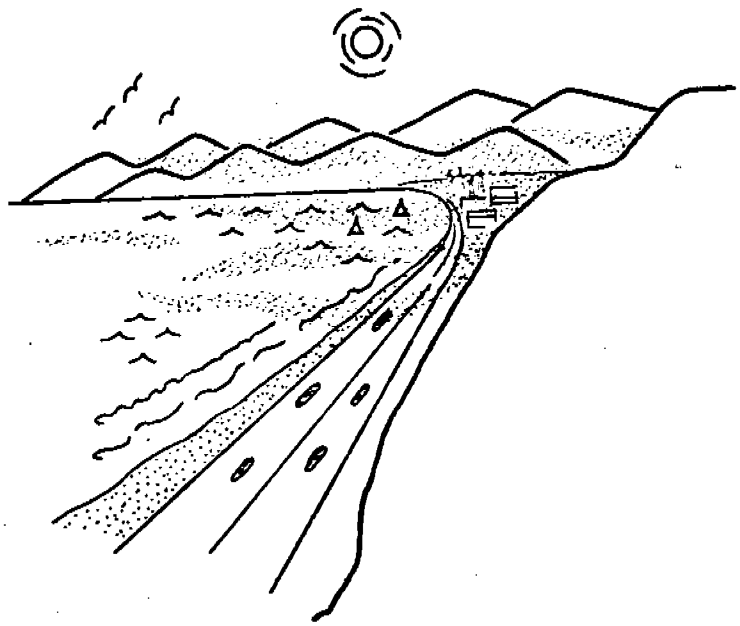
AIR POLLUTION IN VENTURA COUNTY

a study of the nature and extent of air pollution in ventura county



AIR POLLUTION IN VENTURA COUNTY

A study of the nature and extent of air pollution

in Ventura County, California

Conducted Jointly by

THE COUNTY OF VENTURA HEALTH DEPARTMENT

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and

THE BUREAU OF AIR SANITATION
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Supported in part by

The United States Public Health Service
Department of Health, Education, and Welfare

June 1966

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CONCLUSIONS AND RECOMMENDATIONS

Ventura County has a photochemical air pollution problem - arising predominantly from motor vehicle emissions. During the survey period from May 1, 1965, to April 30, 1966, more than 70 adverse smog days, as indicated by the State Department of Public Health's air quality standards, were experienced. The air pollution in the county is characterized by elevated atmospheric oxidant concentrations, vegetation damage, reduced visibility, and some eye irritation.

The photochemical smog originates primarily from motor vehicle traffic in the more densely populated portions of the county. On some days of high oxidant readings, smog produced from local sources was augmented by pollution entering Ventura County from Los Angeles County by way of the Pacific Ocean. There was no evidence of pollution arriving overland from Los Angeles County.

Air pollution in the Ojai Valley develops chiefly from motor vehicle traffic within that valley. The Ojai Valley is sheltered and normally is not subjected to the flow of polluted air from the Oxnard Plain.

The county as a whole is not significantly affected by air pollution from sulfur dioxide, fluorides, dust, smoke, carbon monoxide or nitrogen dioxide. Localized air pollution problems, however, do occur in some areas, e.g., dust from gravel pits, asphalt batching plants, and mineral processing; odors from cattle feeding, smoke from burning trash (particularly from the Fillmore and Santa Paula dumps), and smoke from orchard heaters (Ojai).

In the course of the study, damage to vegetation from photochemical smog was observed throughout the southern part of the county, including the predominantly rural Simi, Ojai, and Santa Clara Valleys. Plants so affected were avocado, citrus, field crops, vegetables, flowers, and weeds. Injury to lemon and orange from dusts was observed but no evidence was found of damage from ethylene, fluorides, nitrogen oxides, or sulfur dioxide.

Meteorological conditions in Ventura County are similar to the other coastal regions of Southern California where high levels of air pollution are experienced. The county's weather is strongly influenced by the subsidence inversion associated with the semipermanent Pacific high pressure cell; winds are often light. These conditions permit the accumulation of pollutants in the atmosphere; the sunny days that are experienced over much of the year favor photochemical reactions between organic compounds and oxides of nitrogen. The topography has a marked influence on the air pollution potential of the various portions of the county. The orientation of valleys and mountains may, in some instances, enhance the transport of polluted air inland from the Oxnard Plain - for example, Santa Clara Valley. In other instances the topography provides sheltering from the normal air flow - for example, Ojai Valley.

As population and motor vehicle traffic increase in Ventura County, photochemical smog will increase, at least until a considerable portion of motor vehicles are equipped with controls as required by Federal and State laws.

The population growth expected to take place in Ventura County will bring about an increase in pollutants because of new industrial sources and greater burning of refuse. Unless control is exercised over emissions from these sources, non-vehicular air pollution will increase in the county.

The presence of air pollution in Ventura County and the rapid growth which is expected to take place indicate that the County should develop capabilities and resources to deal with the problem.

An air pollution control district will eventually be needed. If a district is not established at this time, the County should provide resources in an existing Department to carry on a program of air sanitation until an air pollution control district is formed. The activities and costs of an air pollution control district are detailed in the section beginning on page 29 of this report.

The major advantages of establishment of an air pollution control district in Ventura County are: (1) control of effluents from trash burning and new industrial operations, (2) uniform countywide regulations and (3) a single administrative agency with whom industry, other governmental agencies, and the public can communicate with respect to air pollution controls.

INTRODUCTION

In 1963 the Ventura County Board of Supervisors were required by State law to determine if the used car provisions of the Motor Vehicle Pollution Control Act were necessary in Ventura County. In the process of making this decision, it became apparent that only limited data were available on air quality in the county. Furthermore, there was a difference of opinion as to the amount of pollution originating in the county and the amount transported into the county from Los Angeles.

The Board of Supervisors concluded that there would be little benefit from a control program for used motor vehicles in Ventura County, but agreed on the need for a better understanding of air pollution problems of the county. As a result, they instructed the Ventura County Health Department to make an air pollution fact-finding survey.

The County Health Department consulted local air pollution control agencies, the California State Department of Public Health, the Regional Office of the U.S. Public Health Service, and some others concerning how such a study should be made. The State Department of Public Health had been making air quality evaluations in Ventura County since 1963 to delineate the statewide air pollution picture.

It was decided that the Ventura County Health Department and the State Health Department engage in a joint study with the State Department of Public Health providing an engineer to supervise the study, much of the equipment needed, the use of it's air monitoring station at the City of Ventura, and the part-time services of a meteorologist. The County provided $20,787 and obtained a grant from the U.S. Public Health Service for an additional $41,573. These funds were used to purchase supplemental air monitoring and wind measuring equipment, employ a consulting engineer and two instrument technicians, and provide for a vegetation damage survey and the measurement of inversion conditions.

A study plan included (1) an analysis of the present air quality in Ventura County, (2) investigation of meteorological conditions influencing air pollution, (3) evaluation of the extent of plant damage from air pollution, (4) investigation of the possible importation of polluted air from Los Angeles County, (5) inventory of present air pollution sources, and (6) a projection of probable future air pollution problems.

PAST STUDIES

Limited air quality measurements had been made in Ventura County prior to this study. The State Department of Public Health established its air monitoring station in the City of Ventura in October, 1963, approximately 19 months before the study began. The data from this station showed that photochemical air pollution developed from time to time in that city, but the data were insufficient to evaluate the frequency, severity, extent, and causes of air pollution throughout the county. The findings of this station were, however, one of the factors that led Ventura County and the State Department of Public Health to conclude that a joint study of the countywide air pollution problem was needed.

The construction of a new power plant by the Southern California Edison Company at Point Hueneme prompted the State Department of Public Health and the Ventura County Health Department to study the sulfur dioxide in the air in Oxnard in 1959 and 1960. Over the four months period prior to the beginning of operation of the plant, all SO_2 measurements were 0.03 ppm or less. The average daily peak SO_2 concentration was 0.008 ppm.

For the same time period the following year, after the power plant was in operation, the SO_2 concentration ranged up to 0.30 ppm. The average was 0.067 ppm. The data further showed that the high values were associated with restricted time periods and probably were related to the burning of fuel oil in the power plant.

The first of the historical weather records studies was made in 1956 by North American Weather Consultants as part of an evaluation of air pollution potential in Ventura County. This was a meteorological analysis of data from Oxnard Air Force Base, Point Mugu, and Ventura County fire stations.

The study concluded that smog occasionally reached Ventura County from Los Angeles by way of the ocean but that the Oxnard Plain itself was a source of pollution affecting the inland valleys. The study further pointed out that while the Ojai Valley and the Santa Clara River Valley could receive pollution from the plain, the valleys south of Oak Ridge were the most probable receptor areas for air pollution in the county.

EFFECTS OF AIR POLLUTION IN VENTURA COUNTY

Air pollution in Ventura County, as elsewhere, is of concern because of its effects on the community - health effects, economic effects, and nuisance effects.

No attempt was made to study the effects of air pollution on the mortality and morbidity of people in Ventura County. However, the California State Health Department's ambient air standards for the more important pollutants were used to relate air quality to possible health effects. The Department's "serious level" standards were not reached during the study. Its "adverse level" standard for oxidant was exceeded on numerous occasions. This standard is based on photochemical smog and indicates a level of air pollution where eye irritation, vegetation damage, and reduced visibility can be expected.

Damage to vegetation from air pollution is the economic effect of chief concern to Ventura County. The County contracted with personnel of the Air Pollution Research Center of the University of California at Riverside to determine the nature and extent of vegetation damage caused by air pollution. The survey was conducted in the principal agricultural and population centers of the county including the Thousand Oaks, Santa Clara, and Simi Valleys. The survey visit dates were September 20, October 9 and 25, November 22, and December 22, 1965.

Damage to vegetation from photochemical air pollution was found in all of the major areas examined; no evidence of ethylene, fluorides, nitrogen oxides, or sulfur dioxide was found, but injury on lemon and orange from dusts was seen. Symptoms observed were principally those produced by the peroxyacyl nitrates (PAN), but ozone damage was also found. Thus, it was evident that photochemical air pollutants were present throughout the southern part of the county including the predominantly rural areas of the Simi, Ojai, and Santa Clara Valleys.

Based on air pollution-caused markings on various plant species, damaging episodes of photochemical air pollutants appeared to have occurred during the weeks of September 13, September 27, October 18, November 8, and December 13. Damage from the first three episodes was generally spread throughout the areas surveyed; no new injury was found in the upper Santa Clara Valley after October 18 nor at Simi, Conejo Village, Oak View, and much of the Oxnard Plain after November 8. In each of the episodes on the Oxnard Plain, damage was most severe near Oxnard and the least severe southeast of it. These observations, in general, support the findings of the air monitoring network which showed that episodes were more frequent and widespread during the first two months of the fall season.

There was incontrovertible evidence that the photochemically produced air pollutants, ozone and PAN, were present in all of the areas observed during the study period in concentrations sufficient to damage sensitive plant tissue. In some of the areas such as Simi, Thousand Oaks, and Ojai, there were few useful sensitive indicator plants available for a thorough study of the plant damaging potential of air pollutants. The effects might have appeared more severe at some of the observation sites if plant material had been more plentiful.

The fact that damage to vegetables growing in the Oxnard Plain was less severe in fields farthest from the urban centers of the Santa Clara Valley indicates that most of the toxicants were probably generated in the heavily populated region and that movement from other areas was probably of less importance.

The injury to vegetation seen in the southern portion of Ventura County was similar to that observed in southern Los Angeles County in 1947. The nature of the damage, however, was somewhat different since ozone injury to plants was not observed in Los Angeles County until about ten years later.

As Ventura County continues to grow, increasing damage to agriculture is inevitable unless air pollutants are effectively controlled.

Specific information obtained in the vegetation damage study is found in Tables XXXV and XXXVI and Figures 5-9 in the Appendix.

NUISANCE EFFECTS

In Ventura County, nuisance effects associated with air pollution from non-vehicular sources were noted from smoke, dustfall, and particulate from open burning, orchard heaters, and material handling and processing operations. Odors were also observed on several occasions - these primarily of animal origins.

ATMOSPHERIC CONTAMINANTS IN VENTURA COUNTY

The major portion of the study was an air monitoring program to determine the nature and extent of the air pollution problem and to obtain information on the current concentration of contaminants. Air pollutants were measured at seven sites in Ventura County from May 1, 1965, until April 30, 1966. Figure 1 shows the locations of the sampling sites; Table II gives a summary of the data obtained from the continuous analyzers that were used. The details of site location and equipment and methodology used are shown in Table III on page 14. More detailed data on concentrations of pollutants are shown in the Appendix, pages 33 through 46.

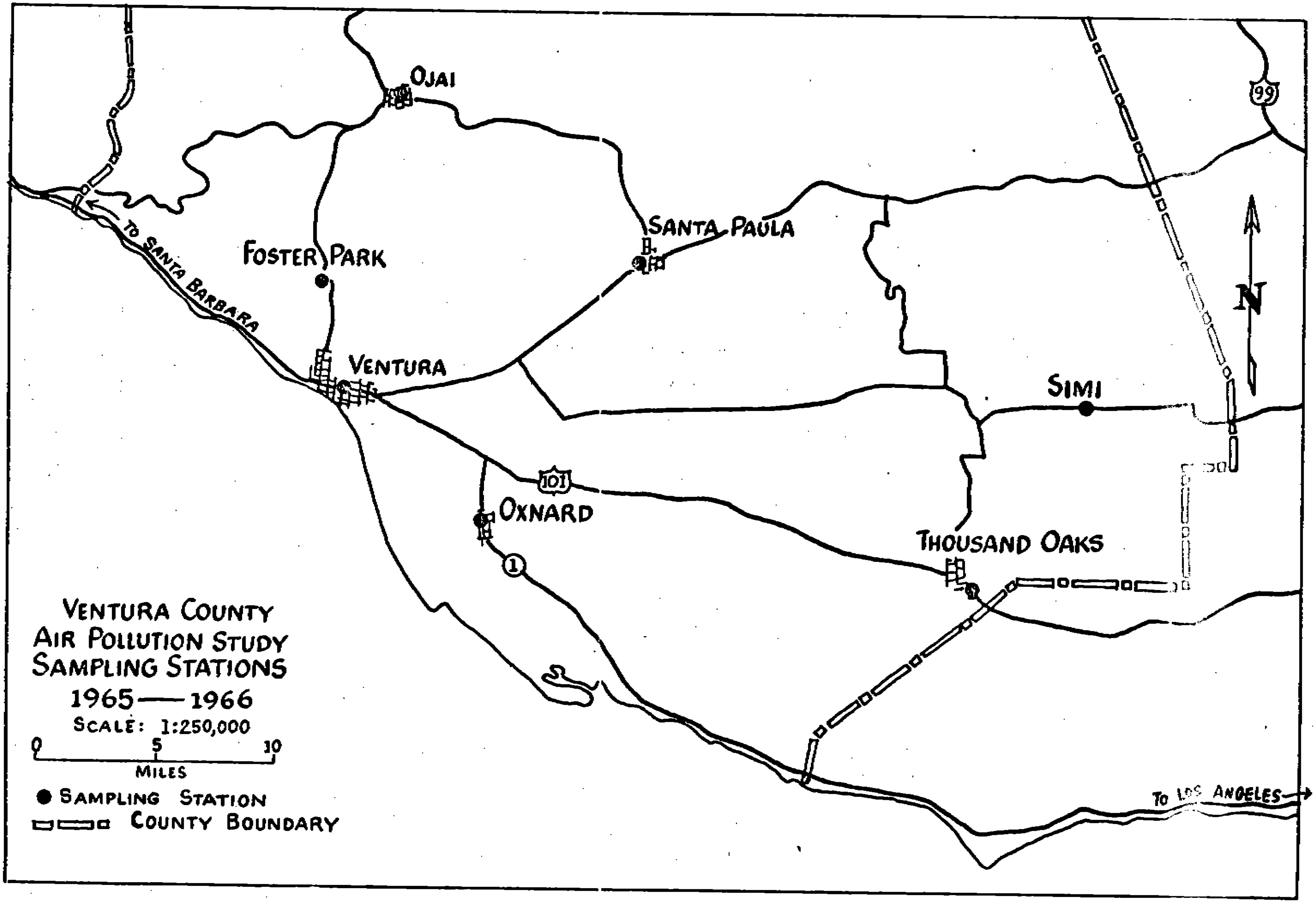
Oxidant or "oxidant index" is a measure of photochemical smog. This type of air pollution results in eye irritation, a unique type of vegetation injury, reduced visibility, and a peculiar odor. When there is photochemical smog, high oxidant concentrations are recorded. The State Department of Public Health has adopted an air quality standard for "oxidant index" of 0.15 parts per million (ppm) for one hour. This standard represents a level of smog at which eye irritation and other manifestations of smog are noticed by a significant percentage of the public. Any day on which the oxidant index reaches or exceeds 0.15 ppm for one hour is called an "adverse" day.

During the 12-month period from May 1, 1965, to April 30, 1966, Ventura County had 73 days on which an adverse smog value was measured somewhere in the county. Two-thirds of the adverse smog days occurred during the months of July through November. Frequency of adverse smog days at each station where oxidant was measured continuously was as follows:

TABLE I

STATION	NUMBER OF ADVERSE OXIDANT DAYS	HIGHEST HOURLY OXIDANT VALUE AND DATE OF OCCURRENCE
Thousand Oaks	42	0.25 ppm April 1, 1966
Ojai	19	0.24 ppm October 6, 1965
Santa Paula	25	0.24 ppm October 6, 1965
Ventura	13	0.27 ppm October 6, 1965
Oxnard	14	0.21 ppm October 22, 1965

FIGURE 1



VENTURA COUNTY
AIR POLLUTION STUDY
SAMPLING STATIONS
1965 — 1966
SCALE: 1:250,000
0
5
10
MILES
SAMPLING STATION
COUNTY BOUNDARY
OJAI
FOSTER PARK
VENTURA
SANTA PAULA
SIMI
OXNARD
THOUSAND OAKS
TO SANTA BARBARA
TO LOS ANGELES
N
99
101
1

TABLE II

SUMMARY OF CONTINUOUS AIR MONITORING DATA FOR GASEOUS POLLUTANTS
VENTURA COUNTY, MAY 1965 THROUGH APRIL 1966

(Concentration in part per millions)

OXIDANTS:

STATION	PEAK	MAXIMUM HOURLY AVERAGE	AVERAGE OF THE MAXIMUM HOURLY AVERAGE FOR EACH MONTH
Ojai	0.26	0.24	0.16
Oxnard	0.25	0.21	0.15
Santa Paula	0.29	0.24	0.16
Thousand Oaks	0.28	0.25	0.19
Ventura	0.35	0.27	0.16

CARBON MONOXIDE:

STATION	PEAK	MAXIMUM HOURLY AVERAGE	AVERAGE OF THE MAXIMUM HOURLY AVERAGE FOR EACH MONTH
Ojai	16	10	7
Oxnard	28	20	10
Ventura	22	13	8

NITROGEN OXIDES, HYDROCARBONS, AND SULFUR DIOXIDE:

STATION	PEAK			MAXIMUM HOURLY AVERAGE			AVERAGE OF THE MAXIMUM HOURLY AVERAGE FOR EACH MONTH		
	NO_x	HC	SO_2	NO_x	HC	SO_2	NO_x	HC	SO_2
Oxnard	–	–	0.07	–	–	0.06	–	–	0.03
Ventura	0.58	33	–	0.45	21	–	0.27	15	–

During the preceding 12-month period (May 1, 1964, to April 30, 1965), when data were obtained only at City of Ventura. there were 11 adverse oxidant days at that station. Highest hourly average reading was 0.31 ppm on November 6, 1964 and January 30, 1965.

Oxidant was also measured by manual methods on a random basis during the summer and fall smog season at Simi and Foster Park where continuous monitoring equipment was not available. On the days sampled, there were no adverse days at Simi and only one at Foster Park. The highest value recorded at Simi was 0.13 ppm; at Foster Park it was 0.19 ppm. If oxidant had been measured continuously at these stations higher values might have been found.

The oxidant index usually reached its highest value around noon in Oxnard and Ventura, approximately the same time or a little earlier at Thousand Oaks, and later at Santa Paula and at Ojai.

The oxidant data establish that Ventura County experiences photochemical smog. The number of adverse oxidant days recorded there is fairly high when compared to other regions of the State where air pollution is recognized as a serious problem. During the period May 1, 1965 to April 30, 1966, Los Angeles experienced 195 such days, San Diego County, 90 and the San Francisco Bay Area, 56. Ventura County experienced 73. Maximum hourly oxidant values were not as high in Ventura County, however. The maximum in Ventura County was 0.27 ppm as compared to 0.58 in Los Angeles, 0.95 in San Diego and 0.33 in the San Francisco Bay Area.

TABLE III

MONITORING STATIONS

STATION LOCATION	EQUIPMENT
Ventura: County Health Department Building 3147 Loma Vista Road	Oxidant: KI[1] colorimeter Nitrogen Oxides: Saltzman colorimeter Hydrocarbons: Flame ionization analyzer Carbon Monoxide: Infrared analyzer Soiling: AISI sampler Wind: Continuous recording
Ojai: Ojai Elementary School 414 East Ojai Avenue	Oxidant: KI colorimeter Nitrogen Oxides: Sequential Saltzman sampler (colorimeter) Carbon Monoxide: Infrared analyzer Soiling: AISI sampler Wind: Continuous recording
Santa Paula: Ventura County Fire Department Headquarters, 530 West Main	Oxidant: KI colorimeter Soiling: AISI sampler Wind: Miles of wind up and down valley read 3 times a day
Foster Park: City of Ventura Water Filtration Plant Ventura Avenue, 3/4 mile south of Foster Park	Oxidant: KI sequential sampler and colorimeter Nitrogen Oxides: Sequential Saltzman sampler Wind: Miles of wind up and down valley read 3 times a day
Oxnard: City County Building 242 West 2nd Street	Oxidant: KI colorimeter Carbon Monoxide: Infrared analyzer Sulfur Dioxide: Electrolytic conductivity analyzer Soiling: AISI sampler Wind: Continuous recording
Thousand Oaks: Conejo Elementary School 280 Conejo School Road	Oxidant: KI colorimeter Nitrogen Oxides: Sequential Saltzman sampler Soiling: AISI sampler
Simi: Community Fire Station 3192 Los Angeles Avenue	Oxidant: KI sequential sampler Nitrogen Oxides: Sequential Saltzman sampler Wind: Continuous recording

Particulate Matter: Dustfall jars and Hi-vol samplers at all seven stations.
Sulfur Dioxide: Lead peroxide candles at all seven stations.

[1] KI: potassium iodide.

Carbon monoxide in California communities comes chiefly from motor vehicle exhaust. The gas is toxic in elevated concentrations, and the State Department of Public Health has adopted a carbon monoxide ambient air standard of 120 ppm for 1 hour or 30 ppm for 8 hours to protect the public health.

This compound was measured continuously at Oxnard, Ventura, and Ojai. At no time did the concentrations reach the ambient air standard. The peak instantaneous value recorded was 26 ppm at Oxnard, and the hourly concentration that included the peak value was 20 ppm. During the 12-month period there were only 19 hours when carbon monoxide was above 10 ppm at Oxnard, 3 hours at Ventura, and none at Ojai. Data for the Ventura station during the preceding 12-month period were similar to those obtained in this study.

Sulfur dioxide and sulfation values are indicators of air pollution from sulfur compounds. Sulfur dioxide in the atmosphere usually comes from the burning of fuels containing sulfur or by the oxidation of hydrogen sulfide of either natural or industrial origin.

At elevated concentrations, sulfur dioxide is toxic to man and animals; at about 0.3 ppm for 8 hours, it injures sensitive vegetation; in the presence of oxygen and moisture, sulfur dioxide may be converted to sulfuric acid which is corrosive to metals. The State Department of Public Health has set ambient air standards for sulfur dioxide as follows:

0.3 ppm for 8 hours, or 1 ppm for 1 hour based on damage to vegetation;
5 ppm for 1 hour based on health effects.

Monitoring of Ventura County air for sulfur dioxide by the State Department of Public Health from 1959 to 1960 indicated that atmospheric concentrations were generally low. Only one station, therefore, was equipped with an instrument to measure sulfur dioxide. The station was located at Oxnard because it is downwind from the Mandalay power plant. The peak recorded value of SO_2 was 0.07 ppm indicating that concentrations of this compound were low and confirming previous findings by the State Department of Public Health. However, it should be noted that during the study period natural gas was used as fuel by the power plant; most of the fuel oil usage was during operational tests of the oil burning equipment.

To determine if there was much variation in sulfur dioxide levels throughout the county, each of the seven stations was equipped with a lead-peroxide candle which converts the sulfur compounds in the air to solid lead sulfate. The amount of sulfate formed during an exposure period of a month is a measure of "sulfation" and is related to the sulfur compounds in the atmosphere. Values found at all stations were low (see Appendix). Thus, sulfur was not found to be a problem in Ventura County under fuel burning practices during the study period.

Particulate matter was determined by measuring dustfall, suspended particulate, and soiling (Coh values). Dustfall is a measure of the matter that settles out of the air onto the surface of the ground and buildings; suspended particulates are particles that remain suspended in the air for long periods; soiling (Coh values) is a measure of smoke or of the "blackness" of the particles in the air. Summaries of particulate matter concentrations are shown in Table IV, page 16.

Dustfall at all sites ranged from a low of 2.1 tons per square mile at Ojai to a high of 29.4 tons at Oxnard for individual months. The average values for the entire period of the study varied from 8.3 tons per square mile per month at Ojai to 13.6 at Oxnard. These figures fall in the lower range of values in California communities.

TABLE IV

SUMMARY OF ATMOSPHERIC PARTICULATE MATTER
VENTURA COUNTY, MAY 1965 THROUGH APRIL 1966

STATION	RANGE OF CONCENTRATION			AVERAGE CONCENTRATION	
	Particulate[1] (Micrograms Per Cubic Meter)	Soiling (Coh Values)	Dustfall (Tons Per Square Mile Per Month)	Particulate[1] (Micrograms Per Cubic Meter)	Dustfall (Tons Per Square Mile Per Month)
Foster Park	23-133		7.4-14.8	65	11.5
Ojai	14-114	0.2-11.5	2.1-15.3	70	8.3
Oxnard	42-242	0.2- 2.5	6.4-29.4	99	13.6
Santa Paula	26-122	0.2- 2.6	5.5-15.6	79	9.7
Simi	91-160		4.3-15.1	119	10.6
Thousand Oaks	32-138	0.2- 2.0	4.7-14.8	79	9.0
Ventura	46-167	0.2- 2.2	6.2-20.2	80	10.1

[1]Suspended Particulate Matter.

Average suspended particulate matter concentration varied from 65 micrograms per cubic meter ($\mu g/m^3$) at Foster Park to 119 micrograms per cubic meter at Simi. The maximum value for a single sample ranged from 114 $\mu g/m^3$ at Ojai to 242 at Oxnard.

The values in Ventura County generally were in the lower range of concentration found in California cities. The higher average concentration found at Simi probably reflected the intensive building construction program in that area. The concentrations at Simi were equivalent to the average found in urban areas, but were higher than the concentrations usually found in smaller communities.

Coh values were measured at five sites (Ojai, Oxnard, Santa Paula, Thousand Oaks, and Ventura). More than 94 percent of all the Coh values were less than 1.1 and over 70 percent were less than 0.6. With the exception of Ojai, none of the values exceeded 3.0. During December, 1965, a few of the samples at Ojai were very high. these probably resulted from the use of orchard heaters. In most California communities Coh values vary from 0 to 5. A value below 1.0 represents a clean atmosphere; greater than 2.0 usually indicates undesirable levels of smoke or particulate matter; and 10 represents an atmosphere laden with heavy black smoke.

Hydrocarbon and nitrogen oxides were measured continuously only at Ventura; nitrogen oxides were also sampled manually on a part-time basis at Simi, Foster Park, and Thousand Oaks. These compounds are of interest mainly because they react in the atmosphere to produce photochemical smog. Oxidant, a product of this reaction, is a much better indication of photochemical smog, therefore, data for hydrocarbons and nitrogen oxides must be considered in light of data for oxidant.

Hydrocarbon concentrations were usually between 2 and 15 parts per million (as carbon) and nitrogen oxides ($NO+NO_2$) were usually less than 0.25 parts per million (as NO_2). The maximum hourly concentration for hydrocarbon was 21 ppm and that for nitrogen oxides 0.45 ppm.

SOURCES OF AIR CONTAMINANTS IN VENTURA COUNTY

An estimate was made of the atmospheric pollutants discharged in Ventura County to determine the relative contribution from the more significant sources.

Types of sources included in the inventory were motor vehicles, power plants, industries, agricultural burning and orchard heaters, open dump and backyard burning, organic solvents, and aircraft. Sources of objectionable odors in the county were also identified.

Particulate matter from sources such as plowing and tilling, crop dusting, road construction, and land clearing and leveling was not estimated because of lack of data on which to base emission factors.

Table V shows the sources and estimated emissions of the more important contaminants in tons per day. The values were obtained by dividing the estimated total annual emissions by 365 days. In referring to the Table, it must be remembered that the emission from some sources - for example, orchard heaters -- is not uniform throughout the year. Detailed description and tabulations of all emissions are to be found in the Appendix.

Information in Table V shows that motor vehicles are the largest source, and account for approximately three-fourths, of the total air pollution emissions in Ventura County. Motor vehicles also account for three-fourths of the hydrocarbons, almost one-half of the oxides of nitrogen, and nearly 90 percent of the carbon monoxide.

The emissions from other modes of transportation, including aircraft, railroads, ships and diesel-powered motor vehicles, are small compared to those from gasoline powered motor vehicles.

Approximately one-fourth of the oxides of nitrogen was emitted from the combustion of natural gas in the Mandaley Steam Station Power Plant and one-fifth from the combustion of gaseous fuel in petroleum production. Fuel oil did not account for a significant amount of oxides of nitrogen since only a small amount was burned in the county.

Emission of oxides of sulfur averaged 4.4 tons per day. However, when orchard heaters are in operation these emissions rise to about 28 tons per day.

Particulate matter from backyard burning averages about 21 tons per day. This represents 57 percent of the estimated total particulate matter emissions for the county. Burning of agricultural debris which averages 6.5 tons per day is the only other source that averages more than 2 tons per day of particulate matter. Orchard heaters, however, emit approximately 90 tons per day on the days when they are in operation. During these periods they are, by far, the most important source of particulate matter.

A number of sources of objectionable odors were identified. The most important of these were cattle feed yards, poultry ranches, low grade crude oil extraction, and the exhausts of diesel-powered motor vehicles.

TABLE V

AVERAGE EMISSIONS OF AIR CONTAMINANTS IN VENTURA COUNTY
JUNE, 1966

SOURCE	EMISSIONS - TONS PER DAY				
	Hydro-Carbons and Other Organic Gases	Oxides of Nitrogen as Nitrogen Dioxide	Oxides of Sulfur as Sulfur Dioxide	Carbon Monoxide	Particulate Matter
Motor Vehicles					
Gasoline-powered	92	23	1.4	455	2.0
Diesel-powered	1.4	1.4	0.3	0.3	0.3
Total from Motor Vehicles	93	24	1.7	455	2.3
Railroads and Ships	n	n	n	n	n
Aircraft	0.4	0.6	n	2.9	0.7
Combustion of Fuels in Stationary Sources Excluding Petroleum Industry					
Gaseous	0.1	14	n	n	0.7
Liquid	n	0.5	1.0	n	0.1
Total from Combustion of Fuels	0.1	14.5	1.0	n	0.8
Industrial					
Petroleum Industry	15.2	10.9	1.2	n	0.2
Rock Crushing	n	n	n	n	0.1
Asphaltic Concrete Batch Plants	n	n	n	n	0.5
Concrete Batch Plants	n	n	n	n	0.1
Concrete Products	n	n	n	n	1.0
Other Industrial	n	n	n	n	1.5
Total from Industrial	15.2	10.9	1.2	n	3.4
Organic Solvent Usage					
Surface Coating	3	n	n	n	n
Degreasing	5	n	n	n	n
Drycleaning	2	n	n	n	n
Total from Organic Solvents	10	n	n	n	n
Waste Disposal (excluding agricultural debris)					
Open Burning - Dumps	0.6	n	n	6.9	1.1
Open Burning - Backyards	1.5	0.1	0.1	32	16
Incinerators	n	n	n	n	n
Total from Waste Disposal	2.1	0.1	0.1	39	17.1
Agricultural Sources					
Debris Burning	0.6	n	n	13	6.5
Pesticides	0.3	n	n	n	na
Orchard Heaters	4.7	na	0.4	na	1.4
Total from Agriculture	5.6	na	0.4	13	7.9
GRAND TOTAL	126	51	4.4	510	32

n Negligible (less than 0.05 tons/day)
na Not available.

