

LIMITED capacity of the atmosphere in the Los Angeles Basin to disperse gaseous wastes accounts for its peculiar susceptibility to smog.

While much has been done to determine actual sources of smog, the author contends that nothing has yet been definitely proved. He tells here of the wide variety of investigative programs—covering meteorology, chemistry, combustion products, aerometric surveys, statistics, physical measurements, rubbish disposal, and other vital aspects—undertaken by APF, a nonprofit organization sponsored by local industry, business, and civic groups.

Discussion of this paper starts on p. 618.

THE Los Angeles Basin is an industrial community situated in a meteorological environment different from any other large city in the world. Between the strong inversions a great portion of the year and the attendant low wind velocities, the capability of the atmosphere for the dispersion of gaseous wastes is extremely limited.

Shortly after World War II, the smog problem became so great that the community forced State action and formed the first county-wide Air Pollution Control District. This was in 1947. Following the pattern used in other cities, the District first removed a large quantity of particulate matter or smoke from the air and later reduced sulfur dioxide emissions. Reduction of these materials had helped greatly in other cities, but in Los Angeles the smog continued to increase. Research work done at the District indicated that hydrocarbon emissions from the refineries were responsible for eye-stinging smog. Again, control measures were invoked and the emission of hydrocarbons from the refineries was greatly reduced. Even this has not cured the situation. As smog continued, the public demanded direct action by legislation, ignoring the fact that the causes of smog were still unknown. This led to attacks on the Air Pollution Control District, the Board of Supervisors, and participating industries, and finally to dissension between some of these groups. All of this is documented in the press. Air pollution control threatened to become a political football and a campaign weapon. Valid and persistent work by the Air Pollution Control District continued despite the political atmosphere, though impeded by it.

In September, 1953, we had some particularly bad smog days. A group of civic leaders met at the California Club about that time. Remembering how community action had improved the water situation and also the harbor problem, this group of men asked themselves what they, as citizens, could do to aid the Air Pollution Control District in the elimination of smog. It was obvious that more facts concerning the nature and origin of

smog were necessary before proper controls could be invoked. These facts, in turn, could only be uncovered through research.

In November of 1953, a group of about 100 civic and business leaders met at the Ambassador Hotel and founded the Southern California Air Pollution Foundation (on Dec. 21, 1955, the Board of Trustees officially changed the name of the Foundation to the Air Pollution Foundation), "an independent scientific organization supported by public-spirited citizens—to help determine the causes of smog and implement its elimination."

The Foundation was incorporated as a nonprofit research organization under the laws of California on Nov. 18, 1953. It is financed by contributions from a cross-section of Southern California industry (ranging from aircraft to zinc), business, and private citizens. The breadth of this civic enterprise may be obtained by examining a list of trustees of the Foundation (Table 1).

The broad base upon which the Foundation was formed may be obtained by looking at the purpose of the Foundation in its "Statement of Policy."

APF is an independent, nonprofit corporation which has been established for the following purposes:

1. To cooperate with, and to assist in coordinating the efforts of, governmental agencies, educational institutions, specialized research groups, and medical, legal, and other technologists, so that every phase of air pollution shall be the object of careful study and constructive, remedial action.
2. To provide for the conduct of research on those phases of the problem not already undertaken or completed by other agencies.
3. To inform the public periodically concerning the nature and extent of air pollution, progress made in its elimination, and obstacles to such elimination.

The following statements indicate the basic ap-

Table 1 - APF Board of Trustees

Chairman - Fred D. Fagg, Jr., president, University of Southern California
Vice-Chairman - Stephen W. Royce, president and manager, Huntington-Sheraton Hotel, Pasadena
Treasurer - James E. Shelton, president, Security-First National Bank
Raymond B. Allen, chancellor, University of California at Los Angeles
F. M. Banks, president, Southern California Gas Co.
Arnold O. Beckman, president, Beckman Instruments, Inc.
Walter Braunschweiger, executive vice-president, Bank of America
Asa V. Call, president, Pacific Mutual Life Insurance Co.
Edward W. Carter, president, Broadway-Hole Stores, Inc.
Lee A. DuBridge, president, California Institute of Technology
Roy M. Hagen, president, California Consumers Corp.
Charles F. Kettering, vice-president and research consultant, General Motors Research Laboratories
John A. McCone, president, Joshua Hendy Corp.
Harvey S. Mudd, president, Cyprus Mines Corp.
William C. Mullendore, chairman of the board, Southern California Edison Co.
Fred B. Ortman, chairman of the board and president, Gladding, McBean & Co.
Alden G. Roach, president, Columbia-Geneva Steel Division and Consolidated Western Steel Division, United States Steel Corp.
Dr. J. Philip Sampson, president, County Medical Association
Reese H. Taylor, president, Union Oil Co. of Calif.
P. G. Winnett, chairman of the board, Bullock's, Inc.

