velocity. Thus, the velocity dependence of the slope of these distribution curves identifies the mechanism of filtration, and the magnitude of the slope indicates the intensity of the filtering action.

The filtering action of fiber mat is the cumulative effect of particle removal by individual fibers. The collection efficiency of an individual fiber, η_d, is defined as the ratio of the cross-sectional area of the aerosol stream from which particles are removed to the projected area of the fiber in the direction of flow and may be obtained from the slope of the distribution curve on the semi-log graph. This slope may be substituted directly for $(\ln N/N_0)/L$ in the expression derived by Langmuir (*2*) and confirmed by Davies (*3*) and Chen (*4*) for the single-fiber efficiency:

$$\eta_d = -\ln\frac{N}{N_0}\,\frac{\pi(1-\alpha)d_f}{4\alpha L} \qquad (1)$$

where N_0 and N are the upstream and downstream particle concentrations, respectively, α is the volume fraction occupied by the fibers, L is the thickness of mat, and d_f is the fiber diameter, all in consistent units. Fiber efficiencies, evaluated for those experiments conducted at linear velocities of 0.2 to 2.5 cm/sec showed that η_d is proportional to $1/\text{velocity}^x$, where x is experimentally observed to be approximately ½. This decrease of efficiency with increasing velocity indicates that, in this flow region, diffusion is the primary mechanism of filtration.

Using the method of Langmuir (*2*), which is based on diffusion of particles to the fiber surface in a fluid within a time equal to $\pi d_f/2v$, Stairmand (*5*) derived the following expression for the efficiency of diffusion collection:

$$\eta_d = \left(\frac{8D}{vd_f}\right)^{1/2}, \qquad (2)$$

where v is the fluid velocity, and D is the diffusion coefficient calculated from the Einstein expression (*6*)

$$D = \frac{CkT}{3\pi\mu d_p}\,. \qquad (3)$$

Here d_p is the diameter of the particle, C is the Cunningham coefficient, μ is the viscosity of the fluid, and the other symbols have their conventional meanings. The quantitative agreement between Eq. 2 and the experimental value of velocity dependence is confirmation that diffusion is the primary filtration mechanism under the specific conditions treated.

Particle diameters calculated from the experimental data by Eq. 2 are shown in Table 1 for experiments at several different velocities. The double sets of figures represent the two groups of particle sizes demonstrated by the separate portions of the curves in the semi-log radioactivity-distribution graphs discussed. The use of Eq. 2 emphasizes the smaller end of the particle-size spectrum and the results agree well with the lower end of a particle distribution graph obtained from electron photomicroscopy of an aerosol prepared at 2.5 cm/sec. In the third column of Table 1 another set of diameters, weighted toward the larger particle sizes, was calculated as follows. Radioassay results from the filter mats, along with specific-activity data from the irradiated zinc-foil electrodes, were combined to give the total weight of zinc removed by the filters in each experiment. The number of particles produced was calculated from both the volume of air transported and a particle concentration for the aerosol (read from a condensation nuclei counter, Gardner Associates). The concentrations observed are consistent with those which would be expected from the geometry of the experiment and from the coagulation theory expounded by Whytlaw-Gray (*7*). From the weight of aerosol filtered (a density of 1 is assumed) (*8*) and the number of particles per experiment, an average diameter was calculated for the particles in each experiment. It should be noted that at the higher velocity, the particle diameters calculated theoretically are low compared with the radiochemical value, because the interceptional process is beginning to contribute to the filtration. The agreement between the three different methods for determining particle size is good.

Table 1. Comparison of particle sizes determined by different methods.

Gas velocity (cm/sec)	Particle diameter (Å) calculated by:	
	Diffusion (Eq. 2)	Radiochemical data
0.2	104	180
	168	
0.35	100	160
	180	
0.5	52	135
	98	
0.85	36	105
	70	
1.4	35	80
	105	
2.5*	13	65
	28	

* An aerosol prepared at 2.5 cm/sec, examined by electron microscopy, had a median diameter of 120 Å and a geometric standard deviation of 2.0.

The influence of mechanisms other than diffusion can be seen in the distribution curves for higher velocities (4.8 to 44 cm/sec) in Fig. 1. The velocity independence of the lower part of these curves identifies the interceptional mechanism. The slope of the upper part of these curves increases with air velocity indicating that inertial effects are important. Particles in the large end of the size range contribute greatly to this deposit because of their greater content of material.

We have demonstrated that the character of radioactive aerosols may be determined by an analysis of their filtration behavior in terms of diffusion, interception, and inertial impaction by making use of observed depth distributions in specially prepared filters. In the diffusion region we have determined particle sizes from this behavior.

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Nitrous Oxide Produced by the Catalytic Oxidation of Organic Nitrogen Compounds

Abstract. *Nitrous oxide is produced by the catalytic oxidation of organic nitrogen compounds of several distinct structural types with Hopcalite catalyst at a space velocity of 21,000 hours^{-1} and at temperatures near 300°C.*

The production of nitrous oxide in 70 percent yield by the catalytic oxidation of ammonia has been reported by Kobe and Hosman who employed a manganese oxide-bismuth oxide catalyst at 200°C (*1*). Krauss (*2*) and Nagel (*3*)

Table 1. Hopcalite catalyzed oxidation of nitrogen compounds. The space velocity was 21,000 hr^{-1} and the temperature was 315°C.

