PAPER I

Survey on the Radioactive Contamination of the No. 5 Fukuryu Maru

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As a result of the hydrogen bomb test at Bikini Atoll on March 1st, 1954, the radioactive dust, so-called "Bikini Ashes", happened to fall on a Japanese fishing-boat, (99.9 tons) named the No.5 Fukuryu Maru, which was then sailing approximately 90 miles from the center of the nuclear detonation at Bikini. The position of the boat was outside the "danger zone" from which the United States had long since warned all shippings. Her crew of 23 suffered from radiation sickness by this tragic accident, which was disclosed after the boat returned to her home port of Yaizu on March 14, 1954. The radiation hazards seemed to have been caused mainly by the radioactive dust, but not by direct exposure to the nuclear explosion.

In order to prognosticate and to find proper treatment for these afflicted fishermen, it was urgently necessitated then to measure the radioactive contamination of the boat. For this purpose, we went to Yaizu to examine the No. 5 Fukuryu Maru with the radiation monitor* on March 19, April 21 and May 16, 1954.**

The radiation dosage rate of contamination observed for combined β- and γ-radiation is given in Table 1.

As shown in this table, the contamination in every part of the boat was found not to decrease according to the general fission-product decay law, $t^{-const.}$ It may be explained by the fact that after the boat returned to her home port she was flushed by hand and scoured by rain-water several times.

It is important to estimate the total accumulated dosage of radiation of the crew during their stay on the boat from March 1st to March 14th, but this estimation was very difficult, because the intensity of the radioactive contamination decreased not only according to the radioactive decay but also due to rain, spray of sea water, and flushing. However, we tried to calculate this value by assuming following

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* Radiation monitor type 1118A manufactured by EKCO Electronics Ltd., Southend-on-Sea, Essex, England.

** On this occasion we would like to express our sincere appreciation to Dr. T.Maekawa, Chief of Sanitation Division of Shizuoka Prefecture, and staffs of Yaizu Municipal Office for their kind helps in this survey.

Table 1. Radioactive contamination ($\beta+\gamma$) of the No.5 Fukuryu Maru.

Site \ Date	March 19 (mr/h)	April 21 (mr/h)	May 16 (mr/h)
Forecastle-deck	10～25	<3	<1.5
Right board	25～30	3～6	<3
Left board	35～55	5～6	<3
Main-deck	20～25	<1	<1
Fish hold	10	1	<1
Upper-deck	20	6	2
Quarter-deck	17～30	3～5	1～2
Quarter crew space	50～70	9～11	5～9
Fore crew space	—	3	—
Engine room	20	3～12	3
Captain room	35	—	—
Wheel house	35	7	2～4
Wireless room	15	3	—
Roof of wheel house	35	20	11
Galley	35	6	3
Wet rope (on the upper-deck)	80～150	20～30	—
Fibers of hemp-palm bound on a fishing implement (on the right board side)	95	15	10

conditions: 1) Radioactive contamination decreased only according to the fission product decay law, $A_t=A_0t^{-m}$, where A_t is radioactivity at time t after the nuclear detonation, and A_0 and m are constants. 2) Radiation effect upon the crew is

Table 2. Decay law of the radioactive ashes and the contamination of the boat.

Decay law		Observers
$A_t=A_0t^{-1.37}$,	16 days $\leqq t \leqq$ 71 days ($\beta+\gamma$, white ashes)	K. Kimura *et al*[a]
$A_t=A_0t^{-1.81}$,	16 days $\leqq t \leqq$ 110 days ($\beta+\gamma$, untreated ashes)	T. Shiokawa *et al*[b]
$A_t=A_0t^{-2.71}$,	16 days $\leqq t \leqq$ 110 days ($\beta+\gamma$, a soluble portion from 10 mg ashes in 100 ml water for 24 hours)	T. Shiokawa *et al*[b]
$A_t=A_0t^{-1.68}$,	16 days $\leqq t \leqq$ 110 days ($\beta+\gamma$, insoluble portion)	T. Shiokawa *et al*[b]
$A_t=A_0t^{-1.66}$,	46 days $\leqq t \leqq$ 110 days (γ contamination of the boat)	T. Shiokawa *et al*[b]
$A_t=A_0t^{-1.4}$,	16 days $\leqq t \leqq$ 47 days (γ contamination of the boat)	F. Yamazaki and H. Kakei[c]
$A_t=A_0t^{-1.17\pm0.02}$,	64 days $\leqq t \leqq$ 145 days ($\beta+\gamma$, white ashes)	M. Ishibashi *et al*[d]
$A_t=A_0t^{-1.24\pm0.05}$,	64 days $\leqq t \leqq$ 145 days ($\beta+\gamma$, dark grey ashes)	M. Ishibashi *et al*[d]

a) K. Kimura *et al.*, Japan Analyst, 4, 335 (1954) (In Japanese)
b) T. Shiokawa *et al.*, Japan Analyst, 4, 349 (1954) (In Japanese)
c) F. Yamazaki and H. Kakei, Kagaku, 24, 295 (1954) (In Japanese)
d) M. Ishibashi *et al.*, Paper VII, this issue

assumed to have begun 6 hours after the detonation and continued over 312 hours during their stay on board the boat. In Table 2 are listed observed decay laws given by some workers for radioactive ashes and contamination of the boat. Our results of calculation are given in Fig. 1, where the total accumulated dosage for the crew (t=6 h to t = 318 h) is expressed as a function of the assumed γ radiation dosage rate of contamination on the boat in the afternoon of March 19 th (t= 444 h).

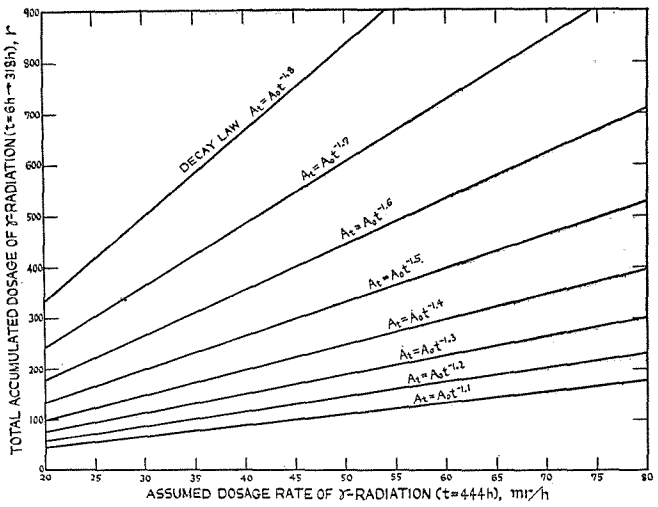

Fig. 1 Total accumulated dosage of γ-radiation for the crew on board the No.5 Fukuryu Maru (t = 6 h→318 h) as a function of the assumed dosage rate (t = 444 h), assuming various decay laws for the radioactive contamination.

Due to the circumstances mentioned above, we can not conclude accurately the value of the total γ dosage for the crew, however, from other reasonings it seems probable that the average value is between 200 and 500 r.

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