Thus, our data provide further evidence for a "vesicle hypothesis" (*9, 13*) and suggest that transmitter is released by exocytosis with at least temporary incorporation of vesicle components into plasma membranes (*14*).

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4. Fixation consisted of perfusion with a mixture of phosphate-buffered glutaraldehyde and formaldehyde followed by soaking of slices for 1 hour at 4°C in the same fixative and then postfixing in 1 percent O_sO_4. After slices were dehydrated in ethanol and embedded, large ultrathin sections were cut in the transverse plane.
5. Electron micrographs were systematically taken with a Siemens Elmiskop IA by recording fields at the corners of grid openings. For morphometric measurements, a series of random electron micrographs were assembled, and all axodendritic synapses that showed characteristic membrane densities were evaluated. Profile circumferences were measured with a map measurer, and profile areas with a planimeter.
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3 December 1971; revised 14 January 1972 ■

Carbon Monoxide Concentration Trends in Urban Atmospheres

Carbon monoxide is a pollutant of urban air that has recently begun to attract increased attention (*1*). Although the concern about this gas at present is associated with vehicular exhaust, CO is not a new pollutant in man's environment. It is always produced during incomplete combustion and has long been artificially present in man's environment.

A number of studies of CO concentrations in the air of New York City have been made during the last 50 years (*2–6*). For purposes of comparison, the data of Table 1, which summarize the results of studies made between 1922 and 1967, are limited to those locations in the city at which vehicular traffic is heaviest. According to these data, the CO concentration near busy thoroughfares and intersections in New York City is not increasing and may actually have decreased since 1922.

The predominant modern source of CO is the exhaust gases from the internal-combustion engine. Approximately 97 percent of the CO in the air of New York City is currently attributable to this source (*7*). Prior to the advent of the internal-combustion engine, the major source was fuel burning for space heating, water heating, cooking, and the production of electrical energy. The types of fuel consumed in New York City during the past several decades have changed radically, the predominant shift having been from coal and manufactured gas (*8*) to oil and natural gas. The exhaust gases from the combustion of fuel oil and natural gas do not contain CO in significant amounts. The various fuels consumed in New York City during 1934 and 1965 are shown in Table 2 (*2, 9*).

Concurrently with changes in the types and amounts of fuel being burned, there have also been improvements in the combustion efficiencies of heating units. The coal- and wood-burning stoves that were present in many individual apartments 50 years ago have been replaced by larger, more efficient boiler units that provide heat and hot water for entire apartment buildings. Moreover, the coal furnaces that provided heat for tens of thousands of New York's private homes a half century ago have been replaced with oil or gas furnaces.

As an example which illustrates such changes in fuel consumption patterns and the corresponding reduction in CO emissions, let us consider the effect of the elimination of anthracite coal as a space heating fuel in one- and two-family dwellings. In 1934, 4.6×10^6 tons (4.1×10^6 metric tons) of anthracite were burned in such structures in New York City for space heating purposes (*9*). If we assume that 1 pound (454 g) of coal requires 8 pounds of air to produce 13,000 Btu (51,500 kcal) of heat (*10*), and that flue gas from coal-burning dwellings is approximately 1 percent CO (*11*), we estimate that 400,000 tons of CO were emitted from the one- and two-family dwellings that burned coal in 1934. The vehicular

Table 1. Carbon monoxide concentrations in New York City streets from 1922 to 1967.

Year	CO concentration (ppm)	Sampling condition	Reference
1922	100	Moderate-heavy traffic	(*5*)
1932	Range, 2–129; average, 32	Heavy traffic (average: 1900 cars per hour)	(*6*)
1966	Peak hourly average range, 19–95; average, 32	In-traffic sample, very heavy traffic	(*2*)
1967	Hourly average range, 1–17; average, 8	45th St. and Park Ave., continuous samples, heavy traffic flow (1000 to 3400 vehicles per hour)	(*3*)

Table 2. Consumption of the principal fossil fuels in New York City during the years 1934 and 1965.