CLIMATOLOGY AND METEOROLOGY

The dispersal of atmospheric contaminants is determined mainly by the winds and the height into which the contaminants are mixed in the atmosphere. Light winds and a shallow mixing layer (low inversion) are favorable to the accumulation of pollutants. It is during these conditions that air pollution episodes usually occur.

The flow of air in Ventura County between May and mid-September is dominated by the sea breeze which flows across the coastal plain and through the major valleys toward the interior during daylight and evening hours. At night, drainage winds flow down the valleys reaching the coastal plain between midnight and dawn. Between mid-September and April the sea breeze is weaker and the drainage winds stronger. Stormy weather or Santa Ana winds may for short periods interrupt the normal late fall and winter wind pattern.

The semipermanent inversion which is subject to seasonal and daily variations generally is lower and more intense near the coastline than over interior parts of the county. Also, the inversion layer undergoes local changes in height near the Santa Ynez Mountains. These space and time variations result in a complex distribution of the inversion over the county.

GENERAL DISPERSION CHARACTERISTICS

Pollutants are most effectively dispersed during Santa Ana winds or stormy weather conditions and at these times little air pollution is experienced. Good dispersion in much of the county - with little air pollution present - also occurs when the sea breeze is well-established and flows across the coastal plain at 10 to 15 miles per hour. Under these conditions, the marine layer of air beneath the inversion is deep and provides a large mixing volume.

During much of the year, however, the marine air layer is shallow and the sea breeze weak; this lessened mixing volume results in poor dispersal of pollution and high air pollution potential.

WIND AND INVERSION MEASUREMENTS

Continuous wind measurements were made at each of the air monitoring sites. In addition, wind data were available from other sites in the county. These data were used in assessing the air contaminant data at each of the stations and the air pollution potential in Ventura County.

Because the U.S. Weather Bureau does not take upper air soundings in the county, 297 aircraft ascents were made during June through December, 1965, to obtain information on the variation of temperature and humidity with height above the ground. The aircraft ascents were made at the same time of upper air soundings by the U.S. Weather Bureau at Vandenberg Air Force Base and at Santa Monica and Los Angeles Airports.

The topography of Ventura County produces channelization of the winds, thus lessening the opportunity for good lateral dispersion as the sea breeze flows to interior points in the county. Solar heating of the interior, however, has the effect of increasing the height of the inversion thus affording some increase in the available mixing volume.

Detailed data and discussion on wind and inversion data is to be found in the Appendix, beginning on page 81.

Summaries of this data will be found in Tables VI and VII.

TABLE VI

AVERAGE INVERSION HEIGHT SUMMARY COMPARING
DATA FROM AIRCRAFT ASCENTS AND RADIOSONDE FLIGHTS

MONTH AND TIME OF SOUNDING	INVERSION HEIGHT - FEET ABOVE MEAN SEA LEVEL				
	Vandenberg	Ventura Airport	Fillmore	Simi	Los Angeles
	Elevation 330 Feet	Elevation 50 Feet	Elevation 490 Feet	Elevation 820 Feet	Elevation 105 Feet
June					
0300 PST	1670	2500	3760	3710	2680
1500 PST	1250	2000	3490	2760	2760
July					
0300 PST	900	280	980	1810	560
1500 PST	1730	980	2390	1720	900
August					
0300 PST	790	1000	950	1820	1120
1500 PST	1250	850	2600	1730	1140
September					
0300 PST	1430	640	1410	950	1710
1500 PST	1750	1710	4500	1590	-
October					
0300 PST	450	50	490	820	110
1500 PST	590	500	2000	1680	-
November					
0300 PST	330	600	490	820	790
1500 PST	1140	1140	2000	1500	-
December					
0300 PST	330	50	490	820	1900
1500 PST	840	1040	2360	2890	-

TABLE VII

MONTHLY AVERAGE WIND SPEEDS AT AIR MONITORING STATIONS

(Miles per hour)

MONTH	YEAR	VENTURA	OXNARD	OJAI	FOSTER PARK	SANTA PAULA	SIMI	THOUSAND OAKS
June	1965	6.0	7.4	3.6	7.5	9.0	4.7	5.6
July	1965	6.2	6.6	4.6	6.3	7.2	4.5	6.1
August	1965	na	7.3	4.3	5.8	7.1	4.5	6.0
September	1965	5.1	7.2	3.7	6.0	6.5	4.8	7.1
October	1965	4.6	6.5	3.8	7.2	7.3	5.3	7.1
November	1965	na	7.1	3.4	6.2	5.3	5.6	7.8
December	1965	na	7.3	3.0	7.2	7.4	8.2	7.8
January	1966	6.1	8.1	3.6	7.0	6.8	9.5	8.1
February	1966	5.8	7.5	3.3	6.1	7.2	na	7.2
March	1966	na	6.9	4.0	6.0	7.5	na	6.7
April	1966	na	6.9	4.3	5.9	7.1	4.5	5.5

na Not available.

Table VI shows the comparative heights of the inversion base for the three sounding sites in Ventura County and the U.S. Weather Bureau upper air stations at Vandenberg Air Force Base and Los Angeles Airport. (After August no 1500 PST soundings were taken at the latter station) The data show the continuous nature of the inversion along the coast due to the effect of the eastern Pacific high pressure area and that the inversion base undergoes extensive height variation over the interior of the county.

Table VII is an abbreviated summary of average monthly wind speeds at the seven air monitoring stations. Data shown as not available (na) were not obtained because of instrument failure. The average wind speeds at Ojai, about half that of the other stations, emphasize the sheltered nature of the Ojai Valley. More wind flows up the Santa Clara River Valley (Santa Paula) than up the Ventura River Valley (Foster Park) in summer. Higher average wind speeds occur in winter at Simi, Thousand Oaks, and Oxnard due to the dominance of land breezes.

AIR POLLUTION POTENTIAL

Air pollution in the several regions of Ventura County may be caused by the sources within those regions or may be transported from other areas. The relative importance of locally created air pollution and transported pollution will depend upon the nature and quantity of emissions and the topographical and meteorological conditions.

The Conejo-Russell Valley area has a high potential for air pollution both from local sources and transport from the Oxnard Plain by the sea breeze. The inversion still has a strong influence on the mixing volume and the sea breeze often pentrates into this area. This high potential for air pollution is borne out by the oxidant measurements that were made at Thousand Oaks.

The Simi Valley appears to have less of a pollution potential. One reason is that solar heating of this valley appears sufficient either to frequently destroy the inversion or to alter it enough to provide an increased mixing volume compared to localities closer to the coast. Although exposed to the sea breeze, the Simi Valley ends at the Santa Susana Mountains and often is affected only by locally generated winds.

The air pollution potential of the Santa Clara River Valley is strongly influenced by sea breezes from the north Oxnard Plain. Because of broadening of the valley at Fillmore and modification of the inversion by solar heating, it is not likely that high concentrations of pollutants would be carried further up the Santa Clara River Valley than this point by the sea breeze.

Because it is sheltered, the Ojai Valley has considerable potential for high air pollution levels. This sheltering is associated with low winds and very stable air during most of the year, particularly during the late fall, winter, and early spring. Under these conditions locally generated contaminants would be confined in the valley during night and early morning hours.

Meteorological conditions during fall, winter, and early spring months may occasionally permit pollution which has accumulated over the ocean west of Los Angeles to be blown into the Santa Barbara Channel and thence onto the Oxnard Plain. At least four times during 1965 and early 1966 "adverse smog" episodes were attributed to encroachment of polluted air from the seaward area. Occurrences of less severe smog episodes were noted on eight or ten instances.

THE ECONOMY OF VENTURA COUNTY

The growth in population, industrial development, and motor vehicle use and the success in controlling emissions will determine the future air quality in Ventura County. Further urbanization of the county is assumed.

The population has been growing at a faster rate than any other county in the State. The annual rate of growth average 10 percent from 1960 to 1965. The Ventura County Planning Department forecasts that approximately the same rate of growth will continue during the next 15 years. That Department also predicts that the population of Ventura County will increase from 320,000 in January, 1966, to a figure between 1,010,000 and 1,355,000 by 1980 and between 2,030,000 and 2,630,000 by the year 2000.

The predicted 1985 population by area is as follows:

Ventura-Oxnard	300,000 - 500,000
Camarillo Area	150,000 - 200,000
Conejo	125,000 - 175,000
Moorpark	40,000 - 80,000
Simi	125,000 - 175,000
Santa Paula	40,000 - 100,000
Ojai	20,000 - 100,000
Fillmore-Piru	20.000 - 60,000

Census data for Ventura County from 1900 to 1966 and forecasts to the year 2000 are shown in Table VIII and are plotted in Figure 2 on page 26.

Data from the State Division of Highways <u>Annual Traffic Census</u> reports show how traffic density is increasing rapidly in areas of the county. (See Table IX)

TABLE VIII

POPULATION OF VENTURA COUNTY

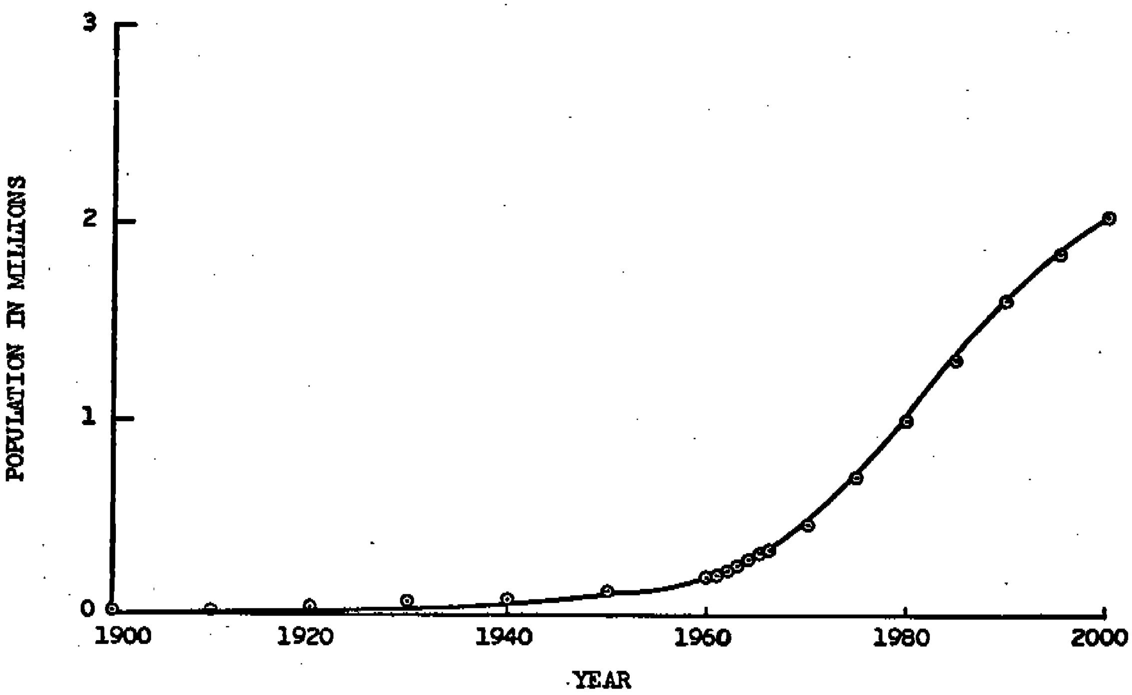
1900-1966 with Forecasts to 2000

YEAR	TOTAL POPULATION	YEAR	TOTAL POPULATION
1900	14,367	1964	288,275
1910	18,347	1965	320,361
1920	28,724	1966	328,550
1930	54,976	1970	475,000 - 570,000
1940	69,685	1975	720,000 - 920,000
1950	114,647	1980	1,010,000 - 1,355,000
1960	199,138	1985	1,320,000 - 1,775,000
1961	212,200	1990	1,620,000 - 2,140,000
1962	229,337	1995	1,860,000 - 2,425,000
1963	248,857	2000	2,030,000 - 2,630,000

The figures for the years 1900 through 1960 are official U.S. Census data. The remaining figures are estimates made by the Ventura County Planning Department. Estimates for the years 1960-1966 were made as of April 1.

Figure 2

POPULATION OF VENTURA COUNTY



Note: The average of the maximum and minimum predicted figures were used for the years 1970 to 2000.

Source: U.S. Census figures 1900 to 1960. Ventura County Planning Department estimates and projections: 1961 to 2000.

TABLE IX

TRAFFIC CENSUS DATA FOR VENTURA COUNTY, 1963 AND 1964

LOCATION OF CENSUS	TRAFFIC CENSUS			
	1963		1964	
	Peak Hour	Average Daily Peak Month	Peak Hour	Average Daily Peak Month
Highway 101, West of Moorpark Road, Thousand Oaks	3,300	37,600	3,600	41,500
Highway 101, East of Central Avenue, Camarillo	3,600	34,700	4,300	43,800
Highway 101, East of Telephone Road, Ventura	4,000	38,900	4,000	49,000
Route 126, Harvard Street, East of 5th, Santa Paula	1,350	15,000	2,200	18,000
Highway 33, Oakview	1,250	12,700	1,400	14,700
Saviers Road, North of Channel Island Boulevard, Oxnard	1,650	18,300	2,700	33,800
Vineyard Avenue, North East of Route 101, El Rio	1,400	13,200	1,700	20,500

Source: State of California, Department of Public Works, Division of Highways, Annual Traffic Census.

Along with the added population and motor vehicles will come more combustible trash to be burned and a variety of commercial activities to service the population.

At present Ventura County is an important agricultural county. It ranks 15th among all counties in the United States by value of all farm products sold. Chief dollar crops are lemons, oranges, and vegetables. Agriculture will undoubtedly remain an important aspect of the economy.

Ventura County is also a large oil-producing county. Only ten states, including California, has a greater valuation of petroleum and natural gas produced than Ventura County. Very little of the petroleum is processed in the county, however. Other important mineral products are sand, gravel, and clay.

Manufacturing is on the increase in Ventura County. Most of it can be classified as light industry. Further growth in manufacturing activity is anticipated. The Planning Department forecasts that manufacturing employment will increase from its present 12,000 to 70,000 in 1985. (See Table X, page 28) How much of the manufacturing will be basic processing with a high air pollution potential is not known.

It is evident that Ventura County will grow rapidly and become more like the large metropolitan centers in other parts of California. This growth will result in the discharge of increasing quantities of pollutants into the county's atmosphere. In turn this will bring about more air pollution problems and the need for a county program to control emissions from the non-vehicular sources.

Since motor vehicles are the largest sources of emissions in the county, the number of vehicles will have an important bearing on air quality. Statewide motor vehicle registration has been increasing even more rapidly than population. The table below shows vehicle registration in Ventura County since 1940 and estimates until 1980 based on motor vehicle registration and population forecasts.

Year	Registered Motor Vehicles
1940	27,600
1950	48,400
1960	91,700
1965	158,000
1970	260,000
1980	590,000

TABLE X

VENTURA COUNTY
ESTIMATED EMPLOYMENT BY INDUSTRY - WITH FORECAST FOR 1985

INDUSTRY	AVERAGE 1960		APRIL 1965		FORECAST 1985	
	Number	Percent	Number	Percent	Number	Percent
Agriculture, Forestry, Fishing	13,625	20.0	11,700	13.4	32,000	9.2
Mining	2,575	3.8	2,425	2.8	8,700	2.5
Construction	4,475	6.6	6,000	6.9	20,000	5.7
Manufacturing Total	7,025	10.3	12,275	14.1	70,000	20.0
Durables	4,400		9,300			
Nondurables	2,625		2,975			
Transportation, Communication and Utilities	2,825	4.1	3,725	4.3	18,300	5.2
Trade-Wholesale-Retail	12,250	18.0	16,700	19.2	67,000	19.1
Finance, Insurance, Real Estate	1,725	2.5	2,675	3.1 }		
Services	9,000	13.2	11,750	13.5 }	64,000	18.3
Government	14,700	21.6	19,800	22.7	70,000	20.0
Total	68,200	100.0	87,050	100.0	350,000	100.0

Source: 1960 and 1965 figures are from California Department of Employment, Research and Statistics Division. 1985 Forecast is from Wilsey, Ham, and Blair "1985 General Plan for Ventura County."

FORMATION OF AN AIR POLLUTION CONTROL DISTRICT

Under existing laws in California, local agencies are responsible for the control of emissions from all sources except motor vehicles. The State and Federal governments are charged with the responsibility of controlling emissions from motor vehicles.

Inasmuch as the air pollution problem in Ventura County is primarily one of photochemical smog from motor vehicles, it can be asked why the county should establish an air sanitation program.

As the county develops there will be more sources of air pollution and more people who will be affected. Even at this time, there are a number of localized air pollution problems from dusts, smoke, and odors. While motor vehicles are the most important source of compounds that produce photochemical smog they are not the only sources.

The presence of air pollution in the county now and the expected growth of the area in the future indicate that Ventura County should provide administrative means for effectively dealing with this problem. The extent of the effort will vary with the needs as indicated by factors such as complaints and number and types of industries.

Most California counties that recognize the need to provide for air pollution control have followed one of three administrative procedures, depending upon the size of the county and the seriousness of the problem.

The first is the county air pollution control district set up as a separate department in the county government. Such a district has countywide authority and a control officer with full-time duties. This is the pattern of Los Angeles, Riverside, and San Bernardino Counties.

The second is a county air pollution control district placed within an existing department. Such a district also has countywide authority and the same powers as a separate department, but administrative and operating costs are somewhat reduced. The saving is achieved, of course, by increasing the work load on the parent department, which sometimes introduces administrative problems. This is the pattern in San Diego, Sacramento, Monterey, and Humboldt Counties, where the air pollution control districts are in the health departments, and in Orange County, where it is in the Agricultural Commissioner's office.

Third, in some counties air pollution control ordinances have been adopted and administered as part of the health department program. The sanitation section was given specific air pollution control functions, and one or more persons are assigned these duties and given some training. This system is used in San Joaquin County and, formerly, in Monterey County before the present air pollution control district was formed. The effectiveness of such a program is limited because it applies only to the unincorporated areas.

Givenbelow is information on the most likely activities, the number of personnel and their qualifications, space requirements, and the annual budget for an air pollution control district.

The most likely activities at first would be the following:

1. Air monitoring to determine air quality.
2. Follow-up of complaints.
3. Advice to government officials, the public, industry, and others concerned with air pollution problems.
4. Enforcement of Sections 24242 and 24243 of the California Health and Safety Code.
5. Development of applicable rules and regulations as required.

The minimum personnel for the job would be:

1. An air pollution control officer with administrative ability who can communicate with the public and other government officials.
2. An engineer with ability to evaluate control methods and control equipment design and operation.
3. A chemist with knowledge of air pollution measurements and analytical procedures.
4. A technician who can operate a monitoring station and carry out air sampling and analysis.
5. An air pollution control inspector.
6. A clerk-stenographer-typist.

Initially, (4) and (5) above might be combined and an existing department head designated as the control officer. Existing laboratory personnel might be used for chemical work. In that case, the additional minimum staff would be:

1. Air pollution control engineer.
2. Technician-inspector.
3. Secretary.

Starting salary for the three new jobs would be approximately $13,000, $7,500, and $5,000 per year, respectively.

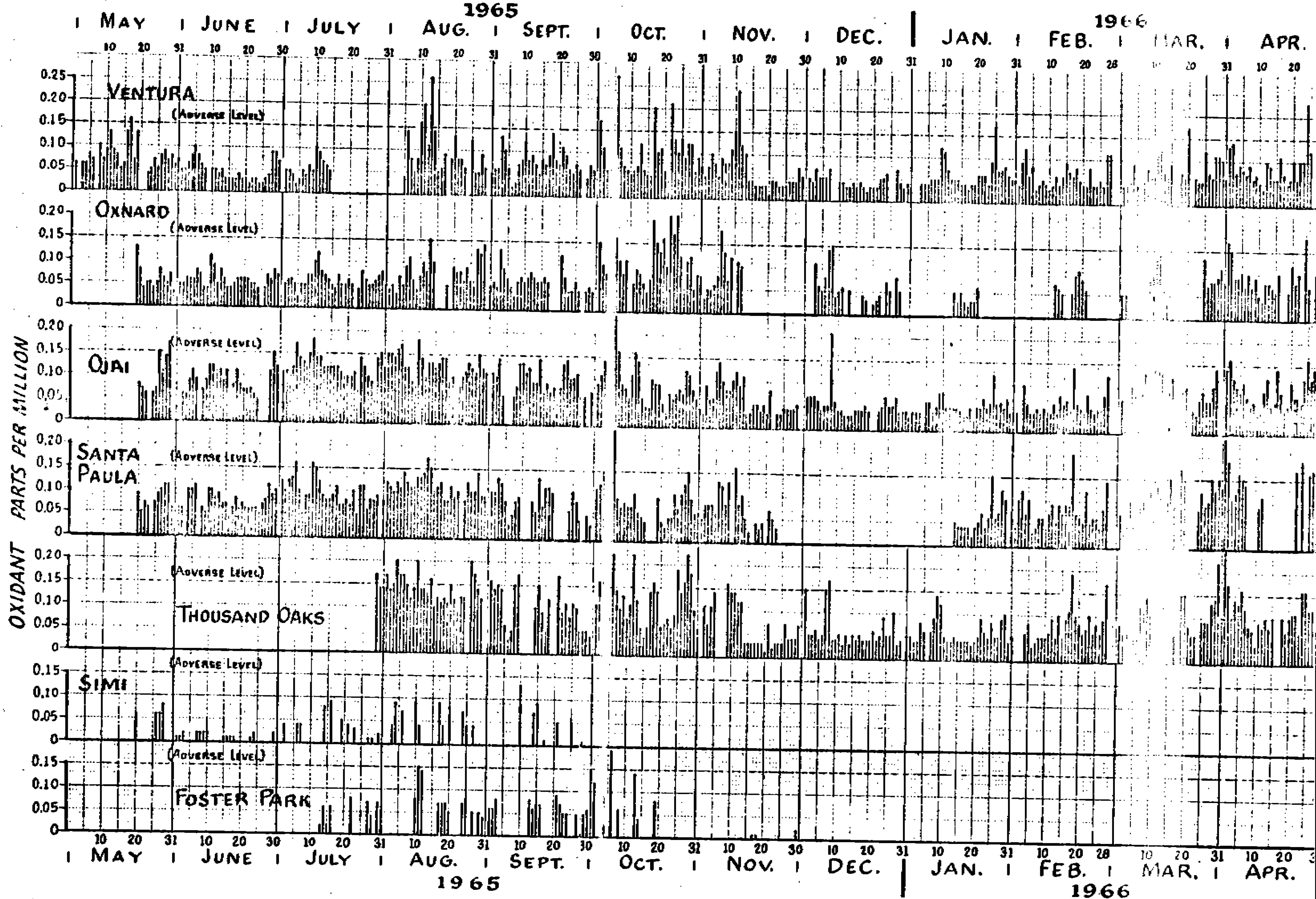
Recommended continuous monitoring instruments are those for oxidant ($5,500) and sulfur dioxide ($5,500). Other air sampling equipment and basic laboratory equipment will amount to $1,700 per year. Other expenses will be those incidental to any government office or laboratory of this size.

It is likely that Ventura County could qualify for Federal funds to cover two-thirds of the cost of setting up and operating an Air Pollution Control District for three years.

APPENDIX

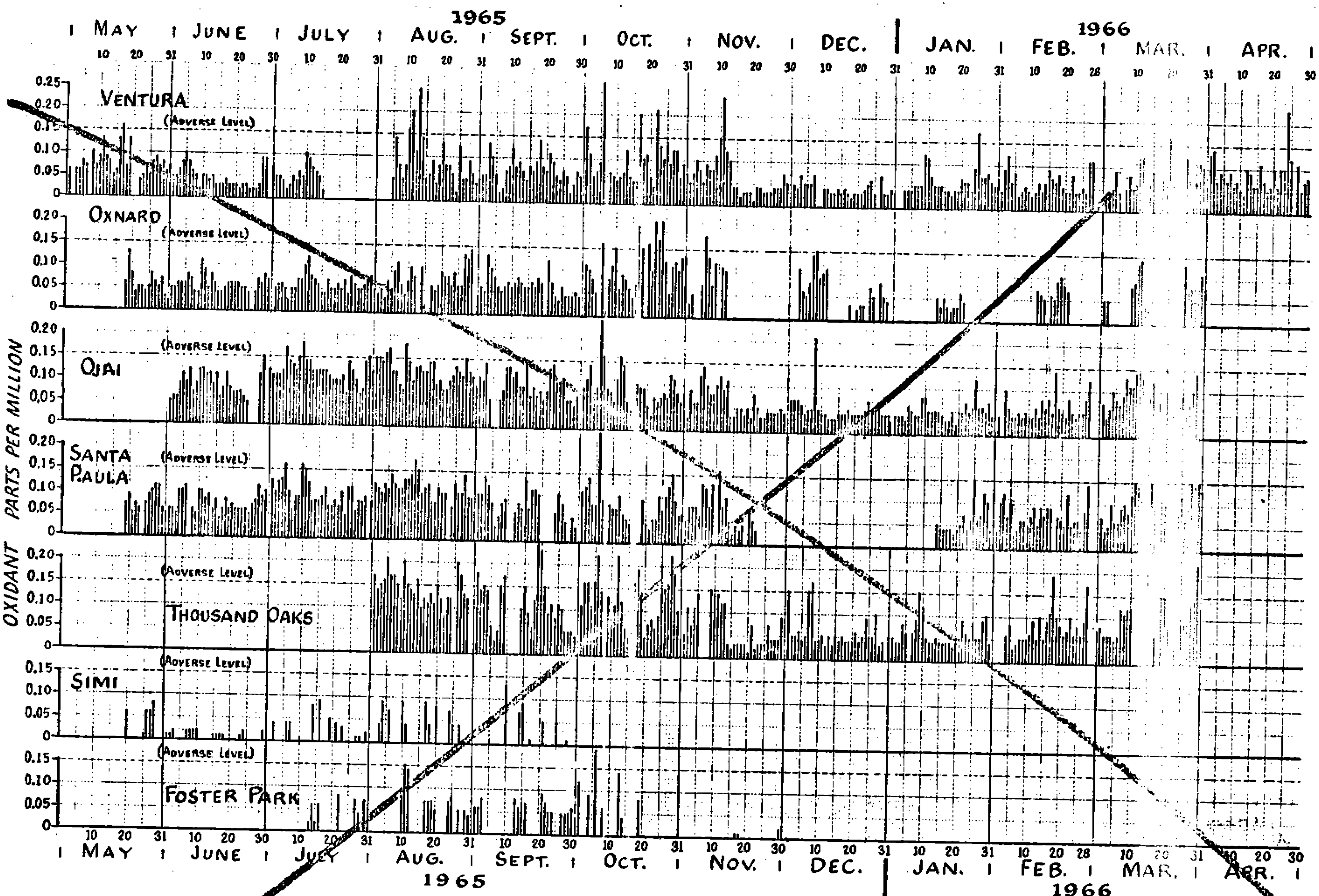
AIR QUALITY MEASUREMENTS

FIGURE 3



MAXIMUM HOURLY AVERAGE OXIDANT CONCENTRATION BY DAY & STATION; MAY 1965 TO APRIL 1966

FIGURE 3



MAXIMUM HOURLY AVERAGE OXIDANT CONCENTRATION BY DAY & STATION; MAY 1965 TO APRIL 1966

TABLE XI

CONTINUOUS OXIDANT DATA
MONTHLY SUMMARIES OF CONCENTRATIONS
AND NUMBER OF ADVERSE DAYS
(ppm)

