MUC-ERR-211
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TO: NOT CLASSIFIED
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BIOCHEMICAL SURVEY SECTION

Edwin M. Russell

Monthly report

REPORT FOR THE MONTH, JUNE, 1946

1.	J.J.N.	7.	A.H.D.	13.	R.E.Z.
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[redacted]

June 20, 1946

TO: Dr. J. J. Nickson--Director, Health Division

FROM: E. R. Russell

Subject: Monthly Summary for Biochemical Survey Section

Plutonium Injestion Studies: Plutonium appearing in the feces of individuals working with or in areas contaminated with the element may indicate (1) that the material is deposited in the lungs and is being coughed up and swallowed, (2) that the material has entered the intestines by way of the mouth, (3) that the material is deposited in the body and is being eliminated by the intestines, or (4) that the fecal elimination is a combination of any or all of the preceding factors. The experimental evidence on the rates of elimination of plutonium by way of the kidneys and the intestines is such that one could very easily establish the existence of plutonium incorporated in the body. Urinary plutonium excretion is from 2-4 fold greater than fecal plutonium excretion.

In a preliminary survey on a few persons of the Metallurgical Laboratory, single fecal specimens were found to contain as much as 200αc/m. Some of these individuals were removed from contaminated areas for at least one week and a fecal analysis at the end of this period showed only a slight decrease. Even at the end of two weeks one individual having an initial count of $\sim$200 α c/m in a single specimen decreased to only 30 α c/m. That the plutonium was not incorporated in the body was shown by simultaneous analysis of the urine which indicated a body content of less than 0.1 microgram.

The question as to whether the plutonium detected in the feces was coming from the lungs or if there was a slow elimination of injested material in one which could not be answered since no experiments had been conducted along this line. The animal studies by R. Abrams on the inhalation of plutonium aerosols showed a lung retention of 50% after 20-30 days and 10-20% retention after 100 days. This would indicate fairly slow lung elimination. In order that one might gain some idea as to the rate of intestinal elimination, it was thought advisable to conduct experiments with humans whereby approximately 400 α c/m were injested and the elimination rate followed. Previous experiments with animals showed that less than 0.1% of injested plutonium is absorbed from the gut and therefore this amount of plutonium would not results in the absorption of above tolerance amounts. The details of the tests are given in the following section.

On May 13, 1946, six individuals drank a solution prepared as follows: 10 ml of a 0.01 M hydrochloric acid solution containing 39 ∝c/m of plutonium per ml was added to 100 ml of drinking water and without mixing the individual drank the solution. The solution was prepared in this manner to (1) minimize the adsorption on the glass container, and (2) to minimize the hydrolytic action.

During the first 24 hours after the injestion, each individual collected the urine diminated and this was assayed for plutonium. All of the specimens showed that less than 0.1% of the plutonium was absorbed. Each fecal specimen was collected during the following six days and the plutonium content determined. The analyses are based on a 90% recovery which is the efficiency of the bismuth phosphate-lanthanum fluoride method. The results are shown in Figures 1 through 6. There is an uncertainty for the first point obtained in Figure 3 due to the condition of the specimen when received. However, it is indicated from these results that the half life of plutonium in the intestines is sufficiently different from that in the lungs (on the basis of animal studies) for one to determine if plutonium is deposited in the lungs by an analysis of the stool specimens over at least a two week period. These tests will be repeated where a cathartic is given immediately after the injestion of the plutonium.

I. Routine Stool Analysis: 249-MLH-3510 (Sellers-Monroe)

In a previous report (MUC-ERR-206) the results of the analysis of stool specimens obtained from two individuals were given. These individuals were known to have been exposed to an atmosphere having above tolerance amounts of plutonium. Since this time specimens have been analysed from individuals working in less contaminated areas. The results indicate that over 80% of the persons working in areas where as much as 100 micrograms of plutonium are handled, even though the air count is below tolerance, there is danger of accumulation in the lungs unless adequate precautions are taken. A few of the individuals (9) in the West Stands showed counts ranging from 1-30 ∝c/m in a single fecal specimen. Specimens analysed from other areas (only 4 in number) where little if any plutonium is handled showed less than 1 ∝c/m. Before any definite conclusions can be drawn it would be necessary to make a more thorough study of individuals in the various areas.

