

correspondence

Energy unit for global use

SIR,—Very large powers of 10 occur in discussions of global energy, one example being the exajoule (10^{18} joule). As this number is larger than the number of seconds since the big bang ($\sim 5 \times 10^{17}$) its size is difficult to appreciate, and a more intuitive unit is desirable.

Annual energy consumption is dimensionally power, and a good unit of power is a 60W continuously burning light bulb. (One could make it a 100W bulb, but that is slightly less modest.)

Furthermore it makes sense to report power per capita of the world population. Table 1 then expresses some important energy flows: the figures for 2000 AD and 2020 AD are based on exhibit 19 of Bloodworth, I. J. *et al.*, World Energy Demand to 2020, Executive Summary (World Energy Conference, London, 1977).

The table shows the low average efficiency of photosynthesis: there is evidently scope for the development of high energy yielding crops.

To see the proposed unit in action, we ask to what extent the deserts of the world—a somewhat fuzzy concept—could supply world energy requirements by direct conversion of solar radiation (to electricity, say). This is not a practical idea at present, but it is nonetheless important to have answers to such a question.

Assuming rather poor devices of 1% efficiency and an insolation at one tenth of the solar constant, one finds that the deserts would give an adequate yield for some decades to come (Table 2). Although there is in fact a great deal in hand at present, this advantage is being eroded.

The numbers for the energy consumption are reasonably small when expressed in these units and it is hoped that they carry an intuitive meaning.

Yours faithfully,

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Military structure is off-target for science jobs

SIR,—David Horrobin's military solution to the problems of job opportunities and job security (8 March, page 118) could more aptly be described as the final solution, for if implemented, his ideas would further encourage short-term grant funded work using basic scientists as technicians and assistants. The lack of prospects offered would simply discourage those wishing to enter research as a profession and would commit research to a supportive role in advancing the careers of teachers and, in medical research, clinicians. But what is the problem he is trying to solve? If it is the "unequivocal . . . decline in research productivity between the years of 35 and 45" then his efforts are misguided: I challenge the myth that research scientists are more susceptible to 'burning out' than any other professional group. The "decline in research productivity" reflects a combination of withdrawal of short-term funding support (experience comes expensive) and the scientist's disillusionment with the abysmal career prospects.

In his proposed career structure we would know by the age of 35-40 whether or not we were suitable. If not, the alternative would be "the comfortable knowledge that they would have three years . . . to plan a second career." Who on earth is going to employ a middle-aged scientist stigmatised by his so-called "decline in research productivity." Like the universities, industry and government recruit largely at the graduate level and so even if they wished to pick up the academic 'casualties' they would not be able to do so. These proposals would also curb any independent thought, for the research worker would be continuously trying to please and impress the departmental 'Field Marshal' in the hope of being awarded another five years in

the despatches for efforts above and beyond the call of duty. Lastly, he resorts to the expedient of the gratuity payment. These always seem very generous at the time but, as many workers have recently found, the money is very soon spent, leaving the dole queue and senescence as the only feature on a bleak horizon.

Certainly scientists need a stimulus to work. But this should take the form of improved career prospects with adequate peer review by which effort, achievement and responsibility are rewarded; the game of Russian roulette in which the trigger is pulled every five years is no basis for a profession.

Yours faithfully,

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Sergei Kovalev: remember a colleague

SIR,—Soviet biologist Sergei Kovalev is now in the fourth year of a seven-year term in a strict regime labour camp. He was sentenced in December 1975 for making known various violations of human rights by the Soviet state. Past support by scientists around the world has helped him to receive needed medical assistance and has ameliorated the harsh punishment given to him in the labour camp. Renewed efforts are now required to support him, lest he fade from the public eye and be left to the "mercy" of his jailers.

Scientists at the State University College at Buffalo and State University of New York at Buffalo have contributed funds and have purchased a journal subscription in Kovalev's name. It is sent regularly to him at his prison address. Colleagues at other institutions might well do likewise. Letters to Soviet authorities may also be helpful.

As spring approaches most of us in the northern hemisphere are going about our research and teaching and sharing the love of our families. Let us remind ourselves of our colleague, Sergei Kovalev, who is freezing in a Siberian labour camp because he dared to speak out in favour of human rights. We owe him a great debt and should do all that we can to help him in his time of need. As a symbol of our concern I suggest that each of us send a letter or greeting card to Dr Kovalev at:

Pochtovy Yashchik
No 5110-1BC
Moskva
USSR

This will let him know that he is not forgotten and will remind Soviet authorities that we have not forgotten our colleague. A blizzard of greeting cards would be an appropriate message at the end of this winter season.

Yours faithfully,

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Table 1 Important energy flows (Earth averages)

	60W bulbs per capita	Joules per annum
1975 [World population 4×10^9]		
Food consumption	2	1.5×10^{19}
Energy consumption	33	2.5×10^{20}
Photosynthesis yield	410	3.1×10^{21}
Solar energy incident on Earth	396,000	3.0×10^{24}
2000 AD [World population 6×10^9]		
Energy consumption	51	5.8×10^{20}
2020 AD [World population 7×10^9]		
Energy consumption	76	1.0×10^{21}

Table 2 Possible power yield from deserts

Year	Yield (60W bulbs p.c.)	Requirements from Table 1 (60W bulbs p.c.)
1975	141	33
2000	94	51
2020	81	76

Mean insolation is 135Wm^{-2} ; efficiency of devices 1%.