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By
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April 1964

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New York Operations Office
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TABLE OF CONTENTS

TEXT

TABLES

Table of Contents (cont'd)

ILLUSTRATIONS

ABSTRACT

A 5" x 3" NaI(Tl) detector and a high pressure ionization chamber have been used to obtain gamma ray spectra and total gamma dose rates at approximately 100 locations during the course of several survey trips in the southeastern, central, and western United States.

Reasonably precise estimates of the dose rates from each of the individual components of both the natural and fallout gamma fields are made using the pulse height spectra and relatively simple methods of analysis. The equipment and types of locations surveyed are discussed briefly and the methods used for determining component and total dose rates from the pulse height spectra are summarized.

The total terrestrial dose rates as well as the partial dose rates from the uranium-238 series, thorium-232 series, potassium-40, zirconium-niobium-95, and rhodium-106 are tabulated for each location. Particular results of interest with respect to environmental gamma radiation, effects of precipitation on fallout gamma dose rates, and the validity of the spectral analysis methods are discussed. Among these results are the relatively high natural dose rate levels in the Denver, Colorado area and the correlation between fallout gamma dose rates and mean annual rainfall for several sites on the Olympic Peninsula, Washington.

INTRODUCTION

For the past several years, HASL has maintained a continuing interest in the natural radiation environment, with particular emphasis on its more penetrating components.[1] Sensitive ionization chambers have been developed to measure the total dose rate from both terrestrial and cosmic radiation sources.[2] The presence of significant quantities of gamma-emitting fission products in the environment as a result of nuclear weapons testing necessitated the development of techniques for inferring the contribution of fallout to the total measured dose rate. Relatively simple methods of analysis have been developed which allow reasonably precise estimates of the individual components of the terrestrial gamma radiation field to be made from a pulse height spectrum obtained in the field with a 5" x 3" NaI(Tl) detector.

This report summarizes these methods[3] and presents the total terrestrial and individual component dose rates determined from spectrometric and ionization chamber measurements taken in 1962 and 1963 at numerous locations in the southeastern, central and western United States. Most of these locations were grouped in a few areas of particular interest (e.g., Denver and Colorado Springs, Colo.; the San Francisco Bay area; the Olympic Peninsula, Washington; and a region near Aiken, S.C.) for studying the natural radiation environment and for verifying our methods of determining dose rates. A number of spot measurements were also taken enroute to these areas from our laboratory in New York City.

SURVEY TECHNIQUES

Choice of Site

Survey locations were usually city parks, school or church lawns, or vacant lots providing fairly large (at least 30 ft. in diameter), grassy, flat areas, whose soil appeared to be fairly typical of the locale. The requirement for flatness is important for two reasons: first, the interpretation of the pulse height spectra in terms of dose rate relies on the assumption of relatively uniform distribution of emitters in a flat "half space"; second, ground depressions often show elevated fallout gamma dose rate levels.

Instrumentation and Field Measurements

The instruments used in a typical survey included portable scintillation counters, the NaI(Tl) spectrometric system, a high pressure ionization chamber, and an altimeter (Fig. 1). The portable scintillation detectors were used to survey the area to assure that the dose rate was relatively uniform throughout. The large NaI(Tl) detector was placed near the center of the area, one meter above the ground, and connected by a 50 foot coaxial cable to a multichannel analyzer system in the HASL Corvan vehicle. Power was supplied by the car battery through a 12 volt DC-AC converter. The gain of the system was adjusted to obtain a spectrum extending from zero to about 3.5 MeV. A twenty minute live time was found to provide adequate statistics. Two typical spectra are shown in Figure 2.

The high pressure ionization chamber filled with argon was used to measure the total dose rate and was placed a few feet from the crystal. The altimeter provided the elevation data necessary to infer the cosmic ray contribution to the ionization current measured by the pressure chamber. In addition to the instrument measurements, notes were made of any unusual conditions prevalent such as recent rainfall, very wet soil, unusual instrumental fluctuations, and ground depressions. A complete set of measurements usually required about 35 minutes from time of arrival to time of departure.

DOSE RATE DETERMINATIONS

Total Terrestrial

The field reading of the ionization chamber (current) can be converted directly into terrestrial and cosmic dose rate values since the chamber has been calibrated in the laboratory for gamma rays[2] and its cosmic ray response and the variation of the cosmic radiation dose rate as a function of altitude have been determined fairly accurately.[3] The total terrestrial dose rate can also be calculated from the gamma ray spectrum obtained from the NaI(Tl) detector. The total "energy" (counts per channel multiplied by the gamma ray energy represented by that channel) in the spectrum from 0.15 to 3.4 MeV has been found to correlate very well with the ionization chamber terrestrial dose rate values, even for locations whose spectra exhibit large fallout peaks. The calibration factor obtained in the laboratory using a standard radium source was consistent with that inferred from the field ionization chamber values.[4]

Dose rates can also be inferred from the portable scintillation counters used to survey the site area. These instruments are equipped with count rate meters and the dependence of their response on environmental conditions and incident gamma ray energy is such that they are not suitable for direct dose rate calibration. The instruments can, however, be "field calibrated" against the ion chamber by plotting the readings of each instrument in a given area against the corresponding terrestrial dose rates obtained from the ionization chamber data. The calibration curve thus obtained may be used to interpret readings of the portable scintillation counter in terms of dose rate for any location in the area as well as to detect any spurious ionization chamber readings.

For each location a "best" value of terrestrial dose rate was calculated by averaging the ionization chamber and total spectrum energy values. The dose rates inferred from the portable instruments were usually used only as a check since these values are generally not as precise as the values obtained from the other two methods.

Natural Gamma

Two methods of spectrum analysis are used to obtain estimates of the dose rate contributions from the three major natural contributors to the terrestrial gamma radiation field. The first method is based on the assumption that the estimated area under a total absorption peak characteristic of the U^{238} series (1.76 MeV), Th^{232} series (2.62 MeV), and K^{40} (1.46 MeV) is directly proportional to the total dose rate contribution from all the gamma rays of the parent emitter or series of emitters. Laboratory studies of the variation of estimated peak counts as a function of primary flux and angle were carried out for various standard monoenergetic sources using the laboratory background spectrum to simulate the field situation. The information obtained from these experiments was combined with calculations of the angular distribution of primary flux and the total dose rate per unit primary flux for the various emitters, assuming known decay schemes and uniform source distributions in the ground, to arrive at a conversion factor from estimated peak counts to dose rate for each of the three naturally occurring components of the total terrestrial gamma radiation field.[4] These conversion factors are given in Table I.

The second method relates the "energy" as defined previously in three energy bands centered on the three above-mentioned photopeaks (E_1, 1.32-1.60 MeV; E_2, 1.62-1.90 MeV; E_3, 2.48-2.75 MeV) to dose rate by means of three simultaneous equations:

$$T = 0.41\ (E_3 - 0.60)$$
$$K = 0.10\ (E_1 - 0.7\ E_2 - 0.5\ E_3 - 0.7)$$
$$U = 0.29\ (E_2 - 0.06\ E_1 - 0.93\ E_3 + 0.50)$$

where T, K, and U are the dose rates in μr/hr from the Th^{232} series, K^{40}, and the U^{238} series respectively. The constants in these equations were first obtained by applying a multiple regression analysis to a large number of field spectra, using the values of K, T, and U calculated from the peak area method. In all three cases the correlation was very good, substantiating our methods of estimating peak area. The magnitude of the first coefficient of each equation, however, is dependent on the accuracy of our peak method conversion factors, In the case of the K and T equations, this coefficient can be obtained independently in a manner analogous to that used in obtaining the conversion factors for the peak method. This was done and the values obtained agreed to within 5% with those predicted by the regression analysis. The U coefficient could not be calculated independently due to the significant contribution to the E_2 band in the field situation of scattered photons from higher energy gamma rays of the uranium series. Rough estimates of this effect indicate that the coefficient of the U equation obtained from the regression analysis is a reasonable one. This band method has the advantage of being more amenable to routine data analysis procedures and of providing more precise individual determinations of component dose rates. Both the band and peak methods agree very closely on the average.

