

which the confusion the author introduces by attempting to use the noun "man" to be sometimes male only, sometimes male and female, and sometimes female only, reaches the ludicrous. For example, the title of Table 1 reads "Range of variation in the incidence of common cancer in men (unless specified ♀)." Even the author could not accept entries for cervical, uterine or breast cancer in a table labeled "men."

If she is a council member of an AIP Member Society, she will receive mail from the Director of AIP addressed to "Councilmen" (as well as to "Chairmen").

In a very real sense, we are what we say. And what much of the scientific community appears to be saying to young women is that it is male. If this appearance is to be altered, changes in language may have to lead the way.

VERA C. RUBIN

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8/19/77 Washington, D.C.

Electron beam fusion

The news of the success of electron-beam fusion efforts at Sandia and Kurchatov reported in August (page 17) is of considerable interest to us in the Plasma Physics Division of the Naval Research Laboratory. I would like to clarify, however, the description provided of similar NRL programs. Within the NRL Plasma Technology Branch, there exist two quite distinct efforts which involve the pulsed compression of fusion plasma.

One program is concerned with the generation, transport and focussing of intense proton beams to implode thermonuclear pellets, in the manner of laser or electron-beam-initiated inertial fusion schemes. The present work, by G. Cooperstein, S. A. Goldstein, R. E. Lee, D. Mosher and S. J. Stephanakis, has concentrated on the delivery of energy to the target area, without detailed consideration, as yet, of sophisticated pellet features such as magnetic thermal insulation. (The influence of magnetic fields on particle-energy deposition in targets has been a subject of separate interest.)

The other implosion-generated fusion program (referred to in the news item as "the linear program at NRL") is actually the *liner* implosion research effort. The concept, called LINUS, involves the use of rotationally stabilized imploding cylinders, compressing plasmas in which magnetic fields provide particle containment, not merely thermal insulation. As in the proton-beam work, the present effort, by P. J. Turchi, R. L. Burton, D. L. Book, A. L. Cooper *et al.*, has involved the study of techniques for concentrating energy to achieve high energy densities.

Stable, implosion-reexpansion cycles have been generated allowing the repetitive action required for pulsed fusion-reactor systems. Separate investigations of plasma-magnetic field configurations suitable for liner compression are underway by other groups.

Both implosion efforts will eventually make use of material inertia to hold fusion plasmas at high energy density for times long enough to achieve net energy gain. In the proton-beam work, however, such times are measured in nanoseconds, while the liner systems will require tens of microseconds. The common interest in the Plasma Technology Branch that connects these two efforts is the development of high-energy-density systems, but the detailed physics is quite different.

PETER J. TURCHI

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8/22/77

In your recent news story on electron-beam fusion (August, page 17), credit for having proposed both electron thermal insulation and to a lesser degree also alpha-particle confinement, both by the magnetic self-field of the electron beam, is given to the Russians, notably Leonid Rudakov.

I do not think that this is quite correct. At a meeting of the International School of Physics "Enrico Fermi" in Varenna, Italy, I had proposed both concepts, as can be seen from the proceedings published by Academic Press in "Physics of High Energy Density." My presentation was also attended by scientists from Livermore, Los Alamos and the Soviet Union.

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8/19/77

Conserving helium

It is presently our national policy to allow *all* helium associated with natural gas to escape into the atmosphere¹ and thence irretrievably into interplanetary space. The escape from atmosphere to space is slow, so that some helium can be recovered from the atmosphere, but the energy cost of such recovery is prohibitive and rising. As alternative sources of helium we may turn to the planet Jupiter or to the Sun itself. The disadvantages of such energetically distant helium sources by comparison with earthbound natural-gas deposits are plainly evident.

The quality of our future is critically dependent upon the availability of abundant and inexpensive helium. Without it, the large-scale applications of superconductivity recently described by Brian Schwartz and Simon Foner (July, page 34) can never materialize. In par-

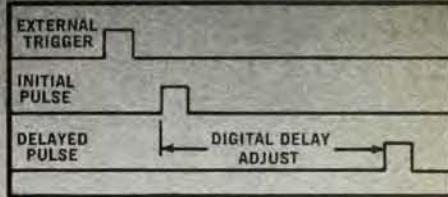
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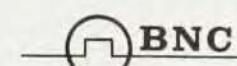
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letters

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ticular, helium shortages may forever preclude our use of high efficiency coal-fired MHD generators and superconducting transmission lines. Note that Peter Glaser, in his recent article "Solar power from satellites" (February, page 31), refers specifically to solar-powered Brayton-cycle engines using helium as their working fluid. Such engines are potentially important on Earth as well as in orbit. The near-ideality of helium gas is widely displayed in textbooks,² and the desirability of helium as the working fluid in a variety of heat-engine types (including Stirling-cycle) should therefore also be widely recognized. Helium is additionally useful as a reactor coolant, and is vital to future energy-efficient dirigible commerce.

