THE AUTHOR COMMENTS: Both Dennis Willen and B. A. Syed present Israel's destruction of Osiraq, the Iraqi reactor, as a justification for the actions of Schlumberger-Doll, that is, their company's acceptance (or self-imposition) of the Arab boycott on its US research. This seems to me rather inappropriate due to the following reasons:

▶ Even if the Israeli action in Iraq were condemnable, it is irrelevant. Two wrongs do not make a right.

▶ Concerning Willen's worry about freedom of research in nuclear physics in Iraq, I quote from *The New Scientist* of 2 April 1981: "Reign of Terror sweeps Iraq's scientific community: one of Iraq's top atomic scientists, Dr. Hussain Shahristani, has been killed while in custody, *New Scientist* has learned. Shahristani's death seems to exemplify an intense wave of terror directed at intellectuals and academics—particularly scientists and engineers—in Iraq . . . " The article goes on to describe how international actions, including that of the US, could not save Shahristani. "A reliable source from Iraq's nuclear community has now told *New Scientist* that Shahristani was tortured etc., *New Scientist* has also contacted three scientists who recently managed to escape from Iraq . . . Fears for the safety of Dr. M. D. Jaffar, head of the Experimental Physics Department of the Atomic Energy Commission, who is in custody, are now growing . . ." More names are listed.

The *New Scientist* **85**, 620, and **86**, 67, also contained similar news, including a list of seven scientists and engineers executed in 1980.

Osiraq, a 70 MW reactor, could have very little to do with Iraqi research. Iraqi science may flourish some day, as it did in the days of Sumer or of the Abbassids, but that day is still far off. There is no way in which Osiraq, a highly specialized research tool, could have fitted in a valid program for the development of that fledgling scientific effort. All Osiraq could do in Iraq was to make plutonium. What for?

In his first public statement after Osiraq's destruction, Iraq's president called upon the Arabs to help Iraq in developing the Arab bomb. This was *his* answer to that question.

▶ I agree with Syed that PHYSICS TODAY should worry about persecuted or murdered physicists who are not Jewish (Sakharov isn't). I have personally tried to help indirectly in the case of Shahristani and Jaffar (the latter has just been heard from, we understand, in Canada). Has Syed tried to organize a petition in their favor? As to the Egyptian physicist who was assassinated in Paris, his murderers have not been caught. The technique resembled that of Carlos and of Black September and so forth. Israel was not implicated.

▶ This is a world where one year after Iraq openly invaded Iran and slaughtered tens of thousands in Abbadan and elsewhere, it has yet to be condemned by the United Nations or the Security Council. Syed objects to my TV appearance explaining the case for preemption. I am sorry—I abhor violence—but this was an Entebbe-like action where the lives of hundreds of thousands were at stake. I do not know of an alternative solution to that dilemma in the immediate future, though peace should provide an answer in the (very?) long run. I have discussed the issue in the *Bulletin of the Atomic Scientist*, September 1981. A more detailed presentation, "Avoiding Uncontainable Proliferation," will appear in the Proceedings of the International Symposium "The World-Wide Aspects of Nuclear War," held at Erice (Sicily) in August 1981, to be published by Plenum Press (A. Zichichi, editor).

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9/81

History of accelerators

James Leiss' "Guest Comment" on the impact of accelerators on science and technology (July, page 9) is so perceptive I hesitate to quibble over some minor points. Still, for the sake of historical accuracy. . . .

Leiss refers to Cockcroft and Walton as using the first "electrostatic" generators to produce nuclear reactions with artificially accelerated particles. Their generators were not "electrostatic" in the usually accepted use of that word; they produced their large (for that time) potential differences by brute force rectification of alternating currents from transformers. In 1930 they used two "kenotrons" (that is, large, well-insulated vacuum diodes using tungsten filaments) in series to provide 200 or 300 keV, and then in 1932 an ingenious arrangement of transformer, kenotrons, and capacitors (in what are now called voltage doublers, triplers, or quadruplers) to provide accelerating potentials of more than 700 kV.[1] The first "electrostatic" generators for accelerating particles were evolved by Van de Graaff[2] at about the same time.

Leiss goes on to ask what life would now be like if the early accelerators and their many descendants did not now exist. Among other intriguing consequences, he asserts that "Electron microscopes . . . would not exist." Cathode-ray tubes and high-voltage rectifiers were in use, in one form or another, long before certain of their components and newly developed elec-

trostatic and magnetic lenses were used in the early (circa 1930–32) electron microscopes by M. Knoll, R. Ruska, R. Rüdenberg and others.[3] To assert that modern electron microscopes (or early x-ray tubes, for that matter) are or were dependent on particle accelerators is quite misleading, rather like describing a television tube or vidicon or electrostatic dust precipitator as a "particle accelerator."

None of this, of course, detracts from the main thrust of Leiss' thesis.

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The account given by James Leiss in July prompts the following historical remarks as a guide to future public policy in the field of accelerator development.

The thousand-odd accelerators now in use in the semiconductor industry for ion implantation, to which Leiss referred, were the product entirely of the private sector, working with very limited resources. The first model of an implanter for use on a production line was made to the specifications of Mostek Corp. by Accelerators, Inc., a very small company in Austin, Texas, in 1971–72. Some of the technical problems were formidable, such as production of large ion currents using highly corrosive compounds of boron and phosphorus, and the delivery of high-current ion beams to large areas of semiconductor with excellent uniformity. The scientific staff of Accelerators, Inc., recognizing the seriousness of the problems and the national significance of what it was doing, sought support from the National Science Foundation. Eventually the problems were solved, but not a cent of support was obtained from the NSF despite the billions spent on accelerator development by it and other federal agencies.

Leiss also refers to the application of accelerators to cancer treatment and cites "studies of accelerator configurations which might be suitable for location in hospitals." It is pertinent to observe that the NSF, DOE and the National Cancer Institute have recognized the need for a hospital-compatible neutron generator for cancer treatment for fifteen years, but none has yet been developed. Development grants and contracts have been repeatedly awarded, but have been invariably made to public-sector agencies without open competition. We still do not have a machine that meets specifications. Yet a design initially proposed by Accelerators, Inc., and fully described in the literature,[1] has been repeatedly refused support by public agencies without a single technical objection ever having been given to justify rejection of the proposal.

There is no doubt that a good deal has been achieved with the billions of federal dollars spent on accelerator development and research in the last fifty years. But considering the above-cited experiences, it is far from obvious that the federal effort has been cost-effective and in accordance with traditional standards of openness and free competition in the market-place of ideas. A critical study of the management of federally funded accelerator programs seems amply warranted.

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Weapons scientists

I was very pleased to see that you published a letter from Glenn Stumpff (May, page 102) in which he defended his position as a scientist involved in the development of weapons systems. All too often the debate on military research is weakened by the reluctance of those involved to make their views public. Whether this is the result of their habitual involvement with secrecy or lack of interest, I don't know. I assume it is not because they fear that their case is weak.

However, my pleasure at seeing his letter will not prevent me from pointing out that his argument is full of holes and commenting on one failure in particular, especially since Donald McNeill also omits mention of it in his reply. Stumpff's letter could have been written (changing names of countries here and there) equally well by a Russian weapons scientist. This is important because it draws attention to the fact that Stumpff is a part of a weapons-producing system. This system incorporates the US government, the US military structure, its industrial system, its scientists and its intelligence agencies; in addition it includes the Russian government, the Russian mili-

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