

Interlude—On radiation, safety and secrecy

The British authorities have an ongoing duty of care for the civilian and military personnel who staffed the test sites and the population of neighbouring atolls. This is based on the core principle that the prime responsibility for management of radiation risks rests with the organisation responsible for activities that gave rise to the risks.

This duty was recognised at the time, in the commitments made by the Ministry of Supply for Fijian troops deployed on Christmas Island:

The Ministry of Supply has undertaken to indemnify the Government of Fiji against claims for pensions to which men of the Fijian Military Forces or their dependants may become entitled to as a result of death or injury sustained by them during their service on the Nuclear Weapons Testing Base at Christmas Island in the Pacific.¹

In the lead-up to the tests in early 1957, UK Prime Minister Harold Macmillan publicly dismissed any concern about extensive radioactive fallout, noting:

We will make our tests so small and on such a scale that they cannot really add to anything that would be dangerous in the world.²

In March 1957, Macmillan told the House of Commons:

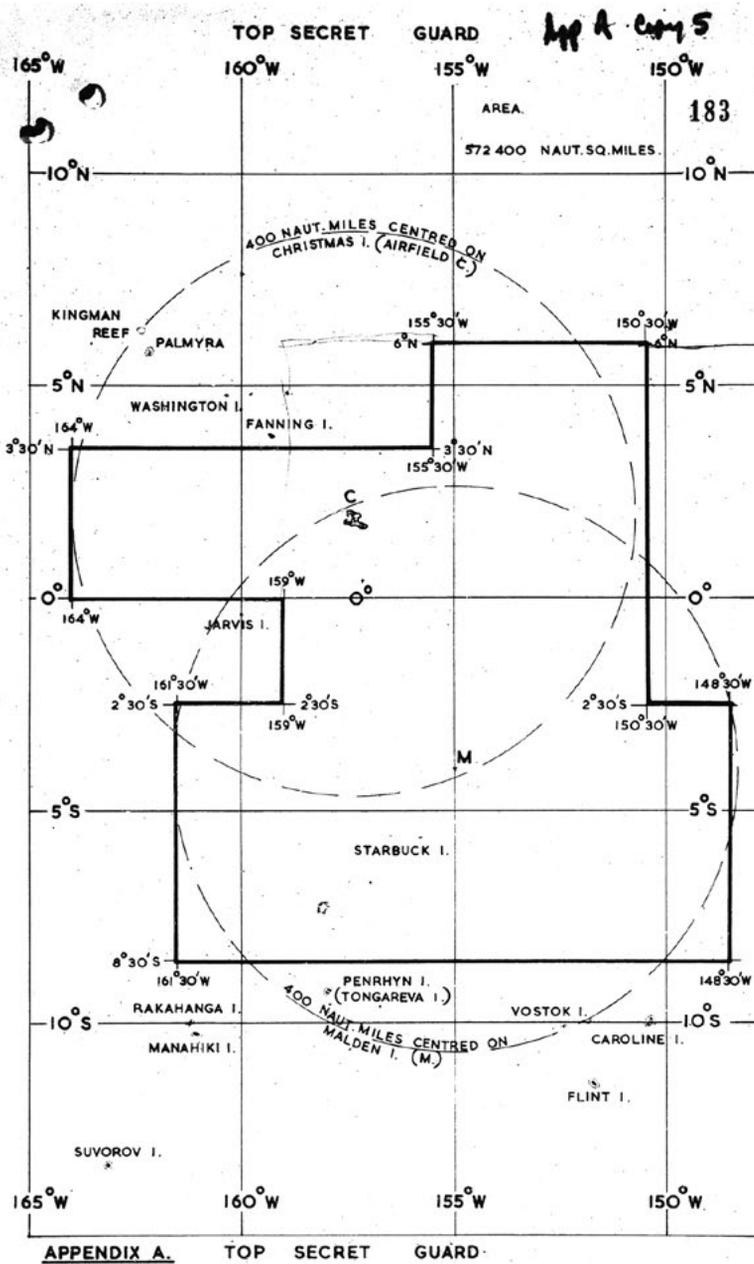
The present and foreseeable hazards, including genetic effects, from external radiation due to fall-out from the test explosions of nuclear weapons, fired at the present rate and in the present proportion of the different kinds, are considered to be negligible.³

1 Letter from G.M.P. Myers, Ministry of Supply, to D.J. Derx, Colonial Office, London, 17 June 1958. CO1036/514.

2 "Our H-bomb tests will be "so small", *News Chronicle*, 28 March 1957.

3 Statement by Prime Minister Harold Macmillan, UK House of Commons, Hansard official report, 5 March 1957; Vol. 566, col. 178.

GRAPPLING WITH THE BOMB



Map of Grapple Danger Area

Note the way that radioactive fallout will move within neat squares, avoiding inhabited islands like Penrhyn, Jarvis and Fanning.

Source: Colonial Office file CO1036/280.