Year	Anthracite coal ($\times 16^6$ tons)	Bituminous coal ($\times 16^6$ tons)	Fuel oil ($\times 10^6$ gallons)	Natural gas* ($\times 10^9$ cubic feet)	Manufactured gas* ($\times 10^9$ cubic feet)
1934	10.6	9.1	611	None	54
1965	0.72	5.4	4086	167	None

* One cubic foot equals 0.028 m^3.

emissions of CO in the five boroughs of New York City are currently estimated to be 1.4×10^6 tons, whereas the total CO emissions from all space heating sources are at present only 20,000 tons (*7*). Thus, in 1934 this single source, 4.6×10^6 tons of anthracite, contributed about 30 percent of the quantity of CO presently being emitted from vehicular sources. The total coal consumption in 1934 was 10.6×10^6 tons of anthracite and 9.1×10^6 tons of bituminous.

The CO emissions from automobiles in New York City in 1934 are difficult to estimate. Gasoline consumption in the metropolitan area, which includes New York City and nearby counties in New York, New Jersey, and Connecticut, was about 525×10^6 gallons (1980×10^6 liters) in 1934, as compared to 2.1×10^9 gallons in 1969. Because of the relatively greater growth in the suburban counties, a larger fraction of the gasoline is undoubtedly now purchased and used in the suburban counties rather than within the city. The only available figures for gasoline consumption for the years 1934 and 1969 are those which include Nassau, Suffolk, Rockland, and Westchester counties, in addition to New York City. Also, increased emissions due to the greater quantities of gasoline now being consumed are partly offset by the higher combustion efficiency of contemporary engines (*12*). The higher concentrations of CO in the air of New York City in 1934 could undoubtedly be explained fully if data were available on other sources of this gas whose outputs have since diminished or been eliminated.

This historical trend may be similar to that in other cities in climates that require space heating, but Paris is the only other large city for which we have been able to find comparable data. In 1928, Cambier and Marcy (*13*) reported CO concentrations in the streets of Paris that ranged from 40 to 60 parts per million (ppm). In a report by Labonde and Menetrier (*14*) of measurements made during the period from 1959 to 1964, it was reported that the hourly concentration of CO exceeded 10 ppm only 91 times in the 6 years of the study.

A discussion of the concentrations of CO to which human beings have been exposed in past years would not be complete without the inclusion of a number of indoor sources of CO that no longer exist. For example, the use of manufactured gas, which was discontinued in New York City in 1956, was the cause of several hundred accidental deaths per year, in addition to a considerable number of suicides. Deaths due to accidental exposure to CO in New York City have diminished over the years, from a peak of 379 in 1945 to an average of three per year during the past 5 years (*15*). The number of sublethal cases of acute CO intoxication is presumed to have been very much larger than the number of fatalities, and it can also be assumed that relatively high exposures which did not produce symptoms of acute intoxication occurred with some degree of regularity, but there are no data on this aspect of the problem. Badly adjusted ventilation systems and leaking gas fixtures were the main causes of excessive indoor exposure to CO.

It is possible that even higher concentrations of CO in the air prevailed in past times under more primitive conditions of living, but very few data are available. A recent report from New Guinea (*16*) shows that the concentration of CO in the huts (indoor fires are used for space heating) averages 21 ppm, with peaks as high as 150 ppm. Thus, although CO from relatively advanced technology is a ubiquitous contaminant of the modern environment, it is very possible that the concentration of this gas in the air we breathe is now lower than at any time since man first learned to use fire.

Lewin (*17*) traced the early history of CO poisoning and concluded that this poisoning "of all, stands alone in its close relation to the history of the civilization of mankind." Among the many examples given by him, he cites Julian the Apostate (A.D. 331–363), who was almost asphyxiated because he had a small fire brought into his room. We believe that the dangers from badly ventilated indoor stoves are well known to many Americans. No data on Japanese homes in which the hibachi is used for heating have come to our attention, but they would be of interest in this regard.

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11 January 1972