

AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY REPORT

AUSTRALIAN STRONTIUM 90 TESTING PROGRAM 1957-1978

Background to the report

In early June 2001 a report appeared in the *Daily Mail* newspaper in the United Kingdom detailing the use of human bone tissue for the measurement of strontium 90 in the context of a US program called "Project Sunshine".

Whilst there are some indications that Australia laboratories sent bone samples to the US as part of Project Sunshine¹ the majority of activity undertaken in Australia related to a national program for the measurement of strontium 90 in human bone in the period 1957-1978.

In response to the newspaper report the CEO of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Dr John Loy, issued a media release indicating that ARPANSA held records in relation to fallout monitoring by Australia and in particular Australia's involvement in the measurement of strontium 90.

Measurement of Strontium 90

The scientific literature² in relation to the measurement of strontium 90 states that following the explosion of nuclear devices in the atmosphere, an assessment can be made of strontium 90 contamination of the environment by investigating the following materials:

- (a) Precipitation and soil;
- (b) The groups of foodstuffs responsible for the main intake of strontium 90 by the population, namely milk, milk products, grain products, vegetable and fruits, meat; and
- (c) Human bone tissue

The monitoring program in Australia was based on continuous measurement of the level of the radioisotope [strontium 90] in these materials.³

The Australian monitoring program was carried out under the auspices of the Atomic Weapons Tests Safety Committee from 1957 until that committee's abolition in 1973. The remainder of the program was carried out under the auspices of the Australian Ionising Radiation Advisory Committee (AIRAC) until the program's conclusion in 1978.

¹ A fuller account of Project Sunshine is found at Attachment A.

² An overview of some of the literature published in relation to the measurement of strontium 90 in Australia is at Attachment B.

³ Strontium 90 and Caesium 137 in the Australian Environment During 1969: Atomic Weapons Tests Safety Committee Report AWTSC No 2 May 1971

Australia's Strontium 90 survey – a chronology of events

Atomic Weapons Tests Safety Committee (AWTSC) and the National Radiation Advisory Committee (NRAC)

The Atomic Weapons Tests Safety Committee was set up in July 1955 within the Department of Supply. Its charter was to examine information and other data supplied by the United Kingdom relating to atomic weapons tests and the safety measures to be taken in relation such tests. It was also charged with advising the Prime Minister of the conclusions arrived at by the Committee and in particular alternative or more extensive safety measures that may be considered necessary.⁴

The membership of the AWTSC at establishment was Professor LH Martin (Defence), Professor E W Titterton (Head, School of Nuclear Physics, Australian National University), Dr EC Eddy (Director, Commonwealth X-ray and Radium Laboratory), Professor JP Baxter (Australian Atomic Energy Commission) and Mr WAS Butement (Chief Scientist, Department of Supply). The AWTSC oversaw the safety aspects of the atomic weapons test undertaken in Australia in the 1950's, including those tests undertaken at Monte Bello Islands, Emu, Western Australia and Maralinga, South Australia.

The membership of the AWTSC was changed in 1957, its size reduced and terms of reference modified as a consequence of the establishment of the National Radiation Advisory Committee (NRAC). The decision to form the NRAC was taken by the then Prime Minister Sir Robert Menzies following advice from the then Minister for Supply.⁵

The new mission for the AWTSC was to concentrate on the safety aspects of atomic weapons testing. The purpose of the NRAC was to advise the Prime Minister and the Government on Commonwealth-wide radiological surveys and measurements, to arrange for the supply of information to international organisations concerned with radioactivity and to arrange for the supply of samples when appropriate.

The revised membership of the AWTSC was Professor E Titterton, DJ Stephens (Head of the Commonwealth X-Ray and Radium laboratory) and LJ Dwyer (Director of Meteorology). The AWTSC continued to report to the Minister for Supply.

The membership of NRAC was Sir MacFarlane Burnet (Director of the Walter and Eliza Hall Institute of Medical Research), Professor Sunderland, Professor E W Titterton, Dr WP Holman (Peter MacCallum Clinic), Mr DA Gill (CSIRO), and Mr D J Stephens. The NRAC reported directly to the Prime Minister.

