clean air

Samples of four papers presented at the 49th annual meeting of the Air Pollution Control Association, May 20–24, 1956, Buffalo, are the following condensations of papers by Dr. F. W. Bowditch, Dr. August T. Rossano, Dr. Charles R. Williams, and Benjamin Linsky, president of the association.

Organized in 1907, the Air Pollution Control Association is the only national association devoted solely to air pollution control. Its membership represents widely diversified interests of industry, science, education, government, and the public.

Technical committees of the organization develop standards and reports and initiate research for industry. APCA publications keep members informed of new equipment, surveys, and research.

The *Journal of the Air Pollution Control Association* is published four times a year. Abstracts of current literature are published monthly. The yearly proceedings contain all the papers presented at the annual meeting.

Copies of individual technical papers can be obtained from Harry C. Ballman, executive secretary, Air Pollution Control Association, 4400 Fifth Avenue, Pittsburgh 13, Pa.

The Louisville Study

PHR brief

To meet the need for rubber products in World War II, the Federal Government embarked on an intensive program of synthetic rubber production. A large plant for production of chemical rubber was built in an industrially zoned area on the southwest side of Louisville, Ky. Within a short time a dense network of plants producing rubber or its components sprang up. The area appropriately became known as Rubbertown, and shortly thereafter residents of the West End, an adjacent residential area, began complaining of odors, dust, and eye irritation.

By August T. Rossano, Jr., Sc.D., director of field studies, Community Air Pollution Program, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati.

This air pollution was generally attributed to operations in Rubbertown. Citizens' attempts at court action were unsuccessful.

History of Air Pollution Control

Louisville established a smoke commission which later became the Louisville Air Pollution Control Commission. After passage of a State enabling act, air pollution control became countywide with creation of the Jefferson County Air Pollution Control District in 1952.

Studies by the University of Louisville and the Battelle Memorial Institute attempted to determine the nature and source of air pollution in the West End. Their findings shed some light on the problem, but the results were not sufficiently conclusive to effect the desired abatement.

In July 1955, within a few days after Public Law 159 authorized the Public Health Service to establish a research and technical assistance program in air pollution, the Jefferson County Air Pollution Control District requested the Service to assist with a study of pollution in the West End. The interested agencies agreed to the Service's proposal for a joint Federal, State, and local study.

The study was formally initiated in January 1956. The schedule calls for 6 months of preparation for full-scale operation, 1 year of detailed study and observation, and 3 to 6 months to evaluate and report findings. The broad objectives are to augment existing knowledge of the nature, extent, and sources of the problem as a basis for rational control.

Memorandum of Agreement

The memorandum of agreement sets forth the conditions of the study. The Air Pollution Control District of Jefferson County, the Louisville and Jefferson County Board of Health, the Kentucky Department of Health, and the Community Air Pollution Program of the Public Health Service are the cooperating agencies.

A steering committee, consisting of a representative from each agency, assists the technical director in nontechnical matters. The director serves as executive secretary of the committee and presents monthly progress reports to it. The release of nontechnical information is by unanimous approval of the committee. Final reports will be issued jointly by the cooperating agencies.

The budget is approximately $175,000 a year. The local contribution is largely in funds with which to procure additional personnel, equipment, supplies, and services. Industry has subscribed approximately half of the local funds. The Federal contribution is in technical services and equipment. Local and Federal contributions are approximately equal.

Preliminary Operations

Personnel were recruited through personal communication and advertisements in technical journals and local newspapers. Employment of the non-Federal staff is by contract between the individual and the county control district. Responsibility for recruitment and selection rests with the technical director.

His staff consists of an engineer in charge, who is responsible for administrative, statistical, engineering, chemical, and meteorological services, and 13 full-time employees, who include personnel from the local board of health, Air Pollution Control Board, and the United States Weather Bureau. In addition, private and governmental consultants participate in the study. The chemical laboratories are provided by the State health department.

Plan of Study

The first objective of the study is determination of the quality of the air in and around the West End by analyses for various particulate and gaseous pollutants and for variations and fluctuations in their concentrations. Time and space considerations include diurnal, seasonal, and long-range trends and patterns and comparisons of pollutant concentrations on the basis of their horizontal and vertical distribution.

The second major objective is a study of the relation to air quality of meteorological and micrometeorological factors.