Air Pollution Foundation—

What It Is and What It Does

W. L. Faith, Air Pollution Foundation

This paper was presented at the SAE Golden Anniversary Annual Meeting, Detroit, Jan. 10, 1955.

proach to smog outlined in the Air Pollution Foundation charter:

What the Foundation Proposes to Do

1. To assemble a competent technical staff to organize and direct a broad program of cooperation, research, and public information.
2. To determine, record, and publish what has been accomplished to date by all agencies dealing with the Southern California problem.
3. To determine what remains to be done and to employ experts – through the device of research or service contracts – who will provide information and advice for the shaping of future policies and action.
4. To collect information as to what other municipal areas have done, and are doing, under similar circumstances.
5. To provide and maintain a library of materials pertinent to the subject of air pollution.
6. To consult with, exchange information with, and to suggest to governmental and private agencies those research activities, enforcement methods, or other matters, which have not yet been conducted or tried and which seem to offer promise of air pollution abatement – so that the efforts of all groups and individuals may be coordinated properly.
7. To publish current information – by the most appropriate means – on all phases of air pollution and its abatement.

What the Foundation Does *Not* Propose to Do

1. It will not duplicate services already ren-

dered by governmental or private agencies.

2. It will not conduct research activities directly – unless it appears clear that no existing agency can conduct them as advantageously.

3. It will not expend funds entrusted to it for the constructing or equipping of Foundation laboratories that will duplicate facilities already available.

4. It will not hold public hearings for the purpose of receiving complaints, or in any way substitute for governmental agencies now charged with responsibility for certain phases of the air pollution problem.

5. It will not offer any immediate or ready solution for a very complicated, long-range problem.

The Foundation actually got under way on Feb. 1, 1954, when Dr. Lauren B. Hitchcock was appointed its president and managing director. As the organization chart shown in Fig. 1 indicates, the Foundation is basically a research team of five scientists, supplemented with the necessary related personnel.

The Foundation Program

The first activities of the Foundation were to evaluate the existing situation with respect to air pollution in the Los Angeles Basin. This was done through a series of conferences, among which was a conference on Vehicle Combustion Products and Other Emissions, held in Pasadena on Aug. 19, 20, and 21, 1954. This was a closed session attended by 65 representatives of the automotive and petroleum industries. Other conferences, aimed at evaluating

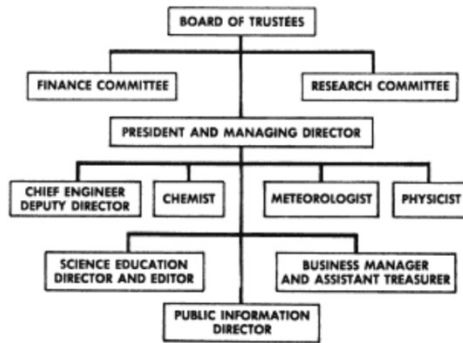


Fig. 1 - APF organization chart

the current situation and determining appropriate courses of action, covered meteorology, atmospheric chemistry, analytical methods, incineration and rubbish disposal, and others.

The evolved research program for 1954 is outlined in Table 2. The highlights of this program are listed below.

