RADIOACTIVITY SURVEY DATA in Japan

NUMBER 5
NOV. 1964

National Institute of Radiological Sciences
Chiba, Japan

Preface

The initial issue of this series of publications, compiled from national radioactivity survey networks was published in November 1963. Subsequently, four issues have been published, all of which have been received enthusiastically by institutes and researchers both domestic and in foreign countries.

The primary purpose of these publications is to furnish accurate data together with all the indication necessary for thier proper interpretation and utilization.

It is our desire that this publication fulfills this goal and provide interesting and meaningful information to all who receive this publication. We hope that we will be of special aid to those researchers who are engaged in the evaluation of the radioactivity level of environmental cotamination in Japan.

This edition contains radioactivity survey data following the nuclear detonation test conducted on the Chinese mainland, assumed to be at Lake Lop Nor. In view of the nearness of Japan to the test site, measurable amount of fresh radioactivity was detected shortly after the test.

It is our pleasure if this publication was found useful by our readers for sientific interest, chiefly in information on short-lived radionuclides from that test.

Any suggestions for the improvement of future publication will be deeply appreciated.

Kempo Tsukamoto, M. D.

Directer,
National Institute of Radiological Sciences

Radioactivity Survey Data in Japan

Number 5

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National Institute of Radiological Sciences

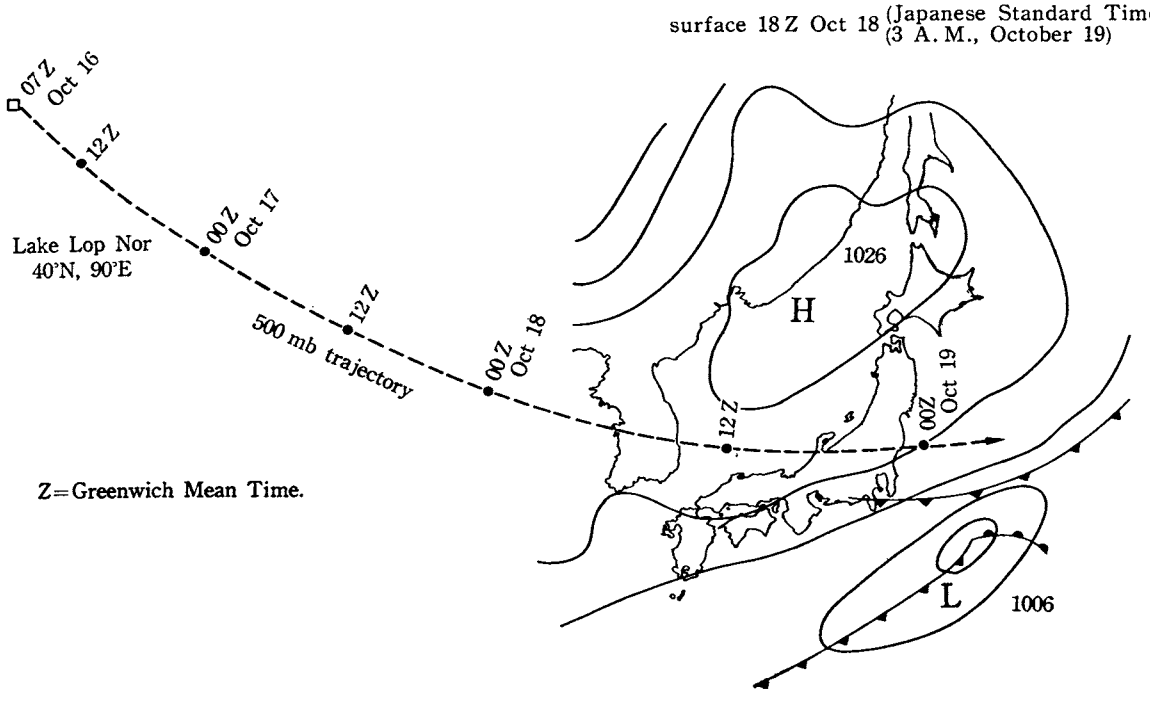
Introductory Note

On the October 16th, 1964, the People's Requblic of China carried out her first nuclear test explosion. The test area is believed to be in the neighborhood of Lake Lop Nor, 40°N. Lat., 90°E. Long., about 4,000 kilometers west-northwest of Japan. In Japan, abnormal microbarographic record was not observed, therefore the magnitude of this explosion may have been in the low kiloton range.

Figure 1 shows surface weather pattern at 3 A. M. October 19th, (Greenwich Mean Time; 18Z Oct. 18th). Rain associated with the low atmospheric pressure located to the east-southeast of Tokyo did not contain radioactive debris from this explosion. Immediately after a passage of this low, a traveling anticyclone from the continent (1026 millibar) expanded over Japan. Then, radioactivite dry fallout was detected in the central part of Japan. In this figure, 500 millibar trajectory from the test area are also shown. The best agreement between this trajectory and detection of radioactivity was obtained.

After the anticyclone had passed to the eastern ocean, there was a spell of rainy weather for a few days. Radioactivity was detected in rain water at various locations throughout Japan, during this period. Then, radioactivity in fallout rapidly decreased, and returned the previous levels.

Figure 1. Surface Weather Pattern at That Time.



Meteorological Data

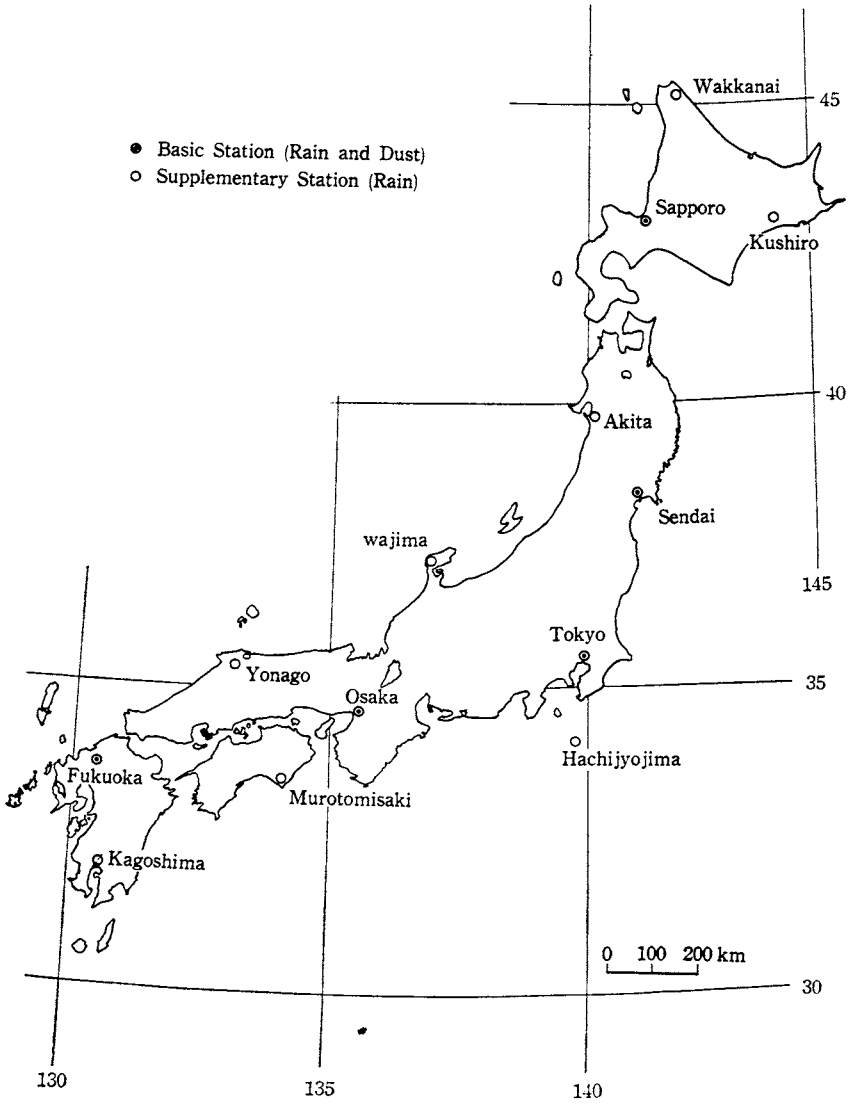
Gross Beta-radioactivity in Rain and Dry Fallout

Part I *(Meteorological Agency)*

The Meteorological Agency has measured gross beta-radioactivity in rain and dry fallout since 1955 at local weather stations.

At 13 stations, shown in Figure 2, rain samples is collected in five liter glass bottle through a coated stainless steel funnel 25.2 centimeters in diameter. The bottles are changed at 9 A. M. every day, and one hundred milliliters of the rain water is taken as a sample. The radioactivity of the rain samples is measured six hours after the sampling. Uranium oxide (U_3O_8) mounted on a sample dish is delivered to each station as a reference source.

Figure 2. Fallout Observation Network of Meteorological Agency



Results obtained during the period October 11th to November 10th, 1964 are shown in Table 1. Radioactivity in rain was first detected on the 20th, and remained high during the period 21th to 24th, Octber when it rained in various parts of Japan. After 25th, the radioactivity in rain decreased rapidly, and activity above 1.0 pCi/m*l* was not observed in November. Figure 3 shows temporal variation of the radioactivity content in rain since November 1962. The value in Figure 3 is measured 72 hours after the sampling. Fresh fallout in October 1964 was not as high in comparison with former nuclear tests.

