LETTERS

Materials Research Center

The announcement of the proposed "National Center for Advanced Materials" to be established at the Lawrence Berkeley Laboratory (Research News, 18 Feb., p. 827) demands that those of us who care about precise use of words as well as numbers protest with the utmost vigor. If industry is subject to a "truth in labeling" act, should not scientists, science administrators, and policy-makers be subject to the same?

Whether or not the nation needs a $140-million Advanced Light Source (ALS) synchrotron may be debated, but whether the nation needs an "Advanced Materials Center" is a different question. As one scientist who thinks he and the laboratory he directs has contributed in collaboration with industry to making advanced materials a reality in this country, I have recently surveyed 20 outstanding colleagues in other universities who have likewise contributed in "advanced materials." Not one would dream of (i) connecting the ALS to "advanced materials" and (ii) spending $140 million on a fifth (or is it sixth?) facility in preference to purposive, joint, university-industry research along the Department of Defense (as opposed to the Department of Energy) model. For that price we could put U.S. industry on top in two or three major advanced materials technologies.

I believe that, unless the materials community—both in industry and in academia—thinks clearly but radically about what science is good for the nation and only derivatively about what is good for science, we will not have a chance to reverse the thoughtless, debateless drift in R & D policy. There may be excellent reasons for believing that the ALS should have a high priority, but Congress should know where it falls in a list of materials research priorities.

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Arthur L. Robinson writes that the first public discussion of the National Center for Advanced Materials (NCAM) proposal occurred when it was submitted to a subcommittee of the National Academy of Sciences (NAS) (Solid State Sciences Committee). This is not correct. I was chairman of that subcommittee. We met for the first time in July, at which time there were rumors of a proposal to be submitted to the Department of Energy by Lawrence Berkeley Laboratory (LBL) involving a synchrotron radiation source, the subject of our subcommittee's study. I called David Shirley, the director of LBL, to find out the facts. He described the proposal's content and rationale over the telephone and agreed to have a description of the storage ring sent. This description arrived in time for our next meeting in September. We did not have the complete proposal, nor had I requested it. We had only a description of the storage ring itself, representing roughly half the construction costs of NCAM. We discussed the storage ring briefly, for it was not our charge from the NAS to "referee" proposals. This was hardly a public discussion of the NCAM proposal. The first public airing of the proposal appears to have been a meeting of the NAS Solid State Sciences Panel in Washington on 8 February, at which Shirley gave an audience of 100 to 150 people a fuller description of NCAM than our subcommittee had in September.

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Detection of Nuclear Tests

R. Jeffrey Smith, in his article "Reagan plans test ban revisions" (News and Comment, 18 Feb., p. 819), quotes me as stating in the early 1970's that "Soviet cheating within this range had no 'military significance vis-à-vis our own position.' " At the time I had assumed that we and the Soviets would design our tests to give a yield of 150 kilotons, if successful. We hoped that, on the average, we would be within 10 or 15 percent, plus or minus, of the design goal. If the Soviets were to design for, say, 175 kilotons, I did not believe it would have any significant impact. At that time I did not anticipate that the Western bureaucrats in charge of our testing would dictate that our design yield be biased below the 150-kiloton limit in order to guarantee we would never exceed 150 kilotons. As a result, our upper optimistic design yield was dictated independent of the agreement with the Soviet Union to be appreciably less than 150 kilotons. At the same time, contrary to my expectation, the Soviets were not content to center their testing around 150 kilotons. In the 1970's, we noticed that a Soviet test was appreciably above 150 kilotons by our existing criteria. Over the years, subsequent tests appeared to us to range as high as 400 kilotons, based on detection criteria that were in effect at the time of the initial agreement.

Since the signing of the original agreement, we have renormalized our criteria for detection in order to reconcile the seismic signals received to keep the Soviet tests within the 150-kiloton testing limit. I personally question the validity of the renormalization.

As quoted, I was willing to live with a bias of perhaps as large as 50 percent in favor of the Soviet Union, but I certainly had not anticipated the factor's approaching 300 percent, which in my opinion we have experienced. If we are going to continue to respect the 150-kiloton limit, I believe we should insist on on-site instrumentation in the Soviet Union and the United States with representatives from both countries present.