In 1957 Mr J R Moroney was appointed as Secretary to both Committees. He remained Secretary of that Committee until the Committee's demise in 1973.

Following discussions between representatives of the British Atomic Energy Research Establishment (AERE), the British Atomic Weapons Research Establishment (AWRE) and the Australian Atomic Weapons Tests Safety Committee on 13 and 24 May 1957 in Melbourne and Harwell, two sampling programs for Strontium 90 measurement were agreed

⁴ Letter from Howard Beale, Minister for Supply to the Prime Minister, RG Menzies dated 15 March 1957

⁵ Ibid

upon by the parties. One was to be of a continuing nature, samples to be collected in August –September annually and the other was intended to be a special pre-Antler⁶ survey in May-June 1957.⁷

The parties agreed that scientific and financial responsibility for these programs should lie with Australia. The sampling program included soil, vegetation, milk, sheep bones and human bones.

The National Radiation Advisory Committee had its first meeting on 10 June 1957. The Chairman, Sir Macfarlane Burnet opened the meeting stating that:

“The primary reason for the formation of this committee was to maintain public confidence that adequate measures were being taken to prevent medical and genetic damage from tests of nuclear weapons carried out in Australia.”⁸

The agreed terms of reference for the committee were:

“The National Radiation Advisory Committee has the overall function of advising the Commonwealth Government on the problems arising from the use of ionising radiations as these may affect human animal and plant life. It is the task of this Committee to advise the Prime Minister of measures necessary to ensure that the health and welfare of the Australian community is safeguarded in these matters and to define the levels of radiation which are appropriate to the legitimate needs of medicine, defence, industry, education and scientific research. The Committee will function as a clearinghouse of information on its field. It will receive all relevant information from overseas on radiation hazards from such bodies as the International Committee on Radiological Protection and the UN Scientific Committee on the Effects of Atomic Radiation [UNSCEAR]...

There are five fields in which ionising radiation may provide hazards to human well being – medical or genetic- and which need consideration by this Committee.

- i) atomic explosions
 - a) in the vicinity of test explosions,
 - b) as a result of global fall out...”⁹

In relation to the AWTSC, the views expressed by members of the NRAC at its first meeting were:

“It was emphasised that NRAC was the overall authority and the [Atomic Weapons Tests] Safety Committee was only one of the Committees to which the NRAC should give directives...”¹⁰

Professor Titterton stated that it was desirable that 90Sr analyses should be carried out in Australia and results should be made available to the NRAC.”

⁶ Antler was a series of tests undertaken at Maralinga in September – October 1957

⁷ Strontium 90 survey in Australia 1957-58: Interim Report by the Secretary of AWTSC 18 April 1958

⁸ Minutes of first meeting of the National Radiation Advisory Committee held at 339 Swanston Street Melbourne on 10 June 1957; Agenda Item 1 Terms of Reference of the NRAC

⁹ Ibid

¹⁰ View expressed at the NRAC meeting on 10 June 1957

In relation to Sr90 analyses

“Requests from the Manager New York Operations Office, United States Atomic Energy Commission for information on 90Sr analyses and from the UN Scientific Committee on the Effects of Atomic Radiation for data on radioactive fallout in Australia, which had been held pending the foundation of NRAC were referred to the [Atomic Weapons Tests] Safety Committee.”¹¹

At its second meeting on 5 August 1957, the members of NRAC discussed Australian participation in the Standardisation program of the measurement of 90Sr. It was resolved that NRAC:

“should take part in the United Nations 90Sr Standardisation program and that within Australia the work should be entrusted to the laboratories of the Commonwealth X-ray and Radium Laboratory and the Australian Atomic Energy Commission.”¹²

At the third meeting of the NRAC held on 6 November 1957 the Committee dealt with a letter from Mr Merrill Eisenbud, a representative from the United States Atomic Energy Commission Health and Safety Laboratory (HASL) inviting Australia’s participation in a fallout monitoring program. The meeting of the NRAC noted that previous correspondence proposing participation in the USAEC program has been referred to the AWTSC. Professor Titterton advised the NRAC that the AWTSC had accepted the invitation.¹³

November 1957 – collection of samples begin

In November 1957 pathologists in each of the capital cities were approached by JR Moroney as Secretary of the AWTSC to secure co-operation in collecting the samples.¹⁴

The purpose of the survey was discussed with each and a brief outline was given of the overall program to signal the importance of human bone tissue. The letter stated in part:

“The problem of Strontium 90 as a potential hazard is under active investigation in many parts of the world. The National Radiation Advisory Committee has been approached by the Atomic Weapons Tests Safety Committee,...for assistance in gathering samples.