To this day, the official position of the UK Government is that the Grapple nuclear tests involved rigorous safety standards, which protected service personnel and civilian staff from exposure to radiation. The government has argued that—with the exception of some aircrew—those present on Christmas Island were too far from the actual detonation point to be at risk from direct exposure and the ‘prompt radiation’ effect. Successive government ministers have stated:

The mass of evidence shows that the health and safety of the trial participants were regarded very seriously, and that a great deal of trouble was taken over radiological protection.⁴

On paper, the Grapple Task Force had established elaborate radiation monitoring systems. In reality, these were not always implemented. For example, before the early tests, sailors were issued with film badges to measure the total dose of radiation received, similar to those used in hospital radiotherapy departments. But not everyone was given the badge, a fact acknowledged by the UK Ministry of Defence (MoD) in 2008:

Badges were not issued to all personnel: the Ministry of Defence estimates that 21 per cent of total participants [in Australia and Kiribati] had badges. In general, more badges were issued for the earlier tests (96 per cent of those present at Operation Hurricane had a badge while only 20 per cent of those at Operation Grapple).⁵

A New Zealand Defence Force (NZDF) study of the operation, declassified in 1996, revealed that many of these badges were not processed to provide evidence of radiation exposure:

Before each nuclear test the crewmen were issued with a new film badge and after the test they would be collected and sent for processing on *HMS Narvik*. However, during Operation Grapple most film badges—including those from the New Zealand frigates—were not processed, principally because of problems with storing the chemicals needed for processing.⁶

4 ‘Nuclear Test Veterans’, Statement by Secretary of Defence John Spellar MP, UK House of Commons, Hansard official report, 4 February 1998, col. 1009.

5 ‘UK atmospheric nuclear weapons tests: UK programme’, Factsheet 5, UK Ministry of Defence, June 2008.

6 John Crawford: *The involvement of the Royal New Zealand Navy in the British nuclear testing programmes of 1957 and 1958*, research paper for New Zealand Defence Force Headquarters, Wellington, New Zealand, 1989 (declassified 1996), pp. 23–24.

The Christmas Island veterans argue that they were often placed in the path of radioactive fallout, that existing records don't document the realities on the ground and that there were many pathways for them to ingest or inhale hazardous particles of fallout.

In the aftermath of the tests, the British Government eventually conducted studies of the health of nearly 14,000 military personnel, run by the UK National Radiological Protection Board (NRPB). These studies dismissed the claims of many veterans that they had been exposed to hazardous levels of radiation. The official report reveals 'no detectable effect on the participants' expectation of life, nor on their risk of developing cancer or other fatal diseases'.⁷

These claims are still vigorously contested by veterans' associations in Britain, Australia, New Zealand and Fiji. They have critiqued the official health reports and have campaigned for independent medical studies to investigate the documented health effects that they attribute to exposure to ionising radiation rather than other causes. As detailed in Chapter 20, independent studies like the genetic survey conducted at Massey University in New Zealand have shown significant adverse impacts.

Some veterans go further, claiming they were deliberately used as guinea pigs or 'lambs to the slaughter'.⁸ They argue that, well before the nuclear tests, senior members of the British military bureaucracy clearly saw that personnel would be exposed to radiation as part of the nuclear test program.

Documentary evidence from the UK archives suggests that one of the purposes of the tests was to study the effects of nuclear detonations on personnel as well as equipment. For example, the British Chiefs of Staff had a Defence Research Policy Committee on the Atomic Weapons Trials, looking at the military applications of atomic energy. A memo from the committee, dated 20 May 1953, states that a series of 'tests' needed to be included in future atomic weapons trials:

7 Lorna Arnold: *Britain and the H-bomb*, (Palgrave Macmillan, London, 2001), p. 243.

8 Statement by Avon Hudson, in Roger Cross and Avon Hudson: *Beyond Belief—the British bomb tests, Australia's veterans speak out* (Wakefield Press, Kent town, 2005), p. 171.

The Navy requires information on the effects of various types of atomic explosions on ships and their contents and equipment ... The Army must discover the detailed effects of various types of explosion on equipment, stores *and men, with and without various types of protection*.⁹

A memo from the Royal Air Force (RAF), dated 29 November 1955, states:

During the 1957 trials, the RAF will gain invaluable experience in handling the weapons and demonstrating at first hand the effects of nuclear explosions *on personnel* and equipment.¹⁰

A meeting was held at the Atomic Weapons Research Establishment (AWRE) at Aldermaston on 15 July 1958. At the meeting, attended by Task Force Commander Air Vice Marshall John Grandy and Grapple scientific director Roy Pilgrim, service and medical representatives discussed whether, in the aftermath of Grapple Y, to revise radiological safety precautions for Christmas Island issued the previous March.¹¹

Arguing against medical advice that blood tests should be carried out before the next round of Grapple Z tests, Air Commodore W.R. Stamm of the Princess Mary RAF Hospital objected to blood sampling being carried out on individual servicemen:

If the person was examined and found to be normal before posting to Christmas Island and who later developed leukaemia, it might be difficult to refute the allegations that this is due to radiation received at Christmas Island.¹²

The meeting finally agreed that men in the forward areas would be given blood counts, while a decision on the rest of the servicemen would be taken at a later date.

