The actions of the Centers for Disease Control and Prevention are scrutinized regarding the misallocation of $8.8 million dollars that was to support research on chronic fatigue syndrome. Suggestions are offered for improving the analysis of factors potentially contributing to childhood cancer. An idea for a Hippocratic oath for scientists described in a previous editorial draws comments on how much responsibility scientists should have, if any, for how their research is used: "[T]he misuse of scientific knowledge cannot occur without the activity or complicity of other people." And an idea to apply manure to arable lands as a means to sequester carbon is discussed.

Misallocation of CDC Funds

According to the Centers for Disease Control and Prevention (CDC), the reason for the misallocation of $8.8 million (plus another $4.1 million that is impossible to trace) mandated by Congress for the study for chronic fatigue syndrome is because some "brilliant scientists" are "not very good managers" (News of the Week article by Martin Enserink, 7 Jan., p. 22). But the use of this "dizzy scientist" stereotype by the CDC as an explanation seems to be an attempt to conceal what is a more serious problem—a government scientist apparently arrogating to himself the choice of what is to be studied after Congress has decided otherwise. That the acting director of the CDC provided Congress, in the words of the inspector general of the Department of Health and Human Services, with "inaccurate and potentially misleading" information supports this view. The fundamental problem is the tension between "experts" and elected officials, and the publics they represent, about what is or is not an important health problem.

What makes this report more troubling is that William Reeves, the whistle-blower, is the one who appears to be in trouble with the CDC, rather than the administrator-scientist who misallocated the funds or the acting director who misled Congress or its representatives. Perhaps the scientific community could hear more about what administrative and personnel actions the CDC and other federal health agencies are taking to clarify the difference between the authority to select problems and the authority to select appropriate scientific procedures to study those problems.

John H. Gagnon
Emeritus professor of sociology, State University of New York, Stony Brook. E-mail: jgagnon@bigplanet.com

Childhood Cancer

I would like to clarify and comment on some of the issues raised in the article "The elusive causes of childhood cancer" by Jocelyn Kaiser (3 Dec., p. 1833), which accompanied Kaiser's News Focus article "No meeting of minds on childhood cancer" (p. 1832). First, the hypothesis regarding a possible link between infant leukemia and chemotherapy drugs that are topoisomerase II inhibitors did not develop from the "genetic shuffle...common in infants whose mothers were treated during pregnancy with chemotherapy drugs." Rather, mixed linkage leukemias that arise after chemotherapy for a primary malignancy fueled this hypothesis (*1*) (see Corrections and Clarifications at the end of this section).

Second, I agree with Frederica Perera's statement regarding the need for the collection of direct biological evidence of exposure (rather than relying primarily on parents' memories of food or chemical exposures). However, several of the agents that we are interested in (for example, specific dietary constituents and alcohol) have an extremely short half-life in vivo and do not necessarily create a biological fingerprint to be measured years later. Furthermore, it is problematic to retrospectively assess the habits and exposures during pregnancy of a mother whose child develops leukemia at the age of 10. One way to explore the potential problems associated with our analytic approach and perhaps discover appropriate biological markers would be to identify large groups of pregnant women (thousands), conduct interviews, collect blood samples, and perform environmental monitoring. Subsequent interviews could be conducted after the birth to determine the validity and reliability of their responses regarding pregnancy-related exposures (when compared with responses obtained while they were pregnant), as well as the usefulness of potential biological markers of exposure.

Finally, to Perera's comment regarding the need to assess inherited variations in genes that may predispose children to cancer, I would add "within biologically defined subgroups." The lack of consistent information with respect to the etiology of childhood cancer can partly be attributed to the heterogeneity of the disease and insufficient study power to test hypotheses within more homogenous subgroups. In many cases, the traditional diagnostic categories are collections of etiologically distinct entities. As an example, most of the childhood leukemia epidemiology studies have been conducted on either childhood leukemia as a whole, or have included two disease stratifications within analyses: acute myeloid leukemia or acute lymphoblastic leukemia. It is becoming apparent, however, that biologically distinct subgroups of leukemia exist (for example, infants and children with Down syndrome). Studies suggest that focused, epidemiologic investigations of these rare subgroups might provide new answers (*2*).

