is a strong feeling in New Zealand that such a scheme will come eventually.

There is little pressure in Britain at the moment for creating a no-fault scheme for compensating disability. Indeed, consumer pressure groups are pushing in the opposite direction—towards an enhanced legal system—when it comes to compensation for product injury.⁷ My experience of the chaos in America—where strict liability prevails—convinces me that progress towards a full no-fault system could be much preferable.

This is the second of three articles.

References

- ¹ Smith R. Problems both sides of the Atlantic. *Br Med J* 1981;282:1443-5.
- ² Ison TG. *Accident compensation*. London: Croom Helm, 1980.
- ³ Royal Commission of Inquiry. *Compensation for personal injury in New Zealand*. Wellington: New Zealand Government, 1967.
- ⁴ National Committee of Inquiry, Compensation, and Rehabilitation in Australia. Canberra: Australian Government, 1974.
- ⁵ Palmer G. *Compensation for incapacity: a study of law and social change in New Zealand and Australia*. Wellington: Oxford University Press, 1979.
- ⁶ Hocken AG. There is a hole in your bucket, dear Minister. *Br Med J* 1982; 284:407-8.
- ⁷ Anonymous. Compensation for drug injury. *Br Med J* 1979;iii:1674-5.

Personal Paper

What's wrong with the funding of cancer research?

PHILIP HUGH-JONES

I fear that what I am writing may sound like the complaints of a failed examination candidate, but I am distressed by my experience of trying to get money to support some cancer research. I have no training in oncology, but have considerable experience in research in thoracic medicine.

It all started when I went, and was fascinated by, an exhibition called "Light Fantastic" at Burlington House some years ago, which showed the principles of the laser and the development of holography. At that time we were one of the first hospitals to change from rigid to fiberoptic bronchoscopy for most patients. We have a large bronchoscopy list of up to 20 patients a week, many of whom regretfully have lung cancer. It seemed to me that shining a laser down a fibre light guide in the biopsy channel of a bronchoscope might be a good way of concentrating destructive energy locally into a tumour which, after all, arises within the bronchus. It always has seemed a pity to have to operate surgically or to use x-rays through the entire chest to get at a tumour in the airway. Furthermore, if hypoxic cells within a bronchial carcinoma would take up a dye, because of their damaged membranes, then by using the complementary wavelength light from an appropriate laser it might be possible to destroy preferentially tumour cells compared with others. Possibly a naive idea, but with hindsight, I think not.

So, early in 1977 two of us borrowed a pulsed ruby laser from a commercial firm for some pilot experiments and did a search of the world literature on laser action on biological tissues. We discovered that a Neodymium-YAG (Nd-YAG) laser gave better penetration than a ruby laser so, later that year, we applied to the Cancer Research Campaign for support. The application was rejected, so we had to borrow an experimental Nd-YAG laser, which had an erratic output. We then had the fortune to co-operate with an eminent cancer research expert who had worked on transplanting non-immunising breast carcinoma to the skin of mice, as an experimental model, to try out the effects of the

laser. At first he was rightly cautious about the project, but was finally convinced by experiment that the YAG laser might indeed have a place in the treatment of lung cancer.

Thus, early in 1978, I put up the idea of comparing the direct action of a YAG laser with that of photo-activation of dyes to the Medical Research Council as part of an application for renewal of a programme grant we had enjoyed on our research unit for different lung diseases. After the elapse of many months and a supplementary application (partly because they had lost the original) they rejected the programme grant but seemed impressed enough with some of its contents to suggest I might re-apply, using them as separate project grants. This I did but, in spite of evidence from the current literature at that time about the likely use of lasers and dye uptake, they rejected the laser project. I was surprised enough to ask to visit the Medical Research Council head office to inquire the reason, but I was told that it was not their policy to reveal reasons for rejection of grant applications, though they did suggest verbally that I might like to apply to a cancer research foundation.

Balked again

So I wrote to the Imperial Cancer Research Fund in January 1979, but received a letter from the chairman of their council saying "... it is the policy of my council to appeal for donations in support of a full-time research staff in our own laboratories whereas the complementary role of grants to universities, hospitals and medical schools is fulfilled by the Cancer Research Campaign. May I therefore suggest you approach the Secretary General [of the Cancer Research Campaign] with your proposal?"

