Radioactivity Measured in Alaskan Natives, 1962–1964

Abstract. *Measurements of the cesium-137 content of northern Alaskan natives during the summer of 1964 indicated that the adults of the interior village of Anaktuvuk Pass had the highest average body burden: 1280 nanocuries of cesium-137. This is an increase of 200 percent over the average body burden found in the summer of 1962 and 100 percent over that found in the summer of 1963. The greatest burden found in a native in 1964 was 2.4 microcuries of cesium-137, but the highest burden of all, 3.0 microcuries, was measured in a non-native living mainly on caribou meat. Sodium-22 was found in samples of urine from Eskimos, and subsequently in the Eskimos themselves and in reindeer and caribou meat.*

Periodic measurements of the amounts of Cs^{137} in northern Alaskan natives have been made since the summer of 1962 (*1*) by means of a portable whole-body counter. The most recent measurements, made in July 1964, indicate that the amount of Cs^{137} in Eskimos has increased since the summer of 1962.

In Table 1 the results obtained during the summers of 1962, 1963, and 1964 for adults (15 years and older) are compared. By 1964 the average body burden in Eskimos of Anaktuvuk Pass had increased by more than 100 percent since 1963 and by more than 200 percent since 1962. The Cs^{137} content of people in other villages had also increased. Because caribou meat is eaten only sporadically at Barrow and Fort Yukon, and because the body burdens in these people were not approaching equilibrium with the caribou component of their diet, measurements were discontinued in these two villages. Anaktuvuk Pass usually has abundant caribou meat (*2*) and the average burden of people in this village is more directly related to the amounts of Cs^{137} in caribou. A man from Anaktuvuk Pass had the highest amount of Cs^{137} found in an Eskimo: 2.4 μc. However, a burden of 3.0 μc was measured in a non-native living in the small village of Ambler; his diet consisted mostly of caribou meat.

Table 1. Amounts of Cs^{137} in adult (aged 15 years or more) Eskimos and Indians of Alaskan villages, estimated by means of a portable whole-body counter.

Village	Cs^{137} (nanocuries)	
	Average	Maximum
Summer 1962		
Anaktuvuk Pass	421	790
Kotzebue	138	518
Barrow	52	166
Point Hope	17	119
Summer 1963		
Anaktuvuk Pass	628	1240
Kotzebue	140	732
Barrow	60	177
Point Hope	39	88
Fort Yukon	34	181
Summer 1964		
Anaktuvuk Pass	1280	2400
Kotzebue	321	929
Point Hope	50	92
Arctic Village	614	1156

Similar increases in body burdens of Cs^{137} have been measured in Swedish Lapps by Liden and Naversten (*3*) and in Finnish Lapps by Miettinen (*4*). The maximum body burden measured in northern Finns was 2.66 μc in April 1964.

Measurements were again made on children (4 through 14 years) in Alaska this summer; their body burdens were consistently lower than those of adults. In adult females the burdens were still about two-thirds as high as in adult males; in children the burdens were about one-fourth as high as in adult males. The average body burden of children at Anaktuvuk Pass was 341 nc, which is a 50 percent increase over the average for 1963.

This summer, Cs^{137} was measured in the native Athapascan Indians of Arctic Village for the first time; their body burdens were higher than those of people from any other village except Anaktuvuk Pass. Since caribou meat makes up a large part of their diet except in summer (they do not practice meat storage through the summer as the Anaktuvuk Pass people do), their body burdens were probably higher during the spring; when measurements were obtained in July, the Indians of Arctic Village had not eaten caribou for several weeks.

Frequent measurements since January 1964 of the Cs^{137} content of Eskimos at Anaktuvuk Pass indicate that the average body burden of these Eskimos changes by as much as a factor of two during the year. The highest burdens of Cs^{137} occurred during July; the lowest occurred in the winter months. Monthly samples of urine from people in the coastal village of Point Hope show that here maximum burdens occur during the winter and minimum burdens during the summer. That this cycle is the reverse of that at Anaktuvuk Pass may be explained by differences in methods of meat storage and in the seasons for killing caribou at the two villages. Details of this study will be published elsewhere.

