

## PAPER V

# Radioautographic Studies of the Materials Obtained from the No. 5 Fukuryu Maru Contaminated by Radioactive Ashes

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### INTRODUCTION

Radioautographic studies have been made of the materials obtained from the No. 5 Fukuryu Maru, which had been contaminated by the radioactive ashes produced by the hydrogen bomb test at Bikini Atoll on March 1st, 1954.

### MATERIALS

Hemp-palm ropes and gloves used as fishing implements on board the No. 5 Fukuryu Maru, side boards of the boat, and dust collected from the deck of the boat, were examined. These materials were obtained from the boat at Yaizu Harbor on March 19th, 1954. Tunas, which had been carried by the boat to Yaizu Harbor, were also examined. These tunas were supplied from Yaizu Harbor to the Central Market in Kyoto on March 17th, 1954.

### METHODS

First the materials were examined by survey radioautography using X-ray films. Some of them were studied further by detail radioautography using stripping method.

#### 1) Survey radioautograph.

Fuji X-ray films and Sakura X-ray films were used. Materials such as ropes and gloves, which did not affect the emulsion, were placed in direct contact with the films. Fins and skins of the tunas were dried at 37°C. for 4 to 5 days, pressed under a lead block of 20 kg. weight in order to make them as flat as possible, and placed in contact with the films. Between each film and sample a sheet of thin paper was interposed to prevent the films from moistening. Exposure was given for 1/2 to 2 days. Developing was carried out with Fuji Rendol developer at 19°C. for 4 minutes.

#### 2) Detail radioautograph.

Fuji ET-2E stripping plates, 15  $\mu$  thickness, were used. Fibers of the gloves and ropes were mounted on glass slides with 2% celloidin methanol. The samples were covered with the emulsion floated on water, dried, and kept in a desiccator, containing calcium chloride as a drying agent, in a refrigerator at 0° to 5°C. The

length of exposure time was 10 to 14 days. Developing was carried out with Kodak D19 developer at 19°C. for 3 to 4 minutes. After gentle washing in water, fixing took place in 40% sodium thiosulfate for 10 minutes. After washing in water for 30 minutes, the samples were dried, treated with xylol, covered with cover slips by Canada balsam, and observed under the microscope and photographed.

## RESULTS

1) Tuna. Survey radioautographs of the caudal and pectoral fins and skins of the tuna revealed spotted radioactivity. In the caudal fins, the radioactivity was especially high at the distal part. Projecting parts of the caudal fins showed also high radioactivity (Fig. 1). In the skins, the radioactivity was high at the contact points of scales. Fig. 2 shows a detail radioautograph of the scales.

2) Hemp-palm ropes and hemp-palm fibers used for fishing implements. Fig. 3 shows the radioautograph of a hemp-palm rope obtained from the No. 5 Fukuryu Maru. The distribution of radioactivity was not uniform. As shown in this figure points with high radioactivity and those with low radioactivity were seen alternately. In the detail radioautographs of the fibers obtained from the hemp-palm ropes and fishing implements (Figs. 4, 5, 6), small radioactive particles less than  $100\mu$  in diameter were seen attached to the fibers. The distribution of these particles was not uniform.

3) Gloves. Fig. 7 shows the radioautograph of the gloves used by the crew of the No. 5 Fukuryu Maru. As seen in this figure, the radioactivity was marked at the tip of the fingers, especially on the palm side. The radioactivity was also pretty marked at the proximal part of the gloves. The skin lesions, which were observed at the wrist joint of the crew might be attributed to this radioactivity. In the radioautographs of the fibers obtained from the gloves small radioactive particles from 10 to  $50\mu$  in diameter were seen attached to the fibers (Figs. 8, 9). Radioactive particles larger than  $100\mu$  in diameter were not found.

4) Clothes. Inner parts of the clothes, which were piled up on the boat, showed no radioactivity by radioautographic method.

5) Side boards. Pretty high radioactivity was found on the side boards, especially on their inner side (Fig. 10).

6) Dust. In the radioautographs of the dust collected from the deck of the boat a considerable number of radioactive particles ranging from 10 to  $200\mu$  in diameter were seen (Fig. 11). Judging from the size of the particles, it was suggested that small radioactive particles would be easily scattered by the wind.