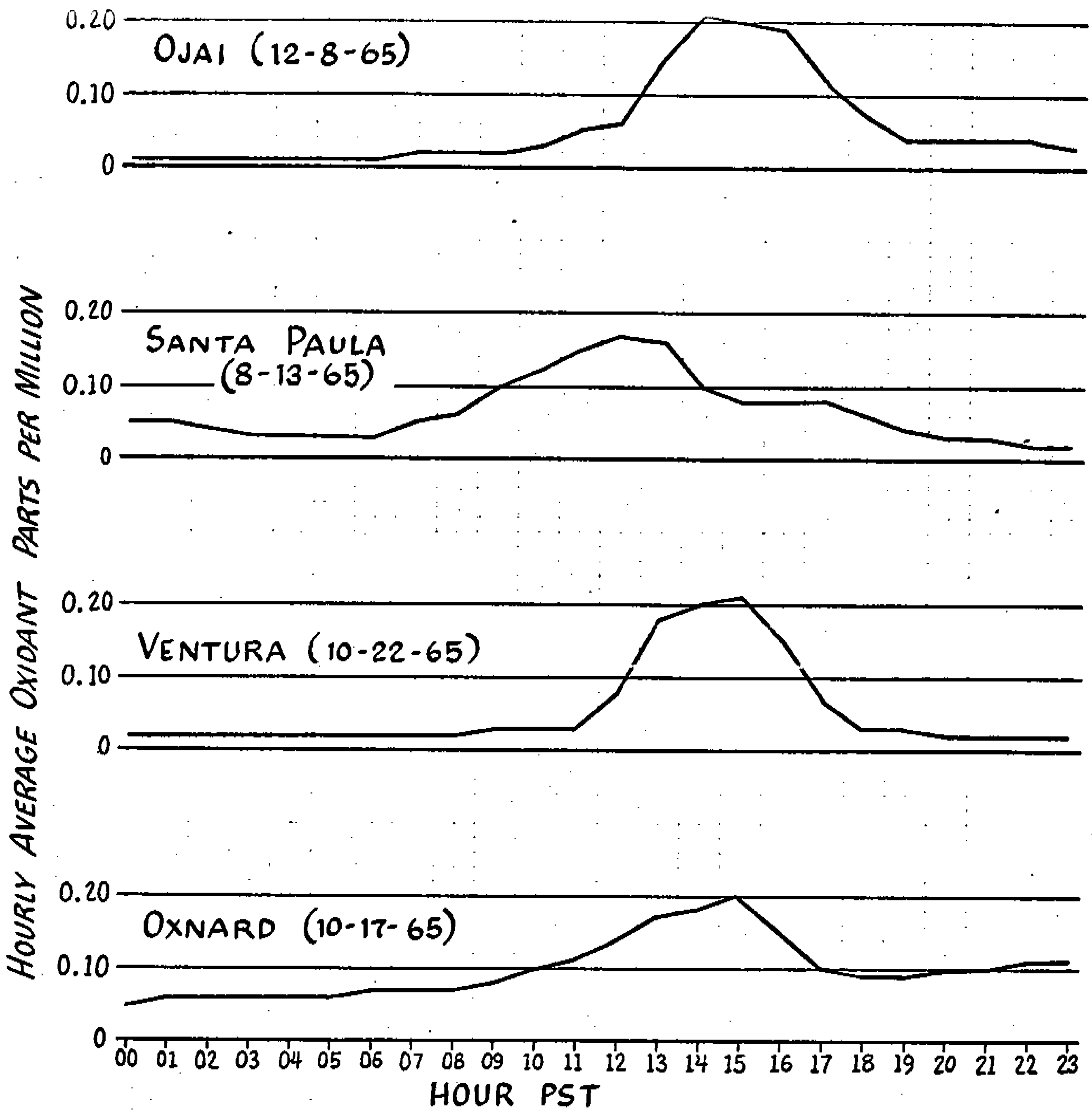
STATION	1965								1966				
	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	
Peak Concentration													Yearly Peak
Ojai	.17	.15	.20	.19	.15	.26	.14	.22	.13	.15	.15	.18	.26
Oxnard	.14	.12	.12	.17	.15	.25	.19	.19	-	.17	.20	.25	.25
Santa Paula	.13	.12	.18	.18	.16	.25	.17	-	.16	.18	.16	.29	.29
Thousand Oaks	-	-	-	.22	.26	.24	.17	.18	.15	.20	.23	.28	.28
Ventura	.18	.11	.11	.31	.15	.32	.25	.08	.18	.13	.20	.35	.35
Average of Daily Peak Concentrations													Arith. Avg.
Ojai	.12	.09	.13	.12	.10	.10	.06	.06	.06	.06	.09	.10	.09
Oxnard	.06	.07	.07	.09	.07	.14	.10	.07	-	-	.10	.10	.09
Santa Paula	.09	.08	.11	.12	.09	.10	.08	-	.07	.09	.11	.15	.10
Thousand Oaks	-	-	-	.15	.12	.14	.07	.06	.06	.09	.10	.12	.10
Ventura	.08	.05	.06	.12	.08	.11	.07	.05	.07	.07	.08	.10	.08
Maximum Hourly Average Concentration													Arith. Avg.
Ojai	.17	.15	.18	.18	.14	.24	.14	.21	.12	.14	.14	.16	.16
Oxnard	.13	.11	.12	.15	.13	.21	.18	.15	-	-	.14	.18	.15
Santa Paula	.11	.11	.16	.17	.13	.24	.16	-	.15	.15	.17	.24	.16
Thousand Oaks	-	-	-	.20	.17	.22	.16	.17	.14	.19	.22	.25	.19
Ventura	.16	.10	.10	.26	.14	.27	.24	.07	.17	.12	.12	.23	.16
Average of Daily Maximum Hourly Average Concentrations													Arith. Avg.
Ojai	.10	.09	.12	.12	.09	.09	.06	.05	.05	.06	.08	.10	.08
Oxnard	.06	.06	.06	.08	.06	.11	.09	.06	-	-	.08	.09	.08
Santa Paula	.08	.07	.10	.11	.08	.09	.07	-	.06	.07	.11	.14	.09
Thousand Oaks	-	-	-	.17	.09	.12	.07	.06	.06	.08	.09	.11	.09
Ventura	.08	.05	.05	.09	.07	.10	.06	.04	.06	.06	.07	.08	.07
Number of Adverse Days													Total
Ojai	2	1	4	6	0	3	0	1	0	0	0	2	19
Oxnard	0	0	0	1	0	8	1	1	0	0	0	3	14
Santa Paula	0	0	3	2	0	3	1	-	1	1	6	8	25
Thousand Oaks	-	-	1	11	6	10	1	3	0	2	3	5	42
Ventura	1	0	0	3	0	4	2	0	1	0	1	1	13

TABLE XII

MONTHLY OXIDANT COMPARISONS
VENTURA COUNTY AND OTHER CALIFORNIA COASTAL AREAS

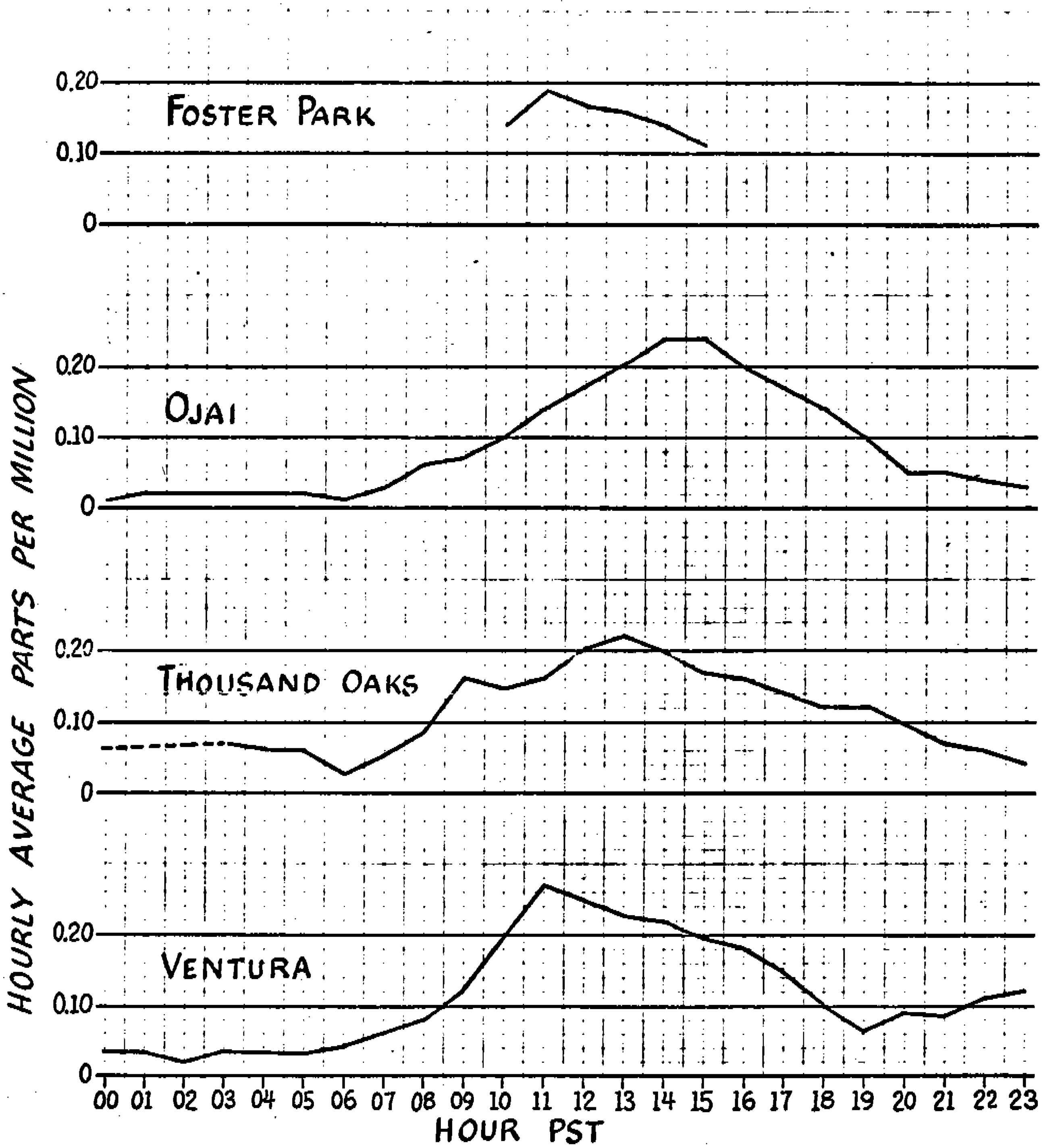
STATION	1965								1966				
	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	
PEAK OXIDANT CONCENTRATIONS, PPM													**ARITH. AVG.**
Ventura County	.20	.15	.20	.31	.18	.32	.25	.22	.18	.19	.23	.29	.23
Bay Area	.28	.29	.26	.32	.43	.42	.14	.08	.10	.13	.30	.31	.26
Los Angeles County	.35	.36	.47	.57	.49	.67	.48	.27	.22	.20	.57	.45	.43
San Diego County	.21	.15	.28	.22	.41	.98	.37	.33	.20	.29	.34	.31	.34
MAXIMUM HOURLY AVERAGE CONCENTRATIONS, PPM													**ARITH. AVG.**
Ventura County	.17	.15	.18	.26	.17	.27	.24	.21	.17	.17	.22	.25	.21
Bay Area	.23	.25	.21	.27	.33	.32	.12	.06	.08	.09	.24	.26	.21
Los Angeles County	.32	.33	.42	.52	.39	.58	.44	.20	.20	.18	.50	.44	.38
San Diego County	.20	.14	.18	.19	.30	.95	.34	.30	.18	.26	.33	.29	.31
NUMBER OF ADVERSE OXIDANT DAYS													**Total**
Ventura County	3	1	6	15	6	17	4	3	1	2	6	9	73
Bay Area	4	2	12	9	8	15	0	0	0	0	3	3	56
Los Angeles County	9	15	31	31	22	24	12	5	3	4	19	20	195
San Diego County	4	0	5	8	9	17	7	12	3	10	6	9	90

FIGURE 4



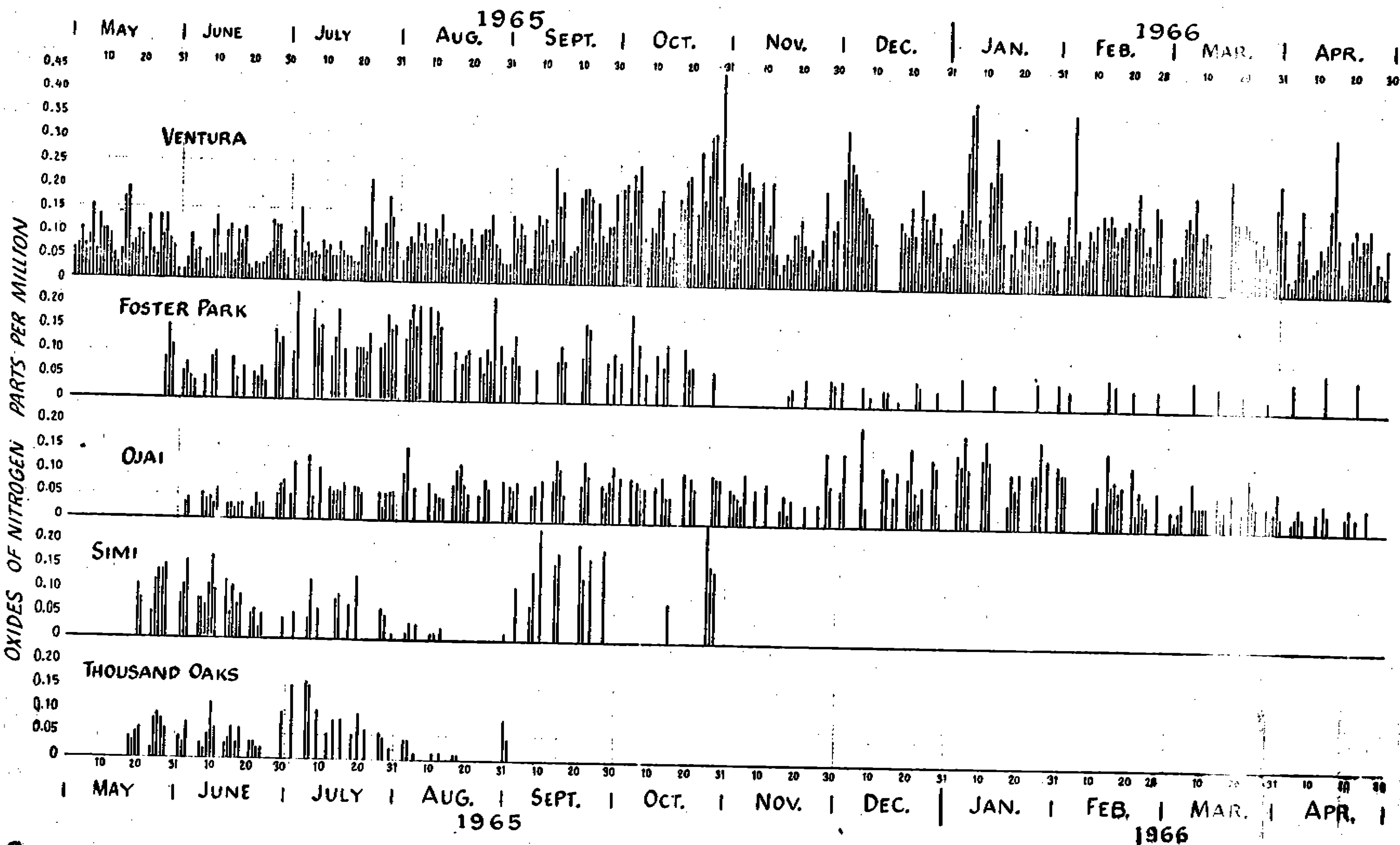
EXAMPLES OF ADVERSE OXIDANT DAYS AT VARIOUS LOCATIONS

FIGURE 5



TYPICAL DIURNAL DISTRIBUTION OF OXIDANT ON A SMOGGY DAY (OCTOBER 6, 1965)

FIGURE 6



MAXIMUM HOURLY AVERAGE OXIDES OF NITROGEN CONCENTRATION BY DAY & STATION; MAY 1965 TO APRIL 1966

TABLE XIII

CONTINUOUS OXIDES OF NITROGEN DATA
[illegible]
(Parts per million)

YEAR AND MONTH	PEAK	AVERAGE OF DAILY PEAKS	MAXIMUM HOURLY AVERAGE	AVERAGE OF DAILY MAXIMUM HOURLY AVERAGE
1965				
May	0.27	0.13	0.19	0.09
June	0.18	0.08	0.13	0.06
July	0.27	0.10	0.21	0.08
August	0.22	0.11	0.14	0.08
September	0.38	0.17	0.24	0.12
October	0.57	0.25	0.45	0.18
November	0.38	0.19	0.26	0.13
December	0.47	0.21	0.33	0.14
1966				
January	0.58	0.22	0.39	0.15
February	0.43	0.20	0.37	0.14
March	0.34	0.16	0.24	0.12
April	0.51	0.13	0.33	0.10
Average	0.38	0.16	0.27	0.12

TABLE XIV

GASEOUS POLLUTANTS-SEQUENTIAL SAMPLING
(Parts per million)

STATION	DATE OF SAMPLING	MAXIMUM 15-MINUTE AVERAGE CONCENTRATION	AVERAGE OF MONTHLY PEAK CONCENTRATION	AVERAGE OF DAILY PEAK CONCENTRATION
			TOTAL OXIDANTS	
Foster Park	June-November, 1965	0.19	0.13	0.07
Simi	May, September, October, 1965	0.13	0.11	0.07
			NITROGEN OXIDES	
Foster Park	May, 1965-April, 1966	0.29	0.18	0.09
Ojai	June, 1965-April, 1966	0.19	0.13	0.07
Simi	May-October, 1965	0.25	0.16	0.09
Thousand Oaks	June-September, 1965	0.16	0.12	0.05

TABLE XV

CARBON MONOXIDE

STATION	1965								1966			
	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
	NUMBER OF HOURS ABOVE 10 PPM											
Oxnard	0	0	0	0	1	2	2	7	7	0	0	0
Ventura	0	0	0	0	0	2	0	0	1	0	0	0
Ojai	-	0	0	0	0	0	0	0	0	0	0	0
	PEAK CONCENTRATION, PPM											
Oxnard	12	10	11	10	18	21	18	26	28	13	8	9
Ventura	6	5	5	8	12	22	13	13	18	15	10	15
Ojai	-	3	7	5	7	10	9	14	16	11	9	16
	MAXIMUM HOURLY AVERAGE CONCENTRATION, PPM											
Oxnard	8	7	6	8	13	13	13	20	17	8	6	7
Ventura	4	3	3	7	7	13	8	9	12	10	6	10
Ojai	-	3	6	4	7	8	6	10	10	8	6	5

TABLE XVI

HYDROCARBONS: NUMBER OF DAYS WITH MAXIMUM HOURLY AVERAGE CONCENTRATION AT CERTAIN LEVELS VENTURA STATION

YEAR AND MONTH	NUMBER OF DAYS WITH MAXIMUM HOURLY AVERAGE CONCENTRATION WITHIN DESIGNATED RANGE				
	0-5	6-10	11-15	16-20	21 and Over
1964					
September	5	9	9	7	
October	4	10	11	5	1
November	6	12	5	2	
December	10	7	9	2	
1965					
January	2	16	10	4	
February	2	17	7	2	
March	4	25	2	0	
April	5	14	10	1	
May	11	15	5	0	
June	17	11	2	0	
July	17	10	4	0	
August	12	14	5	0	
September	3	10	12	5	
October	3	7	14	7	
November	10	10	6	2	
December	3	24	3	0	
1966					
January	3	17	11	0	
February	0	17	11	0	
March	2	8	13	8	
April	8	10	8	4	
Total	127	263	157	49	1

TABLE XVII

MONTHLY SUMMARIES OF SULFUR DIOXIDE
CONCENTRATIONS BY CONTINUOUS ANALYZER AT OXNARD
(ppm)

YEAR AND MONTH	PEAK	AVERAGE OF DAILY PEAK	MAXIMUM HOURLY AVERAGE	AVERAGE OF DAILY MAXIMUM HOURLY AVERAGE
1965				
May	.02	.01	.02	.01
June	.02	.01	.02	.01
July	.03	.01	.02	.01
August	.03	.02	.03	.02
September	.03	.02	.02	.01
1966				
February	.07	.03	.06	.02
Average	.03	.02	.03	.01

TABLE XVIII

SULFUR TRIOXIDE CONCENTRATION BY LEAD CANDLE METHOD
(Milligrams of SO_3 per square decimeter per day)

STATION	FOSTER PARK	OJAI	OXNARD	SANTA PAULA	THOUSAND OAKS	SIMI	VENTURA
1965							
May	0.10	0.05	0.09	0.08	0.12	0.13	0.08
June	0.13	0.08	0.07	0.08	0.08	0.11	0.05
July	0.14	0.06	0.06	0.09	0.08	0.13	0.06
August	0.20	0.11	0.11	0.11	0.14	0.16	0.06
September	0.09	0.11	0.08	0.07	0.08	0.11	0.08
October	0.08	0.05	0.09	0.11	0.09	0.12	0.08
November	-	<0.05	0.11	0.06	0.08	0.09	0.05
December	0.06	<0.05	0.09	0.09	0.12	0.16	0.06
1966							
January	<0.05	<0.05	-	0.11	0.13	0.16	0.08
February	0.05	<0.05	0.10	0.09	0.09	0.15	0.07
March	0.07	<0.05	0.08	0.07	0.07	0.08	0.05
April	0.06	0.06	0.15	<0.05	0.06	0.06	<0.05
Arithmetic Average	0.09	0.06	0.09	0.08	0.10	0.12	0.06

TABLE XIX

**SUSPENDED PARTICULATES BY HIGH-VOLUME METHOD
MICROGRAMS PER CUBIC METER IN
24-HOUR SAMPLING BEGINNING ON DATES LISTED BELOW**

[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	
Date	µg/m³	Date	µg/m³	Date	µg/m³	Date	µg/m³	Date	µg/m³	Date	µg/m³	Date	µg/m³
Summer: May 10 through August 31, 1965													
		5/20	81	5/20	58	5/24	80			5/27	77	5/10	62
				5/25	115							5/27	69
6/ 2	38	6/ 8	49	6/ 9	77	6/ 4	94	6/21	77	6/ 2	42	6/ 9	68
6/ 7	53	6/15	75	6/15	75	6/10	86	7/ 1	137	6/17	58	6/22	49
6/17	50	6/23	38	6/24	46	6/14	78	7/14	124	6/30	85	7/ 2	49
6/25	61	6/29	78	6/28	67	6/22	58	7/20	120	7/ 6	88	7/19	58
7/ 8	65	7/ 1	76	7/ 7	50	7/ 7	66	7/23	115	7/13	98	8/ 5	52
7/14	86	7/13	84	7/12	77	7/12	76	8/ 6	131	7/27	62	8/14	52
7/20	91	7/16	72	7/29	102	7/22	68	8/13	102	8/ 4	122		
7/23	84	7/19	66	8/ 3	42	7/30	74	8/17	137	8/11	69		
7/26	82	7/28	87	8/10	78	8/ 2	60	8/26	122	8/20	102		
8/12	133	8/ 3	88	8/19	73	8/ 6	89	8/31	131	8/23	94		
8/20	91	8/11	87			8/10	98						
8/23	81	8/19	81			8/18	80						
8/25	129	8/27	88										
8/31	79	8/30	74										
Average	80		75		69		77		120		82		55
Maximum	133		88		102		94		137		122		68
Fall: September 1 through November 30, 1965													
9/14	79	9/13	84	9/28	242	9/ 1	68	9/16	91	9/ 3	32	9/ 2	84
9/24	59	9/22	94	10/ 5	133	9/ 2	98			9/ 7	42	9/13	81
9/27	41	10/ 7	98	10/ 6	140	9/ 4	109			9/15	108	9/27	54
10/ 8	69	10/29	97	10/14	72	9/ 8	67			10/13	106	10/ 8	81
10/11	70	11/ 5	99	10/19	128	9/16	89					10/26	60
11/ 1	71	11/17	14	10/26	130	9/21	75					11/ 6	107
11/ 8	69	11/29	56	11/ 2	116	10/28	112						
11/15	6					11/ 4	122						
Average	58		77		137		93		91		72		78
Maximum	79		99		242		122		91		108		107
Winter: December 1, 1965 through February 28, 1966													
12/ 1	27	12/10	35	12/22	78	12/ 8	109*	2/ 2	93	1/31	55	12/ 7	106
12/ 6	53	12/13	25	1/ 3	61	12/28	26	2/ 4	157	2/ 7	72	12/22	71
12/15	25	12/22	96	1/19	74	1/ 4	83	2/14	119	2/21	57	1/ 4	46
12/20	49	1/ 6	70	1/24	148	1/25	73	2/28	160	2/23	56	1/17	64
1/ 6	50	1/11	78	2/ 7	66	2/ 3	54			2/26	72	2/ 3	[illegible]
1/11	68	1/21	50	2/16	79	2/ 7	43					2/12	127
1/24	54	1/27	53	2/21	51	2/16	88						
1/31	23	1/31	44			2/21	70						
2/ 9	30	2/ 9	42										
2/15	59	2/14	72										
2/23	65	2/24	45										
Average	46		56		82		68		132		62		83
Maximum	68		96		148		109		160		72		127
Spring: March 1, 1966 through April 30, 1966													
3/ 2	35	3/ 2	25	3/ 2	87	3/ 4	51	3/30	104	3/14	79	3/ 4	94
3/28	82	3/10	114	3/14	129	3/ 8	92	4/ 4	109	3/21	79	3/16	167
4/ 5	105	3/15	91	3/21	172	3/24	58	4/13	135	3/28	138	3/28	115
4/13	65	3/25	61	3/28	154	4/ 1	90	4/18	98	4/11	73	4/10	99
4/21	97	3/28	83	4/ 4	110	4/ 5	83			4/20	81	4/27	96
		4/ 7	75	4/27	107	4/26	113			4/25	101		
		4/13	76										
		4/20	76										
Average	77		75		127		81		112		92		114
Maximum	105		114		172		113		135		138		167
Averages and Maximum Values for the Year May 1965 through April 1966													
Average	65		70		99		79		119		79		80
Maximum	133		114		242		122		160		138		167

* Road work 150 yards from the High-Volume instrument.

TABLE XX

SOILING, COH VALUES UNITS
SUSPENDED PARTICULATE MATTER BY AISI METHOD

STATION	RANGE OF COH UNITS, LINEAL FEET, 2-HOUR AVERAGE	NUMBER OF 2-HOUR READINGS IN THE DESIGNATED RANGE OF COH UNITS													PERCENT OF READINGS IN DESIGNATED INTERVAL
		1965								1966				Total During 12 Months	
		May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr		
Ojai	0 - 0.5	272	319	339	339	311	267	256	227	201	263	291	281	3,366	83.3
	0.6- 1.0	37	4	9	15	20	57	80	106	72	65	64	47	576	14.2
	1.1- 2.0						12	10	30	23	6	3		84	2.1
	2.1- 4.0						1		1	1	2	2		7	
	4.1- 6.0								4	2				6	
	6.1- 8.0								1					1	0.4
	8.1-10.0								2					2	
	10.1-12.0								1					1	
														4,043	
Oxnard	0 - 0.5	345	336	349	340	326	282	241	147	-	207	274	281	3,128	81.4
	0.6- 1.0	25	30	23	30	27	74	93	78	-	70	88	66	604	15.7
	1.1- 2.0		0		2	2	10	18	42	-	14		11	106	2.8
	2.1- 3.0		1						2	-				3	0.1
														3,841	
Santa Paula	0 - 0.5	179	307	361	349	308	316	254	283	211	274	311	225	3,378	87.4
	0.6- 1.0	1	41	6	23	30	52	98	77	29	30	36	19	442	11.5
	1.1- 2.0			1		8	4	4	11		8	5		41	1.1
	2.1- 3.0								1					1	
														3,862	
Thousand Oaks	0 - 0.5	-	28	266	242	258	262	223	242	240	278	257	292	2,588	72.6
	0.6- 1.0	-	3	82	109	75	84	104	57	77	46	92	56	785	22.1
	1.1- 2.0	-		12	15	18	26	29	16	26	11	23	12	188	5.3
														3,561	
Ventura	0 - 0.5	352	353	359	341	315	286	281	291	291	264	306	325	3,764	86.2
	0.6- 1.0	20	7	13	29	30	75	59	76	72	66	66	35	548	12.6
	1.1- 2.0				2		11	19	5	9	6			52	1.2
	2.1- 3.0							1						1	
														4,365	

TABLE XXI

DUSTFALL

(Tons per square mile)

STATION	1965								1966				ARITH. AVG.
	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	
	VENTURA COUNTY SITES												
Foster Park	13.5	7.4	14.8	12.5	10.5	10.6	-	11.5	-	-	-	-	13.5
Ojai	6.3	6.7	11.9	15.3	7.2	10.3	-	5.9	5.1	5.6	14.7	2.1	8.3
Oxnard	12.5	17.7	8.8	6.4	15.6	15.1	-	7.0	-	15.7	29.4	7.8	13.6
Santa Paula	8.2	9.0	8.7	13.0	5.5	6.9	-	4.4	-	8.7	15.6	16.9	9.7
Simi	9.7	15.1	11.4	13.4	9.1	12.4	-	-	-	4.3	14.0	6.0	10.6
Thousand Oaks	6.2	9.3	7.0	7.4	10.6	10.9	-	4.7	10.0	11.0	14.8	6.6	9.0
Ventura	9.4	6.6	7.6	6.2	9.4	13.3	6.9	12.7	11.6	10.0	20.2	7.3	10.1
	OTHER CALIFORNIA SITES												
Bakersfield	37.5	35.4	24.6	62.3	22.7	18.2	16.7	5.3	22.2	13.3	17.9	21.6	24.8
Berkeley	10.2	-	8.7	11.6	10.7	13.3	14.3	11.1	12.7	9.9	9.6	-	10.2
Fresno	12.8	13.9	10.4	8.8	13.9	19.1	13.6	5.3	19.2	7.4	12.1	15.7	12.4
Oakland	13.0	14.4	13.9	17.2	51.2	14.5	13.4	12.5	16.0	10.4	10.4	13.6	16.7
Sacramento	17.0	15.7	18.4	13.9	17.9	57.3	17.9	15.7	16.6	17.9	13.7	22.8	20.4
Santa Barbara	9.7	7.5	7.0	6.9	8.0	10.9	7.2	10.2	10.7	10.3	11.2	11.5	9.3
Stockton	-	-	15.4	11.4	16.3	16.2	-	12.5	9.6	10.6	8.7	16.5	13.0

Gasoline-Powered

The number of registered motor vehicles in Ventura County for the years 1959 to 1965 and the estimated total number of registered and fee exempt vehicles as of July 1, 1966 are shown below.

TABLE XXII

GASOLINE-POWERED AUTOMOBILES, TRUCKS AND BUSES IN VENTURA COUNTY

TIME PERIOD (YEAR ENDING DECEMBER 31)	FEE-PAID AUTOMOBILES, TRUCKS AND BUSES					ESTIMATED FEE-EXEMPT AUTOMOBILES, TRUCKS AND BUSES	TOTAL AUTOMOBILES, TRUCKS AND BUSES
	Automobiles	Trucks and Buses	Automobiles, Trucks and Buses	Increase Over Preceding Year			
				Number	Percent		
1959	70,784	12,413	83,197				
1960	76,852	13,054	89,906	6,709	8.1		
1961	83,924	14,368	98,292	8,386	9.3		
1962	96,135	16,437	112,572	14,280	14.3		
1963	103,637	16,288	119,925	7,353	6.5		
1964	117,213	19,674	136,887	16,962	14.1		
1965	132,738	22,306	155,044	18,157	13.3	2,000[a]	157,000
July 1, 1966							170,000[b]

a Based on January 1, 1966 state average of 1.25 percent of motor vehicles exempted from fees.

b Based on an average increase of 11 percent per year in the number of registered motor vehicles in Ventura County during the years 1960 to 1965.

Using the state average of 2.0 gallons of gasoline consumed per day per motor vehicle, the 170,000 motor vehicles registered or exempted from fees in Ventura County consume approximately 340,000 gallons of gasoline per day. (See Table XXIII)

(The emission factors and emissions of air pollutants from gasoline-powered automobiles, trucks, and buses in Ventura County are listed in Tables XXIII and XXIV.)

TABLE XXIII

EMISSION FACTORS FOR AIR POLLUTANTS FROM GASOLINE-
POWERED MOTOR VEHICLES IN VENTURA COUNTY

POLLUTANT	EMISSIONS IN		
	Parts Per Million	Percent of Supplied Fuel	Tons Per Million Gallons of Gasoline
Hydrocarbons[1,2]			
As Hexane, in Exhaust Without Control	900		203
As Hexane, in Exhaust With Control	275		62
Blowby (uncontrolled)		2.1	64[a]
Evaporation Losses		1.4	43
Oxides of Nitrogen as Nitrogen Dioxide[1]	1,000		67
Oxides of Sulfur as Sulfur Dioxide[3]			4
Carbon Monoxide			
In Exhaust Without Control[1]	34,000 (3.4%)		1,380
In Exhaust With Control[1]	15,000 (1.5%)		610
In Blowby (uncontrolled)[3]			10
Particulate Matter[3]			6

1 Emission factors from State of California Department of Public Health.
2 Reported as total hydrocarbons as hexane which equals 1.8 times the hydrocarbons measured by the non-dispersive infrared method.
3 From Los Angeles Air Pollution Control District data (R-1, page 23).

a Assumes density of the gasoline is 6.2 lb/gal (R-1, page 23).

TABLE XXIV

EMISSIONS OF AIR POLLUTANTS FROM GASOLINE-POWERED
MOTOR VEHICLES IN VENTURA COUNTY
AS OF JULY 1, 1966[1]

POLLUTANT	EMISSIONS, TONS PER DAY
Hydrocarbons	
As Hexane, Exhaust	66
Blowby	11
Evaporation Losses	15
Total	92
Oxides of Nitrogen as Nitrogen Dioxide	23
Oxides of Sulfur as Sulfur Dioxide	1.4
Carbon Monoxide	
Exhausts	452
Blowby (uncontrolled)	3
Total	455
Particulate Matter	2.0

1 Based on estimation that 7 percent of the motor vehicles in Ventura County have exhaust control devices and 50 percent have blowby control devices.

Diesel-Powered Trucks and Buses

Only [illegible] percent of the motor vehicles registered in California are diesels, but they consume 5 percent of the motor fuel sold in California.(R-2) Assuming this same percentage applies in Ventura County, 18,000 gallons of diesel fuel are consumed daily in the county.

