tion with Hg^{197} compared to Hg^{203} for both surface and deep "tumors". The scatter problem is a serious drawback in the utilization of low γ ray energy isotopes in scanning.

It is possible that Sodee's ". . . tissue to background ratio" refers to the count rate over a lesion compared to normal brain background (usually called target:non-target ratio). Collimator design, tumor size and location, radioactivity level, etc. all effect target:non-target ratio. Without experimental details it is difficult to evaluate an improvement from 1.7 to 2.7 when using Hg^{197} instead of Hg^{203}. It is possible that large surface lesions would give rise to better target:non-target ratios because of the attenuation of Hg^{197} radiation coming from deeper brain layers but conversely this implies that deep lesions would be difficult to visualize. In general, our laboratory studies indicate that the target:non-target ratios with Hg^{197} are worse than with Hg^{203}.

Because of its short half-life, the radiation dose from Hg^{197} is distinctly lower than from Hg^{203}. This permits higher scanning doses. When routine scanning equipment is used (as opposed to collimators and crystals specifically designed for low energy isotopes) this is the only advantage of Hg^{197}. The other physical properties of the isotope are detrimental to good scanning. Each investigator must weigh these factors for himself. In our opinion the improved ability to detect small deep-seated lesions more than compensates for the high radiation dose from Hg^{203}.

No doubt Hg^{203} Neohydrin will be replaced by better brain scanning agents in the near future. There are many possible compounds with a wide variety of physical and biological properties. It would be a shame to settle for an agent with the deficiencies of Hg^{197} Neohydrin.

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TO THE EDITOR:

In his paper entitled "The Use of a Modified Radioactive Test for Evaluating the Peripheral Circulation" which appeared in the Journal, May 1963 pp 244-248 Dr. Razzak suggests that the areas under the uptake curves be calculated according to the formula:

$$\text{Area} = N_F\,(t - 0.69\,T_{\frac{1}{2}})$$

where N_F is the level of activity at 10 minutes, t equals 10 minutes, and $T_{\frac{1}{2}}$ is the time to reach one half of the plateau activity. The same formula is repeated in the legend of Fig. 1. According to the author this equation was derived by integrating

$$N = N_F\,(1 - e^{-\lambda t})$$

The author's result is erroneous. The correct result of the integration is

$$\text{Area} = N_F\left(t - \frac{T_{\frac{1}{2}}}{0.69}\right)$$

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The author Dr. Razzak agrees with this observation. He states, "This does not entail any other correction in the numerical figures given in the paper."

Editor

TO THE EDITOR:

Reference is made to the method of extrapolation of precordial counting curves as suggested by Gorten and Hughes (1). I agree that a semilog replot of the downslop of the primary circulation curve is tedious, and that direct extrapolation of the original curve by visual inspection, with or without the aid of a French curve is, as they said, "not considered to furnish

the accuracy or consistency commensurate with the other parts of the technic." They propose, instead, the use of a set of exponential curves in order to achieve the requisite accuracy, while at the same time eliminating the tedium.

I should like to point out that a method exists for mathematically determining the area under the extrapolated portion of the curve, without actually performing the extrapolation, thereby obviating the need for any of the aforementioned techniques. The total area under the precordial counting curve for the first circulation may be used to determine the mean time of the first circulation of indicator by (Fig. 1):