Why is our precious helium resource being so inexcusably squandered? The previous administration and Congress have failed to recognize any connection between helium and energy. The natural-gas industry did not wish to suffer the inconvenience of helium separation and management. The government wanted to "save" the expense of supervising the natural-gas industry in these activities. Let us be specific about what this means: the government has valued little pieces of paper with numbers on them more highly than it has valued our future helium-dependent energy options. It is difficult to find historical precedents for such monstrous stupidity, though the exchange of Manhattan Island for a few beads and trinkets does come to mind.

The scientific community must educate the present administration and Congress in these matters, and prod them to action. It would be appropriate to demand that no natural gas from the newly discovered Mexican deposits³ be allowed to enter this country until provisions are made for the separation and secure storage of all helium contained in this and other natural gas.

References

1. W. D. Metz, "Helium Conservation Program: Casting it to the Winds," *Science*, Vol. 183, 11 January 1974, pages 59-63.
2. D. Halliday, R. Resnick, *Physics*, Wiley, 1966, page 531, Fig. 21-3.
3. S. T. Atlas, W. J. Cook, "Energy: A Gas Bonanza," *Newsweek*, 1 August 1977, pages 61-62.

LEONARD M. BALL
8/9/77

Eugene, Oregon

rather clear evidence that small systems are generally preferred by the users (would you trade your car for a seat on the subway?) and probably are much more cost effective in the long run. (Think about a collection of household septic tanks compared to a municipal sewage system). About the only constant benefit of the massive systems is that they require massive government (that is, tax) funding, which provides massive income to the practitioners of the soft (as in solid sewage) sciences.

Think small about the energy shortage. There are techniques available that will permit a simple, inexpensive, batch-process conversion of cellulose of any form to alcohol, with a yield of the order of 100 gallons of ethanol per ton of raw material, with some additional byproducts. Processing of a batch takes a few days, could be done with most of the processing energy supplied by simple solar heaters, and could mostly be done right on the farm.

Input to such a converter can be any form of organic matter, such as sawdust, brush, orange peels, old newspapers, or jungle. The process is simple. The shredded raw material is digested for a day or two by an enzyme, at 50°C, to produce about 99% conversion of cellulose into sugar. The sugar is then fermented to produce alcohol (at room temperature), and the alcohol is distilled out at about 80°C, to give 99% ethanol. Here in Kentucky we have plenty of experts with practical experience on the last two steps.

Ethanol, if cheap enough, can replace petroleum for nearly all purposes, especially for fuel, although aircraft would have a bit of a problem because of the low energy content compared to hydrocarbons (about 50%).

"Cheap enough" can be of the order of 10¢ a gallon if enough cleverness is used in the design of equipment that can be run by farmers. Raw materials are no problem on a worldwide basis. There are vast acreages of useless jungle all over the Third World, and widespread use of an alcohol fuel economy would mean a redistribution of wealth from Arabia to places like Thailand, Indonesia, Central America and Africa, coupled with a great decrease in the energy cost to developed countries.

To top it off, alcohol, if not drunk, is absolutely non-polluting. All of the CO₂ produced originally came from the air, and all of the heat produced came from sunlight falling on the plants.

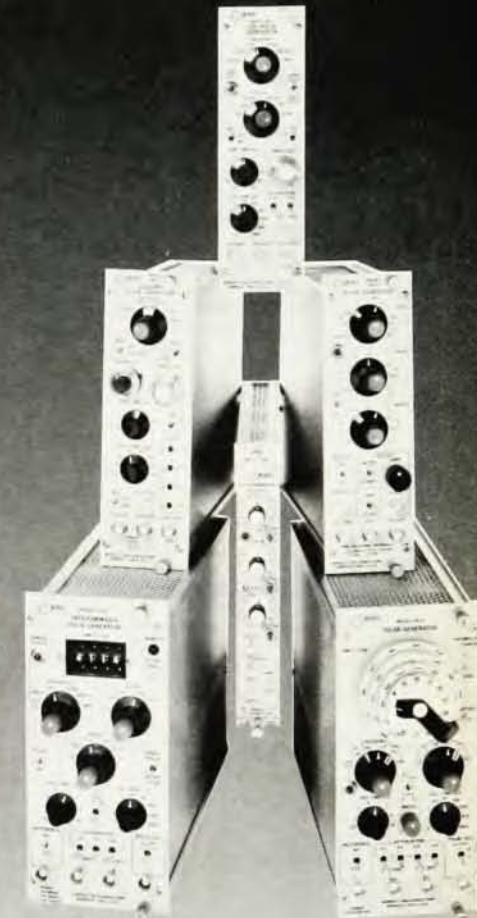
Finally, there is no shortage of biomass. The amount of unwanted plant life, if converted to alcohol, would supply the world's liquid-fuel requirements for many decades to come. And it could be done now, since all of the technology is immediately available.

YALE JAY LUBKIN
Ben Franklin Industries, Ltd.
Casey Creek, Kentucky □

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Thinking small about energy

There seems to be a hysterical fascination these days with enormous systems to solve problems, like mass transit, or L-5 complexes, or solar-power satellites, or *in-situ* burning of shale deposits, despite the