Fallout Gamma

Two methods are also used for predicting the dose rate from gamma emitting fallout radionuclides.[5] The first relates the estimated areas of the two prominent fallout peaks at 0.75 MeV (Zr^{95}-Nb^{95}) and 0.51 MeV (Ru^{103}-Rh^{103}, Ru^{106}-Rh^{106},

Ba^{140}-La^{140}) to dose rate in a manner analogous to the peak method described previously for the natural emitters. In the case of fallout, however, the emitters are assumed to be distributed in the soil according to the relation $S = S_o e^{-az}$, where z is the depth beneath the surface in cm., S_o is the emitter concentration at the surface in units of curies/cm^3, and S is the concentration at depth z. We have chosen the constant, a, to be 1/3 cm^{-1} since, on the basis of available depth distribution data, this choice appears to be a reasonable approximation for other than recently deposited fallout. The calibration coefficients for the fallout peaks (see Table I) are quite sensitive to depth distribution (i.e., the value for "a"), and the dose rate from freshly deposited fallout, whose distribution would be better described by a nearly plane source, will be overestimated by our model. The conversion factor used for the 0.5 MeV peak is based on calculations for Rh^{106}, since this isotope dominates the 0.5 MeV activity for thermonuclear weapon fallout more than about six months old.

The second estimate of fallout dose rate is obtained by subtracting the sum of the natural gamma dose rate estimates from the "best value" of the total measured terrestrial gamma dose rate. The two fallout estimates agree fairly well in general, suggesting that Zr^{95}-Nb^{95} and Rh^{106} were the primary fallout gamma contributors during these surveys. Any significant Cs^{137} (0.66 MeV) contribution would be partially included with that of Zr^{95}-Nb^{95} since their total absorption peaks generally overlap in our spectra. Other fallout emitters generally constitute only a very small proportion of the dose rate.

VALIDITY OF DOSE RATE VALUES

The best indication of the validity of the dose rate values presented in this report is the excellent agreement between the sum of the individual components and the total terrestrial dose rates, obtained over a wide range of terrestrial gamma fields. Furthermore, independent soil concentration determinations of K^{40} and Th^{232} at many of our survey locations have shown good agreement with concentrations inferred from our dose rate estimates. Unfortunately, U^{238} soil concentrations derived by assuming radioactive equilibrium in the decay series are not directly comparable to our U^{238} dose rate values due to the reduction in dose rate caused by radon-222 emanation from the soil.[4] The reproducibility of individual measurements has also been investigated at several standard locations in the New York City area. In addition, our ionization chamber measurements have been directly compared with those of other investigators.[6]

Based on these findings we conservatively estimate standard deviations of an individual determination of ± 10% for Th^{232} and K^{40}, ± 20% for U^{238}, and ± 0.5 μr/hr for total fallout for our individual component dose rate values, while ± 7% and ± 0.5 μr/hr would be reasonable uncertainties to assign to the total natural and "best value" terrestrial gamma dose rate values, respectively. These error estimates are of course only educated guesses and include both systematic uncertainties in the various calibration factors and experimental and statistical uncertainties involved in individual determinations. Further comparison of our data with soil sample measurements, as well as the expected decrease in fallout contributions as a result of the test ban treaty, should enable us to evaluate more accurately the validity of our dose rate estimates, especially the contribution from the U^{238} series.

RESULTS AND DISCUSSION

Table III contains a detailed presentation of the data for the surveys covered by this report. Any interpretation of these data in terms of radiation exposure to the population should consider carefully the significance of open field dose rate measurements in terms of their relation to dose rates in homes, on concrete roadways, in buildings, and at other locations. We have found that the total dose rate levels inside typical New England homes are about 70% of the outdoor natural levels.[7] This factor does of course depend strongly on the type of building material, and in these areas wood frame houses were quite prevalent. Furthermore, natural radiation levels may vary considerably with time due to such factors as snow cover, soil moisture, and natural fallout.[8] Thus, individual measurements are not necessarily representative of the average gamma radiation field. This is particularly true of the isolated spot measurements which constitute a large proportion of the data reported. These measurements are of significance only so far as they fit into a meaningful pattern.

Southeastern United States

Spot measurements constitute the major portion of the data obtained in the southeastern United States enroute to and from Houston, Texas. The measurements in Houston and Galveston were made in conjunction with the International Symposium on the Natural Radiation Environment at Rice University and are discussed in an appendix to the Proceedings.[6] On the return trip to New York, several measurements were made in the area of Aiken and Lexington, South Carolina. These measurements were made as a cooperative venture with the Aerial Radiological Measuring Surveys group (ARMS)[9] and were of interest in that fairly large variations in natural levels were found in a relatively small area. These variations were due primarily to varying Th^{232} soil concentrations. This area also was notable in that potassium soil concentrations appeared to be quite low. High Th^{232} dose rate contributions were also obtained at locations in the Raleigh, North Carolina vicinity. Fallout levels during this trip were found to be relatively high, mostly ranging between 4 and 5 μr/hr.

Central and Western
United States

In October of 1962 an extended survey trip was undertaken between New York City and the west coast, concentrating on the following areas: (1) Sundance, Wyoming and vicinity, (2) the Olympic Peninsula in Washington, (3) the San Francisco Bay area, and (4) Denver and Colorado Springs, Colorado. A part of this survey was repeated in October 1963 in order to recheck several measurements and also to obtain additional measurements in the Denver area.

Sundance, Wyoming and Vicinity

The Sundance area measurements were taken to evaluate previous air ionization chamber readings obtained in 1961. These earlier measurements were prompted by the construction of the PM-1 reactor near Sundance. Natural dose rate levels in this area were found to be 6-8 μr/hr. The observed fallout dose rates ranged from 2-5 μr/hr in October, 1962 and 3-4 μr/hr in October, 1963.

Olympic Peninsula, Washington

The series of measurements made in the northern part of the Olympic Peninsula, Washington (Clallam Co.), were of special interest since, over a distance of approximately 50 miles, the mean annual rainfall varies by a factor of nearly 10 from east (Sequim) to west (Forks). Under such conditions one might expect a substantial variation in the fallout level since fallout depostion is strongly influenced by quantity of rainfall. Alexander and his co-workers have found a clear correlation between Sr^{90} deposition and mean rainfall levels at five sampling locations in Clallam Co.[10] Measurements of terrestrial gamma levels at these and several other sites in early October 1962 are summarized in Table II. The increase of the fallout gamma dose rates with mean annual rainfall is noteworthy, and the degree of correlation seems quite as good as that for the accumulated Sr^{90} soil content. But care must be exercised here in coming to appropriate conclusions, since the quantity of relatively short-lived gamma emitters present depends on recent rainfall to a much greater extent than is the case with Sr^{90}.

The Forks locations are of particular interest since these measurements were made during or between periods of heavy rainfall. The spectra show a distorted K^{40} peak at 1.46 MeV, which is clearly the result of a considerable La^{140} contribution at 1.6 MeV. This implies substantial recent fallout deposition; this fact is also evidenced by the lack of agreement between the two methods of estimating fallout dose rates. As mentioned previously, recent deposition generally implies a more nearly plane source than in our model, and thus more peak counts per unit dose rate for the various fallout isotopes. Therefore, our peak method would tend to overestimate the fallout dose rates. In addition, the La^{140} contribution might also cause us to overestimate the K^{40} and U^{238} dose rates. Fortunately, the Forks locations were among the few where a significant La^{140} contribution was observed.

The Olympic Peninsula area was also of interest in that the natural levels (3-5 μr/hr) were among the lowest measured by us during our various surveys. These levels were about

50% below the average values found for natural gamma radiation levels (7 μr/hr).

San Francisco Bay Area

The survey in this area was undertaken in cooperation with the University of California Lawrence Radiation Laboratory (UCRL) at Berkeley. Soil samples were taken at our survey locations and analyzed spectrometrically by UCRL scientists for K^{40}, Th^{232}, and U^{238} concentrations.[11] Their results were most helpful in assessing the validity of our methods of analysis. Two specific locations were of particular interest. The first was a fern patch near Bonny Doon, California, where we obtained our largest K^{40} dose rate contribution (over 8 μr/hr), corresponding to a soil potassium concentration of about 5%. This measurement was very helpful in verifying our K^{40} calibrations. The second was an asbestos mine near Copperopolis, California. This location was unique in that there appeared to be almost no (<1 μr/hr) gamma radiation from natural sources in the serpentine bedrock itself. This enabled us to obtain a spectrum which was due primarily to cosmic radiation (see Figures 3 and 4). The measurements obtained at this location were especially useful in substantiating the cosmic ray calibration of the ionization chamber as well as in verifying the assumption of negligible cosmic ray contribution to the total spectrum "energy" (spectrum "energy" due to cosmic sources is equivalent to a gamma contribution of ~0.2 μr/hr at sea level). It should be noted that the 1963 measurement was not taken at exactly the same location as the 1962 measurement. The larger U^{238} series dose rate in 1962 may have been due partly to radon-222 daughters in the air or on the surface of the ground.