Collection of samples of top soil, dried and processed milk, types of herbage which may form part of the human diet, and animal bones may all be arranged with comparative ease...However there is a special need for human bone samples to complete the data.”¹⁵

On 2 December 1957 JR Moroney wrote a follow up letter to the pathologists which stated in part:

¹¹ Minutes of first meeting of the NRAC: Agenda Item h)

¹² Minutes of the Second Meeting of the National Radiation Advisory Committee held at the Physics Department, University of Melbourne on 5 August 1957: Item 8(a)

¹³ Minutes of the Third Meeting of the NRAC held at Australian Atomic Energy Commission Building, Coogee on 6 November 1957: Item 9 (iii)

¹⁴ Letters from JR Moroney, Secretary of the AWTSC dated 22 November 1957.

¹⁵ Letter from JR Moroney dated 22 November 1957.

“You may have perhaps considered it possible that the question of the sampling and radiochemical assaying of bones would not be regarded kindly by the general public. Consequently I would be most grateful if in the future you could treat this matter and its related correspondence as either confidential or personal, as you wish.”¹⁶

Some of the pathologists who were initially approached were unable to assist, as they were already involved in collecting bone samples for Strontium 90 analyses and forwarding them to Columbia University for their worldwide survey of the subject.¹⁷ It is assumed that this reference is to “Project Sunshine”.

From December 1957, human bone tissue from both adults and children was collected in Perth, Adelaide, Melbourne, Sydney and Brisbane. The requirements were set arbitrarily at 12 adults and 12 children’s samples for each region.

On 5 February 1958, JR Moroney wrote to the participating pathologists¹⁸ noting that it had:

“...been decided to continue collection and analysis of human bone for the next few years and if the material were available to cover more adequately the now known distribution of strontium with age... It is hoped that you will be able to continue and possibly extend your supply of bone tissue.”

“To date the most extensive measurements of strontium 90 in human bone have been performed by two groups, one under Dr J L Kulp at Columbia University and the other under Dr Jr Bryant at Woolwich Arsenal UK. The Columbia group collects samples from 20 stations throughout the world while Bryant has concentrated more on tissue of local origin....

The most recent information on age distribution of Strontium 90 in bone ... indicates the need for emphasis on tissue under 20 years and particularly under 5 years; the maximum occurring at about 1 year is the most important feature of the distribution and any survey must be designed to monitor it.

During 1958, 142 samples were gathered from the Australian capital cities...It is apparent that tissue of under 1 year is fairly readily available whilst that between 1 and 5 is scarce making it difficult to establish the extent of the maximum in that age range. Few samples are available from the 5 to 20 age groups, ... while the adult material is mainly over 50 years.

My purpose...is to emphasise the need for tissue at ages apparently not readily available, namely from 1 to 20 years, in the hope that advantage will be taken of all possible sources.

It is hoped that as many specimens as conveniently available, but at least 10, can be provided from each of the five capital cities every six months for each of the following four age groups:

- (a) less than 2 years
- (b) between 2 and 5 years

¹⁶ Letter from JR Moroney dated 2 December 1957

¹⁷ Letter to JR Moroney dated 4 December 1957.

¹⁸ Letter from JR Moroney to participating pathologists dated 5 February 1958

- (c) between 5 and 20 years
- (d) greater than 20 years”¹⁹

In addition Moroney commented:

“You will remember that the confidential nature of the program was discussed in our early approaches. This seems no longer necessary in view of the mass of material now published and to be published on the subject.

It is difficult to imagine any extensive source of specimens that remain untapped, but we would be appreciative of any suggestions to improve supply of 1 to 20 year tissue.

