transferred by means of a fine pipette to Stender dishes containing either concentrated NaOH or 0.1% $KMnO_4$. At the end of 24 hr in NaOH, all tumors were found to be completely decolorized. This may be regarded as a positive reaction, since melanin is bleached by concentrated NaOH.

Tumors in $KMnO_4$ were allowed to remain for 24 hr, then rinsed in several changes of distilled water, and immersed in 0.3% oxalic acid. In all cases, after 12–24 hr in oxalic acid no trace of the dark masses could be found, the pigmented sheath evidently having been completely oxidized. This too may be regarded as a positive test.

Since the results in both cases are those expected of melanin, it would appear that the assumptions previously made concerning the nature of the pigment are correct.

References

1. COWDRY, E. V. *Laboratory technique in biology and medicine.* Baltimore: Williams and Wilkins, 1948. p. 148.
2. HARTUNG, E. W. *J. exp. Zool.*, 1947, **106**, 223.
3. RUSSELL, E. S. *J. exp. Zool.*, 1940, **84**, 363.
4. ———. *Genetics*, 1942, **27**, 612.

An Internal Geiger Counter for the Assay of Low Specific Activity Samples of Carbon 14 and other Weak Beta Emitters in Biological Samples[1]

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The limiting factor in biological experiments with radioactive tracers is the great dilution of the isotope. Further increases in the specific activity of the isotopic compound are often impossible because of its limited availability or because of the biological effects of the radiations. Improvements in counting techniques offer the only practical solution. The procedure described here permits statistically valid analyses of samples having one-fifth or less the activity necessary for mica-window tubes.

The windowless Geiger tube of the continuous gas flow type shown in the accompanying figures (Figs. 1 and 2) permits the counting of all particles escaping from the sample. A satisfactory counting gas is a mixture of helium and alcohol vapor. The helium is bubbled through absolute ethyl alcohol kept at 0° C in an ice bath and the gas mixture passed through the counter.

The counter can be successfully operated with commercially available scaling circuits. The material to be assayed must be spread in fairly uniform thickness on a flat surface or shallow cup within a measured area. Samples of tissues are prepared by spreading an aqueous homogenate of the tissue on a flat copper disk of 2-in. diameter which has been cleaned with ether and oxidized in an oven at 160° C overnight. The spreading may conveniently be done while the copper disk is revolving at the rate of 5 to 20 rpm on a turntable and under a gentle current of dry air. Samples of blood, urine, and solutions or suspensions of water-soluble or insoluble

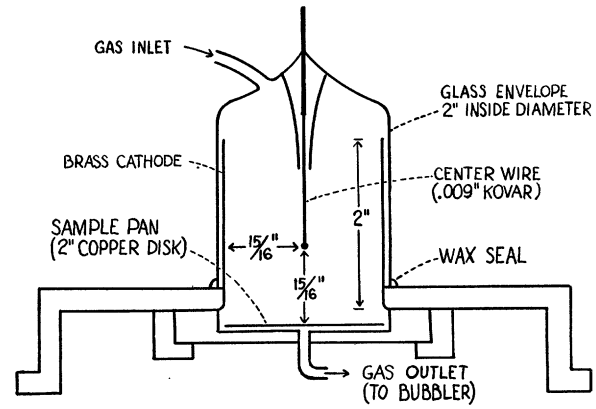

FIG. 1. Cross-sectional view.

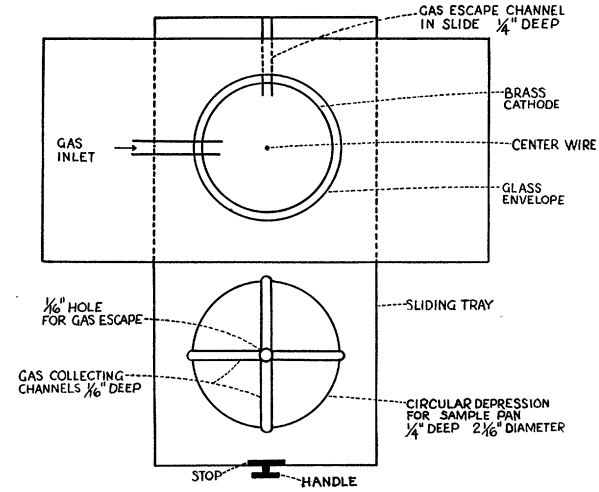

FIG. 2. Top view.

substances may also be spread out in this manner. The sample so prepared may then be inserted in the sliding tray and pushed into the counter.

A simplified version of the Geiger tube can be made omitting the sliding arrangement for insertion of the sample and including a side arm for a gas outlet. In this case the sample is placed on the copper disk as usual, the copper disk on a flat brass plate, and the counter over the sample. The tube can be made relatively airtight by pressing down on the glass tube or by using stopcock grease or wax at the junction of the glass tube and brass plate. Since the counting gas is always under a slight positive pressure, small leaks are of no impor-

[1] This work was aided by grants from the Life Insurance Medical Research Fund, the United States Public Health Service, and the Dr. Wallace C. and Clara A. Abbott Memorial Research Fund of the University of Chicago.

tance. This counter may also be used for monitoring relatively flat surfaces such as laboratory tables for low-energy beta particles.

