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TO: The Chairman
The Special Joint Committee Concerning
Rongelap and Utirik Atolls
Congress of Micronesia

Sir,

I have pleasure in reporting to you on the medical examinations made during September 1972 by the Brookhaven U.S. National Laboratory team and their consultants, and on the subjects specified in the Memorandum of Understanding between Representative Hans Wiliander and the consultants to your Committee.

I accompanied the team from September 6th to 23rd, and either observed or took part in examinations, including that of the thyroid gland, of most of the people seen on Rongelap and Utirik, and of about 60 of the 80 people to be seen on Majuro. I also examined microscopic sections of thyroid glands removed at operations on these people, and have studied reports of previous surveys and estimates of radiation dose.

I will comment on the lines indicated in the Memorandum of Agreement but think it may be useful to the Committee if I refer first to the aims of these surveys as I observed them.

It seems to me that the surveys have, and have had, three aims which are to a large extent interdependent.

(a) As a primary purpose, to detect at an early stage any radiation-induced abnormality, so that early treatment can be given, e.g. by removal of benign nodules to prevent malignant development, and of malignant nodules to prevent their spread beyond the thyroid or the neck; or to start or supervise treatment designed to prevent such changes occurring (e.g. by giving "Synthroid").

(b) In addition, to maintain a record of the frequency of any observed thyroid or other changes, in relation to the radiation exposure of thyroid glands. When detailed examinations need to be made anyhow as under (a), this record involves no additional examination or study except of the normal frequency of changes occurring in people who have not been exposed, and of the radiation dose likely to have been received by those exposed. It is however of very considerable importance in the proper planning of radiation protection measures, to know the changes that may

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occur after a given exposure and the frequency with which they occur. This incidence information therefore has widely recognized importance, for example in the International Commission on Radiological Protection, and in the United Nations Scientific Committee on the Effects of Atomic Radiation, particularly in view of the careful clinical examinations that are made on the Marshallese people.

(c) To offer any treatment, or advice about treatment, for any condition detected by the general medical examinations, although unrelated to radiation. It is obvious that if a strongly qualified and equipped medical team is making rather extensive examinations in any case to detect and treat any radiation induced condition, the team would wish to offer treatment of any other condition as well. In fact I think that this general and nonradiation aspect of the visit clearly occupied a major proportion of the team's effort. A general "sick-call" for any ill member of the community was announced and held on each day (in Rongelap and Utirik), and each patient so seen was discussed in detail by the whole group in the light of the different findings (clinical examination, blood count, X-ray etc.). The rather full clinical examination of the radiation exposed people was also supplemented by eye examinations and by electrocardiographic, blood and chest X-ray and urine examinations in many cases, and these were of evident value in general medical surveillance, as judged by conditions detected which were unrelated to radiation but which required treatment.

Coming to the points raised in our memorandum of agreement,

1(a). It is difficult to say at all exactly what interval is necessary, but new nodules have been detected on this visit in two people, and possibly a further instance of depression of thyroid function (the latter diagnosis depended partly on later chemical analysis of the blood sample). Both these conditions call for rather prompt action: for the nodules, to establish by surgical removal that they are benign and that they cannot become malignant, or to plan appropriate operation if either should prove to be malignant; and for the depression of thyroid function, if confirmed, to start or increase thyroxine ("Synthroid") dosage.

I understand that one radiation exposed person has been found to have a significantly low white blood cell count, and this will require immediate investigation and probably treatment.

The thyroid tumours of the type liable to follow radiation are relatively slow growing, even if malignant, and the apparently successful complete removal of all that have previously occurred is reassuring. Whether this would have been the case with less frequent examinations is uncertain. There would clearly be greater risk, however, even at this stage after exposure, in widening the interval considerably, since annual thyroid examinations help in ensuring that a malignant nodule is detected early enough for it to be completely removed before it has spread too far

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to be removable.

