

Cancer, reproductive abnormalities, and diabetes in Micronesia: the effect of nuclear testing

Abstract: Many suggest that cancer and other diseases in Micronesia have been caused by nuclear testing in the Pacific. The 50-year commemoration of the March 1, 1954 Bravo thermonuclear test has rekindled interest in this area. This paper explores the documentation for, and the plausibility of, claims for disease causation by nuclear testing. Given the sheer volume of testing that the US conducted in the Pacific, it appears plausible that excess cancer would have occurred in areas of Micronesia other than the Marshall Islands. An excess of birth abnormalities in the Marshall Islands has been documented. While diabetes is not a radiogenic disease, and other cancers are generally less radiogenic than leukemia or thyroid cancer, the social and cultural effects of nuclear testing specifically, and the strategic uses to which Micronesia has been put generally, have had roles in the social production of disease. Integration into a globalized, cosmopolitan economy—with attendant phenomena such as the importation of tobacco, alcohol, foods of poor nutritional value, and new cultural morés—are also factors. **Key Words:** Marshall Islands, health disparities, radiogenic diseases

Seiji Yamada*

Introduction

Across Micronesia, from the Federated States of Micronesia to Guam, many suggest that cancer in these jurisdictions has been caused by nuclear testing in the Pacific. While the US government program for those exposed to fallout from the 1954 Bravo test acknowledges the occurrence of thyroid cancer and leukemia among that group of patients¹, the Nuclear Claims Tribunal² compensates for a number of other conditions. Many Marshallese people believe that other health problems stem from exposure to radiation. These include reproductive ailments³ and diabetes⁴.

This paper explores the documentation for, and the plausibility of such claims, in light of medical and public health science. It also examines the history of nuclear testing in Micronesia in its large-scale historical context and explores its legacy to the health of Micronesian people. Rather than provide an exhaustive accounting, these issues are approached with a broad brushstroke. Further inquiry is suggested.

The Bravo Test

The 50-year commemoration of the March 1, 1954 Bravo thermonuclear test has rekindled interest in investigating the health effects of nuclear testing. At 15 megatons, the equivalent of 15 million tons of TNT, Bravo was the largest

thermonuclear device ever tested by the United States. The people of Bikini Atoll in the Marshall Islands consented to give up their home as a nuclear test site in 1946, "...for the good of mankind and to end all world wars," as they were told by Commodore Ben H. Wyatt, the US military governor of the Marshall Islands⁵. Bravo was detonated at Bikini and winds blew fallout toward populated islands to the east. Fallout fell most directly on 67 people on Rongelap Atoll, 18 Rongelapese visiting Ailinginae, 167 people on Utrik Atoll, 23 Japanese fishermen on board the Fukuryu Maru, and 28 US military weather personnel on Rongerik Atoll^{1,6}. Lesser amounts fell on other atolls as well, most notably Ailuk and Likiep.

The US personnel at the weather station were evacuated the following day, March 2. The fishermen returned to Japan on March 16 with acute radiation sickness. One died some months later, secondary to hepatitis contracted during blood transfusions⁷.

The people of Rongelap were evacuated on March 3, after 51 hours, and the people of Utrik on March 4, after 78 hours⁶. People moved back to Rongelap in 1957 and stayed there until 1985, when it was then determined that food grown on Rongelap was unsafe for consumption.

What did its planners know about the possible health consequences of Bravo? What was known in 1954 about the health effects of radiation? It should be noted that medical science established the harmful effects of radiation over the course of some decades. In the US, radiation was used from the 1930s through the 1950s to treat benign conditions such as acne, tinea capitis, enlarged tonsils, and apparently enlarged thymus glands⁸. However, nuclear testing in the Pacific was carried out in the post-Hiroshima/Nagasaki era. In 1979, Donald Frederickson, Director of the National Institutes of Health, testified that "...by 1950, the International Commission on Radiological Protection and the National Committee for Radiation Protection concluded that there was no safe threshold" for exposure to radiation⁹. Therefore, those who conducted the Bravo test were well

*Hawai'i/Pacific Basin Area Health Education Center, Office of Medical Education, & Division of Ecology and Health, University of Hawai'i John A. Burns School of Medicine, 1960 East West Rd, Honolulu, HI 96822. Tel: (808) 956-9761. Fax: (808) 956-2777. Email: seiji@hawaii.edu

aware of the dangers that radiation posed for humans.