Emission factors and emissions of pollutants from diesels are shown in Table XXV.

TABLE XXV

EMISSION FACTORS AND EMISSIONS OF AIR POLLUTANTS
DIESEL-POWERED TRUCKS AND BUSES IN VENTURA COUNTY

POLLUTANT	EMISSION FACTORS (TONS OF POLLUTANTS PER MILLION GALLONS OF DIESEL FUEL[1]) (R-1)	EMISSIONS (TONS PER DAY)
Hydrocarbons	75	1.4
Oxides of Nitrogen	75	1.4
Oxides of Sulfur	20	0.3
Carbon Monoxide	20	0.3
Particulate Matter	20	0.3

1 These emission factors are based on data in Lemke, Eric E., Shaffer, Norman R., and Verssen, Julien A., "Summary of Air Pollution Data for Los Angeles County." Los Angeles County Air Pollution Control District, January, 1965.

Aircraft

TABLE XXVI

AVERAGE DAILY OPERATIONS AND GASOLINE CONSUMPTION OF AIRCRAFT IN VENTURA COUNTY, JULY 1966

	AVERAGE NUMBER OF DAILY OPERATIONS[1]	GASOLINE CONSUMED PER OPERATION (GALLONS)
Piston-driven		
Single-engine	450	2.3 (Federal Aviation Agency data)
2-engine	50	15 (R-3, page 2)
Jet Aircraft	150	160[a] (R-4, page 6)
2-engine Turbo Prop	10	25 (R-3, page 2)

[1] Based on data supplied by personnel at the airports and air bases. Each departure or arrival, or near touchdown, is considered as a separate operation.

[a] Based on information obtained from military sources, the jet planes are estimated to have an average of 16,000 pounds of maximum thrust.

Emission factors for aircraft below 3500 feet (R-4, page 27) are presented in Table XXVII. Emissions of air pollutants in Ventura County aircraft below 3500 feet are given in Table XXVIII.

TABLE XXVII

EMISSION FACTORS FOR AIR POLLUTANTS FROM AIRCRAFT BELOW 3500 FEET[1]

(Pounds/1000 gallon of fuel consumed)

POLLUTANT	JET AIRCRAFT	TURBO-PROP AIRCRAFT	PISTON-ENGINE AIRCRAFT
Hydrocarbons and Other Organic Gases	21	10	496
Oxides of Nitrogen as Nitrogen Dioxide	37	23	147
Oxides of Sulfur as Sulfur Dioxide	Negligible	Negligible	Negligible
Carbon Monoxide	56	40	2,450
Particulate Matter	54	12	12

[1] R-3, page 3.

TABLE XXVIII

EMISSIONS OF AIR POLLUTANTS IN VENTURA COUNTY FROM AIRCRAFT BELOW 3500 FEET

POLLUTANT	EMISSIONS, TON PER DAY			
	Jet Aircraft	Turbo-Prop Aircraft	Piston-Engine Aircraft	
			1-Engine	2-Engine
Hydrocarbons and Other Organic Gases	0.025	0.002	0.25	0.19
Oxides of Nitrogen as Nitrogen Dioxide	0.44	0.003	0.08	0.05
Oxides of Sulfur as Sulfur Dioxide	Negligible	Negligible	Negligible	Negligible
Carbon Monoxide	0.67	0.005	1.27	0.92
Particulate Matter	0.64	0.002	0.006	0.005

Combustion of Gaseous Fuels

The amounts of natural gas sold in Ventura County by Southern Counties Gas Company from 1950 through 1965 are shown in Table XXIX. According to analytical data furnished by the supplier, this gas has a hydrogen sulfide content approximating that of the natural gas consumed in Los Angeles County (0.15 grains per 100 standard cubic feet).

TABLE XXIX

NATURAL GAS SALES IN VENTURA COUNTY
1950 THROUGH 1965

YEAR	SALES IN MILLIONS OF CUBIC FEET
1950	4,353
1955	5,878
1960	6,846
1961	6,894
1962	8,182
1963	8,785
1964	10,640
1965	11,592

Source: Southern Counties Gas Company.

The average daily volume of gaseous fuels consumed in Ventura County during the year 1965 was 134.5 million cubic feet as shown in Table XXX.

The emission factors and emissions of air pollutants from the combustion of gaseous fuels sold in Ventura County are shown in Tables XXXI and XXXII, respectively.

The emission factors and emissions of air pollutants from the combustion of gaseous fuels at petroleum production and refining facilities are shown on page 59 of this report.

TABLE XXX

GASEOUS FUEL CONSUMED IN [illegible] COUNTY, 1965

CONSUMER	CONSUMPTION IN MILLIONS OF CUBIC FEET	
	Yearly	Daily
Power Plant	22,000	60.5
Industrial (excludes petroleum industry)	2,300	6.4
Petroleum Industry	15,400	42.2
Domestic and Commercial	9,200	25.4
Total	48,900	134.5

TABLE XXXI

AVERAGE EMISSION FACTORS FOR AIR POLLUTANTS FROM THE COMBUSTION OF GASEOUS FUELS[1]

COMBUSTION SOURCE	EMISSION FACTORS, POUNDS PER MILLION CUBIC FEET OF GASEOUS FUEL				
	Hydrocarbons and Other Organic Gases	Oxides of Nitrogen as Nitrogen Dioxide	Oxides of Sulfur as Sulfur Dioxide	Carbon Monoxide	Particulate Matter
Power Plant	4	390	1.0[a]	n	15
Industrial (excludes petroleum industry)	7	214	0.4	0.4	17.6
Domestic and Commercial	n	116	0.4	0.4	18.7

n Negligible.

1 These emission factors are based on data obtained from the Los Angeles Co. Pollution Control District with the exception listed in footnote "a".

a Based on a gas analysis showing a hydrogen sulfide content of 0.39 grains per 100 standard cubic foot.

TABLE XXXII

EMISSIONS OF AIR POLLUTANTS FROM THE COMBUSTION
OF GASEOUS FUELS SOLD IN VENTURA COUNTY, 1965

COMBUSTION SOURCE	AVERAGE EMISSIONS (TONS PER DAY)				
	Hydrocarbons and Other Organic Gases	Oxides of Nitrogen as Nitrogen Dioxide	Oxides of Sulfur as Sulfur Dioxide	Carbon Monoxide	Particulate Matter
Power Plant	0.120	11.80	0.033	n	0.450
Industrial[1]	0.023	0.69	0.001	0.001	0.057
Domestic and Commercial	n	1.48	0.005	0.005	0.237
Total	0.143	13.97	0.039	0.006	0.744

n Negligible

1 Excluding emissions from the petroleum industry which are shown on page 59 of this report.

Liquid Fuels-Stationary Usage

TABLE XXXIII

FUEL OIL USAGE IN VENTURA COUNTY
(Barrels per year)

Power Plant	46,000[a]
Other Usage	30,000[b]
Total	76,000

a Based on average of usage in the years 1964 and 1965.

b Excludes petroleum production and refining and orchard heater usage which are listed on pages 58 and 65 respectively of this report.

The amount of liquified petroleum gas burned in Ventura County is small enough to be considered negligible as far as air pollution emissions are concerned.

The emission factors and emissions of air pollutants from the combustion of fuel oil in stationary sources in Ventura County (excluding the petroleum industry usage), are shown in Tables XXXIV and XXXV respectively.

TABLE XXXIV

AVERAGE EMISSION FACTORS FOR AIR POLLUTANTS FROM THE COMBUSTION OF FUEL OIL IN STATIONARY SOURCES

COMBUSTION SOURCE	EMISSION FACTORS (POUNDS PER THOUSAND BARRELS OF FUEL OIL)				
	Hydrocarbons and Other Organic Gases	Oxides of Nitrogen as Nitrogen Dioxide	Oxides of Sulfur as Sulfur Dioxide	Carbon Monoxide	Particulate Matter
Power Plants	173	5,000	11,000	1.8	893
Other Usage	127	3,360	7,982	6.3	839

1 These emission factors were obtained from the Los Angeles County Air Pollution Control District, April 13, 1964.

TABLE XXXV

EMISSIONS OF AIR POLLUTANTS FROM THE COMBUSTION OF FUEL OIL IN STATIONARY SOURCES IN VENTURA COUNTY

COMBUSTION SOURCE	AVERAGE EMISSIONS (TONS PER DAY)				
	Hydrocarbons and Other Organic Gases	Oxides of Nitrogen as Nitrogen Dioxide	Oxides of Sulfur as Sulfur Dioxide	Carbon Monoxide	Particulate Matter
Power Plants	0.010	0.32	0.71	n	0.06
Other Usage	0.005	0.14	0.33	n	0.03
Total	0.015	0.46	1.04	n	0.09

n Negligible.

Petroleum Production and Marketing

Crude oil producers in Ventura County range from the owner of one oil well that operates intermittently and averages one barrel of crude oil per day to holders of extensive oil leases that produce over 10,000 barrels of crude per day and operate large natural gasoline plants (to separate "wet" gas into consumer gas and natural or "casinghead" gasoline), over 60,000 barrels of crude oil are produced daily in the county.

With the assistance of Western Oil and Gas Association, a survey questionnaire was sent to all the petroleum producers in Ventura County, asking for information on their operations and equipment. The return of information amounted to 96 percent.

Using emission factors developed in previous studies (see Tables XXXVI, XXXVII, and XXXVIII) estimates were made of the pollutants produced in connection with the production of crude oil in Ventura County (see Table XXVIII).

TABLE XXXVI

EMISSION FACTORS FOR THE PETROLEUM INDUSTRY
STORAGE TANKS (R-5,6, AND 7)

MATERIAL STORED	EMISSION FACTORS - POUNDS OF HYDROCARBON PER DAY PER 1,000 BARRELS STORAGE CAPACITY	
	Fixed Roof	Floating Roof
Crude Oil		
Vapor Pressure >1.5 psia	4.55	2.4
Vapor Pressure <1.5 psia	2.25	0.9
Petroleum Distillate		
Vapor Pressure >1.5 psia	23.50	2.4
Vapor Pressure <1.5 psia	0.80	0.8

TABLE XXXVII

EMISSION FACTORS FOR THE PETROLEUM INDUSTRY
BOILERS AND HEATERS (R-8)

CONTAMINANT	EMISSIONS FACTORS	
	Fuel Gas, Pounds Per 1,000 Cubic Feet	Fuel Oil, Pounds Per Gallon[1]
Hydrocarbons, as Hexane	n (R-8)	n (R-8)
Organic Acids as Acetic Acid	0.014	0.011
Aldehydes, as Formaldehyde	0.0031	0.0006
Oxides of Nitrogen, as NO_2	0.23	0.068
Sulfur Dioxide	(calculate from sulfur content)	
Particulate Matter	0.021	0.020

n Negligible.

1 Ventura County: 600 gallons per day, 4% sulfur content.

TABLE XXXVIII

EMISSION FACTORS FOR THE PETROLEUM INDUSTRY
OTHER SOURCES

SOURCE AND CONTAMINANT	EMISSION FACTORS
Gas Internal Combustion Engines (R-9)	
Hydrocarbons (over 95% methane and ethane)	1.2 lbs per 1,000 cf. of gas
Oxides of Nitrogen, as NO_2	0.8 lb per 1,000 cf. of gas
Sulfur Dioxide	(calculate from sulfur content)
Waste Water Separators - HC (R-10)	680 lbs per 100,000 bbl oil produced
Cooling Towers - HC (R-5 and 8)	9 lbs per day per 1,000 gpm water circulated
Pumps - HC (R-11)	
Mechanical Seals	
Centrifugal Pumps	
Reid Vapor Pressure > 26 lbs	9.2 lbs per day per seal
Reid Vapor Pressure < 26 lbs	0.45 lb per day per seal
Packed Seals	
Centrifugal Pumps	
Reid Vapor Pressure > 26 lbs	10.3 lbs per day per seal
Reid Vapor Pressure < 26 lbs	3.15 lbs per day per seal
Reciprocating Pumps	
Reid Vapor Pressure > 26 lbs	16.6 lbs per day per seal
Reid Vapor Pressure < 26 lbs	4.05 lbs per day per seal
Compressors - HC (R-11)	8.5 lbs per day per seal
Relief Valves - HC (R-5)	
Operational Vessels	2.9 lbs per day per valve
Pressure Storage Tanks	0.6 lb per day per valve
Pipeline Valves - HC (R-5)	0.15 lb per day per valve
Tanks Filling Losses - HC (R-8)	
Filling Tank Trucks at Bulk Plants	0.022% of product (gasoline)
Filling Underground Tanks	9.5 lbs per 1,000 gallons (50% of tanks have submerged fill)
Filling Automobile Tanks	12.7 lbs per 1,000 gallons

TABLE XXXIX

EMISSIONS OF AIR POLLUTANTS FROM CRUDE OIL PRODUCTION IN VENTURA COUNTY

SOURCE	EMISSIONS (TONS PER DAY)				
	Hydrocarbons	Other Organic Gases	Oxides of Nitrogen As NO_2	Oxides of Sulfur as SO_2	Particulate Matter
Storage Tanks	1.3				
Boilers and Heaters					
Gas		0.2	2.5	0.3	0.2
Oil		n	n	0.2	n
Internal Combustion Engines					
Gas	0.6[a]		8.4	0.7	
Diesel	n (R-2)	n	n	n	n
Waste Water Separators	0.2				
Cooling Towers	0.1				
Pumps	2.5				
Compressors	2.8				
Relief Valves	2.2				
Pipeline Valves	1.5				
Total	11.2	0.2	10.9	1.2	0.2

n Negligible.

a Does not include 12.0 tons per day of nonreactive hydrocarbons (methane and ethane) from this source.

Emissions of hydrocarbons due to petroleum product marketing in Ventura County include evaporation from storage tanks at bulk storage terminals, filling tank trucks at these bulk plants, filling underground tanks at service stations, and filling automobile gasoline tanks.

With the assistance of Western Oil and Gas Association, a survey questionnaire was sent to all the companies that market petroleum products in Ventura County, asking for information on their operations and equipment.

Using emission factors developed in previous studies (See Tables XXXVI and XXXVIII), estimates were made of the hydrocarbon losses to the atmosphere from this source. These are listed in Table XL.

TABLE XL

EMISSIONS OF HYDROCARBONS FROM PETROLEUM PRODUCT MARKETING IN VENTURA COUNTY

SOURCE	HYDROCARBONS (TONS PER DAY)
Storage Tanks in Bulk Plants	0.2
Tank Filling[1]	3.6
Total	3.8

1 Assume vapor return and 50 percent submerged fill of tank trucks at bulk terminals and 50 percent submerged fill of underground tanks at service stations.

Mineral Processing Industries

Most of the air pollution released from the mineral processing industries in Ventura County consists of dusts released by processes such as crushing, grinding, calcining, drying, mixing, conveying,and loading.

A survey questionnaire was sent to rock, gravel and sand, asphaltic concrete, and concrete batching plants to determine process volumes and degree of air pollution control.

Rock Crushing Plants. Most of the rock crushing plants in Ventura County either obtain the rock, gravel and sand from sources where it is already wet or use water sprays to dampen the rocks before crushing. These plants have a total process weight of approximately 15,000 tons per day.

Based on estimates for similar plants in Los Angeles County, it is estimated that the dust emissions from these plants total approximately 0.1 ton per day.

Asphaltic Concrete Batching Plants. The asphaltic concrete batching plants in Ventura County use water scrubbers to reduce dust emissions. With a combined average production of 5,000 tons a day those plants emit approximately 0.5 ton per day of dust, based on an emission factor of 0.2 pound per ton of asphaltic concrete. (R-12)

Concrete Batching Plants. Most of the concrete batching plants in Ventura County use water sprays, filter material over breathers, and canvas curtains drawn around dump trucks while dumping to control dust losses. Losses are estimated to average 0.1 pound of dust per cubic yard of concrete. With a total average daily production of 2,000 cubic yards per day, these plants have an average dust emission loss of 200 pounds or 0.1 ton per day.

Concrete Products. Industries manufacturing concrete products such as light weight expanded aggregate, blocks, pipe, etc., are estimated to emit one ton per day of dust.

Odor Sources

Among the sources of odors in Ventura County are two large cattle feed yards, poultry ranches, low grade crude oil extraction, irrigation water high in sulfur content, tire burning to prevent frost damage, backyard burning, and exhausts of diesel-powered vehicles.

Organic Solvent Usage

Surface Coating. The emissions of hydrocarbons and other organic gases from surface coating operations in Ventura County are estimated to be three tons per day.(R-13, page 14)

Degreasing. The emissions of hydrocarbons and other organic gases from degreasing as reported by the Los Angeles County Air Pollution Control District were 1.4 tons/day per 100,000 residents in Los Angeles County, as of January, 1965. Using this same emission factor, emissions of hydrocarbons and other organic gases in Ventura County with a population of approximately 340,000 as of June, 1966 are 4.8 tons per day from degreasing operations.

Dry Cleaning. The emission of total organic solvents in dry cleaning plants in tons per 100,000 residents per day was reported to be 0.54 by the Los Angeles County Air Pollution Control District and 0.53 by the Bay Area Air Pollution Control District, as of 1963.(R-14, page 32) With a population of 340,000 the emissions in Ventura County are 1.8 tons per day.

Pesticides. The emissions of organic solvents from pesticides is discussed on page 67 of this report.

Waste Disposal (Open Burning)

Burning Dumps. Two cities in Ventura have burning dumps, Santa Paula and Fillmore. The refuse of approximately 16,000 Santa Paula residents and 1,000 residents of the outlying area, and of approximately 5,500 Fillmore residents and 500 residents of the outlying area are burned in these dumps. Assuming four pounds of refuse are burned per person per day, the weight of refuse burned in the dumps averages 46 tons per day. (R-15, pages 13-14, R-16, page 18, and R-17, pages II-27, 47, 49) Emission factors and emissions of air pollutants from the combustion of refuse in burning dumps are listed in Table XLI.

TABLE XLI

EMISSION FACTORS AND EMISSIONS FOR AIR POLLUTANTS FROM THE COMBUSTION OF REFUSE IN BURNING DUMPS

POLLUTANT	EMISSION FACTORS (POUNDS PER TON OF REFUSE)	EMISSIONS (TONS PER DAY)
Hydrocarbons and Other Organic Gases	14[a,b]	0.3
Oxides of Nitrogen as Nitrogen Dioxide	0.6	0.01
Oxides of Sulfur as Sulfur Dioxide	1.2	0.03
Carbon Monoxide	300[c]	6.9
Particulate Matter	47	1.1

a R-18, page 134.
b R-19.
c Estimated to equal the emission factor for a single chamber incinerator.(R-3, page 34)

Backyard Burning. Approximately 165,000 city residents in Ventura County live in areas where refuse is taken to dumps with landfill operation. Most of the refuse of 140,000 residents of rural and unincorporated areas is disposed of by backyard burning.

According to the records of the Ventura County Fire Department 16,702 burning permits were issued last year, but burning at a distance of 500 feet from any vegetation does not require a permit.

Assuming that there is four pounds of combustible refuse per resident, and approximately three pounds of this is burned, an average of approximately 210 tons of refuse per day are burned in Ventura County. Estimated emission factors and emissions of air pollutants from backyard burning are given in Table XLII.

TABLE XLII

EMISSION FACTORS AND EMISSIONS FOR AIR POLLUTANTS FROM REFUSE DISPOSAL BY BACKYARD BURNING

POLLUTANT	EMISSION FACTORS (POUNDS PER TON OF REFUSE)	EMISSIONS (TONS PER DAY)
Hydrocarbons and Other Organic Gases	14[a]	1.5
Oxides of Nitrogen as Nitrogen Dioxide	0.5[b]	0.05
Oxides of Sulfur as Sulfur Dioxide	0.8[b]	0.08
Carbon Monoxide	300[c]	32
Particulate Matter	150[d]	16

a R-18 page 134 and R-19.
b R-20 page 47, R-21 and R-3, page 35.
c Estimated to equal the emission factor for a single-chamber incinerator. (R-3, page 34)
d R-22.

Incineration. Although the exact number of single or multiple chamber incinerators in Ventura County is not known, the amount of refuse disposed of by this method appears to be small compared to other burning methods.

Agricultural Sources

Crop Debris Burning. The extent of agricultural burning in Ventura County was estimated by referral to data obtained by the University of California Extension Service in agricultural burning surveys in Santa Barbara, Kern, and Riverside Counties and by conversations with local agricultural authorities. It is estimated that an average of 80 tons of prunings and removed trees and seven tons of field and truck crop stubble are burned daily in Ventura County. There were 47,650 bearing acres of orchard crops and 65,261 bearing acres of field and truck crops in Ventura County in 1965. (R-23)

Assuming the emission factors for agricultural debris burning are similar to those for backyard burning as complied by the United States Public Health Service, (R-3, page 35) estimated emissions of pollutants from agricultural burning in Ventura County are given in Table XLIII.

TABLE XLIII

ESTIMATED EMISSION FACTORS AND EMISSIONS FROM AGRICULTURAL BURNING IN VENTURA COUNTY, 1966

POLLUTANT	EMISSION FACTORS (POUNDS OF POLLUTANT PER TON OF REFUSE)	EMISSIONS (TONS OF POLLUTANT PER DAY)
Hydrocarbons and Other Organic Gases	14[a]	0.6
Oxides of Nitrogen as Nitrogen Dioxide	0.5	0.02
Oxides of Sulfur as Sulfur Dioxide	0.8	0.03
Carbon Monoxide	300[b]	13
Particulate Matter	150	6.5

a R-19.
b Assumed to equal the emission factor for single chamber incinerators. (R-3, page 34)

Orchard Heaters

A survey made in 1962 by the Ventura County Department of Agriculture showed there were 43,065 orchard heaters with return stacks and 170,329 heaters without return stacks in Ventura County. According to Mr. C. J. Barrett, Ventura County Agricultural Commissioner, there were approximately the same number of each of these two types of heaters in the county as of May 1966. There are approximately 700 wind machines in the county.

Based on information obtained from records of some of the growers for the winters 1955-1956 through 1965-1966 it is estimated that the heaters are operated an average of 3 to 4 hours per night of firing, and are fired an average of 5.5 nights per year, for a total of approximately 20 hours per year. Approximately 3/4 of a gallon of fuel is burned per hour per heater. Assuming an average of 2/3 of the heaters are in operation during the year, the quantity of fuel burned averages 2,130,000 gallons per year, 390,000 gallons per night of firing or 5,840 gallons per day averaged over the year.

From data obtained from some of the citrus grove operators and from inspection of heaters in other groves, estimates were made of the numbers of three types of orchard heaters located in the county. The estimates of the emissions factors for carbonaceous particulate matter from these heaters are based on the unpublished results of tests conducted by the Los Angeles County Air Pollution Control District and by inspection to determine the state of condition of the heaters. These emission factors are shown in Table XLIV.

TABLE XLIV

EMISSION FACTORS FOR CARBONACEOUS PARTICULATE MATTER FROM ORCHARD HEATERS IN VENTURA COUNTY

TYPE OF HEATER	NUMBER OF HEATERS	ESTIMATED EMISSIONS OF CARBONACEOUS PARTICULATE MATTER (GRAMS PER MINUTE)	
		Per Heater	All Heaters
Return Stack	90,000	0.2	18,000
Listed in Rule 130e&f, LACAPCD[1]	40,000	0.8	32,000
Listed in Rule 130d, LACAPCD[1]	83,000	6.0	498,000
Total	213,000		548,000

1 Los Angeles County Air Pollution Control District. (R-24)

Evaporation losses according to the operators of some of the largest citrus holdings in Ventura County are approximately two gallons of fuel per heater during the period beginning in early March and ending the middle of November, when the heaters are refilled. Evaporation losses during the period from the middle of November to early March (the period during which the heaters are normally fired) are estimated to be 1/4 gallon per heater. Total evaporation losses of hydrocarbons are 480,000 gallons per year, or 1,730 tons per year, based on a fuel weight of 7.2 pounds per gallon.

The quantity of emissions of sulfur dioxide from the operation of the orchard heaters was calculated by assuming an average hydrogen sulfide content of the fuel of 3/4 of one percent, based on information obtained from users of the fuel oil.

Oxides of nitrogen emission from the combustion of the fuel are considered to be negligible due to a relatively low temperature of combustion.

Emission factors for hydrocarbons from the combustion of the fuel are not available, but such emissions are probably low compared to hydrocarbon losses from evaporation.

Total emissions of air pollutants from the use of orchard heaters in Ventura County are shown in Table XLV.

TABLE XLV

EMISSIONS OF AIR POLLUTANTS FROM THE USE OF ORCHARD HEATERS IN VENTURA COUNTY

POLLUTANT	EMISSIONS (TONS PER DAY)	
	Per Day of Firing	Per Day Averaged Over The Year
Hydrocarbons	na	4.7
Oxides of Nitrogen	n	n
Oxides of Sulfur as Sulfur Dioxide	24	0.4
Carbon Monoxide	na	na
Particulate Matter	90	1.4

na Not available.

n Negligible.

These emissions are based on the amount of orchard heating firing during the winters from 1955-1956 through 1965-1966. Air pollution emissions from orchard heater firing during winters of the severity occurring in 1936-1937 and 1949-1950 would greatly exceed the emissions listed in Table XVII. When properly cleaned and adjusted the 40,000 heaters in Ventura County, of the types listed under Rule 130 e and f of the Los Angeles County Air Pollution Control District, do not have carbonaceous particulate matter emissions exceeding the one gram per minute figure included in Chapter 2, Division 20, Section 24251 of the State of California Health and Safety Code, applying to Air Pollution Control Districts. Experience has shown that under severe frost conditions, when legal restrictions are not in effect, these heaters are not kept sufficiently clean and properly adjusted to have emissions of carbonaceous particulate matter under one gram per minute. During the most severe winters, standby heaters, some of which are as much as 35 years old, are used which have very high particulate matter emissions because of air leakage around the lids.

Pesticides. Approximately 30,000 gallons of xylene-type organic solvents are used yearly in pesticides used in Ventura County. With a density of approximately 7.2 pounds per gallon, the average daily emissions of organic solvents from pesticides are 0.3 tons per day.

Plowing and Tilling. The dust emissions from plowing and tilling are very difficult to estimate quantitatively but these operations are most likely to cause maximum emissions during times of high winds or dry soil conditions.

Other Sources of Emissions

Freeway and other road construction and housing development activity are occasional sources of dust emissions. No data is available on which to base estimates of the amounts of dust emitted from these sources.

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VEGETATION DAMAGE

TABLE XLVI

GENERAL AREAS WHERE PLANT MATERIAL WAS EXAMINED
FOR DAMAGE BY AIR POLLUTANTS
VENTURA COUNTY 1965

LOCATION	DATE OF OBSERVATION				
	Sept 20	Oct 9	Oct 25	Nov 22	Dec 22
Simi	x	x	x	-	x
Thousand Oaks and Conejo	x	x	x	x	x
Oxnard					
Rice Road and Colonia	x	x	x	x	x
West Road and Doris Street	x	x	x	x	x
Hueneme and Saviers Road	x	x	x	x	x
Hueneme and Olds Road	x	x	x	x	x
Hueneme and Wood Road	x	x	x	x	x
Wood Road and 5th Street	-	x	x	x	x
Ventura					
Ventura Freeway and Buena Vista Avenue	-	x	-	x	x
Ventura Avenue	-	x	x	x	x
Foster Park	-	x	-	-	x
Oakview	-	x	x	x	x
Ojai	x	x	x	-	x
Ventura-Santa Paula					
Foothill and Kimball	-	-	-	x	-
Foothill and Wells Road	-	-	-	x	-
Wells and Telegraph	-	-	-	x	-
Foothill and Willowby	-	-	-	x	-
Limoneira Headquarters	-	-	-	x	-
Foothill and Fillmore Street	-	-	-	x	-
Santa Paula	x	x	-	-	-
Fillmore	-	-	x	x	x
Piru					
Route 126 and Howe Road	x	x	x	x	x
Saticoy					
Vineyard Avenue	-	-	-	-	x
Moorpark	-	-	x	-	-

TABLE XLVII

PLANTS EXAMINED IN VENTURA COUNTY SHOWING THE TYPE AND AMOUNT
OF DAMAGE [illegible]

COMMON NAME	SCIENTIFIC NAME	TYPE OF DAMAGE	
		Ozone	Pan
Petunia	Petunia hybrida	x	xxx
Beet			
Sugar	Beta vulgaris	O	xx
Table.	Béta vulgaris	O	xxx
Swiss Chard	Beta vulgaris ciola	O	O
Tomato	Lycopersicon esculentum	O	xxx
Spinach	Spinacia oleracea	xx	x
Lettuce	Lactuca sativa		
Butterhead		O	x
Salad Bowl		O	x
Bronze (Great Lakes type)		O	xx
Cos or Romaine		O	xxx
Pepper	Capsicum frutescens		
Chili		O	O
Bell		O	O
Radish	Raphanus sativus	x	x
Onion	Allium cepa	x	O
Cabbage (Chinese)	Brassica perkinensis	O	x
Orange (Valencia)	Citrus sinensis	x	O
Lemon	Citrus Limonia	x	O
Avocado	Persea americana	xx	O
Troyer Citrange	(Citrus sinensis x Poncerus trifoliata)	xx	O
Barley	Hordeum vulgare	O	O
Wild Oat	Avena fatua	O	x
Little Leaf Nettle	Urtica urens	O	xxx
Dwarf Meadow Grass	Poa annua	x	xxx
Cheese Weed	Malva parviflora	x	O
Sow Thistle	Sonchus arvensis	O	xx
Lambs Quarters.	Chenopodium album	O	xx

O No damage observed.
x Light damage.
xx Moderate damage.
xxx Heavy damage.

Note: For definitions, see next page.

Explanation of "Light", "Moderate", and "Heavy" Damage in Table XLVII.

Light - One to three leaves of the plant injured; less than 10 percent of the leaf area covered by lesions. Light damage would not be expected to cause economic loss to crops except possibly in the following two examples: (1) In the case of leafy vegetables, if the timing of the air pollution episode was such that it occurred when the crop was ready for harvest, the wholesaler might downgrade the quality of the crop because of appearance or the grower might incur added expense because he had to remove damaged leaves or portions thereof in special processing. (2) In the case of flower crops, light damage would be expected to adversely affect the retail sales of sensitive plants, such as petunias.

Moderate - Three to six leaves damaged and up to 30 percent of leaf area affected. Or, fewer leaves damaged and up to 50 percent of the area affected.

Heavy - More than six leaves damaged and more than 50 percent of the area affected. Or, fewer leaves damaged and almost 100 percent of the area affected.

Moderate and heavy damage could be expected to cause some economic loss to all crop plants but the amount cannot be assessed accurately with the assay methods used. Loss would be incurred from one or more of the following effects: reduced growth and yield, delayed maturity, reduced flower and seed set, accelerated leaf drop, poor appearance, or loss of a marketable crop.

Avocado and citrus fruit are not usually damaged but the leaves may be marked, causing them to drop prematurely and thereby interfering with tree growth and fruit production.

Spinach and several varieties of lettuce suffering from moderate to heavy damage at the time of harvest may be unmarketable. Earlier damage may retard growth, thereby reducing yield and delaying maturity.

Economic loss in crops such as tomato may occur from sun scald due to leaf destruction as well as from suppression of growth and production.