9 'Chief of Staff Committee—Atomic Weapons Trials: Reports by the Defence Research Policy Committee', memo labelled Top Secret, 20 May 1953, UK National Archives COS53/257. (Emphasis added.)

10 'Atomic weapons trials and training—Joint Operations', memo by Group Captain S.W.B. Menault, Royal Air Force, 29 November 1955. UK National Archives CMS.2680/55/DD Ops (AWT). (Emphasis added.)

11 Atomic Weapons Research Establishment (AWRE) Trials Planning Branch: *Radiological safety regulations for Christmas Island*, RSRC/58(1), March 1958. UK National Archives, item ES 12/360 (copy in author's files).

12 Cited in Catherine Trundle: 'Searching for Culpability in the Archives: Commonwealth Nuclear Test Veterans' Claims for Compensation', *History and Anthropology*, Vol. 22, No. 4, 2011, pp. 497–512.

The veterans' concern that they were being used as guinea pigs is not simply paranoia. During the Cold War, the United States conducted a number of human radiation experiments. Many of these activities were only revealed after the Clinton administration ordered a review in 1994 of human radiation studies conducted by the United States between 1944 and 1974. The review revealed 'the perhaps surprising finding that officials and experts in the highest reaches of the Atomic Energy Commission (AEC) and Department of Defence (DOD) discussed requirements for human experiments in the first years of the Cold War'.¹³

The review by the Advisory Committee on Human Radiation Experiments found that Cold War practices included experiments on prisoners and invalids, including plutonium injections during the Manhattan project:

Sick patients were used in sometimes secret experimentation to develop data needed to protect the health and safety of nuclear weapons workers. The experiments raise questions of the use of sick patients for purposes that are not of benefit to them, the role of national security in permitting conduct that might not otherwise be justified, and the use of secrecy for the purpose of protecting the government from embarrassment and potential liability.¹⁴

During Operation Grapple, UK politicians and senior officers were reluctant to talk openly about radiation, fallout or potential hazards from the tests, cloaking their lack of accountability under the mantra of 'national security'. One example came just days before the first Grapple test on 15 May 1957. UK Minister for Supply Aubrey Jones drafted a brief statement for public release after the test, but sought approval of the text from the prime minister and other relevant ministers. The Cabinet agreed that the first paragraph was uncontroversial:

The Minister of Supply, the Right Honourable Aubrey Jones has received a report from Air Vice Marshall W. E. Oulton, commander of the Task Force, and Mister W. R. J. Cook, scientific director of the trials, that the first explosion of a nuclear device in the present series took place today at altitude in the central Pacific.¹⁵

13 Advisory Committee on Human Radiation Experiments: *Executive summary and Guide to final report* (Department of Energy, Washington, 1995), p. 24. DOE/EH-96001171.

14 *Ibid.*, p. 26. Not surprisingly, the review found that: 'Current policies do not adequately safeguard against the recurrence of the kinds of events we studied that fostered distrust.'

15 'Draft press announcement by the Ministry of Supply after round one', memo from Minister of Supply Aubrey Jones, 9 May 1957. CO1036/282.

However, the second sentence was more controversial and was eventually deleted:

The order to proceed with firing was given only when the meteorological conditions had proved suitable and reconnaissance had confirmed that no ships or aircraft were in the position of danger.

Foreign Secretary Selwyn Lloyd argued in a memo:

I do not consider that the second sentence is necessary. If by any chance an intruder has got in the way or there has been some accident, we had much better say afterwards that we took all reasonable steps. If no one had got in the way, it will be self-evident that we have taken all necessary precautions.¹⁶

Lloyd also amended the final sentence of the release, arguing that:

I see no reason why in a communiqué of this sort we should get involved in statements about fallout.¹⁷

With the endorsement of Prime Minister Macmillan, one sentence in the draft statement was amended: ‘scientific records are being collected for accurate evaluation to confirm previous estimates of fallout effects and weapons performance’. The final version, issued publicly the day after the test, simply read: ‘Scientific records are being collected for accurate evaluation of the tests.’¹⁸

* * *

One common defence of the British authorities is that they were operating to standards of radiation safety known at the time. In the 1950s, guidelines for radiation exposure were set by the International Commission on Radiological Protection (ICRP), with the British Medical Research Council approving slightly different standards for the nuclear trials in 1952.

16 Memo from Foreign Secretary Selwyn Lloyd to Prime Minister Harold Macmillan, 11 May 1957. CO1036/282.

17 Ibid.

18 Memo from Prime Minister Harold Macmillan (signed P. de Zulueta), 14 May 1957. CO1036/282.

The levels of exposure that were regarded as acceptable in the 1950s are higher than those that are regarded as safe today. A common unit of measurement for exposure was the 'rad', though today the standards are measured in millisievert (mSv). In 1956, as the Grapple Task Force began its work, the ICRP's occupational limit was 3 mSv a week. In 1958, this was amended to 30 mSv a quarter and an annual average of 50 mSv (in comparison, today's occupational limits average 20 mSv per year and 1 mSv per year for the public).