## DISCUSSION

It has been shown that the contamination of the No. 5 Fukuryu Maru was associated with the presence of small radioactive particles. The distribution of the

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radioactivity was not uniform. The radioactive particles were firmly attached to the fibers, and were not easily removed by manipulation. Some of the particles, however, were seen easily scattered by manipulation. Especially in the radioautographs of the gloves, some blackening was found detached from the gloves. Although more radioactivity was found on the inner surface of the side boards, a considerable amount of radioactivity was found still remaining on the outer surface of the boards. This finding might suggest that the radioactive particles were not easily removed, although some of them were washed away by the sea-water. In the tuna radioactivity was found mainly at the peripheral part of the fish. Under the pectoral fins only a small amount of radioactivity was found. This finding might suggest that the contamination of the fish occurred during the transportation. In the dust small radioactive particles were found, which might be easily scattered by the wind. These particles, however, did not penetrate into the interior of the clothes of fine meshes.

#### SUMMARY

1) Radioautographic studies have been made of the materials obtained from the No. 5 Fukuryu Maru.

2) The contamination was associated with the presence of small radioactive particles. Although these particles were easily scattered, it was difficult to remove them completely.

3) These particles did not penetrate into the interior of the clothes of fine meshes.

4) Decontamination by washing with sea-water was not complete.

#### ACKNOWLEDGEMENT

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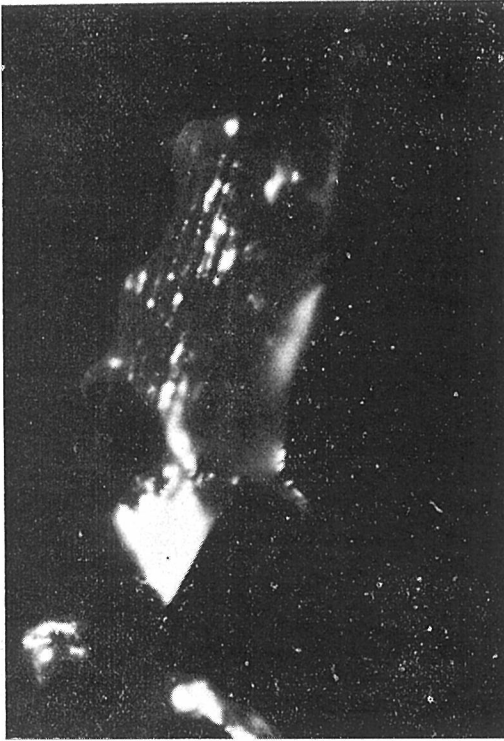


Fig. 1. Radioautograph of the caudal fin of the tuna.

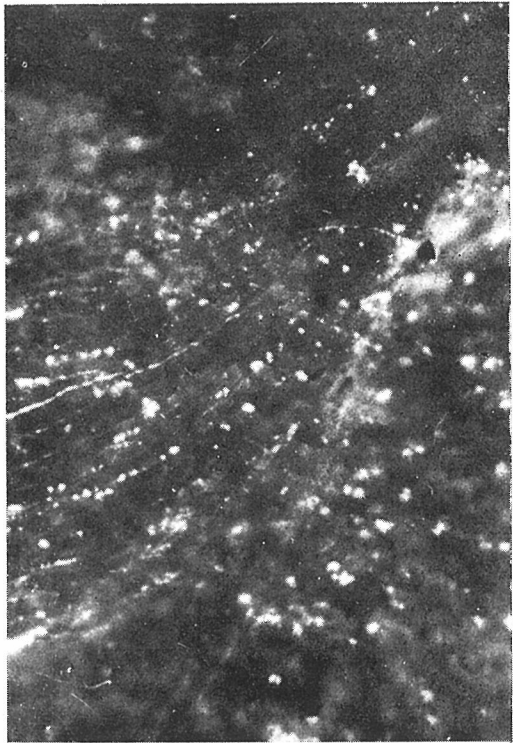


Fig. 2. Detail radioautograph of the scale of the tuna.



Fig. 3. Radioautograph of the hemp-palm rope.

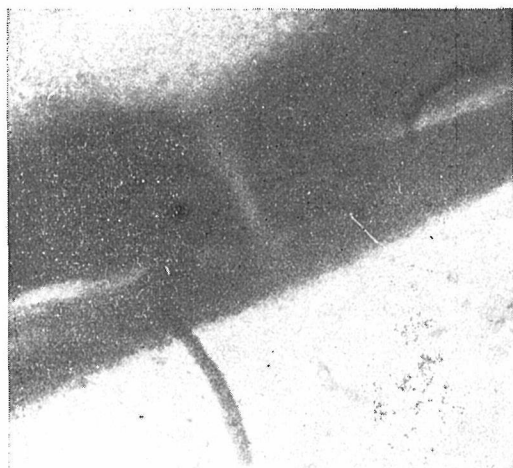


Fig. 4. Detail radioautograph of the fibers of the hemp-palm rope ( $\times 100$ ).