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Fluorides and Dental Caries

Dennis H. Leverett has written a timely article (2 July 1982, p. 26) about fluorides and the changing prevalence of dental caries, but we do not fully agree with several of his points. We were disappointed that he suggests "the definition of the optimum concentration of fluoride in community water supplies needs to be reassessed" because of alleged increase in the prevalence of dental fluorosis in fluoridated communities from increased use of fluorides in other forms. In our opinion, such a suggestion is not in the best interest of the general public. Rather than tinkering with currently recommended optimum concentrations of fluoride in water, we should work to control the availability and use of other sources of fluoride in a community.

Community water fluoridation is the least expensive, most effective, and safest way to provide entire communities with protection against dental caries. No other public health measure has had more critical analysis than water fluoridation. Everyone in a fluoridated community benefits, regardless of age, income, educational level, individual motivation, or the availability of dental care. In contrast, products containing fluoride, such as dietary fluoride supplements and dentifrices, are not so equita-

ble. Although 85 percent of all dentifrices sold in the United States contain fluoride, it has been estimated that 25 percent of the population does not use a toothbrush and dentifrice routinely. Dietary fluoride supplements are prescriber-dependent and are used by relatively few children.

A more logical way to reduce total fluoride intake, if the need for that goal is substantiated, would be to educate health professionals, industry, and the general public about properly prescribing, manufacturing, advertising, and using products containing fluoride. As an example, Leverett does not mention the fact that manufacturers of infant formula were persuaded in the late 1970's to reduce the concentration of fluoride in formulas to tolerable limits (*1*). Manufacturers of baby cereals and juices also took steps a few years ago to control fluoride content (*2*). The makers of other products containing fluoride, consumed intentionally or inadvertently by infants and young children who are still at risk of developing fluorosis, should be encouraged to lower the fluoride content of these products or to state in advertising that they should not be used without supervision in fluoridated communities. Fluoride dentifrices should not be swallowed and used as a source of systemic fluoride. Therefore, young children living in fluoridated and, for that matter, nonfluoridated communities should be supervised when they brush their teeth. Increased efforts should be made to educate physicians and dentists in both fluoride-deficient and fluoridated communities about intelligently prescribing dietary fluoride supplements. These are but a few examples of what has been and can be done to avoid excessive ingestion of fluorides from sources other than drinking water.

Fluoridated water has been used successfully and safely in hundreds of U.S. communities, in some for nearly 40 years, and has reduced the prevalence of dental decay among lifetime residents by about 60 percent. More than 50 percent of our population lives in fluoridated communities. We should not risk reducing dental benefits for everyone in these communities by lowering the concentration of fluoride in drinking water.

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References

1. N. Tinanoff, R. Pinkerton, C. Ramanan, *Conn. Med.* **45**, 141 (1981).
2. S. Foman, personal communication, 8 July 1982.

Leverett's position that there may be less need for "basic research into new caries-preventative measures" is not justified. While it is true that the prevalence of dental caries has declined, the reasons are not as certain as Leverett states. At an international conference on the declining prevalence of caries held at the Forsyth Dental Center in June 1982, epidemiologists from nine countries (United States, Sweden, Denmark, Norway, the Netherlands, England, Scotland, Ireland, and New Zealand) presented data confirming a decrease in the prevalence of dental caries in their respective countries. However, none of the speakers and none of the 111 other scientists in attendance would identify the specific factors responsible for this decline, nor would they state whether the decline would continue, plateau, or reverse.

Leverett states that "caries is clearly a disease with multiple causes" but then provides a simplified discussion of a complex process. He does not mention the significant gaps in our current knowledge concerning the pathogenesis of dental caries and the effects of the fluoride ion on this disease. One can still only speculate about the mechanism of action of the fluoride ion in reducing the prevalence of caries and causing dental fluorosis. We are just beginning to understand the complex interactions between host, diet, and microflora that take place in the oral cavity and their relevance to dental caries. As yet we have no measure of the role that the increased use of antibiotics may have had in bringing about the observed decline in prevalence of the disease. Clearly, if the approach to the permanent eradication of dental caries is to be rational, much basic research still remains to be done.

One consensus of the conference at Forsyth was that the decline in prevalence of dental caries is giving rise to economic factors that will inevitably lead to a substantial reduction in the size and number of dental schools and the number of dental practitioners. If research is curtailed now, we could find ourselves in a situation in which caries prevalence begins increasing, dental manpower is inadequate, and our understanding of preventive measures is incomplete.

Leverett states that "fluorosis, even at severe levels, is of no consequence to health," yet disfiguring mottling of the teeth may be a serious psychological burden to an individual. Furthermore, if concentrations of fluoride are to be reassessed and altered, as recommended by Leverett, in order to reduce the possibility of fluorosis, these changes will alter the role that fluoride is currently playing in the reduction of caries. In either instance the availability of additional caries-preventive options will be extremely valuable.