You may justifiably feel that the proposed demands on you and your staff are beyond those that you originally envisaged in offering assistance. I think it is only fair to remind you that the [Atomic Weapons Tests Safety] Committee will be very pleased to come to some financial arrangement for the work that is to be done for us in your department. We will be very grateful for an assured supply of bone tissue.”²⁰

The AWTSC provided transport and handling facilities for the samples, including containers, identification tags and data sheets. Age, sex and bone type was considered to be the most important data. Security Branch officers of the Department of Supply were involved in collecting the bone samples from the pathologists in each State and sending the samples by “safe hands” to the Defence Standard Laboratories in Melbourne where samples were ashed before being shipped to the UK for radiochemical analysis.

The samples in this period were distributed in age from a few days to 80 years. The samples from each region were grouped to minimise the number of radiochemical analyses.

Samples of ages less than 5 years were analysed separately. That is they were not grouped. These serial numbers were prefixed with IH – infant human. Samples of ages between 5 and 20 years were grouped to represent each region by composite sample. The serial numbers were prefixed with CH – child human. Samples of age greater than 20 years were grouped to represent each region by composite sample. The serial numbers were prefixed with AH – adult human. Samples were then sent to the Atomic Weapons Research Establishment in the UK and to HASL in the US for analysis.

A review of the requirement for bone tissue was made after the February to June 1959 sampling. The requirements were changed such that samples from all autopsies in the stillborn to 40 years were requested from each of the participating pathologists with a smaller number required in the above 40 years age group.²¹ By 1960 the number of samples collected had increased from 441 in 1958, to 1096 in 1959 and 1200 in 1960.²² 1149 samples were provided in 1961.²³ 839 samples were provided in 1962.

¹⁹ ibid

²⁰ op cit

²¹ File note of JR Moroney dated 13 August 1959

²² Bryant, Dwyer, Moroney, Stevens, Titterton: Strontium 90 in the Australian Environment 1957-1960 Australian Journal of Science Vol 24 No 10 April 1962, p397

²³ Manuscript 9 July 1963 Bryant, Dwyer, Moroney, Stevens, Titterton: Strontium 90 in the Australian Environment 1961

This sampling pattern continued until 1968.

Changes to the parameters of the collection policy

In March 1968 Moroney raised the notion that samples should be limited to the under 40 age group, as analyses to that point in time had indicated a constant ratio of Strontium 90 to calcium in the over 40 age group. He indicated that the activities of pathologist should be directed to the under 40 age group.²⁴

It is evident that at a number of stages during the life of the program Moroney had difficulty maintaining the supply of samples. In 1968 Moroney noted in a file note of a telephone conversation with a pathologist that there was:

“The usual problem of technicians forgetting to take bone specimens. Now having to take many organs for research purposes and paid to do so in some circumstances eg 20c per pituitary gland. I proposed ... that we compensate his technicians either on a per specimen basis or with an annual bonus. He preferred the latter and will consider an appropriate sum and let me know.”²⁵

A review was made of the arrangements for the provision of bone tissue samples for strontium 90 analyses in the AWTSC's fallout monitoring program in 1969. A memorandum written at that time noted that the program had been in progress for more than ten years and was needed for a further considerable period. It went on:

“Although the data obtained remains the most important feature of the monitoring effort, it is becoming difficult to maintain the active interest and co-operation of some pathologists and their technicians. It seems that a thorough revision of arrangements and some changes in our requirements could help materially in this respect.”²⁶

Shortly after in July 1969 Moroney wrote to participating pathologists:

“...despite the substantial body of data which now exists in strontium 90 in the Australian population, the concentration of the radioisotope in bone remains the dominant factor in assessing the possible biological hazards of fallout from nuclear weapons tests. As long as these explosions are being carried out in the atmosphere the human bone-monitoring program will be needed. We envisage continuing the measurements for a further considerable period.

With the intention of emphasising the important younger age groups, we have decided henceforth to limit the collection of specimens to ages less than 40 years. However we ask that all material be taken from post mortems where the subject is aged less than 40 years, and that advantage be taken of all possible sources of specimens.”²⁷

²⁴ Letter from JR Moroney to Professor Titterton dated 8 March 1968.

