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MEDICAL PHYSICS QUARTERLY PROGRESS REPORT

July, August, September, 1954

RADIOSTRONTIUM STUDIES

Joseph G. Hamilton, Patricia W. Durbin and Muriel Johnson

January 13, 1954

Special Review of Declassified Reports
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MEDICAL PHYSICS QUARTERLY PROGRESS REPORT

July, August, September, 1954
Radiation Laboratory, Department of Physics
University of California, Berkeley, California

January 13, 1954

RADIOSTRONTIUM STUDIES

Joseph G. Hamilton, Patricia W. Durbin and Muriel Johnson

Approximately 6 months ago an adult female rhesus monkey, which had been bred three months previously, received 50 μc of Sr^{90} and 150 μc of Ca^{45} by intravenous injection. Radiostrontium in the carrier-free state is rapidly deposited in the skeleton, and that which is initially present in the soft tissues is quickly eliminated. The female monkey received the radioisotopes three months before parturition. The period of gestation of the rhesus monkey being approximately six months, this timing is significant, as one would expect very little calcification of the fetal skeleton to have occurred at this time.

On July 7 a male monkey was born, weighing 450 gram. Since the mother was unable to nurse, the baby monkey was separated from her and has been maintained on an artificial diet of cow's milk and sugar supplemented with vitamins, iron, meritene, and banana flakes, and at the present time it weighs approximately 1200 gram. A photograph of the monkey 12 days after birth is shown in Fig. 1. At this time the animal weighed approximately 500 grams. Considerable effort has been expended to make a reasonably quantitative measurement of Sr^{90}-Y^{90} content without sacrificing the animal. Repeated attempts using a large liquid scintillation counter, currently in operation at the Radiation Laboratory at Berkeley, were futile. As a last resort, attempts were made (through the courtesy of the staff in Donner Laboratory) to measure bremsstrahlung, using the large shielded thallium-activated sodium iodide crystal counters. With this arrangement it was possible to measure within a probable error of 50% the Sr^{90}-Y^{90} content of the monkey, which indicates that the maternal transfer of Sr^{90} to the fetus was of the order of 1 or 2 percent. This type of measurement, however, is valid only when a suitable standard is available. As a temporary expedient, a wax phantom was constructed with a capsule containing Sr^{90}-Y^{90} in the center. This is not too satisfactory since the relative stopping power and production of bremsstrahlung by paraffin would be expected to be different from those of the skeleton of an animal. In order to circumvent this problem, a young rabbit of the same weight as the monkey and approximately the same dimensions has been obtained. This rabbit will receive a known amount of Sr^{90}-Y^{90}, and after radioactive equilibrium has been established, a comparison of the two animals will be made with the crystal counters. Subsequently, the rabbit will be sacrificed and a direct measurement made of the Sr^{90}-Y^{90} content of the skeleton. When these values are compared with the Sr^{90}-Y^{90} content of the mother, a more accurate measure of the placental transfer can be made.

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Careful consideration has been given to ways of achieving a higher degree of accuracy. Possibly the least expensive and simplest procedure is to construct two large crystal counters, which will increase the sensitivity by a factor of from five to ten. There is some urgency for this, as the same female monkey has now been bred again, and it is hoped that in due time there will be a second radioactive monkey. There is considerable interest in making a comparison in these two time intervals, for it may be expected that if the second monkey is born it will have less Sr^{90}-Y^{90} than the first monkey.

Attention should be drawn to the fact that the bremsstrahlung from Ca^{45} has been ignored. This is reasonable in view of the fact that it emits soft beta rays with a maximum energy of only 250 kev.

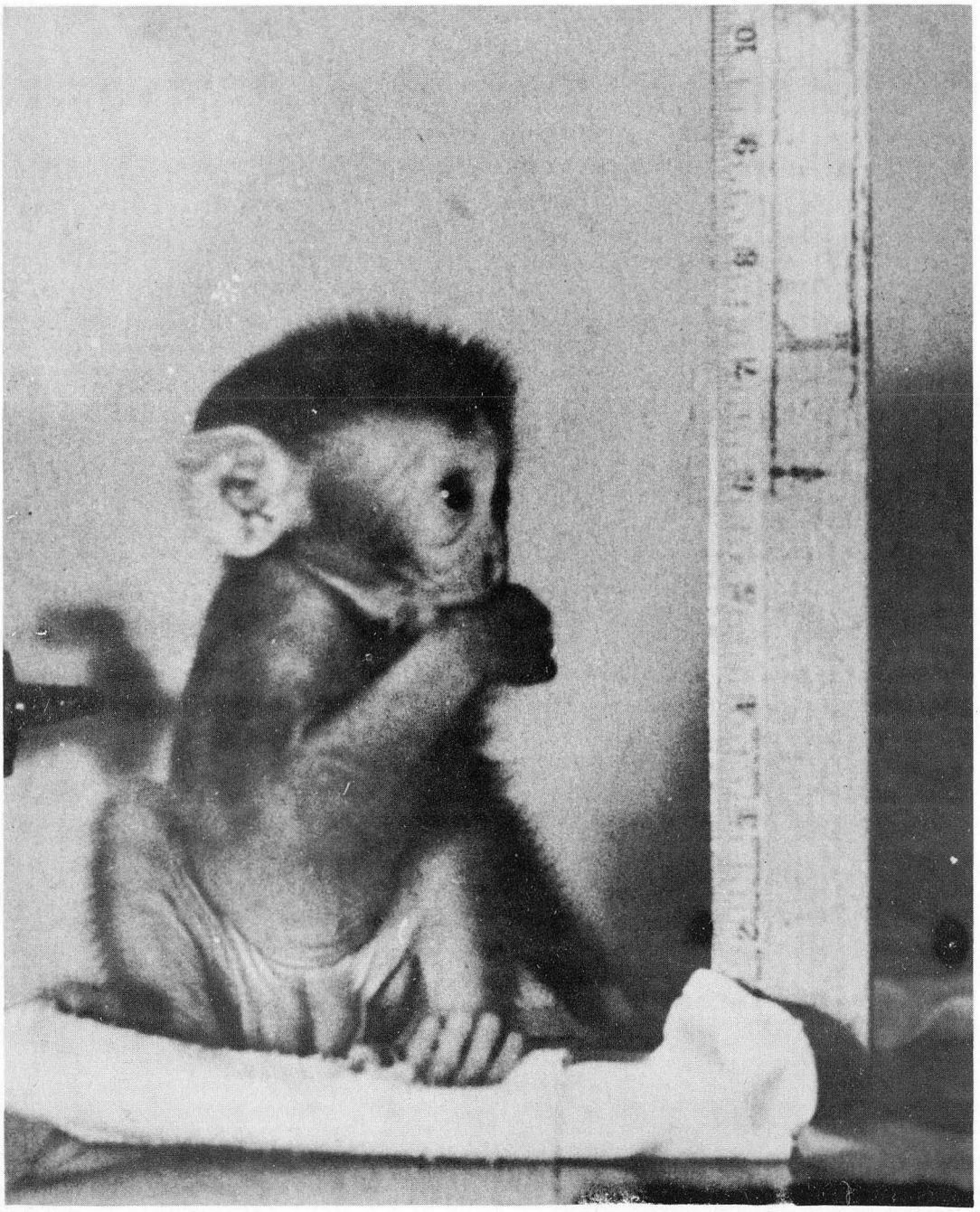

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Fig. 1 A male rhesus monkey 12 days of age; weight 500 grams.

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