As leading nuclear weapons campaigner Dr Tilman Ruff has noted:

There has been a consistent trend over time that the more we know about radiation effects, the greater the evidence indicates those effects to be. Maximum permitted radiation dose limits have never been raised over time; they have always been lowered. For example, from 1950 to 1991, the maximum recommended whole-body radiation annual dose limits for radiation industry workers declined from approximately 250 to 20 mSv.¹⁹

In the 1950s, however, there was already extensive knowledge about the hazards of radiation amongst the scientific community who worked at the AWRE at Aldermaston. The understanding of risk was based on the work of British physicists and biologists over decades, studies conducted on Japanese people affected by the bombing of Hiroshima and Nagasaki and more recent information from US nuclear testing in the Marshall Islands, which was shared with Britain.

This information was also transmitted to British politicians and officials, who nonetheless went out of their way to minimise public knowledge of the risks, and adopted policies that deliberately reduced the safety margins for affected groups.

Later chapters will document the lived experience of service personnel and Gilbertese workers from Christmas Island, which shows they were placed in situations that increased the risk from hazardous ionising radiation.

For the moment, however, let us look at the many ways that the Grapple Task Force and the UK authorities in London deliberately changed proposed safety standards in order to maintain operational secrecy, increasing the risk for people living on Christmas Island and neighbouring atolls. These policy decisions included:

¹⁹ Tilman A. Ruff: 'Health implications of ionising radiation' in Peter van Ness and Mel Gustov (ed.): *Learning from Fukushima: Nuclear power in East Asia* (ANU Press, Canberra, 2017).

- setting standards for radiation protection with different safety limits for ‘civilised’ and ‘primitive’ peoples
- changing the boundaries of the danger area to exclude inhabited islands that came within the original zone
- maintaining a culture of secrecy that put mariners and flight crews at risk by hiding relevant safety information until the last minute.

* * *

In November 1956, Grapple Task Force Commander Air Vice Marshall Wilfred Oulton circulated a study to senior members of the Task Force outlining the ‘Danger Area’ to be promulgated for the Grapple tests. The purpose of the top secret document—issued to just 14 people—was to define an area to warn off shipping, aircraft or fishing vessels that might intrude in the test zone. The study sets ‘several definitions of levels of radioactivity resulting from fall-out’ and looks at the danger of an ‘accidental surface burst’.²⁰

The document reveals that the acceptable dosage of radiation was different for British personnel than for the islanders who lived on Christmas Island and on neighbouring inhabited atolls such as Fanning, Jarvis and Washington in the Line Islands or Tongareva (Penrhyn) in the Cook Islands. The dosage for so-called ‘primitive peoples’ exceeded safety levels set by international standards:

For civilised populations, assumed to wear boots and clothing and to wash, the amount of activity necessary to produce this dosage is more than is necessary to give an equivalent dosage to primitive peoples who are assumed not to possess these habits. For such peoples the corresponding level of activity is called level B’. It is assumed that in the possible regions of fall-out at Grapple there may be scantily clad people in boats to whom the criteria of primitive peoples should apply.

20 ‘Danger Area’, paper from Air Vice Marshall W.E Oulton, 19 November 1956, GRA/TS.1008/1/Air. Only 14 copies of the paper, marked ‘Top Secret—Guard’, were prepared for the British Army and Navy, the Colonial Office, Commonwealth Relations Office and other authorities. CO1036/280.

It is desirable that the Declared Danger Area should at least enclose the whole region in which there is a possibility that level B' may be produced. The dosage at this level is about 15 times higher (for primitive peoples) than that which would be permitted by the International Commission on Radiological Protection.²¹

A meeting of officials held a week later to discuss the study agreed 'that the levels recommended by the ICRP would necessarily be exceeded' and that 'the proposed Grapple Danger Area is considerably larger than that prescribed for similar American tests'. Officials agreed to inform the minister, however, that:

Independent authorities agree that ... only very slight health hazard to people would arise, and that only to primitive peoples.²²

The UK Government was well aware that the atmospheric testing of nuclear weapons would contribute to the spread of strontium-90. This radioactive isotope, with a half-life of 28.8 years, is produced by nuclear fission, and can be carried around the globe as the mushroom cloud extends to the stratosphere and high-level winds.

