Where has Britain's plutonium gone?

Sir — The UK government's Department of Trade and Industry has issued a document that claims to be "…part of the UK's renewed commitment to improve transparency and openness in its management of our national holding of civil plutonium"[1]. In fact the new format provides considerably less information than previously. It no longer gives the reactor-specific data which enabled outsiders like ourselves to make independent assessments. And the total plutonium produced by the UK civil Magnox reactors is still not published.

Until recently, the UK government provided a subtotal of the civil Magnox plutonium. The unpublished balance was sent to the United States before 1971 under "mutual defence agreements" (MDA). Previous Conservative administrations in the United Kingdom maintained that this plutonium was not used in weapons, but refused to quantify the balance.

In 1985, we estimated that this balance was 6.3 ± 0.8 tonnes (refs 2, 3). We revised this figure to 5.4 ± 0.8 tonnes (ref. 4) when it was revealed that the total plutonium in solid waste was much larger than official sources had indicated previously.

In February 1996, the US Department of Energy published an inventory of its plutonium stocks, stating that "… from 1959 to 1980, the US acquired a total of 5.4 tonnes of plutonium in exchange for 6.7 kg of tritium and 7.5 tonnes of highly enriched uranium"[5,6]. The total of 5.4 tonnes is in remarkable agreement with our revised figure published four years earlier. However, refs 5 and 6 did not specify the end uses of the plutonium in the United States, nor did they clarify how much originated in the UK civil Magnox reactors rather than the military ones at Calder Hall and Chapel Cross.

The question of the UK origin of the plutonium is problematic because civil and military Magnox spent fuel was 'co-processed' at Sellafield until 1986. In December 1997, a US press release[7] was issued stating that 0.1 tonne of very high purity plutonium (2% plutonium-240 content) was sent to the United States under the exchange programme and that no other plutonium with plutonium-240 content less than 10% was involved. This suggests that the amount of military-origin plutonium involved in the exchanges was small, consistent with estimates that the total UK inventory of weapons-grade plutonium is relatively small. (Calder Hall and Chapel Cross have not operated on a military cycle for many years.)

We believe that the amount of plutonium of military origin sent to the United States under the MDA was a small part of the 5.4 tonnes, possibly as little as the 0.1 tonne of 2% plutonium-240 purity referred to in ref. 7. We conclude that the United Kingdom provided the United States with around 5.4 tonnes of plutonium from the UK civil stockpile.

All this 5.4 tonnes plutonium is in the US defence stockpile. The UK government maintains it has not been used in weapons, but the US civil destinations that have now been listed contain at most 4 tonnes of plutonium[2,3], leaving around 1.4 tonnes not accounted for. If sufficiently pure, this amount of plutonium could provide up to 300 warheads.

We call on the present (Labour) UK government to clarify fully the past history. The US disclosures have removed the previous (Conservative) UK government's excuse for secrecy, which was because it would reveal the quantity of highly enriched uranium received by the United Kingdom for defence purposes. The United States published the exact figure for the highly enriched uranium involved in the exchanges two years ago, and it does not appear that the security of the realm has been imperilled.

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Journals are best left on the shelf

Sir — I read with interest the announcement that *Nature* would be offering an electronic version of the journal free to subscribers (*Nature* **395,** 415; 1998). I very much enjoy the journal and expect the electronic version to quickly gain a wide readership.

However, the issue of electronic publishing is still contentious. It seems to boil down to this: publishers want to encourage use of electronic versions but still maintain cost-effectiveness, while subscribers (especially institutional subscribers) enjoy such benefits as rapid searching, but want guarantees of permanence. I have no doubt that articles published electronically in journals of high standing will be reasonably 'permanent', in that someone (preferably the publisher) is likely to always maintain a copy.

The discussion of electronic permanence has missed one important aspect: that of permanent availability. If a library subscribes to the electronic version of a journal for, say, five years, it gains the use of the text for those five years. But if budget cuts force the subscription to be dropped, the library's patrons no longer have access to the five years purchased, whereas a library that had ordered a print subscription would always have at least those years paid for on the shelf.

The bottom line argument seems to be the willingness of the scientific community and publishers to make the transition from journals as an item, to journals as a service. I am not willing to invest the cost of several years of a journal subscription in a service that will disappear as soon as I stop paying the fees. A paper journal, on the other hand, can remain on my shelf indefinitely, independent of changing financial situations.

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Hybrid journals

Sir — Science and research libraries in India continue to spend a large proportion of their budgets on subscriptions to printed versions of journals, but frequently cannot subscribe to electronic-only or electronic versions of print journals owing to lack of infrastructure facilities and access to the Internet. Discussions on this topic have overlooked another important development in journal publishing — what is termed the 'hybrid' journal.