The plateau has less than a 4% rise per hundred volts from 1350 to 1550 volts. In this laboratory, the background of the counter shielded with 2 in. of lead is 28 cpm at 1375 volts. A 10-mg sample of barium carbonate containing 0.0005 μc of C^{14} spread on a 10-cm² surface, gave a counting rate of 564 cpm (uncorrected) at 1375 volts. The sensitive area available on the sample holder is 20 cm². The counting gas is inexpensive and readily available. The counter is simple to construct or may be obtained commercially.[2] The time required for replacing a sample and flushing the counter is less than 3 min.

Embryo Size and Productivity in Segregating Generations of Tomatoes[1]

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Much work has been done on size of embryos and their relationship to plant vigor in both inbred and F_1 hybrid populations; but the authors are not aware of similar experimental data in segregating generations except Faberge's (*4*) suggestion that early vigor in F_2 generations may be caused solely by initial seed weight advantage. Ashby (*1*) postulated that hybrid vigor in F_1 tomato lines was due to the possession by the hybrid of a larger embryo than that of the parental strains. Luckwill first confirmed this (*9*), but later (*10*) found evidence to indicate that no general relationship exists between embryo size and increased physiologic efficiency of F_1 hybrids. Other workers also have disagreed with Ashby's theory (*3, 5, 6, 8, 11, 13*).

Some experiments (*1, 2, 7, 8, 11, 13, 14*), however, have indicated that many F_1 lines showing hybrid vigor had larger seed or embryo size than the parental strains from which the hybrids were developed. Hatcher (*6*) has shown that size of seed in tomatoes is determined to a great extent by the number of seeds in a fruit. Natural self-pollination results in greater seed set per fruit than cross pollinating by hand; therefore, seeds from self-pollination are generally smaller in size. This does not explain the increase in size of a portion of the F_2 seeds (i.e., those produced by F_1 plants). Undoubtedly genetic control is also a factor in embryo size.

If it is assumed that in certain specified F_1 lines large size of seed is associated with hybrid vigor as measured in yields of fruit, and that such an association is carried into the segregating F_2 generation, a method is suggested whereby hybrid tomato seed may be produced by selection of seed harvested from F_1 fruits. It is possible to theorize further that if no relationship exists between seed size in tomatoes and productivity in an F_1 line showing considerable hybrid vigor, seed size and vigor may still be related in the segregating generation where transgressive segregation may occur. The first measurable evidence of vigor in segregating progenies might presumably be in larger embryo or seed size.

TABLE 1

AVERAGE WEIGHT PER SEED IN MG

Generation	Diameter of seed: 3000 + μ	2500–3000 μ	2000–2500 μ	Mean
P_1 Rutgers	3.43	2.89	2.38	2.90
P_2 Pritchard	3.43	3.15	2.56	3.05
F_1 R × P	3.78	3.31	2.91	3.33
F_2 R × P	3.69	3.01	2.29	3.00
Mean	3.58	3.09	2.52	...

Preliminary results have supported these possibilities. The correlation coefficients computed between seed weight and embryo weight and between average seed diameter and embryo weight were 0.978 and 0.867 respectively. Both exceed the 1% level of significance. Average seed diameter has, therefore, been used as a measure of seed weight, which in turn was used as a measure of embryo size. One-pound seed lots of two inbred strains of tomatoes, their immediate cross, and seed taken from F_1 generation fruits were sieved through soil screens with spherical openings averaging 3000, 2500, and 2000 μ. Table 1 indicates the average diameter and weight for each size class.

TABLE 2

EARLY AND TOTAL YIELDS IN TONS PER ACRE

Generation and size of seed	8/13/48 to 9/2/48		8/13/48 to 9/30/48	
Mean of Rutgers	2.4		17.3	
Mean of Pritchard	5.9		18.1	
F_1 from seed averaging 3.78 mg	7.0		20.6	
F_1 from seed averaging 3.31 mg	6.2	$\overline{F_1} = 6.1$	20.1	$\overline{F_1} = 19.6$
F_1 from seed averaging 2.91 mg	5.2		18.1	
F_2 from seed averaging 3.69 mg	5.6		19.4	
F_2 from seed averaging 3.01 mg	5.9	$\overline{F_2} = 5.6$	18.5	$\overline{F_2} = 18.7$
F_2 from seed averaging 2.29 mg	5.2		18.1	
Significant difference 19 : 1 ..	0.89		1.30	
Significant difference 99 : 1 ..	1.19		....	

The average deviation in seed weight within the inbred and F_1 materials was 26.5%; in the F_2 it was 38.0%. Assuming that the deviation in the F_1 and inbred lines was environmental (*12*), then 30% of the total variation in seed producing the F_2 progenies was due to hereditary factors.

The field trials included plants grown from each seed-size class for each generation (P_1, P_2, F_1, F_2). A split-plot design having six replications was used. Information was obtained on earliness, vigor of plants, size and shape of fruits, uniformity, and yield. Yields are of

[1] Authorized for publication on January 10, 1949 as Paper No. 1500 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] From the N. Wood Counter Laboratory, Box 76R1, Chesterton, Indiana.