

Cesium 137 Body Burdens of Alaskan Men

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BAARLI and associates (1) and Liden (2) first reported on elevated cesium 137 body burdens in inhabitants of the northern latitudes in 1961. These studies were done in Norway and in Sweden. Palmer initiated a series of parallel studies in Alaska the following year (3-5), and his first report concerned the inhabitants of four villages, Kotzebue, Point Hope, Barrow, and Anaktuvuk Pass. Palmer pointed out that higher average cesium 137 burdens were associated with the consumption of caribou and reindeer meat, as other investigators had observed in Scandinavian Laplanders. The surveys were later extended to include Fort Yukon and Arctic Village, and higher cesium 137 levels were also measured in the village inhabitants who ate reindeer and caribou (see map).

Subsequently, the Division of Radiological Health, Public Health Service, initiated a study to provide, by expanding the geographic area investigated, further data for use in estimating the extent and magnitude of cesium 137 body burdens throughout Alaska. This report presents the results of an initial phase of the study, April and May 1965, which indicate that elevated cesium 137 body burdens are generally prevalent throughout the State.

Cesium 137 body burdens are of public health interest because in unseparated fission products a few weeks old, such as in fallout and in accidental releases from nuclear facilities, cesium 137 is one of the three nuclides of critical importance; the other two are strontium 89 and strontium 90. Cesium 137 is long lived, distributes itself throughout the soft body tissue, and, in the diet, appears mainly in milk, meat,

and vegetables. Since cesium 137 emits gamma radiation, it can be measured directly in the living body with a whole-body counter. In the Arctic, the lichen-to-caribou (reindeer)-to-man pathway is the most important food chain contributing to the cesium 137 body burdens (6a).

Materials and Methods

To measure the cesium 137 levels in a state-wide sample in Alaska, the Division of Radiological Health established sampling points at the Division of Indian Health hospitals in Anchorage, Kanakanak, Bethel, Tanana, Kotzebue, and Mount Edgecumbe. In addition, measurements were made on three persons from Anaktuvuk Pass. The sampling points were established at the six hospitals because each location contained both local residents and people from outlying villages. This selection also provided reasonable assurance that the subjects would represent a good geographic and population distribution. Moreover, the hospitals provided a pre-existing system for contacting suitable native subjects and provided adequate facilities for measuring body burdens and for holding brief dietary interviews. Dr. Kazumi Kasuga of the Division of Indian Health and

