letters

Questions about nuclear power plants

It appears to me that there are a number of questionable points contained both in the article by Walter H. Jordan ("Nuclear Energy: Benefits Versus Risks," May, page 32) and in the accompanying editorial.

Firstly, there seems to be, underlying Jordan's article, the implicit assumption that a geometric progression in consumer demand for electrical power is both a necessary and a desirable concomitant of modern life. I would argue to the contrary. A good fraction of the demand has been generated by the promotional efforts of the power companies, which attempt to induce the consumer to use power for luxuries in addition to the necessities. That we can not forever increase the amount of power we generate should be obvious. Even the most ideal source of electrical power is not 100% efficient. Accompanying the generation of electrical energy there is always waste heat. This heat pollutes our streams and lakes and will pollute our oceans eventually if the power output should grow limitlessly.

Secondly, the assumption that the risks associated with nuclear power generation are inherently less than those associated with either conventional power-generation techniques or with conceivable future methods such as fusion is debatable. While I would agree that the probability of a direct incident with a power reactor is very low, as Jordan argues, I think that there are some indirect hazards that have not been considered adequately. They may indeed exceed the hazards associated with present fossil-fuel plants. For example, even though the amount of radioactive material released into the biosphere may well be below the level of detectable effects in man, how do we know that these materials will not concentrate in parts of our food chains at dangerous levels? Additionally, no mention has been made of the disposal problems associated with the megacurie amounts of fission fragments that will result from complete conversion to nuclear power. Many of these isotopes are long-lived. They are not an easy sort of garbage to get rid of.

Thirdly, I would argue that present-day regulation of nuclear-power reactors is not unduly harsh. If there are any inequities, it is because the regulation of other types of power generation is too lenient. I would be in favor of increasing the stringency of the latter, rather than reducing the stringency of the former. After all, we should recognize that very few organizations that attempt to promote the use of public resources are given the right to regulate themselves. The AEC presently has this right. Who are they to complain!

MARK H. SHAPIRO
The University of Rochester

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Jordan points out that the risks from nuclear power plants are small and argues that any environmental damage due to nuclear-generated energy should be measured against air pollution, exhaustion of fossil-fuel reserves and thermal pollution caused by fossil-fuel plants. He states that the best way to meet the country's growing need for electricity (consumption doubles every ten years) is to construct nuclear plants.

Jordan's argument is built on several assumptions I would like to examine more closely. First, he implies that the environmental damage due to nuclear power will be less than that due to fossil fuel. That may well be true, but if we decide that the environmental damage due to fossil fuel is intolerable, then the argument has taken us nowhere.

In the matter of thermal pollution, for example, nuclear plants discharge 40% more heat to cooling lakes and rivers than fossil-fuel plants per kilowatt-hour. This is because fossil-fuel plants operate at higher temperatures, making for a higher thermal efficiency, and they discharge some of their heat up the smokestacks.

Jordan mentions, and later by implication criticizes, the "intervenors" who blocked the construction of a nuclear power plant on Cayuga Lake. The intervenors—who were mainly Cornell University scientists—believed that the plant's thermal waste would extend the lake's growing season, thereby speeding up the ageing process. It's only a guess, but I think that same group would have opposed a fossil-fuel plant on that lake on the grounds of thermal pollution, air pollution and possible accidental oil discharges.

The fact that both types of plants may well be unacceptable leads to Jordan's second assumption: that America's exponential growth in electric power consumption must be met. My own feeling is that it would be far more profitable to examine the basis of this growth and look for ways to reduce it than to divide into groups opposing or supporting nuclear power.

For example, the production of aluminum from ore consumes huge amounts of electricity. Should we sacrifice Cayuga Lake, as we have sacrificed so many of our lakes and rivers, so that we can litter the countryside with indestructible beer and soda cans?