In about January 1964, we began to find Na^{22} in samples of urine obtained from people at Anaktuvuk Pass. Samples of caribou meat showed that there was enough Na^{22} in the meat to account for the amounts found in urine. The concentration of Na^{22} in the urine appeared to increase during March and April and then to level off; the maximum concentration found in a urine sample was 0.97 nc per liter, which indicates that the body burden of Na^{22} in the donor must have been about 17 nc. When the whole-body measurements obtained in July for ten people with the highest Cs^{137} body burdens were added together, a Na^{22}-peak could be detected; this peak average was equivalent to an average burden of about 12 nc. For comparison, the Na^{22} concentration in urine from Richland, Washington, was about 0.01 nc per liter in April 1964. Samples of caribou and reindeer meat obtained before the summer of 1963 contained very little Na^{22}, indicating that fallout from the latest nuclear tests contains much more Na^{22} than fallout from tests conducted before 1961. Similar results were obtained by Perkins and Nielsen (*5*) who measured the Na^{22} content of samples of foods and urine.

The concentration of Cs^{137} in the air at Richland, Washington, during the first half of 1964 was only about 30 percent less than the concentration during the same period in 1963 (*5*). If similar deposition rates occur in Alaska, and if it is assumed that this rate of deposition will continue to be greater than the rate of loss of Cs^{137} from the lichen component of the food chain, the amounts of Cs^{137} in caribou meat and Alaskan natives can be expected to increase next year.

HARVEY E. PALMER
WAYNE C. HANSON
BOBBY I. GRIFFIN
LESLIE A. BRABY

Hanford Laboratories,
General Electric Company,
Richland, Washington

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6. We thank the PHS for the use of hospital facilities at Kotzebue, and M. C. Brewer, director of the Arctic Research Laboratory, for assisting in providing transportation and facilities in northern Alaska. Work performed under contract AT(45-1)-1350 between the AEC and General Electric Company.

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Mineralogic Changes during Growth in the Red Alga, Clathromorphum compactum

Abstract. *The amount of magnesium in the skeletal calcite of the encrusting marine red alga* Clathromorphum compactum *varies seasonally in response to changes in water temperature. X-ray diffraction analyses of serial samples of this alga collected in the Gulf of Maine indicate more than a 40-percent change in composition during a year and demonstrate a more rapid calcification during warmer periods.*

Marine organisms deposit skeletal parts composed of a wide variety of mineral forms. Among the carbonate-secreting groups, the minerals calcite, aragonite, and a variety of magnesium calcites (*1*) are common (*2, 3*). Green algae deposit aragonite exclusively. Red algae deposit both aragonite and magnesium calcites, the latter containing up to 30 mole percent magnesium, calculated as $MgCO_3$, in solid solution in the calcite (*1*). The coccolithophores deposit a calcite very low in magnesium.

Clarke and Wheeler (*4*) and Chave (*2*) have shown that in calcite-secreting groups of marine organisms, the magnesium content of the whole calcitic tests increases almost linearly with water temperature over the range 0° to 30°C. Thus tropical forms of a given taxon have a higher magnesium content than their boreal counterparts. During an attempt to determine the rate of growth and calcification in an individual encrustation of the red alga *Clathromorphum compactum,* we found that seasonal changes in the magnesium content of the skeletal calcite could be detected.

Because of the small radius of the Mg^{++} ion, relative to the Ca^{++} ion, an increase in the number of Mg^{++} ions in solid solution causes a decrease in the lattice spacings which can be quantitatively evaluated by means of x-ray diffraction techniques. The $d(112)$ spacing of the calcite was measured by using the $d(111)$ of fluorite (CaF_2), added as an internal reference standard. The composition of the calcite was determined from Fig. 1 of Goldsmith *et al.* (*5*). The accuracy of the analytical technique is about ± 0.2-percent $MgCO_3$. Contamination by dried salts from the sea or organically bound magnesium is no problem because only magnesium in the calcite lattice is measured by this technique.

