REVIEW

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REVIEW

The 1958 UNSCEAR report

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Abstract

In the mid-1950s, concern was increasing about the possible effects from the radioactive fallout resulting from nuclear weapon testing. Various scientists from non-nuclear countries such as Sweden and Canada made their politicians aware of the potential hazards of fallout. This concern went up to the General Assembly of the United Nations, which took the unique step of appointing a scientific committee to advise it about the levels and effects of radiation, especially from nuclear bomb testing. The United Nations Scientific Committee on the Effects of Atomic Radiation was established in 1955 and held its first working meeting in September 1956. In less than two years it produced its first, pioneering report, which produced previously secret information about fallout exposure, and hitherto unknown information about natural background and medical exposure.

Fifty years ago, on 13 June 1958, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) approved a 40-page report to the UN General Assembly, supported by nine scientific annexes. This was a truly pathfinding effort, opening up, as it did, the whole previously shrouded area of fallout exposure, not to mention hitherto unknown information about natural background and medical exposure.

It seems to us that it is an apt time and an appropriate subject for a review of the 1958 report, particularly now when the future of UNSCEAR seems uncertain. To forsake UNSCEAR out of ignorance, as could well happen, would be disastrous, considering the possibility that it could play an important role if nuclear proliferation comes about. Even though the UNSCEAR reports, which are recognised and appreciated all around the world, are of indisputable scientific value, the Committee’s real reason to exist is that it provides a forum for agreement on scientific issues that could otherwise be misused in political discussions.

\textsuperscript{3} Member of the UNSCEAR scientific secretariat 1957–1958.
\textsuperscript{4} Member of the Canadian UNSCEAR delegation during the preparation of the report.
UNSCEAR was created at a time when testing of nuclear weapons began to cause atmospheric contamination which resulted in radioactive fallout. This caused public concern, which was amplified by the secrecy surrounding everything to do with it. This is reflected in the acronym ‘UNSCEAR’ which could be pronounced ‘unscares’, a seeming pun that could have been counterproductive had it not been for the integrity and competence of the scientists in the national delegations to the committee and in its secretariat.

Those who were not around in the mid-1950s may find it hard to comprehend the atmosphere of the time. The ‘cold war’ had begun; there was fear about the possible effects of nuclear weapon testing, and there was apprehension about a possible hotting up between the major powers. Secrecy meant that knowledge about ionising radiation and its effects was limited to a privileged few. Indeed, one of us (DS) remembers that in 1955 he was told in great confidence about the existence of radioactive fallout, and especially about the hazard thought to be posed by strontium-90. So secret was this information that the United States Atomic Energy Commission had even devised a code word—Sunshine—to disguise the dreaded nuclide. The supposedly predominant hazard of strontium-90 partly explains the amount of attention paid to it, at the expense of other nuclides that have since come to be regarded as more significant, particularly caesium-137.

At the time of the drafting of the 1958 UNSCEAR report the member countries were Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, Egypt (later United Arab Republic), France, India, Japan, Mexico, Sweden, the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, and the United States of America. More countries (China, Germany, Indonesia, Peru, Poland and Sudan) were subsequently added by the General Assembly, but they did not participate in the drafting of the 1958 report.

The Committee was assisted by a scientific secretariat of unusual strength and competence. That its resources were so good was possibly because it was believed that this was to be a one-off effort. The secretariat was directed by the Canadian geneticist Ray Appleyard. Among the scientific secretaries were Dan Beninson, Maurice Errera, Henri Jammet, Bo Lindell, Herrman Lisco and Eizo Tajima.

The 1958 report established a pattern that has been followed in successive reports, namely a main text and a number of scientific annexes. The annexes form the scientific core of the reports; the main text is more or less a condensed version aimed at the General Assembly delegates who were considered to be ‘infinitely ignorant but infinitely clever’. In the 1958 report, however, there was one exception to pure science, namely paragraph 54, which was only approved by a majority of the committee. The paragraph listed the various sources of radiation to which mankind is exposed. It concluded that ‘all steps designed to minimise the irradiation of human populations will act to the benefit of human health’. The committee added that ‘considerations involving effective control of all these sources of radiation involve national and international decisions which lie outside the scope of its work’. The USSR, supported by Czechoslovakia and United Arab Republic, wanted a different text which suggested that the committee should ‘draw the conclusion that there should be an immediate cessation of test explosion of nuclear weapons’. This was rejected by all other delegations except Belgium (which held the chair), mainly because they wanted the report to be strictly scientific and without policy statements that should be made by the General Assembly. India suggested an alternative wording which was supported by Brazil, France, Japan and the United States, but was rejected by a majority\(^5\).

\(^5\) An anecdotal account of the marathon debate and the subsequent chaotic vote was published in *J. Radiol. Prot.* 2001 21 58–59 (Sowby 2001).
This was the only time a political issue was discussed and referred to in an UNSCEAR report. As the committee continued its work and delegates came to know each other better, political matters ceased to play a role. There was a frosty climate at first, with little fraternising, but the barriers were gradually broken down at receptions and during work in subgroups.