Similarly, much of our electricity goes to power air-conditioners. In some cases, this has made life much pleasanter, but in many urban areas air-conditioning is a substitute for well built, insulated homes and for pleasant surroundings. City dwellers, especially, often use the air-conditioner as a defense against street noise, heat thrown off by traffic and other air-conditioners, and breezeless urban canyons. Manhattan, for example, is an island, but few stroll along its surrounding rivers because these rivers are fronted by highways and electric power plants. The highways allow them to escape to an ever-shrinking countryside and the power plants make tolerable the time they must spend in their homes.

It seems quite clear that any debate on the relative merits of fossil fuel and

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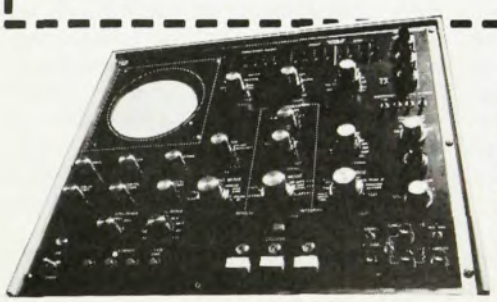

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nuclear fuel must be preceeded by a searching examination of the need for this electricity. While partly a sociological and economic question, it is also a problem for physicists. We have the tools and—hopefully—the imagination to find ways of making a better life without further damaging the environment.

EDWIN H. MARSTON
Queens College
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The interesting article by Walter Jordan, touting the advantages of nuclear power generation from an antipollution point of view, does not discuss at all what I have considered the worst problem in this regard, namely the disposal of spent fuel waste. Is the recycling of this material now so complete that radioactive waste disposal is not longer a problem? If not, it is unfortunate that such a serious possible source of pollution by nuclear power plants was not included in Jordan's discussion.

JAMES B. CONKLIN, JR
University of Florida
Gainesville, Fla.

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Walter H. Jordan argues eloquently for nuclear power as "a virtually inexhaustible supply of cheap electricity" and "a chance to clean up the environment." Then he adds a "third major benefit—the myriad uses of radioisotopes."

The radioisotopes used in industry, medicine and science constitute an infinitesimal fraction of the amounts produced as waste in power reactors. The demand for such isotopes for many years to come can easily be met by small research reactors and accelerators.

To cite this as a benefit of big power stations is like a machine-tool salesman saying: "This computer-controlled, ten-ton punch press is also useful for cracking eggs."

VAN V. TRUMBULL
Washington, D.C.

THE AUTHOR COMMENTS: Both Shapiro and Marston are properly concerned with the increasing consumer demand for electricity, and I agree that there must be a leveling off in this century. But even if we were to achieve zero population growth, which won't be soon, the demands of the have-nots for a living standard approaching that of physics professors will require much more power than we produce today. I see no reasonable alternative to building power stations to supply that demand. Neither would I sacrifice our lakes and rivers to thermal pollution from nuclear or fossil-fuel stations. The "National Environmental Policy Act" of 1969, (Public Law 91-190) and the "Water Quality Improvement Act of 1970," (Public Law 91-224) will require the utilities to add cooling ponds or cooling towers as needed to control thermal pollution. In some cases the waste heat can be used beneficially to heat or air-condition a city—or grow fish or farm crops under glass all year round. Although the power companies (not the AEC) complain about the lengthy and tedious licensing procedures for nuclear plants, I agree with Shapiro that, irrespective of the type of plant, it shouldn't be easy for any industry to get a license to pollute.

Concerning Shapiro's second point, I will leave the comparison of the risks of fission power plants with fusion power plants to some scientist of the next century; I am concerned with the power plants to be built in this decade. My thesis is that meeting that demand with nuclear power plants presents less risk than the other alternatives. The point concerning the concentration of radioisotopes in the food chain is a valid one, for it does happen. The limits on ^{131}I, for example, are set chiefly by deposition of iodine on grass, which is eaten by cows that produce milk that is drunk by children who concentrate the iodine in their thyroid glands. A large number of ecologists at Oak Ridge and Hanford have been investigating all such pathways, and the results are taken into account in setting the effluent standards.