Table 1. Gross β-activity in Rain —Oct. 11 to Nov. 10, 1964—

(Meteorological Agency)

Gross β-activity (pCi/ml)

Station	Oct 11	Oct 12	Oct 13	Oct 14	Oct 15	Oct 16	Oct 17	Oct 18	Oct 19	Oct 20
Wakkanai	0.2						0.7	0.0		
Sapporo	0.1						0.1			
Kushiro										
Sendai				0.1	0.1					
Akita							0.1			
Tokyo				0.0	0.1			0.1	0.0	27.2
Wajima				0.0	0.0			0.1		
Hachijojima		0.1	0.0	0.0	0.1					1.2
Osaka			0.1	0.1				0.1		
Yonago				0.1	0.0		0.1	0.0		
Murotomisaki		0.0	0.0	0.0			0.2	0.1		2.5
Fukuoka				0.0				0.2		
Kagoshima				0.0			0.0			

Station	Oct 21	Oct 22	Oct 23	Oct 24	Oct 25	Oct 26	Oct 27	Oct 28	Oct 29	Oct 30	Oct 31
Wakkanai			1.2	2.4	2.4			0.2		0.3	
Sapporo				3.1	0.4	0.2					
Kushiro	18.5	1.6		3.0							
Sendai	2.6	2.9	7.6	1.8							
Akita	1.0	2.2	6.0	6.0	2.2	1.2				0.5	1.0
Tokyo			11.7	2.6							
Wajima	0.9	0.2	2.5	2.3	2.0				3.2		
Hachijojima			0.5	0.8	0.2	1.4	0.7	0.3	0.3		
Osaka	31.0	8.0	2.5					0.5			
Yonago	1.1	0.3	7.0	20.0	6.0				2.0		
Murotomisaki	16.0	2.5		1.4				0.2			
Fukuoka	0.5	0.3	8.4								
Kagoshima	0.2			0.4							

Station	Nov 1	Nov 2	Nov 3	Nov 4	Nov 5	Nov 6	Nov 7	Nov 8	Nov 9	Nov 10
Wakkanai	0.5	0.4	0.2		0.1	0.4	0.2	0.1		
Sapporo		0.2				0.4		0.6		
Kushiro		0.5				0.3	0.6			
Sendai		0.5	0.4		0.5	0.7				0.1
Akita		0.5			0.5	0.1		0.5		
Tokyo		0.2	0.1							0.1
Wajima		0.1			0.4	0.0	0.5	0.1		0.1
Hachijojima		0.3	0.4			0.0	0.1	0.1		0.1
Osaka		0.1				0.4			0.2	0.1
Yonago		0.3	0.2			0.2		0.8		0.0
Murotomisaki		0.0			0.0	0.0				0.1
Fukuoka		0.1			0.4				0.7	0.1
Kagoshima		0.0								0.1

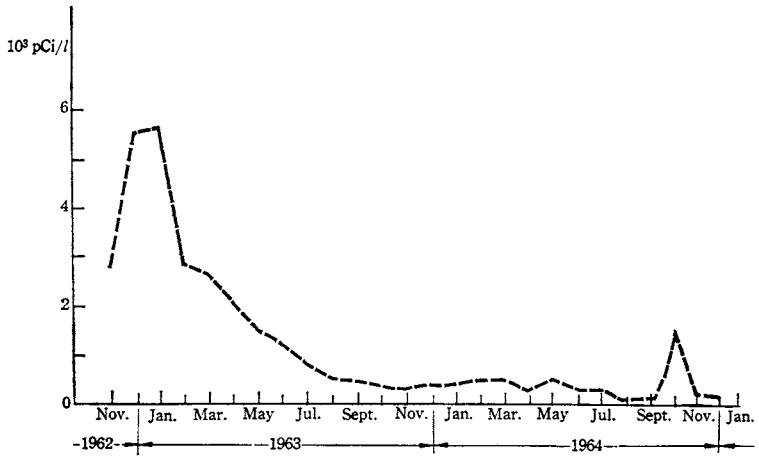
Gross β-deposits (mCi/km^2)

Station	Oct 11	Oct 12	Oct 13	Oct 14	Oct 15	Oct 16	Oct 17	Oct 18	Oct 19	Oct 20
Wakkanai	1.2						2.8	0.0		
Sapporo	1.6						0.1			
Kushiro										
Sendai				0.8	0.3					
Akita							2.1			
Tokyo				0.0	0.1			0.7	0.0	
Wajima				0.0	0.0			2.7		
Hachijojima		0.1	0.0	0.0	0.2					1.7
Osaka			1.3	2.9				1.3		
Yonago				1.0	0.0		0.2	0.0		
Murotomisaki		0.0	0.0	0.0			0.7	0.7		6.8
Fukuoka				0.0				0.7		
Kagoshima				0.0			0.0			

Station	Oct 21	Oct 22	Oct 23	Oct 24	Oct 25	Oct 26	Oct 27	Oct 28	Oct 29	Oct 30	Oct 31
Wakkanai			7.6	10.6	22.3			3.2		1.2	
Sapporo				7.4	11.7	1.3					
Kushiro	38.9	5.4		38.7							
Sendai	29.0	4.9	200.0	1.6							
Akita	12.2	18.5	10.2	146.0	15.2	4.8				1.9	1.2
Tokyo			100.0	3.9							
Wajima	16.7	3.6	23.3	10.6	20.4				23.4		
Hachijojima			4.1	7.4	1.6	4.8	3.0	2.1	1.1		
Osaka	46.5	56.0	9.0					1.7			
Yonago	8.0	5.0	140.0	56.0	8.0				4.0		
Murotomisaki	20.8	15.0		6.0				0.7			
Fukuoka	18.1	0.3	26.0								
Kagoshima	6.3			1.2							

Station	Nov 1	Nov 2	Nov 3	Nov 4	Nov 5	Nov 6	Nov 7	Nov 8	Nov 9	Nov 10
Wakkanai	2.2	3.5	0.6		1.7	1.9	0.4	0.3		
Sapporo		1.0				0.5		1.7		
Kushiro		1.3				0.5	0.8			
Sendai		2.0	1.0		1.0	3.0				1.0
Akita		13.8			6.2	2.4		3.6		
Tokyo		2.0	0.2							2.0
Wajima		2.8			9.7	0.0	1.1	0.8		1.1
Hachijojima		0.5	2.1			0.0	3.2	1.6		4.1
Osaka		2.2				1.0			0.3	3.1
Yonago		10.0	2.0			2.0		7.0		0.0
Murotomisaki		0.0			0.0	0.0			2.2	
Fukuoka		5.6			1.0				0.6	0.8
Kagoshima		0.0								0.5

Figure 3. Temporal Variation of Gross β-activity in Rain
—All Japan Mean Value—



At five stations, air sample is collected by a filter paper type dust sampler. The radioactivity of the filter paper is measured 20 hours after the sampling at the five stations.

Results obtained during the period 11th October to 10th November, 1964 are shown in Table 2. Figure 4 shows the temporal variation of radioactivity content in air since January 1963.

Tadle 2. Gross β-activity in Dust —Oct. 11 to Nov. 10—

(Meteorological Agency)

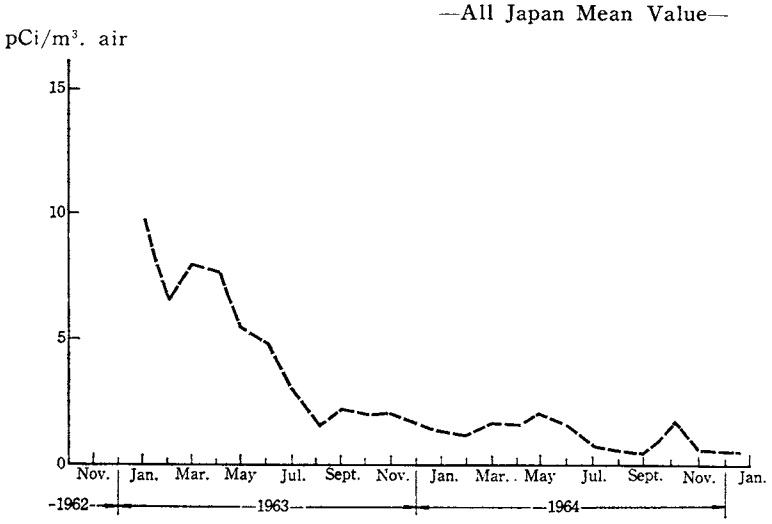
Gross β-activity (pCi/m²)

Station	Oct 11	Oct 12	Oct 13	Oct 14	Oct 15	Oct 16	Oct 17	Oct 18	Oct 19	Oct 20
Sapporo		0.5		0.2		0.7			0.5	
Sendai		1.0		1.2		1.0			0.5	
Tokyo		0.9		0.8		0.8			12.0	3.3
Osaka		0.7		0.7		1.0			18.0	8.0
Fukuoka		1.4		0.0		1.2			1.0	1.0

Station	Oct 21	Oct 22	Oct 23	Oct 24	Oct 25	Oct 26	Oct 27	Oct 28	Oct 29	Oct 30	Oct 31
Sapporo	1.4	1.4	1.4	0.2		0.0		1.0			0.2
Sendai	0.7		3.1	0.2		0.2	0.5	1.0	0.7	0.5	0.2
Tokyo	1.3	1.9	1.4	3.5	1.7	0.9	1.2	1.0	0.8	1.2	
Osaka			2.4			0.1		0.7		0.7	
Fukuoka	0.2	38.0	18.0	1.0	0.5	1.0	1.7	0.7	2.2	1.4	

