letters

ummer 1955 had showed interest in antiprotons. One of them, composed of most competent people, used several Cerenkov counters but not the method of the time of flight over the entire allowed length of the double spectrometer. This seems to show both the competence of the team and the non-triviality of the original plans.

ORESTE PICCIONI
University of California, San Diego
La Jolla

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It has been a long time in coming but the event should surely be no surprise to anyone. The suit brought by Oreste Piccioni against Emilio Segrè and Owen Chamberlain (September, page 69) is a natural consequence of "Big Physics" where a few people have control over the expenditure of large sums.

In saying this I imply nothing about the validity of Piccioni's charges. However, from my experience with a high-energy experimental group I would certainly agree with Clyde Wiegand's view that such experiments do indeed "grow" and, I might add, usually have their roots well disseminated. For this very reason it is no service to physics to single out one or two individuals and give to them what amounts, in the case of the Nobel award, to entire credit for a collective achievement.

R. B. THOMAS, JR
Lockheed Research Laboratory
Palo Alto, California

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Leonard Weisberg asks (September, page 13) why so much passion is raised over "unorthodox" scientific theories. Just as the politician wraps himself in the flag and accuses all who disagree with him as being un-American, the scientist wraps himself in phrases such as "(lack of) causative basis for his ideas" and accuses others of being unscientific. The answer is "vested interests."

That this is so is evidenced in these columns by the complaints concerning reviewing for publications. Almost no one will disagree that it is an adversary process, and yet no reviewer will disqualify himself as one having a conflict of interest. In fact, the editor's choice of reviewer insures that just such a situation occurs. The problem is further compounded by the fact that one never really knows who his adversary is. We do not accept this kind of process in other aspects of our lives, but acquiesce to it in our scientific lives. The system works when an idea agrees with the adversary's interests, but breaks down when the idea is "unorthodox."

Sometimes, when one is fortunate, one gets a very unusual adversary who is secure in his own right, and a new idea is exposed for consideration. However, to depend on such a chance encounter is disheartening for the author and self-defeating for science. I agree with Alfred Landé (May 1971, page 68) that the reviewing process "is inadmissible censorship when one or even three referees try to block an article as incompetent when their own private but precious standpoint differs from that of the author . . ."

Until the system is changed, I feel that Oreste Piccioni is doing a service for science at large (September, page 69) when he demands a hearing outside an arena of possible conflicts of interest. I know nothing about the case, but I do agree most heartily with his statement "I think it's high time that physicists understand that the basic rules of morality are not for them to create because they have been already created and experimented with by the rest of humanity, which by and large is not made of lower animals than physicists."

HAROLD A. PAPAZIAN
Littleton, Colorado

Future energy needs

In the article by Floyd Culler and William Harms on breeder reactors (May, page 28), figure 1 estimates that the energy "needs" for the US in the year 2000 will exceed the 1970 level by a factor of 6.3. By contrast, the present rate of population increase is about 1% per year, or 35% in 30 years. For what conceivable reason can 35% more people "need" 630% more electrical energy? Even today, much of our electrical power is used for luxuries—neon signs in the daytime, air conditioners in the winter, aluminum (rather than steel) beer cans to litter the roadsides, inefficient home heating by electricity. Does each of us really need five times more of that?

Economists tell us that demand, supply and price of any product or service are closely related. The price of electricity (including tax on its use) is wholly controlled by government agencies, and these agencies therefore have the power to lower (or raise) the demand to any desired level, simply by raising (or lowering) prices and taxes. Even a small increase in the cost of power would direct consumers' demand away from electrical gadgets towards goods less noxious to our environment; conversely, if a five-fold per-capita increase in power consumption does occur, it will be the consequence of having fixed prices for electric power at

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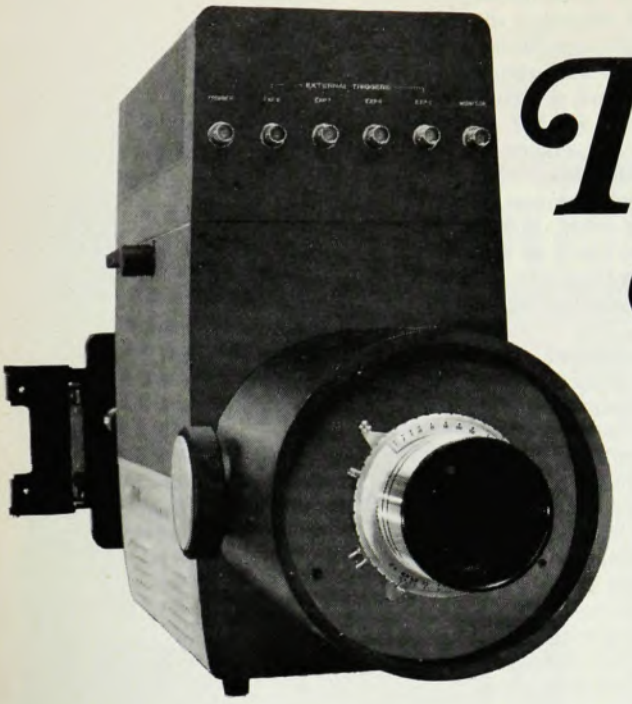