In approaching these two objectives four basic principles were adopted as guides to air sampling and meteorological observations. They are:

A comprehensive network of fixed observation stations covering the area of interest.

Measurements on a simultaneous and continuous basis 24 hours every day including weekends and holidays.

Sampling periods as short as practicable to obtain data suitable for estimating diurnal patterns.

Thorough analysis of selected samples.

Air Sampling

The air sampling network (see chart) is laid out on concentric arcs 2 and 3½ miles from Rubbertown. Most of the stations are between 10° and 50° azimuth to provide greater coverage for the West End area and take into account the prevailing wind direction from Rubbertown. Placing stations equally distant from the source eliminates the distance factor as a variable in comparisons of station results.

Stations 1 and 3 are the upwind and downwind stations 3½ miles from Rubbertown.

Station 5 is on a line between Rubbertown and station 1 and collects data to indicate the influence of distance from the source.

Stations 4 and 6, flanking station 5, increase the chances of collecting polluted air originating in Rubbertown and provide information on the concentration gradient across the polluted air stream under prevailing wind conditions.

Station 2, also on the 3½-mile arc, collects typical samples of urban air not directly influenced by Rubbertown pollution under normal conditions.

In addition at least one fully equipped mobile station, built into a small truck, will supplement the fixed stations.

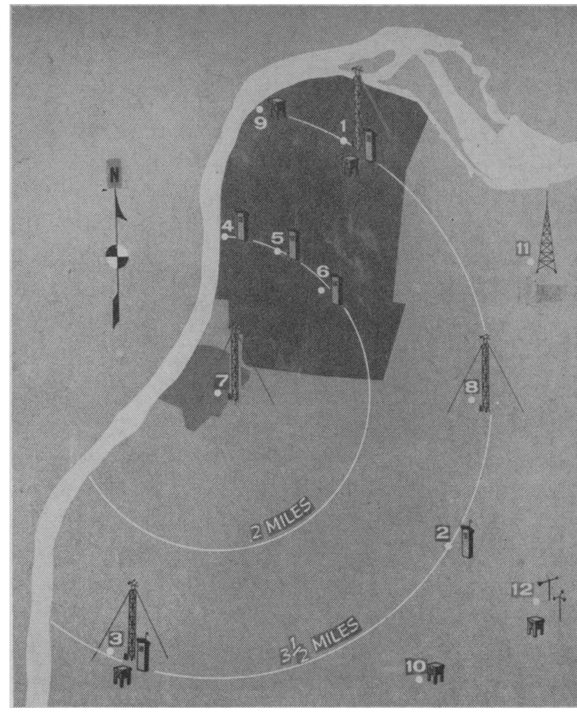
Two conventional high-volume samplers, using glass-fiber or cellulose filter paper, operate alternately at each site on an 8-hour cycle and collect 3 samples daily from each. An automatic timer controls the operation at night.

One innovation is a specially designed standard shelter. Another is having the principal axis of the high-volume sampler on a vertical rather than horizontal plane, thus minimizing any preferential effects.

Modified filter-tape samplers permit analysis of particulate matter by flame photometry. Dustfall containers and adhesive surfaces are likewise provided. Collected material is subjected to special morphological examination.

The analysis of particulates collected by the high-volume samplers consists of determination of total loading and organic and inorganic fractions. Chlorides, sulfates, and nitrates are determined by wet chemical methods. Finally, an analysis for 19 cations is made by emission spectroscopy and flame photometry.

Nonspecific gas sampling on an intermittent basis includes evacuated glass, plastic, and stainless steel containers, and freeze-out traps that use liquid oxygen or nitrogen. Collected samples are analyzed in the mass spectrometer at the National Bureau of Standards. Specific gases are sampled by conventional scrubbers, absorbers, impingers, and evacuated flasks. Continuous gas sampling is presently confined to an SO_2 recorder, to be supplemented later by other SO_2 units and other automatic sampler-analyzer equipment. Under development are continuous gas-sampling techniques utilizing compression cylinders, resin and activated carbon adsorption, and gas chromatography.



Air sampling and meteorological stations, Louisville, Ky.

Meteorological Network

Considerable effort is being devoted to operation of a comprehensive meteorological network, planned, serviced, and analyzed by Weather Bureau personnel assigned to the Sanitary Engineering Center of the Public Health Service and to Louisville. Two of the four main meteorological stations coincide with stations 1 and 3 of the sampling network.

