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1971, pp. 179-182. https://doi.org/10.56577/FFC-22.179

*in:*

*San Luis Basin (Colorado)*, James, H. L.; [ed.], New Mexico Geological Society 22 nd Annual Fall Field Conference Guidebook, 340 p. https://doi.org/10.56577/FFC-22

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# RESULTS OF PRELIMINARY STUDIES OF THE AIR POLLUTION METEOROLOGY OF LIMITED AREAS IN THE SAN LUIS VALLEY

by

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## BLANCA

A wind recording station was established at Blanca by the Colorado Air Pollution Control Division during the winter and spring of 1969-1970. The wind patterns measured by that station showed the usual night-day reversal with high day and low night wind speeds typical of valleys. However, the directions were not those observed in Alamosa.

During the winter, the predominant wind directions were day NW and night E and S; while in the spring and summer they were day NW and night varying between S and W. It is tempting to speculate that Blanca sits not in the San Luis Valley but in a sub valley showing distinct air movement properties. From the point of view of air pollution meteorology, a valley can be considered to have sides as low as 100 ft. (Weedfall, 1967). Such a rise in elevation can be found to the south of Blanca on the south side of Trinchera Creek. It is possible to visualize three valleys; one running W-E, another NW-SE, as well as a N-S valley to the west and south of Blanca. (fig. 1). It is usual to talk about a down-valley flow of air at night, and an up-valley flow of air during the day. If the three possible valleys to the east and south of Blanca assume different importance with various seasons and meteorological conditions, it is easy to see a possible explanation to the observed wind patterns.


FIGURE 1.
Photograph of plastic relief map, Fort Garland-Blanca area prepared by the U.S. Army Corps of Engineers.

These are not academic speculations for it was at one time proposed to put a paper pulp mill just west of Blanca. It has been calculated that the vapors from this plant would have affected Alamosa due to the patterns of wind direction and speed.*

## GREAT SAND DUNES NATIONAL MONUMENT

The state maintains a particulate matter sampler at the Sand Dunes. This station showed an annual average of 24 ug/M$^3$ with a maximum of 112 ug/M$^3$ and a minimum of 2 ug/M$^3$. These are the lowest figures in all categories out of the 50 stations reporting in the state. The new state standards allow 55 ug/M$^3$ particulate matter. Thus you are breathing some of the purest air in the state, provided you do not run into a sandstorm. Of the 24 ug/M$^3$ only 1.2 ug represents benzene solubles. In all likelihood, these would be primarily hydrocarbons.

If the valley is viewed from the dunes, the cities of Alamosa and Monte Vista can be easily identified by the plume of material rising into the air above them. Also easily seen, if burning, are the teepee burners at the various sawmills in the valley. When the wind conditions are right, there will be a haze layer extending from the south, along the west side of the valley and thinning out just beyond Del Norte. This layer is not entirely natural, having man made components in it. Pollutants will not rise through it, but will rise to join this layer and add to it. Usually the layer will have a sharp cut off on top indicating that the upper limit is not diffusion controlled. In general, the layer is thicker to the south. This is for two reasons:

(1) The viewing angle produces greater layer depth to the south.
(2) The pollution sources to the south, including a contribution from New Mexico, (most likely originating

* Calculations done by the Colorado Air Pollution Control Division of the Colorado Department of Health.

on the Taos Plateau), produce materials carried into the valley by southerly winds.

Scientists at Los Alamos have reported on particulate matter haze in the Rio Grande Valley opposite Los Alamos (Liebenbert & Schulte, 1970). It was proposed the haze was due to the power plants in the Four Corners. I would like to suggest that at least part of the haze is due to sources on the Taos Plateau, being the same ones contributing to the haze seen here.

Major particulate sources in the San Luis Valley would be agricultural burning of ditches and fields in the spring and late fall. Yearly sources are teepee burners of lumber mills and various county and city dumps. In addition there is the contribution of the cities in the valley.

All monthly averages shown are based on data taken during 1970, although conclusions were drawn from total data available to date. Numerical data were taken from the Colorado Air Pollution Control Division reports. On occasions, Alamosa particulate matter levels equal those of Denver. (Table I). However, the benzene solubles

TABLE I
COMPARISON OF ALAMOSA AND DENVER IN PARTICULATE MATTER POLLUTION FOR 1970
MEASURED PARTICULATE MATER IN ug/M³

| | | MIN.-MAX. RANGE IN GREATER DENVER AREA | |
|---|---|---|---|
| | ALAMOSA | CASTLE ROCK | GATES |
| Annual Average | 73 | 61 | 132 |
| Maximum | 345 | 127 | 404 |
| Minimum | 24 | 24 | 54 |
| | Benzene soluble in ug/M³ | | |
| | ALAMOSA | CHERRY CR. DR. | GATES |
| Annual Average | 3.7 | 2.5 | 9.6 |
| Maximum | 11.0 | 8.6 | 36.9 |
| Minimum | 0.9 | 0.7 | 2.8 |