Fallout levels in this area were fairly low, ranging from 0-1.5 μr/hr during both the 1962 and 1963 surveys. This might be explained by the fact that both surveys were carried out after several months of very little rainfall.

A number of measurements were made between San Francisco and Denver at elevations greater than 6000 feet. (Fruitland, Rawlins, Laramie, Wyo.). These altitudes correspond to cosmic ray dose rates of about twice the sea level value and thus any significant errors in the cosmic ray calibration of the ionization chamber should show up in the data analysis. None were evident.

Denver and Colorado Springs, Colo.

The Denver area was of special interest. Higher than average terrestrial radiation levels had been measured with air ionization chambers during earlier HASL surveys.[1] These high levels were confirmed by the October 1962 data and were shown to be due to higher than average soil concentrations of K^{40} and Th^{232}, particularly the latter. These measurements were rechecked in 1963 and a number of new measurements were taken. Natural terrestrial levels ranging from 8-15 μr/hr were found. Since cosmic ray dose rate contributions at these altitudes are 6-7 μr/hr,[3] total natural dose rates from penetrating radiations are in the range 14-22 μr/hr. This may be compared to total natural dose rate values of about 10-12 μr/hr in the New York City area. In addition, fallout further increased these levels by 2-3 μr/hr in October 1962 and 1-2 μr/hr in October 1963. This area is the only one yet found in the continental United States where a reasonably large population is exposed to ambient radiation levels 50-100% higher than is usual.

SUMMARY

The wide diversity of sites and conditions encountered on these surveys in the southeast, central, and western United States were extremely helpful in evaluating the validity of our methods of spectrum analysis as well as for studying the performance of our instrumentation in a variety of field situations. The instruments generally performed well and the dose rates inferred from our spectrometric methods and ionization chamber readings were in close agreement over a wide range of terrestrial and cosmic environmental radiation fields.

The data obtained on these surveys indicated that fallout usually contributed a significant amount to the total terrestrial dose rate. Fallout levels encountered in the Spring of 1963 during the survey through the southeast were relatively high (4-5 μr/hr) compared to the levels encountered on the western surveys in October of 1962 and 1963 (2-4 μr/hr). The effect of precipitation on fallout dose rate was indicated by the

results of the measurements in the Olympic Peninsula area and also by the generally lower fallout levels observed in the San Francisco Bay area (1-2 μr/hr).

In addition to providing information about the natural and fallout gamma dose rate levels in particular areas covered by these surveys, these data, when combined with the data obtained from surveys conducted in New England[3] and New York State,[3] permit certain conclusions to be drawn regarding natural environmental radiation levels in the United States in the years 1962-1963.[5] It was found that most of the inferred natural dose rates were in the range 5-9 μr/hr and that the dose rates from K^{40} and the Th^{232} series were generally comparable, usually amounting to approximately 80% of the total natural gamma dose rate, while the uranium series seldom contributed more than 25% of the total natural gamma dose rate. Dose rates from the uranium series ranged between 0.5 and 2.0 μr/hr at almost 90% of the survey locations; K^{40} contributions were in the range 1.5-3.5 μr/hr at over 75% of the locations and two-thirds of the thorium series contributions were between 1.5 and 4.0 μr/hr. The average natural gamma dose rate for the more than 200 locations surveyed in 1962 and 1963 was 7.0 μr/hr.

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TABLE I

DOSE RATE CALIBRATION OF SPECTROMETER

Peak Energy (MeV)	Isotope	Source Distribution	Peak Counts/μr/hr
0.5	Ba^{140}-La^{140}	Exponential	6000
	Ru^{103}-Rh^{103}	Exponential	35000
	Ru^{106}-Rh^{106}	Exponential	18000
0.75	Zr^{95}-Nb^{95}	Exponential	21000
1.46	K^{40}	Uniform	5550
1.76	Bi^{214}(U series)	Uniform	700
2.62	Tl^{208}(Th series)	Uniform	750

TABLE II

MEASUREMENTS ON THE OLYMPIC PENINSULA,
WASHINGTON, OCTOBER 1-2, 1962

Town	Mean Annual Rainfall (in.)*	Sr^{90} (mc/mi^2)**	Gamma Dose Rates (μr/hr) K	U	Th	Zr-Nb	Natural	Total Fallout*** (1)	(2)
Sequim	14	42.0	1.2	0.9	1.2	0.6	3.3	0.8	0.7
Sequim	14	-	1.5	0.9	1.4	0.8	3.8	1.1	1.4
Port Angeles	24	65.3	1.6	0.9	1.0	1.1	3.5	1.4	1.7
Port Angeles	24	-	1.2	1.1	0.9	1.0	3.2	1.3	1.5
Joyce	54	84.1	1.7	1.2	0.8	1.8	3.7	2.4	1.8
Clallam Bay	81	133	1.0	1.3	0.4	2.2	2.7	2.8	2.6
Forks	118	153	1.7	2.2	1.3	2.6	5.2	3.4	2.7
Forks	118	-	1.5	1.7	1.2	2.5	4.4	3.7	2.8
Forks	118	-	1.1	1.1	0.9	2.3	3.1	3.4	2.8

*1960-1962 value.[10]
**October 1-2, 1962 soil determinations.[10]
***(1) from photopeak calibrations; (2) from total terrestrial dose rate measurements with natural component subtracted.

LEGEND

Location	-	Type of location and section of town.
Spect.	-	Total terrestrial dose rate as inferred from "energy" in spectrum.
A	-	Total terrestrial dose rate obtained from high pressure ionization chamber.
Port. Inst.	-	Total terrestrial dose rate inferred from portable scintillation counter readings.
B.V.	-	Best value of total terrestrial dose rate as discussed on page 3.
K,U,T	-	Dose rate contributions from potassium-40 and the uranium-238 and thorium-232 series, respectively.
TOT	-	Total natural dose rate.
Zr	-	Dose rate contribution from zirconium-95 and niobium-95.
Rh^{106}	-	Dose rate contribution from rhodium-106.
$Fo^{(1)}$	-	Sum of zirconium-niobium-95 and rhodium-106 dose rates.
$Fo^{(2)}$	-	The difference between B.V. and the total natural gamma dose rate (TOT).
I_c	-	Cosmic ray dose rate contribution.

TABLE III

SURVEY DATA

Town & Location	Date	Dose Rates (μr/hr) Total Gamma				Natural Gamma				Fallout Gamma				I_c
Southeastern U.S.		Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	
Huntsville, Ala. (Church Lawn)	4/7/63	-	12.2	12.3	12.2	-	-	-	-	-	-	-	-	3.6
Huntsville, Ala. (Church Lawn)	4/7/63	-	-	13.4	13.4	-	-	-	-	-	-	-	-	3.6
Decatur, Ala. (School Lawn, N.E. Side)	4/7/63	11.1	11.2	11.4	11.2	1.1	2.0	3.1	6.2	5.0	1.0	6.0	5.0	3.6
Corinth, Miss. (Field, E. Side)	4/8/63	-	11.8	11.2	11.8	-	-	-	-	-	-	-	-	3.5
Memphis, Tenn. (Harding Coll. Campus)	4/8/63	11.2	11.8	11.7	11.5	1.8	1.7	2.7	6.2	4.0	1.0	5.0	5.3	3.5
Memphis, Tenn. (Southwestern Coll. Campus)	4/8/63	-	11.4	10.7	11.4	-	-	-	-	-	-	-	-	3.5
Little Rock, Ark. (L.R. Univ. Campus)	4/9/63	11.4	12.6	11.8	12.0	1.3	1.9	3.2	6.4	5.6	1.0	6.6	5.6	3.5
Houston, Tex.(Rice Univ. Campus)	4/10/63	9.3	9.4	-	9.4	0.9	0.6	3.0	4.5	4.4	1.2	5.6	4.9	3.5
Galveston Tex. (Galveston Beach)	4/10/63	3.3	3.4	-	3.4	1.2	0.7	0.9	2.8	0.4	0.1	0.5	0.6	3.5

Town & Location	Date	Dose Rates (μr/hr) Total Gamma: Spect.	A	Port. Inst.	B.V.	Natural Gamma: K	U	T	TOT	Fallout Gamma: Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	I_c
Lake Charles, La. (School Lawn, N.E. Side)	4/14/63	8.6	8.4	8.7	8.5	0.7	0.9	1.9	3.5	4.2	1.0	5.2	5.0	3.4
Bay Minette, Ala. (Open Lot, N. Side)	4/15/63	8.8	8.9	9.1	8.9	0.3	1.6	2.8	4.7	3.7	0.9	4.6	4.2	3.5
Macon, Ga.(Tattnall Sq. Park)	4/16/63	10.6	10.9	10.6	10.7	1.1	1.0	4.7	6.8	3.6	0.7	4.3	3.9	3.5
Aiken, S.C. (Lot Near Airport)	4/17/63	8.1	8.5	8.3	8.3	0.2	1.0	1.8	3.0	5.2	1.4	6.6	5.3	3.5

The following measurements were all taken within 10 miles of the junction of U.S. 25 with South Carolina 19. (The minimum distance between any two measurements is 1/4 mile.)

