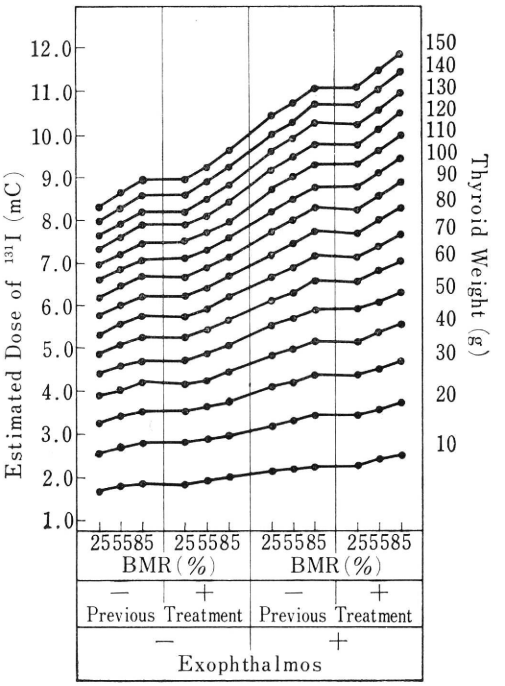
excellent results can be expected in 50% of cases after the first treatment, if the dose of $^{131}I$ is calculated from Model I. Calculations according to Model II, III would give almost the same results.

Figure shows the calculation of a dose of $^{131}I$ from Model I for a 35 year old patient. In Model I, thyroid $^{131}I$ uptake is not a factor, but the average thyroid $^{131}I$ uptake in the cases used to derive Model I was 65.5%. Therefore, when we use Model I, we must be sure that the thyroid $^{131}I$ uptake of the patient is between 60 and 70%.




## Use of Whole Body Counters in Medical Diagnosis

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Recently, whole body counters have been widely used in nuclear medicine. The main uses can be divided into the following two categories: (1) determination of total potassium in the human body using $^{40}K$ activity and (2) metabolic studies following the administration of radionuclides such as $^{22}Na$, $^{42}K$, $^{59}Fe$, and $^{85}Sr$ etc. which are distributed throughout the whole body.

Judging from these applications, whole body counters to be employed in medical diagnosis should be designed differently from those used in health physics studies. Moreover, these counters may have very different features for the two categories mentioned above.

We have built two types of whole body counters at National Institute of Radiological Sciences. The one that is mainly used for $^{40}K$ measurement is made of eight units of large volume plastic scintillators* (50 × 50 × 15 cm rectangular shape), each of which is viewed by four 5 in. diameter photomulti pliers. The counting geometry is as follows: four units are placed above a bed on which a subject lies and another four are positioned under the bed. So, the four units form a 200 cm (length) × 50 cm (width) × 15 cm (thickness) scintillator block, and distance between the two blocks is 40 cm. The whole units are shielded an iron cubicle of 15 cm thickness. Detection efficiency of this counter is such that $^{40}K$ activity in an adult male (about 120 g of potassium) can be determined with the statistical accuracy of ±1.5% for 15 min. counting time of subject and back-

* supplied by Matsushita Electric Co., Japan

ground.

For the accurate assessment of the potassium weight, calibration of the whole body counter is most necessary. We have been attempting to calibrate $^{40}K$ activity in the body by administering a known amount of $^{42}K$ and to correlate the calibration constant (kg/cpm) with subject's weight, weight/height and weight/(height × breast width). As a preliminary experiment, $^{22}Na$ was orally administered to 12 subjects and then they were measured at 2 or 3 hours after the administration since sodium attains an equilibrium in its distribution within a few hours and the distribution pattern is similar to that of potassum.

The calibration constants (uC/cpm) are found to show a linear relationship with the subject's weight, and the weight/height, but correlation with the weight/(height × breast width) is not good. The calibration constants change with the rate of about −0.3%/kg of weight in the range between 35 and 70 kg of the subject's weight. As is expected, the sensitivity of the counter (consequently, the calibration constant expressed as uC/cmp) decreases with body weight. We are planning to perform similar experiments using $^{42}K$.

Another counter was designed for the study of radionuclide metabolism. Two 8 in. diameter × 4 in. thick NaI(T1) crystals.** are placed above and below a horizontal bed. The shielding chamber is made of 20 cm thick iron lined with lead of 3 mm thickness. An important feature of this counter is to have removable lead collimators for the crystals which can be opened or shut by a handle. The two crystals can be scanned simultaneously by a driving motor and a gear mechanism, and the vertical distance between the crystals is varied manually.