TABLE II
MONTHLY AVERAGES OF POLLUTION INDICES IN ALAMOSA FOR 1970

| | PARTICULATE MATTER ug/M³ | BENZENE SOLUBLES ug/M³ | SULFATION $SO_3$-Mg/100cm³/day |
|---|---|---|---|
| Jan | 72 | 6.5 | 0.01 |
| Feb. | 71 | 6.4 | 0.03 |
| Mar | 73 | 2.6 | 0.02 |
| Apr | 70 | 3.3 | 0.03 |
| May | 78 | 3.1 | 0.03 |
| June | 69 | 2.7 | 0.00 |
| July | 60 | 2.5 | 0.07 |
| Aug | 55 | 2.6 | 0.04 |
| Sept | 59 | 3.7 | 0.02 |
| Oct | 78 | 3.1 | — |
| Nov | 121 | 3.7 | 0.02 |
| *Dec | 82 | 4.7 | 0.03 |

* Storm fronts established strong winds for greater than ½ of this month.

would indicate that we are at no time nearly as high as Denver in hydrocarbon concentration, (Table II), or, from other data, in oxide pollutants, (NO, $NO_2$, $SO_3$, CO, etc.). (figs. 2 & 3). The Gelman data shows a bimodal pattern in the particulate matter pollution, with both peaks occurring at night. (fig. 4). The predominant pollution episode is at night due to the very common occurrence of inversions over the city. These are at a very low altitude, less than 100 ft. for those which have been measured. Particulate matter values are obtained from 24 hour averages. Since our pollution occurs mainly at night, the values during the episode would be approximately 1½ the average shown.

The data can be explained under the following assumptions, although what follows does not constitute a proof.

(1) The major source of pollution in Alamosa, at present, is home heating.
(2) Inversion or stagnant air conditions occur almost nightly during the winter.
(3) There is a small ventilation* factor (horizontal), which is not capable of clearing the air under the maximum pollution rate.
(4) There are two temperature drops of large proportions; one at sunset and one at sunrise.

At sunset the temperature drops suddenly; all home furnaces come on to keep up with this, as well as the added load of cooled air introduced into the homes due to the many entrances and exists from many homes at this time. Also occurring is the onset of the inversion to trap this increased output of pollution. The horizontal ventilation cannot keep up and there is an increase in pollution concentration. After 8:00 p.m. the furnaces catch up and activity slows down, resulting in a decreased pollution output rate. The ventilation then starts to reduce the level of pollution under the inversion, but it decreases towards morning as the wind speed decreases. This results in a slight pollution buildup during the night after an initial drop. With sunrise there is another drop in temperature and an increase in activity resulting in another peak of pollution output. With sunrise there also occurs the breaking of the inversion and both horizontal and vertical ventilation increases significantly, clearing the air for the Chamber of Commerce's "pure, clean San Luis Valley air."

The small peak at midnight is not accounted for by this explanation. What would be needed to explain it would be some localized source with an output just after midnight.

## MONTE VISTA

Monte Vista has problems similar to Alamosa (and possibly worse), but documentation is not available.

## ANTONITO

The Mobile Air Quality Laboratory was stationed in Antonito from April 13-21, 1971. During this time it measured CO, NO, $NO_2$, $TO_x$ concentrations. All of these quantities were what would be considered background range (fig. 5). However, the particulate matter count averaged 224 ug/M³ for the three 24 hour samples taken during this period. No confirmation of the source of this pollution was made and this needs further checking.

* Ventilation-air movement resulting in removal of dilution of pollutants.