A. Fecal Specimens Received

Chicago	60
Other	1
Total	61

B. Specimens Analysed

Chicago	60
Other	1
Total	61

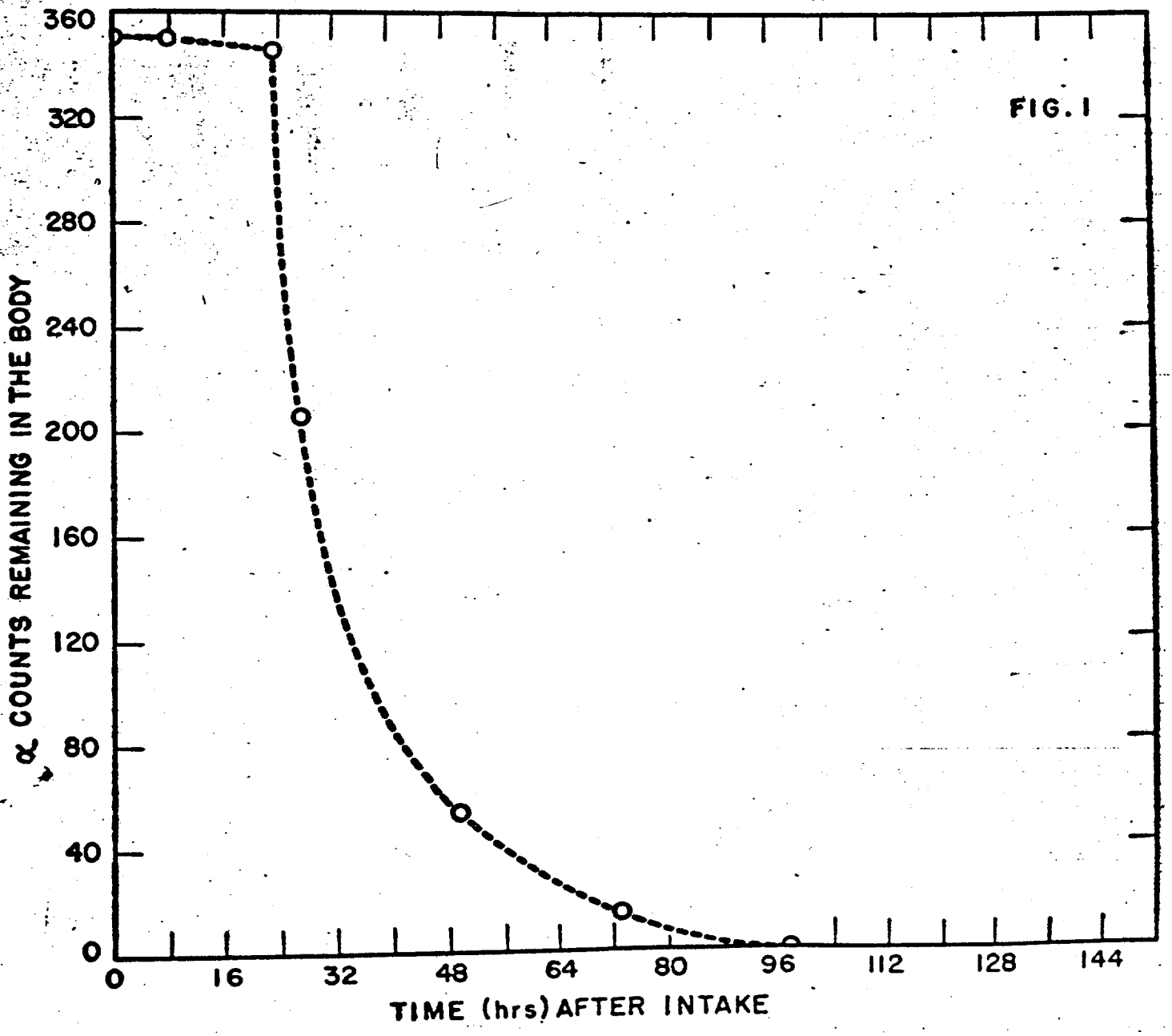