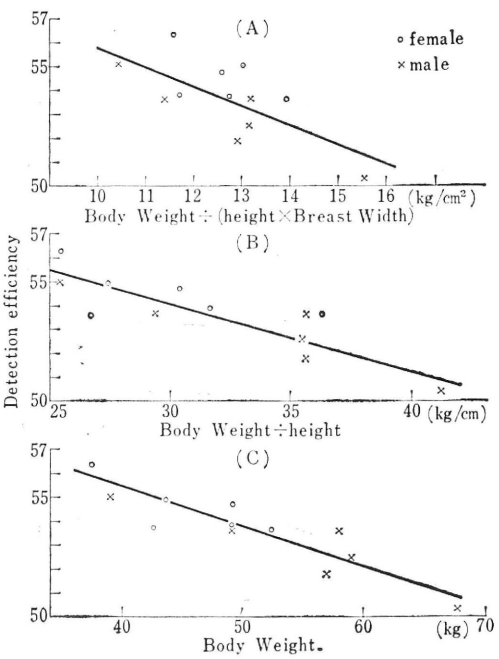
For whole body retention measurement, the crystals with collimator opened are scanned along the long axis of the subject's body and counts from the two detectors are summed and analyzed by a 256 channel analyzer. For the distribution studies the lead collimators of 5 cm thickness are shut forming slit of 10 cm width, and the two detectors are scanned inserting the subject.

Counts from the detectors are summed and then amplified by a linear amplifier. Output of the amplifier is analyzed by the 256 analyzer and simultaneously is directed via a single channel analyzer to a counter-rate meter and recorder system which records a linear scanning diagram in analogue way. In order to obtain quantitative data of the distribution, a 128 channel multi-scaler is also employed to count the output of the amplifier in synchronizing with a driving motor. Counting time per channel of the multi-scaler is so chosen that about 80 channels cover the whole body. The digital scanning diagram thus obtained is corrected for the distortion due to a finite width of the collimator. As a first approximation the radionuclide distribution in the body is assumed to form a plane source of a certain depth. So that, the finite resolution due to the slit width is determined by placing a line source of the radionuclide between the scanning detectors.

Thus, the following relation is expected:

$$|Y| = |A|\,|Y_0|$$

The observed distribution $|Y|$ is a matrix product of the true distribution of the radionuclide $|Y_0|$ and the finite resolution $|A|$.




** supplied by Harshow Chemical Co., U.S.A.

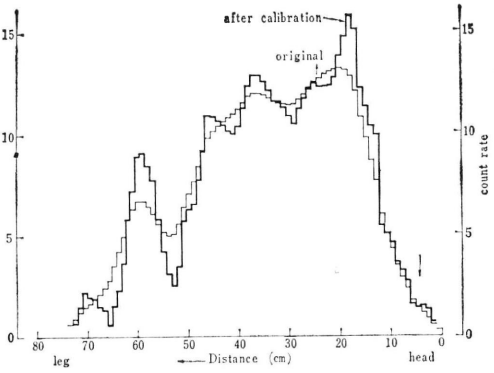
Then, $|Y_0| = |A|^{-1} |Y|$ is obtained.

where, $|A|^{-1}$ is an inverse matrix of $|A|$

However, $|A|^{-1}$ is not easily obtainable and so an iterative method is employed.(1) We have thus obtained $^{132}Cs$ distribution in two adult males.

Finally, it should be mentioned that these two types of counters have also been successfuly applied to health physics problems such as $^{137}Cs$ monitoring in normal subjects and detection of the accidental contamination etc.

(1) L.D. Skarsgard, H.E. Johns, and L.E.S. Green, Radiation Research 14 No. 3 (1961) 261.




## The Application of Double Isotopic Method for the Studies in Hematology

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The simultaneous use of two isotopes has many advantages for the studies in hematology. By the simultaneous use of isotopes of two different elements, it is possible to reduce the time required for the investigation and to compare two different functions under the same condition in the same individual. By the simultaneous use of two different isotopes of the same element, it is possible to compare the metabolism of two different compounds under the same condition in the same subject and to devise new analytical methods for the study of the metabolism of various substances. In this paper some of the examples of the application of double isotopic method for the studies in hematology were described.

1) Determination of the red cell life span in various diseases by the simultaneous use of $^{51}Cr$ and $DF^{32}P$.

In normal controls, hemolytic anemia and aplastic anemia, the red cell life span as measured by $^{51}Cr$ technique was parallel to that as measured by $DF^{32}P$, while in iron deficiency anemia the red cell life span as measured by $^{51}Cr$ technique was longer than that as measured by $DF^{32}P$. This discrepancy was found to be due to the reduced elution rate of $^{51}Cr$ in iron deficiency anemia.

2) Simultaneous determination of the life span of autologous and isologous red cells by $^{51}Cr$ and $DF^{32}P$.

By the use of in vivo labelling with $DF^{32}P$ and in vitro labelling with $^{51}Cr$, it was possible to determine simultaneously the life span of a patient's own red cells and that of a donor's red cells transfused into the patient. By this method it was demonstrated that in a patient with iron deficiency anemia the shortening of red cell life span was due to a defect of the red cell, while in a patient with aplastic anemia the shortening of red cell life span was due not only to a defect of red cell but also to some factor other than the red cell.

3) Determination of blood loss by $^{51}Cr$ and $^{59}Fe$.

In bleeding subjects, it was possible to correct the apparent shortening of the red cell life span as measured by the $^{51}Cr$ technique by the simultaneous determination of the blood loss with $^{59}Fe$.

4) Determination of the splenic uptake of red cells.

In hemolytic anemia, iron deficiency anemia and Banti's syndrome, it was demonstrated by the simultaneous use of $^{51}Cr$ labelled red