The above explanation refers to the following five maps: →

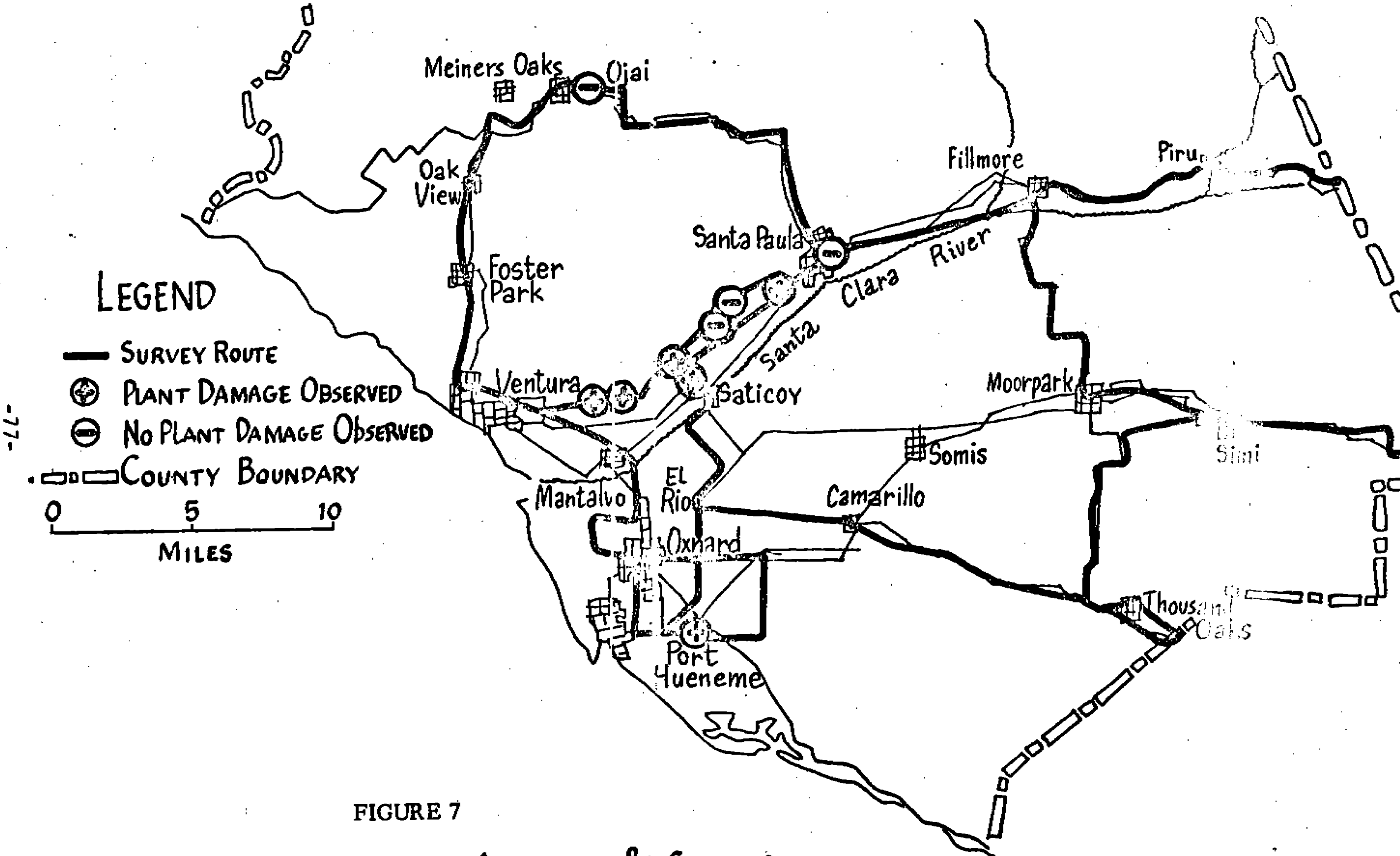


FIGURE 7

OCCURRENCE OF DAMAGE ON AVOCADO & CITRUS

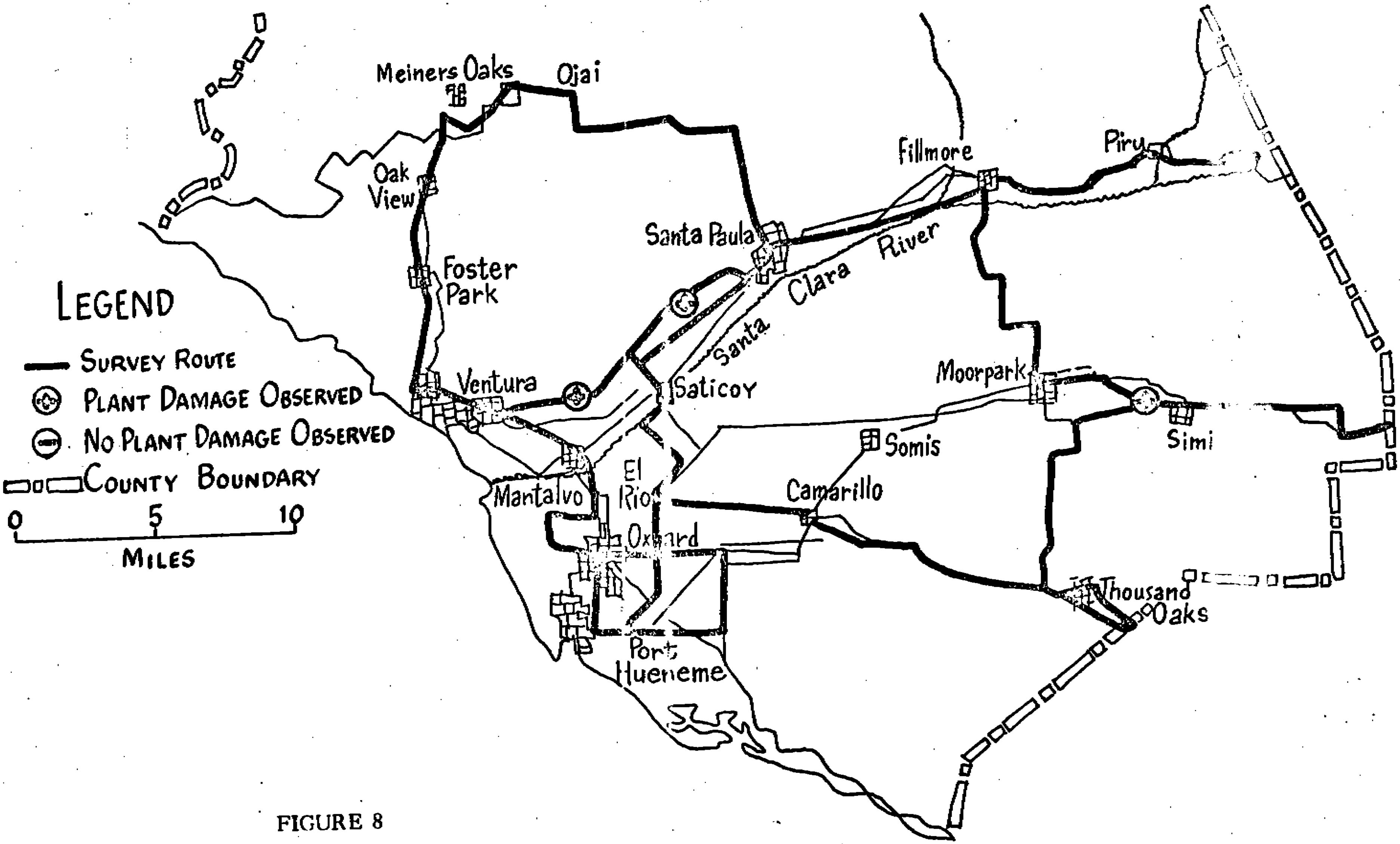


FIGURE 8

OCCURRENCE OF DAMAGE ON FIELD CROPS

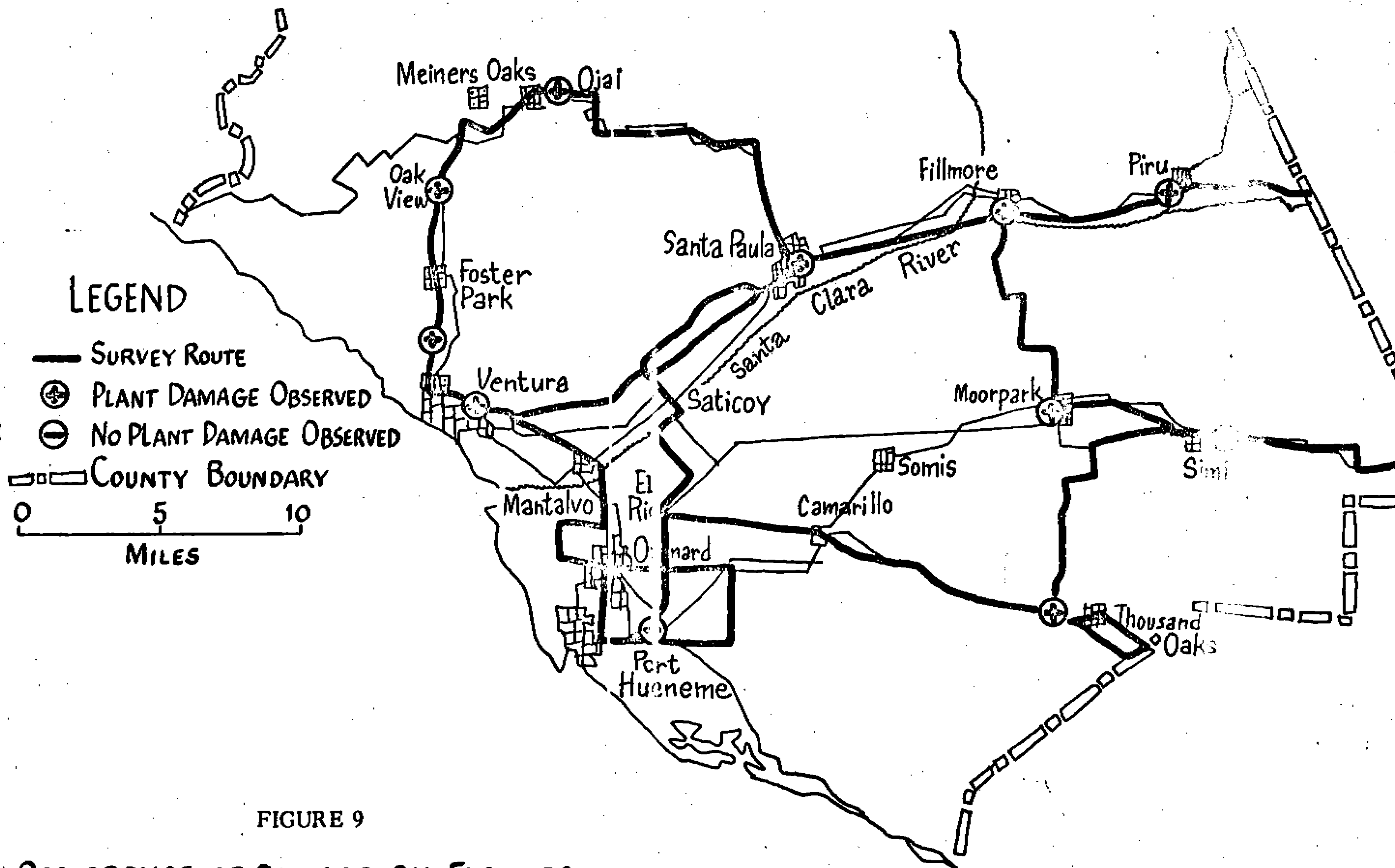


FIGURE 9

OCCURRENCE OF DAMAGE ON FLOWERS

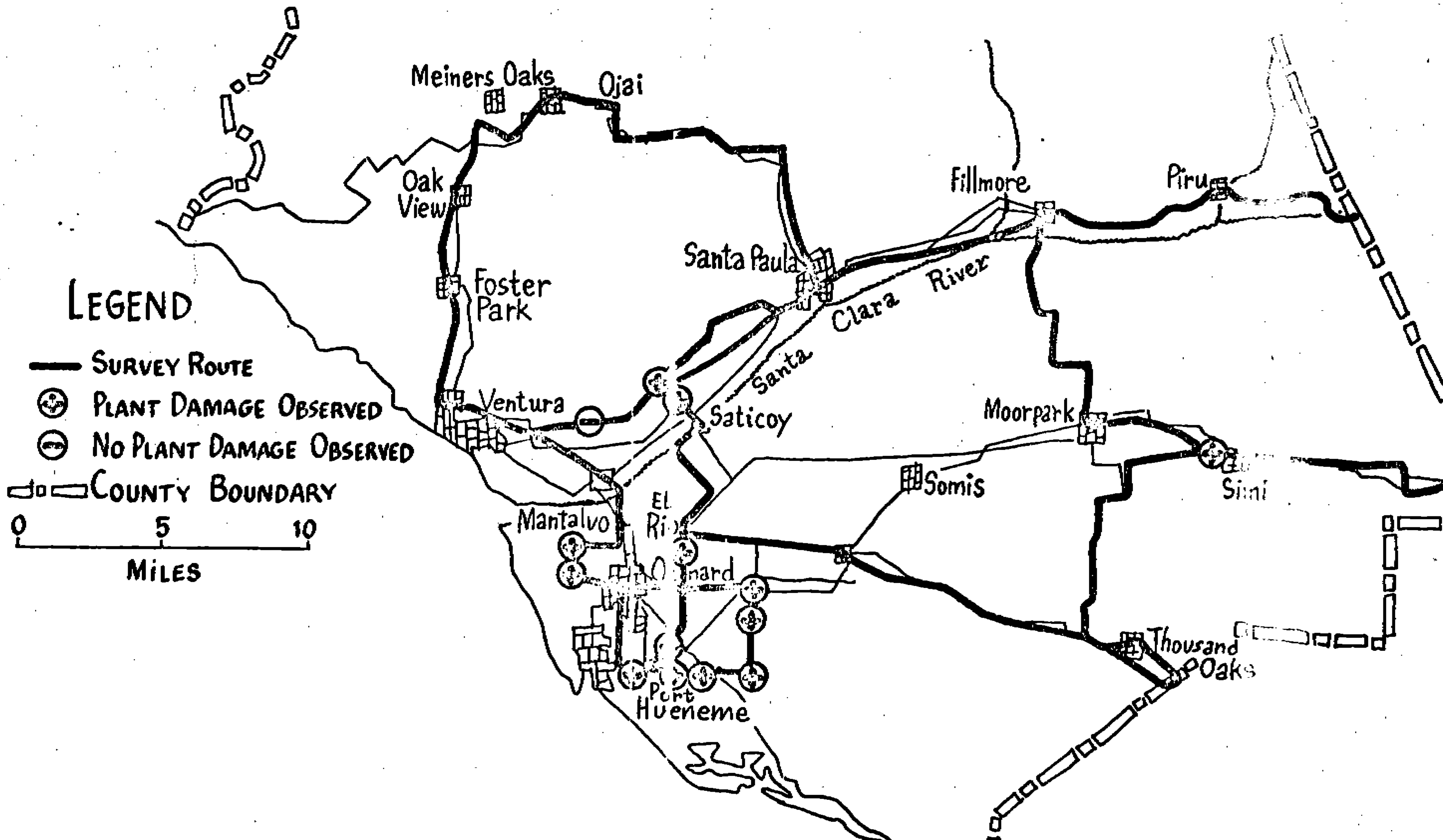


FIGURE 10

OCCURRENCE OF DAMAGE ON VEGETABLES

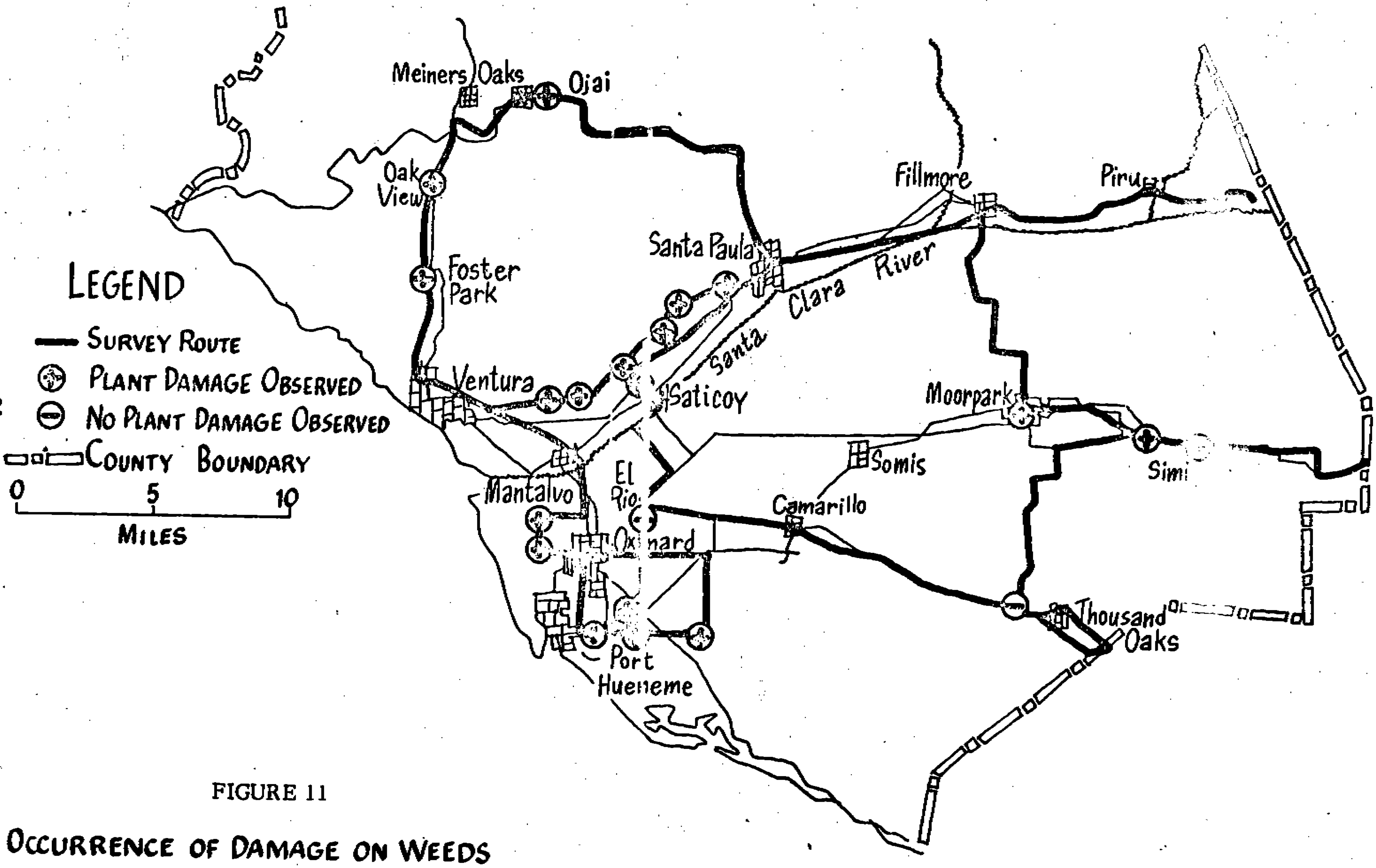


FIGURE 11

OCCURRENCE OF DAMAGE ON WEEDS

METEOROLOGY

METEOROLOGICAL MEASUREMENTS

Continuous measurement of the surface wind was made at each of the seven air monitoring sites to obtain data on the ventilation at each site and to assist with the interpretation of air monitoring data. When high concentrations were recorded at any of the several stations, supplementary meteorologic data were obtained from military and civil airports as well as from the Weather Bureau office at Los Angeles Airport. This enabled special study of the meteorologic conditions accompanying these occurrences.

Because data were not available on the height of the inversion in Ventura County, profile measurements of temperature and humidity were made by means of aircraft ascents from near the surface to 6,000 feet above mean sea level. A total of 270 soundings were made on 54 days during the period June 1 to December 31, 1965. These were made during 90 flights above the coast west of the city of Oxnard, and above Simi and Fillmore.

The accompanying map shows the locations of the wind and air monitoring stations.

Surface Wind Measurement

Three types of wind instrument were used during the survey. Four instruments were Model CI-6 analogue strip chart recording wind sets manufactured by Climet Instruments, Inc., Sunnyvale, California. The sensors consisted of a lightweight 3-cup anemometer having a starting threshold of 1.5 mph, and a balanced wind vane with a damping ratio of 0.3. The recorder was a two-channel Esterline Angus which was driven by a translating unit. Direction range was 0 to 360° and speed range was 0 to 50 miles per hour. These instruments were located at the stations in Ojai, Oxnard, Simi, and Thousand Oaks.

The instrument at the station in Ventura was also manufactured by Climet Instruments, Inc. Essentially the same types of sensors were used as with the CI-6 system, except that the electrical design of the wind vane transmitter was different. This wind measuring system produced a digitally printed record of the miles of wind flow in each of the four standard compass quadrants. Print-out of data occurred automatically once each hour.

Instruments at the stations at Foster Park and at Santa Paula were quite simple. The sensors were a 4-cup anemometer (contacting type) with a starting threshold of 2.1 mph. The pulse output was linear up to a wind speed of 50 mph. The vane shaft operated an eight-sector switch with a rolling-type contactor.

Output from the anemometer was a 6 volt D.C. pulse train with each pulse equivalent to a 1/60 mile of wind. The vane switch contacts were connected together in opposing groups of three. The intervening contacts were left unconnected. The modified wind vane switch delivered a pulse to one of two 6 volt D.C. electro-mechanical counters. One counter totalized the up-valley wind flow and the other the down-valley flow. The boundary conditions at each point of measurement in the two valleys were so sharply defined that use of the instruments as totalizers of up- and down-valley flow was believed adequate. The counters were read at 0800 and 1600 PST daily except that the counters at Santa Paula were read also at 1200 PST. This provided wind flow data for 24-, 16-, and 8-hour periods except that at Santa Paula the data for the 8-hour period was resolved into two 4-hour periods.

At all stations the sensors were mounted on 30-foot masts. With the exception of the Foster Park station all masts were mounted on flat roofs. At Foster Park the mast was based at ground level alongside a small, flat roofed utility building. The anemometer heights above ground were 90 feet at Oxnard, 48 feet at Ventura, 42 feet at Ojai, 30 feet at Foster Park, 50 feet at Santa Paula, 48 feet at Simi, and 45 feet at Thousand Oaks. In each case the sites were amply separated from obstructions which could contribute significant aerodynamic effects.

Diurnal summaries for the prevailing direction(s) of average wind speed are given for each month during the survey in Tables XLVIII through LII for five of the stations. Shown also in these tables are the number of days during the month when the average wind speed during each designated hour was less than 6 miles per hour. The average daily wind speed and 24-hour integrated wind flow (in miles) is given also.

The data from the wind-gaging stations in the Ventura River (Foster Park) and Santa Clara River (Santa Paula) Valleys are summarized in Figure 12. The data are shown by month as average daily cubic miles of wind flow up- and down-valley below the 500-foot elevation. The cross sectional area of each valley below the 500-foot level was computed from a contour plot. The average daily wind flow in each direction was multiplied by the cross sectional area in each case to obtain the 24-hour volume rate of flow. Appropriate corrections were made to the original data to make the results summarized in Figure 12 a meaningful representation of the average daily air volume moving up or down each valley below the 500-foot level. The average daily wind flow up- and down-valley by month is given in Table LIII for 24-hour, 16-hour, and 8-hour periods at Santa Paula and Foster Park except that for Santa Paula the data for the 8-hour period are shown for each 4-hour period.

TABLE XLVIII

VENTURA COUNTY AIR POLLUTION SURVEY
DAILY AVERAGE WIND SUMMARY AT OXNARD
JUNE, 1965-MAY, 1966

DIRECTION AND SPEED BY MONTH	TIME (PST)											
	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200
June, 1965	Average Daily Miles, 176; Average Speed 7.4 mph											
Prevailing Direction	W	NE	NE/E	NE	SW/W	SW/W	W	W	W	W	W	W
Average Speed (mph)	5.0	4.8	4.3	4.6	5.7	8.8	10.4	11.3	10.8	8.5	6.2	4.6
Number of Days < 6 mph	19	20	22	22	14	0	0	0	0	1	13	20
July, 1965	Average Daily Miles, 158; Average Speed 6.6 mph											
Prevailing Direction	W/NW	W/NW	W/NW	NW/N	W	W	W	W	W	W	NW/W	NW/W
Average Speed (mph)	4.1	3.7	4.0	4.0	5.4	8.2	10.0	11.2	11.0	8.0	4.9	4.7
Number of Days < 6 mph	27	30	28	15	7	1	0	0	0	0	21	24
August, 1965	Average Daily Miles, 168; Average Speed 7.3 mph											
Prevailing Direction	W/SW	E/NE	E/NE	E/NE	W/SW	W	W	W	W	W/NW	W/NW	W/SW
Average Speed (mph)	4.6	4.4	4.4	4.8	5.6	9.1	11.2	11.8	11.1	7.0	4.9	4.9
Number of Days <6 mph	24	25	23	21	15	0	0	0	0	8	21	22
September, 1965	Average Daily Miles, 173; Average Speed 7.2 mph											
Prevailing Direction	E/NE	E/NE	E	E	S/SW	SW/W	W/SW	W	W	W/NW	NW/W	NE/E
Average Speed (mph)	4.5	4.6	5.1	6.0	6.0	9.4	11.4	11.8	10.8	7.0	5.2	4.8
Number of Days <6 mph	25	23	21	19	20	2	0	0	0	6	21	22
October, 1965	Average Daily Miles, 163; Average Speed 6.5 mph											
Prevailing Direction	NE/E	NE/E	NE/E	NE	NE/E	W/NW	W	W	W	W	NW/N	NE/N
Average Speed (mph)	6.0	5.3	6.1	6.0	5.4	6.9	9.8	10.3	9.4	6.0	4.1	5.4
Number of Days <6 mph	16	18	15	15	18	13	0	0	0	19	26	20
November, 1965	Average Daily Miles, 171; Average Speed 7.1 mph											
Prevailing Direction	NE/E	NE/E	NE/E	NE/E	NE/E	S/E	W/S	W	W	E/W	E/NE	NE/E
Average Speed (mph)	6.7	6.7	6.9	7.0	6.4	7.7	9.2	8.7	7.3	5.5	6.3	6.9
Number of Days <6 mph	13	14	10	10	13	9	1	2	8	20	17	15
December, 1965	Average Daily Miles, 175; Average Speed 7.3 mph											
Prevailing Direction	NE	NE	NE	NE	NE	NE/E	W/S	W/SW	W/NW	N/NE	NE/E	NE
Average Speed (mph)	7.3	8.0	7.6	7.9	7.6	7.1	8.2	8.5	6.5	5.3	6.4	7.0
Number of Days <6 mph	9	5	10	5	5	13	6	3	19	22	15	8
January, 1966	Average Daily Miles, 175; Average Speed 8.1 mph											
Prevailing Direction	NE	NE	NE	NE	NE	NE/E	SW/W	NW/W	NW/W	NW/N	NE/E	NE
Average Speed (mph)	8.6	8.9	8.7	8.3	8.7	7.7	9.0	10.1	8.1	5.3	6.3	7.6
Number of Days <6 mph	7	4	6	6	5	16	6	1	11	21	16	8
February, 1966	Average Daily Miles, 179; Average Speed 7.5 mph											
Prevailing Direction	NE	NE	NE	NE	NE/E	E/SE	W/SW	W/SW	W	W/NW	E/NE	NE
Average Speed (mph)	7.1	6.9	6.9	7.1	6.8	7.2	9.8	10.8	8.6	6.1	5.8	6.2
Number of Days < 6 mph	11	7	6	6	9	12	3	2	6	17	18	16
March, 1966	Average Daily Miles, 166; Average Speed 6.9 mph											
Prevailing Direction	NE/E	NE/E	NE/E	NE/E	NE/E	SW/W	W/SW	W/SW	W/SW	W/NW	NW/W	NW/NE
Average Speed (mph)	5.2	4.9	5.6	5.7	5.6	8.1	10.4	10.8	9.3	7.0	5.2	5.1
Number of Days < 6 mph*	18	21	18	12	20	6	0	1	2	10	16	19
*4 1/2 Days Missing												
April, 1966	Average Daily Miles, 166; Average Speed 6.9 mph											
Prevailing Direction	NE/E	NE/E	NE/E	NE/E	SW/W	W/SW	SW/W	W	W	W	W/NW	E/SE
Average Speed (mph)	4.4	4.7	4.8	4.8	5.8	9.5	10.9	11.4	10.6	7.8	4.5	3.7
Number of Days <6 mph	22	21	20	23	19	3	1	0	0	5	24	26
May, 1966	Insufficient Data											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												

TABLE XLIX

VENTURA COUNTY AIR POLLUTION SURVEY
DAILY AVERAGE WIND SUMMARY AT VENTURA
JUNE, 1965-MAY, 1966

By Hourly Summary Based on 6-Hour Data Groups

DIRECTION AND SPEED BY MONTH	TIME (PST)											
	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200
June, 1965	Average Daily Miles, 142; Average Speed 5.9 mph											
Prevailing Direction	SW	SW	NW	SW	SW	SW	SW	SW	SW	SW	SW	NE
Average Speed (mph)	3.0	3.0	3.0	5.5	5.5	5.5	10.2	10.2	10.2	4.9	4.9	4.9
July, 1965	Data Not Available; Instrument Being Repaired.											
August, 1965	Data Not Available; Instrument Being Repaired.											
September, 1965	Average Daily Miles, 122; Average Speed 5.1 mph											
Prevailing Direction	NE	NE	NE	NE	SE	SE/SW	SW	SW	SW	SW	NE	NE
Average Speed (mph)	2.5	2.5	2.5	5.1	5.1	5.1	9.2	9.2	9.2	3.7	3.7	3.7
October, 1965												
Prevailing Direction	NE	NE	NE	NE	SE	SW	SW	SW	SW	NE	NE	NE
Average Speed (mph)	3.1	3.1	3.1	5.2	5.2	5.2	7.1	7.1	7.1	3.0	3.0	3.0
November, 1965												
Prevailing Direction	Data Not Available											
Average Speed (mph)												
December, 1965												
Prevailing Direction	Data Not Available											
Average Speed (mph)												
January, 1966												
Prevailing Direction	NE	NE	NE	NE	NE	NE	SW	SW	SW	NE	NE	NE
Average Speed (mph)	6.6	6.6	6.6	6.3	6.3	6.3	7.1	7.1	7.1	6.0	6.0	6.0
February, 1966												
Prevailing Direction	NE	NE	NE	NE	NE	SW	SW	SW	SW	NW	NE	NE
Average Speed (mph)	5.1	5.1	5.1	5.5	5.5	5.5	8.2	8.2	8.2	4.9	4.9	4.9
March-May, 1966	Data Not Available											