The final drafting of the report took place at a five-week meeting in the UN building in January–February 1958. The subsequent work was merely editorial, performed by the secretariat, which was kept busy late into many nights.

The bulk of the report—180 pages out of a total of 228—was taken up by annexes, which were intended to explain the scientific basis for the preceding report to the General Assembly. The following summarises the content of the annexes.

Annex A. Definitions of quantities, units and symbols

The basic dosimetric units used in the report were the absorbed dose, expressed in rad, and the ‘RBE dose’, expressed in rem (‘RBE’ stood for relative biological effectiveness). The ‘exposure dose’, expressed in roentgen (r), was still being used. The appendix was merely one page and consisted mainly of extracts from the 1956 report of the ICRU.

Annex B. Radiation from natural sources

This was the first time that a thorough review of the radiation doses from natural sources was published. The annual ‘RBE dose’ in the human body was estimated at 100 mrem (=1 mSv). The alpha doses to gonads and other soft tissues from radium and its decay products could not be given because of scarce information, and the ‘RBE’ dose from them in the lungs was not yet known. The annual contributions from the three main sources (cosmic rays, external gamma rays and internal potassium–40) were about 30, 50 and 20 mrem, respectively. Better knowledge of the alpha doses from inhaled radon and thoron daughter products in the lungs subsequently raised a new quantity, the ‘effective dose’, from 1 to 2 mSv.

Annex C. Man-made sources other than environmental contamination

This annex was devoted to information on the genetically significant dose (GSD). This quantity was defined in paragraph 27 of the main text as

'the dose which, if received by every member of the population, would be expected to produce the same total genetic injury to the population as do the actual doses received by the various individuals'.

Of particular interest was the GSD from medical exposures, particularly diagnostic x-ray exposures. The drafting of the annex made use of a report of a joint study group of the ICRP and ICRU at the request of UNSCEAR.

The GSD was a relatively new concept, first introduced by Osborn and Smith in 1956 and then elaborated by the ICRP and ICRU (1957). There was an embarrassing mistake in the ICRU/ICRP calculation, resulting in a GSD twice as high as the actual dose if everyone was exposed to the same dose, in conflict with its definition. This mistake was corrected by Eizo Tajima in the draft that he prepared for the Committee in 1957.

The ICRP/ICRU had developed a classification of x-ray examinations to be used in GSD assessments. It was used by UNSCEAR with minor modifications. However, the committee complained that
'the difficulty of applying any standardised method of calculation to a large amount of heterogeneous information from various countries confirms the importance of carefully planning any survey of exposure levels which is to yield a statistically useful result'.

In other words, none of the national reports that were submitted could be used without extensive reassessment using the ICRP/ICRU classification.

The estimated values of the annual GSD from diagnostic exposures in the reporting countries varied from 20 to 150 mrem. The committee also estimated the typical annual per capita\(^6\) mean dose in the active bone marrow in countries such as Sweden, UK and USA, and found that the various examinations contributed between 0.025 and 10 mrem. In the preparation of the report the committee had been sceptical about the relevance of these estimates since there was no agreed assumption on dose–response relation for which they could be used.

For the calculation of the GSD for an individual of a given sex from an examination of a specified type, the report listed the expressions to be used.

Annex D. Environmental contamination

For the first time a scientific review of the fallout problem was made. However, the cold war secrecy prevented a listing of the test explosions, as was made in later reports. In addition, the reluctance of the nuclear weapon states to reveal details about the release of carbon-14 from thermonuclear explosions was reflected in the absence of any reference to that nuclide until the 1962 UNSCEAR report.

The predominant concern about strontium-90 at that time was reflected in the fact that its analysis occupied half of the 131 paragraphs in this annex, whereas caesium-137 was dealt with in a bare dozen. In retrospect this is odd, since caesium-137 was the first radionuclide to cause world-wide attention. The caesium fallout disturbed Rolf Sievert’s whole-body measurements in 1955, and the cause of the disturbance was revealed in 1956 when Miller and Marinelli at Argonne published a report on scintillation spectrometry of fallout caesium-137 in citizens of Chicago, far away from any testing site.

Paragraph 131 in annex D referred to the secretariat’s new approach to assessing doses, but dose commitment was first used in the 1962 report. The new approach was discussed in 1958 by a group of experts of the committee and was published in a UN document (A/AC.82/INF.3), of which the Committee in 1958 said that it had ‘not sufficient time to study and eventually to accept this work which was considered to be of substantial scientific interest; it has decided to make this paper available because it will be useful to scientists engaged in calculations of gonad or bone marrow doses and their biological effects’. Later, Bo Lindell, with the committee’s blessing, published the material in *Health Physics* (Lindell 1960). The term ‘dose commitment’ was suggested by Ray Appleyard.