Conklin and Shapiro point out that I slighted the topic of disposal of high-level wastes. There surely is some risk, particularly with tank storage as practiced currently. However, I hope that very shortly all of the liquid wastes will be converted to glassy solids and stored in some dry geologic structure, such as a salt mine, where water never flows. It has been demonstrated to be practical and economical. It would be very expensive, but not necessarily prohibitively so, to rocket the wastes to the sun.

As for Trumbull's objection, I stated

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in my article that "Research reactors and cyclotrons supply most of the medical isotopes." But the kilocurie isotopic sources such as the ^{68}Co units in hospitals, the $^{13}_{7}$Cs units for x-raying welds, or the ^{98}Sr power supply that was left on the moon are the product of high-powered reactors. Even so, Trumbull could make a good argument that the more important needs could be met by small research reactors and accelerators.

W. H. JORDAN
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Multidisciplinary groups

The symposium on Solid-State Physics, Science and Technology at the Dallas APS meeting this spring was enlightening for many academic physicists and gratifying for those physicists with industrial experience. The continuum of problems encountered in practice has required industrial solid-state physicists to make contact with metallurgy, ceramics and chemistry. Indeed, it was partly the success of such broad effort in materials science that led the Advanced Research Projects Agency to establish interdisciplinary laboratories at universities. However, the actual result of such establishment has been primarily to provide more research space for the traditional departments without fostering the kind of interaction that was expected. Hence even the new PhD in solid-state physics who has done a thesis in an interdisciplinary lab probably is not emotionally or intellectually prepared to make the contributions needed to solve the problems of interest in metallurgy, ceramics and chemistry.

Another approach, which was mentioned by John Bardeen in his speech at the symposium, is the joint appointment in physics and a related department. A professor in such a position is expected to develop a multidisciplinary group. In my case, for example, the group includes two graduate students in physics, two in ceramics and one in metallurgy, plus a postdoc in physics. The members of such a group acquire great regard for the expertise found in the other disciplines represented. They also learn some of the theoretical and experimental techniques and the ways of dealing with problems popular in these disciplines but perhaps novel to an outside student. In brief, all the benefits that were supposed to be realized in the "interdisciplinary" laboratory as an institution can, in fact, be realized much more readily in a single multidisciplinary group.

Not only does the multidisciplinary group arrangement benefit the students, it also stimulates the professor to address himself to problems in related areas that he might not have considered from a location in a single department.

Furthermore, a solid-state physics professor in such a role can use a large part of his research-direction effort on students in engineering departments who are in greater industrial demand than are PhD physicists. Thus he can practice solid-state science vigorously without adding to the overpopulation problem in physics.

In some universities, joint appointments are rare. Nevertheless, the multidisciplinary group could be developed around a given professor, attached to a single department, with the consent of the other departments involved. This can be politically awkward, however, while the joint professorship provides a ready mechanism for the initiation of such a group.

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Unfair to Senator Mansfield

The editorial in the February PHYSICS TODAY, "Hold That Meat Axe," was I think quite unfair to Senator Mansfield. On 20 March 1970 Senator Mansfield is quoted in *The Congressional Record:* "The Federal contribution to scientific inquiry should not be diminished by force of Section 203. If it is, it is because of ineptness at the interagency level." Later in the same speech he says: "A laissez-faire attitude is not justified in the implementation of a sound national science policy. This is not the time for benign neglect when it comes to this Nation's research and scientific efforts."

The portion of Senator Mansfield's speech you quote, *The Congressional Record*, 6 November 1969, has been distorted. The question raised was whether the Congress should vote "to sustain the overall level of academic research . . . or as a matter of national policy to reduce the overall level." The word used is "reduce" not "eliminate" as you used in reply to Orear's letter. In short, Senator Mansfield did not in any way suggest cutting $250 million in research support.

In the very speech from which you quote, Senator Mansfield repeated an excerpt from a speech by Lee A. DuBridge: "As long as science is the stepchild of the military, it will suffer in dignity; it will suffer through lack of assurance of long-term support; it will be under pressure to yield practical results . . ." This is indeed a relevant excerpt from a prophetic speech of 20 years ago.

In a letter to me Senator Mansfield states: "At no time did I demand immediate termination of projects that might not be found to comply with the