²⁵ Handwritten file note of telephone conversation written by JR Moroney and dated 19/09/68

²⁶ Memorandum from JR Moroney to Regional Security Officers, Department of Supply dated 27 May 1969

²⁷ Letter from JR Moroney dated 8 July 1969.

In 1969 Moroney also started sounding out pathologists about the collection of bone material “to give more adequate coverage of still births and other neo natal subjects”.²⁸

In late 1969, the Northern Territory and Papua New Guinea became part of the sampling program. On 3 November 1969 JR Moroney wrote the Director of the Commonwealth Department of Health in the Northern Territory:

“We are anxious to obtain representative material from the resident population of the Darwin area and from a section of the full blooded aboriginal population of the Northern Territory.”²⁹

In addition on the same date he also wrote to the Director of Public Health in Port Moresby. After outlining the program he stated:

“...we are anxious to obtain representative material from the indigenous population of the Territory of Papua and New Guinea, or at least from a section of it for which general information may be provided on diet. I understand that post mortem examinations under your control may include a considerable number of suitable subjects. Therefore I am seeking your cooperation in our survey and asking that bone tissue for strontium 90 analysis be taken from necropsies when the subject is aged less than 40 years.”³⁰

Payment of a bonus for the collection of samples

At this stage of the program the payment of a bonus of \$50 to hospitals providing specimens was proposed:

“I have given a good deal of thought to the desirability of providing your technicians with at least some compensation for their efforts on our behalf. In the past there has been an obvious reluctance to accept such an offer, no doubt on account of the nature of the material and the purpose for which the specimens are intended. However several factors lead me to reopen the question; for example, many technicians have already made considerable contribution to the bone survey with no payment from us and, in some instances it is becoming increasingly difficult to sustain an interest, with a tendency for specimens to be overlooked. We intend continuing the survey from some years and are anxious to maintain an adequate coverage of the population...

Perhaps compensation would best be in the form of an annual or six monthly bonuses paid to the technicians on our behalf through a hospital/laboratory account. Direct payment by us has unfortunate overtones and too much of the appearance of buying tissue; furthermore there are several statutory difficulties in us making payments of that sort. If it is not possible to operate through a hospital/laboratory account for this purposes, perhaps you could accept the sum, say, for “pathological services”, and pass it on to your technicians on our behalf.

²⁸ Letter from JR Moroney dated 9 July 1969

²⁹ Letter from JR Moroney dated 3 November 1969

³⁰ Letter from JR Moroney dated 3 November 1969

Payments in the form of a regular fixed sum, say \$50 would seem to have the most satisfactory connotation. However, the idea would be more effectively expressed if the sum were related to the number of specimens supplied; something like 50c per specimen or whatever you feel is suitable.”³¹

Payments to hospitals of \$50 commenced at the end of the year 1969. The invoices read: “For pathological services rendered by [name] for the Atomic Weapons Tests Safety Committee”.

Australian laboratories commence analysis of samples

In 1969 the Australian Radiation Laboratory began to analyse the ash samples for strontium 90 and after it had been demonstrated that their results were similar to the HASL and UKAERE results the UKAERE ceased analysis at the end of 1969.

Samples were still being sent to HASL and UKAEA for intercomparison between the three laboratories.³²

Card index system introduced

In 1970 a new system of collecting the information was introduced. What was introduced was a printed card that also had a tear-off tag attached both bearing the same identification number. These cards and tags were numbered sequentially and sent in batches of 100 to the participating institutions. The tear off tag was attached to the sample of bone before preservation in formalin. The tag remained attached throughout all subsequent handling of the sample until it was finally ashed with the sample during preparation in the laboratory for analysis.

Increased bonus payment for supply of samples

It would appear that the program suffered some problems in the mid 1970's in relation to supply of tissue. In a Memorandum from a staff member to JR Moroney he noted that:

“...Recently there has again been a tendency for the supply of specimens to diminish. Attributing this to a possible reduction of interest in fallout following the cessation of atmospheric testing of nuclear devices by France and the reducing value of the [\$50] bonus due to inflation a letter was sent to all contributing pathologists on 22 December 1976 in order to stimulate interest in the program. The letters contained the following paragraph:

Since 1969 when the payment of an annual \$50 payment was first introduced, the ravages of inflation reduced the significance of the sum and for this reason alone an increase is warranted. Perhaps a payment of \$50 could be made at mid year as well as just before Xmas...We look forward to hearing your views on our proposal to increase the bonus payments to technicians.