Station	Nov 1	Nov 2	Nov 3	Nov 4	Nov 5	Nov 6	Nov 7	Nov 8	Nov 9	Nov 10
Sapporo		0.0		0.0		1.0			0.2	
Sendai		1.2		0.7	1.7	0.5	0.5		0.2	1.0
Tokyo		0.7		1.0		0.7			1.3	
Osaka		0.7		0.1		0.7			0.5	
Fukuoka		0.7		1.4		0.7			1.4	

Figure 4. Temporal Variation of Gross β-activity in Air
—All Japan Mean Value—

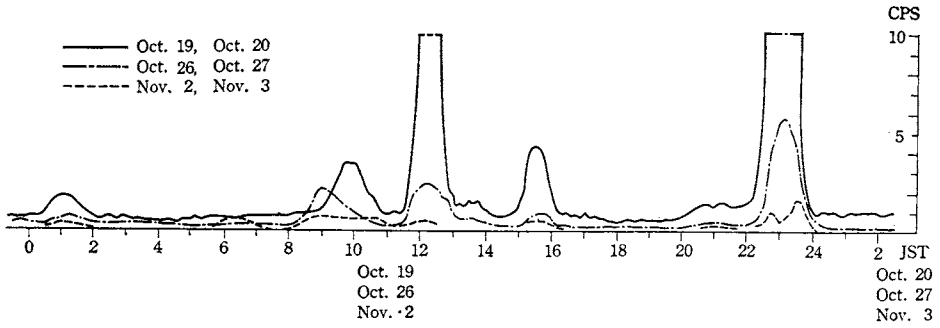


The records observed with a dust monitor (250 l/min) With a moving filter strip at the Meteorological Agency are rather interesting.

Abrupt increases in beta-radioactivity appeared during the period 0 A.M. 19th October to 0 A.M. 20th October, (JST). Figure 5 shows the result for this period and their subsequent decays.

Figure 5. Record of Dust Monitor —October 19 to 20, 1964—

By N. Murayama, H. Fujimoto, and M. Kamiyama
(Meteorological Agency)



Part II (*Meteorological Research Institute, Tokyo*)

The Meteorological Research Institute, Tokyo, is measuring beta-radioactivity in rain and dry fallout collected with a tray.

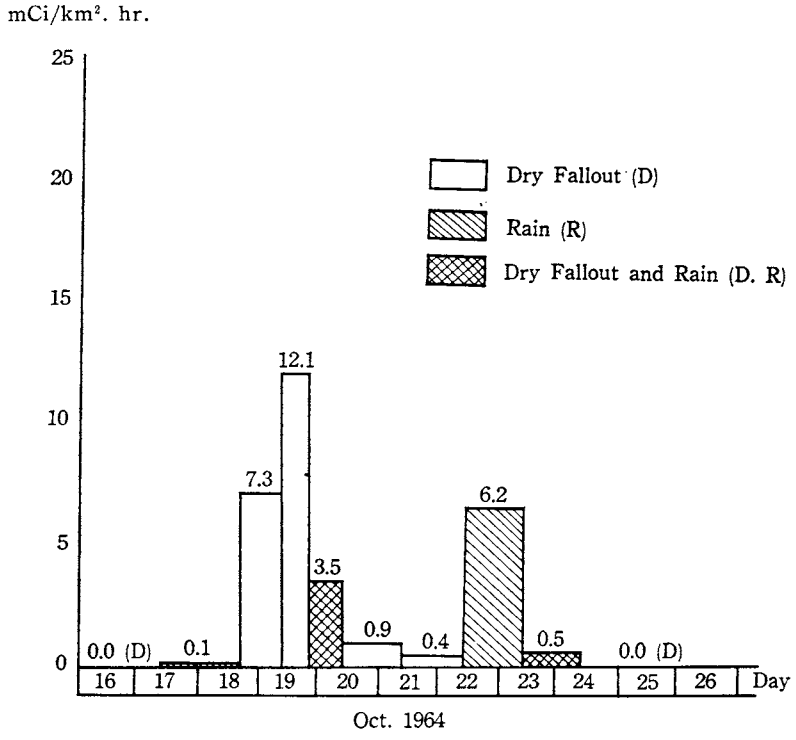
Results of measurements obtained during the period from October 16th, 1964 to October 25th, 1964 when the effect of Chinese atomic bomb was remarkable, are shown in Table 3 and Figure 6.

Table 3. Deposition of Radioactive Fallout
—16th to 25th, October, 1964—

By Y. Miyake, K. Saruhashi, Y. Katsuragi,
T. Kanazawa and Y. Sugimura
(Meteorological Research Institute, Tokyo)

Date of Sampling	Collection Time (hr)	Total β-activity (mCi/km^2)	Remarks
1964 October			
16th 9h-17th 9h	24	0.03	dry fallout
17th 9h-18th 10h	25	2.4	rain (17.7 mm)
18th 10h-18th 16.5h	6.5	0.5	rain (12.2 mm)
18th 16.5h-19th 9h	16.5	120	dry fallout
19th 9h-19th 16h	7	85	dry fallout
19th 16h-20th 9h	17	60	dry fallout and rain (0.95 mm)
20th 9h-21st 9h	24	20	dry fallout
21st 9h-22nd 9h	24	10	dry fallout
22nd 9h-23rd 9h	24	156	rain (12.0 mm)
23rd 9h-24th 9h	24	13	dry fallout and rain (1.5 mm)
24th 9h-26th 9h	48	2	dry fallout

Figure 6. Radioactivity Fallout Rate



Chemical Composition of Fallout

(Meteorological Research Institute, Tokyo)

The Meteorological Research Institute carried out the radiochemical analysis of dry fallout collected on October 18th and 19th, 1964, when the effect of Chinese bomb was remarkable. Results obtained are shown in Table 4. It is to be noticed that neptunium-239 constituted 64 percent in the activity on the fifth day after the explosion test.

Table 4. Radiochemical Analysis of Dry Fallout —October 18 and 19, 1964—

By Y. Miyake, K. Saruhashi, Y. Katsuragi, T. Kanazawa and Y. Sugimura

(Meteorological Research Institute, Tokyo)

Nuclides	Percentage in Activity (Reduced Value on 21st Oct., 1964)
^{239}Np	64.0
^{237}U	2.5
^{99}Mo	8.3
^{103}Ru, ^{106}Ru	
^{105}Ru-Rh	
Alkali earths	5.1
Rare earths	10.7
^{95}Zr, ^{97}Zr	1.0
^{95}Nb, ^{96}Nb	
Others	8.4

Gross Beta-radioactivity in Upper Air

(Research and Development H. Q., Japan Defence Agency)

Since 1960, Research and Development H. Q., Japan Defence Agency has measured the beta-radioactivity of dust in the lower layer of the stratosphere and tropopause with air planes.

The sampling were taken over three areas of Japan with gummed papers attached on the front of wings. The measurements of beta-radioactivity were made with Geiger-Müller counter using a uranium oxide as a reference source.

Results obtained by the gummed papers are shown in Table 5, Table 6 shows results obtained by the dust sampler.

A previous experiment indicated that the radioactivity of one gummed paper per one hour flying corresponded to the radioactivity in four cubic meter of air.

Applying this relationship, the value of the radioactivity in the central area of Japan on October 20th was 425 pCi/m^3. Recentry, filter paper type dust sampler has been fitted to the tap of the plane. Results by this method show 5.7 pCi/m^3 on the same day. Therefore, it appears that high radioactive particles adhered at the layer on the rising way.

In that case like the nuclear test explosion of the People's Republic of China, the detonation were low in height, small in scale, and near Japan, the method by gummed paper is not suitable. but it is possible to show the outline.

Table 5. Gross β-radioactivity in Upper Air
—Gummed Paper— —Jul. to Oct., 1964—

By T. Urai and T. Igarashi
(Reseach and Development H. Q., Japan Defence Agency)

pCi/1 gummed paper

Date	Hokkaido		Chubu		Kyushu	
	10,000m	12,000m	10,000m	12,000m	10,000m	12,000m
2 Jul 64	——	——	——	4.4	——	——
3 〃	13	——	——	——	——	——
13 〃	——	——	——	1.4	——	——
20 〃	——	——	——	6.1	——	——
27 〃	——	——	——	0.24	——	——
3 Aug 64	——	——	——	1.0	——	——
11 〃	——	——	——	0.14	——	——
14 〃	——	——	——	——	——	3.9
17 〃	——	——	——	1.9	——	——
25 〃	——	——	——	0.16	——	——
31 〃	——	——	——	0.6	——	——
7 Sep 64	——	——	——	0.3	——	——
8 〃	42.38		——	——	——	——
16 〃	——	——	0.84	——	——	——
1 Oct 64	1.11	——	——	——	——	——
12 〃	——	——	——	3.08	——	——
17 〃	1.34	2.62	——	——	0.40	11.73
18 〃	9.61	25.65	2.02	2.54	0.70	11.33
19 〃	54.0	11.99	——	102.54	419.30	761.82
20 〃	231.0	350.65	425.10	356.0	60.60	294.0
21 〃	19.50	17.25	——	——	——	——
22 〃	17.39	6.20	——	——	3.28	4.30
23 〃	7.72	25.58	6.89	3.38	38.50	40.60
24 〃	12.18	42.41	3.92	7.05	6.70	11.05
28 〃	180.14	189.15	10.38	10.30	1.84	7.52

Note: Sky Area: Hokkaido 141–144°E 42°5–45°N
Chubu 135–140° 〃 34 –37° 〃
Kyushu 130–132° 〃 31 –32° 〃
Mach Number: 0.7

Table 6. Gross β-radioactivity in Upper Air
—Dust Sampler—

By T. Urai and T. Igarashi
(Reserch and Development H. Q., Japan Defence Agency)

Sampling Date	Altitude (m)	Sampling Hour	Gross β-activity (pCi/m³)
20 Oct 64	10,000	9.50–10.50	5.73
23 Oct 64	10,000	9.30–10.30	0.20

Note: Sky Area
Hamamatsu–Komatsu–Itami–Nagoya.
Hamamatsu–Komatsu–Itami.