In a hybrid journal, the main information is delivered in print whereas

additional or supporting material is available in print and electronically. In a recent development, some journals are providing this supporting material in electronic form only (several journals of the American Chemical Society, for example), and this is a cause of concern for research workers in India and other developing countries.

Because many libraries in India still do not have Internet access, and many researchers do not have any other form of organized Internet access, subscribers to a hybrid journal may have only partial access to its contents. We checked the *National Union Catalogue of Scientific Serials in India*, and find that nearly 40% of Indian libraries that subscribe to some hybrid journals do not have access to electronic information.

We would like to make the following proposals to tackle this problem. First, information-service providing agencies, such as INSDOC or the National Centre for Science Information, could identify hybrid journals with Indian subscribers and establish formal mechanisms for procuring and making available such supporting material in a convenient format and medium on a regular basis. Alternatively, libraries without these facilities could link up with libraries with these facilities for the supply of such materials so that both the libraries and science workers can obtain full access to what they have already paid for. Such services by these agencies could also in principle cover electronic-only journals (subject to copyright and other regulations), so that the gap between the 'haves' and the 'have-nots' is reduced.

Second, we suggest to the publishers of hybrid journals that the type of information available in supporting material is clearly indicated in the printed version so that the reader can decide whether to request it. Not all journals clearly specify the nature of the supporting material.

Finally, secondary sources such as *Chemical Abstracts* and *Current Contents* are acknowledged means of identifying relevant material, but generally do not indicate the existence of supporting material. Hence, the availability of such material is known only when the original article or its photocopy/reprint is seen. It would be useful if secondary sources indicate the existence of such material.

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Popular reaction against science

Sir — The editorial on *The X Files* made some excellent points — especially about the rigour of Mulder and Scully's investigative methods (*Nature*, **394**, 815; 1998). The editorial went on: "The popularity *of The X Files* suggests that the public clearly has more of a feeling for the spirit of scientific enquiry than some give it credit for".

Although I would like to believe this statement, I think it is false. The success of *The X Files* is part of a popular reaction *against* science. Many cultures (particularly in the West) are increasingly secular, and there is a prevailing feeling that there is no longer any mystery that science cannot elucidate. *The X Files* offers the comforting spectacle of science *not* coming up with answers — in fact, of frequently falling flat on its face. The programme's massive popularity results much more from the decline of the church (formerly a wellspring of mysticism), and scientific rumours of an imminent 'Theory of Everything', than from a true spirit of scientific enquiry.

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Two-way street

Sir — Students of phylogeny cannot but welcome the application of their methods to the discovery of relationships between families of manuscripts, as in the recent study of 58 fifteenth-century manuscripts of "The Wife of Bath's Prologue" from *The Canterbury Tales*[1]. It may prove of interest to philologists and phylogeneticists alike to realize that progress may also be made in the other direction.

For example, in their analysis of protistan phylogeny, Ragan and Lee[2] introduced to the biological literature a parsimony-based procedure originally developed[3] to detect textual contamination, a philological equivalent of the lateral transfer of genes (or characters).

Historians wishing to search for the history of current phylogenetic approaches may profitably look into the works of Renaissance scholars such as Angelo Poliziano (1454–94). In his textual reconstruction of classic Greek and Latin works, Poliziano[4] discounted the then fashionable method of relying on the textual version preserved by most extant manuscripts. He advocated instead careful comparative weighting of evidence, because close replicas of the same version or other interdependent sources should not be given the same individual weight as largely independent sources. This is one of the most fundamental principles of current phylogeny-based approaches to comparative biology[5].

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Referencing crystal coordinates

Sir — Analyses of the crystal structures of macromolecules, the coordinates of which are deposited in databases, constitute a growing component of the biochemical literature. Given the magnitude of investment that has been made in determining protein and nucleic-acid structures, this is entirely appropriate; the gold hidden in that vast mine of information needs to be recovered. But I am disturbed by a practice of the community that engages in coordinate analysis: its use of database identification numbers as the sole reference to the coordinate sets discussed in publications.

This is not good scholarly practice. It conceals from readers the identities of the scientists responsible for the coordinate sets used, and makes it difficult for readers to find primary references. It is also unfair. For better or worse, citation indices are increasingly used to evaluate the contributions scientists have made to their fields. No credit will accrue to those who made the effort to determine a structure unless the papers that make use of its coordinates include a proper reference.

For these reasons, the *Biophysical Journal* will from now on require authors to include in their papers full references for all the coordinate data sets they have used, as well as database identification numbers. I hope that other journals will institute similar policies to keep what is now a modest problem from getting out of hand.

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