Technical Papers

Low Energy Counting with a New Liquid Scintillation Solute[1]

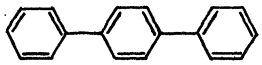
F. N. Hayes, R. D. Hiebert, and R. L. Schuch

Los Alamos Scientific Laboratory,
University of California, Los Alamos, New Mexico

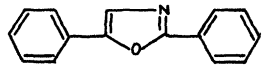
Scintillation studies involving low energy β-emitters such as C^{14} and H^3 require serious consideration of factors rarely encountered in high energy counting.

Conventional photomultipliers with low work function Cs-Sb cathodes (*1, 2*) give large counting rates of dark current in the low amplitude pulse region. Furthermore, Cs-Sb and Ag-Mg (*1*) dynodes are known to emit light on electron bombardment, some of which may not only produce a small amount of regeneration in the originating tube but may also pass over into a coincidence-arranged second tube. These practically coincident pulse phenomena can be referred to as "light dark current."

Our program on C^{14} and H^3 scintillation counting has made use of both coincidence circuitry and refrigeration to decrease dark current. Operation of the photomultipliers and scintillator at 0° C and below does not allow the use of the relatively insoluble *p*-terphenyl (*3*) (I), and therefore has forced us to investigate new and more soluble solutes.



I



II

2, 5-Diphenyloxazole (*4*) (II) has a solubility of 300 g/liter in toluene at room temperature, over forty times as great as *p*-terphenyl. As judged from its variation of RCA 5819 anode current production vs. concentration, 3 g/liter in toluene makes a suitable solution for counting.

This solution will absorb, per centimeter of path through it, more than 10% of light with wavelength less than 368 mμ. It gives a radium-excited scintillation spectrum ranging from 340 to 460 mμ, with maximum intensity at 380 mμ. Similar spectral values for 0.5% *p*-terphenyl in toluene are a range of 320–450 mμ and a maximum of 352 mμ.

The counting apparatus employs a supported removable Pyrex cell viewed by 2 RCA 5819 tubes selected for high signal-to-noise ratio and oriented at 90° to each other in a horizontal plane. This assembly, together with subminiature preamplifiers and 4 in. of iron shielding, was placed in a 6 cu ft refrigerator. The separate outputs were fed into wide band amplifiers and then into fast discriminators with delay line shaped outputs of 0.2 μsec duration. A separate output from one of the amplifiers was taken into a high level discriminator with a pulse width of 4 μsec. The three discriminator outputs were combined in a fast coincidence-anticoincidence circuit, giving passage of low level coincident pulses and rejection of pulses originating in the scintillator of amplitude high enough to be passed by the high level discriminator.

With 30 ml of 0.3% II in toluene and a total amplification of 2500, 35% of the disintegrations from dissolved C^{14}-benzoic acid are recorded as pulses of amplitude between 0.5 and 15 v. Counts/min of total noise include 1–2 of dark current, 20–25 of "light dark current," and 40–60 of radiation background. Use of the dioxane-water solvent and *p*-terphenyl described by Farmer and Berstein (*5*) gave only 7% efficiency with this instrument.

Comparison of compounds for their quenching action on the toluene solution of II gave the order: piperidine > phenol >> pyridine >> cyclohexanone > chlorobenzene >> acetic acid >> chlorocyclohexane = cyclohexanol > cyclohexane > toluene at 10 mole per cent.

A detailed single and mixed solvent study on this compound (II) together with similar studies on more than thirty new solutes will be published shortly.

[1] Work done under the auspices of the Atomic Energy Commission.

References

1. Schaetti, N. *Z. angew. Math. Physik.*, **2**, 123 (1951).
2. ———. *Ibid.*, **1**, 268 (1950).
3. Reynolds, G. T., Harrison, F. B., and Salvini, G. *Phys. Rev.*, **78**, 488 (1950).
4. Lister, J., and Robinson, R. *J. Chem. Soc.*, **101**, 1297 (1912).
5. Farmer, E. C., and Berstein, I. A. *Science*, **115**, 460 (1952).

Manuscript received June 4, 1952.

Body Build and Body Composition

Josef Brožek and Ancel Keys

The Laboratory of Physiological Hygiene,
University of Minnesota, Minneapolis

Sheldon's system of somatotyping was originally proposed as a means for describing the over-all body "type," conceived as a fairly fixed, "constitutional" characteristic (*1*). However, it has been clearly shown (*2*) that the somatotype ratings are markedly affected by changes in nutritional status and, in fact, may be considered as partial measures of nutriture. Although this may have eliminated the supposed virtue of the system as providing a permanent (constitutional) index, its possibilities as a measure of nutriture deserve to be critically examined.

Stuart and Sobel (*3*) noted, in passing and without quantitative documentation, the positive relationship between endomorphy ratings and fatness. An individual predominantly endomorphic in his body type has a heavy *panniculus adiposus,* whereas an ecto-