Navy radiobiology physicians Cronkite, Conard, and Bond, who made up the staff of Project 4.1 (a sub-project within the Castle test series to study the effect on humans of radiation secondary to fallout), were assembled within days of Bravo. As the people of Rongelap were the most heavily exposed, followed by the people of Utrik, they were made the subjects of the US government medical program. In recognition of what counts as evidence in medical studies, the medical program followed the radiation-exposed people together with a control population of unexposed people¹. Told that it was safe to move back to Rongelap in 1957, the exposed and the unexposed Rongelapese ate locally grown food, thus acquiring further body burdens of radioactivity. By 1961, their body burdens of cesium-137 was, "...300 times that of the medical team¹⁰."

The Project 4.1 physicians subsequently followed Marshallese patients at the Brookhaven National Laboratory. A summary published in 1997¹ described the acute radiation sickness that occurred initially. An infant exposed at one year of age died at age 19 of leukemia. They described thyroid cancer peaking 12 to 14 years after the radiation exposure. Thus, leukemia and thyroid cancer are acknowledged to have occurred as a result of Bravo. This summary is available on a US Department of Energy (DOE) web page dedicated to "dismantl[ing] the barriers that have contributed [to] distrust..."¹¹ and can be considered to represent the US government's position.

Of note, the Brookhaven program involved only the exposed 252 people of Rongelap and Likiap and a control group of 177 ostensibly non-exposed individuals. Population studies conducted throughout the country have found elevated rates of thyroid nodules and thyroid cancer in other areas of the Marshall Islands that received lesser quantities of fallout^{12,13}.

Nuclear tests in the continental US

Atomic testing was carried out at the Nevada Test Site from 1951 to 1962, with blast exposure to military personnel who were preparing for the use of nuclear devices as assault weapons. The Nevada Test Site (NTS) was chosen for its relatively constant westerly winds, which carried fallout over much of the continental US. Richard Miller's *Under the Cloud* has maps of the well-documented fallout trail of each continental US shot. As the NTS lies northwest of Las Vegas and northeast of Los Angeles, the winds first took fallout over relatively sparsely populated, southwestern Utah. This area nevertheless includes the Mormon communities of St. George and Carson City, where an increased incidence of leukemia and other cancers began to occur in the 1960s. While the increase in illness and deaths was rapidly evident to the families of the area, epidemiological documentation followed. The early studies that documented the excess of

cancer cases did not have a cancer registry and therefore relied upon death certificate data¹⁵.

In 1997 a National Cancer Institute study¹⁶ reviewed by the Institute of Medicine¹⁷, delineated the estimated dosage to the thyroid, of radioactive iodine 131 (I-131) in every county in the continental US. The study concluded that an excess of 46,000 thyroid cancers (confidence interval 11,300 to 212,000) will occur in the US as a result of the Nevada testing¹⁸.

The mechanism for the production of thyroid cancer in the US is the consumption of milk from cows grazing on grasslands contaminated by I-131. Iodine is naturally concentrated in the thyroid gland where radioactive iodine exerts its carcinogenic effects. This causal mechanism was known at the time of the Windscale accident of 1957 when a uranium fire occurred at a British nuclear reprocessing plant on the Irish Sea, thereby contaminating nearby dairy farms. Milk from those farms had to be destroyed¹⁹. I-131 has a relatively short half-life of 8 days, however, and most of its effects are expected to occur in the course of a few months.

Implications of the Nevada Tests for cancer in the Pacific

As noted by the Nuclear Claims Tribunal², in comparing the Nevada testing with testing in the Pacific, it is important to keep in mind that only relatively small kiloton shots were conducted at the NTS, totaling about 1000 kilotons (kt, equivalent to a thousand tons of TNT), or 1 megaton (mt), one-fifteenth the blast energy of the single Bravo test. The largest of these was 74 kilotons. In the Pacific, a total of 152 mt of devices were tested: 77 mt at Bikini Atoll, 32 mt at Enewetak Atoll, 23 mt at Christmas Island, and 20 mt at Johnston Atoll²⁰.

