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SCIENCE & HUMANITY

DEPARTMENTS: Research in America • The Research Frontier • Letters

ARTICLE: • A Poet's Investigation of Science

RESEARCH IN AMERICA

THE REAL DANGER IN FLUORIDATED WATER

"COME, let us reason together." The words are from the eighth verse of the First Book of Isaiah, and are reputed to be the favorite quotation of the new President of the United States of America, Hon. Lyndon B. Johnson.

The moment is appropriate to accept the advice. Let us reason together here about a corrosive contradiction that exists between American science and American democracy as President Johnson enters office.

Abroad, we proclaim our dedication to the protection and nourishment of the free individual.

At home, we too often discourage the exercise of individual responsibility, without which freedom cannot possibly survive.

An outrageous example is the current drive by the U. S. Public Health Service to force fluoridation of public water supplies throughout the country.

Is there any scientific justification for this campaign, which involves construction of otherwise useless buildings and machinery (more than half a million dollars of initial investment in New York City alone, plus more than three fourths of a million annual maintenance thereafter) at the expense of local taxpayers?

All that has been said in explanation is that when small amounts of fluoride are added to drinking water (larger amounts are fatal) they enhance the resistance of small children to tooth decay.

Small children constitute perhaps one quarter of the population.

Older children and adults, who make up the remaining three-fourths of the populace, receive no benefit whatever from fluoridated water.

Fluorides are available in the form of pills which could be dissolved in the drinking water of children whose parents so desired.

There is, therefore, no need to force all the people to drink chemicals in order to protect the teeth of susceptible young children.

Although most dentists that SR's science editor has talked to about it are opposed to fluoridation, the American Dental Association regularly issues from its national headquarters in Chicago a periodical printed on polished sheets and devoted exclusively to zealous evangelism for the fluoride cause.

Fluoridation Reporter, this paper is called. Most of its text consists of ridicule of opponents of fluoridation. Objections to the addition of fluorides to drinking water are invariably equated with ignorance, bigotry, superstition and emotionalism. Yet the arguments presented in favor of fluoridation read like advertising blurbs for a popularity contest. Their sole appeal is the emotional appeal of the bandwagon. A running record is kept of cities and towns where fluoridation has been adopted (45,000,000 people live in them, compared to 128,000,000 who somehow struggle along without fluorides), and citizens outside those extolled precincts are urged to fluoridate as though their lives depended on the action.

A PERSON hunting for objective scientific research on fluoridation's benefits and dangers finds few unequivocal, rigorously controlled experiments to enlighten him. In twenty hours of public hearings on fluoridation in New York City this year, for example, distinguished physicians warned that broadcast of fluorides through public drinking water would endanger unknown numbers of individuals. These cautions were hooted as scarestuff. The hooters testified that 1 to 1.2 parts of fluoride in a million parts of water would be safe in northern states, and 0.7 to 0.8 parts of fluoride in a million parts of water would be safe in southern states. The lower amounts prescribed for the south were attributed to warmer temperatures in the south which cause most people there to drink more water than most people drink in the north. No one seemed to see that individual northerners who drink more water than other northerners might be subject to the same risks that southerners would be subject to if they were to ingest 1 to 1.2 parts of fluoride per million parts of water.

When one public official testified that crustation and accumulation of fluorides would be bound to occur at various points in New York's 5,700-mile system of water pipes, another official replied that "fluorides can be injected accurately into the city water supply system"—as though that answered the problem that the first official had pointed out.

Fluoridation Reporter often cites, as an endorsement of fluoridation's safety and desirability, the fact that twenty communities which once adopted fluoridation and then abandoned it have since resumed the practice. As for the eighty-three other communities which also tried fluoridation, abandoned it, and since have refused to go back to it, *Fluoridation Reporter* leaves the impression that all their residents are weak minded.

IN THE midst of this emotional binge, one solid argument for fluoridation is offered without contradiction: Dental decay in America today is more widespread than ever before.