Julie A. Ross
Division of Pediatric Epidemiology/Clinical Research, University of Minnesota Cancer Center, 420 Delaware Street S.E., Minneapolis, MN 55455, USA

References
1. J. A. Ross *et al.*, *J. Natl. Cancer Inst.* **86**, 1678 (1994).
2. M. W. Yeazel *et al.*, *Cancer* **75**, 1718 (1995); J. A. Ross *et al.*, *Cancer Causes Control* **7**, 581 (1996); D. Satge *et al.*, *Am. J. Med. Genet.* **78**, 207 (1998).

Societal Responsibilities

The position Sir Joseph Rotblat takes in his Editorial "A Hippocratic oath for scientists" (*Science*'s Compass, 19 Nov., p. 1475) seems to have an underlying assumption that scientists are aware of all the implications and ramifications of their research. On the basis of such reasoning, neither Isaac Newton, Albert Einstein, Pierre and Marie Curie, nor a number of other great scientists should have ever worked in their fields or made their discoveries known because of all the harmful effects that eventually arose from them. It is not a scientist's fault if a discovery ultimately has manifold effects. After publication of research results is when scientists should be concerned with what the public does with the information. Scientists should become involved in public debates just as all citizens should, either directly, or indirectly through their representatives. What are the ethical considerations and conclusions when society is confronted by conflicting uses of a given discovery? Scientists whose research is at the heart of such debates may have a greater obligation to con-

The Curies, 1896

Albert Einstein, 1914

CREDIT: BETTMANN/CORBIS

tribute to the debate than the average citizen because of scientists' greater technical knowledge, but certainly not because of their greater ethical insights. It is in this arena of public participation that professional organizations of scientists could "work out ethical codes of conduct for their members." Such public participation would also help develop and maintain a positive public image of scientists by helping to ensure "responsible application of their work."

Sheldon F. Gottlieb
10418 Utopia Circle East, Boynton Beach, FL 33437–5546, USA

Rotblat's idea of an oath for scientists is a good one, but the misuse of scientific knowledge cannot occur without the activity or complicity of other people—engineers, lawyers, business persons, politicians, advertisers, weapons manufacturers, historians, news writers and broadcasters, and media owners, to name a few. Scientists are certainly responsible for considering the possible and probable uses of their discoveries. However, no oath by any of us will prevent or even discourage those who pursue nonethical uses of the knowledge that our method provides. It is not only scientists' feet that should be held to the fire.

Perhaps we scientists should promise to be conscientious not only in the application of our method but also in the education of nonscientists regarding what science is, why we do it the way we do, and the tentative nature of our product—theory. Indeed, many mistakenly view science as a compendium of facts rather than the application of method. Creating opportunities for this sort of public education is a worthy challenge.

Tim Clair
Laboratory of Pathology, National Cancer Institute, National Institutes of Health, Bethesda, MD 20892, USA

Rotblat suggests that young scientists should "reflect on the wider consequences of their intended field of work before embarking on a career in academia or industry" and proposes that they take, upon graduation, an oath similar to the Hippocratic oath. I support Rotblat's proposal as one of the scientists who helped develop the Jerusalem Statement on Science for Peace, together with participants of the Second International Symposium on Science for Peace, held in January 1997 in Jerusalem and organized and hosted by the UNESCO–Hebrew University of Jerusalem (HUJ) International School for Molecular Biology and Microbiology (ISMBM) (*1*). It was suggested that scientists who accept the Science for Peace oath should also accept the concepts of the Jerusalem Statement: that scientific endeavors and achievements be used only for peaceful purposes, there should be free movement of members of the academic community, there should be a free flow and sharing of scientific information and knowledge, and the academic environment should remain open and dedicated to free expression (*1*).

