not an empirical choice but was suggested by a consideration of the specific function of H_2 in the mechanism of biological nitrogen fixation—certainly a significant example of the role of theory in research. Likewise worthy of mention is that these photosynthetic organisms are the first bacteria to be unequivocally established as nitrogen-fixers since the discovery of *Azotobacter,* and that they are the anaerobic analogue of the blue-green algae as *Clostridium* is to *Azotobacter.* One member, *Rhodospirillum,* also possesses the distinction of having its nitrogen-fixing ability first demonstrated by the use of an isotope, then confirmed with Kjeldahl analyses (*2, 4*), a reversal of the usual procedure, but one that seems appropriate for this atomic age.[2]

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[2] Since this manuscript was submitted, Duchow and Douglas *J. Bact.,* 1949, **58**, 409) have described a new genus of photoheterotrophic bacteria, *Rhodomicrobium vannielii.* Although related biochemically to the *Athiorhodaceae,* its unusual morphology and mode of cell division suggest that it should not be included among the *Eubacteriales*; pending further investigation they suggest it be placed in a provisional appendix to the *Schizomycetes.* Through the courtesy of Prof. Douglas we obtained a strain of this interesting organism for test of nitrogen fixation. Positive fixation has been obtained in both Kjeldahl and isotopic experiments.

Windowless, Flow Type, Proportional Counter for Counting C^{14} [1]

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The need in this laboratory for better counting of $BaCO_3$ samples with low activity has led to the design, construction, and use of a flow type, windowless, proportional counter (*1, 2, 4*).

The advantages to be gained by using proportional counting rather than Geiger-Müller counting are: (1) a higher maximum counting speed and no dead time corrections; (2) less sensitivity of the counter to gas contamination; (3) indefinitely long counter life; and (4) the opportunity to use pulse discrimination to reduce the background.

Operation in the proportional region necessitates the use of an amplifier of voltage gain between 100 and 1,000. This places more stringent conditions on the insulation, shielding, and line isolation of the circuits than is the case with Geiger-Müller counting.

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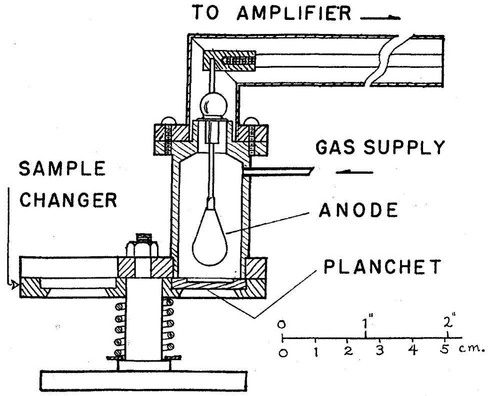

FIG. 1. Section of flow counter and sample changer.

The entire counting apparatus consists of (1) the counter, (2) the sample changer, (3) the electronic unit, and (4) the gas supply tank and connections.

The gas used is argon plus 5% CO_2 and is purchased already mixed. The gas flow is controlled by a needle valve with an extended handle and two stops, one for the flush position and one for steady flow. From the valve the gas is piped to an oil bubbler and thence to the counter. The gas can escape around the planchet and through the hole below.

The electronic unit is a Model 162 amplifier-scaler made by Nuclear Instrument and Development Laboratories. The amplifier has a maximum gain of 400 and the scaler will pass .40-v pulses. The counter is coupled directly into the amplifier input by a short piece of coaxial line. With this arrangement no preamplifier is required and the interference picked up in connections is minimized. An isolation transformer in the 110-v supply is necessary to prevent line interference.

A section of the counter and the sample changer is shown in Fig. 1. The counter has a ¾-in. diam brass cathode and an anode consisting of a loop of .002-in.-diam tungsten wire. The loop is 9 mm by 17 mm and reaches to within 5 mm of the bottom of the planchet. The planchets used are of stainless steel and have a recess 9/16 in. in diam and .037 in. deep. Measurements of the asymmetry of sensitivity of this counter have been made. For a small spot source placed on a planchet near the edge of the recess, the rate of counting with the source in the plane of the loop is 10% more than at 90° from this position. For a reasonably uniform sample, therefore, the asymmetry is negligible.

The sample changer has a rotating disk as shown in Fig. 1, with two holes for planchets and a spring, not shown, which positions the planchets in the counter by catching in each of two notches in the rim of the disk.