Thermonuclear fusion of hydrogen is, by itself, relatively clean. However, to achieve the temperatures necessary for fusion, it is necessary to use fission (of heavy elements such as uranium or plutonium), which creates many radioactive elements. The world's first thermonuclear device, Ivy Mike, detonated at Enewetak in 1952 used liquid hydrogen. Bravo was the first thermonuclear device to use solid lithium deuteride. It was composed of 200 pounds each of uranium-235 and lithium deuteride, and over a ton of uranium-238²¹. It thus created much radioactive fallout. The relative fission/fusion yield of nuclear devices has not been declassified, but the standard estimate is 50%²⁰. The Centers for Disease Control and Prevention Radiation Studies Branch estimates that more than 6 billion curies of I-131 were released by weapons testing in the Marshall Islands. This contrasts with an estimated 150 million curies released by weapons testing at NTS and 40 million curies released by the Chernobyl nuclear power plant accident²².

Although there is no dairy production in the Marshall Islands, I-131 was ingested by Marshallese because the fallout from Bravo contaminated food and water supplies. It is estimated that on Rongelap Atoll, a one-year old child may have had as much as 5,200 Centigrays [cGy - preferred term for measurement of the amount of radiation dose absorbed by the body (1 cGy = 1 rad)] and an adult woman may have had as much as 1,300 cGy of radiation to the thyroid²³.

Over the decades since the testing, residents also assimilated radioactive material—particularly cesium-137 and strontium-90—into their bodies by eating locally grown plants and surrounding reef resources. Upon determining that the coconut crab, in particular, concentrates strontium-90 into its body, the Brookhaven medical team instructed the residents returning to Rongelap in 1957 not to eat it²⁴. In studying the whole of the Marshall Islands, the Marshall Islands Nationwide Radiological Study of 1990-1994 found levels of radiation only slightly higher than the average background radiation worldwide (2.4 mSv y⁻¹), insufficient to account for significant further carcinogenesis²⁵.

In Micronesia, the dominant trade winds blow from east to west. The west-to-east wind direction at the time of Bravo was unusual. Given the sheer megatonnage (152 mt, as noted above) of the nuclear testing and the radioactive elements released in all the Pacific tests, the areas of Micronesia to the west of the Marshall Islands presumably sustained fallout of considerable quantity.

These considerations lead to the possibility that thermo-nuclear testing in the Pacific has caused cancer in areas of Micronesia to the west of the Marshall Islands—what is now the Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, and the territory of Guam. Most likely, the bulk of any such morbidity occurred in these jurisdictions during the 1960s, through the 1970s, with an expected tapering over time. The health services in these jurisdictions were not advanced enough to make specific cancer diagnoses during this period and would have been relatively incapable of identifying diseases such as leukemia or thyroid cancer.

What of other cancers? The Nuclear Claims Tribunal (NCT) in the Marshall Islands compensates individuals for a variety of conditions, mostly cancers of various organs²⁶. Cancer studies from Hiroshima and Nagasaki document that those who were closer to the hypocenters of the blasts had a higher relative risk of developing cancer of various organs, with differing excess risks for different organs²⁷. Such population measures are difficult to translate into causal attribution for individuals because cancer is generally multifactorial, and a variety of environmental and host factors

impinge upon any given individual. The NCT effectively discounts other such factors (such as smoking) and attributes cancers qualifying for compensation solely to radiation. In adopting this approach, the Tribunal concluded that: 1) the failure of the US to maintain contemporaneous exposure data during and after the testing period, 2) the lack of advanced medical diagnostic services, and 3) the absence of baseline non-radiation risk factors for people of the Marshall Islands, all combined, make the “presumed list” method of assessing claims both reasonable and fair²⁸.

Thus, for example, when made a compensable condition in 1996, 51 awards were made for bronchial cancer, the largest for any diagnosis that year²⁹. While there are public policy reasons to pursue such an approach, it encourages the popular view that all cancers are the result of radiation.

Other health effects in the Pacific

The effects of high-dose radiation on human reproduction were evident from Hiroshima and Nagasaki, where cessation of menstruation and congenital abnormalities were seen³⁰. In reporting on reproductive problems among their patients, Cronkite, Conard, and Bond merely observed, “There was an increase in miscarriages and stillbirths in the exposed Rongelap women, but the numbers were small and it is uncertain if this increase was related to radiation effects¹.”