Town & Location	Date	Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	I_c
(Junction, Center Island)	4/17/63	-	-	9.3	9.3	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	9.3	9.5	9.3	0.2	1.5	3.4	5.1	3.9	0.9	4.8	4.2	3.5
(Field)	"	-	-	8.4	8.4	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	-	11.0	11.0	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	12.9	12.9	12.9	0.4	1.0	6.9	8.3	3.1	0.8	3.9	4.6	3.5
(Field)	"	-	-	15.6	15.6	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	-	13.8	13.8	-	-	-	-	-	-	-	-	3.5
(Lot Near Edge-field, S.C.)	"	-	10.6	11.2	10.9	1.1	2.6	3.8	7.5	3.1	0.9	4.0	3.4	3.5
(Woods)	"	-	6.7	6.9	6.7	0.4	1.0	1.2	2.6	3.3	0.8	4.1	4.1	3.5

Town & Location	Date	Dose Rates (μr/hr) Total Gamma: Spect.	A	Port. Inst.	B.V.	Natural Gamma: K	U	T	TOT	Fallout Gamma: Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	I_c

The following measurements were all taken within 10 miles of the junction of the Priceville Road and U.S. 1 (Lexington, S.C. area)

Town & Location	Date	Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	I_c
(Field)	4/17/63	8.2	7.8	8.0	8.0	1.0	1.2	1.8	4.0	3.3	1.1	4.4	4.0	3.5
(Field)	"	-	-	6.1	6.1	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	-	12.8	12.8	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	-	9.3	9.3	-	-	-	-	-	-	-	-	3.5
(Jct. U.S. 1)	"	-	-	10.2	10.2	-	-	-	-	-	-	-	-	3.5
(Fields Near Gilbert, S.C.)	" "	-	-	10-20	-	-	-	-	-	-	-	-	-	3.5
(Field)	"	-	-	10.2	10.2	-	-	-	-	-	-	-	-	3.5

The following measurements were taken at scattered locations along U.S. 401 from the Jct. U.S. 1 to Warrenton, N.C. The approximate mileage from the junction is given as part of the location description.

Town & Location	Date	Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	I_c
(Fields and Lawns, 0.0m)	4/18/63	-	-	~15.0	~15.0	-	-	-	-	-	-	-	-	3.5
(Field, 1.1m)	"	-	-	20.2	20.2	-	-	-	-	-	-	-	-	3.5
(Plowed Field, 2.2m)	"	-	-	12.0	12.0	-	-	-	-	-	-	-	-	3.5
(Ground in Forest, 2.2m)		-	-	13.8	13.8	-	-	-	-	-	-	-	-	3.5
(Field, 5.0m)	"	-	-	17.4	17.4	-	-	-	-	-	-	-	-	3.5
(Field, 6.5m)	"	-	-	19.2	19.2	-	-	-	-	-	-	-	-	3.5
(Forest, 6.6m)	"	18.3	18.5	18.6	18.4	4.5	2.0	8.4	14.9	3.2	0.9	4.1	3.5	3.5

Town & Location	Date	Dose Rates (μr/hr)												
		Total Gamma				Natural Gamma				Fallout Gamma				Ic
		Spect.	A	Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	
(School Lawn, 8.5m)	4/18/63	-	-	11.6	11.6	-	-	-	-	-	-	-	-	3.5
Rollsville, N.C. (Fields & Lawns, 9.2m)	"	-	-	13-14	13-14	-	-	-	-	-	-	-	-	3.5
(Field, 11.6m)	"	-	-	12-13	12-13	-	-	-	-	-	-	-	-	3.5
(Field, 13.5m)	"	-	-	12.8	12.8	-	-	-	-	-	-	-	-	3.5
(Center Island of Jct. N.C. 98, 13.5m)	"	-	-	17.4	17.4	-	-	-	-	-	-	-	-	3.5
(Field off Dirt Road, 21.5m)	"	20.0	19.8	19.5	19.9	5.4	1.0	12.9	19.3	1.9	0.5	2.4	0.6	3.5
Louisburg, N.C. (Field, 25m)	"	-	-	13.8	13.8	-	-	-	-	-	-	-	-	3.5
Warrenton, N.C. (Lawn, 50m)	"	-	-	12.8	12.8	-	-	-	-	-	-	-	-	3.5
Central and Western U.S.														
Madison, Wis. (Field, S.W. Side)	9/22/62	9.6	9.5	10.8	9.6	2.6	1.8	2.8	7.2	2.4	0.2	2.6	2.4	3.7
Spring Valley, Minn. (Field off U.S. 16)	9/22/62	8.8	8.4	10.0	8.6	2.0	1.6	2.5	6.1	2.2	0.4	2.6	2.5	3.8
	10/5/63	8.7	8.6	8.8	8.7	2.0	1.4	2.4	5.8	2.1	0.3	2.4	2.9	3.8

Town & Location	Date	Dose Rates (μr/hr): Total Gamma: Spect.	Total Gamma: A	Total Gamma: Port. Inst.	Total Gamma: B.V.	Natural Gamma: K	Natural Gamma: U	Natural Gamma: T	Natural Gamma: TOT	Fallout Gamma: Zr	Fallout Gamma: Rh^{106}	Fallout Gamma: $FO^{(1)}$	Fallout Gamma: $FO^{(2)}$	I_c
Sioux Falls, S.D. (School Lawn)	9/23/62	12.5	12.8	12.9	12.7	2.7	2.2	3.7	8.6	3.2	.8	4.0	4.1	3.9
	10/5/63	11.3	10.8	11.0	11.0	2.3	2.1	3.3	7.7	3.3	.3	3.6	3.3	3.9
Sioux Falls, S.D. (School Lawn, W. Side)	9/23/62	12.0	11.6	13.8	11.8	2.7	1.6	2.3	6.6	5.0	1.2	6.2	5.2	4.0
	10/5/63	-	-	9.0	9.0	-	-	-	-	-	-	-	-	-
Chamberlain, S.D. (Lot Near Court-house, S. Side)	9/23/62	13.2	14.4	14.2	13.8	3.1	2.0	3.6	8.7	3.7	0.9	4.6	5.1	4.0
	10/6/63	12.0	11.5	11.6	11.7	2.6	2.3	3.0	7.9	3.2	0.4	3.6	3.8	4.0
Murdo, S.D. (Field Near U.S. 16)	9/24/62	-	13.0	13.0	13.0	3.2	-	-	-	2.9	0.7	3.6	-	4.3
	10/6/63	11.8	11.8	11.8	11.8	3.0	1.9	3.1	8.0	3.1	0.6	3.7	3.8	4.3
Rapid City, S.D. (Park, S. Side)	9/24/62	10.2	11.1	12.5	10.2	1.8	2.0	2.6	6.4	2.8	0.6	3.4	3.8	4.7
	10/7/63	-	-	9.4	9.4	-	-	-	-	-	-	-	-	4.7
Rapid City, S.D. (Lot, N. Side)	9/24/62	10.6	13.4	11.4	10.6	1.9	1.7	2.9	6.5	3.1	0.8	3.9	4.1	4.7
	10/7/63	8.1	7.6	8.2	7.9	1.6	2.0	2.4	6.0	2.3	0.5	2.8	1.9	4.7
Spearfish, Wyo. (Church Lawn)	9/24/62	10.8	11.7	11.7	11.3	3.0	1.5	3.0	7.5	3.0	0.7	3.7	3.8	4.9
	10/7/63	-	10.2	10.3	10.2	-	-	-	-	-	-	-	-	4.9
Sundance, Wyo. (West Side) (Lot)	9/25/62	12.2	11.6	12.5	11.9	2.6	2.0	2.5	7.1	4.6	0.5	5.1	4.8	5.6
	10/7/63	12.3	11.6	12.0	12.0	2.5	2.4	2.7	7.6	3.6	0.8	4.4	4.4	5.6
Moorcroft, Wyo. (Small Park)	9/25/62	10.4	10.8	10.9	10.6	2.6	1.9	3.3	7.8	1.8	0.5	2.3	2.8	5.3
	10/7/63	10.9	10.2	10.2	10.5	2.4	2.5	3.2	8.1	2.3	0.4	2.7	2.4	5.3
Yellowstone National Park (Near Old Faithful)	9/26/62	-	6.7	7.0	6.7	-	-	-	-	-	-	-	-	7.7
Butte, Mon. (Lot off U.S. 10)	9/27/62	15.0	15.2	14.2	15.1	3.9	1.2	7.8	12.9	1.8	0.5	2.3	2.2	6.5

