perature-sensitive, pale-green mutants that approach the appearance of normal plants at high temperatures (*5*); while pas_{8549} is a pale-green mutant that approaches the normal phenotype at low temperatures and is the only one of these mutants ever observed to grow to maturity in the field (*3*).

The plants which served as the source of the pastel seeds were used as the pollen parents of the appropriate F_1 offspring to insure a more uniform background for comparisons of homozygous pastel seedlings with the heterozygous albino/pastel seedlings. Also, all comparisons of mutant to normal seedlings were made between plants from the same ear.

Mutant and normal seeds were separated on the basis of endosperm color. They were grown in rows in sand flats for 13 days at 22°C, or for 7 days at 37°C to permit harvesting at comparable stages of growth. A growth chamber with a maximum variation of ± 2°C was used. Fluorescent lamps, supplemented by 150 watt incandescent lamps, supplied the light, and the flats were placed so that the surface of the sand received 1400 foot-candles of light before the seeds sprouted. The amount of light was measured with a Weston light meter, model 756. The seedlings were harvested, weighed immediately, and stored frozen until they could be processed.

The methods used for extracting the pigments and measuring their concentrations have been described by Robertson and Anderson (*3*). A summary of the results are given in Table 1.

The error in technique was about ± 10 percent. No replications other than duplicate aliquots of the samples were used. In the case of the normal seedlings variation does occur from ear to ear, and is probably the result of variation in genetic background and different amounts of heterosis.

The mutations under investigation cause variation in all the plastid pigments. However, the mutations do not affect the pigment levels equally, and the effects vary with the locus in question, as well as with the allelic combination. There is probably not a single, common cause for the different types of variation seen at the different loci, although, for the albinos which are allelic to pas_{8686} and pas_{4880}, production of the more unsaturated colored carotenoids is blocked while the production of chlorophyll is not blocked (*6; 7*).

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Radioiodine in Milk of Cows Consuming Stored Feed and of Cows on Pasture

Abstract. During a period of 17 days, 2 months after termination of the Russian nuclear test series in 1961, iodine-131 was measured in milk. Within 2 days after the study was begun, the herd on pasture showed 270 pc iodine-131 per liter of milk. This concentration decreased with a half-life of 7 ± 1 days. No iodine-131 was found in the milk from sheltered cows that consumed stored feed.

One of the less disruptive measures which has been suggested for reducing the levels of iodine-131 and other short-lived radionuclides which, as a result of fallout, are present in milk is the placing of cows under shelter and providing them with water and hay that had been protected from recent fallout. Thus, the only sources of iodine-131 available to the cows would be inhalation or the ingestion of sheltered feed contaminated by deposition. Under these sheltered conditions, the iodine-131 in milk remained at or below 20 pc/liter while levels in other milk during the same period were as high as 270 pc/liter.

The transfer of significant concentrations of iodine-131 from fallout to milk occurs because the cow grazes over a relatively large surface area. The iodine-131 in milk is an appreciable part of that in the feed, and has been experimentally determined to be on the average as low as 0.03 percent (*1*) and as high as 0.5 percent per liter of milk (*2*). The relatively short period between milking and consumption by humans, generally from 1 to 5 days, is insufficient for extensive decay of the radionuclide to occur. In single dose experiments, the concentration of iodine-131 in milk rose to a maximum within 1 day and then decreased with a half-life of approximately 1 day (*1–5*). Continuous exposure to a single batch of contaminated feed resulted in an iodine-131 peak in milk after 2 days, followed by an exponential decrease with an iodine half-life of 8 days (*1, 4, 6*).

Within the wide range expected from such studies, similar changes of iodine-131 concentrations in milk were obtained when the feed was contaminated by tracer solutions, gaseous deposition, or air filters containing fallout particulates. Under actual grazing conditions, contamination of the grass prior to the study should result in a more rapid decrease of iodine levels in milk because of removal of foliar deposition from grass in addition to radioactive decay (*7*), while the deposition of significant additional radioiodine by rain or dry fallout would be shown by new increases in milk levels.

In the present experiment, iodine-131 levels in the milk of sheltered cows and cows on pasture were compared by gamma spectroscopy (*8*). Ten lactating cows, sheltered and fed stored hay for 2 months at the Oregon State University School of Agriculture, Corvallis, were divided into two herds; one remained sheltered and the other was placed on pasture from 2 to 18 December 1961. The cows on pasture ingested an estimated average of 37 kg of moist grass daily and gave an average of 5.6 liters of milk; the sheltered cows gave an average of 8.0 liters of milk. Cows on pasture also ate 3 kg grain mixture and 1 kg hay, whereas sheltered cows had the same amount of grain mixture and ate hay freely. A 3.5-liter sample of milk was composited daily for each group. Samples of the pasture grass, hay, grain mixture, rain, and drinking water were also analyzed by gamma spectroscopy. The gross radioactivity levels in air were obtained from the Portland station of the Public Health Service Radiation Surveillance Network.