FIG. 1

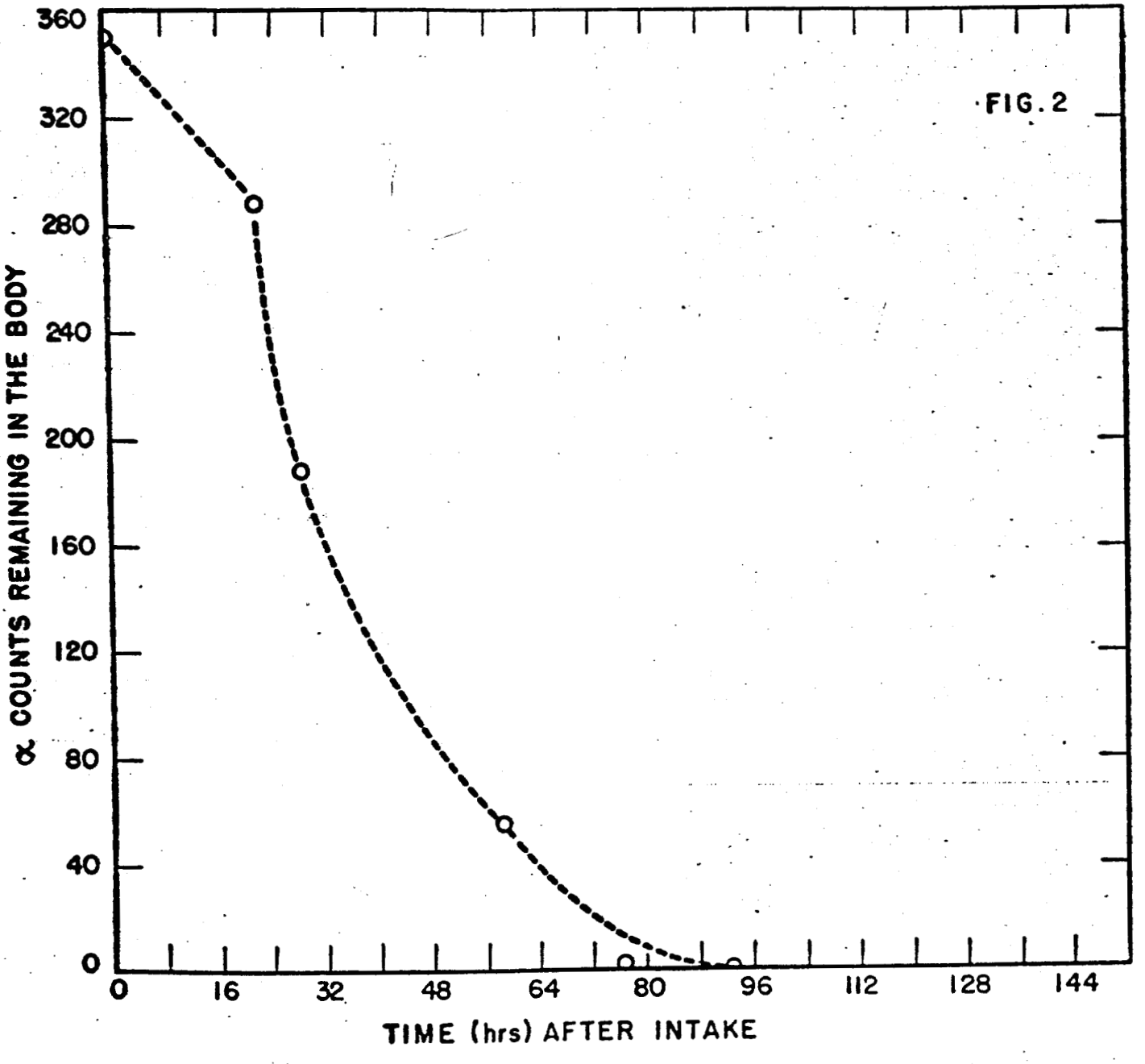

FIG. 2

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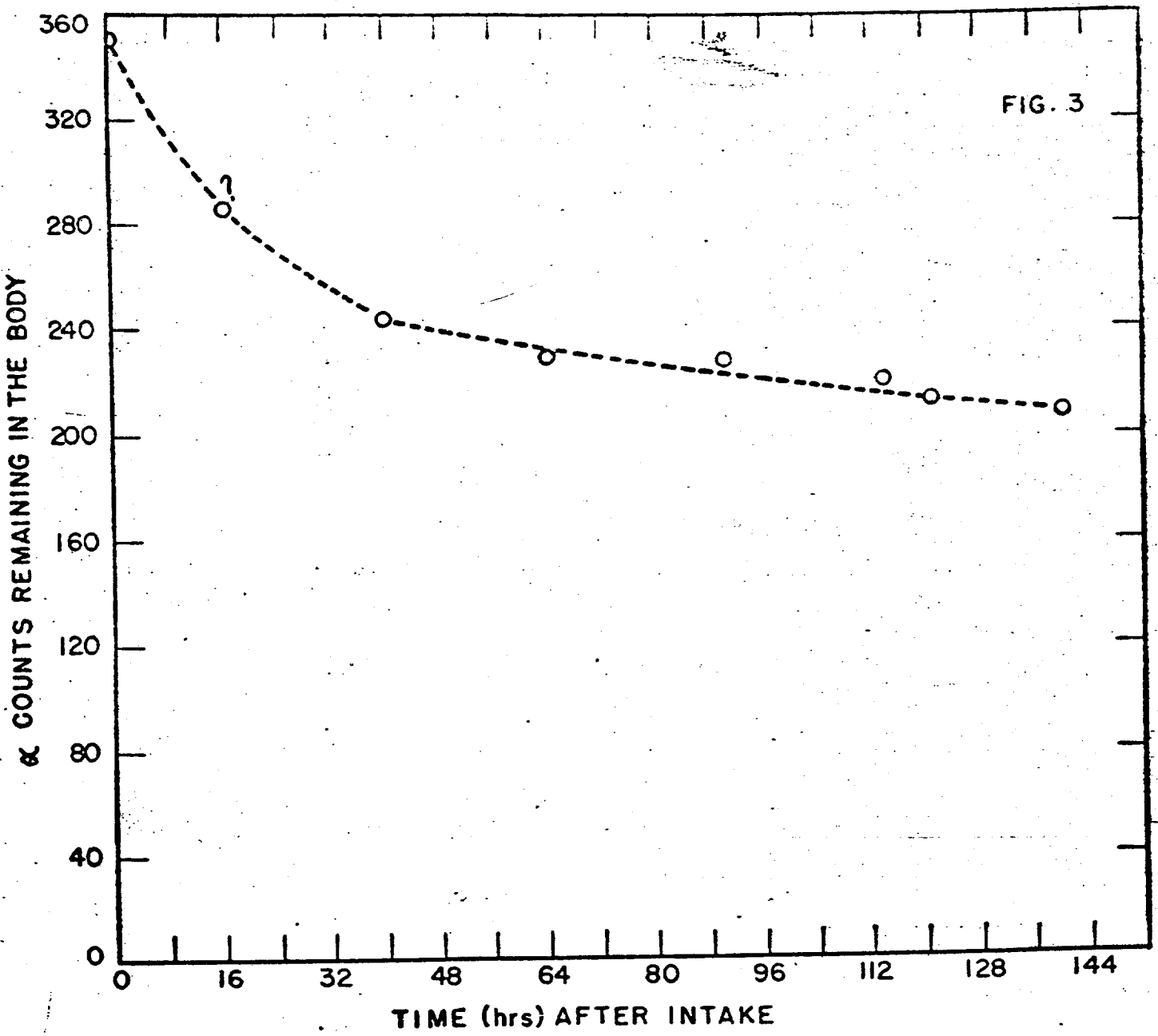
FIG. 3
360
320
280
240
200
160
120
80
40
0
α COUNTS REMAINING IN THE BODY
0
16
32
48
64
80
96
112
128
144
TIME (hrs) AFTER INTAKE