But the spread of tooth decay cannot be traced to influences with which public health measures are usually concerned. Tooth decay is not contagious; it is not a communicable disease.

The rise of tooth decay is a simple matter of population arithmetic. There are more people in America today than ever before; hence there are more teeth. It would be remarkable if there were not more decayed teeth.

As a result, there aren't enough dentists to go around. The obvious solution to that problem is to train more dentists —not to pour chemicals indiscriminately down the throats of those who need dentistry and those who don't.

Since our society depends on individual responsibility, should it not encourage the simple act of tooth brushing?

Must those who do clean their teeth be coerced into drinking daily doses of potentially dangerous chemicals for the sake of those who are too lazy to be clean?

It cannot reasonably be argued that fluoridated water would protect those who are too poor to protect themselves. Tooth pastes and powders are cheap, and are not essential to dental cleanliness in any case. Ordinary table salt, vigorously rubbed, by the bare fingers if a brush isn't available, is eminently effective, as every dentist knows.

Whether the dental profession prefers to abandon its accustomed prerogatives to the fluoride manufacturers, as the medical profession has abdicated much of its responsibility to the drug makers, is a decision for the dentists to make. But whether the U. S. Public Health Service should be pushing the sale of chemicals for purposes clearly not vital to public health is a matter for the U. S. Congress to examine.

The select committee of the U. S. House of Representatives which is now engaged in a broad inquiry into public expenditures for scientific activity might profitably put the question of the U.S.P.H.S. involvement in fluorides on the public hearing agenda. There must be thousands of ignorant, bigoted, superstitious and emotion-ridden Americans who would welcome an opportunity to second the late President John F. Kennedy's proud proclamation to the United Nations General Assembly in September 1963: "We believe . . . that freedom is more enduring than coercion."

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AS Vice President, Mr. Johnson was deeply committed personally to technological spectaculars—moon rockets, an airplane that would fly faster than sound, oil drilling rigs that would float on the surface of the sea and penetrate the crust of the earth on the ocean bottom into the planet's mantle below. Misnamed Big Science, these engineering projects ate big money; he was counted on to guarantee the bills; and, until recently, he usually found the political means to comply.

Although the budget for 1964 has already been hammered into roughly final shape, President Johnson still has time to impress his preferences in particular directions. As President, however, speaking with the voice of the whole people, he will feel constraints that he did not feel as spokesman for Texas and the South. He will be more affected by the great majority of the scientific community that fears neglect of lonely thinkers (source of most notable discoveries of the past) and therefore resents lavish expenditure of time and money on titanic instruments. Opponents to "prestige" spectaculars will be bolder, having before them the encouragement of such incidents as Assistant Commerce Secretary Herbert Hollomon's junking of an unworkable weather satellite in defiance of the wishes of the National Aeronautics and Space Administration.

Just before President Kennedy's assassination, Dr. Philip Abelson, editor of *Science*, journal of the American Association for the Advancement of Science, openly accused the White House Office for Science and Technology of undue secrecy in the handling of priorities for tax-subsidized research. How the priority system—if there is such a system—actually works is the subject of the previously mentioned House investigation.

Criticism of the *status quo* is popping up everywhere, and increasing numbers of scientists are conceding a degree of responsibility to society which they were reluctant to concede before; and they are groping for *modus operandi* through which to carry out the obligation.

Dr. Alvin Weinberg, of the Oak Ridge Tenn. installation of the Atomic Energy Commission, has published a major proposal in *Minerva*. It goes as follows:

"As science grows, its demands on our society's resources grow. It seems inevitable that science's demands will eventually be limited by what society can allocate to it. We shall then have to make choices. These choices are of two kinds. We shall have to choose among different, often incommensurable, fields of science—between, for example, high-energy physics and oceanography or between molecular biology and science of metals. We shall also have to choose among the different institutions that receive support for science from the government—among universities, governtal laboratories and industry. The first choice I call scientific choice; the second, institutional choice. My purpose is to suggest criteria for making scientific choices—to formulate a scale of values which might help establish priorities among scientific fields whose only common characteristic is that they all derive support from the government.

