and perivascular inflammatory lesions with perivascular demyelination, typical of experimental allergic encephalomyelitis. Almost every rat that received ten injections had lesions. The type and severity of clinical signs and histologic lesions did not differ from those encountered when the disease was produced with the aid of adjuvants.

For further study, 400 mg of tissue homogenate were administered in ten injections, five on the 1st day and five 1 week later in the same site, in groups of 10 or 11 rats that had been treated with pertussis vaccine. With this schedule, intracutaneous injections of homogenate of guinea pig cord in the tail or in the right flank were almost as effective as in the right food pad. However, homogenates of rat cord or human white matter injected in the foot pad had much less activity than guinea pig cord; there were relatively mild histologic lesions in eight and three rats respectively, and no definite clinical signs of disease. Guinea pig peripheral nerve tissue was inactive. Guinea pig cord homogenate produced much less disease in Hemlock Hollow Wistar rats (no clinical signs, lesions in only four rats) than in CD F rats, even though the former strain is known to be highly susceptible to experimental allergic encephalomyelitis produced with nervous tissue and adjuvants (*8*). Variation in susceptibility of individual animal strains to EAE is well known in guinea pigs, mice (*9*), dogs (*2*), and rats (*6, 8*).

Thus, the rapid production of severe, clinically manifest EAE, without the aid of adjuvants, required the injection of large doses of nervous tissue of a particular type into a highly susceptible strain of rats. Prior treatment with pertussis vaccine was helpful but not essential. It is possible, but not proven, that pertussis vaccine may act by enhancing the inflammatory response to the inoculum (*8*). The effectiveness of homogenate of guinea pig spinal cord cannot be ascribed entirely to its heterologous character, because human white matter, also heterologous, had little potency. It has been reported, with various animal species as recipients, that certain heterologous nervous tissues are more likely to produce encephalitis than others (*10*). High dosage may be required because of the rapid destruction or inefficient utilization of the antigenic components of nervous tissue. Or, it is possible that the excess of nervous tissue assumed the role of adjuvant. These problems are being studied.

It is probable that experimental allergic encephalomyelitis in animals is related to human postinfectious and postvaccinal encephalomyelitis, and there is some possibility of a connection with multiple sclerosis (*11*). In none of these human situations is there evidence for a pathogenic link akin to the adjuvant customarily used in the experimental disease studies. Therefore, the elimination of the adjuvant may facilitate investigation of relationships among these human and experimental diseases (*12*).

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Estimate of Neutron Albedo on the Moon's Surface Resulting from Cosmic Radiation

The moon does not seem to possess an atmosphere: measurements indicate less than 10^{-9} that of the earth (*1*). The surface of the moon is thus exposed to bombardment by cosmic radiation. The result is that the nuclei on the surface undergo spallation yielding various radioactive nuclei as well as neutrons, some of which constitute an albedo. To obtain an estimate of the neutron albedo resulting from such considerations, the intensity and composition of cosmic radiation, the composition of the moon's surface, and the cross section for the production of neutron albedo must be known.

Cosmic radiation consists of protons, helium nuclei, and other multiple-charged nuclei. The intensities and relative abundances have been extensively studied by means of balloon and rocket experiments near the earth. The absolute intensities seem to vary appreciably with the solar cycle. In addition, there is a large increase of proton abundance when there are solar flares. In the present consideration we shall take the proton intensity as 0.2 particle per cm^2 per steradian (*2*), and the intensity of helium nuclei as one-ninth of the proton intensity. The proton intensity is for energies greater than 600 mev; recent experiments have shown the existence of particles with lower energies but their intensity has not been well determined.

The composition of the surface of the moon can only be inferred from telescopic observation. The present calculation is made for two types of rocks—chondrite and basalt—which probably constitute the moon's surface.

The neutron production in the interaction of proton having energies of 190 mev with various elements has been studied by Gross (*3*). We assume these values for all energies since these neutrons result from lowering the excitation of the target nucleus and these values should constitute a lower limit.

The interactions (stars) of protons produced in the top 1 cm^3 of the moon's surface shall be considered first. The cross sections for protons in various nuclei are well known. The star-production rates and neutron-albedo intensities for basalt are shown in Table 1.

It is seen from the table that the total neutron albedo for the top 1 cm^3 of the surface is 2.12×10^{-2} sec^{-1}. To obtain the total number of neutron albedos from a column of 1 cm^2, we note that we have to multiply the above number by a mean free path of neutron absorption in the rock which is calculated to be approximately 8 cm. We can assume a uniform rate of production within this range since the absorption of primary radiation is compensated by secondary production. Thus, the neutron albedo due to proton interaction is 0.17 neutron per cm^2 sec^{-1}. A similar calculation yields the contribution due to interactions of helium nuclei to be 0.09 giving the total neutron albedo as 0.26 neutron per cm^2 sec^{-1} for basaltic rock. The corresponding value for chondritic rock (high iron) is 0.35 neutron per cm^2 sec^{-1}.

The estimates presented should constitute lower limits since particles with

Table 1. Neutron albedo from the top 1 cm^3 of the moon's surface if the composition is assumed to be basaltic rock.