1(b). Present examination methods appeared to me to be extensive, detailed and careful. In particular, the clinical examination of the thyroid was ordinarily done by one of the team and one observer, with two others of the team and two other observers also in any case of doubt. The laboratory tests used highly sensitive modern methods of detecting any threatened, as well as any actual, depression of thyroid function (by measuring the blood concentration of the thyroid stimulating hormone as well as of the thyroid hormone itself). They are in general of the same type and range as those that I use in my own work in excluding depression of thyroid activity. Apart from additional tests that were made occasionally of the reserve of thyroid function (by injection of thyroid stimulating hormone in a few cases), these are the orthodox routine tests ordinarily done in sound advanced thyroid clinics - given that thyroid scans need to be specially arranged outside the Trust Territories if shown to be required.

I therefore do not see other thyroid tests which should be added, or any present ones deleted. Nor do I see any tests for radiation effects which should be added or deleted. It is a matter of opinion whether any tests carried out as part of general medical care and surveillance, and presumably irrelevant to radiation effects, for example by electrocardiograms or tests on the urine, should be deleted. If an expert team with the necessary facilities is on these islands in any case, and if these tests detect treatable disease that had not otherwise been detected, I think it would not be appropriate to delete them, even though from the narrower point of view their deletion would probably not impair the necessary care of these peoples in regard to purely radiation induced effects. Unless equally detailed medical examination is available to these (and other) islanders from other sources, therefore, it would seem to me wrong to diminish this general health protection, even though the size of the team could be reduced if its work were confined to radiation effects alone and if "sick calls" and general surveillance were excluded. As it stands, I think it could in fact even be held that the exposed islanders may actually have had better health than other islanders - by virtue of non-radiation diseases detected and treated and despite the radiation induced thyroid conditions that have required treatment.

1(c). With so little common language between most members of the team and the people examined, an impression of brusqueness could easily be created, but I did not consider that the many examinations that I saw were inconsiderate. It was particularly obvious that Dr. Conard was being greeted as an old friend, and Dr. Sutow's gentleness and charm in dealing with children and young people were very evident. In general the difficulties seemed to be only those that, for example, I find in London in examining a patient with whom I have no common language: namely that one cannot verbally express reassurance, cannot indicate in detail

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what examinations one is about to make, and cannot explain the purpose or results of each.

It was of outstanding value that Dr. Ezra Riklon first obtained from all who were being examined, an account of any sympotoms they had, and then explained the nature of the intended examinations. In addition, if any abnormality was detected or suspected from the examination, he asked, or interpreted, additional questions to amplify the "history" and to make sure that the individual understood the position and any necessary action. I understand that this arrangement was introduced on this 1972 visit and I would expect that difficulties in communication will have been much reduced by this, particularly in view of his sympathy and his deeply humane and positive personality.

On this general point, I understand that unirradiated people had questioned why they also should be examined and should be exposed to blood sampling and other tests. I was concerned to hear this since, if so, it would imply that their help had not been clearly asked for, or understood to be, on the voluntary basis that such help would be valuable, or essential, to the proper care of their irradiated fellow people. The point here is that if, for example, thyroid nodules were common in unirradiated islanders and did not progress to malignant forms, the proper management of nodules appearing in the exposed people might be quite different from that if such nodules were rarely seen in the unexposed. It would certainly suggest a failure of communication if the co-operation of unexposed people had not been asked for and interpreted as an offer of their help.

1(d). I examined microscopic sections of nodules removed at operation and see no grounds for disagreeing with the diagnoses - of benign or malignant forms - that have been made. The pathologists who have examined and reported on these sections include men who are internationally accepted as expert in thyroid pathology.

2(a). Past medical treatment seems to me to have been on normal and orthodox lines, and appears appropriate.

In particular,

(i) The treatment of any significant depression of thyroid activity by a synthetic thyroxine preparation - in this case "Synthroid" - is a routine, and the regular blood tests (for protein bound iodine and, when the test became available, for the thyroid stimulating hormone) enable deficiencies to be detected early. Taking the whole weekly dose of Synthroid at one time once a week is reasonable, given the slow utilisation of this hormone, and makes it more likely that the appropriate average will be maintained than if doses are to be given daily. It is of course important that Medical Aides should check that correct supplies of tablets are in fact collected regularly.