The milk of the cows on pasture

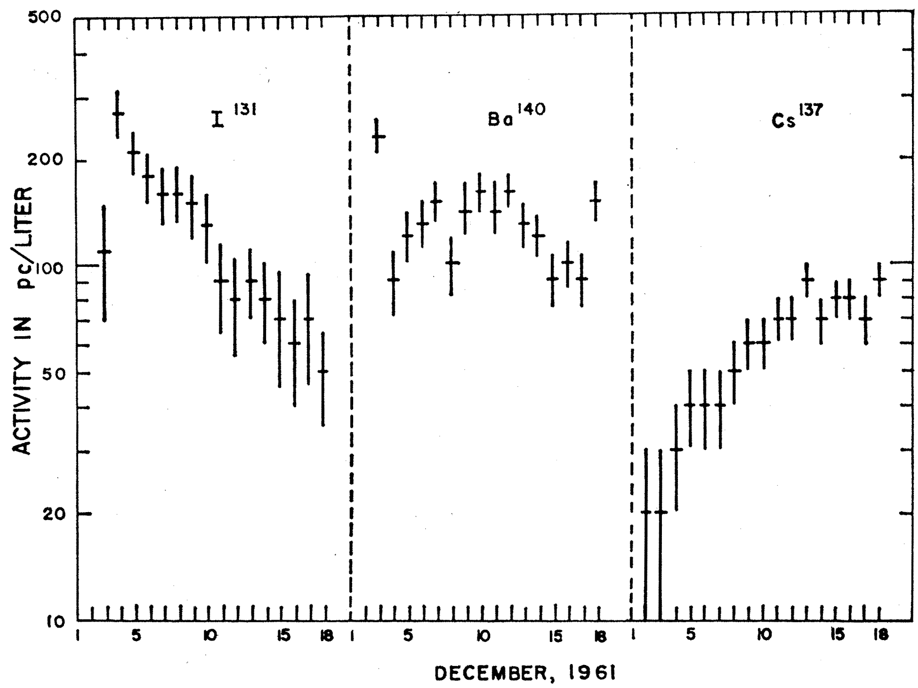

Fig. 1. Iodine-131, barium-140, and cesium-137 concentrations in the milk of cows on pasture.

contained iodine-131, barium-140, and cesium-137 as shown in Fig. 1. With a few possible exceptions, the sheltered cows, eating stored feed, gave milk containing no detectable iodine-131 or barium-140. In 17 daily samples of milk from the sheltered cows, iodine-131 was detected at levels of 30 and 20 pc/liter on 12 and 13 December, respectively, and barium-140 was found at level of 20 pc/liter on 11, 13, and 14 December.

Although they cannot be disregarded, these levels are on the borderline of sensitivity and are not definite indications of the presence of the two radionuclides. The estimated probable error of the values in Fig. 1 is indicated by the vertical bars; the limit of detectability for iodine-131 and barium-140 was approximately 20 pc/liter, based on a sensitivity of 10 pc/liter at the time of counting and radioactive decay periods of 1 to 2 weeks. The cesium-137 level in the milk of sheltered cows was 10 $\pm$ 10 pc/liter throughout the study. These three radionuclides are the only gamma-emitting fission products with half-life periods longer than 1 week normally found in milk of cows ingesting fallout.

The major source of radionuclides from fallout for the cows on pasture was the ingested grass, which supplied 0.6 and 2.1 μc per cow of iodine-131 and barium-140, respectively, on 2 December; the levels decreased to an undetectable amount of iodine-131 (<0.2 μc) and 0.5 μc of barium-140 per cow on 18 December. Cesium-137 was undoubtedly on the grass but could not be detected (<0.2 μc/day intake) because of the relatively large concentrations of ruthenium-103 and zirconium-95. The relative concentrations of the major gamma-emitting fission products suggested a fission product age of 50 to 70 days during the study period.

Fission product levels in air particulates collected at Portland were 10 pc/m^3 or less during the experiment. A breathing rate of 130 m^3/day (*9*) and a fission product mixture that was 2 months old and contained 0.6 percent iodine-131 and 4 percent barium-140 would result in a maximum intake of iodine-131 and barium-140 of 8 and 50 pc/day, respectively, which is four orders of magnitude less than the intake from grass of cows on pasture. Neither stored hay nor drinking water contained any detectable fission products. The grain mix contained only small concentrations of cesium-137, which probably had originated in earlier nuclear tests, and could have been the source of cesium-137 in the milk of the sheltered cows.

The iodine-131 in the milk of the cows on pasture represented on the average only 0.04 percent per liter of the radioiodine ingested. This value is very approximate because of the variations of the grass samples and of the amount of grass eaten by a cow. The iodine-131 and barium-140 levels shown in Fig. 1 take the shape of curves computed for the continuous intake of these radionuclides on the basis of single dose feeding studies (*7*), but are respectively ten and three times lower than these computed values because the measured transfer from feed to milk is lower than the 0.5 percent per liter used in these calculations. The similar shape of the experimental and computed curves suggests that the cows on pasture ingested radionuclides that had been deposited on the grass before the beginning of the experiment. Little additional radioiodine or radiobarium was deposited during the 17 days the cows were on pasture. Thus, based on measurements made on rain, the total deposition of the two radionuclides was less than 0.01 μc/m^2. On 2 December, levels of iodine-131 and barium-140 in grass were 0.09 and 0.32 μc/m^2, respectively, based on 1100 pounds dry grass per acre and 15 percent dry weight. The decrease in level of fission products in grass at a rate greater than the half-life periods probably was the reason that both iodine-131 and barium-140 in milk showed half-life periods of only 7 $\pm$ 1 and 8 $\pm$ 2 days, respectively (Fig. 1) (*10*).

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