³¹ Letter from JR Moroney dated 20 August 1969.

³² Letter from JR Moroney dated 14 August 1970

Owing to factors beyond our direct control the contributions of bone tissue by laboratories of pathologists in Sydney had ceased in 1974-75. In order to renew contributions from that city a much longer letter was sent to pathologists who had previously contributed to the survey. These letters were sent on 17 May 1977 and contained similar paragraphs to the one set out above, seeking their views on increasing the bonus payment to \$100 per year in one or two increments.”³³

From September 1977 the decision was made to compound the samples annually rather than each six months.³⁴ Samples were still sent to HASL for annual analysis up until 1978.

Program ended in 1978

In a letter dated 7 December 1979 Dr JH Harley was informed that:

“Following a change in laboratory policy and a review of the fallout-monitoring program, it was decided that the routine survey of strontium 90 human bone tissue would be terminated at the end of 1978. Hence this material is the last of Australian human bone samples.”

Records held by ARPANSA

Investigations by ARPANSA staff revealed that ARPANSA holds a number of files related specifically to the Strontium 90 testing program. The originating department for these files was the Department of Supply who provided administrative support to the Atomic Weapons Tests Safety Committee (AWTSC). The documents in these files cover the period 1957-1978.

A large number of files relating to fallout monitoring generally, of which the measurement of strontium 90 was one part, are held by National Archives and are under the control of the Department of Prime Minister and Cabinet.³⁵

ARPANSA holds many thousands of individual data sheets and index cards that record information relating to each person from whom tissue was taken, the institution that provided the tissue, the persons age (or date of birth) and the date of post mortem.

In addition to these records there are also in existence 3,400 samples of ashed remains that were retained after the program had ended.

Program over the period 1957-1978

As discussed above, from 1958-1968 samples were provided for all age groups. In 1968 samples were confined to less than 40 years, including neonatal subjects of 30 weeks.

³³ Memorandum dated 23 June 1977.

³⁴ Letter from JR Moroney to Dr Harley, US Energy Research and Development Administration dated 7 December 1979

³⁵ These files were provided by ARPANSA's predecessor, the Australian Radiation Laboratory (ARL) to the Royal Commission into British Atomic Tests in Australia. Following the conclusion of the Royal Commission all files held by the Royal Commission were handed over to the National Archives of Australia.

ARPANSA holds extensive numbers of records of people from whom bone samples were taken. A database is being finalised of this information. The fields in the database are:

Source/Institution
 City
 Pathologist
 Surname
 First name
 Sex
 Date of birth
 Age
 Age units
 Post mortem date
 Post Mortem number

Distribution by State and Territory

Total number of records	21830
States	
Victoria	3828
NSW	4598
Western Australia	2797
Queensland	7243
South Australia	3078
Tasmania	0
Territories	
Northern Territory	39
Papua and New Guinea	171

Distribution by Age

Age	Number
stillborn	688
measured in hours	244
measured in days	1147
measured in weeks	530
measured in months	2162
measured in years	11246
not recorded	5803

Note there are some records where the State and/or age are not recorded.

ATTACHMENT A

Project Sunshine

The Final Report of the Advisory Committee on Human Radiation Experiments (ACHRE), a Committee set up to advise the United States President, President Bill Clinton, outlines the activities of the US and other countries in relation to the measurement of fallout from atomic weapons testing.³⁶

The US study of fallout began with the effects of the first atomic bomb test in New Mexico in 1945. In 1949 the AEC commissioned Project Gabriel, a study to determine how many atomic weapons could be detonated before radioactive contamination of air water and soil would have long range effect on crops, animals and humans. The AEC created a worldwide network for the collection and measurement of fallout.