The equipment at each station consists of a 61-foot aluminum and steel tower supporting a wind vane and anemometor wired at the tower base to continuous recorders. Each station has a recording hygrothermograph and wet-bulb and dry-bulb thermometers housed in standard shelters. Other hygrothermograph recorders are situated high on the south side and in the extreme northwest of the city.

Meteorological instruments installed on a television tower include a wind vane at 525 feet, thermohms at 50, 170, and 524 feet, and continuous recorders at the base. Tower instrumentation will permit vertical soundings of the atmosphere for measuring its stability. Wiresonde observations are made periodically with mobile meteorological equipment.

Source Inventory and Other Studies

The third phase is an inventory of air pollution sources in Rubbertown to learn the nature and rate of industrial discharges and develop a basis for regulatory measures. Preliminary studies are made of plant processes, materials, mechanical equipment, waste products, and points of emission. Detailed stack sampling operations are being carried out with the assistance of the Bureau of Mines and the Public Health Service to determine the amount and chemical composition of solid and gaseous wastes. In addition, size, shape, and surface area of emitted aerosols are determined. Tracer studies will determine the range and influence of selected point sources.

Another major phase is a survey of the nature and origin of objectionable odors in the West End. The procedure includes study of industrial operations and collection and cataloging of samples of odorous material. Staff personnel use odor reference kits during routine surveys and intense fumigations. The Sanitary Engineering Center is developing an olfactometer for quantification of odors.

A pilot study in the West End will determine the nature, extent, and relative frequency of intense local fumigations resulting in objectionable odors, excessive dust, or related discomforts. This undertaking depends largely on the cooperation of trained volunteer observers, who report monthly on their daily records of odor, dust, or irritating pollution incidents. This activity provides both a means for determining the type, location, and frequency of annoying fumigations and a way of alerting emergency crews to peak levels of pollution.

Early in the planning, a working relationship was established with the analytical statistics group of the Sanitary Engineering Center to handle the voluminous data anticipated. In addition to consultation in the design of the survey, the center assists project analysts in the reduction, analysis, and interpretation of data.

This air pollution investigation gives full cognizance to the importance of adequate public information. The public is given a clear understanding of the scope and general approach of the study, the participating organizations and staff, and the amount and variety of technical work required and is apprised of developments by successive news releases. The ultimate aim is favorable public opinion so that the findings and conclusions will be of maximum use.

Automotive Vehicle Fumes

PHR brief

The automotive exhaust problem receiving the greatest attention since the tetraethyl lead scare of the 1920's relates to the areawide smog effects recognized frequently in Los Angeles and far less frequently in other metropolitan areas. The vegetation damage, rubber cracking, eye irritation, and visibility interference noted in Los Angeles are now generally attributed to invisible hydrocarbons and oxides of nitrogen in large part from automotive exhausts.

But the greatest private attention given air pollution from automotive exhausts relates to the localized effects that are recognized daily everywhere in the civilized world. The effects are annoyance to the senses because of odor, visibility interference from the plume, sky darkening by the plume, soiling of surfaces, and toxic effects of some of the gases in confined spaces and high traffic concentrations.

Automotive exhausts include, in addition to the invisible hydrocarbons and oxides of nitrogen, a variety of gases and solid and liquid particles such as invisible carbon monoxide, invisible aldehydes, other invisible nitrogen compounds, visible carbon, visible hydrocarbons, and other complex petrochemicals, invisible water vapor, visible water droplets, and metallic compounds.

By Benjamin Linsky, M.S.E., P.E., at the time of the conference, chief smoke inspector, Detroit Bureau of Smoke Inspection and Abatement, and now, control officer, San Francisco Bay Area Air Pollution Control District.

No community willingly accepts excessive visible automotive exhausts, undoubtedly because the point of exhaust is always less than 15 feet above the road. Usually, these objections are established in local or State traffic laws.

The Detroit Program

Detroit renewed its air pollution control program in 1947 with a new ordinance, new budget, and new staff. So comprehensive was the ordinance in its coverage that as early as 1948 violation notices were being written against smoky diesel trucks by air pollution inspectors using Ringelmann and Umbrascope scales.

The undesirable effects were primarily localized rather than areawide, in the categories of sky darkening, horizontal visibility interference, soiling of surfaces, and annoyance to human senses. The administrative methods used were politely worded violation notices, hearings on maintenance practices of truckers and bus operators to improve internal reporting and correction, and court enforcement.