Meteorology - "Meteorology of the Los Angeles Basin," by Dr. Morris Neiburger, senior meteorologist of the Foundation, and James G. Edinger, was the first official publication of the Foundation. Based on this review and several meteorological conferences, the current research program was devised. This consists primarily of an air-tracer survey, in which finely divided fluorescent particles are released from various sources and then collected on filters several miles away over a specific period of time. By counting the particles on the various filters, air-particle movements may be traced. A map

Table 2 - APF Research Program, 1954

Program	Name
10	Meteorological
20	Chemical Measurements
30	Combustion Products
40	Aerometric Survey
50	Statistics
60	Physical Measurements
70	Disposal of Refuse

Table 3 - Aerometric Survey, 1954
(APF Program 40)

	Stations
1. Oxidant	12
2. NO _x	4
3. Hydrocarbons	2-4
4. Carbon Monoxide	2-4
5. Sulfur Dioxide	1-4
6. Particulate Matter	2
7. Plant Damage	6
8. Eye Irritation	10
9. Upper Air (Oxidant, NO _x)	3
10. Visibility	4
11. Temperature & Humidity	4
12. Meteorological Data	50

showing the location of both source and filter for one series of tests is shown in Fig. 2. By means of this technique, it will be possible to determine the reliability of present wind-trajectory techniques of calculating the movement of smog clouds throughout the Basin. Similar studies are also being made. Historical data of the Weather Bureau are also being studied to learn accurately the amount and characteristics of reduced visibility manifestations in the Basin since 1930.

Chemical Aspects - The chief project in this program is being carried out by Stanford Research Institute at their Air Research Laboratories in Pasadena. Night air in Pasadena usually contains fairly high concentrations of air pollutants, but does not exhibit smog manifestations unless irradiated or treated with small amounts of ozone. Smog-sensitive plants will be subjected to night air, and then irradiated or treated as mentioned to determine the variations of damage that ensue. Air of a similar nature will then be scrubbed with various agents to remove definite classes of air contaminants. The scrubbed air will be mixed with ozone or irradiated and then examined for plant-damaging characteristics. In this way, it is hoped that the precursors of smog will be identified. Other chemical projects include more extended studies on the photochemical reaction between hydrocarbons and NO₂, and further identification of the reaction products.

Combustion Products - A project has been initiated at Midwest Research Institute to explore the smog-forming properties of various components of automobile exhaust, as measured by sensitive plants. Previous data indicate that automobile exhaust damages plants more readily than individual hydrocarbons. It is hoped that, by separating the condensable portion of exhaust into various fractions and testing these fractions for smog manifestations, we may clarify present anomalies. Tests



Fig. 2 - Collector stations for air tracer study, with dispersal points (not shown) near center of arc

will be carried out under various motor operating conditions and using several types of fuel. Another combustion project which will be placed shortly will deal with the composition of effluents from backyard incinerators. Current data are both meager and conflicting.

Aerometric Survey - The most extensive project of the Foundation is a 4-month aerometric survey of the Los Angeles Basin. This consists of analyses of the air for contaminants at various locations, and a correlation of air composition with the known manifestations of smog, that is, eye irritation, plant damage, reduced visibility, and high oxidant content. The locations of various sampling stations are shown in Fig. 3. In addition to those shown are one at Santa Barbara, supposedly outside the smog zone, and one at Riverside, about 50 miles inland. The particular measurements being made, and the number of stations involved, are listed in Table 3. Besides the regular measurements at the general stations, we are also sampling the air at various heights above some of the stations. This is being done through the cooperation of the U. S. Navy. A view of a Navy blimp, sampling near the City Hall on a smoggy day, is shown in Fig. 4. Other views taken at various stations are shown in Figs. 5, 6, and 7. The necessary meteorological data are made available by the Los Angeles County Air Pollution Control District, which operates 52 meteorological stations in the Basin. Actually, a large portion of the aerometric survey is financed by the county, and the entire survey is a joint effort with the Control District. The survey is currently yielding about 750 measurements each day. These are recorded on IBM cards and are being correlated on business machines by modern statistical methods.

Statistics - A great many figures have been bandied about concerning the contribution of different sources to air pollution in Los Angeles. These figures are based on someone's estimate of the total amount of fuel used, the number of incinerators in



Fig. 3 - Air sampling stations for 1954 aerometric survey

The Author

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the Basin, and so forth. The Foundation believes that an independent check of reported statistics is necessary, and currently has two projects under way. One of these is an audit by Southwest Research Institute of the petroleum industry's estimate of refinery hydrocarbon emissions. The study has the full backing of the local petroleum industry.

