for tens of thousands of years[2–5].

Most fieldwork in the Arctic is conducted by conscientious researchers who cherish this environment. It is careless and misleading to imply that the Arctic is 'riddled' with their garbage which serves as a testimony to their 'arrogance'. That France encountered only 208 objects across 1,200 km (six of them being cigarette butts) affirms that he was in paradise but simply failed to recognize it.

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Mercury and gold pollution

SIR — Nriagu *et al.*[1] report mercury pollution in the Madeira river in the Brazilian Amazon stemming from the gold rush, mercury being used to extract the gold by amalgamation. The same method of gold extraction was used in mining operations in the last century and the early part of this century in the Dolgellau gold belt of Gwynedd, north Wales in the United Kingdom. Although the scale of the operation in Wales was much smaller, with about 3.7 tonnes of gold being produced between 1860 and 1916 (ref. 2), it has resulted in enhanced levels of mercury in sediments of the Mawddach river, which drains the gold belt area.

We collected sediment samples from the bed of the Mawddach river near one of the most productive mines of the area, Gwynfynedd. Samples were collected during a period of low flow in January 1991 and air-dried. The sediment was sieved and divided into seven fractions, the mercury being concentrated in the fractions between 250 and 63 μm, the highest concentrations being in the 180–125-μm fraction. Here we report an analysis of the 250–180 and the 180–125 μm fractions.

From the data presented in the table, it is apparent that although gold is concentrated in the coarser of the two fractions, mercury is mainly concentrated in the finer of the fractions. There is little correlation between levels of the two metals in either fraction, which would tend to suggest that they occur independently and not in amalgam form.

At the Gwynfynedd operation the processing plant was located at the confluence of the Afon Gain with the Mawddach river, about 600 m from the mine site. Our data show that the highest levels of both mercury and gold occur in the sediments from the Mawddach and the Gain at and just below this point, concentrations showing a marked decline with distance downstream. The relatively enhanced levels of mercury and gold which occur near the mine site probably reflect contamination from the mine. Considerable amounts of sphalerite occur in Gwynfynedd mine, and this mineral contains appreciable amounts of mercury[3].

Although much of the mercury and gold in the sediments probably results from release during extraction, the extremely high values found for both elements in tailings waste near the old mill site suggest that this may be a continuing source of contamination in the river sediments. These tailings are fine and do not support any vegetation and are therefore relatively easily eroded. We found enhanced levels of both mercury and gold in a small channel draining from the tailings into the Mawddach, but found no evidence of enhanced mercury contents of river water.

There is much concern about mercury pollution of river systems resulting from gold extraction in areas such as Brazil and Indonesia. The elevated levels of mercury in stream sediments in this region of north Wales where gold mining was on a fairly small scale more than 80 years ago suggests that this contaminant metal has a fairly long residence time in river sediments. Any disturbance of these sediments even many years after the cessation of gold extraction may result in environmental problems.

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MERCURY AND GOLD CONCENTRATIONS IN SEDIMENTS FROM THE GWYNFYNEDD AREA

Sample	125–180μm		180 – 250μm	
	Au	Hg	Au	Hg
Mawddach 1.2 km above Gwynfynedd	ND	ND	0.14	0.09
Mawddach immediately below mine	0.21	0.13	ND	0.12
Mawddach 400 m below mine	0.11	0.19	0.10	0.15
Mawddach at confluence with Gain	0.45	3.68	0.18	1.26
Gain at confluence with Mawddach	ND	1.15	0.65	2.70
Mawddach 40 m below confluence	5.10	1.60	23.8	0.79
Mawddach 350 m below confluence	ND	0.14	0.06	0.11
Mawddach 2.4 km below confluence	0.12	0.13	0.10	0.05
Mawddach 4.2 km below confluence	—	—	ND	0.05
Tailings materials at old mill site	15.1	6.07	44.0	6.03
Small drainage channel below mill	0.20	0.46	0.26	0.27

ND, not detected (detection limit 0.05 mg kg^{-1}). Dashes, not determined. Values are in mg kg^{-1}.

Alpha-particles and leukaemia

SIR — The interesting demonstration of nonclonal transmitted genetic instability in haematopoietic stem cells after α-particle irradiation[1] was linked with the possibility that it might increase the expected induction of leukaemia by low levels of α-particle irradiation[1,2] in circumstances when most of the exposed cells escape direct radiation damage. It was not proposed that the transmitted instability occurred in particular chromosomes but that the instability could, on occasion, cause a specific leukaemia-initiating lesion and so augment the frequency of induced leukaemia.

But the experimental observations could imply the converse expectation. An induced genetic instability of cellular chromosomes in general, maintained over many cell generations after exposure to α-particles, would be expected to affect the progeny not only of those cells directly damaged at the time of exposure but also of cells in which specific leukaemia-initiating lesions had been induced at that time. Nonclonal chromosomal instability in an initiated cell, especially if causing multiple aberrations (Fig. 2 of ref. 1), leading to its premature death, would decrease the expectation of overt leukaemia.

Observations on human subjects after α-particle irradiation of haematopoietic tissues show that induced leukaemia is uncommon[3–5], much less frequent than orthodox radiobiological concepts would suggest. This is so for dial painters contaminated with ^{226}Ra and ^{228}Ra and for children and adults receiving multiple injections of ^{224}Ra (refs 6,7), all groups with high incidences of induced bone sarcoma, and in other groups with expo-