"Choices of this sort are made at every level both in science and in government. The individual scientist must decide what science to do, what not to do: the totality of such judgments makes up his scientific taste. The research director must choose which projects to push, which to kill. The government administrator must decide not only which efforts to support; he must also decide whether to do a piece of work in a university, a national laboratory, or an industrial laboratory. The sum of such separate decisions determines our policy as a whole. I shall be concerned mainly with the broadest scientific choices: how should government decide between very large fields of science, particularly between different branches of basic science? The equally important question of how government should allocate its support for basic research among industry, governmental laboratories, and universities will not be discussed here.

"Most of us like to be loved; we hate to make choices, since a real choice alienates the party that loses. If one is rich—more accurately, if one is growing richer—choices can be avoided. Every administrator knows that his job is obviously unpleasant only when his budget has been cut. Thus the urgency for making scientific or institutional choices has in the main been ignored both in the United States and elsewhere because the science budget has been expanding so rapidly: the United States government spent $1,600,000,000 on research and development in 1950, $9,000,000,000 in 1960, $14,000,000,000 (including space) in 1962.

"Though almost all agree that choices will eventually have to be made, some well-informed observers insist that the time for making the choices is far in the future. Their arguments against making explicit choices have several main threads. Perhaps most central is the ar-

gument that since we do not make explicit choices about anything else, there is no reason why we should make them in science. Since we do not explicitly choose between support for farm prices and support for schools, or between highways and foreign aid, why should we single out science as the guinea pig for trying to make choices? The total public activity of our society has always resulted from countervailing pressures, exerted by various groups representing professional specialties, or local interests, or concern for the public interest. The combination that emerges as our Federal budget is not arrived at by the systematic application of a set of criteria: even the highest level of authority in the United States, the President, who must weigh conflicting interests in the scale of the public interest, is limited in the degree to which he can impose an overall judgment by the sheer size of the budget if by nothing else. But because we have always arrived at an allocation by the free play of countervailing pressures this does not mean that such free interplay is the best or the only way to make choices. In any case, even if our choices remain largely implicit rather than explicit, they will be more reasonable if persons at every level, representing every pressure group, try to understand the larger issues and try to mitigate sectional self-interest with concern for broader issues. The idea of conflicting and biased claims being adjudicated at one fell swoop by an all-knowing supreme tribunal is a myth. It is much better that the choices be decentralised and that they reflect the concern for the larger interest. For this reason alone philosophic debate on the problems of scientific choice should lead to a more rational allocation. . . .

"A second thread in the argument of those who refuse to face the problem of scientific choice is that we waste so much on trivialities—on smoking, on advertising, on gambling—that it is silly to worry about expenditures of the same scale on what is obviously a more useful social objective—the increase of scientific knowledge. A variant of this argument is that with so much unused steel capacity or so many unemployed, we cannot rightly argue that we cannot afford a big cyclotron or a large manned-space venture.

"Against these arguments we would present the following considerations on behalf of a rational scientific policy. At any given instant, only a certain fraction of our society's resources goes to science. To insist or imply that the *summum bonum* of our society is the pursuit of science and that therefore all other activities of the society are secondary to science—that unused capacity in the steel mills should go to 'Big Science' rather than a large-scale housing program—is a view that might appeal strongly to the scientific community. It is hardly likely to appeal so strongly to the much larger part of society that elects the members of the legislature, and to whom, in all probability, good houses are more important than good science. Thus as a practical matter we cannot really evade the problem of scientific choice. If those actively engaged in science do not make choices, they will be made anyhow by the Congressional Appropriations Committees and by the Bureau of the Budget, or corresponding bodies in other governments. Moreover, and perhaps more immediately, even if we are not limited by money, we shall be limited by the availability of truly competent men. There is already evidence that our ratio of money to men in science is too high, and that in some parts of science we have gone further more quickly than the number of really competent men can justify.

