CORRESPONDENCE

Nuclear hazard

SIR — While it is true, as N. Bielsten states (*Nature* 25 March, p.284), that thousands of people have died over the past 20 years in dam failures, it is naive to compare this to the record of the nuclear power industry. The fact remains that nuclear power reactors represent the only form of civilian technology with the potential to kill several million people in a single accident.

While one can argue *ad infinitum* about the probability of such an event, we must admit that there have been several near misses and, as more reactors are built and as present reactors age and become more prone to failure, the likelihood of such an accident is increasing. For the nuclear power industry to congratulate itself for the fact that no such accident has yet occurred is reminiscent of the fellow who jumped off the Empire State Building and who was heard to exclaim as he passed each floor "So far, so good".

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Fear not frenzy

SIR — Your alliterative headline "Freeze frenzy hits US" in *Nature* of 29 April (p.790) was misleading, and gave a wholly wrong impression about feelings here. There is no frenzy: we are just frightened, and rationally so. I don't want nuclear bombing to destroy me and my family, my home, our laboratories and libraries and universities and so on, but if any major nuclear war starts there seems very little doubt that all this would happen in the first few hours. I imagine that reasonable people would feel similarly in Britain, the Soviet Union and elsewhere. At a recent meeting in here in San Diego, some 3,000 people gathered to discuss nuclear disarmament. The discussions were sober — and sobering — but not frenetic.

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Tangible results

SIR — Martin Raff (*Nature* 25 February, p.642) has observed a disquieting trend towards restricted distribution among scientific colleagues of biological materials.

When research results are in the form of biological material, such as desired gene sequences cloned in a plasmid vector, simple publication of such research results may not be adequate, or simply not most efficient, to advance science.

Such research results should be made available openly and promptly to scientific colleagues, whether in academe or industry. This is the basic premise of the Tangible Research Property policy recently issued at Stanford to affirm appropriate scientific practice (*Nature* 25 March, p.283). The policy specifically adjures against withholding distribution for commercial reasons. Cell lines, including hybridomas, are distributed to colleagues. Broad distribution of Tangible Research Property (TRP) can be done in a fashion which reasonably protects commercial rights. The optimal mode of protecting TRP would involve strictly limited distribution or secrecy, not options for a university to follow.

With the foregoing as background, let me turn to Dr Raff's concern about open distribution of hybridomas and monoclonal antibodies. There is a great demand for monoclonal antibodies, as is well known to readers of *Nature*. Indeed, this issue of *Nature* may have several advertisements offering various monoclonal antibodies for sale. Producing and distributing monoclonal antibodies to large numbers of users is beyond the capability or funding of the normal university laboratory. Private companies provide a significant service to science by making available well characterized monoclonal antibodies of consistent quality to academic and industrial scientists for their research. As monoclonal antibodies find their way to clinical applications, the role of industry will be of even greater significance.

At the point of clinical application, some measure of proprietary protection for commercial sales is needed by industry to enable its considerable investment to bring therapeutic products to market. Exchange of biological materials or other products should and can be accomplished in a fashion that preserves such proprietary protection and thus avoids jeopardizing the public's access to therapeutic or other products derived from such biological materials. This may involve prior (to distribution) agreement by receiving scientists to follow steps not to destroy those proprietary rights needed for commercial development.

Molecular biology is in transit to an era of increased practical applications for public benefit. The commercialization aspect of this can be depressing, as Dr Raff observes, but the beneficial aspect should not be overlooked.

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Billions and upwards

SIR — All support to your "ban the billion" campaign — what use is a scientific word that can mean 10^9 or 10^{12}? Since the ambiguous terms billion, trillion, quadrillion, quintillion, sextillion, septillion, octillion, nonillion (see 6th edition of *Concise Oxford Dictionary*) all end in -llion (and this is therefore a suitable suffix for all large number words) could we not have general agreement on gigallion 10^9, terallion 10^{12}, petallion 10^{15}, exallion 10^{18}? As far as I am aware, none of these words has been used before, and certainly not to denote different numbers from those suggested here.

Larger numbers can be constructed by using two (or more) of the internationally recognized prefixes, for example, megaexallion for 10^{24}, exaexallion for 10^{36}. Cubi- will take us even further, cubiexallion $(10^{18})^3$ being 10^{54}.

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Boldly going

SIR — Wallis (*Nature* 15 April, p.598) appears to support Hoyle's view that there has been insufficient time for the development of life systems on the Earth. In particular, he says that 2,000 proteins of a specified character are required to catalyse the reactions involved, and that these would not have appeared by random assortment of amino acids into polypeptide chains in the time available.

This argument would be valid if the development of life on planets like the Earth depended upon the simultaneous presence of about 2,000 different polypeptide chains, each containing a uniquely specified group of about 6 amino acids to catalyse a particular biological reaction. This is not true.

The emergence of life did not have to await the appearance of a particular collection of proteins. It emerged from the random set of proteins that were already present on the primitive Earth.

Earth's biochemistry is a by-product of the continuous irradiation of the primitive ocean, producing chains of reactions and processing organic molecular systems back down to the free energy gradient. As has been shown experimentally, irradiated systems of appropriate composition contain all the organic forms (proteins, nucleotides, carbohydrates and so on) required for Earth's biochemistry. The huge variety of peptide chain segments present would provide catalytic centres for many of the reactions involved. The self-replicatory and evolutionary properties of systems of proteins and nucleotides then ensures that the peptide-catalysed chains of reactions play an increasing role in the flow down the free-energy gradient, perhaps by the mechanisms described by Black[1]. At some arbitrarily chosen stage in this process of development, we should recognize the system as a form of life.

Wallis's argument does, however, show that no two planets in the Universe can have the same biochemistry. Captain Kirk and the crew of the *Enterprise* are no more likely to find life forms with the Earth's biochemistry than to find them speaking English.

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1. Black, S.: *On the Thermodynamics of Evolution* (*Perspectives in Biology and Medicine*, Vol. 21(3), Spring 1978).

PhD job centres

SIR — In his letter published in *Nature* on 13 May (p.98), A. F. W. Coulson describes an information exchange for PhD students in the life sciences and speculates why this has not been done previously in other fields. May I point out that in physics such a compendium was first published by the Institute of Physics in 1969 at the request of the Standing Conference of Professors of Physics. The Sixth Edition has recently appeared.

I too, Sir, have often wondered why similar volumes have not appeared for other subjects.

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