By the mid-1950s, UK authorities were aware of the role of nuclear testing in the spread of strontium-90. British researchers were involved in Project Sunshine, an initiative started by the US AEC in 1953 to measure the amount of strontium-90 in the bones and tissue of human beings.²³ More than 19 countries were involved in this gruesome project, which involved the use of cadavers—often babies and children—for testing, often without the knowledge or consent of their families. US doctors and scientists in the Marshall Islands also removed both decayed and healthy teeth from Rongelap children and sent them to New York for testing.²⁴

From 1954, the US AEC, the UK Atomic Energy Authority (UKAEA) and the UK Ministry of Agriculture, Fisheries and Food began testing for strontium-90 in food, animals and plants. This was soon extended to human testing and the UKAEA tested bones from thousands of dead

21 Ibid., pp. 2–3.

22 Minutes of meeting on 27 November 1956, marked 'Top Secret—UK Eyes Only'. XY/181/024. CO1036/280.

23 RAND Corporation: *Project Sunshine—worldwide effects of Atomic Weapons* (RAND, Santa Monica, 6 August 1953). The RAND Corporation coordinated Project Sunshine across 19 countries, especially in Europe, North America and Oceania but extending as far as Chile, Brazil and Iran.

24 Barbara Rose Johnston and Holly Barker: *Consequential Damages of Nuclear War—the Rongelap report* (Left Coast Press, 2008), p. 158.

children. Samples from more than 6,000 people who died in Britain were tested between 1955 and 1970.²⁵ In Australia, the Atomic Weapons Tests Safety Committee began a program in 1957 to collect samples in Australia and the Australian-administered Territory of Papua and New Guinea. Bones and samples from more than 21,000 corpses—mainly babies—were incinerated and the ash sent to the United Kingdom for testing.²⁶

On 18 January 1955, the US AEC held a conference to discuss how they could obtain more human material for analysis of strontium-90. US AEC commissioner Dr Willard Libby told the meeting:

Human samples are of prime importance and if anybody knows how to do a good job of body snatching they will really be serving their country ... In 1953 we hired an expensive law firm to look up the law of body snatching. This compendium is available to you. It is not very encouraging. It shows you how very difficult it is going to be to do it legally.²⁷

By 1957, however, the main concern of British officials was whether any public statements should acknowledge the reality that strontium-90 from nuclear testing was being spread over vast distances.²⁸ For example, when the Foreign Office had to develop a statement to reply to Japanese concerns over atmospheric testing, Foreign Office official H.C. Hainsworth noted that the statement should be edited to remove claims that there would be no effects from ‘radioactive material’:

25 The history of Project Sunshine in the United Kingdom and subsequent UKAEA strontium testing programs is documented in the *Redfern Inquiry into human tissue analysis in UK nuclear facilities* (Her Majesty's Stationery Office, London, 10 November 2010), Vol. 1, pp. 405–449. See also Sue Rabbitt Roff: ‘Project Sunshine and the slippery slope: The ethics of tissue sampling for strontium-90’, *Medicine, Conflict and Survival*, Vol. 18, Issue 3, 2002, pp. 299–310.

26 A report from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) confirms that the agency has 21,830 records of people in Australia and Papua New Guinea from whom bone samples were taken—*Australian Strontium-90 Testing program 1957–78* (ARPANSA, Sydney, n.d.), p. 11.

27 The 1955 conference and the legality of sampling is discussed in the *Redfern Inquiry into human tissue analysis in UK nuclear facilities*, op. cit., pp. 410–411.

28 UK officials were well aware of the dangers of long-distance contamination, as the United States had conducted extensive weather and wind mapping during the Operation Castle series. See Thomas Kunkle and Byron Ristvet: *Castle Bravo: Fifty years of legend and lore*, US Defense Threat Reduction Agency (USDTRA) Defense Threat Reduction Information Analysis Center (DTRIAC) SR-12-001, January 2013, pp. 36–88.

The Lord President's Office have expressed some doubt about the phrase used in our Intel. and other public statements that 'firing will not take place under any conditions in which inhabited islands might be affected by radioactive material.' They point to the fact that there will be some increased deposit of strontium-90 in bone as a result of these tests.

We have argued that the sentence in context means that there will be no harmful effect and point to the fact that the Medical Research Council have said that strontium-90 have not yet reached a potentially dangerous level. In view of their doubts, we are trying to avoid using the phrase too frequently, until this point has been resolved.²⁹

* * *

In December 1956, British officials prepared a guidance note with information about the safety precautions for Operation Grapple. This guideline states that 'no individual will be within a circle of 35 nautical miles radius of ground zero, i.e., the point immediately below the burst. Since the burst will take place at a considerable height there will be, assuming all goes as planned, no area of intense fallout'.³⁰

As shown in the map above, the original version of the danger area was a 400-nautical-mile circle around the drop zone, the estimated area for a surface burst equivalent to 150 kilotons.³¹ In reality, even this danger area was too limited. Many of the actual Grapple explosions were much larger than 150 kilotons (three of the tests had yields greater than 1 megaton, and the April 1958 Grapple Y test measured at nearly 3 megatons). Beyond this, prevailing winds tend to carry fallout in long plumes rather than neat circles. The British Government knew this very well, having studied data from recent US hydrogen bomb testing at Bikini and Enewetak atolls, which travelled far beyond 450 miles.