I went back to the Cancer Research Campaign again in March 1979 asking for support for animal studies with a YAG laser and, having obtained approval from the hospital ethics committee for a clinical trial, mainly in patients with advanced lung cancer who were not suitable for any other palliative treatment. We then discovered that a firm in Germany had produced a YAG laser specifically for clinical work, which at that time was much better than the unreliable, rather cumbersome, experimental model we had. A visit to Munich in June 1979 demon-

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strated that their laser could indeed cure cancer of the bladder and other organs and, from their extensive experimental work, was highly likely to help patients with lung cancer. They were enthusiastic and helpful, but in Britain I was told the whole idea was too new to buy such a laser for research. In September 1979 I attended a conference on photobiology in Florence and learnt there that the Americans, Japanese, Italians, Israelis, and others were proceeding energetically with the idea of dye uptake in tumours and were already using an argon laser for dye-fluorescence detection of early bronchial carcinoma and hoped to use a similar principle for treatment. We were having enough trouble in getting any laser, let alone more than one, so, because the other countries seemed so advanced and better equipped to do the complex problem of dye enhancement by light, we plumped for the trial of a Neodymium-YAG laser and its heating effects, especially with the possibility of the heat enhancement of radio-sensitisers specifically taken up on tumour cells. With that idea we put in yet another supplementary application to the original one for Cancer Research Campaign support.

By April 1980, we did get limited help from the Cancer Research Campaign—a wide-channel fibreoptic bronchoscope to take a laser fibre and hire, on a monthly basis, of the German YAG laser; but there was no support for staff, other equipment, or any expenses such as the supply of animals. By July 1980 we had installed the needed 3-phase supply for the laser in our bronchoscopy room and by the end of that year done work with the implanted mouse tumours to show that they responded at different critical energy levels per unit area, well below burning, and that complete cure of these very malignant murine tumours could be obtained. We did not believe that the critical levels could be applied directly to man because murine tumours are more sensitive to heat but we proposed further work with radio-sensitisers to see if they potentiated the action of the laser light and we had clinically been able to stop haemoptysis and give relief from breathlessness in a few patients with very advanced lung cancer by using the YAG laser at bronchoscopy. We had submitted progress reports to the Cancer Research Campaign but in spite of numerous letters and telephone calls for over nine months were never told whether we could keep the laser and we became worried about the costs of its hire. Furthermore, it is impossible to plan properly and proceed with a research programme without knowing from one month to another if the equipment is to be removed, let alone arranging treatment for patients. Finally in September 1981, we learnt from the Cancer Research Campaign that we could keep it at least to the end of that year. Then in December 1981, despite having had descriptions of our animal work accepted for publication, and despite more patients needing laser treatment, we received a letter from the Cancer Research Campaign telling us that they were unable to continue supporting our work and the hire of the laser.

My frustration was then so extreme that I personally saw their scientific secretary to ask their reasons. He was helpful and did grant a contribution towards attending a conference in the USA largely related to the use of lasers at bronchoscopy and for visiting centres concerned with laser work in that country, so that the Cancer Research Campaign could be informed. And what did I and a number of other British physicians in chest medicine learn at the USA conference this year? Nothing that I did not already know about, except the extent of the use of phototherapy in other countries compared with Britain. Our own paper was the only one presented from this country on the subject out of some 18 others from the USA, Japan, France, and elsewhere.

Phototherapy

Briefly, there are at the present time two main types of phototherapy for bronchial cancer, using lasers at bronchoscopy. Firstly, a Nd-YAG laser used for its heating effects in the infra-

red. It is of proved value for stopping haemoptysis and also for immediately giving an airway when other treatment has failed. Secondly, and more importantly, if haematoporphyrin D (HpD) is injected intravenously in man it is taken up by cancer and normal tissues but cleared from the latter more quickly, so that at about 72 hours after the injection it is concentrated differentially within the cancer cells. If then an appropriate red light (at 636 nm from a rhodamine-dye laser driven by an argon laser) is made to illuminate the tumour mass, by inserting a glass fibre down a bronchoscope into the tumour, the tumour cells are killed.

The value of a YAG laser for palliation of advanced lung cancer when radiotherapy has failed is already amply proved. Its value for earlier cases has yet to be found, but the work on hyperthermia in conjunction with radio-sensitisers and chemotherapeutic agents at Stanford University and elsewhere in the USA suggests that the very work we had proposed with a YAG laser might show that it is of value in earlier cases.