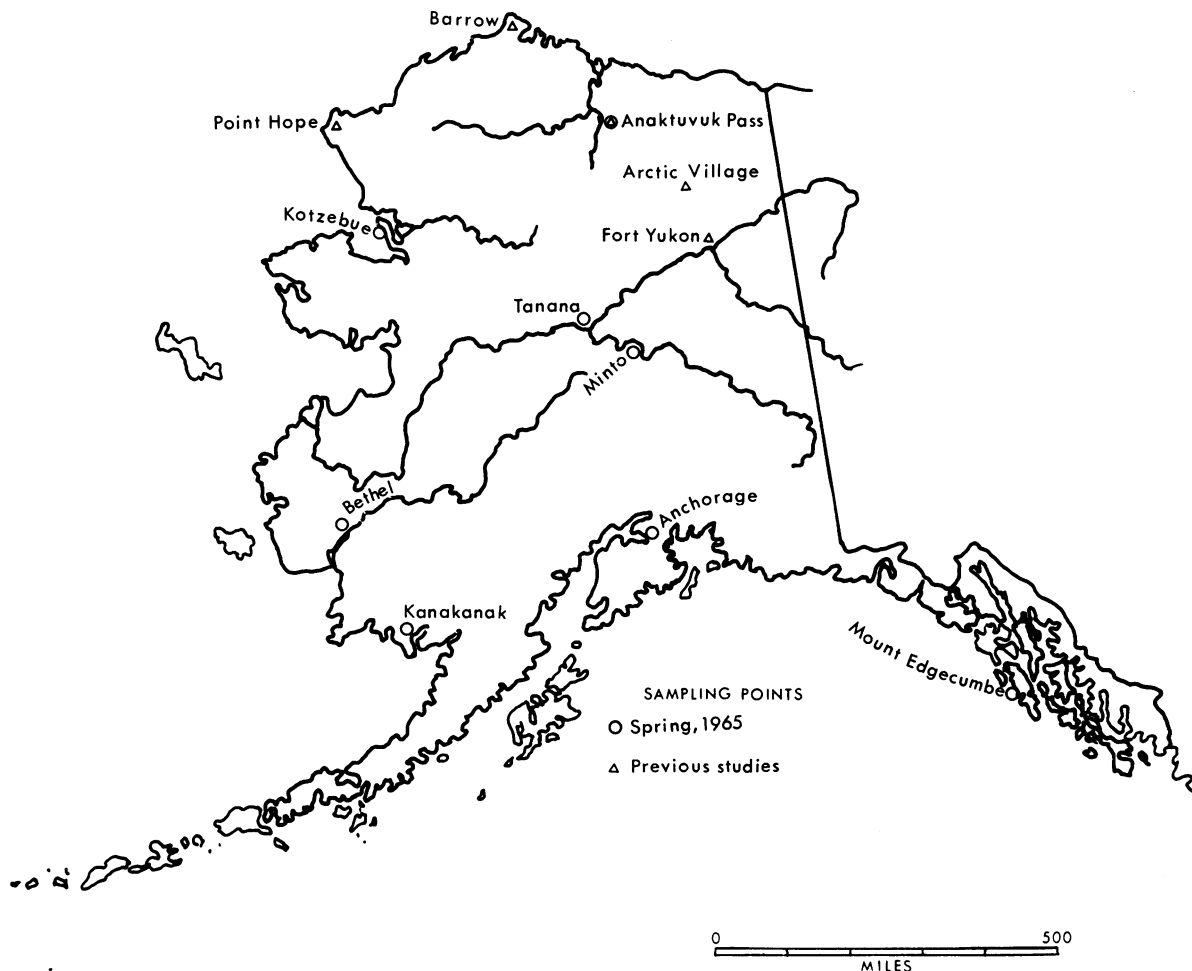
The authors are with the Public Health Service. Dr. Bruce, medical advisor, Technical Operations Branch, when this paper was prepared, is now with the National Institutes of Health. Mr. Remark is a technical project officer, Technical Operations Branch, and Mr. Averett is an electronics engineer, Research Branch, Division of Radiological Health, Bureau of State Services.

the staff of the Alaska Native Hospitals assisted in establishing the sampling points.

The counting method (7) used to measure the cesium 137 body burdens employed a 3- by 3-inch sodium iodide (thallium activated) crystal coupled to a photomultiplier tube, with a preamplifier attached directly to the tube base; the detector requires no shielding other than the subject's body. The subject is seated in a chair in an ordinary room, and the detector assembly is placed on his lap. The assembly is 18 inches long and 4 inches in diameter and weighs approximately 10 pounds. The subject is asked to bend forward so as to afford maximum body shielding to the detector. The detector is then activated for 10 minutes. E. Gannon, Northeastern Radiological Health Laboratory, maintained and operated the elec-

tronic equipment used in the field. Dr. A. Goldin, Northeastern Radiological Health Laboratory, and H. J. L. Rechen and O. G. Briscoe, Rockville Radiological Health Laboratory, Public Health Service, assisted in setting up the standardization and operational procedures for the whole-body counting system. For comparison, a member of the survey team whose body burden was known was also counted at each sampling point.

