ment—of less than a factor of 3000 in power—took 75 years. Milestones along the way included the 1918 Liberty engine, at 420 hp, the versatile Rolls-Royce Merlin engine of 1938, at 1100 hp, raised to 2700 hp by 1945, the Double Wasp, used by US bombers in 1945, at 3400 hp, and the Pratt and Whitney T57 turboprop of 1960, at 15 000 hp. These numbers should help those who weren't involved in the US radar effort of WWII to understand the awe in which those of us who were still hold the achievements of Randall and Boot.

And as I admit my mistake in omitting mention of the RCA radar set, I must point out that Linder's first reference[3] is similarly incorrect when it says, "At the time of our entry into World War II, the twenty (RCA CXAM) sets installed on the most important ships of the fleet were the only radars in use by the Navy." (The CXAM was definitely not a microwave radar set.) The official history of the MIT Radiation Laboratory[4] has this to say in its chronological account of what happened in June 1941: "[A Rad Lab-built s-band radar had been] installed on the USS Semmes, and signals were seen on a PPI, display. Production contract for the SG radar set was awarded to Raytheon—the first US order for microwave radar. Becomes the Navy's most widely-used microwave set." So Linder, MIT, RCA and I all show that we, or our writers, are human enough to remember best the things with which we were associated.

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4/83

Using nuclear waste

One of your writers on high-level waste disposal (December, page 36) remarks that waste from one year's power-plant operation would fit under the kitchen table; it might just be a little hot. The other writer remarks that it was once thought that nuclear waste might be useful, but the experts soon changed their tune.

In truth, waste is waste only if it isn't useful. In the days of cheap energy, one couldn't afford much capital invest-

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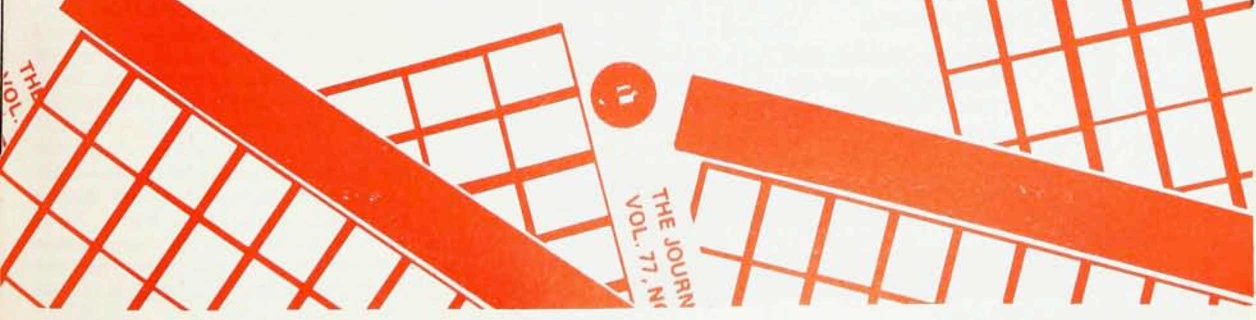

ment to *use* the nuclear waste; storage was the cost-effective strategy.

Nowadays energy is no longer cheap; use could be cost effective if public capital investment could be shaken loose for some novel approaches to use. The objection today is largely emotional. If the 100-year problem is solved, the 1000-year problem is put forward as a crisis. If the 1000-year problem is solved, bring on the 10 000 year problem, which is insoluble by definition. (The human race doesn't have 10 000 years of remembered experience).

The biosphere is far less tender than those who would save it would have us believe. It has already survived a massive natural reactor which burned ages ago in what are now the uranium mines of the Congo, without the benefit of any kind of protection.

A sense of perspective is in order. The fissionable material now in weapons is the threat to mankind, not the powerplants. If only we could begin to burn those warheads for useful power, the threat to the human race would be immeasurably reduced, no matter how careless we became with the powerplant waste product!

The ten tons of ash from a 1000-MW reactor still has an output of 3 MW, give or take a factor of 3; it has already produced $100 000 000 in revenue at 1 cent per kWh. A modest fraction of that sum will buy a lot of lead and a lot of pipe for using the ash.

3 MW is a bit much to heat my house, but it would do very nicely for a public building complex, such as the heating plant of the local Army base or Air Force station. Mind you, it would be cheaper in the short run (especially if your insist on solving 10 000 year problems first) to burn imported oil. But in the long run, as those warheads become power-plant fuel, using the "waste" to heat buildings would be cheap and life-protecting.

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Helium-3 from hot springs

The recent profile of Philip Morrison (August, page 36) contains an elegant and instructive quote from Hans Bethe that is reminiscent of Lord Kelvin's theory of the cooling history of the Earth (in that an unexpected phenomenon, in Kelvin's case radioactivity, made the theory totally incorrect). Bethe refers to the well-known calculations of Morrison and Pine on the production rates of He^3 and He^4 by radioactivity in the crust, which showed that the He^3/He^4 ratio in radiogenic helium in rocks is less than one-tenth the ratio in atmospheric helium.