Ten seconds has been found to be an adequate time for flushing the counter. If flushing is inadequate, the counting rate is depressed until the air has had a chance to clear out. Thus a method of checking on the presence of air is necessary to see if further flushing increases the counting rate.

The counter is operated with the amplifier gain set at X1–30, so that only pulses larger than about 2 mv are registered on the scaler. Under these conditions the relative counting rate for a $BaCO_3$ sample as a function of voltage is indicated in Table 1. Although the plateau slope is rather more than that for a good Geiger-Müller counter, the voltage regulation has been found to be quite good enough to give consistent readings of activity relative to a standard.

TABLE 1

COUNTING DATA

Voltage	Relative rate, R	Background, B*	$\frac{B}{R^2}$
1,500	0.64	0.9 cpm	2.2
1,600	1.00	2.3 cpm	2.3
1,700	1.06	4.8 cpm	3.9

* Partial lead shielding.

It will be noticed from Table 1 that the background is low but that it increases more rapidly with voltage than the $BaCO_3$ counting rate. This may be accounted for by the variability and average smallness of cosmic ray ionization. In any case, this change of background with voltage poses a question as to what operating voltage is best for weak-sample counting. It can be shown that the background (B) divided by the counting rate (R) squared is proportional to the time required to count a weak sample to a given accuracy. Of the voltages shown in Table 1, 1,600 v was chosen for operation of the counter, since this voltage is in the plateau range and gives a low value of B/R^2.

The same criterion may be applied to compare this flow counter with a standard type of end-window counter used in this laboratory. Taking values of 0.4 and 0.16 counts per disintegration for the over-all efficiencies and 3 cpm and 24 cpm for the backgrounds, the flow counter is seen to be 50 times as fast for weak samples. This is equivalent to saying that, for a given time and percent accuracy, the flow counter can count samples which are weaker by a factor of $\sqrt{50} = 7.1$.

A test for coincidence losses was made by following the decay of a sample of C^{11}. The counting rate decayed from the initial rate of 86,000 cpm with a half-life of 21 min. The semilog plot of the data was straight within the counting errors, whereas if significant counting losses had occurred the data would have been below the line at the higher end. From the theory of proportional counter action one would expect the limitation on the maximum speed of counting to be imposed by the circuits of the register rather than by the counter itself.

Several measurements of self-absorption curves in the end-window and flow counters were made on the same sets of planchets. The samples were of different weights but of constant specific activity so that the counting rates would be expected to obey the equation, $N = N_\infty (1 - e^{-\alpha m})$. For both counters the experimental points above 3 mg/cm² were well fitted by this equation. The best values of α were found to be .31 cm²/mg for the flow counter and .30 cm²/mg for the end-window counter (*2, 4*). The ratio of counting rates was found to have a nearly constant value of about 2.6 except for samples of 3 mg/cm² or less. Between 3 mg/cm² and .5 mg/cm² the ratio increases from 2.6 to 3.1. This increase in the ratio for thin samples may be accounted for by soft back-scattered radiation which will penetrate neither the mica window nor the thicker layers of $BaCO_3$.

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Preliminary Report on a Device for the Objective Measurement of the Negative Afterimage Phenomenon

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The study of afterimages has received considerable attention by psychologists as well as physiologists for more than a century. Clinical application (*2–4*) of changes in the afterimage under pathological conditions has been attempted by several workers. A considerable difficulty in investigation of this phenomenon lies in the fact that until now the subject had to be trained for the observation of afterimages. Persistence, concentration, and a good measure of intelligence and reliability are required when reporting on the appearance, disappearance, and nature of afterimages produced after a subject has gazed fixedly for periods ranging from 5 to 30 sec at a brightly illuminated object.

An experiment first described by Bidwell (*1*) has been the basis for the development of an instrument which makes it possible to obtain reliable measurements of some aspects of the negative afterimage, under conditions that make it unnecessary to train the subject for his observations. Since only the afterimage and not the original stimulus is perceived with this method, there is no shift of gaze or attention, an end point can be determined on a measuring scale, and observation becomes so simple that even children and mentally disturbed patients may be studied without sacrificing too much of the reliability of the results.

If a disk, half white and half black, with a sector cut out as a window, is rotated at a certain speed in front of a brightly illuminated colored object in such a manner that first the object through the window, then the white part, and, finally, the black part of the disk are exposed