Though these procedures were effective, difficulties were encountered. The air pollution inspectors, driving civilian cars, in civilian clothes, found it dangerous to stop smoky vehicles on expressways. The ordinance inadequately covered the heavy blue-white emissions from oil-burning jalopies and poorly fueled 2-cycle diesel engines. The automotive smoke problem became more apparent as other smoke problems were reduced.

Industry–City Effort

The Smoke Abatement Bureau of Detroit explored better ways of control. It was decided by the several departments involved that the motor vehicle code should be the basis for effective legal control and that the police would do the job of surveillance, patrolling, and field enforcement with assistance from the bureau.

Accordingly, an ordinance amending the code was drafted, cleared with the city, and introduced by the common council. It was read twice, ordered published, and laid on the table. Then things began to happen.

Engine makers, fleet operators, and bus and truck makers and their organizations met with each other and with the smoke abatement bureau, police department, and corporation counsel. Truck fleet operators and engine salesmen explained to each other how excessive smoke could be avoided. The Automobile Manufacturers Association offered to work with the smoke abatement bureau to develop the best possible program in the hometown of the automobile industry.

The AMA's offer was accepted with a time limit for accomplishment. On its expiration a second time limit was set. Before it expired, the first portion of the project had been adopted by the council. How was this accomplished?

Urban Effects

Linsky has classified eight undesirable community effects, areawide or localized, of air pollutants on level terrain, according to the following categories:

Sky darkening.
Horizontal visibility interference.
Soiling of surfaces.
Vegetation damage.
Other property damage.
Interference with production or services.
Annoyance to human senses.
Direct damage to health.

Steps Toward Agreement

First, the automotive industry, truckers, bus fleet operators, and city representatives talked out the problem. Together they observed cars, buses, and trucks at selected intersections. This established a uniform viewpoint and "equalized the ignorance." At this point the dramatic difference in the effects when different grades of diesel fuel oil were used in identical 2-cycle engine diesel buses belonging to different fleet operators was fully recognized.

The smoke abatement bureau assigned a supervising engineer to work with the AMA committee. Periodic meetings of the committee were held with legal advisers and the author to assure parallel viewpoints.

Meanwhile, a national bus company switched to use of a higher priced grade of diesel oil.

The municipally owned system had done this several years earlier.

The first result was the AMA production of a training film to show the difference between necessary and unnecessary visible emissions.

The ordinance was rewritten by the engineers and legal specialists of the AMA and the city.

The film and its narrative were reviewed by the police department and the industry-city team. The rephrased ordinance was then discussed and agreed upon with one modification that grew out of the practical experience of the police traffic administrator.

The industry-city team then presented the film and the final ordinance to the common council. The council was told that a color-printed pocket guide on visible emissions was in preparation and that its use might justify a change in the ordinance within a year.

The ordinance became effective in April 1956 with the support of trucking, cartage, and automobile club representatives.

The industry-city team showed the film to 300 police traffic safety officers and discussed the ordinance.

The deputy superintendent of police instructed police to give warnings for 60 days and then issue violation tickets.

The police commissioner directed the police department to keep a running count of "smoking vehicle" violations.

Arrangements were made for the industry-city team to present the film and discuss the ordinance with traffic court judges and referees.

The Revised Ordinance

In the original ordinance, the responsibility for smoke violations was placed solely on the operator and did not cover the unattended vehicle with its engine running and smoking. It read:

"No motor vehicle operator shall run his motor with cutout open or make any other unnecessary sound disturbance or operate a vehicle emitting from any source an unreasonable quantity of smoke, noxious gases, or vapor."

In the new ordinance, the owner, lessor, and driver are responsible because real responsibility does not always rest with the driver. Probably he should be solely responsible only when his "heavy foot" or "lazy gear shift hand" allows a diesel engine to lug at low engine speed. The new ordinance covers moving or stationary vehicles and adds the words "excessive," "unnecessary," and "obnoxious" to "unreasonable" in the original. It reads:

"No person, firm, or corporation shall operate or cause to be operated upon any street, highway, or other public place a motor vehicle, while stationary or moving, which emits from any source any unreasonable, excessive, or unnecessary smoke, obnoxious or noxious gases, or vapor."

"Unnecessary" was inserted to cover the heavy foot of the jackrabbit driver of a diesel vehicle, the use of a grade of diesel oil other than that specified by the engine maker, worn piston rings on a gasoline engine, and similar conditions.