TABLE L

VENTURA COUNTY AIR POLLUTION SURVEY
DAILY AVERAGE WIND SUMMARY AT OJAI
JUNE, 1965-MAY, 1966

DIRECTION AND SPEED BY MONTH	TIME (PST)											
	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200
June, 1965	Average Daily Miles, 99; Average Speed 3.6 mph											
Prevailing Direction	W/SW	W/SW	S/SW	S/SW	SW/S	SW/W	SW/W	SW/W	SW/W	W/SW	SW/W	VBL
Average Speed (mph)	2.2	2.7	2.4	2.6	3.6	5.4	6.9	7.6	6.8	5.0	3.3	2.2
Number of Days <6 mph*	27	27	27	27	27	16	3	3	3	18	28	28
*2 1/2 Days Missing												
July, 1965	Average Daily Miles, 110; Average Speed 4.6 mph											
Prevailing Direction	NE/SE	SW	N/NE	SE	SW	W	W	W	W	W	SW	SW
Average Speed (mph)	2.0	2.3	2.4	2.7	3.8	6.2	8.5	8.8	7.3	5.1	3.3	2.3
Number of Days <6 mph*	28	28	28	28	27	6	0	0	1	20	29	29
*2 1/2 Days Missing												
August, 1965	Average Daily Miles, 104; Average Speed 4.3 mph											
Prevailing Direction	N/E	E/S	SE/SW	SE/SW	S/SW	SW	W	W	W	W	W/SW	S/SW
Average Speed (mph)	2.4	2.4	2.4	2.6	3.7	5.9	8.1	7.7	5.0	4.6	3.0	2.3
Number of Days< 6 mph	31	31	31	31	29	4	0	0	0	15	31	31
September, 1965	Average Daily Miles, 88; Average Speed 3.7 mph											
Prevailing Direction	N/NE	N/NE	N/NE	N/E	S/SW	SW/W	W	W	W	W/SW	N/E	N/NE
Average Speed (mph)	1.8	1.9	2.0	2.0	3.0	4.9	7.0	7.3	6.1	3.4	2.4	2.0
Number of Days <6mph*	28	28	28	28	28	21	3	3	5	28	28	28
*2 1/2 Days Missing												
October, 1965	Average Daily Miles, 92; Average Speed 3.8 mph											
Prevailing Direction	N	N	N	N	S/SW	SW/W	SW/W	W	SW/W	N/NE	N/NE	N
Average Speed (mph)	2.2	2.4	2.3	2.7	2.6	5.6	7.5	7.4	5.4	2.9	2.3	2.0
Number of Days< 6 mph	31	31	31	31	31	21	4	2	17	31	31	31
November, 1965	Average Daily Miles, 83; Average Speed 3.4 mph											
Prevailing Direction	N	N/NE	N/NE	N/NE	NE/E	SW	SW/W	SW/W	W	N/NE	N/NE	N/NE
Average Speed (mph)	2.7	2.4	2.6	2.6	3.0	4.3	5.3	5.8	4.2	2.8	3.0	2.7
Number of Days <6 mph	27	28	30	29	27	25	18	11	27	28	25	27
December, 1965	Average Daily Miles, 71; Average Speed 3.0 mph											
Prevailing Direction	N/NE	N/NE	N/NE	N	N/NE	E/SE	SW	SW/W	W/SW	NE/N	NE	N/NE
Average Speed (mph)	2.3	2.5	2.1	2.2	2.1	3.0	4.2	4.8	3.5	2.9	3.0	2.6
Number of Days <6 mph	30	30	30	30	30	29	27	19	27	28	29	29
January, 1966	Average Daily Miles, 86; Average Speed 3.6 mph											
Prevailing Direction	N/NE	N/NE	N/NE	N/NE	NE/E	SE/S	SW	SW/W	W/SW	NE/N	N/NE	NE/N
Average Speed (mph)	3.5	2.9	2.8	2.6	2.4	4.2	5.4	5.8	4.3	2.7	2.7	3.4
Number of Days <6 mph	28	27	28	29	29	28	22	14	27	29	28	27
February, 1966	Average Daily Miles, 78; Average Speed 3.3 mph											
Prevailing Direction	N/NE	N/NE	N/NE	NE/N	E/S	SW/S	SW/W	SW/W	SW/W	NE/N	NE/N	NE/N
Average Speed (mph)	2.2	2.1	1.9	2.0	2.4	4.0	6.4	6.5	5.6	2.7	2.3	2.3
Number of Days <6mph*	26	26	26	26	26	25	14	8	16	25	25	25
*3 Days Missing												
March, 1966	Average Daily Miles, 97; Average Speed 4.0 mph											
Prevailing Direction	NE/N	N/NE	N/NE	NE/N	SE/S	SW/W	W/SW	W/SW	W/SW	W/N	NE/N	NW/N
Average Speed (mph)	2.5	2.7	2.6	2.7	3.1	5.2	7.3	7.9	6.8	3.8	2.6	2.2
Number of Days <6mph*	29	29	29	28	29	23	5	3	7	25	29	29
*2 Days Missing												
April, 1966	Average Daily Miles, 104; Average Speed 4.3 mph											
Prevailing Direction	N/NE	N/NE	N/E	NE/E	SW/S	SW/W	W/SW	SW/W	SW/W	W/SW	W/SW	N/NE
Average Speed (mph)	2.2	2.2	2.4	2.2	3.9	6.2	7.9	8.0	7.0	4.4	2.5	2.5
Number of Days <6 mph	29	30	29	30	28	15	1	2	6	27	29	29
May, 1966	Insufficient Data											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												

TABLE LI

VENTURA COUNTY AIR POLLUTION SURVEY
DAILY AVERAGE WIND SUMMARY AT THOUSAND OAKS
JUNE, 1965–MAY, 1966

DIRECTION AND SPEED BY MONTH	TIME (PST) 0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200
June, 1965	Average Daily Miles, 133; Average Speed 5.6 mph											
Prevailing Direction	SE	SE	SE	SE	SE/S	W	W	W	W	W	W/NW	SE/S
Average Speed (mph)	4.2	4.8	4.6	4.1	4.7	5.7	7.9	9.3	8.9	6.9	4.3	4.2
Number of Days <6 mph	23	19	19	23	23	13	0	0	1	7	22	23
July, 1965	Average Daily Miles, 146; Average Speed 6.1 mph											
Prevailing Direction	SE	SE	SE	SE/S	W	NW/W	NW	NW	NW	NW	N/NW	SE
Average Speed (mph)	4.9	5.0	4.8	4.6	4.5	7.0	8.8	9.6	8.7	6.0	3.6	4.5
Number of Days <6 mph*	17	18	20	22	24	4	3	1	1	9	29	21
*4 Days Missing												
August, 1965	Average Daily Miles, 144; Average Speed 6.0 mph											
Prevailing Direction	SE	SE	SE	SE	S/SE	NW/W	W/NW	W	NW	NW	NE/E	SE
Average Speed (mph)	5.1	6.1	4.4	4.5	4.7	6.4	9.4	9.9	8.8	5.3	3.0	4.7
Number of Days <6 mph	20	13	22	22	25	6	0	0	0	19	30	20
September, 1965	Average Daily Miles, 171; Average Speed 7.1 mph											
Prevailing Direction	SE	SE	SE	SE	S/SE	W/NW	W/NW	W/NW	W	NW/W	N/NW	SE/E
Average Speed (mph)	6.6	6.8	6.3	6.6	6.2	6.6	9.1	10.4	9.4	6.6	4.7	5.3
Number of Days <6 mph	10	9	9	11	11	11	0	1	0	6	23	21
October, 1965	Average Daily Miles, 171; Average Speed 7.1 mph											
Prevailing Direction	SE	SE	SE	SE	S	NW/W	NW	NW	NW	N/NE	SE	SE
Average Speed (mph)	7.1	7.0	6.9	7.7	6.5	7.1	8.8	9.4	8.0	5.0	5.4	6.6
Number of Days <6 mph	6	6	8	6	12	10	2	0	0	26	22	13
November, 1965	Average Daily Miles, 187; Average Speed 7.8 mph											
Prevailing Direction	SE	SE	SE	SE	SE/S	S/W	W/NW	W/NW	NW	N/NW	SE	SE
Average Speed (mph)	7.8	7.9	7.4	7.9	7.7	7.8	9.1	9.5	8.2	6.4	6.9	7.3
Number of Days <6 mph	8	11	8	6	6	9	3	2	6	16	10	9
December, 1965	Average Daily Miles, 189; Average Speed 7.8 mph											
Prevailing Direction	SE	SE	SE	SE	SE	S	W/S	W/S	NW/NE	E/SE	SE	SE
Average Speed (mph)	7.8	7.8	8.1	7.9	8.2	7.6	7.4	9.0	7.8	6.7	7.0	7.7
Number of Days <6 mph*	5	6	4	6	2	8	10	2	8	12	12	5
*1 1/2 Days Missing												
January, 1966	Average Daily Miles, 194; Average Speed 8.1 mph											
Prevailing Direction	SE	SE	SE/S	SE/S	SE/S	S	W/NW	W/NW	NW/W	NE/N	SE/E	SE
Average Speed (mph)	8.6	9.3	8.5	8.4	8.2	8.2	9.0	8.7	7.7	6.0	6.7	7.8
Number of Days <6 mph	7	3	6	6	5	9	4	5	8	19	18	7
February, 1966	Average Daily Miles, 173; Average Speed 7.2 mph											
Prevailing Direction	SE	SE/S	SE/S	SE	S/SE	W/S	W/NW	W	W/NW	NE/N	E/SE	SE
Average Speed (mph)	7.1	7.4	7.1	7.9	6.8	6.7	8.2	9.8	7.3	5.7	5.6	6.0
Number of Days <6 mph	8	8	7	6	8	14	5	1	7	19	18	16
March, 1966	Average Daily Miles, 160; Average Speed 6.7 mph											
Prevailing Direction	SE	SE	SE	SE	S/SE	SW/S	W/NW	W/NW	W/NW	N/NE	SE/E	SE
Average Speed (mph)	5.7	6.2	6.1	6.3	6.1	6.3	8.5	8.8	8.2	5.4	5.5	5.6
Number of Days <6 mph	13	10	16	13	16	25	6	3	6	24	20	17
April, 1966	Average Daily Miles, 133; Average Speed 5.5 mph											
Prevailing Direction	SE	SE	SE/S	SE/S	S/SE	W/SW	W	W	W	NW/N	E/NE	SE
Average Speed (mph)	4.8	5.3	4.7	4.3	4.6	6.3	8.4	8.9	7.9	4.7	3.2	4.0
Number of Days <6 mph*	17	12	15	17	21	17	3	1	2	22	26	24
*3 Days Missing												
May, 1966	Insufficient Data											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												

TABLE LII

VENTURA COUNTY AIR POLLUTION SURVEY
DAILY AVERAGE WIND SUMMARY AT SIMI
JUNE, 1965-MAY, 1966

DIRECTION AND SPEED BY MONTH	[illegible]											
	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200
June, 1965	Average Daily Miles, 112; Average Speed 4.7 mph											
Prevailing Direction	E	NE	E	E	W	SW	SW	SW	W	W	SW	E
Average Speed (mph)	2.3	2.6	2.4	2.8	3.7	5.0	7.4	8.8	8.1	6.1	3.8	2.6
Number of Days <6 mph*	24	24	24	24	24	20	10	3	5	14	24	24
*6 Days Missing												
July, 1965	Average Daily Miles, 108; Average Speed 4.5 mph											
Prevailing Direction	E	E	E	E	SW	W	W	W	W	W	SW	E
Average Speed (mph)	2.2	2.1	2.1	1.9	3.2	6.0	8.7	9.1	7.8	5.1	2.5	2.4
Number of Days <6 mph	30	30	31	31	31	12	3	1	0	17	31	30
August, 1965	Average Daily Miles, 108; Average Speed 4.5 mph											
Prevailing Direction	E/NE	E/NE	E/NE	E/NE	W/SW	W	W	W	W	W	W/E	E
Average Speed (mph)	2.4	2.5	2.5	2.5	3.3	6.0	8.9	9.4	7.8	4.5	2.1	2.5
Number of Days <6 mph	30	30	30	31	31	10	1	0	0	25	31	30
September, 1965	Average Daily Miles, 114; Average Speed 4.8 mph											
Prevailing Direction	E/NE	E/NE	NE/E	E/NE	SW/S	SW/W	SW/W	SW/W	SW/W	SW/W	NE/E	E/NE
Average Speed (mph)	3.3	3.4	3.6	3.0	4.4	5.8	7.9	8.6	7.3	3.8	2.7	3.1
Number of Days <6 mph	28	26	28	27	25	19	6	2	5	28	30	30
October, 1965	Average Daily Miles, 127; Average Speed 5.3 mph											
Prevailing Direction	E/NE	E/NE	E/SE	E/SE	NW/NE	SW/S	W/SW	W	W	W/SW	NW/N	E/NE
Average Speed (mph)	4.1	4.5	4.5	4.5	5.2	6.5	8.1	8.3	6.9	3.3	4.1	3.9
Number of Days <6 mph	27	24	24	22	23	18	7	2	12	28	25	21
November, 1965	Average Daily Miles, 135; Average Speed 5.6 mph											
Prevailing Direction	NE	NE/E	NE/E	NE/E	NE/E	E/S	S/SE	S/SW	S/SW	NE/E	NE/E	NE/E
Average Speed (mph)	4.4	4.9	4.5	5.2	4.9	6.9	7.5	7.9	6.7	4.4	5.0	5.0
Number of Days <6 mph	26	24	22	22	23	16	12	7	6	20	23	23
December, 1965	Average Daily Miles, 198; Average Speed 8.2 mph											
Prevailing Direction	E/NE	NE/E	E/NE	E/NE	S/SW	S/SW	SW/S	SW/S	SW/S	E/NE	NE/E	E/NE
Average Speed (mph)	5.5	6.3	6.1	6.5	7.0	8.4	8.0	8.0	6.3	5.9	6.2	6.3
Number of Days <6 mph*	18	19	16	17	14	11	8	8	15	15	14	14
*3 1/2 Days Missing												
January, 1966	Average Daily Miles, 228; Average Speed 9.5 mph											
Prevailing Direction	E/NE	E/NE	E/NE	NE/E	E/NE	N/E	N/E	N/E	N/E	NE/E	E/NE	E/NE
Average Speed (mph)	7.7	7.2	8.7	9.2	9.7	11.0	11.8	10.9	8.9	7.3	8.5	9.1
Number of Days <6 mph*												
*8 Days Missing												
February, 1966	Station Shut Down for Repairs											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												
March, 1966	Station Shut Down for Repairs											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												
April, 1966	Insufficient Data											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												
May, 1966	Insufficient Data											
Prevailing Direction												
Average Speed (mph)												
Number of Days <6 mph												

FIGURE 12

AVERAGE DAILY CUBIC MILES
OF UP-VALLEY & DOWN-VALLEY WIND
BELOW 500' ELEVATION, SANTA PAULA & FOSTER PARK

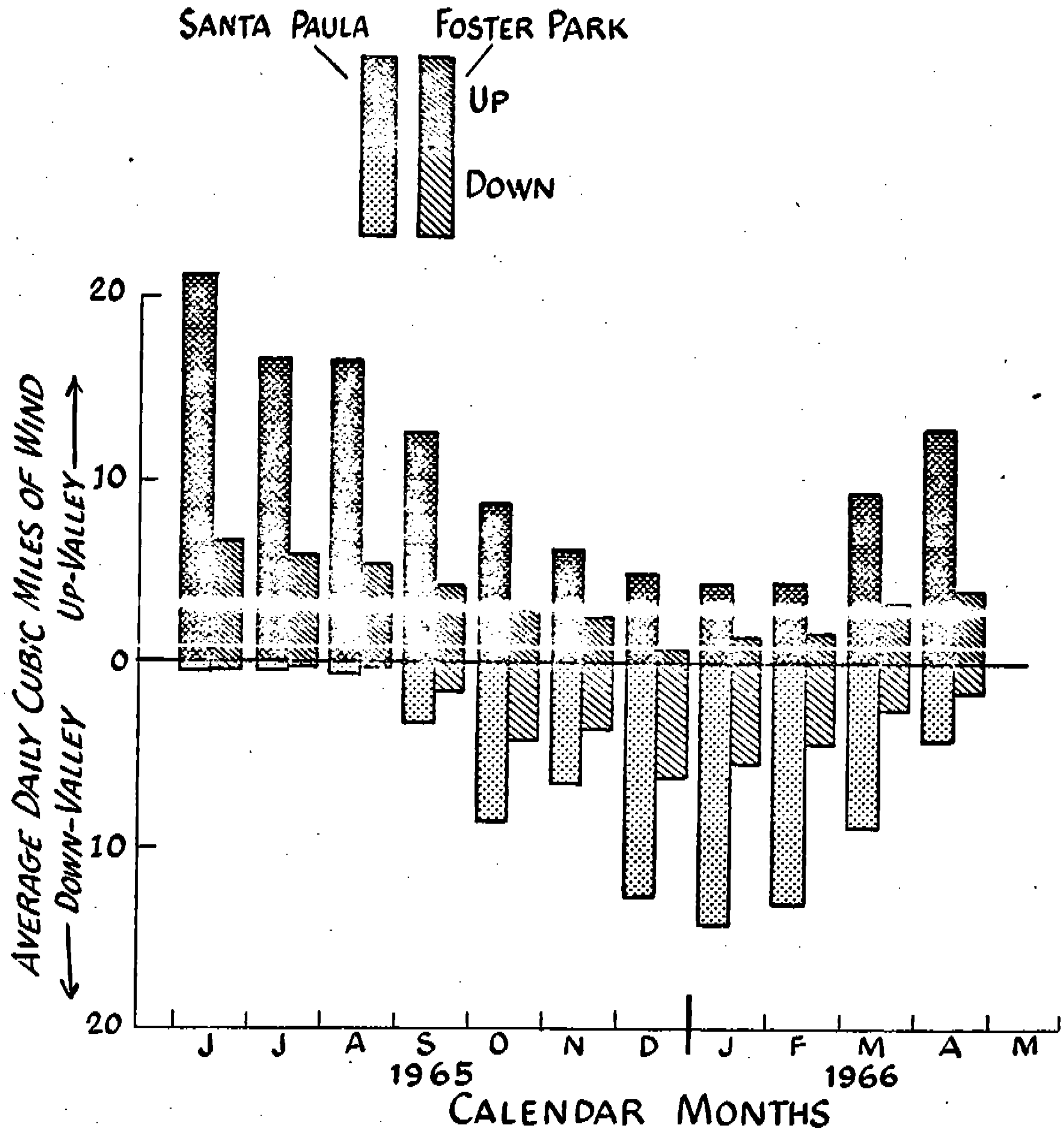


TABLE LIII

VENTURA COUNTY AIR POLLUTION SURVEY
AVERAGE DAILY WIND FLOW UP-AND DOWN-VALLEY
FOR 24-HOUR, 16-HOUR, AND 8-HOUR PERIODS AT FOSTER
PARK AND SANTA PAULA PLUS THE TWO HALVES OF
THE 8-HOUR PERIOD AT SANTA PAULA
JUNE, 1965 THROUGH APRIL, 1966 (PST)

PLACE AND MONTH	24 HOURS ENDING 0800		16 HOURS ENDING 0800		8 HOURS ENDING 1600		4 HOURS ENDING 1200		4 HOURS ENDING 1600	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
SANTA PAULA										
June, 1965	211	6	113	2	96	1	42	<1	54	<1
July, 1965	167	6	72	3	82	<1	42	<1	50	0
August, 1965	163	7	69	7	95	<1	38	<1	57	0
September, 1965	125	32	75	24	71	18	22	12	49	6
October, 1965	87	87	27	64	56	29	21	20	35	9
November, 1965	62	65	21	52	39	20	14	13	25	7
December, 1965	50	127	2	89	24	53	13	33	11	20
January, 1966	43	141	9	99	31	45	6	32	25	13
February, 1966	43	130	12	95	32	45	10	28	22	17
March, 1966	92	89	38	59	56	32	18	20	38	12
April, 1966	129	41	55	28	76	13	30	12	46	1
FOSTER PARK										
June, 1965	169	10	91	5	89	0				
July, 1965	149	1	63	2	83	0				
August, 1965	137	3	55	4	80	0				
September, 1965	104	41	29	49	62	3				
October, 1965	71	102	16	86	52	6				
November, 1965	62	87	35	77	32	11				
December, 1965	22	151	3	49	17	26				
January, 1966	35	132	6	106	27	22				
February, 1966	44	104	10	84	29	16				
March, 1966	83	61	27	57	53	8				
April, 1966	100	43	35	43	60	5				

Upper Air Temperature Measurement

A standard aerograph was used in the aircraft ascents to measure temperature and humidity profiles. Soundings were made during the period beginning June 9 and ending December 21, 1965. This period was selected for two reasons. Inversion records from the Pt. Arguello and Santa Monica Airport indicated that the inversion base elevation was of greatest interest during the last six months of the year as far as air pollution was concerned. Secondly, by limiting the measurement to a six-month period, the number of soundings that could be made each month would constitute a reasonable sample. (The average number of days per month when soundings were taken was approximately nine with a range of 5 to 11).

The soundings were made by North American Weather Consultants, Goleta, California, under contract with Ventura County. The field operations were directed by Mr. Sidney R. Frank. Ninety percent of the soundings were made between 0300 and 0430 PST and between 1500 and 1630 PST. To permit comparison with upper air data from radiosonde stations at Pt. Arguello, about 80 miles northwest and at Santa Monica, about 45 miles southeast of the Ventura Airport the aircraft ascent was normally made at about 550 feet per minute (about half the ascent rate of U.S. Weather Bureau radiosonde balloons) from near the surface to 6,000 feet above mean sea level near the Ventura County Airport and near the town of Fillmore. The sounding over Simi was made by descending from 6,000 feet to near the surface at rate of about 1,100 feet per minute. Corrections were applied to the data to compensate for dynamic heating of the aerograph temperature sensor (bi-metallic strip). A few of the soundings were made at ascent or descent rates of 250 feet per minute. Except for increased detail in the temperature profile, there appeared to be no appreciable advantage in the lower ascent or descent rates as far as the objectives of this survey were concerned.

The data from the aircraft sounding program are shown in Table LIV. Where ground-based inversions are shown (ΔT) is the difference between surface temperature and the temperature top of the inversion.

Monthly averages of the above parameters were computed from upper air data taken at Pt. Arguello-Vandenberg and at Santa Monica-Los Angeles Airport for the same days and times as aircraft soundings were made. These are compared graphically with the averages of similar data from the ascents made over the Ventura Coast. Figures 13 through 19 show the spatial distribution along the coast relative to an arbitrary distances scale of the average inversion base and top at approximately 0300 PST and 1500 PST.

Figures 20 through 26 show for each month the relative distribution of the inversion from the coast to the interior relative to an arbitrary distance scale.

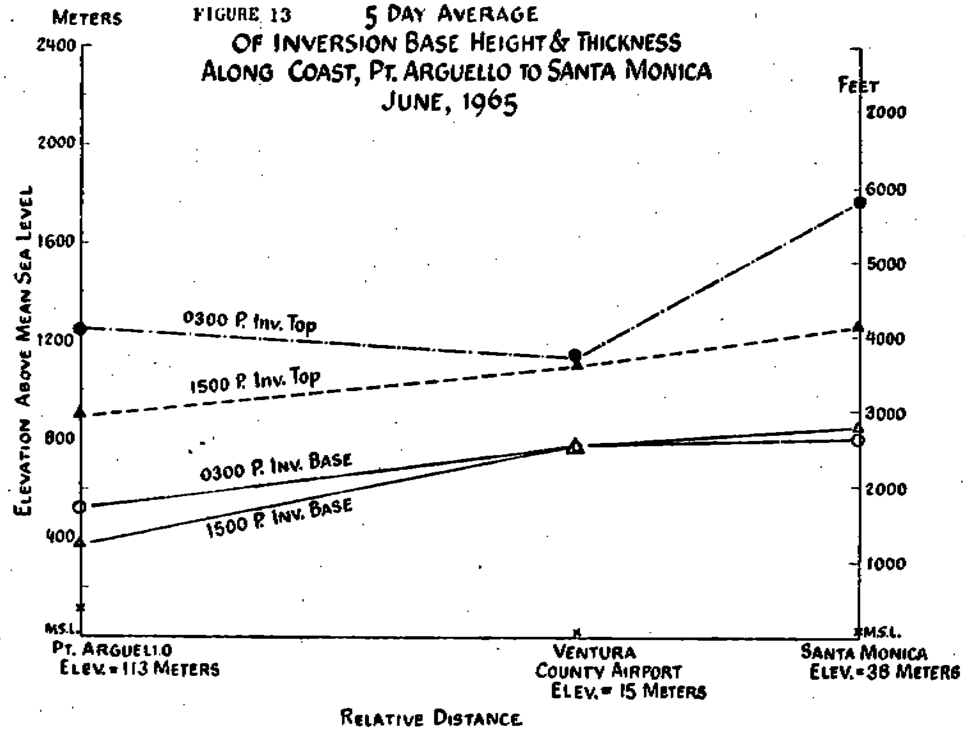


FIGURE 13 5 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS ALONG COAST, PT. ARGUELLO TO SANTA MONICA JUNE, 1965

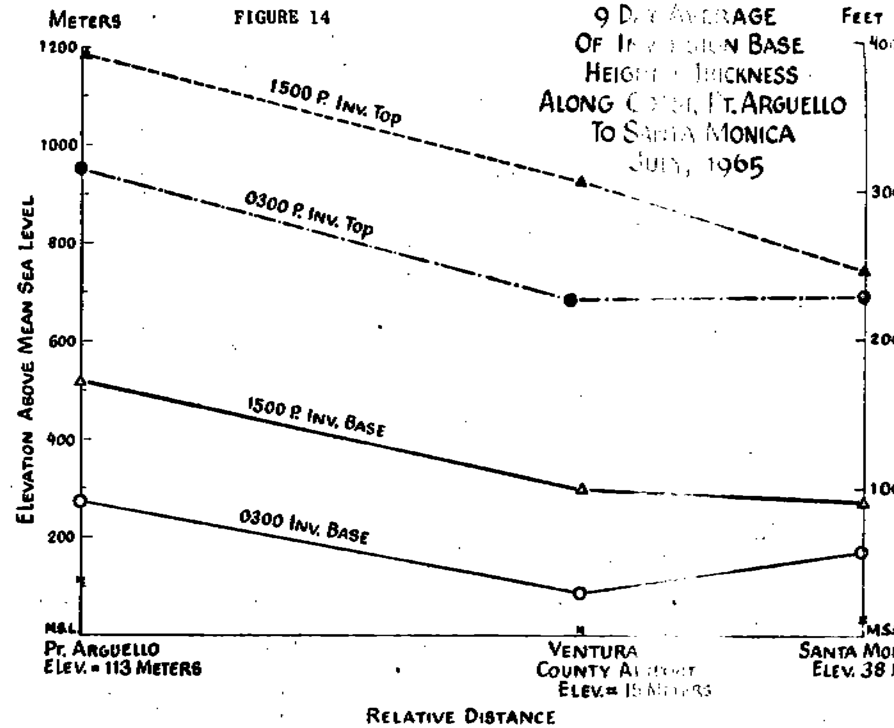


FIGURE 14 9 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS ALONG COAST, PT. ARGUELLO TO SANTA MONICA [illegible], 1965

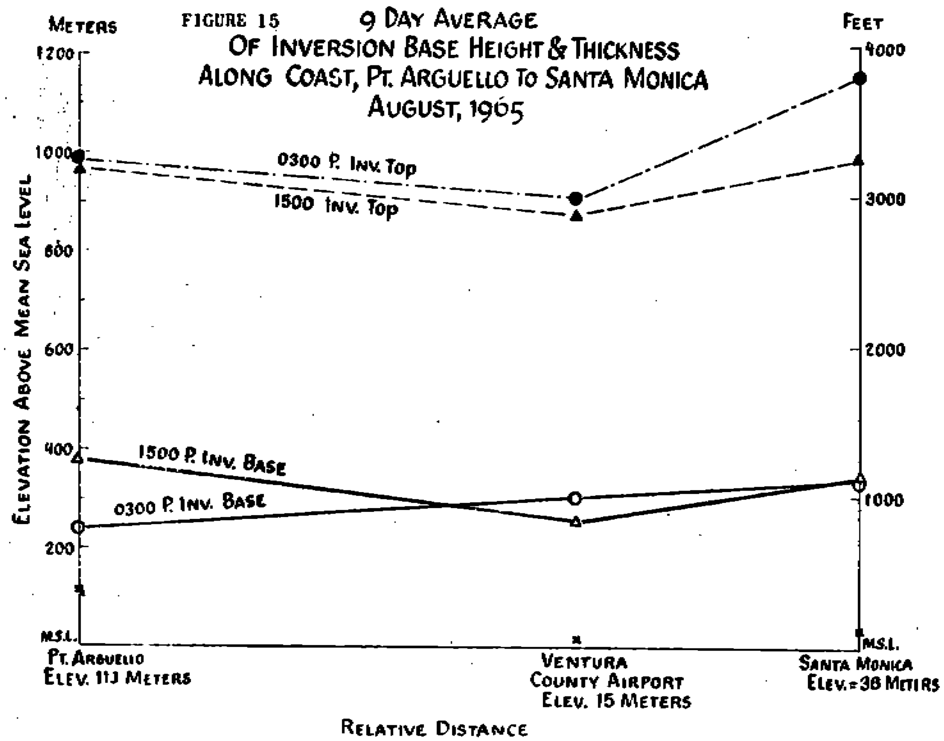


FIGURE 15 9 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS ALONG COAST, PT. ARGUELLO TO SANTA MONICA AUGUST, 1965

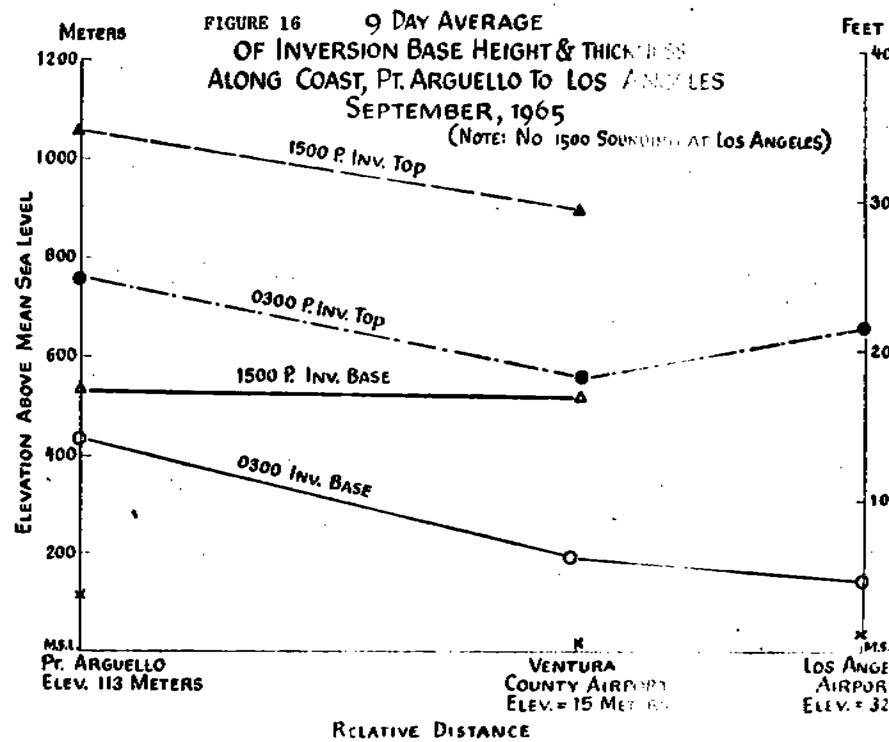


FIGURE 16 9 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS ALONG COAST, PT. ARGUELLO TO LOS ANGELES SEPTEMBER, 1965 (NOTE: No 1500 Sounding at Los Angeles)