$$t_m = \frac{A_t}{C_f}$$

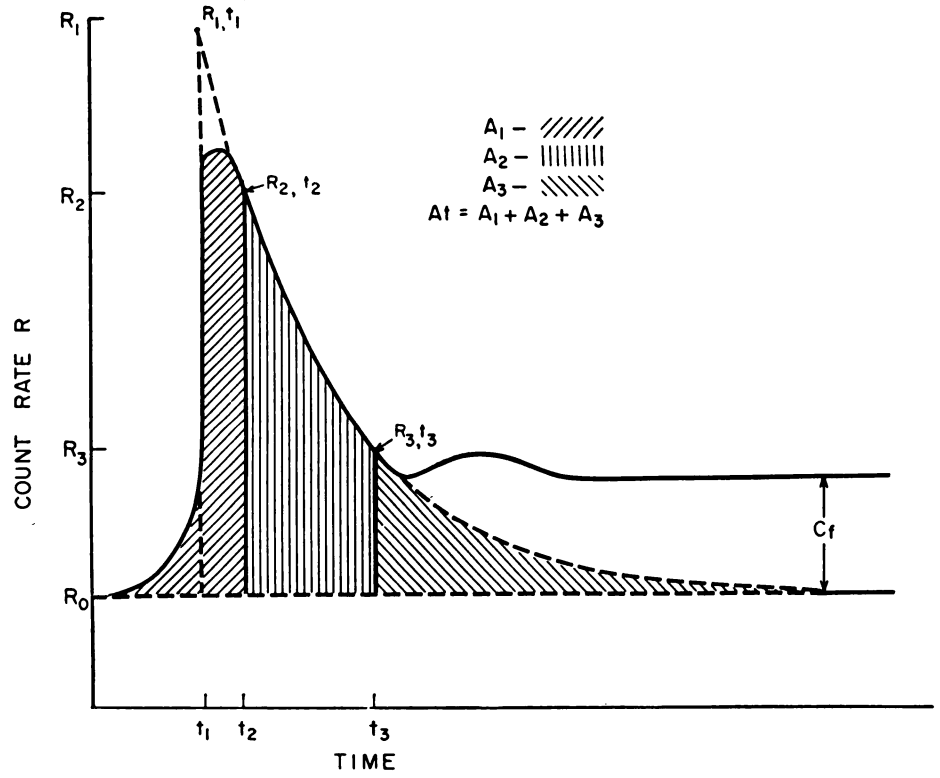

Fig. 1. Diagrammatic representation of a precordial counting curve. Typical curve, solid line; ideal curve, broken line. R_0 is background count rate, R_1 is count rate at apex of ideal curve. The points R_2,t_2 and R_3,t_3 are arbitrarily selected and define the boundaries between A_1 and A_2 and between A_2 and A_3, respectively. C_f represents the height of the curve after distribution of indicator in the blood volume.

This method was described by Zipf, *et al.* (2); using their notation, the area under the extrapolated portion of the curve, A_3 is given by:

$$A_3 = \frac{(R_3 - R_0)}{(R_2 - R_3)} A_2$$

and the total area of the primary circulation curve is given by:

$$A_t = A_1 + A_2 \frac{(R_2 - R_0)}{(R_2 - R_3)}$$

The derivation of these expressions, in somewhat more detail than was presented by Zipf, *et al.* (2) is appended hereto.

This method involves the planimetric measurement of two areas (A_1 and A_2) instead of one (A_1 plus A_2). As this can accurately be accomplished to the tenth of a square inch or better within a minute or two, I feel that this method meets the requirements of Gorten and Hughes without the need for a set of exponential curves.

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2. ZIPF, R. E., MCGUIRE, T. F., WEBBER, J. M., AND GROVE, G. R.: *Amer. J. Clin. Path.* 28:134, 1957.

Appendix

The equation for the downslope of the ideal curve, considering it to be exponential in form is:

(1) $$(R - R_0) = (R_1 - R_0)\, e^{-\lambda(t - t_1)}$$

The total area under the ideal curve is then

(2) $$A_t = \int_{t_1}^{\infty} (R - R_0)\, dt = (R_1 - R_0) \int_{1}^{\infty} e^{-\lambda(t - t_1)}\, dt$$

Multiplying EQ. (2) by $\frac{-\lambda}{-\lambda}$ we have

$$A_t = \frac{(R_1 - R_0)}{-\lambda} \int_{t_1}^{\infty} e^{-\lambda(t - t_1)} (-\lambda)\, dt$$

Now $\int a^x\, dx = \frac{a^x}{\ln a} + C$

if we let $a = e$ and $x = -\lambda(t - t_1)$

then $dx = -\lambda\, dt$

So that $$At = -\frac{(R_1 - R_0)}{\lambda} \left[\frac{e^{-\lambda(t - t_1)}}{\ln e}\right]_{t_1}^{\infty}$$

which reduces to

(3) $$A_t = \frac{R_1 - R_0}{\lambda}$$

by similar reasoning

(4) $$A_2 + A_3 = \frac{R_2 - R_0}{\lambda}$$

(5) and $A_3 = \dfrac{R_3 - R_0}{\lambda}$

Solving equations (4) and (5) simultaneously

(6) $A_2 = \dfrac{R_2 - R_3}{\lambda}$

(7) Or $\dfrac{A_2}{R_2 - R_3} = \dfrac{1}{\lambda}$

Substituting EQ. (7) into EQ. (5)

(8) $A_3 = \dfrac{(R_3 - R_0)}{(R_2 - R_3)} A_2$

Since $A_t = A_1 + A_2 + A_3$

Then $A_t = A_1 + A_2 + \dfrac{(R_3 - R_0)}{(R_2 - R_3)} A_2$

Or $A_t = A_1 + A_2 \left(1 + \dfrac{R_3 - R_0}{R_2 - R_3}\right)$

$$A_t = A_1 + A_2 \left(\frac{R_2 - R_3}{R_2 - R_3} + \frac{R_3 - R_0}{R_2 - R_3}\right)$$

Which reduces to

$$A_t = A_1 + A_2 \frac{(R_2 - R_0)}{(R_2 - R_3)}$$