Despite these flaws in safety protection, London-based officials worked to further reduce the size of the danger zone to avoid potential political problems. Some officials argued that 'such an area is patently too large and has been reduced' according to some 'basic principles'. On this basis, the

29 Letter from H.C. Hainsworth, Foreign Office, London, to R.G. Elkington, 20 March 1957. CO1036/281.

30 'Safety precautions at Operation Grapple', memo from Ministry of Supply, marked 'Top Secret/UK eyes only', 14 December 1956. CO1036/280.

31 The 1956 Grapple Task Force 'danger area' study (GRA/TS.1008/1/Air) and the draft of the map of the danger area can be found in the archives at Colonial Office CO1036/280.

400-mile circular boundaries of the danger area around Christmas Island and Malden Island were artificially redrawn with square boundaries—excluding neighbouring inhabited islands from the danger area.³²

The Gilbert and Ellice Islands Colony (GEIC) Resident Commissioner then published a version of the map with rectangular rather than circular boundaries that were neatly drawn to exclude Washington, Fanning, Palmyra and Jarvis Island, all of which had small islander populations. The protests of businessman James Burns, detailed in Chapter 5, seem to have had a perverse effect, because islands artificially excluded from the danger area include all those where Burns Philp plantations were located.³³

The archives also reveal extensive debate between the Grapple Task Force and officials from the Foreign Office, Colonial Office and Commonwealth Relations Office about the wording of the statement announcing the danger area. A key concern was the need to avoid any reference guaranteeing safety within the danger zone, given the potential for legal liability.

One example was a debate over whether to retain the same warnings as those issued before Operation Mosaic (the two atomic tests conducted in May–June 1956 off the Monte Bello Islands in Western Australia).

The Mosaic warning to mariners included the sentence: ‘All possible precautions will be taken to ensure that no hazard to life or property will occur within the danger area.’ Foreign Office officials argued for its inclusion in the Grapple danger area warning, ‘on the basis that, while such a promise might be difficult to keep and might induce a false sense of security, its omission might be noticed by a legalistically inclined nation’.

In response, the Grapple Task Force Commander called for the deletion of the sentence in any leaflets distributed to mariners near Christmas Island. Oulton wrote to the British Admiralty that:

32 Thanks to Professor Wadan Narsey for this insight. See Wadan Narsey: ‘Raw deal for nuke test Guinea Pigs’, *Sunday Times* (Fiji), 13 June 1999.

33 A version of the final map, with rectangular boundaries and not 400-mile circles, is published in *Headquarters Information Note* No. 4, 18 January 1957. Gilbert and Ellice Islands Colony. F76/6/32 (1957). PAMBU document AU PMB Doc 493.

I feel it unwise to include the final sentence as was done in MOSAIC because it might lull intruders into a false sense of security and they might place too much reliance on my force for both observing them and guiding them out of harm's way.³⁴

Given the 'slight chance of a mishap whereby one of the weapons does not burst until it hits the surface of the sea', the government agreed to declare a danger area on 1 January 1957, to come into force on 1 March.³⁵ Officials later postponed the announcement until 7 January, arguing that 'psychologically, it would be best to avoid such an announcement on New Year's Day'.³⁶

The debate over warnings to mariners and aircraft was more than academic. Oulton's 1987 book *Christmas Island Cracker* opens with the story of the Liberian freighter *Effie*, which sailed into the danger zone around Malden Island and was on course to be near ground zero at the time of detonation. Oulton describes how he was dragged from his bed to the Joint Operations Centre to deal with the crisis:

For a few seconds, he permitted himself the luxury of raging against that stupid bloody man the Secretary of State, who—despite a careful and logical explanation of the vital need for it—had refused to let the international warning notice to mariners be sent out in time to keep shipping clear of the designated danger area. Now, in consequence, they were all in this frightful and very dangerous situation. Blast the man!³⁷

Discussion of the danger area also involved analysis of the hazard to troops on Christmas Island if a plane carrying a hydrogen bomb were to crash on take-off. The AWRE joined with the Admiralty and the National Institute for Oceanography to model what would happen if there was a surface burst, rather than the expected air burst, of a weapon just off Christmas Island. The comforting outcome was that troops housed near the airfield would not need to worry about drowning in a tidal wave. They would already be dead from the heat and blast:

34 Letter from Air Vice Marshall W.E. Oulton, Task Force Grapple, to Admiral W.J. Yendell, Royal Navy, London 17 December 1956, GRA/TS.1008/1/Air.

35 *Ibid.*

36 Letter from D.V. Bendall, Foreign Office, London, to G.A.C. Witheridge, Ministry of Supply, 21 December 1956. CO1036/280.

37 Wilfred Oulton: *Christmas Island Cracker—an account of the planning and execution of the British thermonuclear bomb tests 1957* (Thomas Harmsworth, London, 1987), pp. 3–4.

The conclusion reached is that, with the maximum yield to be expected under the conditions visualised, there is a danger of serious flooding for several miles along the coast near the explosion that would affect the air field in particular, but that this danger would be overwhelmed by the thermal dose received over the same area ... this additional risk of flooding adds little to the other risks.³⁸

* * *

In the early 1950s, the United States maintained an elaborate program for monitoring Soviet nuclear weapons trials, run by the US Air Force Office of Atomic Energy (AFOAT-1).³⁹ US officials soon realised that this system could also be extended to monitor the Grapple tests.

