letters

Research consortia

Kenneth Smith's comments in February (page 24) on industry–university research programs at MIT were widely discussed at The University of Tulsa. We have long been in the peculiar position of drawing more than half our research funds from industrial sponsors, mainly because the oil industry has invested heavily in petroleum engineering research at Tulsa.

Since 1968, continuing consortia have been an increasingly important means of organization. Typically, member firms pay an initiation fee plus annual dues. These funds support graduate students, pay faculty release time and purchase equipment. Each firm sends one delegate to a semiannual advisory board meeting to review progress, to advise the project director on industry priorities to be considered in selecting projects and to offer assistance on solving current technical problems. Any reports are proprietary for member firms for two years, after which they are available for publication. The four existing consortia currently have total annual funding over a million dollars. Experience with this organizational form leads me to three observations.

First, a significant inducement to attracting members is the forum provided by the semiannual advisory board meeting. It not only reduces the burden of periodic reporting to a single effort every six months, at which time all progress must be documented, but it also ensures that sponsors physically observe the experiment. Feedback is immediate and detailed. Board members observe the graduate students growing professionally as their research progresses, thus gaining an unparalleled opportunity for recruiting students trained in topics of specific interest to them. Because the companies send top technical representatives, these meetings become state-of-the-art seminars.

Second, long-term institutional commitment to a single area of study stimulates an interdisciplinary approach to research that benefits the entire scientific–engineering program of the university. In 1983, Tulsa University Artificial Lift Projects was formed to investigate questions in gas lift, sucker rod pumping, hydraulic pumping of two-phase mixtures and multiphase flows in large diameter vertical pipes. The project directors are a mathematician, Dale Doty, and a physicist. As the physicist, I contribute to experimental design, instrumentation, data analysis and fluid dynamical modeling. We feel that our areas of competence are complementary.

Finally, in a period when universities find it increasingly difficult to retain faculty, research consortia provide experimenters with contacts needed for consulting. Scrupulous care must be taken to avoid conflict of interest with the demands of either the consortium or the university.

For certain institutions, industrial–university research consortia are an attractive way to fund long-term research.

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3/84

Test ban—yes

I would like to accept Robert Barker's invitation to contribute to the nuclear-weapons test-ban debate. In both Barker's article and that of Hugh Dewitt in August (page 24), it is obvious that a nuclear weapon is not a scientific research project, but an engineering application of known scientific principles, like an automobile or a computer. In this case, we ought to think of the evolution of a nuclear-weapons design in terms of two steps: the specification of the design problem, and the designer's solution of that problem. Ideally, the specifications should come from the "consumers": the armed forces, the government and, ultimately, the people.

Historically, the government and the people have not assumed the responsiblility for determining these specifications. In the years of the Atomic Energy Commission (AEC), all of this responsibility was delegated to the

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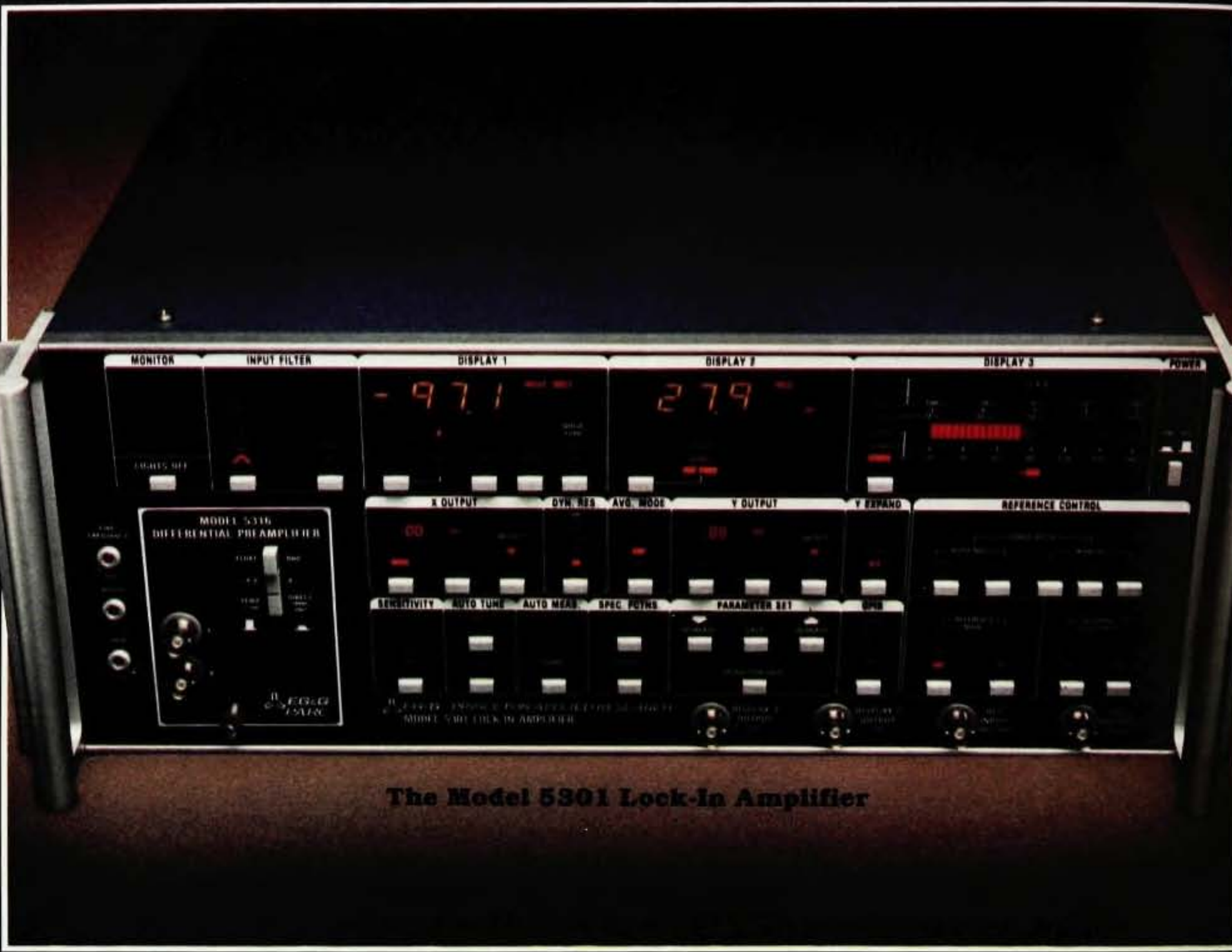