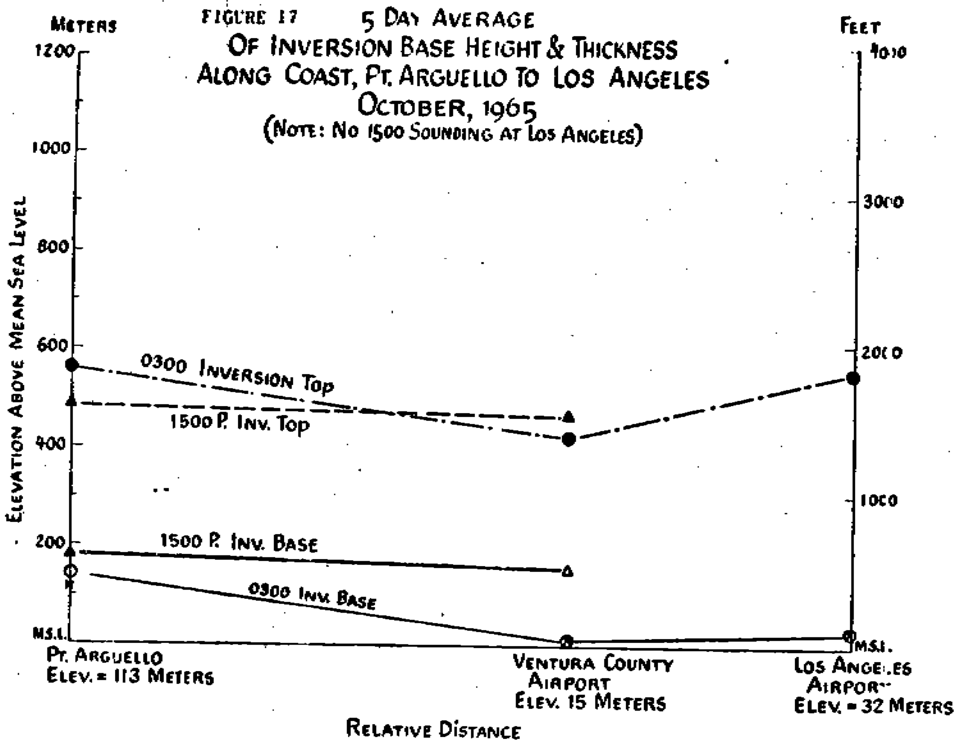


FIGURE 17 5 DAY AVERAGE
OF INVERSION BASE HEIGHT & THICKNESS
ALONG COAST, PT. ARGUELLO TO LOS ANGELES
OCTOBER, 1965
(NOTE: NO 1500 SOUNDING AT LOS ANGELES)

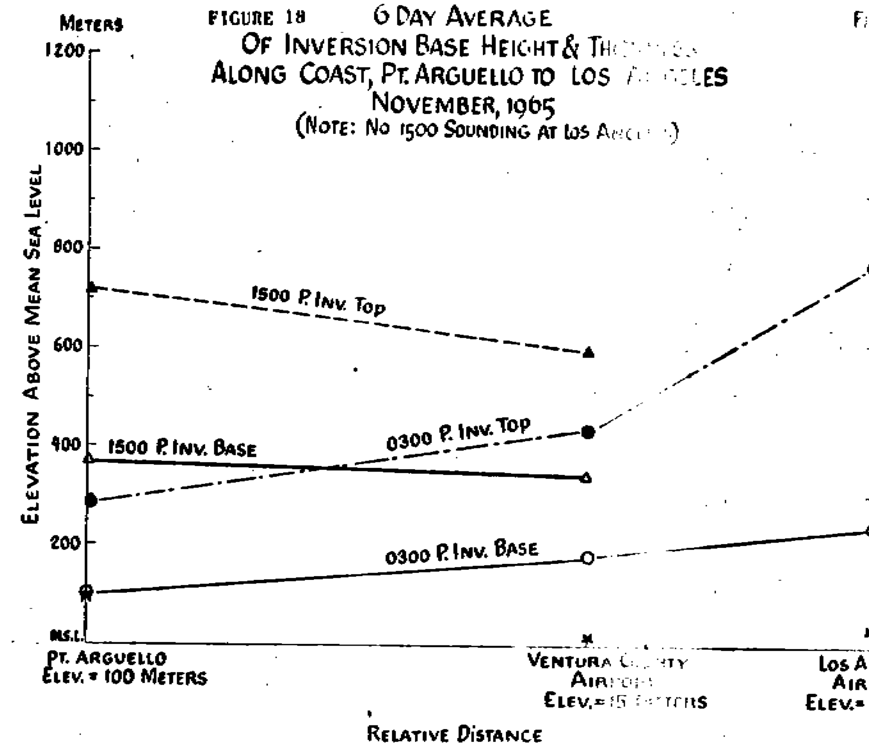


FIGURE 18 6 DAY AVERAGE
OF INVERSION BASE HEIGHT & THICKNESS
ALONG COAST, PT. ARGUELLO TO LOS ANGELES
NOVEMBER, 1965
(NOTE: NO 1500 SOUNDING AT LOS ANGELES)

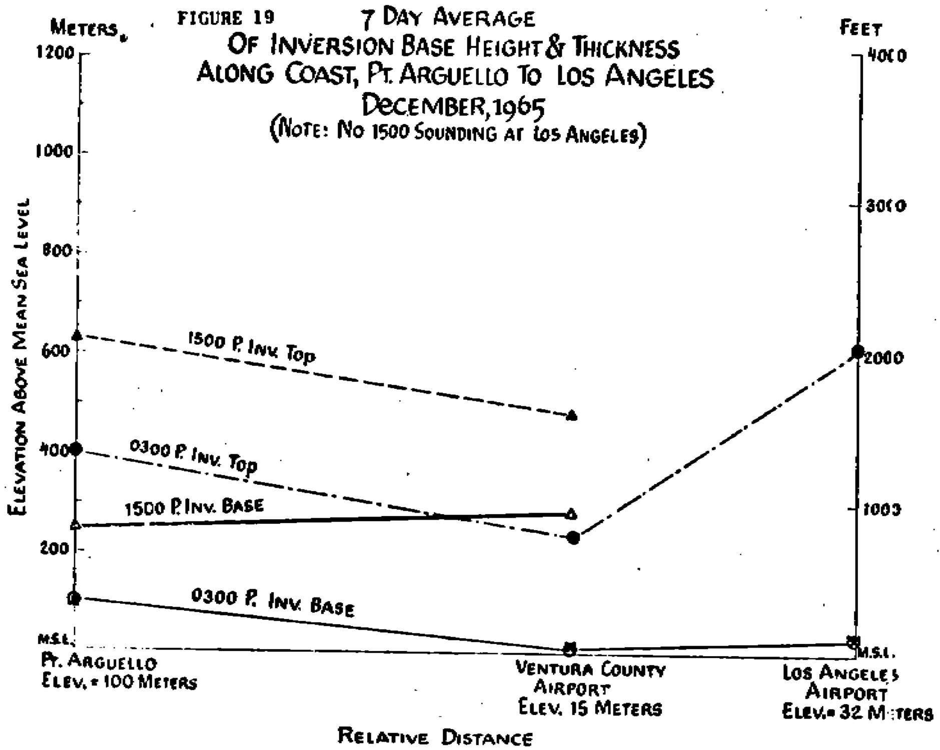


FIGURE 19 7 DAY AVERAGE
OF INVERSION BASE HEIGHT & THICKNESS
ALONG COAST, PT. ARGUELLO TO LOS ANGELES
DECEMBER, 1965
(NOTE: NO 1500 SOUNDING AT LOS ANGELES)

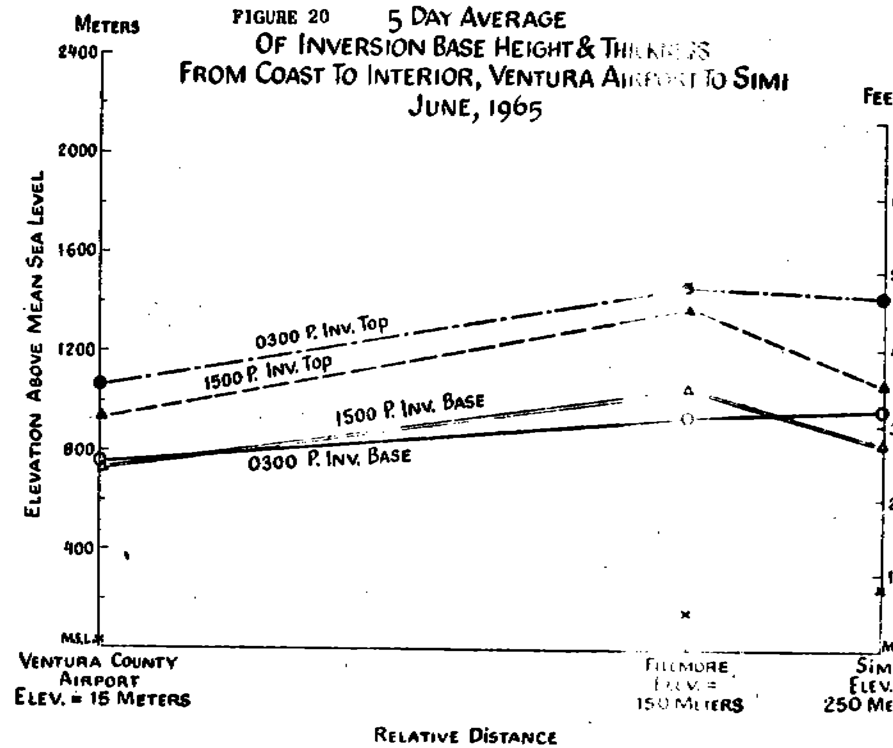


FIGURE 20 5 DAY AVERAGE
OF INVERSION BASE HEIGHT & THICKNESS
FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI
JUNE, 1965

FIGURE 21 9 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI JULY, 1965

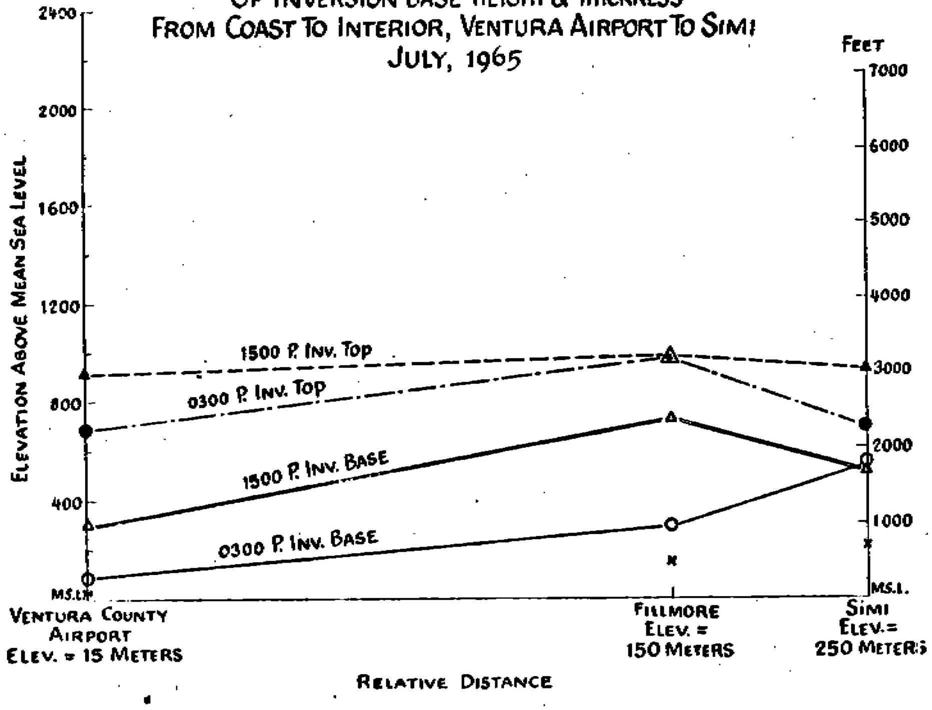


FIGURE 22 9 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI AUGUST, 1965

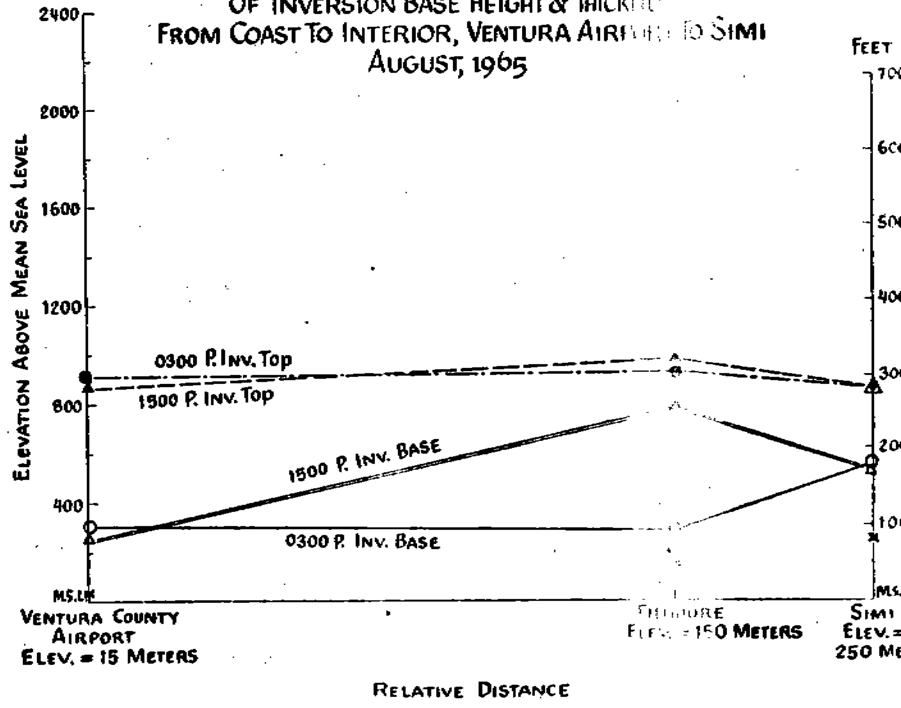


FIGURE 23 9 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI SEPTEMBER, 1965

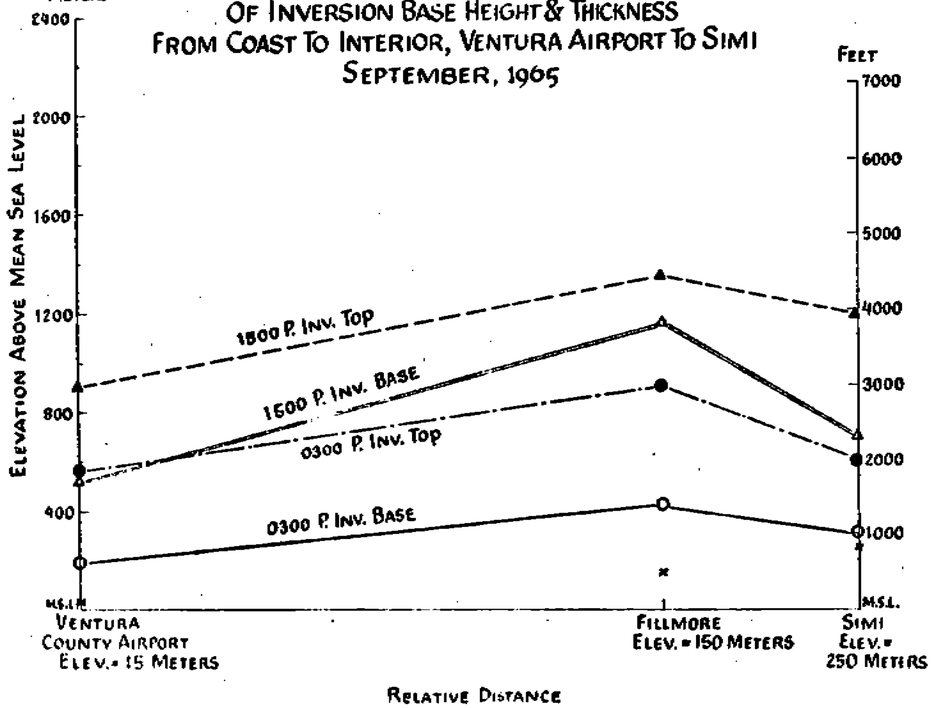
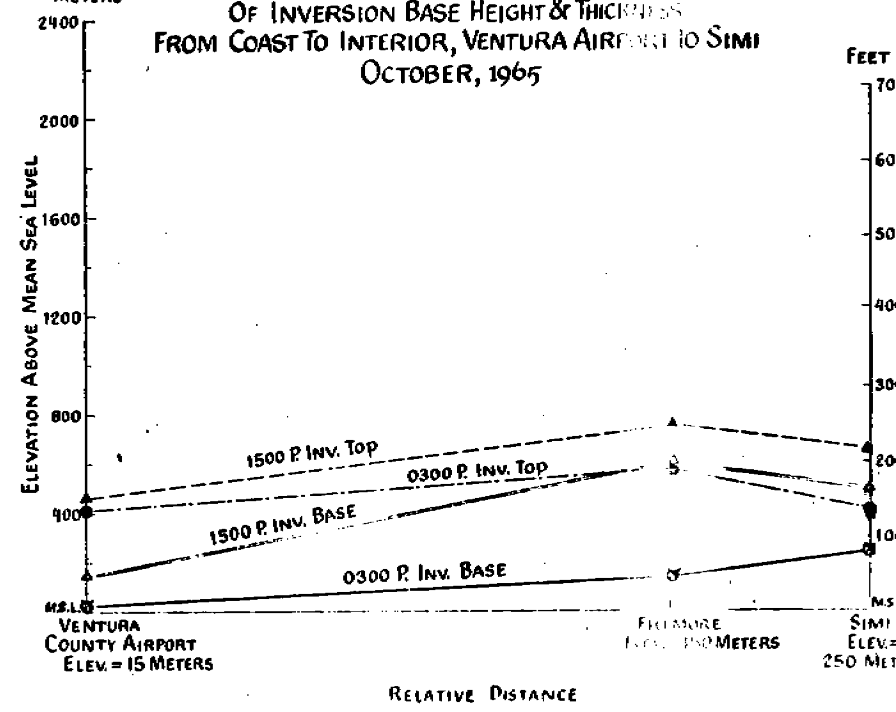


FIGURE 24 5 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI OCTOBER, 1965



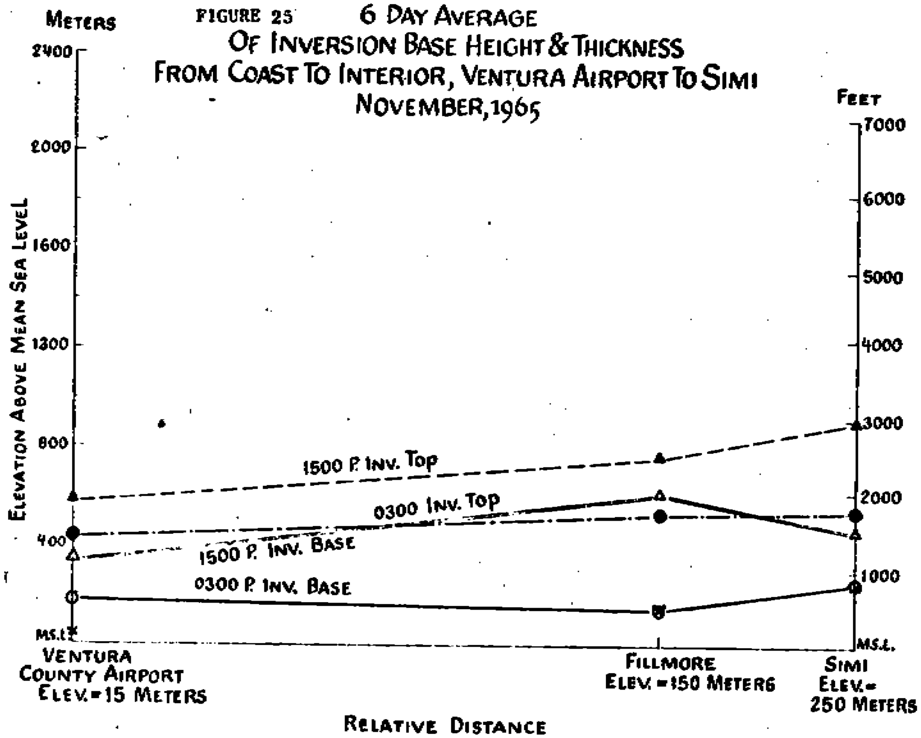


FIGURE 25 6 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI NOVEMBER, 1965

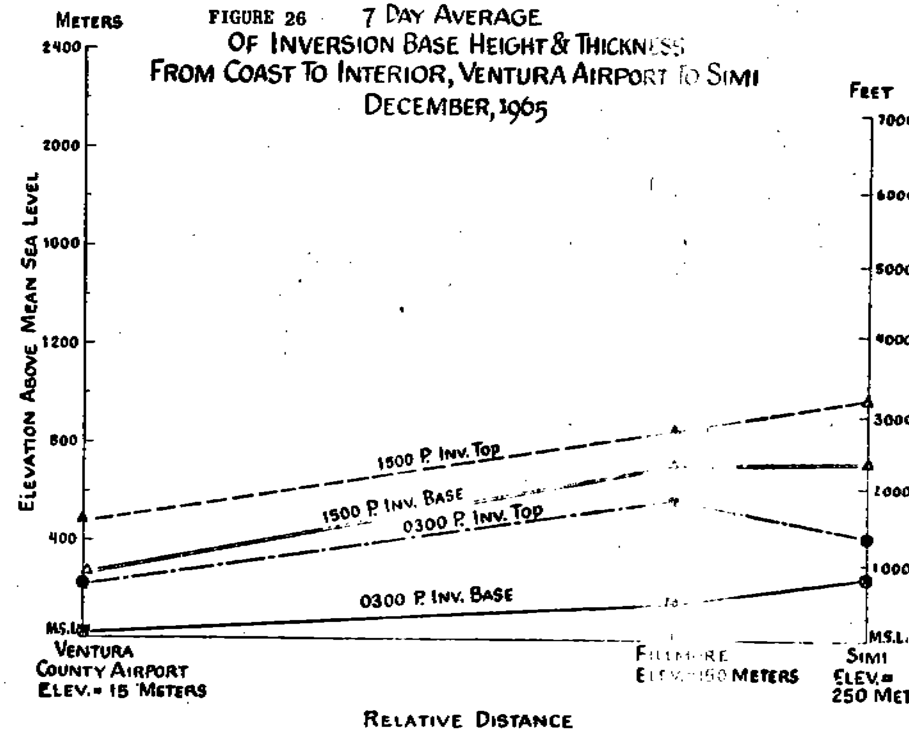


FIGURE 26 7 DAY AVERAGE OF INVERSION BASE HEIGHT & THICKNESS FROM COAST TO INTERIOR, VENTURA AIRPORT TO SIMI DECEMBER, 1965

The comparison is made using the monthly averages of the elevation of the inversion base and top for Ventura Coast, Fillmore, and Simi. During September, October, and November [illegible] inversion [illegible] above the inland stations at 1500 PST, the average given is for the inversion occurrences.

TABLE LIV

VENTURA COUNTY AIR POLLUTION SURVEY
DATA FROM AIRCRAFT SOUNDING PROGRAM OVER THREE LOCATIONS
JUNE-DECEMBER, 1965

DATE AND HOUR OF SOUNDING		Ventura Coast (Elevation: 15 Meters)			Fillmore (Elevation: 150 Meters)			Simi (Elevation: 250 Meters)		
		Inversion Base Elevation (meters)	Inversion Thickness (meters)	Temperature Difference in Degrees Centigrade	Inversion Base Elevation (meters)	Inversion Thickness (meters)	Temperature Difference in Degrees Centigrade	Inversion Base Elevation (meters)	Inversion Thickness (meters)	Temperature Difference in Degrees Centigrade
June 9	0300	1160	360	1.7	1370	220	1.3	1280	490	2.2
	1500	560	540	3.8	910	550	3.0	690	500	2.7
15	0300	960	180	0.3	1360	110	0.2	1390	130	0.3
	1500	1040	160	0.5	1360	270	1.0	1300	120	0.6
26	0300	1280	50	0.2	1620	220	1.6	1480	330	0.7
	1500	1280	400	0.6	1370	220	0.6	1110	140	0.9
27	0300	180	658	0.8	150	1190	3.7	250	725	3.8
	1500	760	90	0.9	610	210	0.5	610	150	1.4
28	0300	230	620	4.8	230	900	4.0	370	610	2.4
	1500	180	480	5.8		No Inversion		500	260	0.8
Average	0300	762	374	1.6	946	528	2.2	954	457	1.9
	1500	764	334	2.3	1062	313	1.3	842	234	1.3
July 20	1500	305	485	4.0	610	150	0.6	380	180	1.6
21	0900	330	930	3.8	610	530	0.5	920	160	1.1
	1500	180	600	4.0	950	130	0.6	610	460	1.3
22	1500	430	450	4.4	690	540	1.1	590	480	1.5
23	1000	305	825	5.0	500	570	2.4	305	550	2.7
	1500	370	545	7.1	820	280	2.9	595	425	3.3
26	1000	1110	350	1.0	1070	320	3.3	900	350	1.6
	1500	810	410	0.8	930	150	1.2	760	530	1.4
27	0900	60	1330	3.5	730	490	0.7	460	700	0.8
	1500	60	1070	3.9	980	180	0.6		No Inversion	
28	0900	210	610	5.7	330	740	0.9	460	430	7.4
	1500	210	370	8.6	580	150	0.7	430	390	1.3
29	0300	90	640	8.0	170	760	7.8	340	160	3.2
	1500	30	1100	4.7	260	430	2.7	310	360	1.2
30	0300	80	560	3.6	430	580	0.5	760	110	0.2
	1000	15	340	2.3	940	80	0.8	1100	150	0.1
Average	0300	85	600	5.8	300	670	4.2	550	135	1.7
	1500	299	629	4.7	728	251	1.3	525	404	1.7
August 9	1500	15	701	9.0		No Inversion		445	152	0.5
10	0300	43	472	6.0	262	915	4.8	250	36	5.5
	1500	25	736	4.5	609	201	0.5	456	153	1.2
11	0300	25	203	3.5	150	280	0.8	381	153	0.6
16	1500	228	408	1.8	581	208	1.5		No Inversion	
17	0300	281	707	3.5	177	866	2.8	250	842	4.4
	1500	357	305	1.0	662	48	0.3	662	353	0.3
18	1500	635	558	3.2	1040	305	1.9	689	248	0.8
19	0300	662	762	3.8	607	561	2.8	863	256	1.0
	1500	327	360	4.7	784	287	1.4	504	293	1.7
20	0300	484	402	5.0	331	461	3.7	273	103	3.6
	1500	153	905	2.4		No Inversion		453	209	1.2
25	0300	336	1108	3.8	239	707	2.6	1306	457	1.0
	1500	329	963	4.4	1091	139	1.2	481	964	0.4
Average	0300	305	608	4.3	294	632	2.9	555	308	2.7
	1500	258	617	3.9	795	198	1.1	527	339	0.9
September 15	0300	402	360	1.7	965	352	1.4	508	254	2.0
20	0300	15	137	7.0	150	50	8.4	250	360	9.8
21	0300	15	135	7.2	150	765	6.4	250	207	9.1
	1500	152	611	1.3		No Inversion			No Inversion	
22	0300	15	595	4.0	150	765	5.5	250	207	10.0
	1500	102	558	3.3		No Inversion			No Inversion	
23	0300	15	845	7.5	150	663	6.7	250	510	8.5
	1500	169	593	4.7	712	203	0.2	504	502	1.3
24	1500	435	508	5.5	794	352	2.0	485	356	2.0
25	0300	476	544	5.3	305	1067	3.8	305	715	3.8

VENTURA COUNTY AIR POLLUTION SURVEY
DATA FROM AIRCRAFT SOUNDING PROGRAM OVER THREE LOCATIONS
JUNE-DECEMBER, 1965

[illegible] Hour of Sounding		LOCATION								
		Ventura Coast (Elevation: 15 Meters)			[illegible] (Elevation: 150 Meters)			Simi (Elevation: 250 Meters)		
		Inversion Base Elevation (meters)	Inversion Thickness (meters)	Temperature Difference in Degrees Centigrade	Inversion Base Elevation (meters)	Inversion Thickness (meters)	Temperature Difference in Degrees Centigrade	Inversion Base Elevation (meters)	Inversion Thickness (meters)	Temperature Difference in Degrees Centigrade
September 27	1500	1551	152	3.3	1703	102	3.0	1246	508	3.0
28	0300	788	153	0.0	1703	102	0.5		No Inversion	
	1500	885	50	0.5	1443	102	1.0	935	564	0.2
29	0300	15	135	2.0	150	460	5.8	250	106	5.0
	1500	345	189	0.5		No Inversion		331	269	0.0
30	0300	15	392	10.5	150	104	11.8	250	156	11.1
Average	0300	195	366	5.0	430	481	5.6	289	314	7.4
	1500	520	380	2.7	1163	190	1.6	700	500	1.3
October 1	0300	15	290	7.5	150	207	10.2	250	207	8.2
19	0300	15	747	6.5	150	662	8.8	250	207	8.5
	1500	152	555	4.2	610	152	1.0	506	256	0.3
20	0300	15	135	9.0	150	460	11.5	250	104	10.0
	1500	152	153	0.8		No Inversion			No Inversion	
21	0300	15	135	9.2	150	100	9.8	250	55	10.0
	1500		No Inversion			No Inversion			No Inversion	
26	0300	15	442	8.8	150	618	10.8	250	207	9.2
	1500	150	354	3.5		No Inversion			No Inversion	
27	0300	15	644	9.0	150	613	12.8	250	207	13.0
	1500	146	223	6.2		No Inversion		518	55	1.0
Average	0300	15	401	8.3	150	467	10.7	250	165	9.8
	1500	150	321	3.7	610	152	1.0	512	156	0.7
November 2	0300	15	137	3.7	150	463	5.0	250	480	7.8
	1500	152	458	2.5	457	120	1.0	457	456	0.3
3	0300	15	490	4.5	150	710	10.0	250	360	8.3
5	1500	152	250	1.2		No Inversion			No Inversion	
9	0300	256	245	0.0	150	210	7.0	250	207	8.2
	1500	457	104	0.4		No Inversion			No Inversion	
10	0300	610	256	0.0	150	259	4.6	250	212	5.0
	1500	610	408	1.3	817	250	0.8		No Inversion	
29	1500		No Inversion			No Inversion			No Inversion	
30	0300	15	135	4.2	150	260	5.7	250	207	7.2
	1500	360	18	0.5	561	105	0.5		No Inversion	
Average	0300	182	253	2.5	150	380	6.5	250	294	7.3
	1500	346	248	1.2	612	158	0.8	457	456	0.3
December 1	0300	15	138	6.3	150	356	1.5	250	104	8.5
	1500	305	49	1.6		No Inversion		250	210	4.7
2	0300	15	293	6.5	150	405	8.8	250	104	8.9
	1500	98	207	1.0		No Inversion			No Inversion	
3	1500	152	305	1.0	250	207	2.4	402	561	1.0
7	0300	15	295	4.0	150	660	7.0	250	104	8.1
	1500	152	342	1.7	549	100	0.0	1016	50	0.0
14	0300	15	137	4.0	150	417	3.3	250	365	5.0
17	0300	15	89	5.0	150	307	6.3	250	305	5.8
	1500	713	98	0.0	1353	123	0.5	1220	201	0.5
21	0300	15	290	7.0	150	398	8.6	250	315	9.2
Average	0300	15	207	5.5	150	424	6.9	250	216	7.6
	1500	284	200	1.1	717	143	1.0	722	256	1.6

METEOROLOGIC FINDINGS

Surface Wind Conditions

Both diurnal and seasonal variations in the sea and land breeze pattern are evident in the wind data from the seven air monitoring sites. Figure 12 illustrates, in bar graph style, the relative amounts of up-valley (sea breeze) and down-valley (land breeze) wind flow on an average daily basis and a seasonal basis for the Foster Park and Santa Paula stations. These data represent particularly channelized wind flow. In Foster Park the magnitudes of the wind flow are less because the channel is coupled with the mountain-terminated Ojai and Santa Ana Valleys. The flow up and down the Santa Clara River Valley represented by the Santa Paula data reflect the increased air flow through a channel that is coupled with a vast interior area (the Mojave Desert).