In early 1957, US AEC and military officials were privately debating how to evade the restrictions of the 1946 McMahon Act to allow collaboration between US and UK scientists on weapons development. One proposal was to use AFOAT-1 monitoring systems to share data:

AFOAT-1 proposes to give the UK copies of the recordings obtained on the UK weapons trials in the spring of 1957, as well as additional information concerning the equipment on which this data was obtained ... The proposed exchange of information will permit acquisition by the US of important information relating to design and fabrication of UK nuclear weapons. AFOAT-1 believes that the proposed exchange of information would not reveal important information or, in fact, any information concerning the design or fabrication of the nuclear components of US atomic weapons.⁴⁰

At the same time, British authorities made preparations to establish their own independent radiation monitoring stations across the Pacific. A confidential briefing paper sent to the US Government noted:

When the tests have taken place, samples of air will be taken, by arrangement with the authorities concerned, at Christmas Island, Canton Island, Penrhyn Island, Samoa, Tahiti, Fiji, New Caledonia, Adelaide,

38 'Christmas Island—effect of a tidal wave in the event of a crash in the sea and explosion on take-off', Ministry of Supply memo, marked 'Secret', 20 February 1957. CO1036/281.

39 For information on AFOAT-1 and US efforts to track radioactive fallout from Soviet tests, see Doyle L. Northrup and Donald H. Rock: 'The detection of Joe 1', *Studies in Intelligence*, Central Intelligence Agency (CIA), Vol. 10, Fall 1966 (declassified by the CIA in September 1995).

40 'Exchange of Information with the British in Connection with its Megaton Weapons Trials Scheduled for the Spring of 1957', Memorandum for the Chairman, Military Liaison Committee, AFOAT-1/SWTD, 11 January 1957. Marshall Islands Nuclear Documentation Database (MINDD).

Brisbane and it is hoped the Tuamotu group, to confirm that no contamination has in fact taken place. Samples of seawater will be taken with the same purpose.⁴¹

From February 1957, Hastings aircraft flew each week from Edinburgh Field in Salisbury, South Australia, to Christmas Island, stopping at Canton, Nadi and Amberley. After April 1957, the returning flights called ‘in addition eastbound at [the airports of] Tontouta, New Caledonia and Faleolo, Western Samoa, to collect radiation measurement samples’.⁴²

One complication for long-range monitoring of radiation was the secrecy surrounding the actual date of the next hydrogen bomb test. The UK MoD was reluctant to allow discussion of radiation protection outside protected, classified channels for fear that the date of the next test would be compromised.

UK officials were anxious that the logistics required in setting up these stations should receive no publicity. In response to possible public concern in Hawai‘i, French Polynesia and New Caledonia about radioactive fallout, British officials prepared calming announcements that could be used if there were any questions:

When announcing last June Her Majesty’s Government’s intention to hold trials of megaton weapons in 1957, Sir Anthony Eden said that the explosions would take place far from any inhabited island and that the tests would be so arranged as to avoid dangers to persons or property. The tests would be high airbursts, which would not involve heavy fallout.

All safety precautions would be taken in the light of the Government’s knowledge and of experience gained from the tests of other countries. Since then, detailed plans for the operation had been made with this as their basis and these assurances can be categorically reaffirmed. There is no question of Hawai‘i being in the slightest danger. Firing will not take place under any conditions in which inhabited islands might be affected by radioactive material.⁴³

41 ‘UK nuclear tests’, advance copy of circular note to all heads of missions, from Foreign Office, London, to British Embassy, Washington, marked Confidential, 21 December 1956. CO1036/280.

42 Telegram no. 45 from Secretary of State for the Colonies to Mr John Gutch, Western Pacific Commissioner, 27 January 1957. CO1036/281.

43 Telegram from Foreign Office, London to British consulate, Honolulu, 7 January 1957. CO1036/280. The same telegram was sent to the British consulate in New Caledonia, substituting the relevant island for ‘Hawaii’.

After the first three tests, as the Grapple Task Force prepared to relocate the testing site from Malden Island to Christmas Island, they decided that there was a need to reconfirm approval for the network of radiation monitoring stations.