"Excessive" was inserted primarily to cover the situation where a diesel engine is too low powered to handle the load with the gearset provided, with a resulting low engine speed, high torque, and shortage of combustion air.

"Obnoxious" was added to acknowledge that the odor of exhaust gases may be controlled through proper equipment design. Engineering advances make this practical, especially for 2-cycle diesel engines and the larger gasoline engines.

Automotive Industry Effort

PHR brief

Industry research by automotive manufacturers over the past years has helped reduce smoke emission from new motor vehicles. In recent years their interest has been formalized in the establishment of the Vehicle Combustion Products Subcommittee of the Automobile Manufacturers Association. This group has engaged in extensive cooperative research on exhaust emissions.

By F. W. Bowditch, Ph.D., chairman of the Special Group on Exhaust Smoke of the Automobile Manufacturers Association and senior research engineer at the General Motors Technical Center, Detroit.

When Detroit sought some means of dealing with vehicles emitting unnecessary amounts of smoke, the AMA offered technical, legal, and engineering assistance. The association proposed a joint research program with the Detroit Smoke Abatement Bureau as a basis for planning satisfactory enforcement.

The subcommittee assigned the technical aspects of the study to a Special Group on Exhaust Smoke, composed of engineering representatives of the major automobile, truck, and engine manufacturers.

Unnecessary visible emissions from gasoline-powered vehicles are usually caused by excessive oil consumption resulting from worn piston rings, cylinder liners, and valve guides. Similar emissions from diesel engines generally result from overfueling that may be caused by incorrect injector adjustment or burned injector tips, restrictions in the inlet air system, substandard fuel, overloading, cold operation, or mechanical deterioration of the engine.

It was readily established that specific legal definitions, such as the length or duration of the emission, have been unsatisfactory in apprehending excessive "smokers." All vehicles do not have the same exhaust problems. Observations of exhaust lengths and duration depend on numerous factors.

Discussions with smoke abatement and police officials, supplemented by street observations, indicated the need to train enforcing officers in recognizing unsatisfactory smoke conditions.

As a first step, the special group produced a training film. Each participating company took color motion pictures of emissions from different types of vehicles against various backgrounds. Because of the difficulty in obtaining shots on city streets, running vehicles on company proving grounds simulated actual smoking conditions. Films best approaching typical conditions were combined in a preliminary film. The final professional version was based on the favorable response of city and industry officials to the preliminary film.

The next step is the development of portable guide materials for enforcement officers. Members of the special group are taking color still shots, which will be thoroughly reviewed with city representatives and user groups. A concurrent study is seeking means to reproduce the pictures in realistic permanent form. The final result will be a kit of simplified charts for identifying grades of smoke emission from automobile exhaust.

Industry lawyers have worked closely with the smoke abatement bureau and the city corporation counsel in rephrasing sections of the ordinance that will complement the training materials. Concentrated, cooperative effort should accomplish the desired result with a minimum of inconvenience to the driving public.

Fluoride Air Pollution

PHR brief

Because sufficient concentrations of fluorides in the atmosphere may damage living matter, it is inevitable that some parts of the United States are concerned about preventing losses of fluorides in manufacturing processes. Industries processing rock phosphate, fluorspar, and other ores of fluorine compounds are the main producers. Industrial consumers contribute their share to air pollution by fluorides.

It is relatively simple to identify an industrial sources of fluorides when there is a single producer in the locality, because of the readily detectable biological effects in the neighborhood. The nature of the environment in which the producer is located will determine, to a large degree, the extent of pollution.

Air pollution by fluorides does not mean that these pollutants are not controllable nor that economic loss is not preventable. Economic loss results only if there is sufficient contaminant to do damage and if there is anything to be damaged.

Increased production of fluorides by industries has accompanied increases in production of fluoride byproducts. Further, when such industries move into areas with little experience in control of air pollution, the degree of con-

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By Charles R. Williams, Ph.D., associate professor of applied industrial hygiene, Harvard School of Public Health, and director, industrial hygiene services, Liberty Mutual Insurance Co., Boston.

tamination tends to run ahead of control measures.

Phosphate Rock

Phosphate rock is used primarily for production of superphosphates (fertilizers), food and medicinal phosphates, elemental phosphorus, phosphoric acid, ferrophosphorus, and stock and poultry feed. It is also applied directly to the soil as fertilizer.