Serial samples of a compact encrustation of *C. compactum* were taken from the surface inward, by cutting into the specimen with a fine file. The depth of the cut was measured with a micrometer ocular. The material removed, in 100- to 200-μ units, was collected, mixed with powdered fluorite, and mounted on glass slides for x-ray analysis. The results obtained are shown in Fig. 1. Layers deposited in the fall contain the gametangia, identified by *C* in the figure.

In the Gulf of Maine, where water temperatures range from near 0° to 13°C, *C. compactum* deposits skeletal calcite containing from 9.5 to 14 mole percent magnesium, calculated as $MgCO_3$. The alga deposits approximately 500 μ of carbonate annually, thicker layers being deposited in the summer and thinner layers in the winter. Since we have not yet determined whether growth and calcification occur when the water temperatures are at their lowest for this region, we do not know whether a full temperature record is preserved in the specimen.

In the case of *C. compactum,* seasonal growth increments are easily identified by the morphology of the colony, particularly by localization of gametangia. The technique described could be applied to other algae, in which the morphologic characteristics of growth are not so definitive, so that growth and calcification rates could be determined.

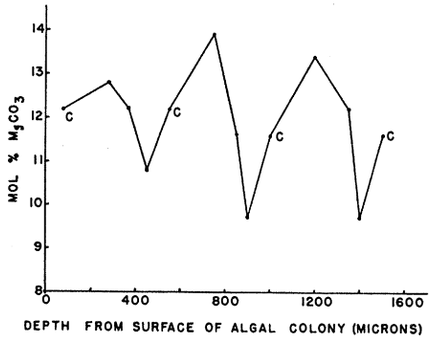

Fig. 1. Magnesium content of successive layers of skeletal calcite in *Clathromorphum compactum.* Fall layers containing gametangia are indicated by *C.*

KEITH E. CHAVE
BRADNER D. WHEELER, JR.*
Marine Science Center, Lehigh University, Bethlehem, Pennsylvania

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6. We thank Dr. W. H. Adey for supplying the specimen. Contribution No. 65-1, Marine Science Center, Lehigh University.
* Present address: A. G. L. and P. Cement Co., Chanute, Kansas.

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Hemoglobin Polymerization in Mice

Abstract. *Polymerization of certain mouse hemoglobins to eight-chain double molecules is completely inhibited by iodoacetamide. Each double molecule appears to consist of two* $\alpha_2\beta_2$*-units linked by way of their* β*-chains with two disulfide bridges.*

Hemoglobins from various strains of mice have been termed either "single" or "diffuse" according to the appearance of electrophoretic patterns of the hemolyzates (*1*). Diffuse mouse hemoglobins have a component sedimenting at approximately 7*S* which increases in quantity during storage (*2*). Discovery that formation of 7*S* components in frog and turtle hemoglobins can be prevented by sulfhydryl (—SH) reagents (*3*) suggested that formation of 7*S* components in mouse hemoglobins might be similarly inhibited. My experiments were designed to test this hypothesis and to determine the number of reactive —SH groups, the number of groups believed to be involved in disulfide (—S—S—) linkages, and distribution of these groups between the α- and β-chains. Initial experiments showed that hemoglobins from each of three strains of mice possess a total of eight cysteine or half-cystine residues per $\alpha_2\beta_2$ unit, of which four freely react with iodoacetamide in a fresh preparation. Hemoglobin from one strain was examined further; the 7*S* component was isolated as described below. It was hypothesized that some of the four reactive —SH groups took part in —S—S— linkage between the two tetramers composing the 7*S* component, and that other —SH groups