Physical Measurements - Areas of study under consideration in the field of physical measurement include the use of microwave techniques in analyzing the atmosphere for contaminants, the use of carbon isotope techniques to determine the source of certain pollutants, and the measurement of solar radiation at various locations in the Basin. One project under way in cooperation with the U. S. Bureau of Standards is a spectroscopic survey of the Los Angeles atmosphere.



Fig. 4 - Navy blimp sampling near city hall on smoggy day

Rubbish Disposal - A conference on incineration, rubbish disposal, and air pollution has been scheduled for early December, 1954. Participants, many of national prominence, will present available data on incineration, landfill, composting, and other methods of refuse disposal, and point out the areas where further research is necessary.

Where Are We Going?

This program is directed toward only one goal: to get further facts concerning smog. With these facts will come the answers to the important questions in this field. What is smog? Where does it come from? How does it move across the Basin, or does it? Are the same or different phenomena responsible for eye irritation, plant damage, reduced visibility, and high atmospheric ozone concentrations? What is the relative importance of known sources of air pollution?

When we have these answers, we shall not have

smog licked. Control devices must still be developed, and we can't wait until the last doubt is erased concerning a specific source before development work begins. There is strong circumstantial evidence that automobile exhaust is a major contributor to Los Angeles smog. Acknowledgment of this situation by the automotive industry has resulted in initiation of actual research work intended to result in reducing the hydrocarbon content of exhaust gases. By this action, the automotive and petroleum industries have given a concrete example of their sense of civic responsibility. The Foundation will do all it can to aid this work and speed it up.

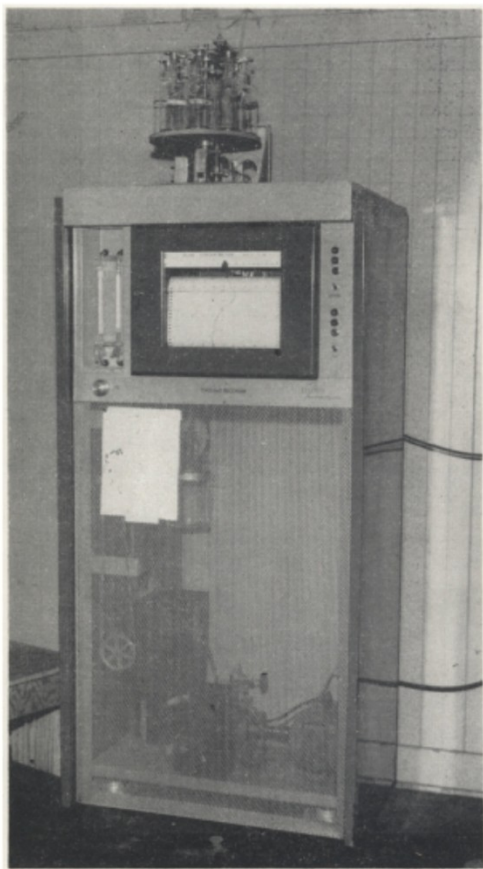


Fig. 5 - NO₂ sample collector (top) and oxidant recorder at Venice aerometric station

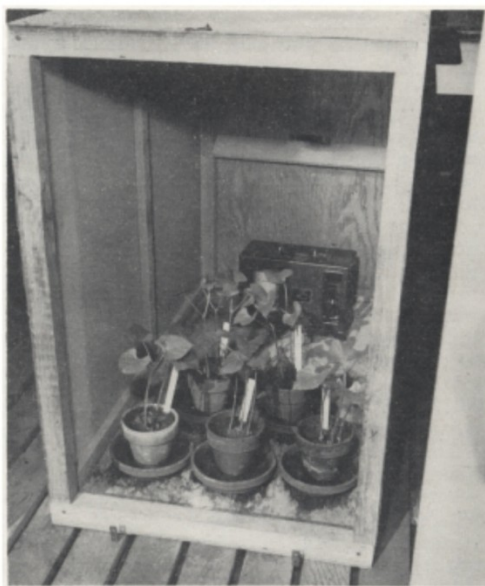


Fig. 6 - Closeup of plant box at Pasadena aerometric station



Fig. 7 - Transmissometer sending and receiving equipment at Dominguez aerometric station. Receiver is in lower left-hand corner; light source is bright spot on lower right-hand corner of roof in middle distance