Gross Beta-radioactivity and Radioactive Iodine and other Radionuclides in Rain and Dry Fallout

(National Institute of Radiological Sciences)

Daily rain and dry fallout samples, from 9.00 A. M. to 9.00 A. M. were continuously collected by the National Institute of Radiological Sciences, located in Chiba City, to determine gross beta-activity and activity of radio-iodine. The gross beta-radioactivity was measured using standard of uranium oxide (U_3O_8) with Geiger Müller counter and measured 8 hours after the time of collection except in case of sample collected 17–18 Oct., 1964. After addition of iodine carrier to the fallout sample, the iodine was chemically separated for radioactivity determination using iodine-131 standard with a beta-ray low background counter. The radioactivity of iodine was calculated back to the time of collection using decay curve of radioactivity of iodine fraction. Decay curves of beta-radioactivity of two samples and derived curves, shown in Figure 7, indicated the existance of iodine-131 (half-life 8.06 d), iodine-132 (half-life 2.3 h) and iodine-133 (half-life 20.8 h).

Results obtained during the period 17 to 31 October, 1964 gross beta-activity and radioactive iodine are shown in Table 7. The ratio of beta-radioactivity of iodine to gross beta-radioactivity was 10 to 15 percent on October 19th and 20th and the percent decreased shortly in a week.

For information, monthly variation of long-

lived radionuclides, strontium-90 and cesium 137, in rain and dry fallout, collected at the Institute, are presented in Figure 8. It shows no remarkable increase of those long-lived radionuclides in October, 1964. Figure 9 show the seasonal variation of various radionuclides in Edo river water which indicate that remarkable amount of strontium-89 (half-life 50.5 d) appeared in October 1964 and decreased shortly, while no remarkable variation was observed in concentration of long-lived radionuclides such as strontium-90 and cesiun-137.

Figure 7. Decay Curves of Radio-iodine extracted from Dust and Rain Water Samples.

By M. Saiki and G. Tanaka
(National Institute of Radiological Sciences)

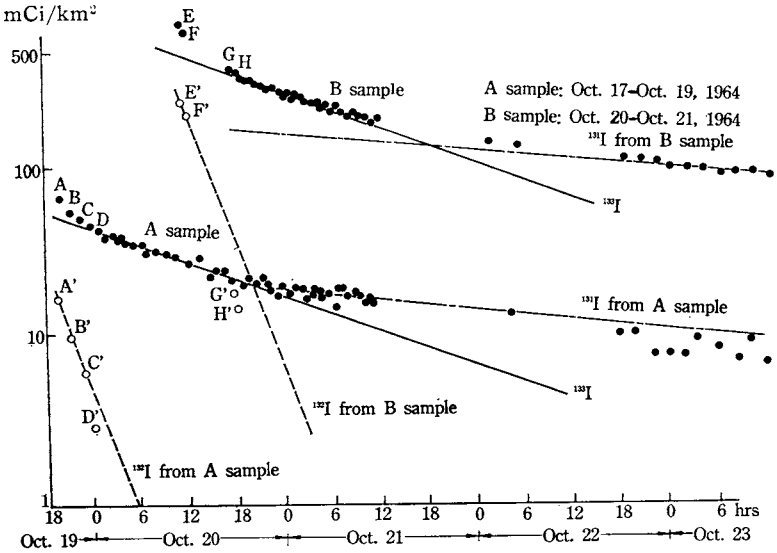


Table 7. Gross β-radioactivity and Radioactivity of Iodine in Rain and Dry Fallout —Oct. 17th to 31th, 1964—

By M. Saiki, G. Tanaka and H. Kamada
(National Institute of Radiological Sciences)

Date of Sampling	Gross β-activity (mCi/km²)	Date of Determination	β-activity of Iodine at the Time of Sampling (μCi/km²)	Ratio $\frac{\beta\text{-activity of Iodine}}{\text{Gross } \beta\text{-activity}} \times 100$
17～18 Oct 64	0.20	19 Oct 64	4.160	9.5
18～19 〃	43.60	19 〃		
19～20 〃	89.80	20 〃	13.400	15.0
20～21 〃	18.20	21 〃	—	—
21～22 〃	5.70	22 〃	0.212	3.7
22～23 〃	28.50	23 〃	0.975	3.4
23～24 〃	3.60	24 〃	0.005	0.2
24～25 〃	3.90	26 〃	0.017	0.4
25～26 〃				
26～27 〃	1.44	27 〃	—	—
27～28 〃	0.70	28 〃	0.003	0.5
28～29 〃	0.85	29 〃	0.001	0.1
29～30 〃	0.27	30 〃	—	—
30～31 〃	0.11	31 〃	—	—

Figure 8. Monthly Variation of Strontium-90 and Cesium-137 in Rain and Dry Fallout.
—Jan. 1964-Jan. 1965, Chiba City—

by M. Saiki and T. koyanagi
(National Institute of Radiological Sciences)

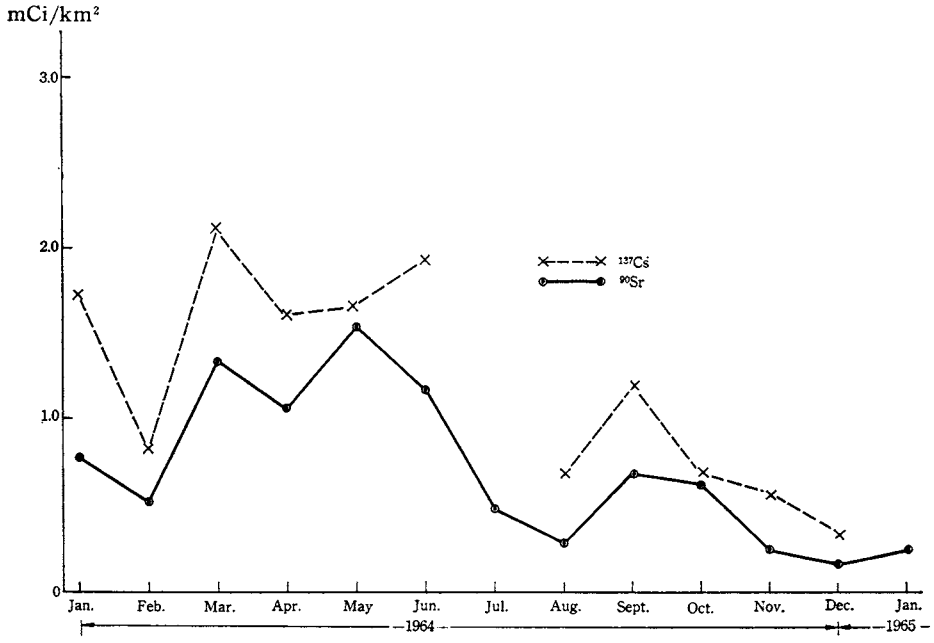
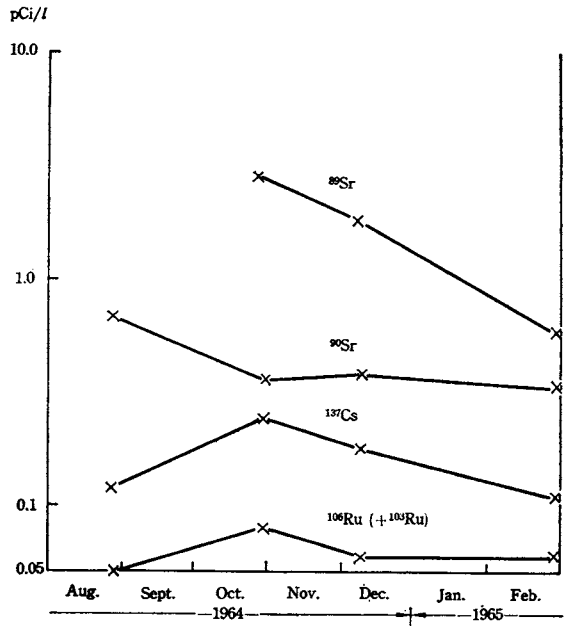


Figure 9. Concentration of Various Radionuclides in
Edo River Water in Tokyo.

By M. Saiki and H. Kamada
(National Institute of Radiological Sciences)



Examination of Highly Radioactive Fallout Particles from the First Chinese Nuclear Test Explosion

(Radiation Center of Osaka Prefecture)

Highly radioactive fallout particles resulting from the first Chinese nuclear test explosion were collected from roofs of the buildings in this Center on 19 and 20 October; a Geiger-Müller survey meter was used to locate the particles. These particles, whose β-activities ranged from a few to 130 mμCi, were found to be distributed on the roofs at a density of 5–6 particles per 1 m^2. By taking autoradiographs of air-borne dust samples and by measuring the variation of fallout concentration in the atmosphere, it was concluded that these highly radioactive fallout particles began to fall on Osaka District late in the evening on 18 October and continued to fall for about 24 hours

Some differences have been found between these Chinese particles and the Russian particles examined formerly, which originated from the Russian explosions in the autumns of 1961 and 1962.