Town & Location	Date	Dose Rates (µr/hr)												
		Total Gamma				Natural Gamma				Fallout Gamma				Ic
		Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	FO(1)	FO(2)	
Missoula, Mon. (Courthouse Lawn)	9/27/62	9.3	9.4	9.4	9.4	3.1	1.5	3.3	7.9	1.4	0.2	1.6	1.5	5.0
Ellensberg, Wash. (Park Near Fair Bldg.)	9/29/62	3.9	3.8	3.7	3.8	1.5	0.5	1.3	3.3	0.4	0.1	0.5	0.5	4.2
Seattle, Wash. (Veterans Hospital Lawn)	"	5.4	5.1	5.4	5.3	1.5	1.4	0.9	3.8	1.5	0.6	2.1	1.5	3.5
Seattle, Wash. (Lincoln Park)	"	5.0	5.5	5.4	5.3	1.4	1.3	0.9	3.6	1.5	0.6	2.1	1.7	3.4
Seattle, Wash. (Park)	"	5.3	5.1	5.8	5.2	1.5	1.5	1.0	4.0	1.8	0.6	2.4	1.2	3.5
Sequim, Wash. (N. Side Lawn)	10/1/62	3.9	4.0	4.5	4.0	1.2	0.9	1.2	3.3	0.6	0.2	0.8	0.7	3.4
Sequim, Wash. (Field, W. Side)	"	5.0	5.3	6.0	5.2	1.5	0.9	1.4	3.8	0.8	0.3	1.1	1.4	3.5
Port Angeles, Wash. (Park, E. Side)	"	4.9	5.4	5.4	5.2	1.6	0.9	1.0	3.5	1.1	0.3	1.4	1.7	3.4
Port Angeles, Wash. (Lawn, N.E. Side)	"	4.4	4.9	4.8	4.7	1.2	1.1	0.9	3.2	1.0	0.3	1.3	1.5	3.5
Joyce, Wash. (Field, W. Side)	"	-	6.6	-	6.6	-	-	-	-	-	-	-	-	3.6

Town & Location	Date	Dose Rates (μr/hr) Total Gamma				Natural Gamma				Fallout Gamma				I_c
		Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	FO(1)	FO(2)	
Joyce, Wash. (Schoolyard, W. Side)	10/1/62	5.5	-	6.7	5.5	1.7	1.2	0.8	3.7	1.8	0.6	2.4	1.8	3.6
Clallam Bay, Wash. (Lawn, E. Side)	10/2/62	5.3	-	6.7	5.3	1.0	1.3	0.4	2.7	2.2	0.6	2.8	2.6	3.6
Forks, Wash. (Field, E. Side)	"	7.9	-	8.6	7.9	1.7	2.2	1.3	5.2	2.6	0.8	3.4	2.7	3.7
Forks, Wash. (Field, E. Side)	"	7.2	-	8.4	7.2	1.5	1.7	1.2	4.4	2.5	1.2	3.7	2.8	3.7
Forks, Wash. (Motel Lawn, S. Side)	"	5.9	-	7.9	5.9	1.1	1.1	0.9	3.1	2.3	1.1	3.4	2.8	3.7
Corvallis, Ore. (College Campus)	10/3/62	8.6	-	8.6	8.6	2.6	2.2	3.6	8.4	0.8	0.2	1.0	0.2	3.5
Crater Lake, Ore. (Field, S. End of Lake)	10/4/62	6.4	6.9	6.8	6.6	1.3	1.7	0.9	3.9	2.5	0.4	2.9	2.7	7.7
Berkeley, Cal. (Lawrence Rad. Lab.)	10/5/62	5.0	5.4	5.6	5.2	-	-	-	-	-	-	-	-	3.7
Richmond, Cal. (Univ. Cal. Soil Mech. Lab.)	10/5/62 10/12/63	4.9 5.2	5.2 5.0	5.1 6.0	5.1 5.1	1.3 1.2	0.9 1.1	2.3 1.7	4.5 4.0	0.5 1.2	0.2 0.2	0.7 1.4	0.6 1.1	3.4 3.4

Town & Location	Date	Dose Rates (μr/hr) Total Gamma				Natural Gamma				Fallout Gamma				I_c
		Spect.	A	Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	
Felton, Cal. (Lot Outside Town)	10/6/62	9.3	9.9	9.6	9.6	4.7	1.2	2.5	8.4	0.9	0.2	1.1	1.2	3.5
	10/12/63	-	8.8	8.8	8.8	-	-	-	-	-	-	-	-	3.5
Santa Cruz, Cal. (Lot Near Beach)	10/6/62	6.3	7.1	6.4	6.7	2.6	1.2	2.0	5.8	0.9	0.1	1.0	1.0	3.4
	10/12/63	-	6.3	6.0	6.2	-	-	-	-	-	-	-	-	3.4
Davenport, Cal. (Shoulder of Road, South of Town)	10/6/62	5.5	6.4	5.9	5.9	1.4	2.0	1.7	5.1	0.4	0.1	0.5	0.8	3.4
	10/12/63	-	-	6.2	6.2	-	-	-	-	-	-	-	-	3.4
Bonny Doon, Cal. (Fern Patch Near Town)	10/6/62	13.4	13.6	13.6	13.5	8.5	2.2	1.9	12.6	1.6	0.2	1.8	0.9	4.0
	10/12/63	12.7	12.8	12.8	12.7	7.7	2.5	1.5	11.7	1.2	0.0	1.2	1.0	4.0
Sunnyvale, Cal. (Vacant Field)	10/6/62	5.4	5.9	5.0	5.6	2.2	1.0	2.1	5.3	0.6	0.1	0.7	0.3	3.4
	10/12/63	5.1	5.2	5.1	5.1	1.7	1.1	1.6	4.4	0.4	0.0	0.4	0.7	3.4
Copperopolis, Cal. (Asbestos Mine Near Town)	10/7/62	1.9	1.6	-	1.8	0.1	1.4	0.1	1.6	0.1	0.1	0.2	0.2	3.7
	10/11/63	0.6	0.2	-	0.6	0.1	0.4	0.0	0.5	0.1	0.0	0.1	0.1	3.7
Reno, Nev. (Idylwild Park)	10/7/63	5.5	-	5.6	5.5	1.5	1.2	2.2	4.9	0.8	0.2	1.0	0.6	5.7