In the early 1950 the US Defence Department created its own fallout research program, under the auspices of the Armed Forces Special Weapons Project. In 1953 the Rand Corporation was contracted to review Gabriel. The review was lead by Dr Willard Libby. The resulting Rand report concluded that strontium 90 (Sr-90) was the most dangerous long-term global radioactive product of bomb testing and that a global study of strontium 90 fall out was needed.

The Rand report noted that atmospheric testing had as an unintended side effect, introduced tracers into the world's eco system. The group recommended that there be a worldwide study of the distribution of strontium 90 from the nuclear detonations that had occurred. The project was named "Project Sunshine." Three laboratories were engaged to analyse samples of Strontium 90. University of Chicago (Libby's university), Lamont Geological Observatory of Columbia University and the New York Office of the AEC. For the pilot program the report suggested that twelve human samples (bone and teeth) be drawn from each of six regions around the world (this did not include Australia³⁷). In addition samples would be drawn from livestock, foodstuffs, water and soil.

The ACHRE detailed the secrecy surrounding the collection of human bones. It was emphasised at the time that the collection of bones would be through personal contacts with foreign doctors and other groups.³⁸

³⁶ Final Report: Advisory Committee on Human Radiation Experiments, October 1995, United States of America pp637-641.

³⁷ The regions that were part of the measurement program at this time were 1) northern Utah or southwestern Idaho 2) Kansas or Iowa 3) New England (Boston) 4) South America 5) England and 6) Japan

³⁸ Ibid p640

ATTACHMENT B – Publications relating to the strontium 90 measurement program

Strontium-90 in the Australian environment 1957-58

F.J. Bryant, L.J. Dwyer, J.M. Martin and E.W. Titterton,
Nature 184, pp.755-760 (1959) Sept. 12

Strontium-90 in fallout and in man in Australia, January 1959 - June 1960

F.J. Bryant, L.J. Dwyer, D.J. Stevens, E.W. Titterton and J.R. Moroney
Nature 190, pp.754-757 (1961) May 27

Measurement of Strontium-90 in the Australian environment up to December 1960

F.J. Bryant, L.J. Dwyer, D.J. Stevens, E.W. Titterton and J.R. Moroney
Nature 193, pp.188-189 (1962) Jan. 13

Strontium-90 in the Australian environment 1957-60

F.J. Bryant, L.J. Dwyer, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 24, pp.397-409 (1962) April
Reproduced as Appendix 1 to the NRAC Report to the Prime Minister June 1962

Strontium-90 in the Australian environment during 1961

F.J. Bryant, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 26 pp.69-74(1963) Sept.

Strontium-90 in the Australian environment during 1962

F.J. Bryant, W.J. Gibbs, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 27, pp.1-6 (1964) July

Strontium-90 in the Australian environment during 1963

F.J. Bryant, W.J. Gibbs, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 27, pp.222-226 (1965) February

Strontium-90 in the Australian environment 1961-1963

W.J. Gibbs, J.R. Moroney, D.J. Stevens and E.W. Titterton and G.U. Wilson
Australian Journal of Science 28, pp.44-59 (1965) August
Reproduced as App.1 of the NRAC Report to the Prime Minister Nov. 1965

Report to the Prime Minister by the National Radiation Advisory Committee
Commonwealth of Australia November 1965

Strontium-90 in the Australian environment during 1964

W. Fletcher, W.J. Gibbs, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 28, pp.417-424(1966) May

Strontium-90 in the Australian environment during 1965

W. Fletcher, W.J. Gibbs, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 29, pp.319-325(1967) March

Strontium-90 in the Australian environment during 1966

W. Fletcher, W.J. Gibbs, J.R. Moroney, D.J. Stevens and E.W. Titterton,
Australian Journal of Science 30, pp.307-313(1968) February

Strontium-90 in the Australian environment during 1967
W. Fletcher, W.J. Gibbs, J.R.Moroney, D.J. Stevens and E.W.Titterton,
Australian Journal of Science 31 pp.174-179(1968) November

Strontium-90 in the Australian environment during 1968
W.J. Gibbs, W.K. Mathews, J.R.Moroney, D.J. Stevens and E.W.Titterton,
Australian Journal of Science 32, pp.238-244(1969) December

Strontium-90 in the Australian environment during 1969
W.J. Gibbs, W.K. Mathews, J.R.Moroney, D.J. Stevens and E.W.Titterton,
Dept. of Supply Report AWTSC 2, April 1971.