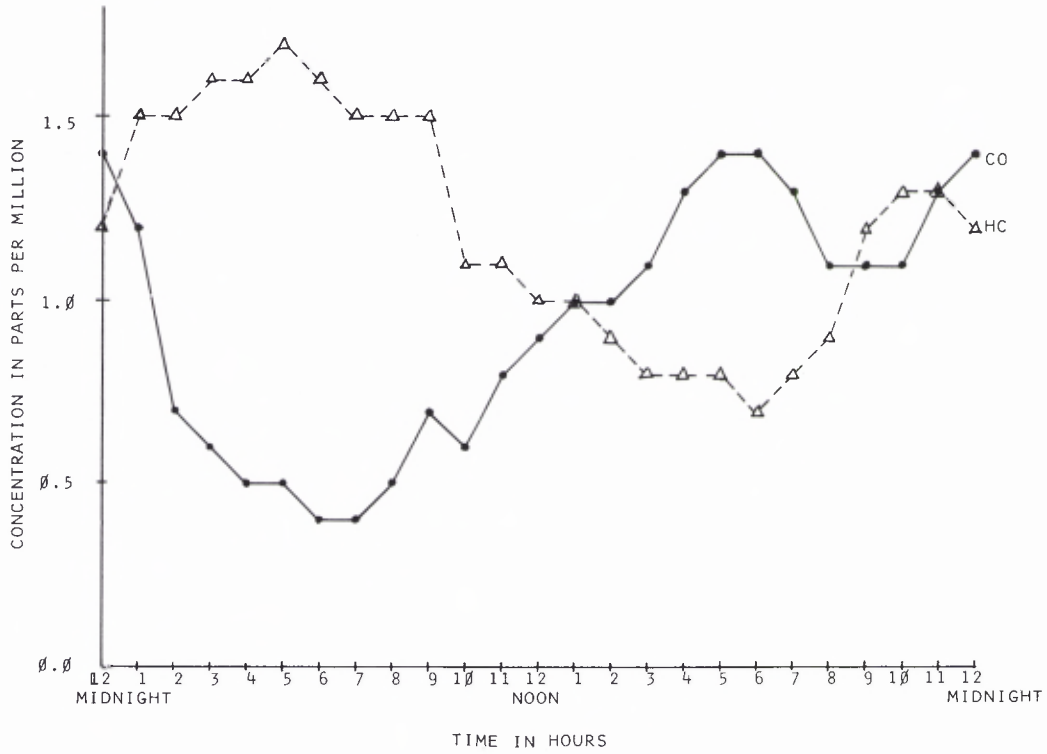


FIGURE 2.

Daily pattern of carbon monoxide (CO) and total hydrocarbons (HC) in Alamosa averaged over a three week period during March, 1971. Data taken by the Colorado Mobile Air Quality Lab.

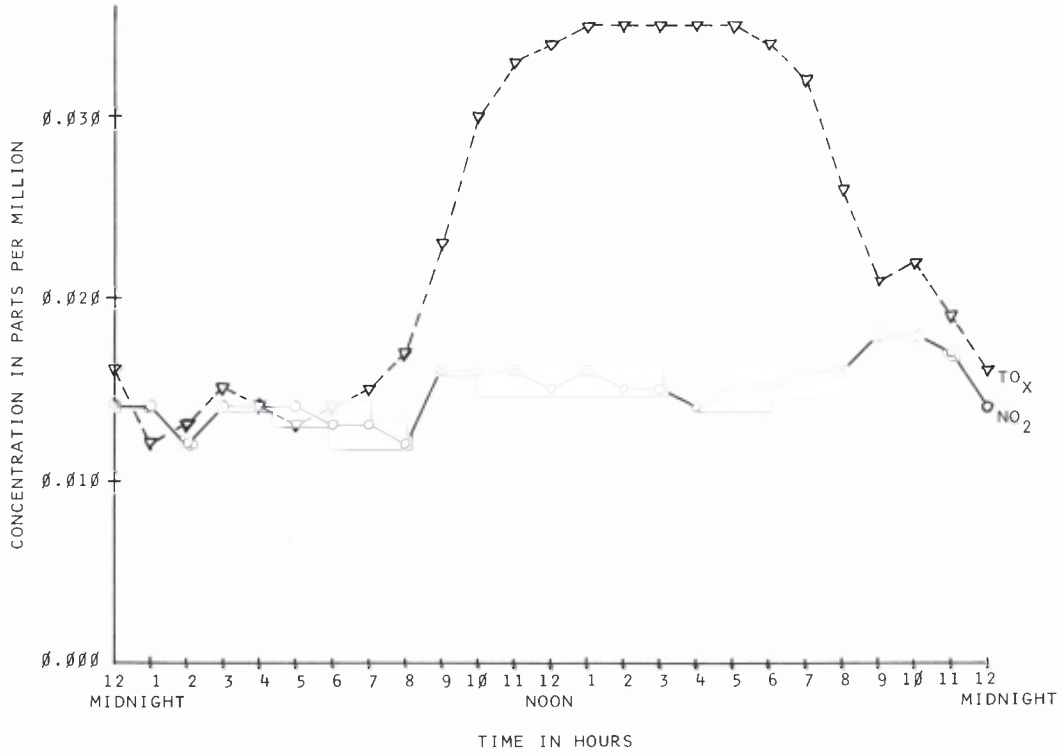


FIGURE 3.