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(ii) A temporary cessation of this administration of Synthroid is necessary when tests for remaining activity are needed in patients who have been treated for thyroid cancer, as was done in the four affected patients in 1968. The period of withdrawal then used was in my view longer than needed and I have discussed this point with Dr. Conard. I find that 1 month is needed, whereas 3 months were used (1 of which apparently arose from delay in travel of patients for the tests). The effect of this would not be, and evidently was not, substantial in causing return of any severe hypothyroid symptoms, and at least it will have made tests to exclude the persistence of tumour tissue more rigorous.

(iii) The administration of thyroxine preparations to decrease the likelihood of nodules developing is also generally accepted practice, and the dosages used are normal ones. The basis for this practice is a theoretical one (to avoid stimulation of the thyroid cells by the body's own production of thyroid stimulating hormone) and it is not known by experience how fully effective it is. It cannot be completely effective, since a nodule has appeared this year in a young woman who was receiving this treatment.

(iv) The removal of "solitary" nodules is normal medical practice if they arise spontaneously, particularly in younger people and often also in older people if they do not decrease after thyroxine administration. When they arise after thyroid irradiation, and if only occurring rarely in unirradiated people of the same race and way of life, there is a much stronger case for removal to exclude possible malignancy.

2(b). Present and proposed treatments continuing on these lines appear appropriate and adequate. I agree with the opinion in the team that the nodules newly detected in two young people (by the time of my leaving Majuro) should be removed surgically, with whatever removal of thyroid tissue or local lymph nodes is indicated by their histological nature (benign or malignant).

A particular problem comes up in testing for the completeness of removal of any malignant thyroid tissue. All the four people from whom thyroid cancers have been removed were examined in detail at the time of operation, and by clinical examinations since, to exclude any remaining tumour tissue, and no evidence has been found of any. They have in addition had scans in 1968 which are reported as showing no concentration of radioiodine in any position which would necessarily indicate tumour tissue to be remaining, no uptake having apparently been found except in positions consistent with remaining normal tissue. I have discussed in detail with Dr. Conard certain additional and sensitive tests that we currently use in this situation, but these might present greater difficulties than those already used, either because of the high concentrations of a characteristic iodoprotein which is present normally in the blood

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of many of the islanders, or because the further tests would themselves involve appreciable additional radiation, or specialized linear scanning equipment which is not available in many centres.

On the three additional points on which the Committee requests comment:

1. It is inevitably difficult to assess the likelihood that further tests, after the return of the Rongelapese and Utirikese, might have added substantially to their radiation exposure, if only because this assessment would depend upon the detailed planning arrangements laid down for conducting these tests in the light of current meteorological reports, height and power of detonation, fission/fusion yield, etc. In retrospect, however, the measurements of background radiation and body burden of radionuclides appear to indicate that in fact the amount of whole body radiation was little increased, probably by less than 3% of that initially received, following the return, either from a raised background or from subsequent tests. The percentage increase in thyroid radiation is likely to have been even smaller. I have not attempted to make any exact determination of this increase, but the above estimate shows that the decision did not increase substantially the exposures received.

2. The team's general medical examinations, both of the exposed people and of the unexposed people attending "sick call" illustrated the value that periodic medical examinations always have for people living in relatively isolated small communities in any part of the world. Your present practice and development of periodic medical visits to the Marshallese and other islands is thus of obvious importance in detection and treatment of chronic illnesses. I was impressed however by the frequency of recent or "acute" illnesses or minor epidemics, the management of some of which would be beyond the facilities of Health Aides. This point is not strictly within my remit as your consultant. I wondered however whether the development of simple and reliable radio links, and appropriate arrangements for discussion when necessary between dispensaries and hospitals in the area, might not give help which could be economically practicable and rapidly introduced, and which would not only allow discussion of difficult problems, but might also provide a valuable form of continuing training and stimulus, particularly for Health Aides in the more isolated situations. I appreciate, however, the problems of supplying and maintaining equipment, and of implementing advice that might be given by hospitals, and that questions of this type will certainly have been reviewed already by your Congress.

3. I cannot comment as an expert on the purely physical estimate of external radiation exposure or the data from which they are derived. These dose estimates, however, appear to have been reliably based on early and subsequent readings, on conventional calculations as to the decrease in fallout radioactivity with time, and on reasonable estimates

of the relevant period of exposure.