An example of promising research that could provide new preventive options is that related to the development of a caries vaccine. Current expenditures by the National Dental Caries Program of the National Institute for Dental Research (NIDR) on research directly related to caries vaccines amount to approximately $800,000, or 8.4 percent of NIDR's caries research budget. This level of support is not consistent with Leverett's description of it as a "great deal of effort."

While few would quarrel with the research proposed by Leverett, it should not be undertaken at the expense of current caries research efforts. A more reasonable proposal would be to suggest that now is an opportune time to take advantage of progress achieved and to make a larger and more realistic investment in research.

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Leverett's article is well written, informative, and appropriate. However, I disagree with one statement in the opening paragraph related to the antiquity of dental caries. Leverett writes: "Dental caries was not prevalent in primitive societies apparently because their diets lacked easily fermentable carbohydrates."

During the past 20 years we have evaluated aboriginal human skeletal remnants from more than 4000 burials in the Upper Missouri River Basin. These burials were of people who lived between A.D. 800 and 1880 and represented multiple cultures, including the Arikara, Mandan, Hidatsa, Middle Plains Woodland, and others. Most of these people were agrarian (growing corn, beans, and squash) and hunter-gatherers. Grain foods were ground by rock.

Dental wear and attrition (probably the result of fine abrasive particles in foodstuffs), caries, tooth loss, dental abscesses, and antral-oral fistulas were prevalent in people who lived in all portions of the millennium represented (*1*). In fact, some had apparently attempted to relieve dental discomfort, presumably from incipient caries, by manipulation with crude toothpick devices (*2*).

Although these people came from only a short span in the total spectrum of mankind, they were definitely "primitive" as compared with those who live in the 20th-century United States. Because

of excellent dental care, good diet, and fluoridation, the Native Americans who live in this region today have much less of a problem with dental caries.

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References

1. W. M. Bass, D. R. Evans, R. L. Jantz, *The Leavenworth Site Cemetery: Archaeology and Physical Anthropology* (Univ. of Kansas Publ. in Anthropology, No. 2, Lawrence, 1971), pp. 184–193; J. B. Gregg, *Bull. Hist. Soc. N.D.* **32**, 3 (1965); _____, A. M. Holzhueter, J. P. Steele, S. Clifford, *Laryngoscope* **75**, 1268 (1965); J. B. Gregg, J. P. Steele, L. Zimmerman, H. Ferwerda, P. S. Gregg, *Ann. Otol. Rhinol. Laryngol.* **90**, 288 (1981); J. P. Steele, J. B. Gregg, A. M. Holzheuter, *S.D. J. Med.* **18**, 17 (1965); L. J. Zimmerman *et al.*, "The Crow Creek Site (39 BF 11) massacre: A preliminary report" (Univ. of South Dakota Archaeological Laboratory, Vermillion, 1980).
2. H. E. Berryman, D. W. Owsley, A. M. Henderson, *Am. J. Phys. Anthropol.* **50**, 209 (1979); D. H. Ubelaker, T. W. Phenice, W. M. Bass, *ibid.* **30**, 145 (1969).

The Horowitzes suggest that, instead of altering the fluoride concentration in drinking water, it would be better to educate health professionals, industry, and the general public as a means of controlling fluoride intake. My approach is different, for the very reason the Horowitzes outline: community water fluoridation is egalitarian and largely outside the conscious control of the consumers, whereas other modes of fluoride therapy are, to use the Horowitzes' words, "not so equitable." When given a choice, the prudent health promoter will opt for the preventive measures that require the least amount of conscious cooperative behavior on the part of the consumer. There is no doubt in my mind that the most reliable means for controlling the total fluoride intake of the population is through adjustment of the concentration of fluoride in the water supply.

Let me cite an example of one difficulty with the Horowitzes' approach, again picking up on a theme in their letter. In the late 1970's, infant formula manufacturers began making formulas with essentially fluoride-free water. Milk-based formulas currently contain 0.04 to 0.08 part per million (ppm) fluoride, a truly negligible amount. However, soy-based formulas contain about 0.4 ppm of bioavailable fluoride. This product, when mixed 1:1 with fluoridated drinking water, results in the consumption of about 0.6 milligram of fluoride per day by infants using the formula. This amount exceeds the threshold for causing some fluorosis [see (*24*) in my article].

As another example, television advertising for fluoridated dentifrices frequently shows a child placing an excessive amount of fluoridated dentifrice on his or her toothbrush. One commercial even shows a child licking the toothpaste off the end of the brush and commenting favorably about the taste.

