enter the bronchial region.

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