Town & Location	Date	Total Gamma: Spect.	A	Port. Inst.	B.V.	Natural Gamma: K	U	T	TOT	Fallout Gamma: Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	Ic
		Dose Rates ($\mu r/hr$)												
Winnemucca, Nev. (Field, N.W. Side)	10/8/62	8.8	-	8.7	8.8	3.4	1.4	3.4	8.2	0.9	0.3	1.2	0.6	5.5
	10/15/63	-	-	9.0	9.0	-	-	-	-	-	-	-	-	5.5
Elko, Nev. (Field, S. Side)	10/8/62	9.2	-	9.5	9.2	3.1	1.1	3.5	7.7	1.3	0.5	1.8	1.5	6.0
	10/8/63	10.9	11.2	11.3	11.1	2.8	2.0	3.3	8.1	2.2	0.3	2.5	3.0	6.0
Wendover, Utah (Field, E. Side)	10/8/62	6.6	-	6.6	6.6	1.3	1.7	2.1	5.1	1.5	0.4	1.9	1.5	5.5
Bonneville Salt Flats (15 mi. E. of Wendover, Utah)	10/9/62	7.3	-	7.7	7.3	1.3	2.0	1.6	4.9	2.5	0.6	3.1	2.4	5.4
	10/16/63	6.5	6.6	6.6	6.6	1.2	1.9	1.4	4.5	1.4	0.3	1.7	2.1	5.4
Salt Lake City, Utah (Field Near Airport)	10/9/62	12.5	-	12.9	12.5	3.1	2.1	3.6	8.8	3.1	0.7	3.8	3.7	5.4
	10/16/63	11.2	10.8	11.5	11.0	3.0	2.4	3.1	8.5	2.2	0.5	2.7	2.5	5.4
Fruitland, Wyo. (Field)	10/16/63	6.2	8.0	8.3	7.1	1.6	1.7	1.7	5.0	1.1	0.3	1.4	2.1	7.0
Rawlins, Wyo. (Lot, W. Side)	10/10/63	9.3	9.1	9.2	9.2	2.8	1.9	3.0	7.7	1.4	0.2	1.6	1.5	7.4
Laramie, Wyo. (Field, N. Side)	10/10/62	7.3	-	7.3	7.3	1.4	1.7	1.4	4.5	3.0	1.1	4.1	2.8	7.6
	10/8/63	7.7	8.3	7.8	8.0	1.4	1.2	1.2	3.8	2.8	0.6	3.4	4.2	7.6
Fort Collins, Colo. (Alfalfa Pasture, S. Side)	10/10/62	10.3	-	10.5	10.3	2.7	1.7	4.2	8.6	1.7	0.4	2.1	1.7	6.1
Denver, Colo. (Lot, N. Side)	10/10/62	15.2	-	13.2	15.2	5.2	1.8	7.1	14.1	1.5	0.2	1.7	1.1	6.2
Denver, Colo. (Park, E. Side)	10/10/62	12.5	-	11.9	12.5	3.4	1.2	6.2	10.8	1.5	0.3	1.8	1.7	6.3
	10/18/63	13.2	13.1	13.0	13.1	3.4	2.7	6.3	12.4	0.8	0.1	0.9	0.7	6.3

Town & Location	Date	Dose Rates (μr/hr) Total Gamma				Natural Gamma				Fallout Gamma				I_c
		Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	
Denver, Colo.	10/10/62	14.5	-	13.2	14.5	5.2	2.1	6.9	14.2	1.3	0.2	1.5	0.3	6.3
(Field Near Air-port)	10/19/63	14.5	13.6	14.1	14.1	5.3	2.3	6.0	13.6	0.7	0.1	0.8	0.5	6.3
Denver, Colo.	10/11/62	14.5	-	12.8	14.5	5.2	2.3	6.9	14.4	1.1	0.2	1.3	0.1	6.3
(Lot, S.E. Side)	10/19/63	-	14.0	13.9	14.0	-	-	-	-	-	-	-	-	6.3
Denver, Colo.	10/11/62	13.0	-	12.4	13.0	3.5	1.8	6.9	12.2	1.3	0.4	1.7	0.8	6.3
(Lot, W. Side)	10/18/63	-	-	11.8	11.8	-	-	-	-	-	-	-	-	-
Denver, Colo. (Lot, W. Side)	10/18/63	10.3	11.2	10.3	10.7	3.1	1.5	4.0	8.6	1.2	0.2	1.4	2.1	6.3
Denver, Colo. (Lot, S.W. Side)	10/18/63	10.7	9.8	9.9	10.2	2.7	2.2	4.2	9.1	1.3	0.3	1.6	1.1	6.3
Denver, Colo. (Lot, S.E. Side)	10/18/63	13.1	12.5	12.6	12.8	4.3	1.7	6.0	12.0	0.5	0.1	0.6	0.8	6.3
Denver, Colo. (Lot, N. Side)	10/18/63	15.4	16.3	15.0	15.8	4.0	2.5	8.7	15.2	0.4	0.2	0.6	0.6	6.3
Denver, Colo. (Lot, N.E. Side)	10/19/63	-	-	14.7	-	-	-	-	-	-	-	-	-	6.3
Denver, Colo. (Womans College Campus)	10/19/63	-	-	14.0	-	-	-	-	-	-	-	-	-	6.3
Colo. Sp., Colo.	10/11/62	12.4	13.0	13.0	12.7	5.2	1.3	3.7	10.2	2.8	0.5	3.3	2.5	6.8
(Open Lot, N. Side)	10/19/63	11.2	11.1	11.2	11.2	4.6	2.2	3.4	10.2	1.4	0.2	1.6	1.0	6.8
Colo. Sp., Colo.	10/11/62	14.0	14.7	15.0	14.4	5.9	1.4	5.0	12.3	2.1	0.2	2.3	2.1	6.7
(Field, Far S. Side)	10/20/63	13.9	13.8	13.6	13.8	5.3	2.5	4.6	12.4	1.4	0.1	1.5	1.4	6.7

Town & Location	Date	Dose Rates (μr/hr): Total Gamma: Spect.	A	Port. Inst.	B.V.	Natural Gamma: K	U	T	TOT	Fallout Gamma: Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	I_c
Colo. Sp., Colo. (Lawn)	10/19/63	9.8	9.1	9.6	9.5	3.7	1.4	2.5	7.6	1.4	0.2	1.6	1.9	6.8
Colo. Sp., Colo. (Grassy Lot)	"	12.2	11.7	11.9	12.0	5.3	2.4	3.7	11.4	0.9	0.1	1.0	0.6	6.8
La Hunta, Colo.	10/11/62	10.8	-	10.7	10.8	3.5	1.4	4.0	8.9	1.8	0.2	2.0	1.9	5.4
(Park, S.E. Side)	10/20/63	-	9.1	9.2	9.1	-	-	-	-	-	-	-	-	5.4
Dodge City, Kansas	10/12/62	10.7	-	11.5	10.7	3.2	1.6	3.1	7.9	2.9	0.2	3.1	2.8	4.5
(Grassy Field, E. Side)	10/21/63	10.1	8.8	9.5	9.5	2.8	1.8	2.9	7.5	2.0	0.2	2.2	2.0	4.5
Wichita, Kan.	10/12/62	10.4	11.2	10.9	10.8	3.2	1.9	2.6	7.7	3.2	0.7	3.9	3.1	4.0
(Field, S. Side)	10/21/63	-	8.6	9.0	8.6	-	-	-	-	-	-	-	-	4.0
Wichita, Kan.	10/22/62	11.3	12.2	11.7	11.7	2.5	2.2	3.4	8.1	2.9	0.7	3.6	3.6	4.0
(Field, E. Side)	"	11.0	10.4	10.7	10.7	2.3	2.5	2.9	7.7	2.3	0.5	2.8	3.0	4.0
Kansas City, Mo.	10/13/62	10.8	11.0	11.3	10.9	2.2	1.9	3.1	7.2	3.4	0.7	4.1	3.7	3.8
(Park, Far W. Side)	10/21/63	-	10.8	11.2	10.8	-	-	-	-	-	-	-	-	3.8
Hannibal, Mo.	10/13/62	10.8	12.1	12.1	11.5	2.5	1.9	2.6	7.0	3.6	0.5	4.1	4.5	3.7
(Riverview Park, N. Side)	10/22/63	-	9.4	9.3	9.4	-	-	-	-	-	-	-	-	3.7
Springfield, Ill.	10/14/63	9.7	10.5	10.8	10.2	2.1	1.8	3.0	6.9	3.1	0.7	3.8	3.3	3.5
(Lot)	10/22/63	-	8.4	8.5	-	-	-	-	-	-	-	-	-	3.5
Franklin Pk., Ill. (Lot, W. Side)	"	9.2	10.0	9.9	9.6	3.0	1.4	3.0	7.4	2.0	0.5	2.5	2.2	3.7
Argonne, Ill.	10/15/62	9.0	9.9	10.4	9.5	2.4	1.7	3.0	7.1	1.9	0.6	2.5	2.4	3.7
(Field, ANL)	10/3/63	10.9	10.8	10.3	10.8	2.8	1.7	3.0	7.5	2.5	0.3	2.8	3.3	3.7