The counting method can measure body burdens of cesium 137 down to approximately 10 nanocuries, based on comparison runs with shielded counters. A nanocurie equals 1×10^{-9} curie. The accuracy varies from ± 10 percent at higher levels, that is greater than 50 nanocuries, to ± 50 percent at lower body burdens, that is less than 20 nanocuries. The



Sampling points for measuring cesium 137 body burdens in Alaska

Table 1. Cesium 137 body burdens in 180 men from selected Alaskan communities

Location	Number in sample	Cesium 137 body burdens (nanocuries)		
		Maximum	Minimum	Average
Anaktuvuk Pass.....	3	1,368	816	1,052
Anchorage.....	30	206	<20	70
Bethel.....	34	293	<20	93
Kanakanak.....	28	1,279	<20	178
Kotzebue.....	23	979	106	454
Mount Edgecumbe.....	27	138	<20	43
Tanana.....	35	88	<20	44

technique is well suited for surveillance operations in the northern latitudes where body burdens often exceed 50 nanocuries and may be 1,000 nanocuries or greater.

Results

The results of measurements of the cesium 137 body burdens of 180 Alaskan men, obtained from April 18 through May 6, 1965, are summarized in table 1. These results indicate that high body burdens of cesium 137 are prevalent throughout most of Alaska; the area includes the Alaskan Peninsula, but excludes the southern panhandle area and some northern interior villages. The values obtained in Kotzebue and Anaktuvuk Pass are in good agreement with previous studies. No similar studies have been done at any of the other sampling points, except a pooled urine-radiochemical analysis study conducted in Fort Yukon, Tanana, and Bethel during the winter of 1962-63 (8). The body burdens estimated from the urine levels from Tanana and Bethel are in good agreement with the values obtained in this study.

Based on the dietary interviews, the sample was divided into caribou eaters and noncaribou eaters. Caribou meat was an important dietary item in all the villages sampled except Tanana and Mount Edgecumbe. No distinction was made between caribou meat and reindeer meat. Radiochemical analyses performed by the Division of Radiological Health during the past 3 years show that there is no significant difference between the concentration of cesium 137 in the muscle of the two animals (9).

The average cesium 137 body burdens for caribou eaters and noncaribou eaters are listed in table 2. The body burdens for caribou eaters ranged from 57 nanocuries at Tanana to 1,052 nanocuries at Anaktuvuk Pass; the mean value was 264 nanocuries for all locations. The range for noncaribou eaters was 43 nanocuries at Tanana to 79 at Kanakanak; the mean was 50 nanocuries for the State. Of the four persons in the Tanana sample who ate caribou meat, two were residents of outlying villages (Fort Yukon and Minto). None of the four had eaten caribou meat recently or in large amounts. Many of the villages which are not accessible to the free-ranging caribou herds (such as the Kuskokwim River villages) are supplied processed reindeer meat through commercial outlets.

In comparison, the mean cesium 137 body burdens for residents of the conterminous United States was 88.97 picocuries per gram of potassium; this was determined by measuring 499 subjects from July 1963 to August 1964 (10). This value may be converted to nanocuries of whole-body exposure by considering that the "standard man" contains 140 grams of potassium (11). A nanocurie equals 1,000 picocuries. Therefore, the converted mean value for the conterminous United States was 12.5 nanocuries. Relating this value to the Alaskan measurements, the levels for caribou eaters were 22 times and the levels for noncaribou eaters were 4 times higher than the mean for the conterminous United States.

Table 2. Effect of caribou consumption on average cesium 137 body burdens, reported in nanocuries

Location	Caribou eaters		Noncaribou eaters	
	Percent of sample	Average cesium 137 body burden	Percent of sample	Average cesium 137 body burden
Anaktuvuk Pass.....	100	1,052	0	-----
Anchorage.....	47	100	53	44
Bethel.....	65	110	35	64
Kanakanak.....	57	253	43	79
Kotzebue.....	100	454	0	-----
Mount Edgecumbe.....	0	-----	100	43
Tanana.....	12	57	88	43

Since all previous studies have indicated that elevated body burdens of cesium 137 in Alaska result from the consumption of caribou or reindeer, a goal of this study was to verify this hypothesis statistically. After dividing the samples into caribou eaters and noncaribou eaters, the mean was calculated for each group, and Student's *t* test for significance was applied. Some difficulty was encountered, because the groups were not the same size. Also, some of the variances, which should be approximately equal for strict application of the test, were markedly different. These conditions were corrected by using Cochran's modification (12) of Student's *t* test.