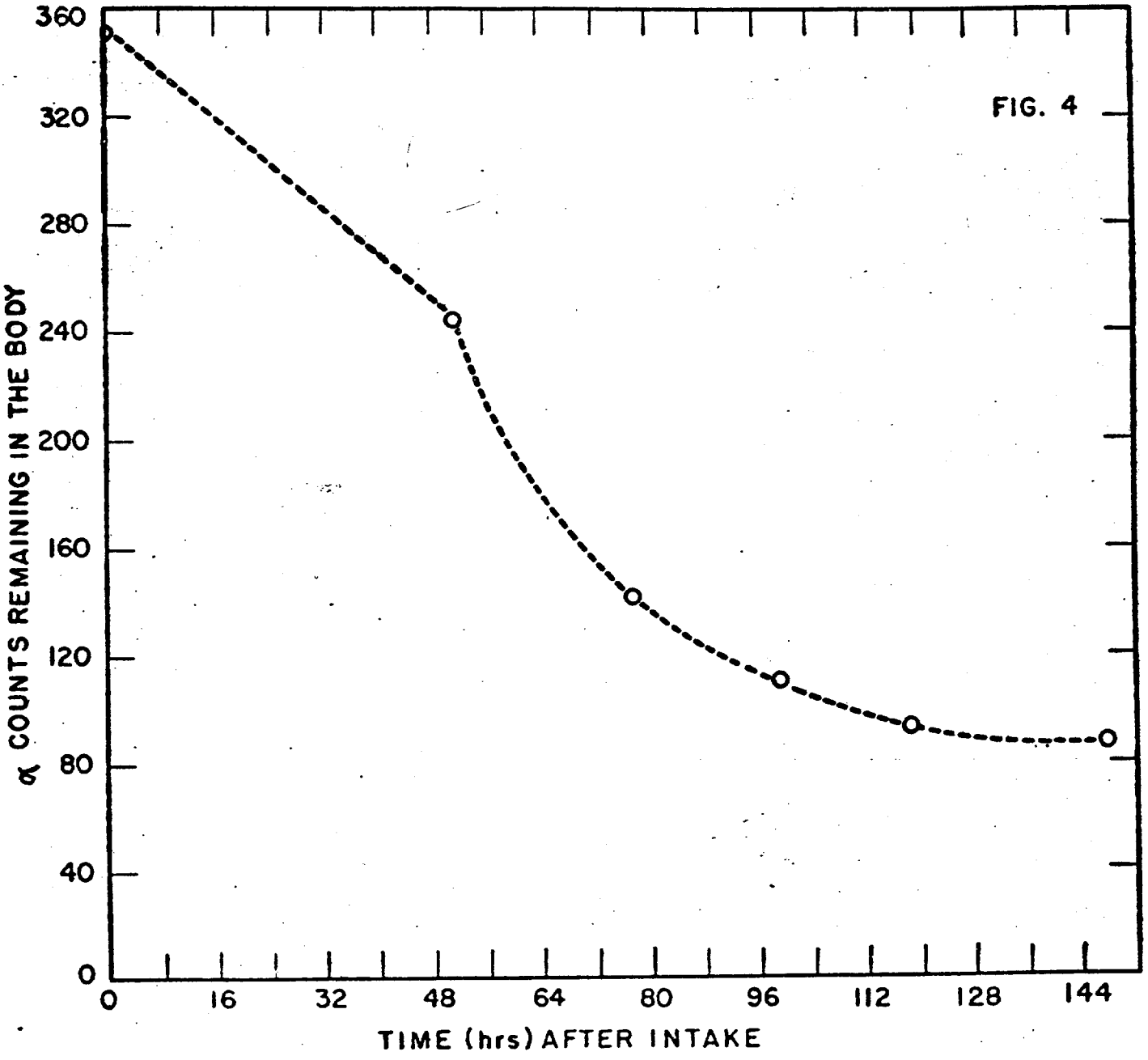

FIG. 4

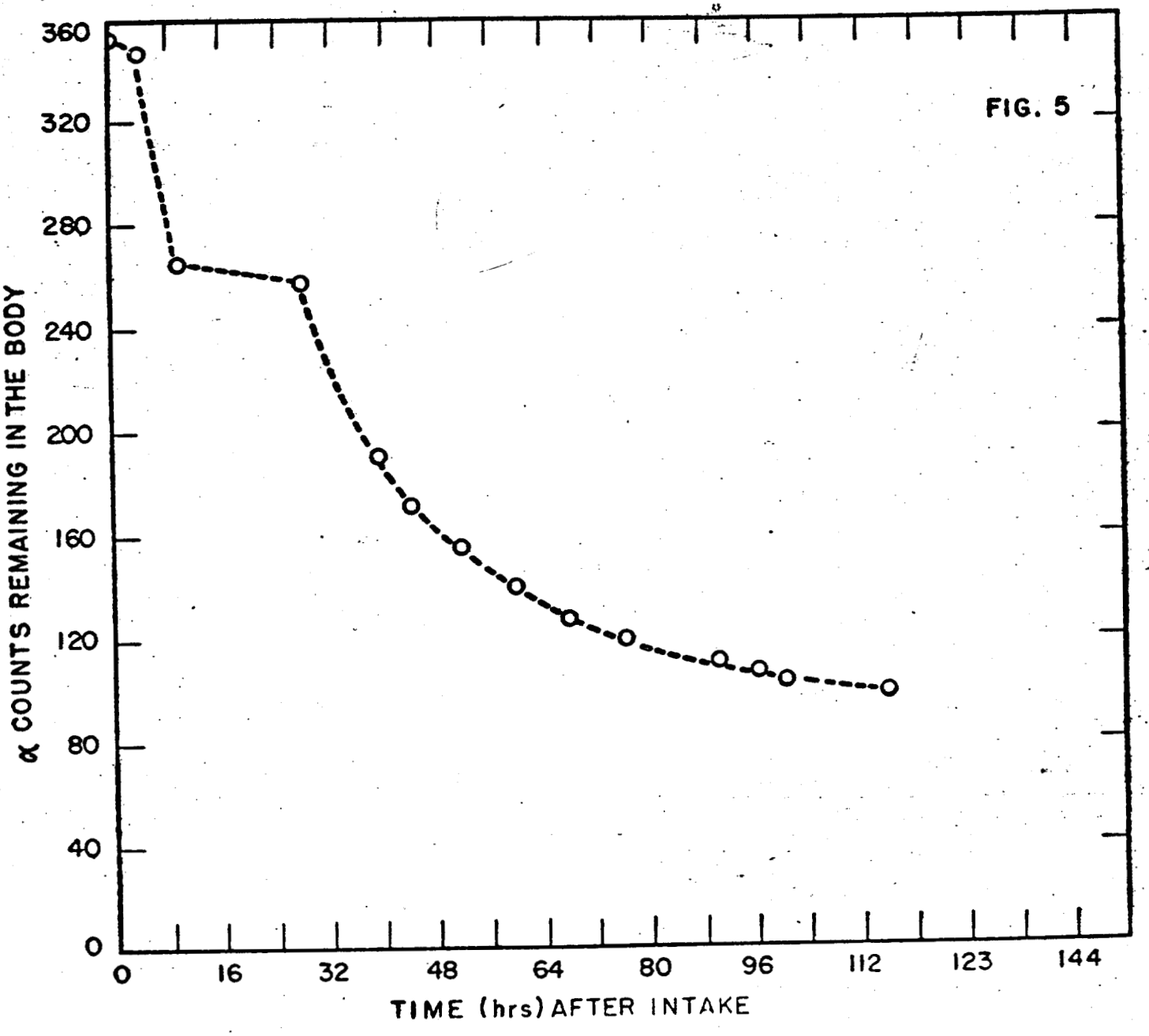
360
320
280
240
200
160
120
80
40
0
α COUNTS REMAINING IN THE BODY
0
16
32
48
64
80
96
112
123
144
TIME (hrs) AFTER INTAKE