Marshallese women reported giving birth to many deformed fetuses. A type of abnormal birth, probably representing hydatidiform moles, are called “jellyfish babies” and described

Marshallese women reported giving birth to many deformed fetuses. A type of abnormal birth, probably representing hydatidiform moles, are called “jellyfish babies” and described by Marshallese women as looking like a mass of grapes.

by Marshallese women as looking like a mass of grapes³¹. Abnormal births described as looking like “peeled grapes³³” were also described by women in Utah who were downwind of the Nevada Test Site. In 1990-1991, Glenn Alcalay conducted a survey of 830 women, every woman of child-bearing age on ten atolls in the Marshall Islands. For the period 1952 and after, he found a strong correlation between the number of congenital anomalies, as well as stillbirths and miscarriages, and the distance of residence from Bikini. The incidence of congenital anomalies increased between the periods, ≤ 1951 vs. ≥ 1952 (the first test in the megaton range being Ivy Mike in 1952)³⁴.

What of other diseases prevalent now? Diabetes is highly prevalent in the Marshall Islands³⁵. Medical practitioners there consider it to be the number one chronic health problem, and the nuclear testing looms large in the memories of Marshallese. It is perhaps natural for Marshallese to ascribe the increasing occurrence of diabetes to radiation. Although diabetes is not considered to be a radiogenic disease in the medical literature, the increasing prevalence

of diabetes globally is certainly related to social and cultural factors. In the Marshall Islands, the social disruption caused by nuclear testing has been a primary feature of its modern history^{36,37}.

With regards to endocrine diseases, however, I-131 is used to ablate functional thyroid tissue in Grave's disease. That is, it kills normal thyroid cells, rendering people hypothyroid, deficient in thyroid hormone. The number of thyroid nodules and cancer found among Marshallese people are indicative of exposure to I-131, which as noted above, has a relatively short half-life of 8 days.

As laboratory testing methods were inadequate in the early years of the Brookhaven program, hypothyroidism was not initially recognized as the cause of the growth lag in children. When hypothyroidism was recognized, these patients were placed on thyroid hormone. In 1966, exposed Rongelapese were placed on suppressive doses of thyroid hormone to inhibit the growth of thyroid tumors¹. In 1994 a thyroid ultrasound survey of the Rongelapese and Utrikese was conducted by the Brookhaven program. Thyroid function was measured at the same time and some patients were found to be hypothyroid^{23,13}.

It is important not to attribute too great a proportion of the health problems in Micronesia to nuclear testing, since there are other factors, such as smoking, which contribute to the cancer burden. In their education program, the Scientific Advisory Panel suggested that, "Smoking one pack of cigarettes a day carries a risk more than 100 times greater than an exposure level of 1 mSv y⁻¹ (100 mre y⁻¹)³⁸."

As noted by Erikson and Lifton in their 2002 review of the social, cultural, and psychological effects of Bravo on the people of Utrik, it is common for people who have been exposed to radiation to believe themselves to be ill and infirm. The attribution of a variety of diseases to radiation exposure has been seen among survivors of Hiroshima, Chernobyl, and Three Mile Island³⁹.

The social production of cancer in the Pacific

A way to view cancer in Micronesia would be to identify large-scale social and economic forces that have negative impacts upon health^{40,41}. At the most fundamental level, the domination by successive colonial powers has led to an abandonment of sustainable, self-sufficient social forms in favor of integration into the globalized, cosmopolitan economy.

Some of the consequences have been as follows: Firstly, as a strategic asset, the Pacific islands became one of the main battlegrounds of the war in the Pacific. When the US was granted control over most of Micronesia as Trust Territories after World War II by the United Nations, the US ostensibly assumed responsibility for the health and welfare of the people. In the post-war period, however, the Marshall Islands and Kiribati were used as test sites for nuclear weaponry. Even now, weapons are tested in the Pacific. France last tested a nuclear device in Polynesia in 1996. The Marshall Islands continue to be used as a test site for the Ballistic Missile Defense system⁴². Intercontinental ballistic missiles are launched from California toward the Marshall Islands, from where extra-atmospheric kill vehicles are launched to shoot them down.

