been redesigned so that there is a difference of electrical potential supplied to the ionization chamber. The 012 × 10 setting reported by Zimmer et al. (*1*) would be incorrect for the newer models.

Second, the majority of Capintec's newer dose calibrators have a shielded ionization chamber. Because bremsstrahlung is backscattered into the ionization chamber by the exterior shield, the resulting activity reading would be exceedingly high using the 012 × 10 setting.

For these reasons, individuals with either a new CRC-2 or a shielded Capintec calibrator should be aware that the calibrator setting reported by Zimmer et al. (*1*) is inappropriate for their calibrator. The company recommends a calibrator setting of 573 × 100 for the newer CRC-2 calibrators and 550 × 100 for shielded calibrators. We have assayed ^{32}P-sodium phosphate using the 550 × 100 setting on our shielded Capintec CRC-6A dose calibrator, with approximately 10% error over the manufacturer's stated assay.

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REFERENCE

1. ZIMMER AM, SILVERSTEIN EA, HOLMES RA: Assay of ^{32}P-sodium phosphate using a commercial dose calibrator. *J Nucl Med* 17: 404–405, 1976

Reply

We appreciate the interest of Gunther, Wilkerson, and Floriddia in our concise communication. They raise a valid point in that the particular calibration setting and multiplication factor determined in our work is valid only for the particular calibrator make and model and also for particular syringes. Any deviation from this, including even changes in geometry when the dose is placed in the ionization chamber, would necessitate a redetermination of the calibration setting. It is certainly true that the calibration setting should be redetermined for other models and counting situations.

In choosing a calibration setting, the user has the option of selecting one that gives higher sensitivity. The calibration setting mentioned in the letter, and supplied by the manufacturer, is not optimal from this standpoint. Hence, if there is no contrary reason based on the internal construction of the dose calibrator, it would be best for the user or manufacturer to give a more sensitive calibration factor for ^{32}P.

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Notations for Tissue Radionuclide Distributions

The letter by Woodard et al. correctly points out that the specification of radionuclide retention as percent administered dose per gram tissue makes comparing both species and individuals of different sizes within the same species difficult (*1*). These workers noted the usefulness of relative retention (RR). If we allow A to represent the activity in a locale (such as the liver), L the weight of the locale, R the amount of radioactivity retained in the whole body, and B the body weight, then

$$(RR) = \frac{A/L}{R/B} = \frac{AB}{RL}, \quad (1)$$

(and the following comments hold whether or not some excretion has occurred). As Woodard et al. note, RR has the advantage that a value of unity results when there is no preferred site of localization or elimination. However, it should be pointed out that RR is itself a complex function and its uncritical use might mask simple relationships. Assume that a radiocolloid is used, and that the liver normally accumulates a constant percent of the material in the individuals or species under discussion:

$$A = KR. \quad (2)$$

This significant fact is lost if RR is employed. Recall that in most species, organ weight is an allometric (exponential) function of body weight (*2*).

$$L = mB^x. \quad (3)$$

Here m and x are constants descriptive of the species. Substitution of Eqs. (2) and (3) into (1) yields:

$$(RR) = \left(\frac{K}{m}\right) B^{1-x}. \quad (4)$$

Since the exponent x is rarely equal to 1, RR is itself a complex function. The constant fractional uptake of radiocolloid by the liver has been masked. Because of this, we believe it imperative to give results both in terms of percent administered dose per organ and relative retention. The expression, percent dose/gram tissue, would appear to be least useful, *except* when used in a ratio comparing organs in the same animal:

$$\text{Concentration ratio} = \frac{\text{percent dose (A)/gram organ A}}{\text{percent dose (B)/gram organ B}}. \quad (5)$$

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REFERENCES

1. WOODARD HQ, BIGLER RE, FREED B, et al.: Expression of tissue isotope distribution. *J Nucl Med* 16: 958–959, 1975

2. SPENCER RP, ROCKOFF ML, SPECTOR H: Studies on quantitation of the ^{51}Cr-erythrocyte spleen-to-liver ratio. *J Nucl Med* 9: 51–57, 1968

Reply

We are pleased that Spencer has extended the discussion of expressing tissue radionuclide distribution. We agree that it is often important to be able to quantitate the fraction of an administered dose that is accumulated in a whole organ. Calculations present no problem when the whole organ is available for measurement in vitro or when adequate meaningful external measurements can be made, as for ^{131}I in the thyroid. Usually, however, the raw data consist of counts per minute in a small specimen of tissue. If the weights of the specimen and the whole organ are available, these figures can be converted directly to give fraction of administered dose per whole organ. If the weight of the whole

organ is not known, it can be approximated by means of equations similar to Spencer's Eq. 3. It is not necessary to compute percent injected dose per gram as an intermediate step, although it is often convenient to do so.

As pointed out by Spencer, the expressions RC and RR do not show the fraction of an administered quantity of radionuclide in a whole organ directly and are not intended to do so. They do show the relation of the concentration of radionuclide actually present in an organ (as distinguished from the amount) and the concentration that would be present if the administered quantity were uniformly distributed or retained throughout the whole body. This permits quantitative comparison of metabolic patterns and kinetics and of radiation dose in different organs of the same body independently of the size of that particular body. It also permits cross-species and intraspecies comparisons provided there are no major differences in body proportions.