Town & Location	Date	Dose Rates (μr/hr) Total Gamma				Natural Gamma				Fallout Gamma				I_c
		Spect.	A	Port. Inst.	B.V.	K	U	T	TOT	Zr	Rh^{106}	$FO^{(1)}$	$FO^{(2)}$	
Argonne, Ill. (Argonne Park)	10/4/63	10.3	10.9	11.1	10.6	2.7	1.8	2.4	6.9	3.2	0.2	3.4	3.7	3.7
Somerset, Pa. (Vacant Lot)	10/16/62	10.4	9.5	10.4	10.4	2.3	1.8	3.7	7.8	2.8	0.8	3.6	2.6	4.2
	10/1/63	14.3	13.1	12.5	13.7	2.5	2.1	3.7	8.3	5.7	1.1	6.8	5.4	4.2
Carlisle, Pa. (Lawn of Army War College)	4/5/63	-	11.2	11.0	11.2	3.3	1.5	3.6	8.4	3.4	1.0	4.4	2.8	
	10/1/63	9.5	9.6	8.4	9.5	3.0	1.5	3.1	7.6	1.6	0.3	1.9	1.9	3.5

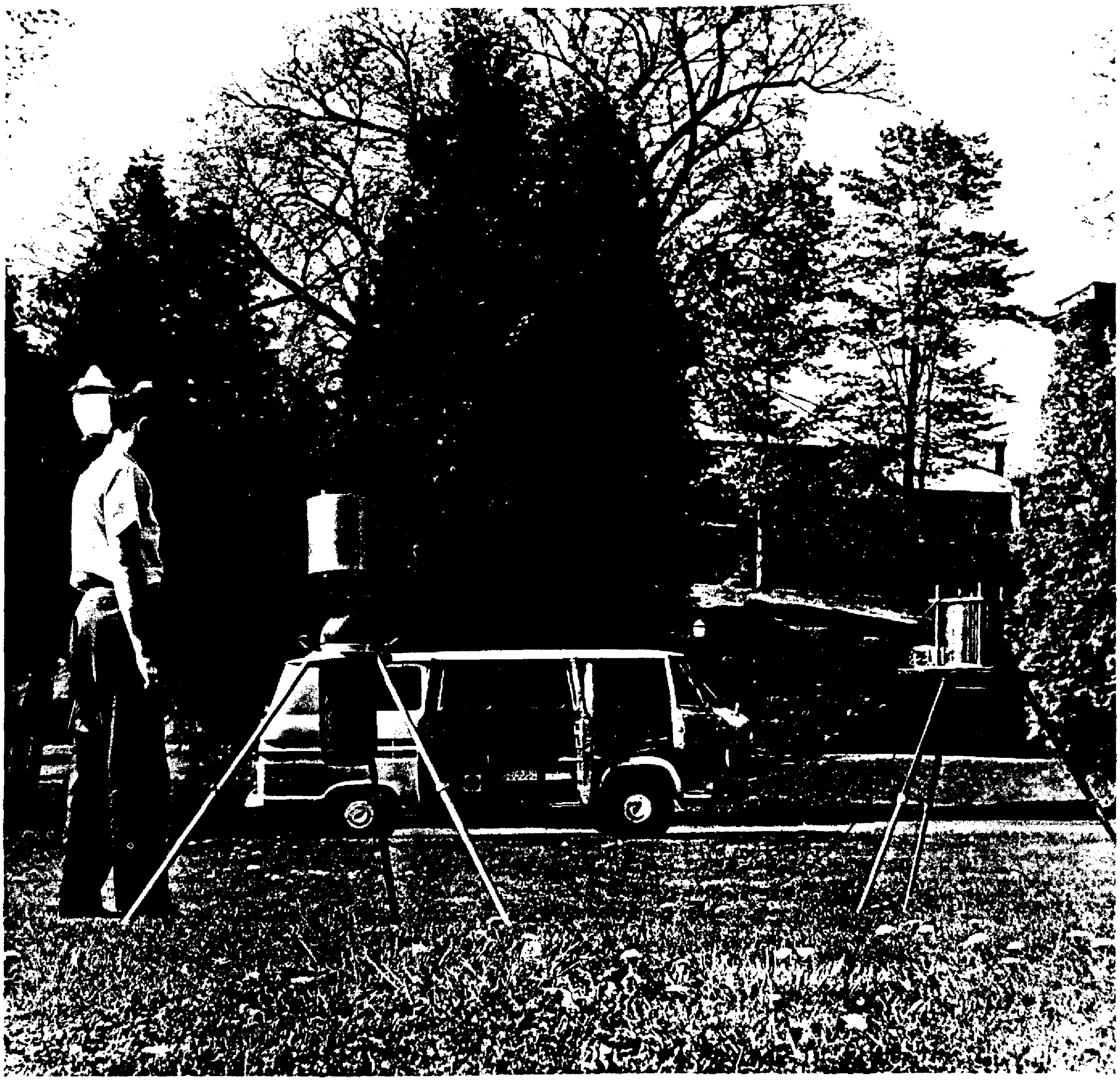

Figure 1. The HASL pressurized ionization chamber and γ spectrometer set up for a typical measurement. Saratoga Springs, N.Y., 1963.

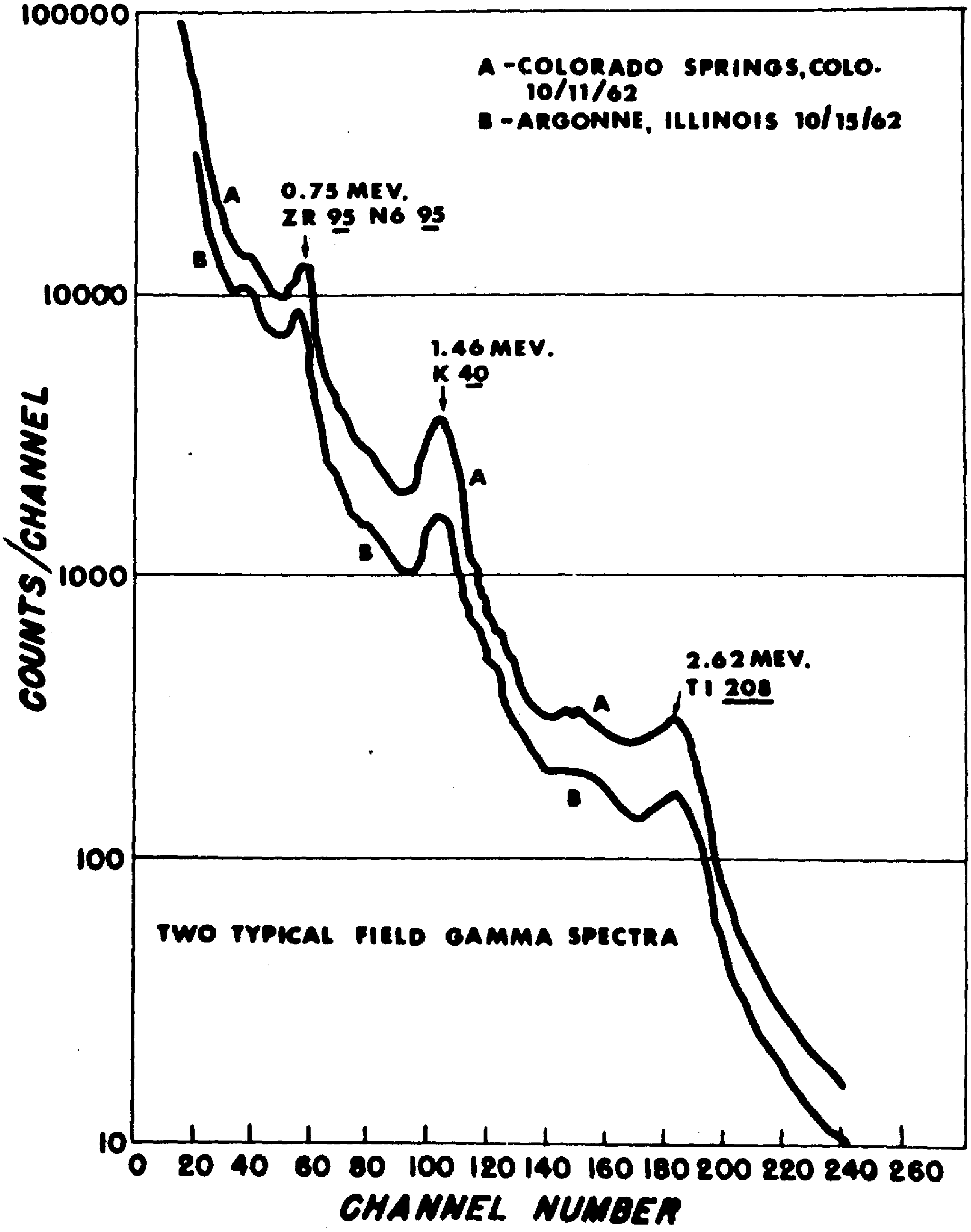

Figure 2. Two typical field spectra obtained during late 1962. The cosmic, natural γ, and fallout γ levels are all somewhat higher at location A.