In Florida and the four western States of Idaho, Montana, Utah, and Wyoming, production has more than doubled since the war. In Tennessee, it has remained relatively stable. United States production increased from 5,399,739 long tons in 1945 to 12,031,213 in 1952.

In general, superphosphates are processed near the source of the ore, but availability and cost of power influences the location for manufacture of elemental phosphorus. Since Florida lacks sufficient power for phosphorus production, it uses most of its rock phosphate for fertilizer. Tennessee and the western States predominate in phosphorus production because of abundant power.

Rock phosphate, if it is high-grade ore, contains 2 to 3 percent fluorine. Fluorine is present in a fixed ratio to phosphorus, roughly 25 tons F in every 1,000 tons of rock processed. Wherever the rock is so processed that fluorphosphate is broken down, large quantities of fluorides can be released.

For every ton of rock processed, 40 to 60 lb. F may be released. A plant processing 1,000 tons a day can produce serious pollution if uncontrolled.

In the production of elemental phosphorus, the fluoride may be released in several processing steps. Because of the complexity of the operation, fluoride balance studies are needed to determine where losses in production actually occur. From an economic standpoint, it is wise to apply control measures only where they are really needed.

Some fluoride loss occurs in calcining or sintering the ore, depending on the temperatures used. Significant loss may occur in the electric furnaces, as fluorides escape into plant air and to the outdoor atmosphere. Other loss is in the off-gas, which in burning releases fluoride to the atmosphere. Substantial amounts of fluoride may be trapped in furnace slag and released as the slag cools.

In the production of superphosphate, the rock is treated with sulfuric acid with a resulting release of hydrogen fluoride and silicon tetrafluoride. The nature of the operation calls for its location in agricultural areas. Large tonnages of ore are handled, and, thus, large quantities of gaseous fluoride are released.

In the production of concentrated superphosphate, a new development in fertilizer manufacture, the release of fluorides is even greater. In some areas, damage has progressed from borderline to definite. This fertilizer is made by producing phosphoric acid from phosphate rock and treating additional rock with the acid.

Control efforts in each of two small areas, one in Florida and one in Tennessee, have been complicated by fluoride emissions from 10 to 12 plants producing superphosphate, phosphoric acid, animal and poultry feeds, and elemental phosphorus. With so many plants and their wide variations in manufacture, it is almost impossible to assess the blame for damage. Since the ultimate criterion is the total amount of fluoride emitted in an area, the permissible effluent from each plant must be reduced substantially.

Major Industrial Users

Fluorides used in the production of steel and aluminum are another large-scale source of pollution.

Though it is difficult to assess the proportions of fluorides released to the air, the steel industry is a major user of fluorspar, primarily as a flux in the manufacture of basic open hearth and basic electric steel. The industry used 53 percent of the fluorspar and 34 percent of the hydrofluoric acid consumed in 1952.

In the production of aluminum metal, the refined ore (alumina) is mixed with fluorides in electrolytic furnaces. The fluorides act as a flux and are released to the atmosphere as a result of decomposition under high temperature. They are carried upward by convection and, in the absence of local exhaust, are generally released through roof louvers. The amount escaping depends on the number and size of the furnaces, on the operating procedures, and on the attempts to control the effluent.

One major approach is the installation of sprays and roof monitors to trap fluorides, but this solution has been unsatisfactory.

A second method is to provide local exhaust ventilation on each furnace and to remove the fluorides by passing the exhausted air through scrubbing towers. The effectiveness of recovery depends primarily on the kind of hood, the volume of air, and the type of scrubber.

Scrubbing systems are costly because of the large volume of air exhausted from large numbers of furnaces. In some plants, 2½ to 3 million cubic feet of air a minute are exhausted and scrubbed.

Aluminum production depends primarily on availability of ore and cost of power. The plants of six producers are located in Arkansas, Alabama, Louisiana, Montana, North Carolina, New York, Oregon, Texas, and Washington.

To judge by damage claims resulting from injury to cattle and vegetation in the Pacific northwest, it is obvious that aluminum reduction plants cannot operate without controlling the fluoride effluent.

Evaluating Pollution Levels

It is almost impossible to set permissible levels for the amount of fluoride effluent. The severity of the problem depends on the amount of emission and its distribution. Distribution is affected by climate, wind direction, and terrain. Time is a factor because gaseous fluorides may be retained and built up in vegetation.