FIG. 5

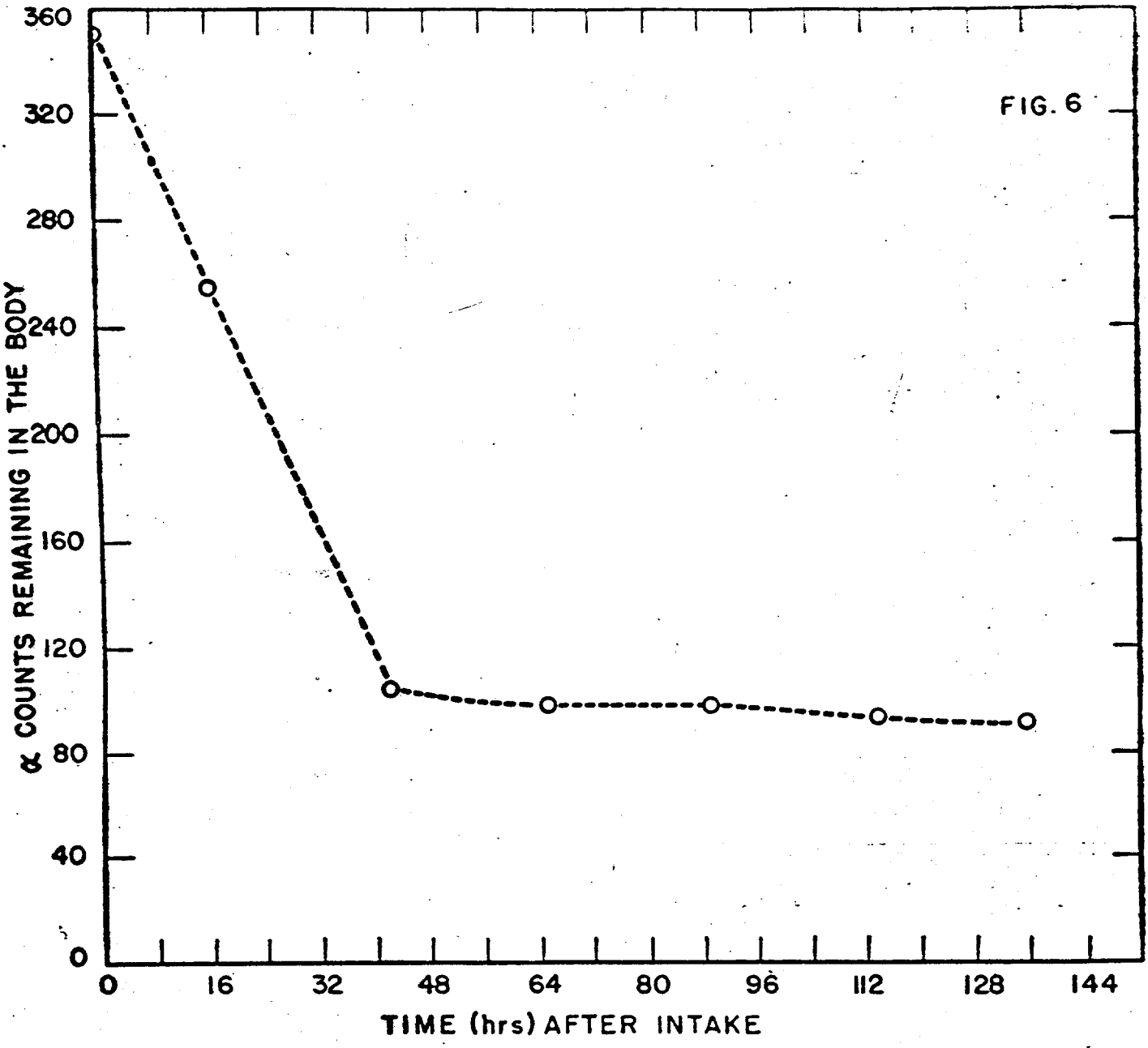

FIG. 6

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II. Routine Urine Survey: 249-MLH-3501 (Jackson-Sellers-Monroe)

A. Urine Specimens Received

Chicago	59
Other	5
Backlog	20
Total	84

B. Specimens Analysed

Chicago	76
Other	5
Total	81

C. Backlog 3

Special Urines: R. Lesko

A. Received 34

B. Analysed 32

The data in Table I is a continuation of the urinary plutonium excretion results of Table III, MUC-ERR-206. As is seen the daily plutonium excretion has remained at nearly 0.01% at the end of 160 days.

Table I

Daily Plutonium Urinary Excretion
(MX-200)

Days After Injection	24-hour Volume	% of Injected Dose Excreted
130	540 ml*	0.0091
131	810*	0.011
133	550*	0.0075
135	600*	0.0077
137	710*	0.0094
139	880*	0.010
142	950*	0.0089
145	460*	0.006
149	1140*	0.010
152	490*	0.011
155	430*	0.0056
156	560*	0.011
158	520*	0.012
159	285*	0.0037
160	335*	0.012
161	490*	0.0073
163	520*	0.0086

* Uncertain about complete 24 collection--Results on the basis of volume received.

III. Sputum Analysis 249-MLH-3520

A. Specimens Received and Analysed 2

IV. Experimental Tissue Analysis 365-MLH-3530 (Reed-Brown)

A. Specimens Received 100

B. Specimens Analysed 80

Plutonium Therapy Studies: Metal Displacement

(Schubert-Revinson-Tolmach)

A group of white female rats (~200 grams body weight) were given intravenous injections of 0.24 mgm of plutonium in the form of the +6 citrate. A few hours later they were subjected to metal therapy treatment--namely, interperitoneal injections of zirconium in sodium citrate solution. The amounts of zirconium given were previously found to be non-toxic.

The results of the excretion levels for the first week were extremely gratifying. Rats which received 500 mgms Zr per kg body weight (I.P. injection) a few hours following plutonium administration excreted in the urine 14.4 - 18.1% of the total injected plutonium in the first day while the controls excreted only 1.14 - 1.86% of the total injected plutonium. Part of the therapeutic effect was due to the sodium citrate solvent since those animals receiving identical doses of sodium citrate except for Zr excreted 6.27 - 6.42% of the plutonium.

On the second day the excretion level of the control rats dropped to .068 -.136%, but the rats which had received an additional 250 mgms of zirconium excreted 1.30 - 1.34%. On the second day the excretion level of the rats that had received 500 mgms of zirconium had dropped to .185 - .284%, the third day to .046 - .088%. On the third day, however, they were given an additional 500 mgms of zirconium and this caused the plutonium excretion to rise to 1.18 - 1.21% on the fourth day as compared to .038 - .123% for the controls.

Full details will be provided in a forthcoming report. The results reported here confirm earlier work. There is reason to believe that the excretion levels can be raised considerably higher. It appears that the fecal excretion is unaffected one way or the other by the treatment.