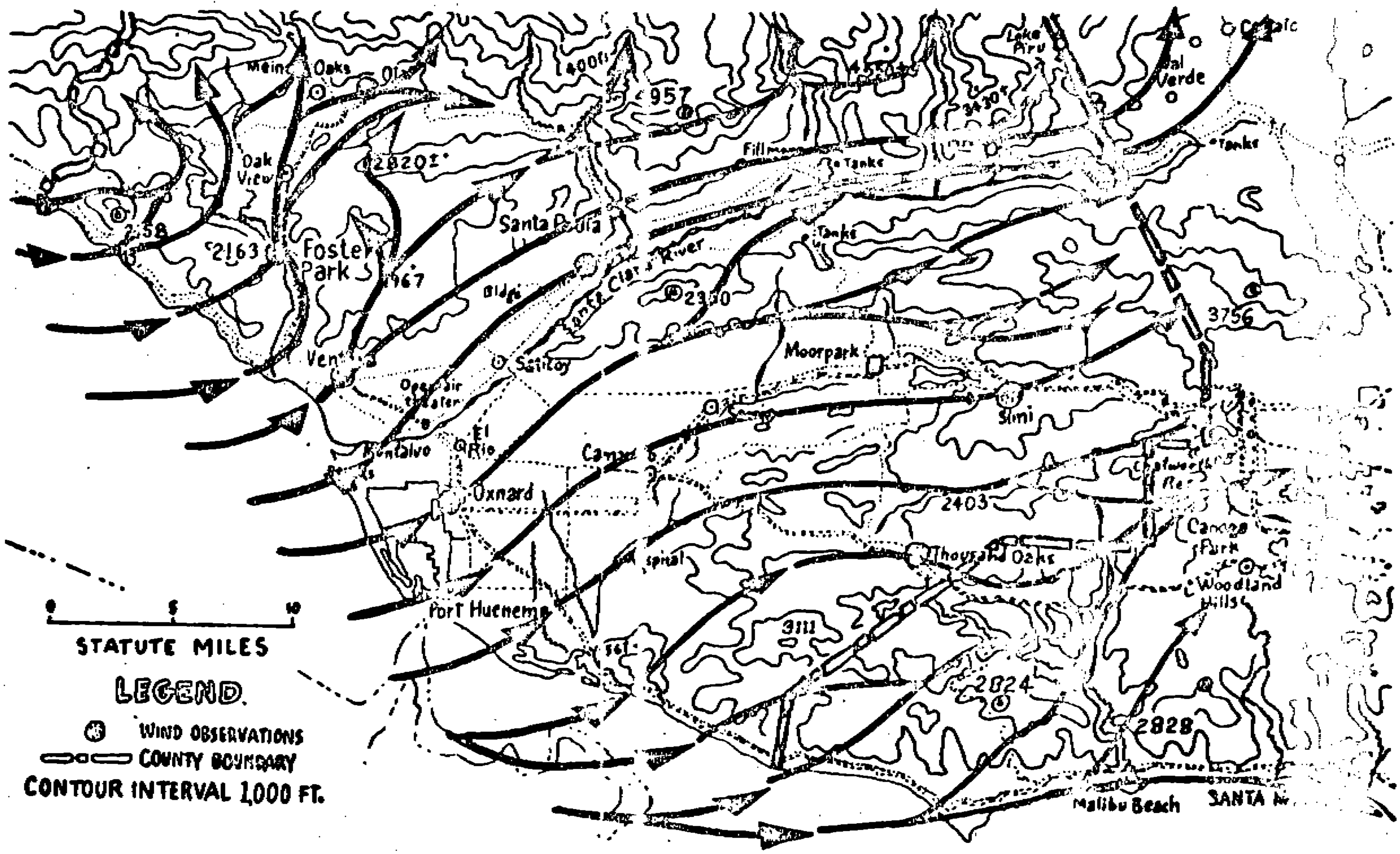
The Thousand Oaks and Simi stations, which are located in interior valleys that end at mountains, have pronounced drainage wind patterns which are interrupted by the daily arrival of the sea breeze during the late morning hours. In winter the sea breeze reaches these interior stations for only a few hours in the afternoon.

The stations on the coastal plain are almost completely dominated by onshore winds in summer. In winter, land breezes reaching the coastal plain are usually quite light. Off-shore wind flow due to large-scale barometric pressure gradients produce a scouring effect on all valleys and flood the coastal plain. This involves dry interior air which is made even drier by the katabatic effect along south and southwest facing mountain slopes. On one of these occasions the down-valley flow at Santa Paula was 433 miles of wind during one 24-hour period which is equivalent to an average wind speed of 18 miles per hour.

Variations in the depth of the marine air layer beneath the subsidence inversion have a marked effect on how the topography influences the air moving inland. Figure 27 shows a streamline map of the sea breeze flow inland when the marine air layer is deep (2,500 to 3,000 feet). Except for the influence by well-defined channels, the sea breeze streams towards the interior without much hindrance. Figure 28 shows a streamline map when the sea breeze was confined to a relatively shallow marine air layer (1,000 to 1,500 feet). Under these conditions channelization by the principal topographic features is more pronounced.

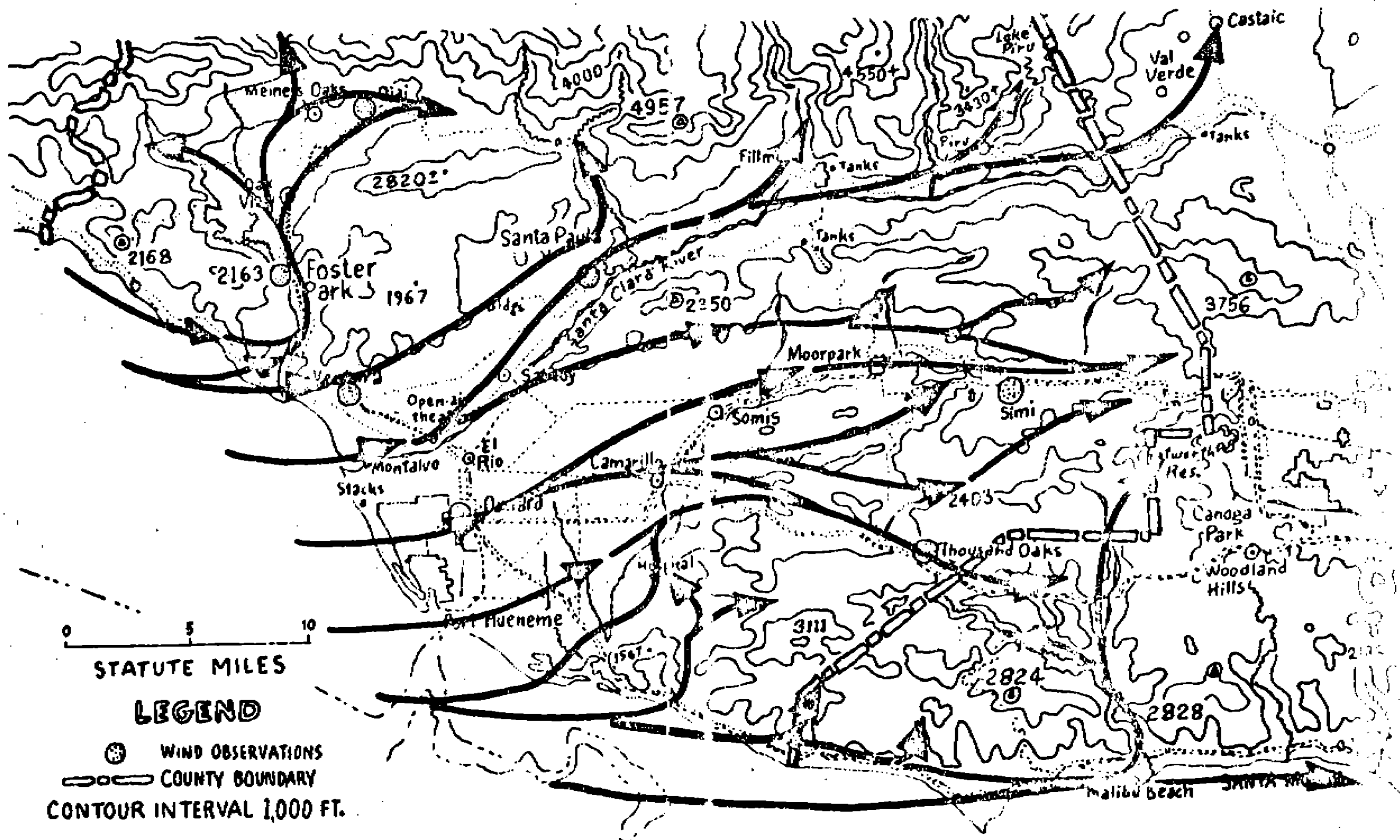
Light winds for extended periods ordinarily are conducive to the occurrence of air pollution episodes. When the oxidant concentration was at or above the adverse level (15 pphm) at the various air monitoring stations, the average wind speeds were between 6 and 10 mph. The following table shows a comparison of

FIGURE 27



DEEP MARINE LAYER
SEA BREEZE FLOW

FIGURE 28



SHALLOW MARINE LAYER
SEA BREEZE FLOW

wind speeds at five stations during the specified number of hours when the oxidant concentration was at or more than 15 pphm. The station at Simi had no adverse oxidant experience and is included in the table for sake of completeness.

TABLE LV

AVERAGE WIND SPEED DURING
ADVERSE OXIDANT OCCURRENCES

STATION	NUMBER OF HOURS OXIDANT CONCENTRATION 15 PPHM	AVERAGE MILES PER HOUR FOR SPECIFIED HOURS	PRINCIPAL WIND DIRECTION
Ventura	37	6.0	W
Ojai	44	7.7	W
Oxnard	24	7.9	W
Thousand Oaks	67	7.7	W to NW
Simi	0	-	-
Santa Paula	20	10.4	SW

Inversion Conditions

Characterizing inversion conditions for Fillmore and Simi by averaging the small number of soundings may not provide a true picture. The Santa Ynez Mountain range which lies to the north of the inhabited valleys of Ventura County is known to have extensive influence on the inversion. Previous studies by Edinger of University of California (Los Angeles)* and by Meteorology Research Inc. (Altadena)** have shown that the inversion is subject to considerable variation in height and strength because of the interaction between the winds-aloft and the Santa Ynez range. These studies which mapped the inversion in two dimensions along a transect using aircraft fitted with fast-response temperature measuring equipment, showed that the inversion layer has an undulatory spatial distribution depending on the directions and speeds of the winds-aloft relative to the Santa Ynez range orientation.

The data obtained at Fillmore and Simi during aircraft soundings must be viewed as a more or less instantaneous sample of an inversion which continually is undergoing changes in structure by virtue of local influences of terrain features.

There is little doubt that the subsidence inversion layer slopes upward from the coast of the Ventura Plain toward the interior.

The inversion data gathered during this survey suggests that it may persist over the interior in the afternoon during June, July, and August. The rather small temperature differences through the inversion suggest that degradation due to solar heating is a significant factor in reducing the ability of the inversion to restrict local vertical motions in the atmosphere in the interior of the county.

Additional deterioration of the inversion over the easternmost end of the Simi Valley and the Santa Susana Mountains and Simi Hills probably occurs. This is caused by a zone of convergence which exists over these mountains and the western edge of the San Fernando Valley due to opposing air flows arriving via the Simi Valley and the San Fernando Valley. This zone of convergence has been documented by Edinger of the University of California (Los Angeles).***

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*Edinger, J.G. and L. Myrup, The Observed Modification of the Structure of the Marine and Inversion Layers by Terrain Features, (Part III of "Variability of Low Level Thermal Stratification over Coastal Terrain Features"), U.S. Weather Bureau Contract No. CWB 9666, Department of Meteorology, University of California (Los Angeles), 1961.

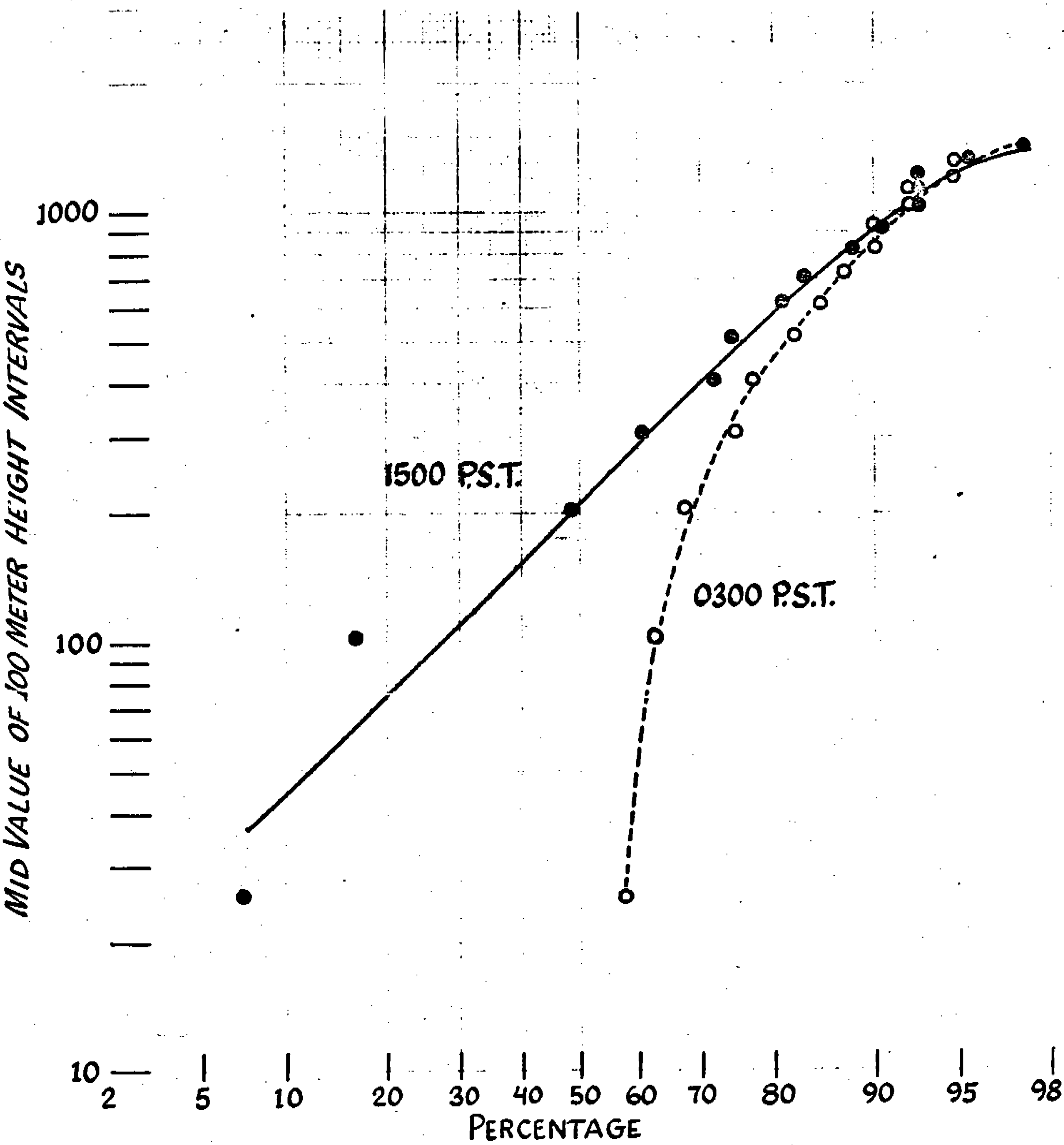
**Meteorology Research Inc., Report (unpublished) under contract to Pacific Missile Range, 1963.

***Edinger, J. G. and A. Helvey, The San Fernando Convergence Zone. Bull. Amer. Meteorol. Soc. 42(9), 626-35, September, 1961.

During the fall and winter months the subsidence inversion weakens, and on a large percentage of the afternoons over the interior of the county there is no inversion. The frequency of ground-based nocturnal inversions in the interior valleys increases with the advancing fall and winter season. In the sheltered Ojai and the Simi Valleys, the nocturnal ground-based inversions can become intense during the early morning hours due to the combined effects of radiational cooling and the drainage winds from the surrounding mountain slopes. On every clear night during fall and winter, pollutants from local sources would be held close to the ground under these inversion circumstances.

A log-probability plot of the June to December inversion experience over the coastal part of the Ventura (Oxnard) Plain is shown for the early morning (0300 PST) and the afternoon (1500 PST) in Figure 29. At 0300 PST more than 50 percent of the inversions were at or near the surface during the late fall and winter months. A more normal distribution is typical of the afternoon (1500 PST) inversion during this period. Fifty percent of the inversion bases are at elevations less than 200 meters (610 feet). Thirty percent lie between 200 and 600 meters (1,830 feet) and the balance between 600 and 1,400 meters (4,600 feet). The continuity of the inversion along the southern California coast (see Figures 13 through 19 in the previous section) is shown by the comparison of soundings above the coastline near Oxnard with those at Point Arguello and Santa Monica.

FIGURE 29



CUMULATIVE FREQUENCY DISTRIBUTION OF INVERSION BASE HEIGHT ABOVE VENTURA COAST LINE, JUNE THRU DECEMBER, 1965.

The analysis of meteorological conditions during the January 30, 1965 occurrence of exceptionally high oxidant concentrations in Ventura and Santa Barbara showed a clearly-defined encroachment by air pollution from the Los Angeles area. A nocturnal land breeze* which transported pollutants from the Los Angeles area out over the seaward area was confirmed from 3-hourly U.S. Weather Bureau maps. Streamline analysis of the 3-, 5-, and 10-thousand foot wind patterns showed the development of a cyclonic eddy above the Santa Barbara Channel beginning about 0400 PST on January 29. By the morning of January 30 this pattern had persisted aloft for 24 hours and caused a low pressure depression to form over the Channel. The sea-level map for 0400 PST (U.S. Weather Bureau) confirmed this. There existed, then, a pattern in the barometric pressure distribution which prevented the normal influx of fresh marine air flow into the Santa Barbara Channel. Northward movement of the accumulated pollution over the seaward area west of Los Angeles began when a local sea breeze began moving on-shore during the late afternoon, the polluted air layer enveloped Ventura and Santa Barbara. Hourly weather observations from several coastal stations showed lowered visibility (less than 3 miles) following the late afternoon onset of a weak, local sea breeze.

Similar observational data were gathered for assessment of the October 6, 1965 incident. As in the case of the January 30 situation, the first indication of a departure from the normal circulation pattern was noted at the 3,000 foot level by 1300 PST, October 5. A small cyclonic eddy circulation appeared above the Santa Barbara Channel which produced a low pressure depression along the coast by the early evening hours of October 5. As in the case of the January 30 episode, the October 5 and 6 situation prevented the normal flow of fresh marine air into the Santa Barbara Channel. The way was open for northward encroachment of the off-shore polluted air layer. With the onset of a weak sea breeze the polluted layer was borne onshore into Ventura County.

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*Such a condition develops fairly regularly during the winter (and fall) season. Due to the abrupt change in coastline orientation from roughly north-south at the western edge of Los Angeles to an east-west orientation lined by the Santa Monica Mountains, a boundary condition exists which generally confines the pollution carried by the nocturnal land breeze to the seaward area south of the Channel Islands. The degree to which the northern boundary of the off-shore polluted layer can encroach beyond its usual position depends on wind conditions in the Santa Barbara Channel. Unless some change occurs, in the meso-scale barometric pattern to exclude the normal flow of marine air into the Santa Barbara Channel after passing Point Conception, the off-shore polluted layer does not penetrate northward to the Channel Islands.

The hourly weather observations taken at Oxnard Air Force Base indicate that the sea breeze reached that point at about 0940 PST. Visibility subsequently deteriorated to 1 3/8 miles with a 1[illegible] degree dewpoint spread. The penetration of polluted air was apparently not confined only to the upper Ventura Plain. Ojai and Santa Paula stations reported peak concentrations of 26 pphm oxidant in the afternoon. Hourly observations taken at Santa Barbara Airport showed that there was no well-defined sea breeze nor any abrupt lowering of the visibility. Reference was made with the noon observation at Santa Barbara that the visibility was lower than the station visibility to the east due to haze. Pt. Mugu and San Nicolas Island both reported shallow fog throughout the 6th of October. This would suggest that the low depression occupying the Channel area was small in extent but still provided an opportunity for the encroachment of polluted air from south of the Channel Islands.

On January 25, 1966, the meteorologic situation previously described occurred again. The low pressure area over the Santa Barbara Channel, though weak, provided an opportunity for smog reactants over the seaward area to move northward along the Ventura coastline. The sea breeze began moving on-shore about 1100 PST and the oxidant concentration began to rise. The adverse level (15 pphm) was not reached until 1400 PST. It persisted above this level until 1700 PST. Evidently, the sea breeze succeeded in carrying the smog reactants to Santa Paula where the oxidant remained at the adverse level (15 pphm) for an hour and 10 minutes beginning at 1530 PST. A similar meteorologic condition occurred again on April 24, 1966, when 35 pphm peak oxidant concentration occurred at 1:30 p.m. in Ventura.

DISPERSION CHARACTERISTICS OF THE VENTURA ATMOSPHERE

The diversity of valley sizes, orientations and exposures to prevailing winds make it convenient to describe several contiguous zones within the county. It should be kept in mind, however, that these boundaries are a discussion convenience and are not meant to convey discrete discontinuities in the lower atmosphere.

The six zones chosen are shown on the accompanying map of the southern half of Ventura County. They are identical with those used in the 1956 report on pollution potential of Ventura County prepared by North American Weather Consultants. In the light of the data gathered during this air pollution survey (1965-1966), there appeared to be no reason to change the zone designation. These same zonings will be used also as the basis for discussion in the section of this report dealing with pollution potential.

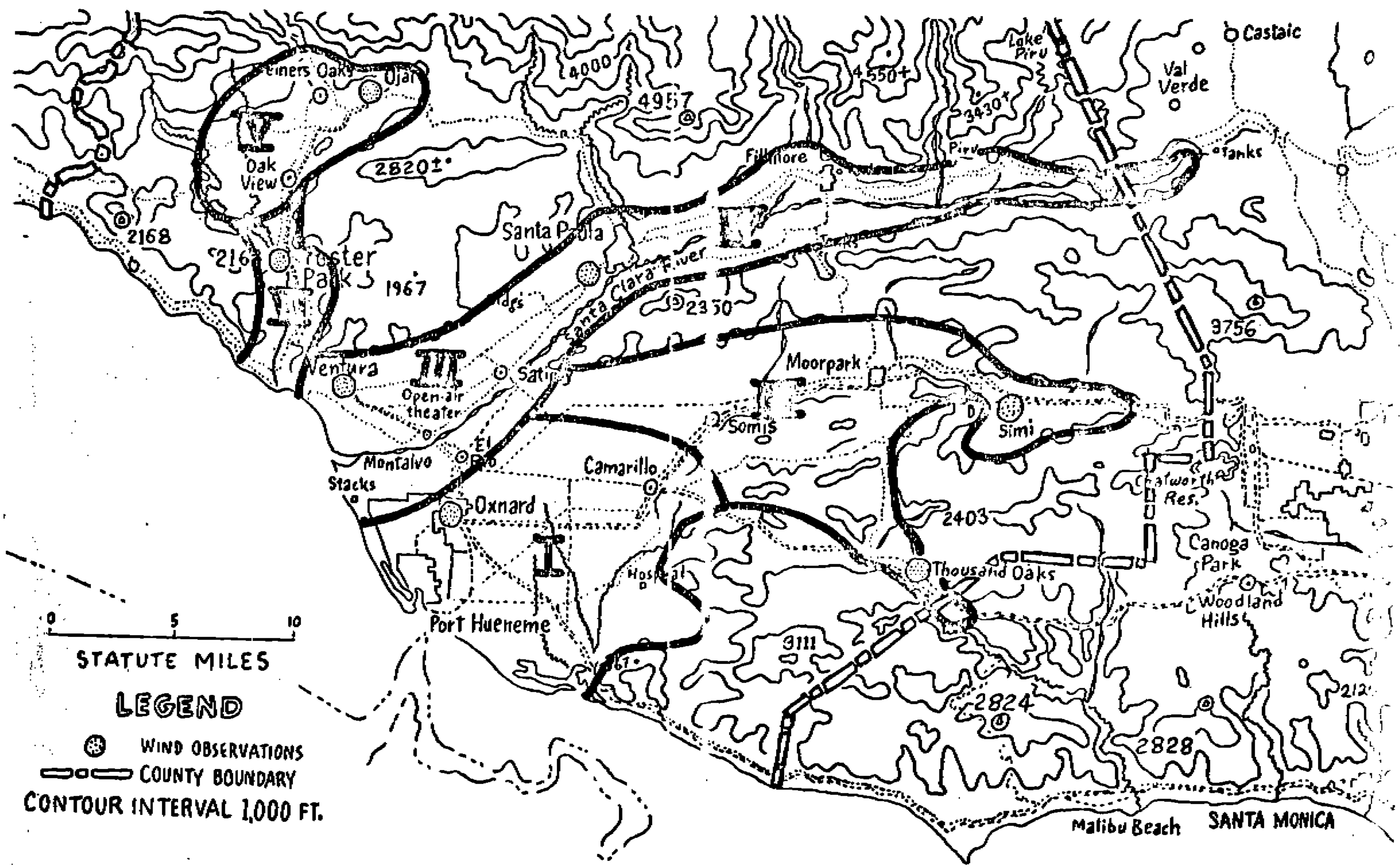
The two most important meteorologic parameters affecting pollutant dispersion in the atmosphere are ventilation by the natural wind and turbulent motion, which is a function of wind speed, atmospheric stability and aerodynamic roughness of the surface over which the wind is flowing. These factors and their interaction with topographic features are the basis of this discussion of dispersion characteristics.

Zone I - This area comprises about two-thirds of the coastal plain. It is considered separately because the nocturnal land breeze experienced originates mainly from the Simi Conejo Valleys via the Camarillo (Pleasant) Valley. (See Figure 30)

This area differs from that of the northern third of the plain due to more variability in the beginning time of the daily sea breeze.

The strength and depth of the sea breeze varies from day to day. A weak and shallow sea breeze penetrating the coastal plain will result in a more prolonged transition period affecting the southern and easternmost parts of Zone I. Some idea of the relative occurrence of light winds can be had by comparing the percentage frequency of light wind (less than 3 mph) at the Oxnard monitoring station, Oxnard Air Force Base, and Point Mugu Naval Air Station. Respectively, these percentages are 1 to 3 percent, 17 to 27 percent, and 18 to 36 percent. Stagnant air conditions are considerably more likely in the east and south parts of Zone I than in the northwestern parts where wind speeds of 3 to 6 mph occur 17 to 33 percent of the time. These conditions prevail between sunrise and 1000 to 1100 PST.

FIGURE 30



POLLUTION DISPERSION ZONES

Inversion data obtained during this survey shows that the sea breeze layer was 500 feet or less during onset of the sea breeze approximately 7 percent of the time and 1,000 feet or less about 12 percent of the time. From one third to almost one half of the light wind occurrences in the south and east parts of Zone I are characterized by shallow layers of marine air. Dispersion is poor under these circumstances.

After the sea breeze is fully developed dispersion is improved due to increased turbulence, faster wind speeds (3-12 mph), and increased mixing depth. During the period May through August these conditions prevail almost daily between 1000 or 1100 PST and 2000 or 2100 PST.

Zone II - This zone includes the interior valleys bounded on the north by South Mountain and Oak Ridge, by the Santa Monica Mountains on the south and by the Santa Susana Mountains and the Simi Hills on the east.

The valleys included in this zone are influenced by local winds which drain from the surrounding mountain slopes during the night time hours. These conditions prevail in all seasons and dominate most of the hours before noon and after 6 p.m. in the winter season. These local wind conditions prevent penetration of the sea breeze during nocturnal hours.

During the sea breeze season when the marine air layer is shallow (1,000 feet or less) channelization of the wind-flow by the valleys is at a maximum. Channelization of the winds and shallow mixing volume, limit the dispersal of pollutants. When the marine air layer is relatively deep (more than 1,000 feet) the effect of the mountains on flow of wind is diminished. Wind-flow is usually stronger and the mixing volume is greater. Under these conditions dispersion characteristics are greatly improved.

The work of Edinger of U.C.L.A.* indicates that in the extreme eastern parts of this zone the opportunity for upward dispersion increases because of the convergent flow between the Ventura sea breeze and the San Fernando Valley breeze. This contributes to better dispersion of pollutants. The zone of convergence varies in its location depending on the relative strengths of the two opposing breezes.

Zone III - This zone includes the extreme northwestern coastal plain and the lower Santa Clara River Channel below Saticoy. During the active sea breeze season (June 15 to August 15) the north easterly nocturnal drainage from the

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*Edinger, J. G. and R. A. Helvey, The San Fernando Convergence Zone. Bull. Amer. Meteorol. Soc. 42(9) 626-34 September, 1961.

Santa Clara River Valley seldom overcomes the south westerly sea breeze which varies in average speed of from 4 to 11 mph. Dispersion under the conditions of this period usually is good. The nocturnal drainage reaches the coast with increasing frequency after August 15. A transition period of one or two hours allows a build-up of pollution to occur before the fresh sea breeze begins. When the sea breeze develops slowly dispersion characteristics are poor for two to four hours during late morning or early afternoon.

<u>Zone IV</u> - This zone includes the Santa Clara River Valley east of Saticoy. The Santa Ynez Mountains on the north side of the valley and South Mountain and Oak Ridge on the south side, channelize the sea breeze flow to the interior. There is a substantial flow of air through this channel because it is the principal access to the interior desert area. The wind speed for the eight hours ending at 4 p.m. averages 12 mph during the sea breeze season as measured at Santa Paula. Dispersion in the lower part of Zone IV is good during the sea breeze season.

Due to an abrupt widening of the valley in the vicinity of Fillmore there is local deceleration of the breeze. This change in width of the valley frequently causes a counterclockwise circulation to be established in the mouth of the Sespe Creek Valley. This curtails the effectiveness of other dispersion parameters such as turbulence and mixing height.

Previous studies as well as upper air data gathered during this study indicate that the inversion undergoes substantial changes in elevation depending on the exposure of the surrounding mountain ranges to the winds-aloft. When the Santa Ynez Mountains provide a lee side effect upon the inversion, the latter is at a lower elevation than over the surrounding countryside. Under these conditions the effective mixing height may be considerably less than at the threshold of the Santa Clara River Valley or over the Oxnard Plain. Dispersion, thus, can be lessened locally by these factors in the Sespe Creek-Fillmore area.

<u>Zone V</u> - The Ojai and Santa Ana Valleys are included in this zone since they are sheltered and end at the Santa Ynez and the Sulphur Mountains. Ventilation by the sea breeze is hampered during low inversion conditions. The abrupt broadening of the Ventura River Channel in the vicinity of Oak View causes a decrease in wind speed and diminished dispersion as the air flowing up-valley spreads.

With high inversion levels (1,000 feet or better) fresh marine air is more likely to enter into these valleys. Casitas Pass furnishes another access for the sea breeze as do the passes through the Red Mountain Ridge.

Due to the sheltered nature of these valleys the late fall and winter nights are characterized by cold air drainage from the surrounding mountain ridges, providing very stable atmospheric conditions. Dispersion is low and until a drainage flow down the Ventura River Channel is established there would be very little transport of locally generated pollution.

Zone VI - The lower Ventura River Channel is included in this zone. During summer time, low-inversion conditions, the flow of wind through the valley averages 7 to 8 mph for the daylight hours. Dispersion is hampered near the edges of the channel by lessened air movement and low mixing height. During inversion conditions characterized by a mixing height of the order of a thousand feet, the dispersion is considerably increased. Not only is the up-valley wind flow stronger (10 to 11 mph during daylight hours) but also the boundary effects of the channel topography are much less.

Dispersion is less during the fall and winter season. A period of transition occurs almost daily between the cessation of the down-valley drainage flow and the onset of the up-valley sea breeze. The light winds during these transition periods coupled with the stable atmospheric conditions typical of the fall and winter seasons result in poor dispersion during the morning hours.