erties of the Martian surface (*6*, *10*) the amplitude of seasonal temperature variations decreases by a factor of 10 within a layer of the order of several centimeters. If this is the case, the shorter wavelengths would be more likely to reflect seasonal variation than would the longer wavelengths.

Recent radar results (*16*) suggest that Martian dark areas are probably lowlands rather than highlands; thus one is tempted to ascribe to them higher humidity and higher reflectivity than to the dry, bright uplands. One way to check this conclusion would be to measure seasonal and diurnal changes in radar reflectivity of bright and dark areas; any correlation between radar reflectivity and the well-known Martian "wave of darkening" would be of great interest. This task will be difficult to accomplish from Earth because of the small variation of the phase angle and the large variation of distance between Earth and Mars; an orbiter would be ideally suited for the purpose. One must remember, however, that plantetary radar reflectivity is a function of many parameters; thus a seasonal variation could be accounted for by several models. Nevertheless, the ice-water mechanism seems more realistic and more attractive than an analogous mechanism based on the variable photoconductivity (*17*) of the soil.

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28 December 1967

Atmospheric Particulates: Specific Surface Areas and Densities

Abstract. *Suspended particulates in Pittsburgh air were collected on glass-fiber filters. The specific surface areas of particulates brushed from the filter surface varied from 1.55 to 4.51 square meters per gram when measured by the Brunauer-Emmett-Teller (BET) method with nitrogen and krypton, after 8-hour degassing of the samples at 25°C. Specific surfaces of the same samples varied from 4.3 to 8.00 square meters per gram after 4-hour degassing at 200°C. Bulk densities and densities of samples were 0.49 to 0.64 and 2.0 to 2.6 grams per cubic centimeter, respectively. These data provide some basis for explanation of unpredictable responses reported after inhalation of mixtures of pollutant gases and particles by animals and man; they should also assist in interpretation of gas-solid phase reactions in the atmosphere.*

It has been clearly demonstrated experimentally that simple mixtures of air pollutants, when inhaled by animals during single short exposures, can cause unpredictable responses (*1*); two of the responses noted have been referred to as synergism and antagonism (*2*). The interaction of gases and vapors with particles is believed to be associated with the abnormal effects observed in the population during episodes of acute air pollution in Donora, Pennsylvania, the Meuse Valley, and London. Although such studies were followed by investigations of the particle-size distributions of potentially irritant particulates in urban atmospheres (*3*), little work has been done on the physical properties of suspended particulates in urban air. One of the mechanisms proposed to explain the enhanced effects observed when certain combinations of gases and particles are inhaled is that the gas is adsorbed or absorbed by the particle, with subsequent high local concentration of gas at the site of deposition of the particle in the lung (*4*).

We now report data on specific surface area and density for suspended particulates in Pittsburgh, Pennsylvania. These data, the first to be reported for an urban aerosol, together with accumulating data on the dimensions and chemical natures of urban aerosols, should assist toxicologists in interpretation of effects observed during episodes of acute air pollution and during inhalation experiments with animals in the laboratory.

Samples of air were collected on the roof of the Graduate School of Public Health between November 1966 and April 1967. Particulates were collected on filter paper (*5*) with a high-volume sampler (*6*). Stations of the National Air Sampling Network normally collect samples during a 24-hour period, but this study required large samples for analysis, and sampling time was 1 to 2 weeks at flow rates of 0.87 to 1.45 m^3/min. For analysis, samples of about 1 g were obtained by brushing of the top layer of removable dust from the filter; data on particulate weight concentration (micrograms per cubic meter) for this site are available (*7*).

The specific surface of samples was measured by the Brunauer-Emmett-Teller (BET) method (*8*); nitrogen and krypton were each used for four sam-

Table 1. Specific surface areas, bulk densities, and densities of suspended particulates in Pittsburgh air; adsorbates are in parentheses. Density values are averages of two determinations for each sample. Effective cross-sectional areas occupied by the adsorbates were assumed to be 16.2 and 19.5 Å^2 per molecule for nitrogen and krypton, respectively (*8*).

Sampling period	Specific surface (mg^2/g) degassed at		Density (g/cm^3)	
	25.0°C	200°C	Bulk	Specific
10–22 Nov. 1966	(N) 4.51	(N) 6.86	0.49	2.1
22–29 Nov. 1966	(Kr) 2.61	(Kr) 4.81	.62	2.1
12–26 Jan. 1967	(N) 2.83	(N) 7.27	.57	2.0
26 Jan.–10 Feb. 1967	(N) 3.35	(N) 8.00	.60	2.1
10–24 Feb. 1967	(N) 2.46	(N) 4.52	.63	2.6
3–18 Mar. 1967	(Kr) 1.55	(N) 4.61	.64	2.0
3 Mar.–7 Apr. 1967	(N) 2.86	(N) 4.49	.62	2.0
10–17 Apr. 1967	(Kr) 2.35	(N) 4.31		2.3
	Arithmetic means			
	2.81	5.61	0.59	2.2
	Arithmetic standard deviation			
	0.86	1.50	0.05	0.2

ples because in the latter four samples the total surface available for adsorption was too little for nitrogen. The specific surface of each sample was measured twice: once after degassing for 8 hours at 25.0° ± 1.0°C and again after degassing for 4 hours at 200°C. In all instances the specific surface available for adsorption was higher in the second measurement (Table 1). The amount of material vaporized was estimated to be about 10 percent by weight.