In Kakanak, the levels of the two groups were significantly different at the 95 percent confidence limit. We were unable to test the data from Kotzebue, Tanana, or Mount Edgecumbe because every subject in the Kotzebue sample ate caribou meat, whereas at Tanana, only four subjects ate caribou meat, and at Mount Edgecumbe, none (table 2).

The data from Mount Edgecumbe suggest that there might be a correlation between high body burdens of cesium 137 and consumption of Sitka deer meat. This hypothesis was also tested with the *t* test, and the data showed a significant difference at the 90 percent probability level. There is certainly sufficient evidence to warrant a more detailed ecologic and food utilization study of the Sitka deer.

After estimating the magnitude, extent, and factors affecting the elevated body burdens in Alaska, it is possible to relate the findings to the recommendations of the Federal Radiation Council. A body burden of 3,000 nanocuries of cesium 137 corresponds to the Radiation Protection Guide for whole-body exposure of persons in large population groups (13, 14, 6). "This is the level or average annual body burden which . . . can be used as an indication of when there is a need for a careful evaluation of fallout exposure" (6b). The Federal Radiation Council recommends that "Surveillance and research programs examining the special ecological situations in the arctic region continue until future trends can be predicted with greater confidence" (6c). Also, we must consider the fact that human body burdens, at least in the Anaktuvuk Pass area have an annual cyclic variation, with

the peak occurring in July or August. The average annual values cannot be calculated from the measurements reported here. A program of continued surveillance, designed to produce a dependable average annual value, is in operation in Alaska by the Public Health Service.

Summary

To assess the extent and the magnitude of the reportedly elevated cesium 137 body burdens in Alaska, 180 men in seven communities scattered throughout the State were counted in April and May 1965 to determine their cesium 137 body burdens. In addition, they were interviewed about their dietary consumption.

The whole-body counting device consisted of a portable, unshielded, gamma scintillation detector coupled to appropriate instrumentation. The measurements indicated that body burdens higher than those recorded in the conterminous United States existed throughout Alaska.

The data were divided according to whether or not the subject ate caribou (reindeer). The average body burdens for the caribou eaters were significantly higher than for noncaribou eaters. Based on these measurements, the Public Health Service is continuing its program of surveillance in Alaska. However, the higher burdens do not exceed the radiation protection guidance recommended by the Federal Radiation Council.

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Education Notes

C and B Defense Course. The training branch of the Division of Health Mobilization, Public Health Service, has designed a course to provide selected health and medical personnel with a general knowledge in the technical aspects of chemical and biological defense. The course emphasizes the urgency of adequate training, prior planning for chemical and biological defense, and development of a program to continue essential activities in the event of a disaster.

The students will include representatives of State and local health departments, faculty members of affiliated schools in the Medical Education for National Defense Program, Veterans Administration, Public Health Service, and other interested individuals.

The course will be conducted in cooperation with the U.S. Army Chemical Center and School at Fort

McClellan, Ala. Three 1-week courses are scheduled to be held Nov. 1-5, 1965; Mar. 7-11, 1966; and May 16-20, 1966. For further information and application forms write: Deputy Chief, Training Branch, Division of Health Mobilization, Office of the Surgeon General, Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, D.C. 20201.

World Health Organization. Short-term fellowships are available to full-time United States public health or educational workers in 1966 for the improvement and expansion of health services.

A fellowship award covers per diem and transportation, and will be limited to short-term travel programs. Federal Government officers and employees are ineligible. The deadline for receiving applications is January 1, 1966. Additional information about the fellowships, which will probably not start before May 1, 1966, is available from Dr. Howard M. Kline, Public Health Service, Washington, D.C. 20201.

Program Notes

Dentists Help Combat Heart Disease

The Stickney Public Health District, Oak Lawn, Ill., has initiated a project to detect streptococcal infections in children receiving public health dental care. Its aim is to prevent rheumatic fever in children and serious heart disease later. The Illinois Department of Public Health and the Public Health Service are subsidizing the project.