The value of photo-activation of HpD by a rhodamine-dye/argon laser is equally proved. At Roswell Park Centre, in Buffalo, in Los Angeles, and, I believe at the Mayo Clinic, it is in routine use. It is similarly in routine use in Japan (where they have already shown that some inoperable lung cancers can be rendered operable) and in other countries. But its full use and place in relation to surgery, radiotherapy, and chemotherapy are yet to be determined. In my view its introduction could be as important as that of the introduction of ionising radiation, for it can be used for many different types of cancer in many different parts of the body, some not readily treatable by any other means. Because there are no cumulative effects many treatments can be given over a length of time to control a cancer. I do not know whether it is being used clinically in this country for other types of cancer because I do not deal with such patients, but it is certainly not being used endobronchoscopically for lung cancer.

British lack of interest

Why the lack of interest in Britain? I do realise that assessing a flood of grant applications when money is limited is a thankless and invidious task, but why all the secrecy from the Medical Research Council? Surely a failed applicant can be told either that his project failed on scientific grounds and preferably told why, so that he does not waste more time, or that it was a good idea but that there were no funds to support it. This is especially important as I suspect grant applications rejected by the Medical Research Council may be prejudiced in relation to other potential supporters.

It could well be that the projects we suggested were poor ones, though I think I can prove that they were not. I do not claim that we would have initiated work with HpD had we had support for our original application four years ago, but we would have been using it, as well as the Neodymium-YAG laser, and have known more about the place of both techniques, and we would have relieved many patients seriously disabled by lung cancer for whom there is no other effective palliative treatment.

What should be done at this stage? There is no doubt that prevention of lung cancer by education against cigarette smoking is of prime importance, if it is practicable. But were everyone to stop cigarette smoking this year, which is inconceivable, the pandemic of lung cancer would still be with us for decades to come. Thus I believe there is urgent need for appropriate phototherapy to be available in a number of centres in Britain. I know many eminent colleagues in chest medicine who would support me in this contention, but they feel as frustrated as I do about it. Naturally, during these last four years I have also asked the Department of Health and Social Security whether support might be forthcoming for laser work. They were sympathetic, but I was told that the money they had available was to be used only for the development of British lasers.

Although they had already supported an investigation to compare an argon with a Nd-YAG laser to stop acute gastric bleeding (a trivial problem compared with the frequency of lung cancer), I was told by a sympathetic representative of the Department of Health and Social Security that it was official policy not to support clinical trials of lasers for treatment—that was the province of the Medical Research Council, Cancer Research Campaign, or Imperial Cancer Research Fund.

I feel I should not still have to be begging for the hire of a now obsolete German Nd-YAG laser, even though the manufacturers have been most accommodating, because new British or German equipment can be bought outright and its maintenance will be more satisfactory. Patients should not have to be sent home because of equipment failure. I also want to proceed with what we suggested four years ago—namely, to use a dye laser for photoactivation of HpD, now that the technique seems so hopeful. And I think other competent centres in Britain should also have appropriate lasers available. Yes, the capital cost for us to start a complete programme of research and find a place of phototherapy with both types of laser treatment, and concurrently to provide a clinical service, would be large—about £70 000 to do it all properly. But even that is little compared with the cost of some equipment used for cancer therapy; and it would only need about half that amount for a less ambitious programme in some of the centres.

Was there no money for this work? It seems to me that there was plenty available for cancer research. According to the *Handbook of British Medical Research Charities* the two cancer bodies, Imperial Cancer Research Fund and Cancer Research Campaign, had between them in 1981 joint capital assets of no less than £58 600 000 and a joint income for that year of £29 750 723. Yet we couldn't get the £17 000 required, then, to buy an obsolete German laser. I must support the Cancer

Research Campaign to the extent that they do give out all the money they get for research, and were even overspent in 1981. In the past, the Imperial Cancer Research Fund was criticised, rightly in my view, for spending too little of the money it received from charity directly on research. For example, in 1979 and 1981, respectively, it had incomes of £9.7m and £16.1m but gave out only £6.2m and £14.8m. Thus if it did not distribute over £5 000 000 in those two years, which are the only ones I know about, no wonder its capital assets are so large. A recent article in *Nature*,¹ however, states that even the Imperial Cancer Research Fund seems to be running short of cash, despite last year's income being the largest ever. This appears to be because it is spending no less than £3m towards a cyclotron, £12m towards building a new laboratory, and because government cuts have meant that some of its workers get less from other sources. But why is it the policy of the Imperial Cancer Research Fund to support only its own staff? Why should not the money collected from the public for cancer research be distributed for any competent research project, especially if it's a new endeavour, rather than the money being available only to a limited number of established workers?