"Our scientific and governmental communities have evolved institutional and other devices for coping with broad issues of scientific choice. The most important institutional device in the United States is the President's Science Advisory Committee, with its panels and its staff in the Office of Science and Technology. This body and its panels help the Bureau of the Budget to decide what is to be supported and what is not to be supported. The panel system, however, suffers from a serious weakness. Panels usually consist of specialised experts who inevitably share the same enthusiasms and passions. To the expert in oceanography or in high energy physics, nothing seems quite as important as oceanography or high energy physics. The panel, when recommending a program in a field in which all its members are interested, invariably argues for better treatment in the field—more money, more people, more training. The panel system is weak insofar as judge, jury, plaintiff and defendant are usually one and the same.

"The panel is able to judge how competently a proposed piece of research is likely to be carried out: its members are all experts and are likely to know who are the good research workers in the field. But just because the panel is composed of experts, who hold parochial viewpoints, the panel is much less able to place the proposal in a broader perspective and to say whether the research proposal is of much interest to the rest of science. We can answer the question 'how' within a given frame of reference; it is impossible to answer 'why' within the same frame of reference. It would therefore seem that the panel system could be improved if representatives, not only of the field being judged but also representatives of neighboring fields, sat on every panel judging the merits of a research proposal. A panel judging high energy physics should have some people from low energy physics; a panel judging low energy physics should have some people from nuclear energy; a panel judging nuclear energy should have some people from conventional energy; and so on. I should think that advice from panels so constituted would be tempered by concern for larger issues. . . ."

One improvement on the panel mechanism suggested by Dr. Weinberg comes immediately to mind. The panels might include not only scientists but a certain number of non-scientists. And the non-scientists should not all be chosen because they are "friends" of science. The voice of an occasional sharp critic could have a salutary effect.

—John Lear,
Science Editor.

THE RESEARCH FRONTIER

WHERE IS SCIENCE TAKING US?

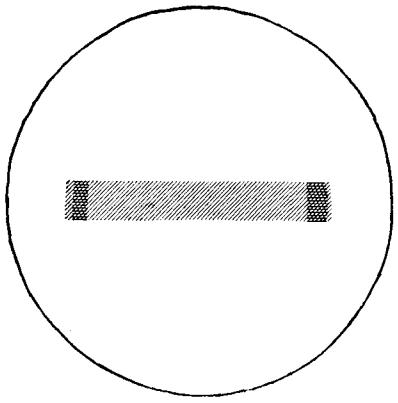
Much now depends on the disposal that will be made of the late President John F. Kennedy's political legacy. One crucial item is his proposal to plan a joint expedition to the moon with the Russians. Some of the practical reasons for such a scheme are just coming into the public ken.

The telescopic maps on this and the opposite page tell a disconcerting story of how much remains to be done before a moon trip can be considered.

Because of fuel limitations of the rockets that will orbit the moon and lower a ferryboat to the lunar surface, moon landings must be held within 5 degrees north and south of the moon's equator and within 45 degrees east and west of the moon's central meridian (see shaded strip in sketch immediately below). Within this narrow zone of safety, flat lands must be found to receive the spaceships from earth. Two such possibilities have been chosen randomly here, one near either end of the restricted strip (see cross-barred sections in the sketch below).

Note that the possible landing site in the west (the two columns immediately to the right, on this page, show an enlarged view of it) has much flatness but is hard to hit because the moon moves rapidly westward during the spaceships' approach. The eastern landing possibility (see opposite page for its topographical details) is easier to reach but hemmed by rugged terrain.

No American robot explorer has yet succeeded in getting to the moon. Until one does, scientists cannot tell whether the lunar surface is packed hard, porous, or buried deep in dust.



—Doug Anderson, after maps by Aeronautical Chart and Information Center (U.S.A.F.)