Public health dentists discovering children with suspicious symptoms will perform throat swab tests for analysis. Those children infected with streptococcus (group A beta hemolytic) will be referred to the family physician for evaluation and treatment.

Oklahoma PKU Test

A new law in Oklahoma allows the State health department to make PKU testing of newborn infants mandatory.

Michigan Hemophilia Control

The University of Michigan Medical Center has set up a statewide hemophilia control service to aid Michigan physicians and dentists and their patients.

The service, established in July 1965, will create an extensive file on Michigan's estimated 300 to 400 hemophiliacs, showing which disorder a patient has and what can aid him in an emergency.

The program is supported in part by the Michigan Chapter of the National Hemophilia Society. It has been set up within the university's Simpson Memorial Institute and draws upon medical specialists from the university hospital.

Washington Laboratory Accredited

The Commission on Laboratory Inspection and Accreditation of the College of American Pathologists recently awarded a certificate of accreditation to the division of labo-

ratories, Washington State Department of Health. It is the first time the college has accredited a State public health laboratory.

The laboratory provides diagnostic services for private and local health department laboratories and to private physicians in the State. It serves also as a training center for microbiologists in the field of infectious diseases.

Baby Sitter Courses in Pennsylvania

More than 600 persons have graduated from baby sitting courses organized by William F. Waslick, a Pennsylvania Department of Health environmental safety representative in Wilkes-Barre. In 8 hours of training held in 3 or 4 sessions, the graduates have learned how to change diapers, give first aid, administer rescue breathing, and prevent child accidents.

A registered nurse, a policeman, and a Red Cross representative have helped teach the courses.

Connecticut Requires Fluoridation

Connecticut has become the first State in the nation to pass legislation making fluoridation of its water supplies mandatory.

The law passed on May 28, 1965, requires utilities serving a population of 50,000 or more to begin fluoridation on or before January 1, 1967. Utilities serving populations of between 20,000 and 50,000 must fluoridate no later than October 1, 1967.

Alaskan Sanitation Aides

The Alaska Division of Public Health's *Sanitation Aide* includes reports by the division's sanitation aides that reflect their accomplishments and difficulties. For example, Roy Vincent, reports on "Point Hope Activities" for January 1965:

"Water supply now located 7 miles east of village. Ice hauled by dog team. One water barrel repainted. Well with 15-inch concrete lining

will be cleaned and ready for summer.

"Honey buckets, chemical, and outdoor toilets for summer use. For collection purposes—burlap gunny sacks for empty cans and oil barrels for body waste.

"Dump on ocean ice ½ mile west of village. Marker set up on beach; sign pointing out to ocean says 'Dump 100 yards.'

"Tethers—sled dogs have been chained except those under 6 months. General meeting held—subject 'Warning against rabies from animals (dogs and foxes).'

"Dr. Kope, Special Forces doctor, helped out with medical care in this village.

"Fifty foxes and 1 polar bear have been killed by trappers."

Health Association 40 Years Old

The 1965 spring issue of the New England Health Education Association's *Newsletter* commemorated the organization's 40th anniversary. The issue includes a historical sketch by Grace Limoncelli Rosselli and messages from the association president, Frances H. Pitt, from the honorary president and honorary members, and from past presidents. A paper by Michael Tarentino presents a look at the future of health education.

Unimmunized Preschool Children

Preschool children in New York are not as well protected against disease as children of school age, recent immunization surveys show.

The surveys are part of a statewide campaign to vaccinate all children under 5 years and susceptible groups over 5 against poliomyelitis, diphtheria, whooping cough, smallpox, and measles. Their aim is to determine immunization levels for various communities and age groups and to identify pockets of under-protection.

Items for this page: Health departments, health agencies, and others are invited to share their program successes with others by contributing items for brief mention on this page. Flag them for "Program Notes" and address as indicated in masthead.
