MEDICAL RESEARCH COUNCIL

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COMMITTEE ON PROTECTION AGAINST IONISING RADIATIONS

Programme for the U.K. Delegation to the Tripartite Conference on Permissible Levels of Radiation to be held in Washington, D.C., U.S.A., on the 30th and 31st March and 1st April, 1953

A. Previous Conferences

At the Chalk River Conference (September, 1949), the following matters were discussed:-

(1) Basic anatomical and physiological data on "Standard Man".

(2) R.B.E.s for α and β particles, fast and slow neutrons, and protons.

(3) Permissible exposures to external radiations (x and γ rays, β rays, fast and slow neutrons):-

(a) Whole body irradiation - long continued exposure.

(b) Whole body irradiation - single exposure.

(c) Hands - long continued exposure.

(d) Head - long continued exposure.

(4) Permissible exposures to internal radiations (m.p.l.'s in body, in air and in water):-

Group I - Ra^{226}, Rn^{222}, natural U, U^{233}, Pu^{239}, natural Th^{232}, $Th^{234}(UX_1)$, and Po^{210}.

Group II - Fission products.

Group III - H^3, C^{14}(as CO_2), Na^{24}, P^{32}, S^{35}, A^{41}, Co^{60}, Sr^{89}, Sr^{90}(+ Y^{90}), I^{131}, Xe^{133} and Xe^{135}.

At the Buckland House Conference (August, 1950) further discussions took place on many of the above items and on some new problems. In the main, these dealt with internal radiation hazards. The permissible levels for H^3, C^{14}(as CO_2), Na^{24}, P^{32}, S^{35}, A^{41}, Co^{60}, Sr^{89}, Sr^{90}(+ Y^{90}), I^{131}, Xe^{133}, Xe^{135}, Po^{210}, Ra^{226}, U^{233}(soluble and insoluble forms), and Pu^{239} were reviewed. Other items discussed were:

(1) Whether radioactivity in particulate rather than in gaseous form is likely to increase the hazard,

(2) permissible fluxes for fast and slow neutrons (fluxes expressed in neutrons per sq.cm. per sec.); and

(3) genetic factors in radiation hazards.

B. International Commission on Radiological Protection

Many of the findings of the above Tripartite Conferences were incorporated in the Recommendations of I.C.R.P. in 1950.

Since that time, there has been a Radiobiological Conference in Stockholm. A report (PIRC/18) on the Conference has previously been presented to the M.R.C. Protection Committee. It will be recalled that the main findings were:-

(1) That the basic figure of 0.3r. in any one week, recommended in 1950 by I.C.R.P. for the maximum permissible exposure of the critical tissue (blood-forming organs), remain unchanged.

(2) That, below a certain weekly exposure level, routine blood counts need not be made.

(3) That, in circumstances in which exposure of large populations occurs, it is necessary to apply a considerable factor of safety to reduce the permissible level below that of 0.3r. per week in tissue allowed to persons occupationally exposed.

C. Recent work

At the last meeting of the M.R.C. Committee on Protection against Ionising Radiations, reports were presented by the various Sub-Committees, summarising their work in their respective fields during the past year or so.

(1) Report PIRC/15 (Amended) deals with the work on high energy radiations and heavy particles. The Sub-Committee made the following recommendations:-

(a) Permissible exposure to X and γ rays above 3 MeV:-
For X or γ rays of quantum energy greater than 3 MeV, it is not possible to base the permissible whole body exposure on a measurement of surface dose. (A dose of 0.5r. to the surface for energies less than 3 MeV was based primarily on an estimated dose of 0.3r. or 30 ergs/g. to the critical tissues, taken to be several cm. below the surface. For high energy radiation, the dose a few cm. below the surface may be many times greater than that at the surface). Accordingly, the maximum permissible exposure for ionising radiations of quantum energy greater than 3 MeV shall be that which causes an energy absorption not greater than 30 erg/g. in any part of the body in any one week.

(b) Permissible exposure to neutrons:-

(i) The r.b.e. for neutrons in the energy range from thermal to 5 MeV is taken to be 10 (as in the current recommendations of I.C.R.P.). The Sub-Committee deferred for further consideration the reasons put forward by some members for raising the r.b.e. to 20.

(ii) Exposure in the energy range thermal to 5 MeV can be expressed either as that which would produce an energy absorption of 3 erg/g. per 40-hour week at a depth of 2 cm. below the surface of soft tissue, or as that which, for periods not exceeding 40 hours per week, corresponds to the following fluxes.

Neutron energy	Permissible flux (neutrons/cm^2/sec)
0.025 eV to 10 KeV	2000
0.1 MeV	400
0.5 MeV	150
1 MeV	100
2 to 5 MeV	50

(2) Report PIRC/15A (Amended) deals with the work of the Sub-Committee on External Radiation. Efforts have been concentrated mainly on assessing, for the general population, the mean radiation dose at the gonads as a result of diagnostic examination. It was found that the average gonad dose per head of the population in this country is, at present, small compared with the contribution from natural radiation.

(3) Report PIRC/15B (Amended) deals with the work of the Sub-Committee on Internal Radiation.

Maximum permissible levels have been provisionally recommended for 20 isotopes, other than those given by I.C.R.P. Consideration has also been given to the importance of such elements as boron and lithium in the lens of the eye, to dosimetry of radioactive isotopes in tissues, and to the radiation toxicity of Thorotrast.