The Chinese particles were collected about 3 days after the detonation and, due to the initial decay which indicated a half-life of about 2.4 days, most of the collected particles became difficult to isolate 1 month after the collection. Activities of the Russian particles ranged from a few to about 100 mμCi at the time of the collection although they were collected, at earliest, about 1 week after the detonations. Some of them could be isolated 6 months after the collection. The specific fission product activity at a given age of the Chinese particles was about a factor 100 less than that of the Russian particles.

We collected about three hundred particles of which about sixty were isolated from among their accompanying dust particles with the aid of a microscope and a Geiger-Müller counter, immersed in a small drop of cedar oil, and examined microscopically. In Table 8 are represented the mean diameters, the colors, the shapes and the β-activities of the examined fifty-seven particles. Microphotographs of about a quarter of them are shown in Figure 10. The photographs designated by (P) were taken with the microscope focussed on the perimeter of the particles and show the contour of the perimeter clearly, but show the front surface only vaguely. The photographs designated by (F) and (M) were taken in order to show the change in depth of the surface state of the particles; the microscope was focussed on the front surface and on the middle part between the front surface and the perimeter, respectively. Most of the particles were, quite or nearly, spherical, but there were some particles which deviated considerably from the spherical or were amorphous. The surface of some particles was creased. Not a few particles had submicron particles adhered on their surface. Such small particles sometimes were observed to be separated from the main particle during the isolation procedure. There were several particles which consisted of two nearly the same size particles adhered or fused to each other. Color varied from particle to particle; black, reddish black, red, reddish brown, yellow, golden and colorless. Black or reddish black particles were the most frequent. In the case of the Russian particles, color also varied from particle to particle, but individual particles were rather uniformly colored. Contrary to this, among the Chinese particles examined there were several particles which consisted of two or more parts of distinctly different colors or were mottled with two or more colors.

Table 8. The Result of Microscope Examination of the Particles

By T. Mamuro, A. Fujita and T. Matsunami

(Radiation Center of Osaka Prefecture)

Sample No.	Mean Diameter (μ)	β-activity* (mμCi)	Color	Shape	Plate No.
1	7.4	59.9	upper: golden, lower: reddish brown	spherical	
2	7.8	19.2	red and black, mottled	spherical	
3	9.0	9.3	black	ellipsoidal, creased surface	
4	9.9	51.0	black	spherical	
5	10.6	14.0	black	spherical	
6	10.6	3.9	black	spherical	
7	10.6	3.6	black	spherical	
8	11.5	16.0	yellow, transparent, a red small particle adhered on the surface	spherical	
9	12.0	46.1	reddish black	oval	
10	12.3	43.3	reddish brown, mottled	spherical	
11	12.3	3.1	black	ellipsoidal creased surface	
12	12.3	4.9	black	spherical	
13	13.0	5.9	black and yellow, mottled	spherical	
14	13.1	6.8	black and golden, mottled	semispherical	
15	13.2	48.2	black	spherical	
16	13.3	67.5	black	spherical	
17	13.3	19.9	red	spherical	
18	13.5	26.2	yellow	angular	
19	13.5	7.4	black	spherical	
20	13.6	46.9	reddish black	spherical	
21	13.6	46.1	reddish black	spherical	
22	13.8	18.9	black, a red small particle adhered on the surface	spherical	
23	14.0	14.8	black	spherical	
24	14.2	7.2	black, red and black small particles adhered on the surface	spherical	
25	14.6	50.2	golden, several angular pieces adhered on the surface	spherical	
26	14.6	8.1	black	spherical	
27	14.9	6.0	reddish black	spherical	
28	15.6	5.7	black	spherical	
29	16.0	23.0	black	spherical	
30	16.2	21.8	black, a red small particle adhered on the surface	spherical	
31	16.2	12.2	black	like pear	
32	16.8	8.7	black	spherical	
33	17.0	133.0	right and left sides: reddish brown, middle part: black	ellipsoidal	
34	17.0	12.5	black	spherical	
35	17.0	12.7	black	spherical	
36	17.4	51.5	red	spherical	
37	17.6	16.3	black, a red small particle adhered on the surface	spherical	
38	17.7	5.2	colorless, transparent	spherical	
39	17.8	7.7	reddish black	spherical	
40	18.6	17.5	black	spherical	
41	18.6	17.5	black	spherical	
42	18.6	22.1	black	spherical	

43	18.8	51.0	yellow, transparent	spherical	
44	18.9	9.9	red	spherical	
45	18.9	20.1	black	spherical, creased surface	
46	19.2	4.8	upper: black, lower: white	spherical	10
47	19.5	10.9	yellow, several red and yellow small particles adhered on the surface	spherical	
48	19.6	4.1	yellow, several yellow and red small particles adhered on the surface	spherical	11, 12, 13
49	19.8	13.8	black, golden streak	spherical	
50	16.6	7.0	black	spherical, many small particles adhered on the surface	14, 15, 16
51	main: 15.4 separated: 7.2	11.8	main: black separated: reddish brown	spherical spherical	17, 18
52	l** : 12.0 s***: 8.0	5.6	l: black and red, mottled s: black and red, mottled	two spherical particles adhered to each other	
53	l: 13.5 s: 10.8	33.8	l: reddish brown s: black	two spherical particles adhered to each other	
54	l: 15.4 s: 11.6	6.9	l: black s: red	two spherical particles fused to each other	19
55	l: 14.6 s: 6.8	50.0	l: reddish brown s: black and white	two spherical particles adhered to each other	
56	l: 15.5 s: 14.0	38.2	l: golden s: golden	the smaller particle is behind nonradioactive dust particle	
57	outer: 22.2 inner: 10.3	5.0	outer: colorless, transparent inner: black	spherical	20

* β activity at noon on 19 October
** the larger particle
*** the smaller particle

Figure 10.

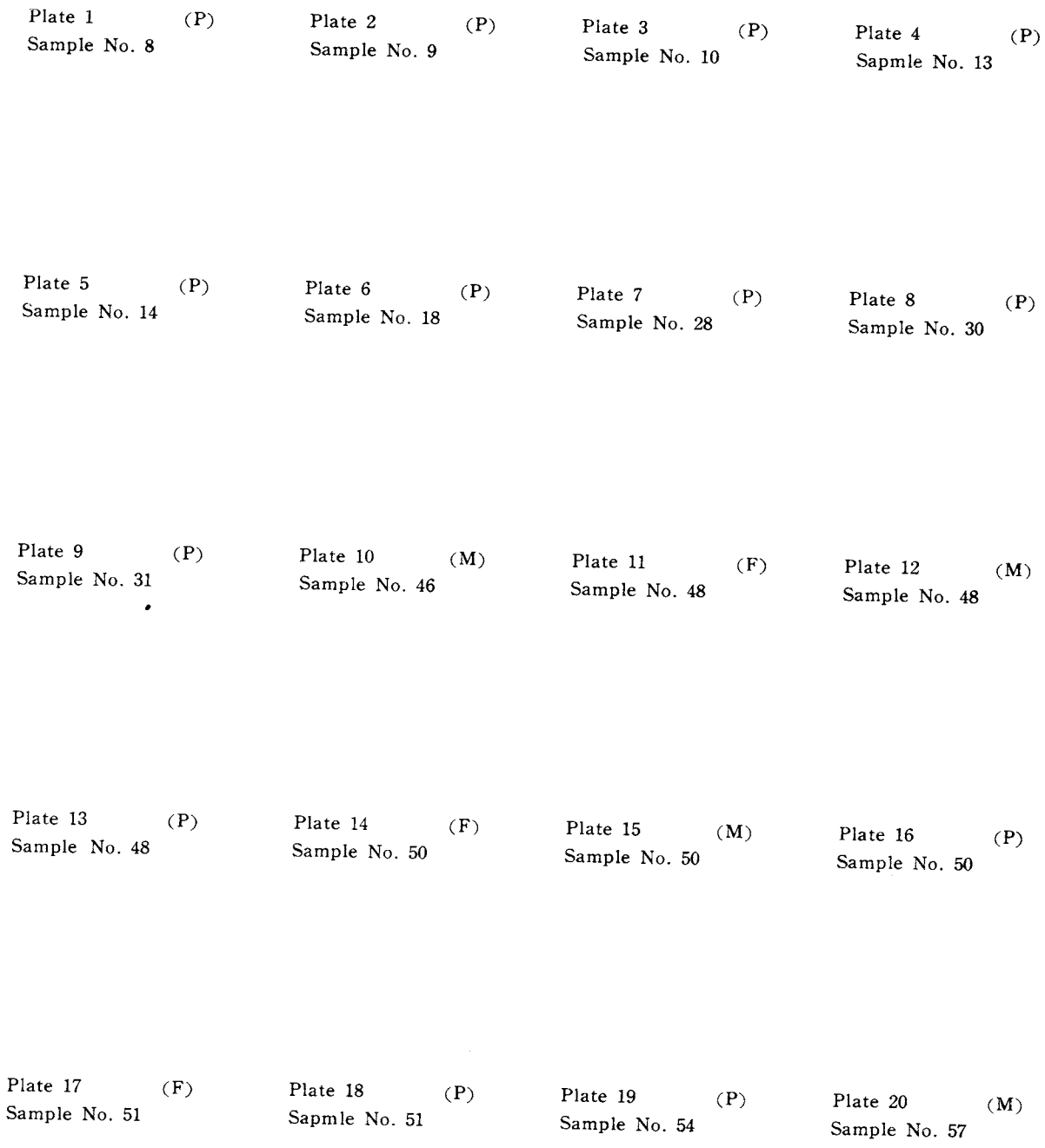


Plate 1 (P)
Sample No. 8
Plate 2 (P)
Sample No. 9
Plate 3 (P)
Sample No. 10
Plate 4 (P)
Sapmle No. 13
Plate 5 (P)
Sample No. 14
Plate 6 (P)
Sample No. 18
Plate 7 (P)
Sample No. 28
Plate 8 (P)
Sample No. 30
Plate 9 (P)
Sample No. 31
Plate 10 (M)
Sample No. 46
Plate 11 (F)
Sample No. 48
Plate 12 (M)
Sample No. 48
Plate 13 (P)
Sample No. 48
Plate 14 (F)
Sample No. 50
Plate 15 (M)
Sample No. 50
Plate 16 (P)
Sample No. 50
Plate 17 (F)
Sample No. 51
Plate 18 (P)
Sapmle No. 51
Plate 19 (P)
Sample No. 54
Plate 20 (M)
Sample No. 57

Figure 10.