For Grapple X, Task Force Commander Wilfred Oulton sought the approval of the United States, Australia and New Zealand to establish a network of radiation measurement stations at various locations on their territory across the Pacific. These stations were proposed for Aitutaki and Penrhyn (Cook Islands), Nadi (Fiji), Brisbane (Australia), Canton Island, Kwajalein Atoll (Marshall Islands), Honolulu (Hawai'i), Malden Island and Fanning Island (GEIC), and Apia (Western Samoa).⁴⁴

On 21 August, Squadron Leader R.J. Wilson, the RAF officer responsible for air operations, wrote to Foreign Office and Commonwealth Relations Office officials, seeking their support to negotiate the establishment of radiation monitoring equipment on US, British and Commonwealth soil:

There is a requirement to take radiation measurements at various locations in the Pacific during the above operation. The equipment to be used and services required will be almost identical to those in Operation Grapple and the period of operation is expected to be from about mid-October until mid-December 1957. The locations concerned are as follows: Honolulu, Kwajalen [sic], Fanning Island, Canton Island, Penrhyn Island, Brisbane, Western Samoa, Fiji.⁴⁵

For the first round of tests on Malden Island, the Task Force had set up radiation monitoring instruments in Fiji, at the Royal New Zealand Air Force (RNZAF) base at Nadi airport. As the second round of tests on Christmas Island was being prepared, London officials wrote to the Governor's office in Suva, seeking practical support from the local administration:

In connection with the new operation, it is required to take radiation measurements, as before, in Fiji. The equipment to be used and the services required will be almost identical to those for Grapple and the period of operation is expected to be from about mid-October until mid-

⁴⁴ 'Outlying recording stations', letter from Air Vice Marshall Wilfred Oulton, Grapple Headquarters Task Force, London, 20 September 1957. GX/TS.3015/4/AIR. CO1036/283.

⁴⁵ 'Operation Grapple X—Long Distance Radiation Measurements' letter from RAF Squadron Leader R.J. Wilson, Headquarters, Task Force Grapple, to Foreign Office and Commonwealth Relations Office, 21 August 1957. GX/TS.3010/S/air. CO1036/282.

December 1957. Permission is requested to set up the equipment in Fiji and it is hoped that the persons who kindly gave the equipment a few minutes attention daily during Grapple will be willing to do so again.⁴⁶

Fiji Governor Sir Ronald Garvey replied to London confirming that:

We will willingly assist, but facilities for both radiation and micro-barograph measurements were provided at Nadi airport from previous tests. Assume you will again make direct approach to New Zealand authorities.⁴⁷

Once again, however, the demand for secrecy helped override the practicalities of establishing this network. The radiation monitoring station in Nadi would require the cooperation of RNZAF personnel, but London was reluctant to inform the colonials! A letter to the Governor of Fiji noted:

In view of desire to maintain secrecy about forthcoming nuclear test to last moment, may be decided undesirable approach to New Zealand personnel at Nandi [sic] about operating this equipment. In that event only alternative will be to ask if district officer in area Nandi will operate the equipment.⁴⁸

London's paranoia about operational secrecy was somewhat undercut by the realities of the coconut wireless in small island states, where information passes freely outside official channels. Locals were clearly aware that an operation was looming, given the constant stream of aircraft flying between Nadi and Christmas Island. As the Governor of Fiji informed London:

You should know that the build-up of traffic through Nadi from Christmas Island is naturally causing some speculation.⁴⁹

46 Telegram no. 209, marked 'Secret and personal' from the Secretary of State for the Colonies to Sir Ronald Garvey, Governor of Fiji, 23 August 1957. CO1036/282.

47 Telegram no. 224, from Sir Ronald Garvey, Governor of Fiji to Secretary of State for the Colonies, marked 'Immediate, secret and personal', 29 August 1957. CO1036/282.

48 Telegram no. 231 from Secretary of State for the Colonies to Sir Ronald Garvey, Governor of Fiji, 30 September 1957. CO1036/283. The constant travel of the district officers meant that the New Zealanders were eventually asked to fulfil this role.

49 Telegram no. 252 from Sir Ronald Garvey, Governor of Fiji to Secretary of State for the Colonies, 4 October 1957. CO1036/283.

Similar requests were sent to the Western Pacific Commission to re-establish radiation monitoring systems on Canton Island, without telling the technicians who would use the equipment:⁵⁰

In view of instruction to keep fact and date of new operation secret as long as possible, not desirable for you to inform Cable & Wireless and civil aeronautics administration on Canton. Not necessary to do so in relation to Fanning, since now understood that meteorological station task force proposed to set up on Fanning will look after radiation measurement equipment installed there.⁵¹

Even though effective radiation monitoring would require extensive preparation and training of staff, secrecy overruled practicality. A letter from the MoD in September 1957 noted that:

Discussions could take place with persons who are not covered by any security acts, either British or American. It has been ruled on the highest level of the fact that further megaton trials are also to take place and the date of the trial, and anything that might reveal this, is TOP SECRET. Consequently it is necessary to ensure that no breach of security occurs during these discussions, which could obviously have been avoided. I therefore suggest you should follow the Foreign Office suggestion and clear the necessary arrangements through channels which can handle classified information.⁵²

50 Telegram no. 391 from the Secretary of State for the Colonies to Assistant High Commissioner, Western Pacific, 22 August 1957. CO1036/282.

51 Telegram no. 93 from Secretary of State for the Colonies to Resident Commissioner, Gilbert and Ellice Islands Colony, 2 September 1957. CO1036/282.

52 Letter from H.B. Macklen, Ministry of Defence to G.A.C. Witheridge, Ministry of Supply, 9 September 1957. CO1036/282.

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