Daily pattern of total oxidant ($TO_x$) and nitrogen dioxide ($NO_2$) levels in Alamosa over a three week period during March, 1971. Data taken by the Colorado Mobile Air Quality Lab.

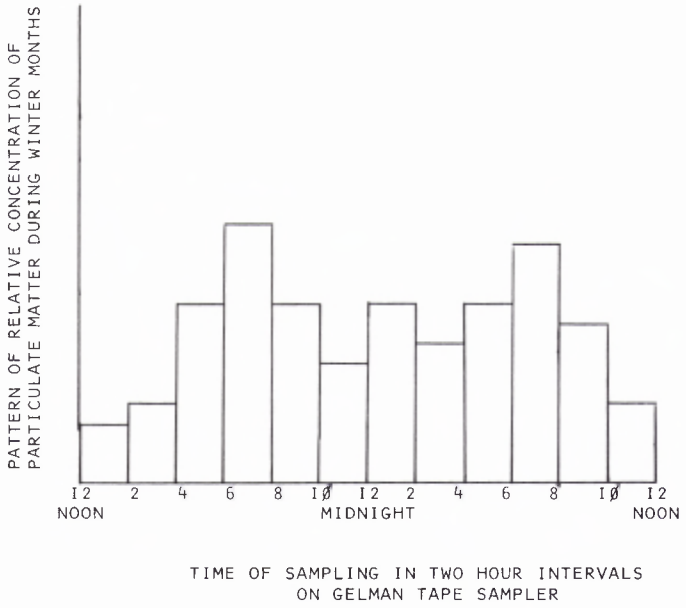


FIGURE 4.

Daily particulate matter pollution time pattern for Alamosa during the winter months 1970-71.

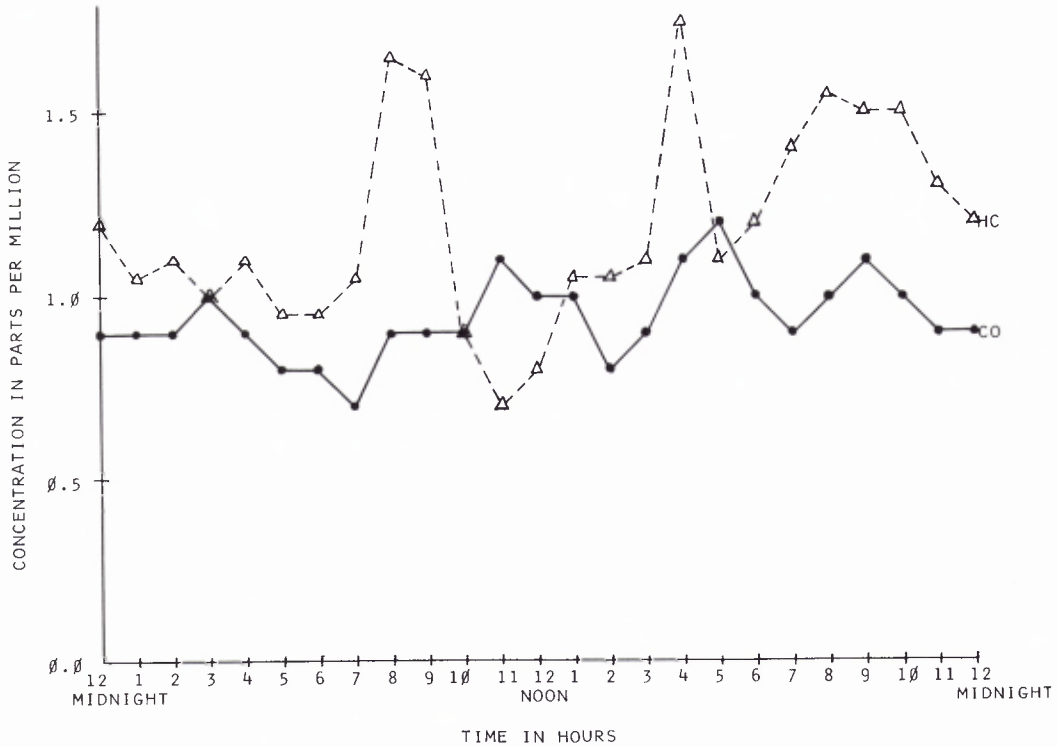


FIGURE 5.

Daily pattern of carbon monoxide (CO) and total hydrocarbons (HC) in Antonito averaged over a 9-day period in April, 1971. Data taken by the Colorado Mobile Air Quality Lab.

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