pesticides have yielded inconclusive results about the risks presented.³ Effective safety margins, based on the best risk assessment models and full information, are necessary in making decisions regarding environmental health policy because of this uncertainty. Yet, remarkably, no published comprehensive British environmental health impact assessments or audits of pesticides seem to exist. The British process of registering pesticides does not entail effective audit or environmental health impact assessments.

Potential environmental health effects of pesticides must be assessed from the start of the extraction process for basic chemicals to the end of the waste disposal process and residue chain. This does not happen. Information on the pollution effects and health effects of energy used in manufacturing and transporting materials for pesticides is not readily available. Data on resistance of pests and damage to beneficial predators on pests resulting from use of pesticides are lacking. Knowledge of possible pollution effects of pesticides is still limited.

Pesticides occur in rain⁶ and fog⁷ and as pollutants of materials and atmospheres in various buildings. Researchers have found many pesticide residues in the air and house dust of homes.⁸ A study recently showed that over nine months the potential exposure of a crawling infant to flea pesticides could exceed the World Health Organisation's no observable effect levels.⁹ Full audits and environmental health impact assessments of pesticides would identify such potential sources of pollution, would ensure a better assessment of any chemical's impact on the environment, and should be introduced into all relevant legislation in the United Kingdom. This requires active medical participation to monitor and predict the effects of environmental pollution on health and to ensure that Britain endorses the highest environmental standards.¹⁰

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Health risks associated with bathing in sea water

SIR,—Short reports are a useful way of publishing case reports or series in which the message is simple. Epidemiological studies, however, are generally more complex, and it is unlikely that sufficient information about the control of potential biases and confounding can be given in short reports to allow readers to interpret the results critically.

This is exemplified by R Balarajan and colleagues' report of a study of health risks associated with sea bathing.¹ The paper gives insufficient information for readers to assess whether the respondents were aware of the purpose of the study and might therefore have been biased in their responses to follow up questions, whether the interviewers were aware of the hypothesis under consideration, and what effect non-ownership of a telephone might have had. In addition, the validity of telephone reporting of symptoms by British respondents is unclear, although it may have been evaluated as part of the study.

The most persuasive finding in the study is the so called dose-response effect of different forms of immersion. These, however, are not defined, and it is unclear whether wading might be a dampening of the ankles or being in up to the bather's neck. Immersion of the head might be expected to confer a considerable risk, and it is not clear if this was included in any of the definitions. The second problem with this aspect of the study is whether the result might be due to confounding. Though age and sex were adjusted for (in an unspecified manner), other variables are potentially associated with both sea bathing and the range of outcomes reported, such as social class, smoking, and alcohol consumption. Were these recorded and were they confounders?

Finally, the study tested procedures for studies of the effect of sea bathing but not for bathing in contaminated water—for example, the strategy of examining the variation in contamination at each beach was not addressed.

The paper leaves us to conclude that the information is insufficient. Although the authors refer to other sources, these are unpublished reports that have not been peer reviewed. It seems preferable for research sponsored by the government to be published in a way that permits fully informed judgment of the findings. Certainly, the evidence presented in this paper alone does not justify the conclusion that the study's design is suitable for application. Judgment of the suitability of any study's design must depend on well documented, rigorous methodology.

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AUTHORS' REPLY.—We agree with A J Hall and L C Rodrigues that our most persuasive finding was the dose-response effect of different forms of contact with sea water: those bathing activities that entailed more immersion usually resulted in more symptoms being reported.

There are clearly difficulties in determining the precise degree of immersion of bathers without detailed questioning. We had estimated at the design stage of the study that the prevalence of self reported symptoms (particularly gastrointestinal symptoms, including diarrhoea) was likely to be low. This in turn implied that a large sample (2000 subjects in 19 days) would be required to obtain sufficient events for detailed analysis. We also knew that age and to some extent gender strongly influenced the type of sea water activity pursued, and these characteristics could easily be judged by the trained interviewers for quota sampling.

To avoid prolonging the interview at the beach questions were kept to a minimum so as to focus on key information such as a telephone number for contact; whether the subject lived locally or was a day tripper or holidaymaker at the resort; and the degree of contact with sea water. To distract from knowledge of the real hypothesis under question interviewees were asked if they had consumed

10 locally purchased foods (individually identified) on that day.

At the telephone interview the questions on sea water activity and on foods were repeated, and only then were subjects asked about their illnesses or symptoms after the interview at the beach. The interviewers at the beach were not aware of the questions about symptoms to be posed at the telephone interviews, which were conducted by a different team of interviewers, who were briefed to avoid reference to symptoms until the final stage of that interview.

