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velopment, a rocket based upon a metal heat exchanger-reactor was also investigated. In this design heat conduction was canceled by opposing gas convection (which is the same means by which a cold bunsen burner maintains a hot flame). By this strategy gas temperatures up to and including the melting point of tungsten (3600°K) were reliably achieved without risk of failure. A sizable fraction of the output of gas was atomic hydrogen, and the power density in the exchanger, as compared to that in the flame of an atomic hydrogen torch, yielded a very favorable power-to-weight ratio. Exchanger modules were run at full power and heat for as long as 2 hours and restarted repeatedly hundreds of times in 1/10 second without visible deterioration. The problem of thermal neutron capture, which Spence mentions, proved far less formidable than had been feared; actual rocket designs which were submitted to nuclear mock up became critical with very modest uranium loadings (1). In brief, feasibility had been widely demonstrated for a device with performance far beyond the potential of graphite. Design was rapidly maturing and construction of the first model had already started when we were given a directive to use the Kiwi-A nozzle. This meant cutting back the hydrogen flow to 3 kilograms per second. At this miniscule flow rate, the buffering effect of gas convection was gone, and the entire project was scrapped for the single reason that the design would not tolerate an unrealistically low power. Had Spence's criteria been well appreciated at the time, the decision would have been different. As an old space buff, I can daydream quite wistfully on what the scientific fruits of a post-Apollo program might have been.

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Reference

1. B. W. Knight, *Nucl. Sci. Eng.* **19**, 393 (1964).

Federal Funds Mean Federal Control

Abelson's editorial (17 May, p. 721) about federal support of universities was apropos concerning reductions in federal funds. It suggests how a mere threat of reduced funds can enslave the recipient. But it seems to me he missed the *major* point about federal

control. Obtaining funds by means of the power to tax is appealing, to be sure, as against our having to sell our programs to willing "buyers" as voluntary purchasers or supporters. But we must never forget that the overriding point comes from the highest judiciary (law) of the land:

It is hardly lack of due process for the government to regulate that which it subsidizes. *United States Supreme Court Wickard v. Filburn*, 317 U.S. 111, p. 131, October 1942.

One wonders what the course of finance for education would now be if this ruling decision had been on the desk of every university administrator continuously over the past quarter century. It is a stern discipline for all who yearn for easy money from this source and at the same time hope to be free from political control.

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Orwellian Parody

My letter (15 Mar.) was written as a parody. Several of my friends and colleagues understood it as such, without prompting from me. Did Herz (Letters, 24 May)?

My parody was inspired by another parody which, like the sentence I objected to, was a paraphrase of Scripture. In his essay "Politics and the English language," George Orwell used an example to show what he felt was wrong with the writing of his day. He obtained it by translating Ecclesiastes 9:11 as follows:

I returned and saw under the sun, that the race is not to the swift, nor the battle to the strong, neither yet bread to the wise, nor yet riches to men of understanding, nor yet favour to men of skill; but time and chance happeneth to them all.

into what he called "modern English of the worst sort":

Objective consideration of contemporary phenomena compels the conclusion that success or failure in competitive activities exhibits no tendency to be commensurate with innate capacity, but that a considerable element of the unpredictable must invariably be taken into account.

Clearly Orwell's essay applies as well to science as it does to politics.

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