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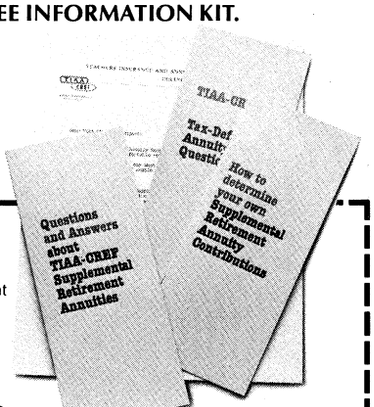


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# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

**REPORTS**





**COVER**

Nearly cloud-free view of Vatnajökull ice cap, which covers about 8400 square kilometers at 64°30′N along the southeastern coast of Iceland. Landsat image shows the extent of snow- and ice-free ground on 22 September 1973. See page 943. [R. S. Williams, Jr., U.S. Geological Survey, Reston, Virginia]

## LETTERS

### History of Science: Perceptions

Several statements in the report of my lecture on history of science at the AAAS annual meeting (News and Comment, 25 Jan., p. 389) require correction. A slip of memory evidently led me to call Otto Hahn's collaborator Strassner instead of Strassmann. More important, the organizer of the colloquium "Do scientists have blood on their hands?," who was not known to me, has since persuaded me that my perception of the tenor of the principal presentation was unduly affected by the provocative choice of words for the title from Robert Oppenheimer's famous statement to Truman.

The presentation was by a serious historian specializing in the political role of science in the early atomic age; and I was at fault in stating that no one present was knowledgeable about the technical aspects of nuclear weapons. Actually, several physicists and others knowledgeable about these issues were in the room, and it was inappropriate to cite the occasion to illustrate the proposition that judgments about the political morality of decisions to develop and employ atomic weapons have too often been uninformed with respect to the precise technical prospects at critical junctures.

The final point concerns the reporting of my lecture. I did not intend to leave the impression that personality has no place in the history of science. My view is the contrary, and I believe I observed that even scientists, when they take any interest at all in the history of science, are likely to fasten on minor matters of gossip or scandal instead of on content.


CHARLES C. GILLISPIE
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One would never guess from Gillispie's lecture at the AAAS annual meeting or from William J. Broad's account of it that the history of science is in a period of intellectual excitement and growth unmatched since the 1930's. Historians of science are reaching out to new problems and methods. They are learning ways of analyzing the creative process and the diffusion of ideas as social processes. With historians of technology and medicine they are analyzing the two-way interaction between basic research and practice. Joined by recruits from general history and the social sciences, historians of science are finding wider audiences in these allied disciplines. Especially for those who, like myself,

came to history from careers in science, the past decade has been one of enormous intellectual refreshment and progress. The history of science is flourishing and growing in an otherwise depressed academic market.

Of what, then, is Gillispie complaining? He alleges that standards of scholarship are declining. I disagree. There are *different* standards now from those of a generation past; but not inferior standards—quite the contrary. There is just no question that standards of scholarship, sophistication in the use of archives, and standards of intellectual significance are much higher now than they were a decade ago; and they continue to improve, markedly among younger historians. The "decline of standards" is an old trick. A century ago the defenders of compulsory Greek cried "declining standards" to prevent the invasion of college curricula by the experimental sciences. This kind of argument may be good politics, but it is not good policy or good history.

Gillispie warns that the new historians of science are undermining the authority and public support of science by talking about scientist-entrepreneurs and scientist-politicians. I think the real danger is misplaced idealism. Can we really doubt in 1980 that the health of science depends on scientists' entrepreneurial and political skills? Is it wise to base public support for science on a false image of scientists as apolitical, isolated intellects and truth-seekers? To do so is to court disaster, for when the inevitable disillusionment comes it will indeed breed disrespect and cynicism. Historians and sociologists of science must contribute to an honest and realistic picture of the scientific enterprise as a social institution, not different in any fundamental way from other economic, cultural, or political institutions. To counsel historians to put scientists back in an imagined ivory tower is a great disservice both to the history of science and to science itself.

ROBERT E. KOHLER
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## Occupational Lead Exposure and Cancer

Recent issues of *Science* have contained comments (*1*) on the role of occupational and environmental factors in cancer causation and of epidemiology in identifying such associations. In light of this interest, we present here a reevaluation of data previously interpreted as supporting the noncarcinogenicity in humans of lead, one of the most ubiquitous substances in the environment.