I would now like either to be told by the expert assessors why I have been wrong over the last four years and why the published work on phototherapy is unsatisfactory or, alternatively, for research and treatment in phototherapy to be supported in Britain as it is in many other countries. There ought to be money available between the Department of Health and Social Security, the Medical Research Council, the Imperial Cancer Research Fund, and the Cancer Research Campaign.

Reference

- ¹ Walgate R. Marking time. *Nature* 1982; **296**, 595.

What are the hazards of x-ray examinations in childhood?

In most diagnostic x-ray examinations the body tissues are exposed to relatively low doses of radiation. In many the dose delivered to important tissues, such as the gonads, amounts to only a tiny fraction of the dose received annually and unremittingly from natural sources of radiation in the environment. Furthermore, the dose rates most often used in diagnostic examinations fall within the range of exposure that has been proposed by both national and international protection bodies as acceptable annually in occupational exposure. At the low level of dose exposure encountered in diagnostic radiation, the untoward effects being considered are either genetic or carcinogenic. Bone marrow, breast, lung, and thyroid are the tissues most susceptible to the induction of cancer by irradiation. It is therefore essential that all reasonably practical steps are taken to minimise exposure to radiation. Requests for examinations, particularly those needing higher exposure, must be well justified medically. Patients and parents of children who require radiographic examinations should be reassured that the degree of risk to the individual patient for most routine examinations is very low. When examinations at higher exposures are needed the medical benefit is still expected to outweigh the risks of harm from radiation.^{1 2} There is evidence that, for the same absorbed dose, the risk of induced cancer may be appreciably higher in children compared with adults. For example, in leukaemia the risk of induction for the same dose exposure may be twice as great in children. Again, there is an appreciably higher risk of breast carcinoma arising in an adolescent breast that has been irradiated compared with other ages. It must be remembered, however, that the radiation dosage delivered during x-ray examinations of children are usually smaller than those received by adults. For example, the dose required for an adult chest radiograph may be greater than that received by a neonate by a factor of 10. At the same time, the relative small size of the child means that target organs such as thyroid and gonads may be much closer to the main beam. Clearly, special attention to minimising the dose in children is needed, for with a longer life expectancy they have a greater potential for the manifestations of the late effects of irradiation. Nevertheless, it should be emphasised that for the individual child the degree of risk of cancer

induction from the normal range of doses used in diagnostic radiology is low. To place this in perspective, in a follow-up study of 1480 children who had had multiple cardiac fluoroscopy no increase of cancer above the expected rate was found.³ This study provided 26 000 years of patient follow-up. It does illustrate the difficulty of collecting meaningful data in a group of patients who have been exposed to diagnostic radiation, but where this has been done no significant deleterious effect has been shown. During the past 20 years attention has been focused on diminishing the exposure of everyone to radiation. It is therefore appropriate that strenuous efforts have been directed towards improving the standards in diagnostic radiology. In paediatric radiology special problems arise related to the need to define fields more carefully and the use of the immobilisation techniques to obtain an examination of high quality. Thus skilful radiography, advice from medical physicists on doses, and discussions with clinicians as to the importance of any particular examination all contribute to achieving high standards of practice. Interestingly, although the total number of radiological examinations in childhood have increased in recent years, the radiation dose per examination has decreased owing to these improved techniques.—M C PEARSON, consultant radiologist, London.

¹ United Nations Scientific Committee on the Effects of Atomic Radiation. *Sources and effects of ionising radiation*. New York: United Nations, 1977.

² ICRP. *Recommendations of the International Commission on Radiological Protection*. Oxford: Pergamon Press, 1977. (ICRP Publication No 26.)

³ National Council on Radiation Protection & Measurement. *Radiation protection in paediatric radiology*. Washington: NCRP, 1981.

Correction

Services for children: outpatient clinics and day care

We regret that we omitted to acknowledge the growth chart shown in this paper by Dr H B Valman (27 March, p 963). The chart was adapted from that described by D Gairdner and J Pearson in *Archives of Disease in Childhood* and published by Castlemead Publications, Hertford (ref GPB).