Yechiel Becker
UNESCO-HUJ ISMBM, Department of Medicine, Hebrew University of Jerusalem, Jerusalem 91120, Israel. E-mail: becker@md2.huji.ac.il.

References

1. Y. Becker *et al.*, "The Jerusalem statement on science for peace"(*Science for Peace Series*, vol. 3, UNESCO, Venice office, 1997), pp. 13–16. Available at: www.tau.ac.il/~becker/UNESCO_HUJ/j_stat.html

While appreciating the intent of Rotblat's Editorial, I have concerns for the inference that scientific enterprise should be socially directed. The question raised is, whose morality shall prevail in the direction science will take? The scenario that presents itself includes such prohibitions as human genetic research and someone's ideas as to which questions are suitable for inquiry, perhaps based on variable moral codes, political agendas, and religious fervor. In this direction lie dangers every bit as egregious as those that concern Rotblat.

A. Loren Amacher
Geisinger Medical Center, Danville, PA 17822, USA. E-mail: lamacher@psghs.edu

Response

I agree with most of the correspondents, although I take exception to some of the points made by Gottlieb. I did not make the assumption that scientists are aware of all the ramifications of their research; this is obviously untrue. What I did imply was that they should desist from research when its harmful ramifications can be foreseen. Nor can I accept Gottlieb's suggestion that only *after* carrying out the research work—which may have harmful consequences—should the scientist become concerned, jointly with the public, about ways of dealing with the consequences. Surely, the whole point is to try to prevent them in the first place; this is where the need for an ethical code for scientists comes in.

Clair is quite right that many other groups are involved in any misuse of scientific knowledge. However, this does not absolve the scientist from taking the initiative. And I agree, researchers should also be teachers, educating nonscientists about the nature of science and the role it plays in modern society.

What sort of moral criteria should be adopted? asks Amacher. I share with him the agonizing on this issue. A possible answer is provided by Becker, with his Science for Peace program, although for many this may be far too general.

Joseph Rotblat
Pugwash Conferences, 63A Great Russell Street, London WC1B 3BJ, UK

Considering Manure and Carbon Sequestration

In his Policy Forum "Carbon sequestration in soils" (25 June 1999, p. 2095), William H. Schlesinger notes that manure application has been suggested as a possible mechanism for soil carbon sequestration (*1, 2*) and suggests that, although manuring has a number of practical applications, it has no value as a method for sequestering carbon in soil. Schlesinger's basis for this argument is that for every hectare of land manured, 3 hectares are required to grow silage for the livestock that produce the manure. The greater soil organic matter (SOM) concentrations in manured fields, he says, "can thus be expected to be associated with declining SOM on a proportionally larger area of off-site lands."

Schlesinger's position holds true if extra livestock are included in production systems solely to produce extra manure to then apply to land for the purposes of carbon sequestration. However, livestock are raised for the provision of agricultural products; manure is merely a by-product. We suggest that this by-product (as well as perhaps other by-products of our society, such as human sewage sludge) could be better used to increase SOM levels, thus sequestering carbon (*1, 2*).

The Kyoto Protocol sets a baseline condition (1990) against which all changes in carbon emissions and offsets are measured. Changes in manure management must, therefore, be assessed relative to this baseline. In Europe, for example, we estimate (using 1990 figures) that 820 million metric tons of manure are produced each year (*3*). Only 54% is applied to arable land (*4*), with the remainder applied to nonarable agricultural land (such as grassland). Large applications of manure to grassland over many decades do not change SOM levels appreciably (*5*) and so do not contribute to long-term carbon sequestration, because the SOM content of grassland soils is already high and the manure is not incorporated into the mineral soil. As a result, the SOM content of grassland increases proportionately less than does the SOM content of arable land when receiving the same amount of manure.

Carbon can be sequestered in soil relative to the 1990 baseline if all manure produced is incorporated into arable land. Using a relation between manure application rate and yearly increase in SOM (*1, 2*), we estimate that if all manure were incorporated into arable land in the European Union, there would be a net sequestration of 6.8 teragrams of carbon per