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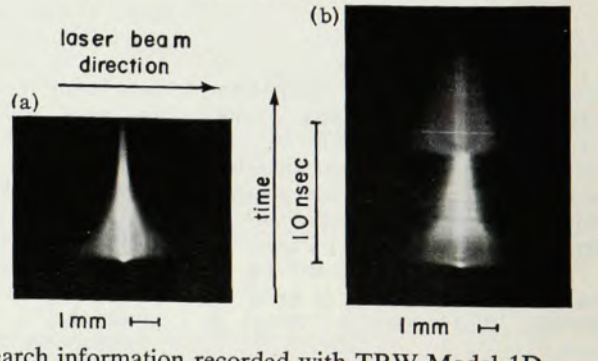

(a) Streak photograph of spark in nitrogen, at a pressure of 3300 mm Hg, produced by a single subnanosecond laser pulse. (b) Streak photograph of spark in air, at atmospheric pressure, produced by two subnanosecond laser pulses.

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an inappropriately low level.

Reasonable men can, of course, differ as to what level of power consumption should be sought to optimize the quality of life in the US. My point here is simply that the level is in no sense preordained; rather, it is something we can, and should, control by public policy decisions involving pricing and taxing power production.

HERBERT B. ROSENSTOCK
Naval Research Laboratory
Washington, D. C.

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Perhaps it is to justify the AEC's costly liquid-metal fast-breeder reactor project that the article by Culler and Harms contains a number of highly debatable assumptions. The rapid price increase for uranium with increased use, and the low projected capital cost of an unproven design as well as the low operating costs for processing and disposing of ever larger stocks of highly radioactive materials, are among these [A. L. Hammond, Science **176,** 391 (1972)]. Even with such assumptions, the ore needs and the projected generating capacity curves shown do not indicate a real need for LMFBR's until the year 2000, by which time many of the extrapolations made are almost bound to be out of date.

However, the most disturbing underlying assumption is the projected electrical energy generation curve. Do we really need five times as much energy per person in the year 2000? Should we not think of how to improve the quality of life by using energy more efficiently? As physicists we pride ourselves on asking fundamental questions. The whole thesis of Culler and Harms falls flat on its face if the answer to the US energy requirements is that its growth *rate* will shortly begin to decrease.

The physics establishment may well be successful in getting billions of dollars for the LMFBR; but if the resulting reactors cannot be sold to the utility industry on a cost basis, the whole physics community will suffer the backlash.

PETER W. NEURATH
Tufts University School of Medicine
Boston, Massachusetts

THE AUTHORS COMMENT: Our projection of probable future electrical capacity was taken from AEC analyses as noted in the article. Similar estimates of growth in electrical energy have recently been made by such diverse sources as the Federal Power Commission,[1] the National Petroleum Council,[2] the Cornell–NSF Workshop,[3] and the Chase Manhattan Bank.[4] All of these estimates are based largely on extrapolations of past experience, and Rosenstock observes correctly that future consumption patterns may be altered significantly by economic and political policies.

However, the suggestion that we pick a maximum power level for the country and use pricing policy to prevent further growth seems presumptuous. It is far from clear that the price elasticity of domestically used electric power is such that a "small increase in the cost of power" would significantly affect consumer use of power for "gadgets." The "Quality of life" is an elusive concept, and it has not been demonstrated, to our knowledge, that an improvement would be obtained by shifting consumption from electricity to other goods. A more rational approach might be to reduce environmental impacts where possible and to price electricity at its full social cost (including an allowance for any remaining environmental impacts). All indications are that electrical demand would then continue to rise sharply for a number of years. Meeting such power demands is likely to require both increased emphasis on efficiency of use and the development of new energy sources such as breeders.

Studies are in progress on the factors influencing our national demand (or requirements, which is by no means the same thing) for electric power, including one here at ORNL under NSF support. Hopefully, such studies will provide the basis for public debate of these issues.

References

1. US Federal Power Commission, The 1970 National Power Survey, Dec. 1971, Part 1, page I-3-15.
2. National Petroleum Council Committee, *US Energy Outlook*, Chapter 1, pages 7, 10, 11.
3. Summary Report of the Cornell Workshop on Energy and the Environment, Print, 92nd Congress, 2nd Session, 1972.
4. The Chase Manhattan Bank, *Outlook for Energy in the United States to 1988*, June 1972.

F. L. CULLER, JR
W. O. HARMS
Oak Ridge National Laboratory

Blackbody fluctuations

In their comments on my letter (August, page 9) concerning their article "The Concept of the Photon," (March, page 38), Marlan Scully and Murray Sargent have stated that I was incorrect in claiming that the Einstein equation for fluctuations in the blackbody spectrum could be derived by semiclassical means, without reference to particle properties or a quantum character of the radiation field. In view of published work that demonstrates what I intended to claim, I as-

continued on page 79