Simultaneously, the Sub-Committee on Internal Dose of the U.S. National Committee on Radiation Protection has been working to establish maximum permissible levels for a number of isotopes. It is ultimately envisaged that their findings will be published in a National Bureau of Standards Handbook (No. 52). A few pre-publication copies of the report have been received in this country and reveal that about 70 isotopes have been given consideration. (The number includes those dealt with at Chalk River and Buckland House.) It has been noted that there are some important differences in the principles adopted by the M.R.C. Sub-Committee and by the U.S. Sub-Committee. Mrs. J.I. Palmer (of A.E.R.E.) has produced a summary of the two sets of recommendations

and has pointed out that many of the differences between them can be accounted for by two facts:-

(a) If the maximum permissible level of Sr^{89} is assessed on the basis of its observed biological effect relative to 0.1 μC Ra, a value of 2.0 μC is obtained. (This is the present I.C.R.P. value.) Of r. however, the Sr^{89} level is assessed as the amount which will produce 0.3 equivalent r. in tissue, the value obtained is 11. The M.R.C. Sub-Committee has chosen the former basis and has extended this to other bone-seeking isotopes. The U.S. Sub-Committee has taken 0.3 equivalent r. in tissue as the basis for estimating m.p.l.'s for bone-seeking isotopes. Thus there arises a difference by a factor of 5. For some of the isotopes, e.g., Y, Zr, Ce, Pr, Pm, Sm and Eu, the M.R.C. Sub-Committee has allowed a further factor of 5 for uneven distribution of the isotopes within the bone. Accordingly in some cases, there is a factor of 25 difference between the British and U.S. figures.

(b) In some cases (e.g. Y^{91} and Ru^{106}), calculations indicate that the damage to lung and to gut by temporarily retained isotopes is greater than that to the ultimate organ of storage. The British figures are based on the damage to the lung and gut, the U.S. figures on the damage to the organ of storage.

D. Programme for Washington Conference

(1) Preliminary meeting of U.K. delegates on 29th January, 1953.

The U.K. delegates, together with Dr. Katherine Williams and Dr. A.S. McLean, held a preliminary discussion of the programme on 29th January. The following is a summary of the conclusions reached.

(a) Radium.

The value of 0.1 μC as the m.p.l. for Ra. should be retained, though this probably contains a safety factor compared with the minimum damaging dose.

(b) Sr^{89}.

The value of 2.0 μC, which is accepted by all parties as the m.p.l. for Sr^{89} in the body, shall be retained.

(c) Ca^{45} and Ba^{140} (+ La^{140}).

It is felt that the distribution of Ca, Ba and Sr. in the skeleton, though not necessarily identical, are so similar that the same considerations should apply to these elements. Accordingly the delegation advocate the adoption of the British figures, which are based on the above level for Sr^{89}.

(d) Y, Ce and other bone-seeking rare earths.

The question here is as to the necessity for an additional factor of 5 for inhomogeneous distribution. The meeting was not unanimous about the policy to adopt. On the one hand, it might well be that the figure for Sr. already contains a factor (either as a safety factor or as a factor to allow for uneven distribution), which does not justify applying a further factor of 5, relative to Sr, for Y and similar isotopes. On the other hand, Hamilton and Vaughan have shown that the distribution in bone of isotopes like Y is different from Sr, and accordingly the M.R.C. Sub-Committee allowed an extra factor of 5 (PIRC/IR/33). It was, however, felt by the delegation that this procedure is quite arbitrary and that the question of applying this extra factor should be left open for discussion in Washington.

(e) Irradiation of the gut.

It was noted that there were differences of 2 or more orders of magnitude between the U.S. and British figures for the m.p.l.'s of Y and other non-absorbed elements in water. These differences could be ascribed to the fact that the U.S. Sub-Committee had assumed very low uptake figures for the rare earths and had not allowed for irradiation of the gut.

It was decided to abide by the British figures, based on 24 hours half life in the gut with a possible small relaxation for self-absorption of β rays in the contents of the gut. Dr. McLean said that the faecal excretion of Pu indicated that a 24-hr. half life was a reasonable assumption. He has offered to prepare a note for the delegation summarising the results which he has obtained.

(f) Uptake from ingestion.

Drs. Loutit and McLean said that recent observations with fission products and Pu made them doubtful of the validity of the very low gut uptake figures hitherto accepted. It was also noted that the U.S. Sub-Committee had assumed only 0.03% uptake of Po from the gut to the spleen, which they considered to be the organ of deposition. This seemed to be a low figure compared with the evidence presented in "Biological Studies with Po, Ra and Pu".

(g) M.p.l.'s for α emitters.

(i) Pu. The m.p.l. for Pu should not be altered until fresh evidence is produced.

(ii) Th, Rn and Ac. It is desirable that new assessments be made.

(2) There is a meeting of the M.R.C. Sub-Committee on Internal Radiations on 19th February, when doubtless consideration will be given to the above matters. It is hoped that it will be possible to report upon the views of the Sub-Committee at the meeting of the Main Protection Committee which is to be held later the same day. Other problems which should receive consideration at the Tripartite Conference are:-

(a) Basic dose for X and γ rays up to 3 MeV:-
  (i) whole body exposure;
  (ii) partial exposure.

(b) Basic dose for X and γ rays above 3 MeV (30 erg/g.?)

(c) Permissible exposure to β rays. (Is the value of 1.5 equivalent r. too restrictive?)

(d) R.B.E. values.

(e) Neutrons:-
  (i) Permissible exposure (i.e. 3 erg/g.?).
  (ii) Permissible fluxes.

(f) Emergency doses.

(g) Life doses.

The U.K. delegation would welcome the advice of the Main Protection Committee on all the above items.

W. Binks
Secretary