Relative risks adjusted for gender and age were obtained with standard logistic regression models.

We agree that the validity of telephone reporting of symptoms is unclear, but we assume that, although overall reporting levels may be inflated, this should not distort the dose-response relation we observed. Follow up medical examinations are not feasible for this type of study.

Hall and Rodrigues are right to raise the question of relating the symptoms reported to bathing in contaminated sea water. As we indicated in our paper, the quality of the water varied appreciably day by day, and we also know that it varied by time of day and by location at each beach. Clearly, the proportion of bathers experiencing, for example, gastrointestinal symptoms can be plotted daily together with the quality of the sea water and relation between the series examined. Unfortunately, for analyses addressing this question and the responses about food consumed we have observed too few events; we await the data to be collected in August this year before we can complete these aspects of the study.

In summary, we agree with the sentiment and points raised by Hall and Rodrigues, but the design of this study was a balance between what was desirable and what was achievable with the resources available.

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Unnecessary radiology

SIR,—Fiona Godlee in her very comprehensive article on environmental radiation¹ refers to the report from the Joint Working Party of the National Radiological Protection Board and the Royal College of Radiologists,² which called attention to a study showing that some 33% of patients attending an orthopaedic clinic in Scotland had to have repeat x ray examinations because their original films were not provided by their general practitioners.³ There is a danger that this rate of 33% may become misconstrued as being the norm in orthopaedic clinics generally. One step towards misconstruction may have occurred already through a *BMJ* editorial which, in referring to the Scottish survey, commented: "The missing radiograph is another cause of unnecessary exposure, and a survey in an orthopaedic clinic reported that a third of all patients had repeat examinations because of missing films—a bland statement of a shocking fact."⁴ The editorial was correct but did not mention two important aspects of the Scottish survey. Firstly, the survey was concerned only with referrals from general practitioners, and, secondly, most of the missing x ray films had been taken at four health centres (G R Sutherland, personal communication) and at other hospitals away from the orthopaedic clinic.

To assess the repeat x ray rate in a more typical English district hospital setting, we carried out the following audit. During a three week period in August and September 1991 we prospectively surveyed all patients attending 29 consecutive

orthopaedic clinics. The x ray facilities serving the clinics are limited to Northwick Park Hospital and to one other site, which provides services to the patients of general practitioners but is staffed and organised by the Northwick Park radiology department. Five patients out of 491 referred for radiography had a repeat x ray examination because of missing films: a repeat radiography rate of 1%. Furthermore, the Scottish authors expressed their 33% of repeat examinations as a percentage of all patients attending the orthopaedic clinic (whether sent for radiography or not)³; our equivalent figure for repeat radiography for all patients attending our orthopaedic clinics was substantially less than 1%.

The important message from the Scottish survey would seem to be that health centres that have x ray facilities may be associated with a high level of repeat x ray examinations in patients subsequently referred to hospital for an orthopaedic opinion. Clearly, that particular problem needs to be dealt with.

For understandable reasons of brevity the *BMJ* editorial failed to convey the particular background to the Scottish survey.⁴ When *BMJ* editorials, commentaries in the lay press,⁵ or indeed review articles such as Fiona Godlee's refer to unnecessary x irradiation in this particular context the authors might consider that it could be reassuring to their readers, as well as to patients, to note that a repeat rate of less than 1% has been shown to occur in the setting of a district hospital where local health centres do not have x ray facilities. At present this represents a more typical setting for the United Kingdom in general than do the arrangements existing in Scotland.

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Risk of Down's syndrome and amniocentesis rate

SIR,—Charlotte Fleming and David J Goldie observed that most women (60%) who were aware that their risk of bearing a fetus with Down's syndrome was at least 1:200 (derived from their age and serum α fetoprotein concentration) did not undergo amniocentesis.¹ They comment on the serious implications for the potential benefits of introducing population screening for Down's syndrome based on risk.

The national Down's syndrome cytogenetic register for England and Wales recorded 323 prenatal cases and 737 postnatal cases of the syndrome in 1989. After allowance for natural fetal loss, and in the absence of prenatal diagnosis, 973 affected infants would have been expected to be born, 602 to women aged under 35. Thus 236 cases of Down's syndrome were prevented by prenatal diagnosis.²

In the absence of biochemical screening the indications for offering karyotyping to women aged under 35 are a previously affected child, the presence of a balanced translocation, and abnormal findings on ultrasonography. In 1989, 38 cases of Down's syndrome (adjusted for spontaneous fetal

loss) were detected in this age group. Currently the most effective biochemical screening method is the triple test, which, using a cut off of 1:200, has the potential to detect 57% of cases surviving to birth for a false positive rate of 3.9%.³ Assuming that 40% of women with a risk of 1:200 or greater (1.56% of pregnant women) choose to have amniocentesis, then the expected number of cases detected in those aged under 35 would be 137 (0.4×0.57×602). Biochemical screening would have improved the overall detection rate from 24% to 34%, which, though not optimal, remains beneficial.