Spencer makes the important point that body proportions may vary considerably between species and to some extent with age and size within a species. Additional examples not discussed by him are the relatively greater weight of the human brain and the relatively greater skeletal weight in large animals. Usually the radionuclide is distributed in different concentrations in numerous tissues all of which contribute to the total-body retention. While correction for the varying proportions of these tissues between species could be made, the variations between individuals of the same species, as shown by Stahl (*1*), are so large that little would be gained. Correction may be necessary, however, in cases in which the fraction of an administered dose retained in a single organ approaches 100%. An example is the ^{18}F retained in the skeleton after the initial rapid renal clearance from the rest of the body. In such a system the skeletal RR will be smaller in a large-boned animal than in a small-boned one, because the retained fraction of the administered dose is distributed in a larger fraction of the total-body mass. Investigators should keep this possibility in mind when interpreting observed differences in RC or RR between species.

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REFERENCE

1. STAHL WR: Organ weights in primates and other animals. *Science* 150: 1039–1042, 1965

Coincidence-Counting Assays of ^{123}I

The assay of ^{123}I using a NaI well counter was discussed recently by Hudson et al. (*1*). They pointed out some of the difficulties introduced into sample counting in a scintillation well detector, due to summing effects from the x-ray–x-ray coincidences at 61 keV and x-ray–γ-ray coincidences at 187 keV. They found that those effects can introduce as much as a 50% error in the determination of a given amount of ^{123}I activity.

We outline here an alternative more accurate method of assaying ^{123}I activity, used in our laboratory for pediatric thyroid uptake studies. This method is based on coincidence counting of the x- and γ-rays emitted during the disintegration of the ^{123}I nucleus, as reported by Herman et al. (*2*). A dual-crystal NaI probe was used to measure the counting rates N_γ, N_x, and N_c of the 159-keV γ-ray, the 28-keV x-ray, and the net γ-ray–x-ray coincidences. The absolute disintegration rate N_0 of an ^{123}I sample was then given by the equation:

$$N_0 = \frac{0.86\, N_x N_\gamma}{N_c}. \qquad (1)$$

Using a 3 × ¼-in. NaI crystal as the x-ray detector and a 3 × 1-in. NaI crystal as the γ-ray detector, and setting the x-ray and γ-ray spectrometer windows to encompass the entire photopeaks, we explored the various factors that may influence the accuracy of this assaying method. The 99.9% pure ^{123}I used in these studies was obtained from the Crocker Nuclear Laboratory Cyclotron of the University of California at Davis, where it was produced by ^{127}I (p, 5n) ^{123}Xe reaction and subsequent β^+ decay of the ^{123}Xe to ^{123}I. The shipment was assayed in a NaI well counter to an accuracy of ± 10%.

First, the dependence of indicated activity on the separation distance between the center of the source and the faces of the two crystals [namely, the source-to-crystals distance (SCD)] was investigated for three different activities. Aliquots of ^{123}I solution were diluted in a 1-ml volume of water and counted while the center of the source was at various equal distances from the NaI crystal surfaces. The results are shown in Fig. 1. Both the 1.10 ± 0.11-μCi and the 11.3 ± 1.13-μCi nominal sources (Crocker Laboratory assay) show the same dependence of indicated activity on

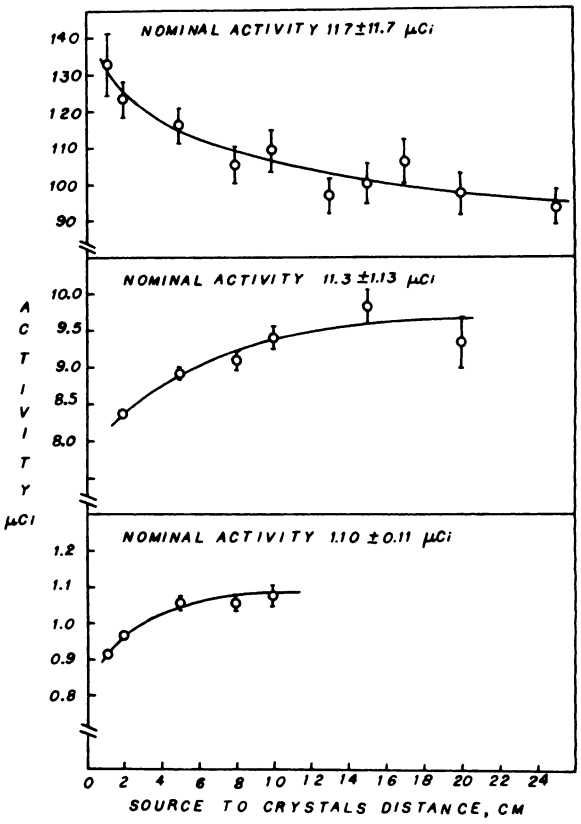

FIG. 1. Assays of three activities for various source-to-crystal distances.