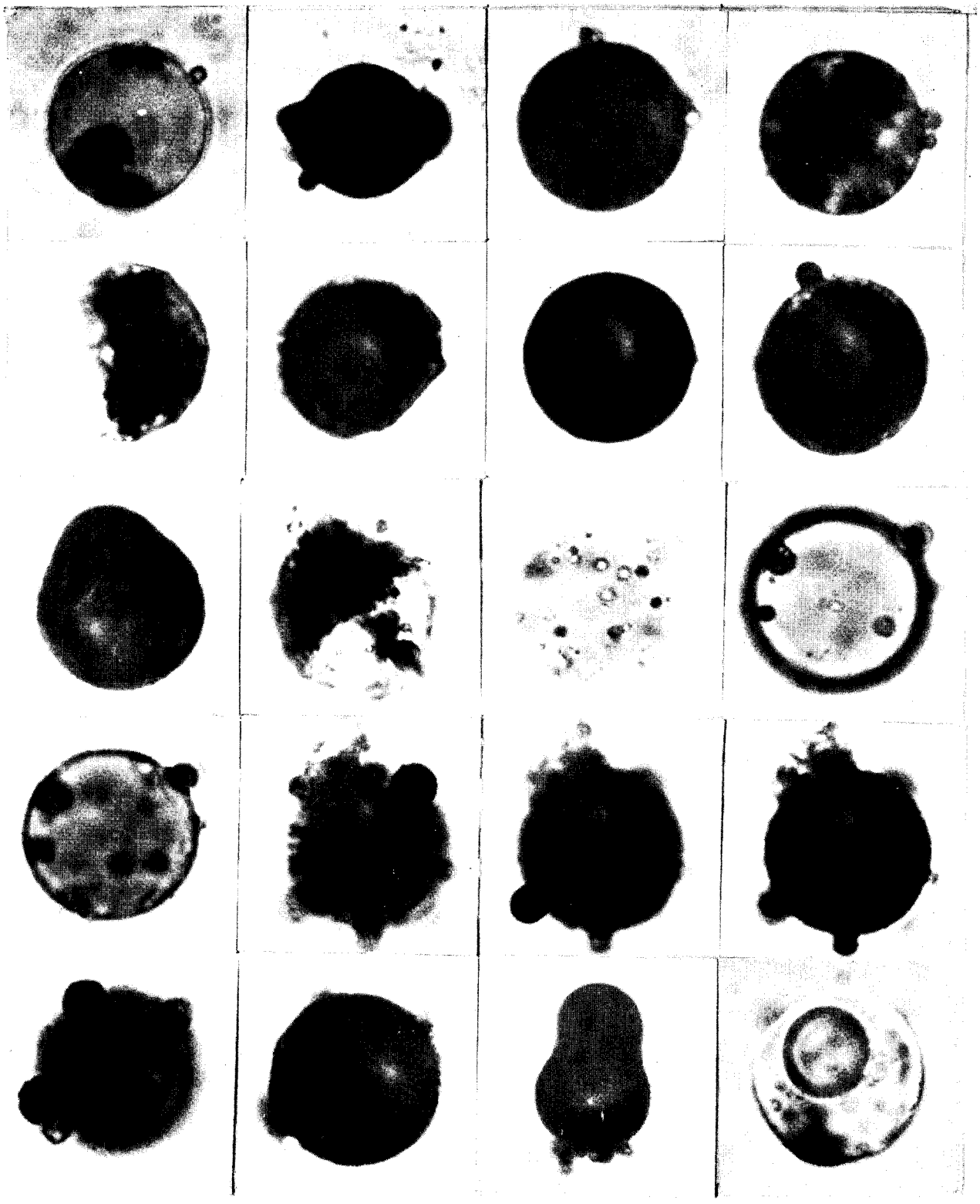
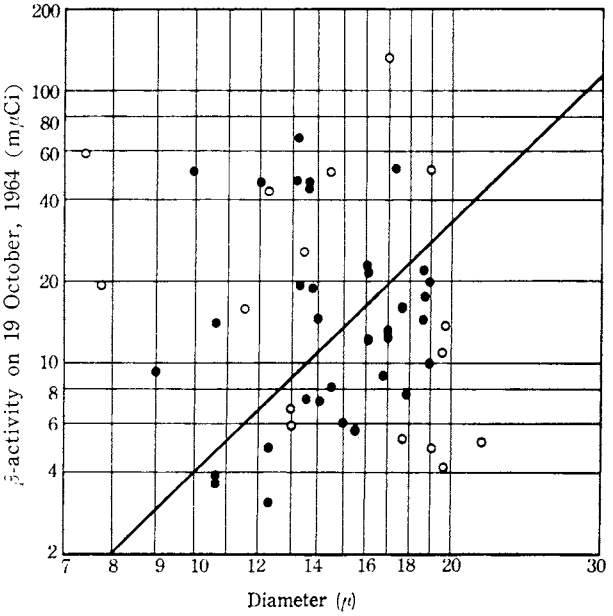


Figure 11 represents the relation between particle diameter and β-activity, where the solid circles indicate the uniformly colored, black, reddish black, red or reddish brown particles and the open circles concern the particles colored otherwise. A straight line of gradient is drawn for comparison. From this figure we can not derive so clear a trend that activity is proportional to volume as we could on the Russian particles. There appears to be a rough trend that the specific activity of the particles indicated by the open circles is either much larger or much smaller than the specific activity of the particles indicated by the solid circles. It should be noted that there were few particles whose diameter exceeded 20 μ. This agrees with the generally accepted conclusion that the motion of particles smaller than about 20 μ is determined mainly by atmospheric motions while the motion of particles larger than 20 μ is determined mainly by the gravitational settling.

More conspicuous differences between the Chinese and the Russian particles have been found in radionuclide fractionation. Two opposite types of radionuclide fractionation have been found in the Chinese particles. The first type was quite similar to the fractionation that was observed in the Russian particles. The radiochemical composition of the particles fractionated in this type was much enriched in $^{95}Zr+^{95}Nb$ and impoverished in ^{103}Ru, taking a middle position for most of other nuclides. The particles fractionated in the second type were, just contrary to those fractionated in the first type, much enriched in ^{103}Ru and impoverished in $^{95}Zr + ^{95}Nb$. The second type of fractionation was never found in the Russian particles that were examined. It was found that the particles having exceedingly higher activities among the collected three hundred particles were all fractionated in the second type and that the others were fractionated variously, some being fractionated in the first type and others in the second type.

Figure 12 is a γ-ray spectrum of the filter paper dust sample on which air-borne dusts were collected during 64 hr from 23 to 26 October 1964 by passing about 1,500 m^3 of air. Figure 13 is a spectrum of the forty particles which were estimated to have β-activities ranging from a few

Figure 11. Relation between Diameter and β-activity of the Particles



Solid Circles: black, reddish black, red or reddish brown particles
Open Circles: particles colored otherwise

to 10 mμCi at the time of the collection. These particles were medium in activity among the about three hundred particles collected at that time. Figure 14 is a spectrum of single particle which was exceedingly highly radioactive among the collected ones. These three spectra were measured on the same day, on 4 November, 19 days after the explosion. There are no great differences between the spectra in Figure 11 and 12, but it is clearly seen that the composition of $^{140}Ba + ^{140}La$ was somewhat more enriched in the filter paper dust sample while the compositions of ^{131}I and ^{239}Np were somewhat more enriched in the forty particles. On the other hand, the spectrum in Figure 13 shows that the radiochemical composition of this single particle was much impoverished in $^{95}Zr + ^{95}Nb$, ^{141}Ce and $^{140}Ba + ^{140}La$ and much enriched in ^{103}Ru. The second type of fractionation could be seen clearly in this particle.

The spectra (F) and (S) in Figure. 15 are γ-ray spectra of two particles which were fractionated in the first and the second types of fractionation, respectively. These spectra were measured on the same day, on 13 November, 28 days

Figure 12. γ-ray Spectrum of The Filter Paper on which Air-borne Dusts were collected During 64 hr. from 23 to 26 October 1964, measured on 4 November.

