from 0.001 to over 0.40 p.p.m., depending on the city and the time of year. In Detroit 96 per cent of 18,000 1/2-hour readings were less than 0.15 p.p.m. and 67 per cent of these were 0.05 p.p.m. or less. Average monthly values of 0.02 p.p.m. were recorded during the summer months of June and July. During the winter months the average values reached a high of 0.11 p.p.m. in December.

Another gas found in the community atmosphere is *hydrogen sulfide*, which at ordinary temperatures has a specific gravity of 1.19 referred to air and has in very low concentrations, a powerful characteristic odor. The sources of this gas may be a wide variety of industrial processes, including refineries, sewerage installations, oil fields, and, in slight amounts, auto exhaust. Air hygienists are interested in hydrogen sulfide because of its effects on health, its odorous characteristics, and its economic effects. The toxic effects are well known. In the field of air pollution, it was identified as the atmospheric contaminant that killed 22 people and hospitalized 320 in Poza Rica, Mexico.[4]

The economic effects of hydrogen sulfide are best illustrated by the discoloration of lead-pigmented paints, the reported incidents of which are too numerous to mention. It should be stated, however, that these reported observations occurred during times when the excess liberations of hydrogen sulfide may be classified as accidents. During normal periods the hydrogen sulfide never reaches such concentrations. Moreover, it does not damage plants in low concentrations. Zimmerman[22] states that when 29 plant species were fumigated with less than 40 p.p.m., little or no injury occurred.

Data on the concentrations of hydrogen sulfide in various cities are limited. In general, however, except for accidents, or in the direct path from a known source, the concentrations range from 0.000 to 0.020 p.p.m.

Hydrogen fluoride, with respect to air pollution, is one of the most important halogen compounds. Hydrogen fluoride is liberated into the atmosphere from many sources; however, the biggest problems to date are in areas near aluminum plants and phosphate-fertilizer plants. The petroleum industry, in the synthesis of high-octane gasoline, uses considerable amounts of anhydrous hydrogen fluoride. Tables 3 and 4 show the data reported by Largent on concentrations of fluoride and hydrogen fluoride.[23]

Fluorides are also used, and are a source of air pollution, in the electrolytic refining of metals, pickling of metals, electroplating operations, etching of glassware, steel manufacturing, and cement plants. Although coal varies[24] in fluoride content, its burning results in the emission of fluorides.

[22] P. W. Zimmerman, "Effects on Plants of Impurities Associated with Air," *Proceedings of the U. S. Technical Conference on Air Pollution*. McGraw-Hill, New York, 1952, Ch. 7, p. 127.

[23] E. J. Largent, "Effects of Air-borne Fluorides on Livestock," *Proceedings of the U. S. Technical Conference on Air Pollution*. McGraw-Hill, New York, 1952, Ch. 6, p. 65.

[24] A. E. Crossley, Fluorine in coal: IV. The industrial significance of fluorine in coal in steam-raising, gas-making and brewing, *J. Soc. Chem. Ind. (London)*, **63**, 34 (1944).

TABLE 3

Concentrations of Fluoride in the Atmosphere
(Within or in the vicinity of certain factories as reported by several investigators)

Location	Concentrations of F in air: mg./m.[3]	Concentrations of F in air: p.p.m. as HF	Observer
Cryolite plant (inside)	16–497	18–547	Roholm
Aluminum plant (inside)	0.04–3.77	0.05–3.43[a]	Agate
Aluminum plant (outside)	0.03–0.22	0.04–0.24	Agate
Rock phosphate plant (outside)	0.02–3	0.01–4.3[b]	Largent

[a] Maximum amount reported in the gaseous form was 2.79 p.p.m.
[b] Maximum amount reported in the gaseous form was 0.029 p.p.m.

TABLE 4

Fluoride Content of Samples of Air Collected on a Farm Adjacent to a Rock Phosphate Factory

1947	Fluoride in air expressed as HF: Gaseous component (p.p.m.)	Fluoride in air expressed as HF: Total, including dust (p.p.m)
June	0.012	0.012
	0.024	4.3
July	0.012	0.024
	0.024	0.056
August	Nil	Nil
	0.029	0.040
October	Nil	Nil
	—	0.173

In sufficient concentration, hydrogen fluoride is toxic to humans; however, the damage to plants and livestock from gaseous and particulate fluorides has received more attention. The gladiolus is one of the most sensitive plants, being injured in atmospheres having values of only 1 or 2 parts of fluorine to a billion parts of air. In livestock, fluorosis results in irregularly worn teeth, a stiff-legged gait, poor nutritional state, and a reduction in the output of milk.

Clayton and Giever,[25] using filter paper as the collecting medium, reported an average fluoride concentration in Detroit of 0.12 μg. per cubic meter of air; using standard impinger, the value was 0.87 μg. per cubic meter of air. They concluded the difference between these values probably could be accounted for by the gaseous fluorides.

Oxides of nitrogen. Nitrogen dioxide and its polymer, nitrogen tetroxide, are found together in the atmosphere. Some of the sources of this gas are the manufacturing of nitric acid and the nitration of cellulose and other organic materials, such as the manufacture of celluloid and certain types of film. It is also liberated

[25] G. D. Clayton and P. M. Giever, "Report on 1951 Environmental Findings." March, U. S. United States Section, International Joint Commission, Technical Advisory Board on Air Pollution.