Secondly, the displacement of people by weapons testing has diminished the people's ability to produce staples such as taro and breadfruit. Pacific Islanders have become more dependent upon imported white rice and processed foods such as canned meats. In addition, both tobacco and processed foods are commodities produced, imported, and promoted by multinational corporations. Finally, social forces that privilege the rights of corporate interests over the rights of people to healthful lives facilitates the importation of such unhealthful commodities.

Thirdly, the Pacific Islanders have witnessed a breakdown of traditional cultural values and increases in rates of obesity, alcohol, tobacco, and other drug use. Extended families have been separated. Cultural norms regarding the care of children have been disrupted. As communities lose their ability to produce their own food, the people lead more sedentary lives. This has led to an epidemic of obesity throughout the Pacific Islands. Obesity is believed to contribute to 20% of the cancer mortality in the US⁴³. The breakdown of cultural value systems also leads to people seeking refuge in tobacco, alcohol, and unsafe sexual practices. Increased sexual contacts within populations and with other populations have contributed to the spread of pathogens such as the human papillomavirus and the hepatitis B virus, both with roles in cancer causation.

Conclusion

Given the megatonnage of nuclear testing that the US conducted in the Pacific, it appears plausible that excess cancer would have occurred in areas of Micronesia other than the Marshall Islands. Unfortunately, it is probably not possible to document whether excess cancer occurred in Micronesia during the 1960s. A major reason is that health services in most of Micronesia were not sufficiently equipped to make specific cancer diagnoses then.

... it is common for people who have been exposed to radiation to believe themselves to be ill and infirm. The attribution of a variety of diseases to radiation exposure has been seen among survivors of Hiroshima, Chernobyl, and Three Mile Island.

An excess of birth abnormalities in the Marshall Islands has been documented. Such also appears to be part of the local knowledge of the people, and the occurrence of congenital abnormalities in other radiation-affected areas of the world lends support.

While diabetes is not a radiogenic disease, and other cancers are generally less radiogenic than leukemia or thyroid cancer, the social and cultural effects of nuclear testing specifically, and the strategic uses to which Micronesia has been put generally⁴⁴, have each had a role in the social production of disease. Integration into the globalized, cosmopolitan economy—with attendant phenomena such as the importation of tobacco, alcohol, foods of poor nutritional value, and new cultural mores—have also contributed. It will not do to ascribe all diseases to nuclear testing. The prevention and control of cancer in the Micronesia will need to be a broad-based effort.

Acknowledgements

I would like to thank Julia Estrella, Rosalie Bertell, and the two anonymous reviewers of this manuscript.