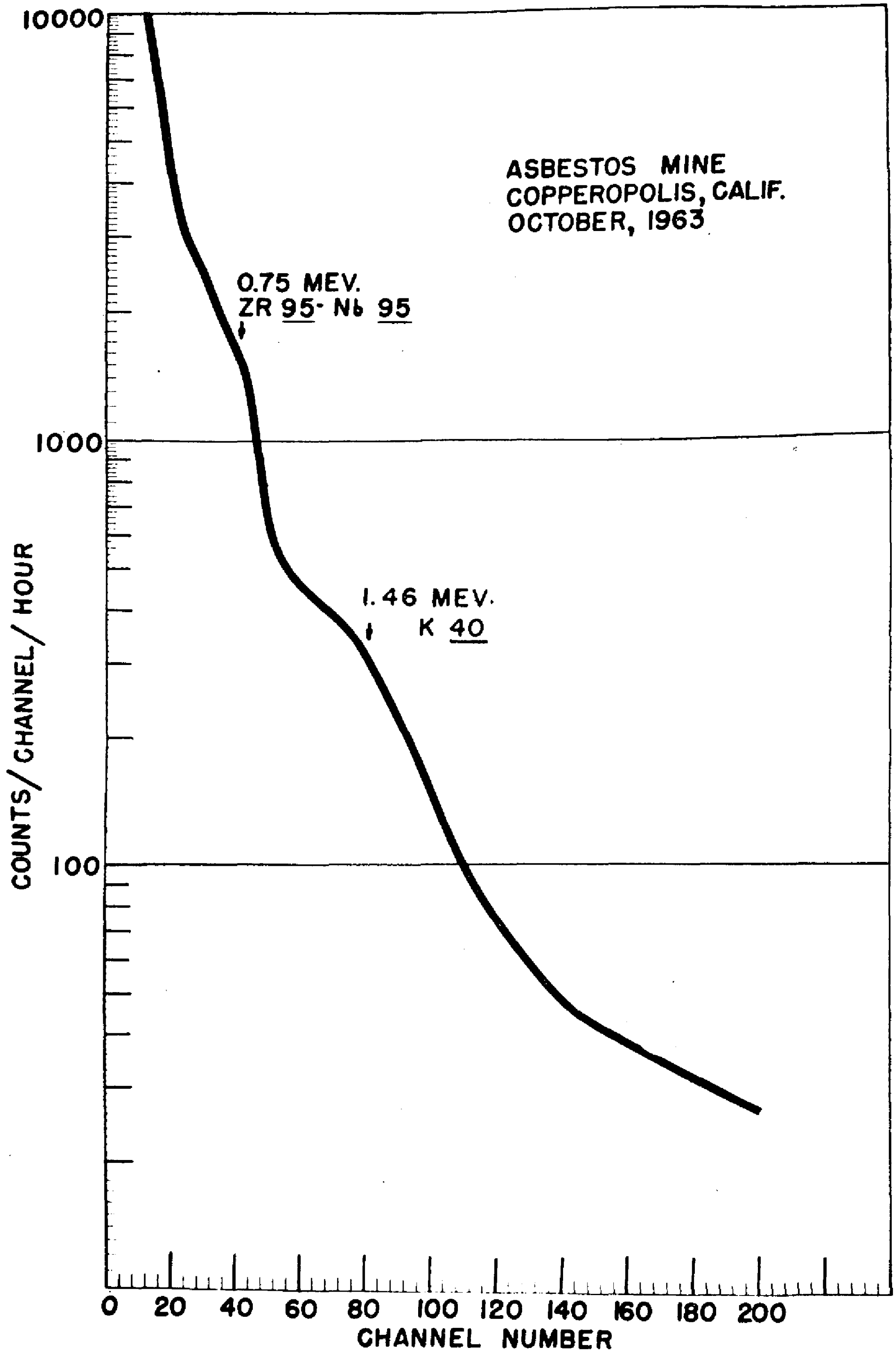

Figure 3. Field spectrum obtained over freshly exposed serpentine at asbestos mine near Copperopolis, California. This spectrum was accumulated in approximately one hour of live time as opposed to the twenty minute live times for the spectra of Figure 2.

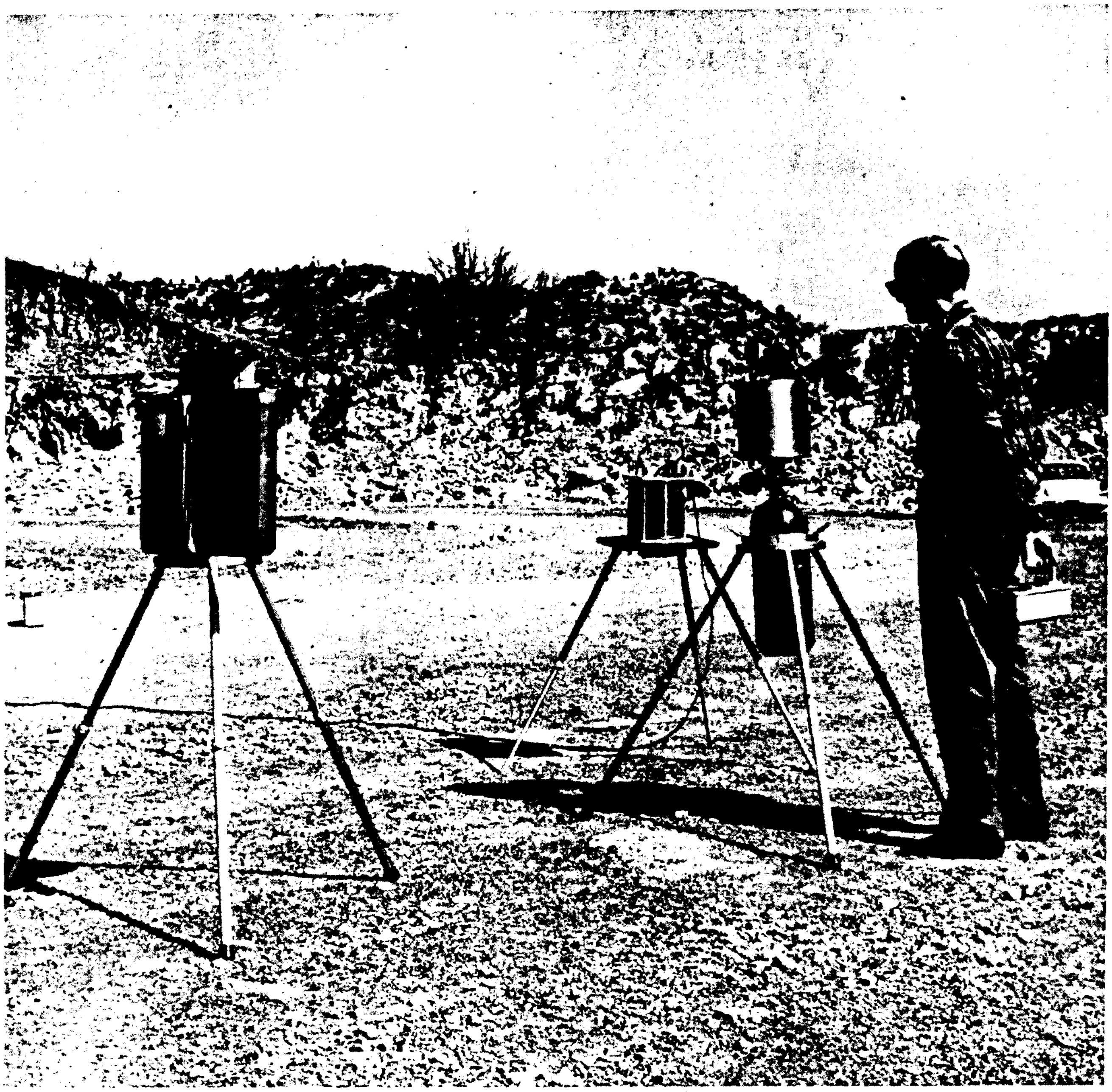

Figure 4. Fresh serpentine exposure at asbestos mine near Copperopolis, California.