Strontium 90 and Caesium 137 Monitoring and Radiation Doses to the Australian Population
W.J. Gibbs, J.R.Moroney, D.J. Stevens and E.W.Titterton in:
Strontium 90 and Caesium 137 in the Australian Environment During 1969 and some results
for 1970
Atomic Weapons Tests Safety Committee Report AWTSC No 2 May 1971

Measurements of Strontium 90
J Bonnyman, J H Harley, W K Matthews and J R Moroney: in
Strontium 90 and Caesium 137 in the Australian Environment During 1969 and some results
for 1970
Atomic Weapons Tests Safety Committee Report AWTSC No 2 May 1971

Strontium 90 and Caesium 137 Monitoring and Radiation Doses to the Australian Population
W.J. Gibbs, J.R.Moroney, D.J. Stevens and E.W.Titterton in:
Strontium 90 and Caesium 137 in the Australian Environment During 1970 and some results
for 1971
Atomic Weapons Tests Safety Committee Report AWTSC No 4 September 1972

Measurements of Strontium 90
J Bonnyman, J H Harley, W K Matthews and J R Moroney: in
Strontium 90 and Caesium 137 in the Australian Environment During 1970 and some results
for 1971
Atomic Weapons Tests Safety Committee Report AWTSC No 4 September 1972

ATTACHMENT C FILES

Originating Department/ Committee	File No	File Title	Contents	Location
Department of Supply (AWTSC)	R57/6/3	Sr90 Overall Organisation and analytical results	Documents in the range 1957- 1975	ARPANSA
AWTSC	R57/6/11A	AWTSC: Sr90 Human bone Samples from Adelaide	Unknown	Unknown
AWTSC	R57/6/11B	AWTSC: Sr90 Human bone Samples from Perth	Unknown	Unknown
AWTSC	R57/6/11C	AWTSC: Sr 90 Human Bone Samples from Melbourne	Documents in the range 1957- 1975	ARPANSA
AWTSC	R57/6/11D	AWTSC: Sr 90 Human Bone Samples from Sydney	Documents in the range 1957- 1975	ARPANSA
AWTSC	R57/6/11E	AWTSC: Sr 90 Human Bone Samples from Brisbane	Documents in the range 1957- 1975	ARPANSA
AWTSC	R57/6/11F	Unknown	Unknown	Unknown
AWTSC	R57/6/11G	AWTSC: Sr 90 Human Bone Samples from Northern Territory and New Guinea	Documents in the range 09/69- 06/03/73	ARPANSA
AWTSC	R57/12/8	NRAC agenda and minutes of meeting	Documents in the range 1957-1965	ARPANSA
AWTSC	R57/6/30	Paper for publication – Strontium 90 in the Australian environment 1957-58	Documents in the range 1957-1958	ARPANSA
AWTSC	R57/6/44	Paper for publication – Strontium 90 in fall out and in man in Australia 1959-1960	Document range 1959-1960	ARPANSA
AWTSC	R57/6/47	Paper for publication – Strontium 90 in the Australian environment 1957-60	Document range 1957-1960	ARPANSA
AWTSC	R57/6/62	Paper for publication – Strontium 90 in the Australian environment during 1961	Document range 1960-1961	ARPANSA

Originating Department/ Committee	File No	File Title	Contents	Location
AWTSC	R57/6/64	Paper for publication – Strontium 90 in the Australian environment 1962	Document range 1961-1962	ARPANSA
AWTSC	R57/6/78	Paper for publication – Strontium 90 in the Australian environment 1963	Document range 1962-1963	ARPANSA
AWTSC	R57/6/79	Paper for publication – Sr 90 and Cs 137 in the Australian environment 1961-1963	Document range 1961-1963	ARPANSA
AWTSC	R57/6/85	Paper for publication – Strontium 90 in the Australian environment 1964	Document range 1963-1964	ARPANSA
Australian Radiation Laboratory (ARL)	90-2-1	SR 90 Human bone tissue – overall program and organisation	Document range 1976-1981	ARPANSA