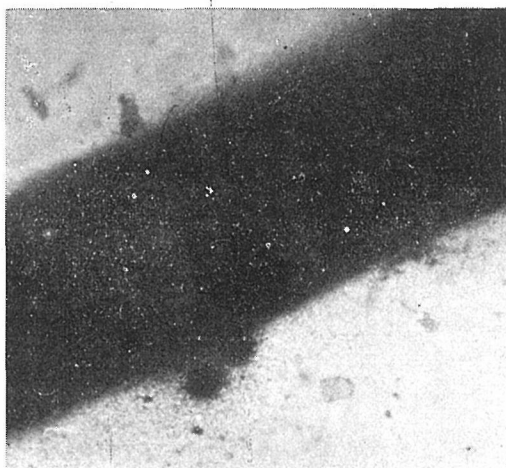


Fig. 5. Detail radioautograph of the fibers of the hemp-palm rope ( $\times 100$ ).

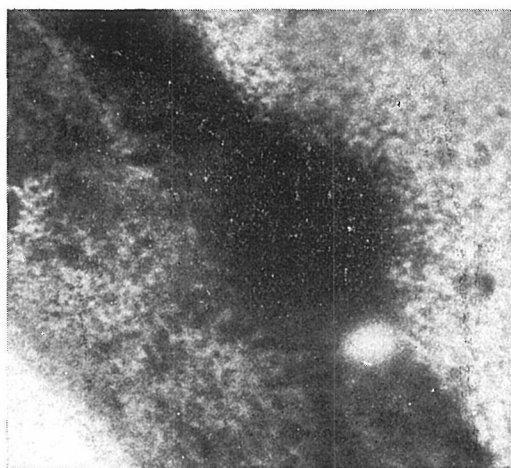


Fig. 6. Detail radioautograph of the fiber of the hemp-palm rope ( $\times 300$ ).



Fig. 7. Radioautograph of the glove.



Fig. 8. Detail radioautograph of the fibers of the glove ( $\times 100$ ).

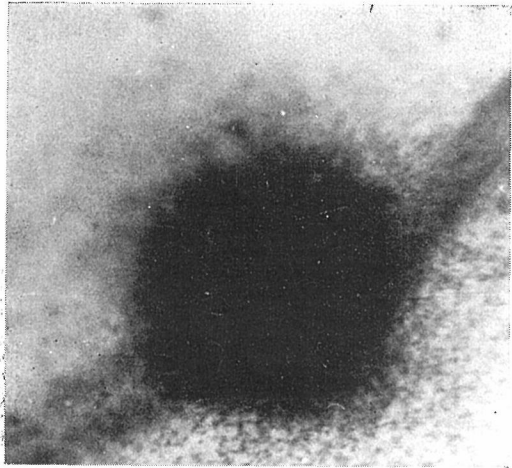


Fig. 9. Detail radioautograph of the fiber of the glove ( $\times 400$ ).



Fig. 10. Radioautograph of the side board.

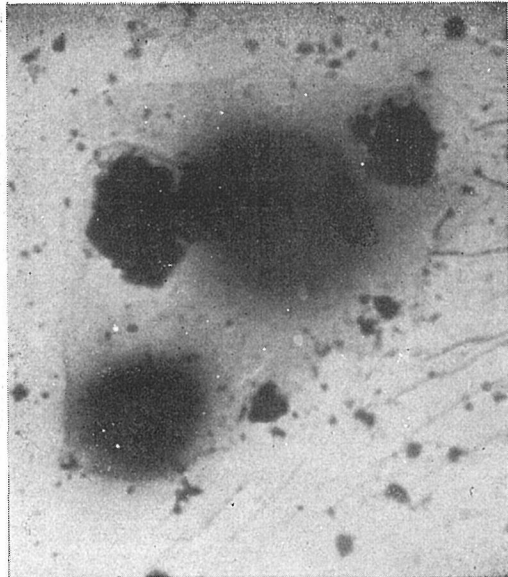


Fig. 11. Radioautograph of the dust on the deck of the No. 5 Fukuryu Maru ( $\times 100$ ).