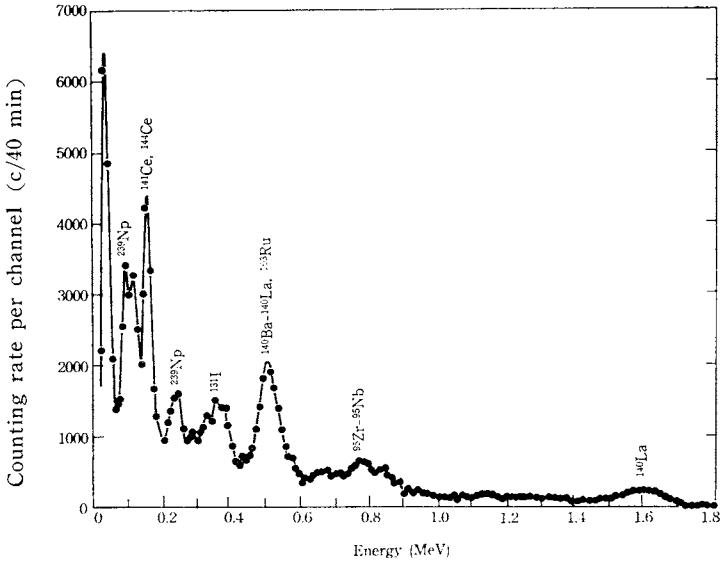
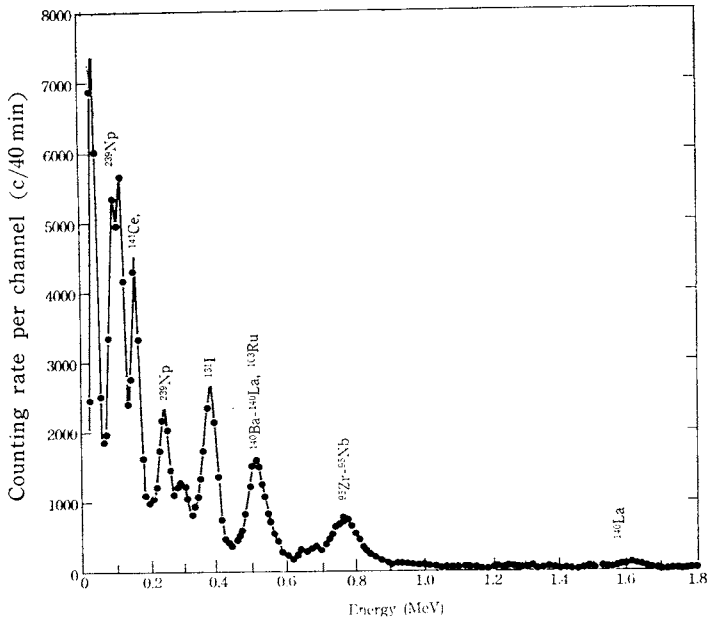


Figure 13. γ-ray Spectrum of The Forty Highly Radioactive Fallout Particles, measured on 4 November.



after the explosion. The two spectra are quite reversed with respect to the photopeak heights due to ^{103}Ru and $^{95}Zr + {}^{95}Nb$, indicating the substantial difference in radiochemical composition between the two particles. The fact that the spectra in Figure 12 and 13 are relatively similar to each other may be explained in the following way. The forty particles were a mixture of particles which were fractionated in different degrees, some being fractionated in the first type and others in the second type. So in the average their γ-ray spectrum came to take a form similar to that of the filter paper dust sample which might be regarded to be relatively less fractionated.

The differences between the Chinese and the Russian particles stated above may be considered to be ascribed to the fact that the former were produced in a small scale land surface burst while the latter were produced in large scale air bursts.

Figure 14. γ-ray Spectrum of Single Highly Radioactive Fallout Particle, measured on 4 November.

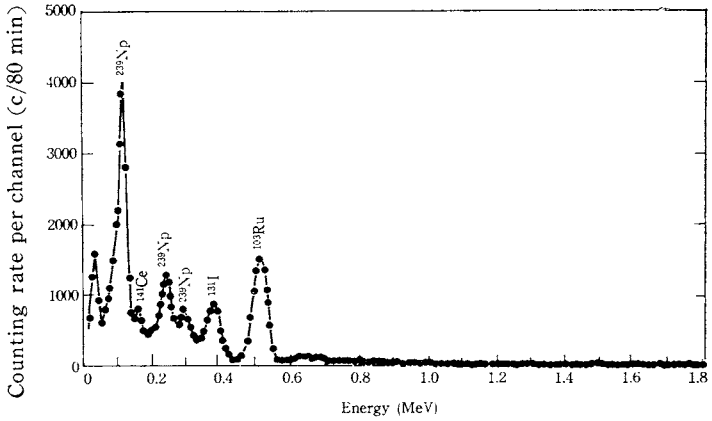
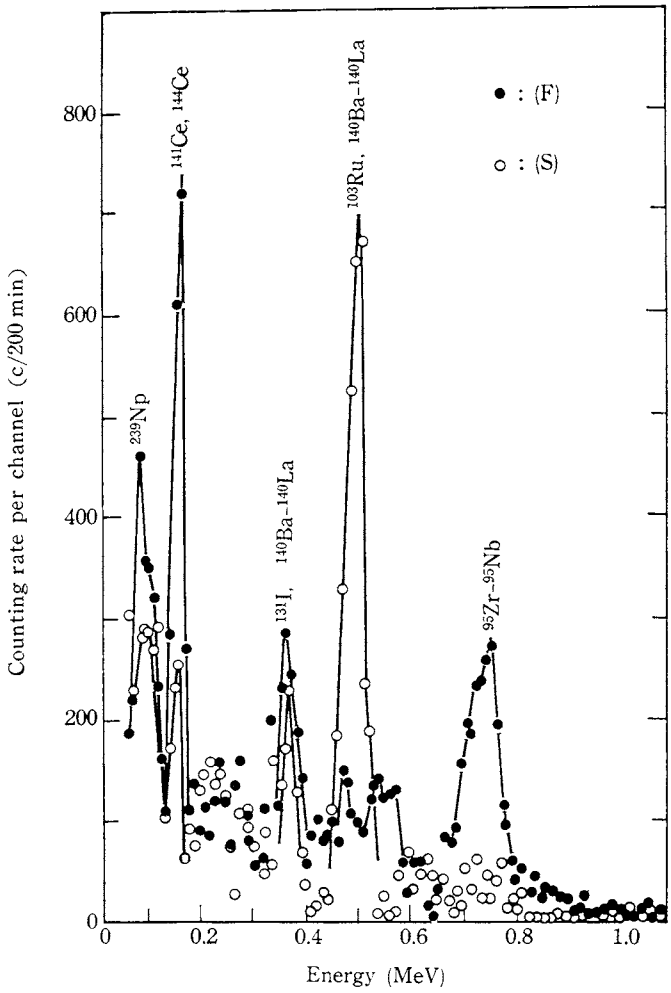


Figure 15. γ-ray Spectra of Two Typical Highly Radioactive Particles which were fractionated in The Different Types of Fractionation, both measured on 13 November.



(F): The first type; (S): The second type

Dietary Data

Radioactive Iodine-131 in Milk

Part I *(National Institute of Animal Industry)*

The National Institute of Animal Industry analyzed Iodine-131 content in milk during the period of consequence of Chinese nuclear test explosion.

Milk sample was collected from cows bred at the farm of this Institute, in Chiba. Radioactivity was measured by gamma spectrometry after chemical separation. The radioactivity of iodine was calculated back to the date of sampling.

Results obtained are shown in Table 9.

Table 9. Iodine-131 in Milk —Oct. 15 to Dec. 3, 1964—
By H. Danbara and T. Mitsuhashi
(National Institute of Animal Industry)

Date of sampling	I-131 (pCi/*l*)
15 Oct 64	—
17 〃	—
21 〃	40
28 〃	400
30 〃	255
2 Nov 64	114
10 〃	142
17 〃	8
25 〃	42
3 Dec 64	14

Part II *(National Institute of Radiological Sciences)*

Concentrations of iodine-131 in milk were also determined by the National Institute of Radiological Sciences during the period 18th October to 12th November, 1964. Milk samples were taken from an open market, a milk plant, and a farm, located in the northern part of Chiba Prefecture. Iodine was chemically separated from milk sample and it's decay of beta-radioactivity was determined for calculation of radioactivity of iodine-131. The radioactivity of iodine-131 was calculated back to the date of sampling.

Results obtained are shown in Table 10.

Table 10. Iodine-131 in Milk — Oct. 18 to Nov. 12, 1964—
By M. Saiki and G. Tanaka
(National Institute of Radiological Sciences)

Date of Sampling	^{131}I (pCi/*l*)	Sampled from
18 Oct 64	1.2 ± 0.1	Market
19 〃	4.7 ± 0.2	Market
20 〃	13.8 ± 0.3	Market
23 〃	437.0 ± 2.5	Farm
〃	175.0 ± 1.3	Plant
24 〃	73.9 ± 0.9	Farm
〃	112.0 ± 1.3	Plant
25 〃	205.0 ± 1.8	Farm
〃	89.6 ± 1.2	Plant
26 〃	212.0 ± 1.6	Farm
〃	22.3 ± 0.5	Plant
27 〃	72.9 ± 0.9	Farm
〃	49.2 ± 0.8	Plant
5 Nov 64	15.2 ± 0.5	Market
〃	19.8 ± 0.5	Plant
6 〃	2.0 ± 0.2	Market
〃	20.4 ± 0.5	Plant
7 〃	3.5 ± 0.2	Market
10 〃	10.3 ± 0.4	Plant
11 〃	17.8 ± 0.4	Plant
12 〃	9.2 ± 0.3	Plant

Animal Data

Iodine-131 in Thyroid Glands of Animals

(National Institute of Radiological Sciences)

Concentrations of iodine-131 in thyroid glands of dairy cattles, Japanese cattles and pigs collected from slaughter houses were determined by the National Institute of Radiological Sciences. Iodine was chemically separated from thyroid gland sample and it's decay of beta-radioactivity was determined for calculation of radioactivity of iodine-131. The radioactivity of iodine-131 was calculated back to the date of slaughter.