The estimates of internal exposure in the initial phases depend upon three types of assumption:

(i) The size of the thyroid glands into which the radioactive iodine was concentrated, and the way in which gland size varies with age. Estimates of gland size made in different countries do not vary greatly, and the sizes assumed for the Marshallese children, in the absence of direct data, are typical average values.

(ii) The types of radioiodine taken into the body, and whether by inhalation, drinking water or food (since this affects the time and duration of exposure). The types of radioiodine present at any time since nuclear fission are well established on physical grounds, and the assumed modes and durations of intake seem reasonable.

(iii) The amount of these radioiodines incorporated in the thyroid and hence the radiation exposure of glands of any given size. Here the estimate has to be based on measurements of the amounts excreted in pooled urine specimens taken 15 days after exposure, and on assumptions as to the proportion of the initial uptake that will be excreted during this 15th day. The original assumption was that 0.05 to 0.2% of the initial uptake would be excreted on that day. I have recalculated this figure on the basis of the best later estimates of which I am aware for the speed of discharge of iodine from the normal thyroid and its appearance in the urine, and obtain a figure of 0.09%, in good agreement with the central value for the original assumptions. I have also seen a calculation by Dr. Rall and Dr. Berman based directly on measurements of iodine turnover in five Marshallese people. This gives a higher percentage, and therefore a lower estimate of radiation exposure as based on the measured urinary excretion. It should also be added that, if the thyroid radiation itself altered any of these (normal) values, it would do so by accelerating the discharge of iodine from the gland, and perhaps also by increasing the proportion excreted in the urine. Both these changes would thus lower the estimate of thyroid dose. The average thyroid dose may thus have been lower than estimated, and it seems unlikely to have been higher. It must be emphasized however that these are estimates of the likely <u>average</u> dose from internal radiation. Doses received by different children are likely to have differed considerably from the average appropriate for their age, owing to individual variations in size of gland, in amount of contaminated water drunk, or air inhaled, and in the discharge rate of iodine from the thyroid gland.

I apologize for the considerable length of this report and recognize that much of it deals with minor points of technical or medical detail. I felt however that, on questions of the type which your Committee has raised and with which it must be concerned, it was

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preferable to state the basis for opinions, even if the detail is technical, rather than to give general conclusions without supporting reasons. I hope that my comments deal adequately with the information and opinions that you require, and that you will not hesitate to raise with me any other questions that your Committee may wish.

Yours sincerely,

E. Eric Pochin CBE MD FRCP.

Dr. E. Eric POCHIN, CBE MD FRCP

Director of the (British) Medical Research Council's Department of Clinical Research, in University College Hospital Medical School, London; and Consultant Physician in University College Hospital, and Honorary Lecturer in the Medical School.

Fellow of the Royal College of Physicians since 1946, and member of its Council from 1966 to 1968. Member of the Association of Physicians of Gt. Britain and N. Ireland, of the Royal Society of Medicine, and of the British Medical Association. Member of the Ethics Committee of the School and Hospital.

Engaged since appointment as Director of the Department in 1946 in clinical work in thyroid and other diseases, in medical teaching, and in research, particularly into the investigation and treatment of thyroid disease, the treatment of thyroid over-activity, and the study of the diagnosis, metabolism and therapy of thyroid cancer; and author of various papers on thyroid cancer and disease.

Member of the European Thyroid Association, the Thyroid Club of London, and (corresponding member) of the American Thyroid Association.

Member of the International Commission on Radiological Protection, formerly Vice Chairman (1959-62) and Chairman (1962-69) of this Commission and member of its Committee on Internal Dose.

Member, formerly Chairman, of the British Medical Research Council's Committee on Protection against Ionising Radiation and member of its Committee on Internal Dose.

Member of the British Institute of Radiology, and Honorary Member of the Faculty of Radiologists, British Radiation Protection Association and the Japanese Radiological Society.

UK Representative on United Nations Scientific Committee on the effects of Atomic Radiation since 1956, and formerly Chairman of its Biological Section.