The bulk density of samples was determined by placing a small amount of each sample in a capillary column (inner diameter, 2 mm) of known weight and volume and closed at one end. The tube was tapped gently on a hard surface during and after introduction of the sample, until gentle tapping did not increase the height of the sample above a predetermined level in the tube. Duplicate determinations were made for each sample (Table 1).

The densities of the particulate samples were determined by placing a weighed sample in a weighed micropycnometer of about 1-cm^3 volume (*9*). While the sample was under vacuum, ethylene glycol was introduced by syringe until it was covered. The weight per unit volume of dust was calculated from glycol density and by assumption that the volumes of glycol and particulate sample were additive (Table 1).

The results for specific surface of suspended particulates are lower than those reported (*10*) for activated carbons (560 to 1397 m^2/g) and silica gel (669 m^2/g), but are higher than that of diatomaceous earth (4.2 m^2/g). Values are lower than those determined for particulates emitted in the exhaust of a diesel engine—28 to 50 m^2/g (*11*).

Little is known about the bulk density or specific density of particulates in urban atmospheres, so it is difficult to compare our results with those of others. Whitby *et al.* (*12*) found that the specific density of acetone-insoluble particles in urban air varied from 1.5 to 3.0 g/cm^3; bulk density varied from 0.2 to 1.5 g/cm^3. Junge, on the basis of chemical composition, suggested values of 1 to 2 g/cm^3 for most natural aerosols, depending on the relative humidity (*13*).

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Enzyme-Catalyzed Reactions of the Carcinogen N-Hydroxy-2-fluorenylacetamide with Nucleic Acid

Abstract. *A protein fraction obtained by gel filtration of a 105,000*g *supernatant of rat liver catalyzes three reactions of the hepatocarcinogen* N*-hydroxy-2-fluorenylacetamide with nucleic acid. Cofactor requirements and isotopic studies suggest that the reactive intermediates involved may be* N*-2-fluorenylhydroxylamine, and phosphate and sulfate esters of* N*-hydroxy-2-fluorenylacetamide.*

Interactions of chemical carcinogens with nucleic acids and proteins may play an important role in the induction of tumors (*1*). The aromatic amides constitute a class of carcinogens for which metabolic activation is a prerequisite to combination with macromolecules. A primary step in this activation appears to be *N*-hydroxylation (*2*). *N*-Hydroxy derivatives are generally more carcinogenic than the parent amides (*3*) and are thought to be more closely related to the metabolites which ultimately react with protein and nucleic acid (*1*). Further metabolic transformation of the hydroxamic acids is necessary for combination to occur, however, as in the

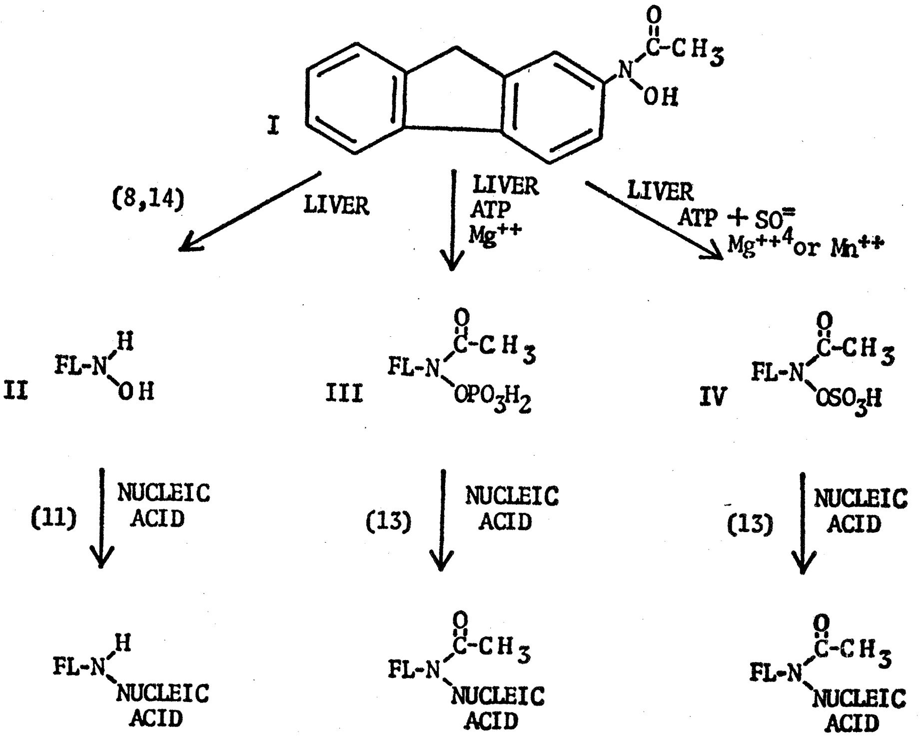

Fig. 1. Proposed pathways of incorporation of N-OH-FAA into nucleic acid by rat liver. Numbers in parentheses denote references to publications in which the reaction or its potential has been demonstrated; *FL* = 2-fluorenyl.