Element	No. of stars	No. of neutrons/star in the backward hemisphere*	Albedo neutrons/sec
O	0.0185	0.25	0.0046
Mg	.0012	1.0	.0012
Al	.0024	1.0	.0024
Si	.0080	1.0	.0080
Ca	.0019	1.2	.0023
Fe	.0018	1.5	.0027

* Energy between 0.5 and 12 mev.

energies lower than 600 mev have not been taken into account. Recent experiments show the existence of large numbers of particles of lower energy, but considerable uncertainty exists (*4*).

It may be said that, during solar flares, the intensity of particle radiation increases by several orders of magnitude and should yield a high neutron albedo on the surface of the moon (*5*).

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Differential Respirometer of Simplified and Improved Design

Abstract. *A differential respirometer, with a single reference flask for multiple active flasks, and with improved digital readout (in microliters, 0 to 500) volumometers, and which eliminates the need for glassware calibration, is described.*

A recent analysis of the construction and operation of respirometers suggested that a number of improvements might be possible and desirable.

First, the three-way-tail stopcock, as used in the conventional Warburg apparatus, appeared to be a needless and probably vestigial complexity. It permits the connection of the flask side of the manometer to the atmosphere or a source of gas, but a considerable extra amount of plumbing is required for gassing by evacuation, and a large amount of manipulation is needed for gassing by flow. A comprehensive discussion on altering gas atmospheres is given by Burris (*1*). The use of h-shaped tubes connected to the manometer serves to equalize the pressure applied to the two sides of the manometer, preventing displacement of the fluid during gas flow.

In the manometer design described here, a simple straight-through valve (Fig. 1) is placed between the two arms of the manometer at the level of the horizontal tube which goes to the flask. This valve may be open or closed, and performs the two functions necessary for an experiment which requires gassing: (i) to provide a connection to, and a free path between, the two arms of the manometer to equalize the pressures on the two columns of manometer fluid; and (ii) to connect the flask side of the manometer momentarily to the atmosphere for pressure equilibration.

The straight-through valve may be used either with a manometer with calibrated arms, or with a micrometric manometer in which a calibrated micrometer returns the manometer fluid to its balanced position by movement of a piston in the enclosed volume. This latter method gives a reading directly in microliters, which eliminates the need for calibration of glassware, and simplifies calculations. With the straight-through valve, parts can readily be placed so that, with the flow method of gassing, dead spots are minimized.

A constant pressure system has been used in respirometry for many years. It was facilitated when a mass-produced, plastic micrometer for gas displacement was produced by Roger Gilmont Industries. This represented an advance, but had the disadvantage that it did not have a digital readout. It had to be read like a machinist's micrometer. To overcome this, I designed a simple digital device in which the threaded portion of the micrometer passes through the three counter wheels, being slotted and keyed to the lowermost (Fig. 2). This was an original idea, but not new. An examination brought to my desk patents on similar devices, making a pile about 2.5 cm thick. The oldest was dated 1899. A minor improvement was gained by increasing the total displacement from 200 μl in the Gilmont to 500 μl in the model described.

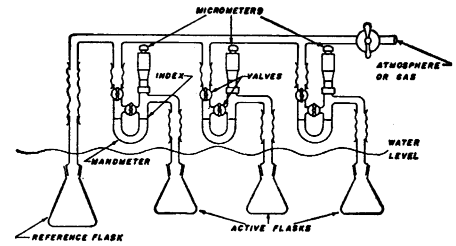

Fig. 1. Differential respirometer system with single reference flask.

The use of differential manometers for respiratory studies has been advantageous, as the influence of varying barometric pressure may thereby be eliminated. Differential manometers, however, have been little employed because of their complexity, fragility, and cumbersome size. It has been necessary to balance each flask containing a respiring material with a reference flask, cutting in half the number of measurements that can be made.

In a constant pressure system, as mentioned above, the change in volume is compensated by the measured movement of a plunger in the enclosed space. Thus there is no change in the level of the manometric fluid. Upon analysis, it became apparent that this permits the connection of a large number of manometer flask combinations to a single reference flask. This is illustrated schematically in Fig. 1. The effects of varying barometric pressure and moderate variations in temperature are elimi-

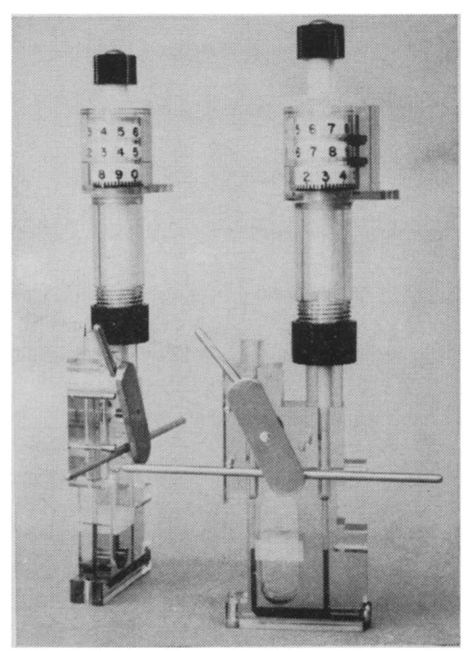

Fig. 2. Micrometric manometer (volumometer).