The committee’s often quoted compartment model with the pathways input → atmosphere → earth’s surface → diet → tissue → dose was first introduced in the 1969 report. Nevertheless, to discuss fallout was a novelty. But in the 1958 report the method used was to assess equilibrium situations and calculate 70-year doses. The committee calculated biological detriment and used a risk coefficient reported as 52 leukaemia cases per million rem (which might, more correctly, have been expressed as 52 cases per million and rem). It also estimated the hereditary harm from nuclear weapons testing.

\(^6\) The grammatically correct term ‘per caput’ was used in later UNSCEAR reports.
Annex E. Methods of measurement

This was a very short (less than two pages) summary of the main methods for sampling and activity measurements.

Annex F. Fundamental radiobiology

This was a major annex with 20 pages of text plus 407 references. It began by making a distinction between the two major theories of mechanisms for the action of radiation on human cells: direct and indirect action. However, it was still a classical review without insight into present-day molecular biology. The close relation to cancer research was stressed.

Annex G. Mammalian somatic effects

The main components of the annex were life-shortening in experimental animals, life-shortening effects in man, and cancer in man. The effects in animals were divided into short-term and long-term; the latter were discussed in a report written by Robin Mole (1957), and quoted in full. As regards life-shortening in man, paragraph 18 is of particular interest:

‘The extent to which repeated small exposures to x-rays shorten the life of man is a matter of speculation. In the past radiologists were so exposed, but from the mortality statistics it cannot be demonstrated that the life-span of this group of medical specialists has been shortened relative to that of other medical specialists although this has been suggested. It is known, however, that the incidence of leukaemia is increased in these men.’

As regards cancer in man, the main sources of information were the ABCC data from Hiroshima and the Court-Brown and Doll data after x-ray exposure of patients suffering from ankylosing spondylitis. The risk that could be assessed was mostly the induction of leukaemia, which explains the concentration in the report on the dose to bone marrow. The committee considered the possibility that cancer production is a linear, non-threshold function of radiation dose, although it warned that at low doses the incidence may be much lower than that predicted by a linear function based on all of the data. This somewhat tentative conclusion as regards the leukaemia risk contrasted markedly with the committee’s firm assertion that, for hereditary effects, ‘it is accepted that radiation-induced mutations... increase in direct proportion to the genetically significant exposure, even at low dose levels...’. Nevertheless, the committee went so far as to present a risk factor of 52 cases of leukaemia per million and rem. This was probably the first time that a risk estimate was made by a reputable body. Risk estimates for other cancers were made in the committee’s subsequent reports.

Annex H. The genetic effects of radiation

One of the most remarkable scientific achievements ever, the disclosure of the structure of the DNA molecule, was published by Crick and Watson in 1953 but was only slowly reflected in the scientific literature. It won the discoverers the Nobel Prize in 1962. Today it forms the basis of the science of molecular biology. The 1958 report deals with gene mutations and chromosomes, which explains why the dose to gonads was so important. The recognition that DNA had been unveiled was limited to a couple of paragraphs, which ended with the modest statement that ‘very many geneticists believe that the ultimate carrier of genetic information is likely to be the arrangement of the nucleotides in DNA’.
Annex I. List of reports submitted to the committee

In the early years of the committee there was a lot of fuss about acceptable information. The member states (and other UN members) submitted special reports which were assumed to form the source of information in addition to papers in the scientific literature. Sometimes a delegate objected to data used by the secretariat, on the basis that they had not been received through proper channels. This may explain why nothing was said in the 1958 report about the Windscale accident in 1957, in spite of the fact that it was not kept secret by the British.

Discussion

How representative were the conclusions in the report? It was a pioneering effort, but how good were the results? To compare numerical results in the 1958 report with results in later reports is difficult because the modes of assessment have changed and different quantities are estimated. The estimation of doses and the assessment of the leukaemia risk, however, are not much different from present estimates. A major exception was the absence of any contribution to the effective dose (a concept that had not yet been formulated) from radon daughter products in the lungs. Nevertheless, the 1958 report played an essential part in the opening up of our knowledge of ionising radiation, its magnitude and its biological effects.

References

ICRP and ICRU 1957 Exposure of man to ionizing radiation arising from medical procedures *Phys. Med. Biol.* 2 107–151


Lindell B 1960 An approach to the question of computing doses and effects from fall-out *Health Phys.* 2 341–65

Miller C E and Marinelli L D 1956 Gamma ray activity of contemporary man *Science* 123 122–3

Mole R H 1957 Shortening of life by chronic irradiation *Nature* 180 456–60

Osborn S B and Smith E E 1956 The genetically significant dose from the diagnostic use of x-rays in England and Wales *Lancet* 16 949–53


Sowby F D 2001 ICRP and UNSCEAR: some distant memories *J. Radiol. Prot.* 21 57–62

Watson J D and Crick F H C 1953 A structure for deoxyribose nucleic acid *Nature* 171 737–8