References

1. Cronkite EP, Conard RA, Bond VP. Historical Events Associated with Fallout from Bravo Shot – Operation Castle and 25 Y of Medical Findings. *Health Phys* 1997; 73(1), p. 179. Available from: <http://tis.eh.doe.gov/health/marshall/marshall.htm>. Accessed July 24, 2004. The authors were three Navy radiobiology research physicians assigned to the original Department of Defense/Atomic Energy Commission medical team that cared for and studied the victims of fallout. All three were subsequently involved in long-term medical surveillance at Brookhaven National Laboratory on Long Island.
2. Nuclear Claims Tribunal. Available at: <http://www.nuclearclaimstribunal.com/>. Accessed July 24, 2004.
3. Anjain, Jeton. Statement of Senator Jeton Anjain, Rongelap Atoll, Republic of the Marshall Islands, Trust Territory of the Pacific Islands before the Fourth Committee of the United Nations, October 30, 1985. Available at: http://www.ratical.org/radiation/inetSeries/wwc1_6.txt. Accessed March 16, 2004.
4. Gittelsohn J, Maas L, Gammino V, Palafox N. Overnutrition and undernutrition in the Republic of the Marshall Islands: Report of a pilot study and future directions. Baltimore, MD: Johns Hopkins University School of Hygiene and Public Health, 1998.
5. Niedenthal J. A Short History of the People of Bikini Atoll. Available at: <http://www.bikiniatoll.com/history.html>. Accessed July 24, 2004.
6. Deines AC, Goldman DI, Harris RR, Kells LJ. Marshall Islands Chronology 1944 to 1990. Available from: <http://worf.eh.doe.gov/ihp/chron/>. Accessed July 24, 2004. This reference gives slightly different figures: 64 people on Rongelap Atoll, 17 on Ailingae, and 154 people on Utrik Atoll.
7. Eisenbud M. Monitoring distant fallout: the role of the Atomic Energy Commission Health and Safety Laboratory during the Pacific Tests, with special attention to the events following Bravo. *Health Physics* 1997; 73(1):21-27.
8. Sarne D, Schneider AB. Thyroid cancer II: external radiation and thyroid neoplasia. *Endocrinol Metab Clin North Am* 1996; 25(1):181-195.
9. Health effects of low level radiation. Joint Hearings, 96th Congress, 1st session, April, 1979, cited in Ball, Howard. *Justice downwind: America's atomic testing program in the 1950s*. New York: Oxford University Press, 1986. p. 40.
10. Conard et al. Medical survey nine and ten years after exposure, p. 5, cited in Pennan Barry, Policy of reassurance. Unpublished paper, p. 21.
11. U.S. Department of Energy. Environment, Safety, and Health. Marshall Islands Program. Available from: <http://tis.eh.doe.gov/health/marshall/marshall.htm>. Accessed July 25, 2004.
12. Hamilton TE, van Belle G, LoGerfo JP. Thyroid neoplasia in Marshall Islanders exposed to nuclear fallout. *JAMA* 1987; 258:629-636.
13. Takahashi T, Simon SL, Trott KR, Fujimori K, Nakashima N, Arisawa K, Schoemaker MJ. A progress report of the Marshall Islands Nationwide Thyroid Study: an international cooperative scientific study. *Tohoku J Exp Med* 1999; 187:363-375. Thyroid function was also measured in the Marshall Islands Nationwide Thyroid Study, but abnormalities were not noted in this progress report.
14. Davis M. *Dead cities*. New York: New Press, 2002, p. 42-45.
15. Ball H. *Justice Downwind: America's Atomic Testing Program in the 1950s*. New York: Oxford University Press, 1986.
16. Klausner RD. Estimated exposures and thyroid doses received by the American people from Iodine-131 in fallout following the Nevada atmospheric nuclear bomb tests. Testimony before the Senate Appropriations Subcommittee on Labor, Health and Human Services, Education and Related Agencies October 1, 1997. Available at: <http://www3.cancer.gov/legis/testimony/i-131.html>. Accessed July 24, 2004.
17. Institute of Medicine. Executive Summary. Exposure of the American people to iodine-131 from Nevada nuclear-bomb tests: review of the National Cancer Institute study. Available from: <http://books.nap.edu/catalog/6283.html>. Accessed July 24, 2004.
18. Land C. Calculation of the estimated lifetime risk of radiation-related thyroid cancer in the United States from Nevada Test Site fallout. Presented at the National Academy of Sciences, Institute of Medicine Committee on Exposure of the American People to I-131 From Nevada Atomic Bomb Tests: Implications for Public Health, December 19, 1997. Available at: <http://rex.nci.nih.gov/massmedia/falloutcalculation.html>. Accessed July 24, 2004. Various estimates are given for different assumptions.
19. Miller RL. *Under the cloud*. New York: The Free Press, 1986, p. 359.