Results are presented in Table 11 to Table 13. Specific differences were found in iodine-131 concentration of the thyroid gland, and the iodine-131 concentration were decreased in the following order: dairy cattles > Japanese cattles > pigs.

Table 11. Iodine-131 in Thyroid Glands of Dairy Cattles —Oct. 22, 1964 to Jan. 25, 1965—

By M. Saiki and G. Tanaka
(National Institute of Radiological Sciences)

Date of Slaughter	Location of Feeding	Weight of Samples for Analysis (g. wet)	Concentration of Iodine-131 (pCi/g wet)
22 Oct 64	—	30.8	1.43 ± 0.16
24 〃	Hokkaido	38.4	3.23 ± 0.23
28 〃	Hokkaido	20.0	5.90 ± 0.34
29 〃	Chiba	28.4	88.1 ± 1.02
30 〃	—	28.3	79.8 ± 0.98
7 Nov 64	—	36.6	76.6 ± 0.95
11 〃	Hokkaido	4.2	32.8 ± 0.68
12 〃	—	22.7	8.6 ± 0.36
13 〃	—	15.8	15.5 ± 0.50
14 〃	—	13.3	74.5 ± 0.95
17 〃	Chiba	12.2	14.6 ± 0.16
18 〃	Hokkaido	15.1	62.8 ± 0.87
20 〃	—	19.0	32.6 ± 0.69
28 〃	Chiba	29.0	1.09 ± 0.14
5 Dec 64	—	17.2	5.80 ± 0.31
〃	—	15.5	7.29 ± 0.35
15 〃	—	110.0*	0.06 ± 0.03
7 Jan 65	—	20.0	0.18 ± 0.04
11 〃	—	14.3	0.59 ± 0.10
12 〃	—	20.5	0.36 ± 0.07
13 〃	Chiba	35.0	0.26 ± 0.06
18 〃	—	18.5	0.14 ± 0.03
23 〃	—	30.0	0.16 ± 0.04
25 〃	Chiba	27.0	0.26 ± 0.06

* Thyroid gland tumour

Table 12. Iodine-131 in Thyroid Glands of Japanese Cattles —Oct. 22, 1964 to Jan. 6, 1965—

By M. Saiki and G. Tanaka
(National Institute of Radiological Sciences)

Date of Slaughter	Location of Feeding	Weight of Samples for Analysis (g. wet)	Concentration of Iodine-131 (pCi/g. wet)
22 Oct 64	—	34.5	0.99 ± 0.13
24 〃	—	25.0	1.60 ± 0.16
28 〃	Gunma	29.5	31.0 ± 0.66
7 Nov 64	—	34.2	43.2 ± 0.76
12 〃	Shiga	6.0	7.22 ± 0.34
13 〃	Hokkaido	6.2	30.3 ± 0.66
14 〃	—	9.2	34.4 ± 0.71
17 〃	Miyagi	12.1	3.11 ± 0.22
18 〃	—	9.6	3.85 ± 0.25
19 〃	Chiba	11.2	16.3 ± 0.51
20 〃	—	8.0	16.4 ± 0.51
28 〃	Miyagi	22.0	5.83 ± 0.31
〃	Miyagi	12.3	6.98 ± 0.32
5 Dec 64	—	12.5	7.60 ± 0.36
12 〃	—	20.0	2.65 ± 0.21
22 〃	—	22.7	0.68 ± 0.11
23 〃	—	29.0	0.79 ± 0.11
〃	—	19.5	0.99 ± 0.13
6 Jan 65	—	120.0*	0.21 ± 0.06

* Thyroid gland tumour

Table 13. Iodine-131 in Thyroid Glands of Pigs
—Oct. 22, 1964 to Jan.18, 1965—

By M. Saiki and G. Tanaka
(National Institute of Radiological Sciences)

Date of Slaughter	Location of Feeding	Weighe of Samples for Analysis (g. wet)	Concentration of Iodine-131 (pCi/g. wet)
22 Oct 64	—	33.0	6.99 ± 0.34
23 〃	Chiba	33.8	3.37 ± 0.23
〃	Hiroshima	38.1	0.51 ± 0.08
29 〃	Aichi	25.8	14.36 ± 0.45
6 Nov 64	—	35.6	8.72 ± 0.12
12 〃	Shimane	39.8	11.72 ± 0.45
〃	Shimane	15.1	8.45 ± 0.12
17 〃	Ibaragi	9.1	1.12 ± 0.15
18 〃	Chiba	6.7	7.32 ± 0.35
2 Dec 64	Fukushima	20.0	3.08 ± 0.23
3 〃	Kagoshima	13.0	5.01 ± 0.29
5 〃	—	29.0	3.36 ± 0.24
6 〃	—	14.0	4.55 ± 0.28
12 〃	—	21.5	3.95 ± 0.25
8 Jan 65	—	15.0	0.41 ± 0.07
17 〃	Chiba	36.0	0.03 ± 0.02
18 〃	—	30.0	0.11 ± 0.04

Human Data

Iodine-131 in Human Thyroid Glands

(National Institute of Radiological Sciences)

Concentration of iodine-131 in human thyroid glands were observed by the National Institute of Radiological Sciences during the period from October 20th to November 6th, 1964. Thyroid gland samples were removed from normal persons who died by traffic accidents in Tokyo. Iodine was chemically separated from thyroid gland sample and it's decay of beta-radioactivity was determined for calculation of radioactivity of iodine-131. The radioactivity of iodine-131 was calculated back to the date of death.

Results obtained were shown in Table 14.

Table 14. Iodine-131 in Human Thyroid Glands
—Oct. 20 to Nov. 6, 1964—
By M. Saiki and G. Tanaka
(National Instiutte of Radiological Sciences)

Date of Death	Location of Residence	Age	Sex	Weight of Samples for Analysis (g·wet)	Concentration of Iodine-131 (pCi/g wet)
20 Oct 64	Tokyo	60	Female	14.3	0.56 ± 0.07
〃	〃	70	Male	10.1	0.60 ± 0.07
22 〃	〃	64	Male	8.9	0.96 ± 0.10
28 〃	〃	0*	Male	1.2	1.29 ± 0.11
〃	〃	74	Male	8.4	0.04 ± 0.02
29 〃	〃	45	Male	9.4	0.24 ± 0.03
〃	〃	57	Male	7.8	0.13 ± 0.03
30 〃	〃	25	Female	9.2	0.16 ± 0.03
〃	〃	39	Male	14.4	0.05 ± 0.03
6 Nov 64	〃	27	Male	11.1	0.02 ± 0.01

* New born

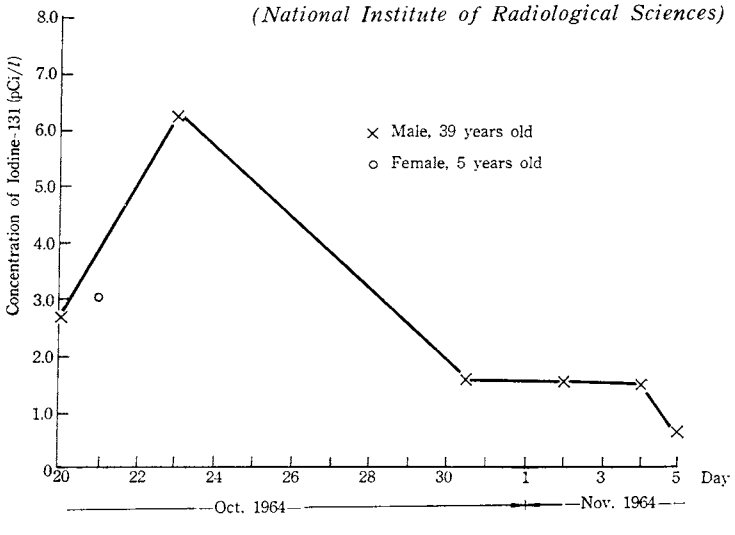
Iodine-131 in Human Urine

(National Institute of Radiological Sciences)

Variation on concentration of iodine-131 in human urine was observed by the National Institute of Radiological Sciences. Urine somples were collected from a man, a staff of the Institute, who was aged thirty nine. Iodine was chemically separated from urine sample and it's decay of beta-radioactivity was determined for calculation of radioactivity of iodine. The radioactivity of iodine-131 was calculated back to the date of sampling. Results obtained were shown in figure 16.

In addition to the results, iodine-131 concentration in the urine of girl aged five years old was determined on 21st October 1964 showing comparative high concntration as 3.0 ± 0.7 pCi/*l*.

Figure 16. Iodine-131 in Human Urine.
By M. Saiki and G. Tanaka
(National Institute of Radiological Sciences)



Contributor

The results quoted in this issue were contributed by the following institutes.

Institute and Address	Item
Research and Development H. Q. Japan Defence Agency 13, Mita, Meguro-ku, Tokyo	Upper Air
Meteorological Agency 7, Ote-machi-1-chome, Chiyoda-ku, Tokyo	Fallout
Meteorological Research Institute Kita-4-chome, Koenji, Suginami-ku, Tokyo	Fallout
National Institute of Animal Industry 959, Aoba-cho, Chiba-shi	Milk
National Institute of Radiological Sciences 9-1, Anagawa-4-chome, Chiba-shi	Fallout, Milk, Animal, Human
Osaka Prefecture Radiation Center Sinya-machi, Sakai-shi, Osaka-fu	Fallout Particle

Note: The expression of address of the National Institute of Radiological Sciences changes to before-mentioned address on and after January 1st 1965.