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"experts" of the AEC laboratories. This was a perpetuation of the public awe at the sudden ending of the war with Japan at Hiroshima and Nagasaki. Today, ever since the dissolution of the AEC, nuclear-weapons design specifications continue to be determined by the "experts," as described by Dewitt.

Barker's statements about "modernization" vividly illustrate that one of the highest-priority specifications imposed on the nuclear-weapons designer is that the design must fit a given "delivery vehicle," many of which undergo large accelerations and temperature changes, as well as space limitations. An extreme example is the shell of the 8-inch self-propelled cannon pictured in Dewitt's article.

These challenging specifications have been successfully met by the nuclear-weapons designers, but one must still question the relevance of their clever solutions to national security needs. We are told that the resultant designs have short stockpile lifetimes; thus constant redesign or replacement of the nuclear-weapons stockpile is required. One is reminded of the Red Queen in Lewis Carroll's "Through the Looking Glass," who ran as fast as she could just to stay in the same place. Were the highest-priority specification to be changed to long stockpile life, it could reduce the required number of nuclear tests because the replacement rate would be lowered. It would also lead to different nuclear-weapons designs that would impose specifications in the opposite direction—namely, specifications on the delivery vehicles. For example, the cannon mentioned above could be replaced by a rocket. From the viewpoint of the nation's security, the relaxation of tension due to a lower rate of nuclear testing may be worth the technical changes in the designs of the nuclear warheads and their delivery vehicles.

The adoption of a comprehensive nuclear-weapons test ban would have similar effects. The highest-priority specification would then be that the weapons design could not be tested at all. More "conservative" designs would be drawn up, and delivery vehicles would have to be modified to accommodate them, but it would still be possible to build and maintain a nuclear-weapons stockpile, despite the change to a less exciting lifestyle for nuclear-weapons designers.

History shows several examples of nuclear-weapons designs that were accomplished without benefit of prior testing. The Hiroshima bomb was not tested before it was used. The first trial of the Nagasaki bomb design, the Alamagordo test, was successful. The first hydrogen-bomb test, at Eniwetok in 1952, was successful. Furthermore, the small nation of Israel has recently convinced the world that it has built a stockpile of nuclear weapons, without testing. In addition, present-day nuclear-weapons designers have access to the results of hundreds of past nuclear tests and to more elaborate computers than their predecessors had. They should have little trouble meeting the "no nuclear test" specification.

Whoever considers the effects of a comprehensive nuclear test ban should also keep in mind the history of the atmospheric test ban, which was stimulated by the fear of fallout. It certainly led to an immediate relaxation of tension, as if people thought it was a complete cessation of tests. If a real international comprehensive test ban is achieved, it will have a similar psychological effect. However, after several years people will begin to realize that nuclear stockpiles still exist, even without testing. The permanent relaxation of tensions will have to be sought in efforts to create world-wide toleration, understanding and cooperation. It all comes back to that: In the long run, a comprehensive test ban would only be a partial gesture, not a complete banishment of the nuclear-weapons threat.

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Med school: a bitter pill

I wish to reply to Mark Nedder's letter (October, page 15) on the value of a physics education, as my own experience has been somewhat different. About 7 years ago I came to the conclusion that research opportunities in my field of elementary particle theory were virtually non-existent (you could just about count the number of new tenure-track positions opening in the field per year on the fingers of your hands, and you'd have fingers left over), so I decided to study medicine. Besides the trauma of going back to being a student at the institution where I had been a faculty member, I found that the way of thinking in clinical medicine is totally different from that in particle physics. The practice of medicine involves principally a large amount of rote memorization: The treatment for this disease is this dose of that medicine, without a necessity for a real understanding of the reasons behind it, if they are known at all. Trying to attack these problems from a problem-solving orientation does not help at all, and I have found that my training as a physicist to think in this way has proven to be a significant hindrance. This is the case even though I have chosen the specialty of radiation therapy, where I would hope that my