

correspondence

Fast reactor safety

SIR, — In his article on fast reactor safety (26 July, page 270) Norman Dombey claims to introduce to non-specialists some features of fast reactors that are not available outside the technical literature. The non-specialist would do well to treat this article with caution as it contains a number of errors (some of them elementary) and is more likely to mislead than to inform. The following is a list of some of the more outstanding errors:

- "Thermal reactors are designed to be in their most reactive nuclear configuration". This is incorrect and some examples were given by Professor F.R. Farmer (12 April, page 593). Some reactivity coefficients in thermal reactors are positive and are not all negative as stated — indeed gas-cooled Magnox reactors have operated safely for over 20 years with strongly positive moderator temperature coefficients.

- "Thermal reactor has less than one critical mass" This is incorrect: all reactors have to have at least one critical mass.

- "So in a fast reactor of the design envisaged in CFR1 . . . there will be no overall negative Doppler coefficient" The reasoning and the conclusions are both incorrect and there is in fact a strong negative Doppler coefficient which is a major contributor to the safety of the reactor. (I have now seen the erratum (9 August, page 444) which corrects this point.)

- "For example a coolant channel gets blocked, sodium boils . . . pieces of plutonium fall and form a molten mass which if large enough can become prompt critical." This is incorrect. The reactivity effect of voiding a single channel is so small that there would be little effect on the power level in the rest of the core. There is insufficient fuel in a single fuel sub-assembly to produce criticality even if all the fuel pins in it were melted and compacted.

There are other incorrect technical statements: for instance, sodium is more easily contained than high pressure water or steam and is not as corrosive to reactor constructional materials; and the delayed neutron fraction, on which the normal control behaviour of thermal reactors as well as fast reactors depends, is nearly twice as great as stated (and is always greater in a fast than in a thermal reactor with the same fissile material).

These errors are important in that they convey the impression that fast reactors are difficult to control, unsafe and not well understood. On the contrary the fast reactor in normal operation has no tendency to become unstable and can be left for hours without any adjustment of the controls. Temperature and power control is simple, straightforward and easy to engineer to very safe standards. Their safety has been the subject of intense study for very many years and it is well understood. Clearly there will continue to be work related to the detailed choice of safety features until licensing rules have been formulated and as with other reactor types the preferred selection of intrinsic and engineered safety features will be clarified during negotiation of the licence for the first commercial reactor. What is important is that fast reactor designers are confident that they can meet safety standards at least as stringent as those applied to other reactor types. Furthermore any design features incorporated for safety reasons are not likely to increase the expected cost by more than a few per cent.

The economic statements are equally ill-founded. The increases in the capital cost of

SNR 300 were due largely to late changes in the design requested during the complex licensing process which was being developed using SNR 300 as a guinea pig: even if the changes incorporated in this way were thought to be necessary for later reactors the cost of including them *ab initio* would be small compared with the costs of SNR 300.

Whilst the capital cost for a fast reactor appears to be inherently higher than for a thermal reactor — estimates range from as low as 1.1 times to about 1.5 times or perhaps approaching 2 times for the first-off commercial sized demonstration plants — there is little doubt that the lower fuel cycle costs will more than compensate as uranium prices increase, due to pressures in the next few decades on the limited supplies of uranium ore. The breakeven point could well be before the end of the century, which is the timescale for planning exploitation of the fast reactor system. Remember the fast reactor will produce about 60 times more energy than a thermal reactor for the same quantity of uranium. Commercial designs are of course being developed to meet safety requirements which are included in cost estimates, and the implications by Dr Dombey that designers have to suddenly take them into account after the rest of the design is complete shows a lack of understanding of the attitude of design engineers to safety.

Despite his failure to reach it by logical argument, Dr Dombey's general conclusion that the UK should continue to collaborate as closely as possible with other countries in developing the fast reactor is commendable and has been stated on many occasions to be current policy. Articles which undervalue the extent of the UK's possible contribution to such a collaboration are not likely to be of assistance in such collaborations.

It is disturbing that the article contains so many inaccuracies, which, compounded with the error about the Doppler Coefficient, gave such an unbalanced view of fast reactor safety at a time when an impartial academic view would have been particularly valuable.

Yours faithfully,

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Domestic animals are not inferior

SIR, — Mellanby (*Nature* 275, 82; 1978) attacks opponents of 'factory farming' for their errors in animal behaviour, as well as for their own behaviour at his talk. First, while not wishing to justify the human behaviour he describes, it should be borne in mind that many in the environment movements have suffered far worse behaviour at the hands of establishment figures — treatment not all that different from what is meted out to dissidents in the socialist world, well detailed in the columns of *Nature*.

Second, there are scientific, practical and humane reasons for objecting to some aspects of intensive husbandry. Those who are critical of such practices do not get their views published — in contrast to the regular columns in *Nature* by such strong advocates of 'factory farming' as T. H. Jukes and Mellanby.

Third, since Mellanby frequently (and rightly) complains of occasional errors and oversimplifications made by environmentalists may we have the opportunity of correcting some of his.

The statement by Mellanby, "Domestic animals, cattle and sheep, and pets such as dogs and cats only exist because man breeds them . . . but if man disappeared from the world, so would most domestic animals" seems at variance with his later comment about the feral cat ". . . endangering the native fauna . . .". Both statements are misleading.

The feral cat in Australia largely has the rabbit as its major prey (Coman, B. J. and Brunner, H., *J. Wildlife Management* 36, 848; 1972). Habitat destruction by man is the major threat to Australian native fauna (Marshall, A.J., *The Great Extinction*; Hienemann, Melbourne 1966).

In reviewing literature on the success and failure of introduced animals, we find that there is no statistically significant difference between domestic and wild species in regard to successful establishment in the absence of human care. Indeed, some major animal domesticates, notably goats, pigs, cats, dogs, and rabbits become successful in a variety of habitats and resist sustained human efforts at control or eradication.

The idea that domestic animals are inferior and degenerate — and thus less deserving of humane attention — is widespread. It is dangerous to confuse science and value judgements, however, and it is worth bearing in mind that Konrad Lorenz justified his support for the German 'eugenics programme' on the basis that man was becoming domesticated (Haldane, J.B.S. in *Culture and the Evolution of Man*; Galaxy Books, Oxford University Press, New York, 1962 and Nisbett, A., *Konrad Lorenz*; J.M. Dent, London 1976).

Yours faithfully,

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Brazilian official was illegally dismissed

SIR — I wish to congratulate you for the story on the Brazilian exiled scientists (26 July page 268). I would only like to rectify a misquotation concerning my husband, an ex-official of the Brazilian Parliament who was illegally dismissed for political reasons when the military took over in 1964, and was not "an ex-deputy whose mandate was annulled", as published.

Yours faithfully,

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What use is scientific awareness?

SIR — your concern for the lack of scientific awareness of the British public is commendable (9 August, page 435), but may I ask to what end? As an unemployed maths teacher who has never held any scientific or technical position, I am probably as close to the "general public" as your regular readership extends. I try to keep myself informed on all branches of science, and my general scientific awareness is far greater than could ever be reasonably expected as a norm. I think it is worth noting that as far as I know this awareness has never been of the slightest benefit to anyone.

Yours faithfully,

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