Compound	Introduced concen. (ppm)	N_2O formed (% theoretical)
Ammonia*	140	70
Monoethanolamine*	19	20
Morpholine	35	16
Pyridine	40	17

* Raising the furnace temperature diminished the yield of N_2O from monoethanolamine and ammonia.

also report the production of nitrous oxide from ammonia with similar catalysts. With Hopcalite catalyst, an unsupported mixture of copper and manganese oxides, in an apparatus previously described (*4*), the same yield of nitrous oxide from ammonia was obtained. In addition, I obtained yields of nitrous oxide from organic progenitors in the range 16 to 20 percent (see Table 1).

Since there was no attempt to obtain maximum production of nitrous oxide, it may well be that there are conditions of temperature and space velocity (volumes of air stream per volume of catalyst per hour) which would result in greater yields of this substance with the same catalyst. Nitrous oxide concentrations in the catalytic reactor effluent were obtained by gas chromatographic comparisons with known gas mixtures prepared in stainless-steel pressure bottles. All three of the organic compounds studied, representing distinct structural types, produced the theoretical amount of carbon dioxide equivalent to complete combustion. In a separate experiment in which the concentration of ammonia introduced was 352 parts per million (ppm), less than 5 parts per million of nitrogen dioxide were detected in the reactor effluent. This indicates that the major product of the Hopcalite-catalyzed oxidation of ammonia is nitrous oxide, the remainder of the ammonia probably being converted to nitrogen and water.

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Sea Level Changes in the Past 6000 Years: Possible Archeological Significance

Abstract. *Evidence from many stable areas indicates that sea level has risen slowly during the past 6000 years, with a total change of about 6 meters. Since the same period is also important in the history of man, the rise in sea level explains the widespread submergence of building sites and other human relics along coasts where ancient man lived.*

The changes in sea level which accompanied the melting of the great ice sheets of the last glacial episode are important because knowledge of such changes can guide archeologists in their search for the habitation of ancient man in coastal areas. Such information can also be used for establishing the relative stability of many coastal areas during recent millennia; and it is important for coastal geomorphologists to know how long, if at all, the sea level has been at its present position.

Currently, there are three schools of thought relative to the changes in sea level which have taken place during the past 6000 years. (i) The sea has fluctuated repeatedly from about 1.5 m below to 3 m above the present level. This has been maintained in many articles by Fairbridge (*1*). (ii) Sea level has been constant during most or all of this period. This has been defended by Fisk (*2*) and by McFarlan (*3*), and has been a common opinion among Gulf Coast geologists. (iii) The rate at which sea level was rising decreased about 5000 to 6000 years ago, but the level has continued to rise slowly up to the present. This opinion has come from the dating of samples in various stable coastal areas, and was first expressed in 1956 by Shepard and Suess (*4*) and further documented in 1963 (*5*).

It should now be possible to settle this controversial history by utilizing the large number of new carbon-14 dates established for costal areas. In establishing the history of sea level it is necessary to obtain elevations and dates either of organisms that lived at or near sea level, or of salt marsh peat. These samples should come from areas that appear to have been as free from warping movements as possible.

Actually, no area has been entirely stable in the past, so all one can do is to avoid areas such as those where there has been upwarping due to isostatic recovery from ice loads; where deltas like the Mississippi are known to be sinking at a very appreciable rate; where there has been recent mountain-building; or where earthquakes indicate instability. The following have been considered as satisfactory areas, partly because many samples from them have been dated: the shelf and coastal area of Texas, the coastal waters around Florida, and the lowlands of the Netherlands. Samples from a number of other areas that are probably equally stable have been compared with the dates from these three, and all of the information is plotted in Fig. 1. It will be seen that the result is highly favorable to the third hypothesis of a slow rise during the past 6000 years. The chief exceptions are from Australia, but recent work along that coast indicates that the dates from these samples are unreliable indices of rises in sea level (*6*).

If the sea had fluctuated in the manner suggested by Fairbridge, lowland areas that have been examined in great detail like the coasts of Texas and Louisiana, South Florida, and the Netherlands, would have yielded clear indications of high sea level during the postglacial period. No such evidence exists, as is clearly shown by Gould and McFarlan (*7*), Scholl (*8*), and Jelgersma (*9*) for the three areas.

Further substantiation of the general curve comes from a large number of dates from the East Coast published by Redfield and Rubin (*10*), Stuiver and Daddario (*11*), Bloom and Stuiver (*12*), and McIntire and Morgan (*13*). Previously, it had been supposed that the East Coast, particularly in marginal glaciated areas, could not be used for this purpose, but plotting of the dates against depth (Fig. 2) shows almost the same history of rise that was established from the localities used in Fig. 1. The only difference is that for the past 7000 years, dates from the