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Medical abortion

SIR,—Michael Heard and John Guillebaud's editorial on medical abortion avoids certain aspects of the problem.¹ An economic evaluation of the use of mifepristone has been made. Replying to a debate in the House of Commons, the under secretary of state for health, Stephen Dorrell, said, "I emphasise that we do not envisage the use of mifepristone as a cost saving exercise. Even if we did it would be arguable whether it would be a cost-saving approach."² Further evidence is provided by the British Pregnancy Advisory Service, which has announced that it cannot offer medical termination at the same price as early surgical termination. Treatment with mifepristone will cost £240, compared with £195 for early surgical termination.

Persisting pregnancies are reported as occurring in roughly 1% of cases in which the combined method is used.³ They may result either from the woman changing her mind after receiving mifepristone or from failure of the method. As severe teratogenic effects may occur after the drug is used this is extremely important. A particularly serious teratogenic manifestation is sirenomelia, or the mermaid syndrome, in which the legs are fused together. It has already been reported in France.^{4,5} The possibility of 1000 malformations resulting from 100 000 attempted abortions is daunting.

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SIR,—With regard to Michael Heard and John Guillebaud's editorial on medical abortion¹ I wish to draw attention to the Congenital Disabilities (Civil Liability) Act 1976. It was introduced after congenital abnormalities occurred with thalidomide and was designed to resolve the question of who was liable when a woman took a substance that proved to be teratogenic. It reads:

(1) If a child is born disabled as a result of such an occurrence before birth as is mentioned in subsection (2) below, and a person (other than the child's own mother) is under this section answerable to the child in respect of that occurrence, the child's disabilities are to be regarded as damage resulting from the wrongful act of that person and actionable accordingly at the suit of this child.

(2) An occurrence to which this section applies is one which: . . . b) affected the mother during her pregnancy, or affected her or the child in the course of its birth, so that the child is born with a disability which would not otherwise have been present.

Mifepristone is highly teratogenic in rabbits, producing skeletal abnormalities and abnormalities of the central nervous system, and Pons and Papiernik recently drew attention again to the circumstances in which a child with major skeletal deformities was born after exposure to it.²

Should a woman change her mind after taking mifepristone she would run the risk of having a deformed infant. Most women abort only after the second visit, when a gemeprost pessary is inserted; as a multicentre trial showed, 6% will still not abort.³ Women travel from their home districts to abortion centres, especially the privately licensed ones, and the risk of pregnancies continuing to term after exposure is real.

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The Hillsborough tragedy

SIR,—In the light of James Wardrope and colleagues' article on the tragedy at Hillsborough football stadium¹ we report on one of the survivors of the disaster who suffered isolated traumatic rupture of the mitral valve due to crushing of the chest.

A 45 year old man was in the section of Hillsborough football ground behind the goal when the crushing took place. He lost consciousness but recalls being pulled from the crowd and laid on the football pitch. He recovered rapidly and walked away from the stadium. He was aware of a small superficial scalp laceration and left sided chest pain but did not have bruising or evidence of external injury. He had previously been fit and did not have a history of rheumatic fever or hypertension. No cardiac murmurs had been detected during an employment medical examination four years earlier.

In the next week routine examination by his general practitioner showed a loud mitral regurgitant murmur, and he was referred for a cardiological opinion. An electrocardiogram showed broad P waves in leads I and II and slight increases in voltage in the left ventricular leads compatible with early left ventricular hypertrophy. A chest radiograph showed slight cardiac enlargement with a normal pulmonary vascular pattern. Echocardiographic study showed a prolapsing posterior mitral valve leaflet with moderate mitral regurgitation and good left ventricular contractility. Since then, electrocardiographic changes compatible with left ventricular hypertrophy have become more pronounced, but the patient has remained fit with a normal exercise tolerance.

Non-penetrating crush injury can cause myocardial contusion, valve disruption, and rupture of the great vessels or cardiac chambers. The right heart, being closer to the sternum, is more often affected than the left. Channer *et al* reported six cases of acute right heart strain in people crushed during the disaster at Hillsborough football