Industry is not the only culprit. Inappropriate prescribing of dietary fluoride supplements by physicians and dentists in fluoridated communities is not uncommon.

My recommendation was not that we "tinker" with the fluoride levels in drinking waters. It was that we reassess our original definition in light of what we now know about total fluoride consumption. However, if this reassessment should point toward the desirability of reducing fluoride ingestion, fluoride in drinking water is a logical focus for our attention because of its accessibility, ease of control, and lack of reliance on individual human behavior.

Hein says that we need to maintain the current level of basic science research, while I believe that basic research has gotten ahead of clinical research to the extent that there is a "logjam" of basic research which has not been applied properly to the clinical milieu. The two positions are not incompatible.

Hein states that "none of the speakers [at the Forsyth Dental Center Conference on the declining prevalence of dental caries] and none of the 111 other scientists in attendance would identify the specific factors responsible for this decline [in dental caries prevalence]." This statement is at odds with the published proceedings of that conference (*1*), which include the identification by several essayists of factors that may be responsible for the decline in their particular nations or states. For instance, in Ireland, "both fluoridation and widespread use of fluoride dentifrices are cited as explanations of declining caries" (*1*, p. 1319). In the Netherlands, "the increased use of fluoride in different forms was undoubtedly a causative factor for the reduced caries experience" (*1*, p. 1324). In New Zealand, "fluoridation of water supplies and the widespread use of fluoride toothpaste are considered to be the major factors associated with the observed decline" (*1*, p. 1330). In Massachusetts, "Increased utilization of fluoride dentifrices and dietary fluoride supplements during the twenty-year period provides the most logical explanation for the observed decrease" (*1*, p. 1352). Researchers describing the same phenomenon in Denmark (*1*, p. 1309), Norway (*1*, p. 1335), Scotland (*1*, p. 1338), Sweden (*1*, p. 1344), and the United States (*1*, p. 1351) and the authors of a second study in Massachusetts (*1*, p. 1359) come to similar conclusions.

I did not state, as Hein implies, that we need to alter the level of fluoride in drinking water "in order to reduce the possibility of fluorosis." I identified the increase in dental fluorosis only as an indicator of a change in the amount of fluoride in the environment. This dental fluorosis is not "disfiguring" and is not generally discernible to the lay person.

The final paper given at the Forsyth conference was entitled "Impact of decreasing caries prevalence: Implications for dental research" by K. G. König (*1*, p. 1381) of the Netherlands. König made the following statement, which illustrates what I mean by increased emphasis on clinical research.

> The general and specific knowledge which has been accumulated by dental research in the last decades is sufficient to prevent caries completely. However, only part of the world population has had a chance to acquire this knowledge; of those who have, only a fraction is applying it successfully. Social and behavioral sciences could greatly help to disseminate knowledge about health and increase acceptance so that it will be actually practiced by more and more people.

Hein's conference at Forsyth said it best. There is a decline in dental caries throughout the developed nations. This decline is probably caused by the increased use of fluoride in several modes. Greater emphasis on clinical, applied, social, and behavioral science research is needed to enhance the dissemination of this information and to be assured that the decline will be permanent.

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References

1. *J. Dent. Res.* **61** (Special Issue), 1303 (1983).

Erratum: In the article "Understanding nonrenewable resource supply behavior" by D. R. Bohi and M. A. Toman (25 Feb., p. 927), an error appeared in figure 1 on page 929. The axis on the right-hand side of the diagram should have been labeled "Output (thousand barrels per day)."

Erratum: In the announcement of the Gordon Research Conferences by A. M. Cruickshank (4 Mar., p. 1095), under the heading "Fertilization and the Activation of Development" (p. 1108), four listings under the topic "Gamete recognition and binding II" on 2 August were incorrectly printed. They should have read, "Michael G. O'Rand, (subject to be announced); Bayard Storey, 'Reactions between sperm and zona pallucida leading to fertilization in the mouse'; Bonnie S. Dunbar, (subject to be announced); Paul Wasserman, 'Egg surface glycoproteins that regulate mammalian fertilization.' "

Under the heading "Hormone Action" (p. 1112), two listings under the topic "Prolactin" on 9 August were incorrectly printed, and one was omitted. They should have read, "Henry Friesen, 'Prolactin receptors'; Paul Kelly, 'Second messenger for prolactin'; Jeffrey Rosen, 'Prolactin regulation of casein genes.' "