In 1975, Cooper and Gaffey (*2*) reported on a cohort of 7032 men employed from 1946 through 1970 for one or more years in lead production facilities or battery plants. The stated objective of the study was to determine the mortality patterns of "individuals whose levels of lead absorption were below those associated with plumbism, but above those regarded as normal in the general population." Data on actual airborne lead concentrations were reported not to be available. Employment histories of cohort members were obtained from company records. Vital status was determined through December 1970 for all but 2 percent of the smelter workers and 5 percent of the battery plant workers. For 18 smelter workers and 71 battery plant workers who had died, but for whom death certificates were not obtained, the distribution of individual causes of death was assumed to be the same as for individuals whose certificates had been obtained. Expected numbers of deaths were determined on the basis of rates from the U.S. male population. Standardized mortality ratios (SMR's) were calculated as 100 times the ratio of observed to expected deaths. Statistical significance of the SMR was determined by first calculating the standard error (S.E.) of each SMR with the technique developed by Chin Long Chiang (*3*). If an SMR deviated from 100 by more than

$$z_{(1-\alpha/2)} \times \text{S.E.}$$

it was interpreted as significant at the $100\alpha$ percent level.

The SMR for all causes was 107 for smelter workers and 99 for battery workers. According to Cooper and Gaffey (*2*), deaths from all malignant neoplasms were excessive in smelter workers (69 observed versus 54.95 expected, $P < .05$), but not in battery plant workers (186 observed versus 180.34 expected). An excessive, although not statistically significant, number of deaths resulting from cancer of the digestive organs and of the respiratory system were reported among both smelter and battery plant workers.

In the study by Cooper and Gaffey it appears to us that there are errors in the way they determined statistical significance. First, according to Armitage (*4*) the formula for the S.E. of SMR should read $\text{S.E.} = \sqrt{100 \times \text{SMR/expected}}$, rather than $\text{S.E.} = 100 \times \text{SMR/expected}$,

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# The Oil Price Spiral

Recent events, coupled with those of the last several years, point toward three conclusions:

- Supplies of Middle Eastern oil are subject to sudden interruption.
- Excessive dependence on such oil invites World War III.
- The oil cartel could easily further sharply increase its revenues while cutting production.

Any one of these considerations should be sufficiently persuasive to induce the consuming nations to seek to limit dependence on imported oil. In practice, the most effective goad is likely to be high prices. Past experience indicates that the limit on what OPEC can charge has not yet been reached. A small shortfall of supplies can lead to a great increase in price. In 1973 and 1974, production of oil in the free world was cut by 10 percent. A quadrupling of the price of oil followed quickly. The revolution in Iran led to a decrease in production there, but increases elsewhere held the drop to about 5 percent. This shortfall gave rise to a doubling of the price of oil. Imports by the developed countries have been little affected by the doubling, although at the moment there is a softening of prices on the spot market.

It is obvious that OPEC could extract much more money from the consumers while extracting less oil from the earth. The questions become: When will the next major squeeze occur, and how high will the price go? Any estimate is a wild guess, but a further doubling could occur within a year.

Price increases might be avoided if demand for oil were curtailed substantially. For the short term, this could be achieved by drastic conservation in the developed countries—for example, by gasoline rationing—but at the moment meaningful conservation seems politically unfeasible. For the longer term, prospects for cutting the use of oil are better, and one can visualize how the price spiral might eventually be brought under control through conservation and by the development of renewable energy sources. For the intermediate term, the most feasible solution is enhanced substitution of coal for oil and natural gas.

The energy potentially available in the form of coal is more than an order of magnitude greater than in oil. Important amounts of coal are present in many countries, including all the continents. Most important, the cost of thermal energy from coal is already substantially less than that from oil. In some parts of the world, the contrast is a factor of ten or more. Prospects for steadiness in the price of coal are good, and the large number of potential sources frees coal from the kind of political instability that now characterizes oil.

Quick substitution of coal is feasible in only a limited number of situations where oil had previously replaced coal. But the current contrasts in costs and uncertainties are serving as powerful incentives for exercise of ingenuity in adapting to coal. Action or lack of action by the United States will be an important factor in determining how fast substitution of coal will occur. More coal could readily be produced for both domestic and foreign consumption, but actions to implement the switch to coal have been slow.

Many foreign countries would like to obtain coal here, and delegations from France, West Germany, Japan, Spain, and Denmark have come to the United States during the last 2 months. However, concern has been expressed about the unreliability of supplies due to sudden domestic political moves and about the lack of infrastructure for experts. To make a really significant impact on world energy would require the existence of better rail transport, enlarged port facilities, and larger coal-carrying ships.

Switching toward use of coal will not be easy. However, new technology is being developed to improve the convenience and versatility of coal as a source of energy and chemicals. The United States can make many contributions to such developments. By moving resolutely this country could be crucial in helping to bring energy prices under control and in reducing dangerous tensions.—PHILIP H. ABELSON