20. Simon SL, Robison WL. A compilation of nuclear weapons test detonation data for U.S. Pacific Ocean tests. *Health Phys* 1997; 73(1):258-64. Available from: <http://tis.eh.doe.gov/health/marshall/marshall.htm>. Accessed July 25, 2004.
21. Special Joint Committee Concerning Rongelap and Utirik Atolls. Medical aspects of the incident of March 1, 1954. Saipan, Marianas Islands: Fifth Congress of Micronesia, First Regular Session, February 1973, p. 69. Cited in Barry, p.8.
22. Nuclear Claims Tribunal. Annual report to the Nitijela for the calendar year 1998. Republic of the Marshall Islands: Nuclear Claims Tribunal, 1999, p. 3.
23. Howard JE, Vaswani A, & Heotis P. Thyroid disease among the Rongelap and Utirik population – an update. *Health Phys* 1997; 73(1):190-98. Available from: <http://tis.eh.doe.gov/health/marshall/marshall.htm>. Accessed July 25, 2004.
24. Barry, p. 21.
25. Simon SL, Graham JC. Findings of the first comprehensive radiological monitoring program of the Republic of the Marshall Islands. *Health Phys* 1997; 73(1):66-85. Available from: <http://tis.eh.doe.gov/health/marshall/marshall.htm>. Accessed July 25, 2004.
26. Claims. Nuclear Claims Tribunal. Available at: <http://www.nuclearclaimstribunal.com/claim.htm#conditions> Accessed 24 July 2004.
27. Thompson DE, Mabuchi K, Ron E, Soda M, Tokunaga M, Ochikubo S, Sugimoto S, Ikeda T, Terasaki M, Izumi S, et al. Cancer incidence in atomic bomb survivors. Part II: Solid tumors, 1958-1987. *Radiat Res* 1994; 139(1):129.
28. Nuclear Claims Tribunal. Annual report to the Nitijela for the calendar year 1999. Republic of the Marshall Islands: Nuclear Claims Tribunal, 2000, p. 23.
29. Nuclear Claims Tribunal. Annual report to the Nitijela for the calendar year 1996. Republic of the Marshall Islands: Nuclear Claims Tribunal, 1997, p. 4.
30. The Committee for the Compilation of Materials on Damage Caused by the Atomic Bombs in Hiroshima and Nagasaki. *Hiroshima and Nagasaki: the physical, medical, and social effects of the atomic bombings*. New York: Basic Books, 1981.
31. Kathe Judo of Wotje, as told to Dibblin J. *Day of two suns: U.S. nuclear testing and the Pacific Islanders*. London: Virago Press, 1988, p. 36.
32. Wypijewski J. From a tropical paradise to a nuclear hell. Los Angeles Times 2004 Mar 1.
33. Gallagher C. *American ground zero: the secret nuclear war*. Boston, 1993.
34. Alcalay GH. Statement of Glenn H. Alcalay before the Presidential Advisory Committee on Human Radiation Experiments, March 15, 1995 – Washington, D.C.
35. Yamada S, Dodd A, Soe T, Chen TH, Bauman K. Diabetes mellitus prevalence in out-patient Marshallese adults on Ebeye Island, Republic of the Marshall Islands. *Hawaii Medical J* 2004 Feb; 63:47-53.
36. Pollock NJ. Health transitions, fast and nasty: the case of Marshallese exposure to nuclear radiation. *Pacific Health Dialog* 2002;9(2):275-82.
37. Yamada S, Palafox N. On the biopsychosocial model: political economic perspectives on diabetes in the Marshall Islands. *Fam Med* 2001; 33:348-50.
38. McEwan AC, Simon SL, Baverstock KF, Trott K-R, Sankaranarayanan K, Paretzke HG. Some reflections on the role of the Scientific Advisory Panel to the Marshall Islands Nationwide Radiological Study. *Health Phys* 1997; 73(1):268. Available from: <http://tis.eh.doe.gov/health/marshall/marshall.htm>. Accessed July 25, 2004.
39. Erikson, Kai and Robert Jay Lifton. Sociocultural and psychological impacts of the Bravo nuclear test on the people of Utirik. Monograph prepared for the Nuclear Claims Tribunal, Republic of the Marshall Islands, 28 June 2002.
40. Finau SA, Wainiqolo IL, Cuboni GG. Health transition among Pacificans: unpacking imperialism. *Pac Health Dialog* 2002; 9(2):251-3.
41. Yamada S. Latin American social medicine and global social medicine. *Am J Pub Health* 2003 93(12); 93(12):1994-6.
42. Yamada S. *Militarism and the social production of disease*. In Fort M, Mercer MA, Gish O (Eds.). *Sickness and wealth: the corporate assault on global health*. South End Press, 2004.
43. Calle EE, Rodriquez C, Walker-Thurmond K, Thun MJ. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *New Engl J Med* 2003; 348:1625-38.
44. Solomon AM. Report by the U.S. government survey mission to the Trust Territory of the Pacific Islands. 9 Oct 1963. ■