Continuous sampling of vegetation is the most satisfactory way of evaluating fluoride pollution of the air. A grid system and periodic samples of different kinds of vegetation collected during the growing season best measure the effectiveness of control.

There are few valid criteria for fluorides in vegetation because of two complex factors. One relates to the amount of fluoride that will cause plant damage; the other to the amount that will produce injury in animals which consume the vegetation.

The levels that will damage vegetation vary with species over an extreme range. Fruit trees and some types of flowers are particularly susceptible to injury at low concentrations. Levels in grasses and animal feed that will injure cattle also vary with the condition of the cattle, fluoride intake from water and other sources, and time of exposure.

Extensive fluoride damage has cost industry millions of dollars. In many instances, the cost of claims has been staggering.

To avoid further economic loss, the dissemination of fluorides must be substantially reduced. Ventilation and collection should be installed when a plant is constructed. Vegetation levels should be kept below 30 p.p.m. to prevent damage to cattle.

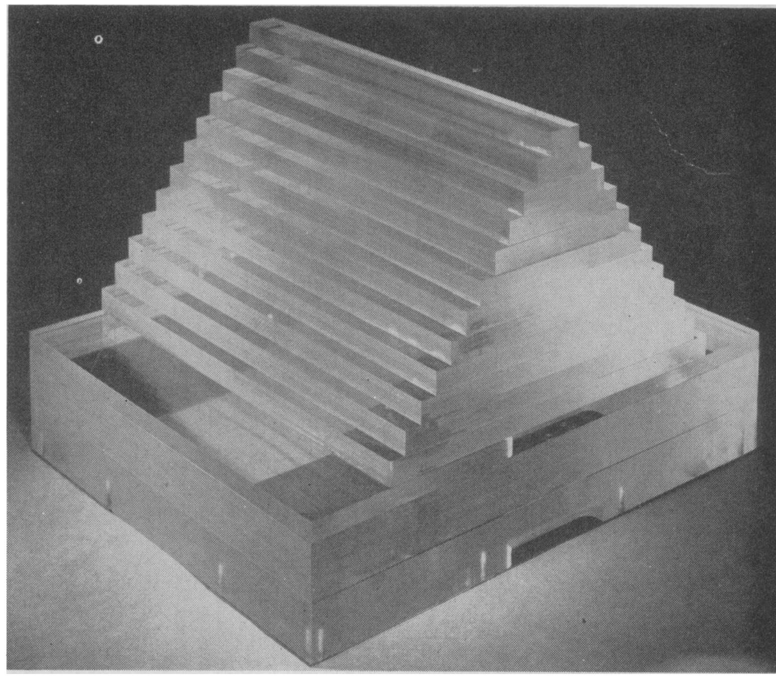
With the extensive data available, it is obvious that no plant emitting large amounts of fluoride can afford to neglect the engineering necessary to atmospheric safety. The possibility that fluoride recovery may prove profitable, also, is only an added incentive.

Fluoridation Progress

Communities with a combined population of 6 million started fluoridating their water supplies in the first 9 months of 1956. The average annual increase for the past 5 years has been 4 million.

The latest tabulation by the Public Health Service shows that fluoridated drinking water is now supplied to one-fourth of the people using public water supplies. About 1,400 cities and towns with a population of over 30 million people were using fluoridated water at the end of September.

Device for Standardizing X-ray Techniques



A large plastic stepped wedge, which facilitates the coordination of research facilities, roentgen film, equipment and technical procedures, providing a high degree of uniformity in results, is being used by the Medical Investigations Branch, National Institute of Dental Research, Public Health Service. This is part of a broad-spectrum research program which embodies extensive roentgen procedures in keeping with the need for long-range human population group studies, correlating systemic conditions with dental problems.

A salient aspect of these studies is the repeated roentgenographic evaluation of individuals and population groups over a span of years. To assure uniform and valid results, roentgen procedures have been standardized as much as possible within the realm of practicability. This has been achieved to a fair degree with the help of Robert Morrison, medical division, and Dr. Herman E. Seeman, research laboratories of the Eastman Kodak Company, Rochester, N. Y.

Dr. Seeman, long interested in this type of problem, developed the plastic stepped wedge which meets the unique requirements of the study series.

The dimensions of the wedge are such that its thinner sections require the same exposure as thin patients and the thicker portions correspond similarly to heavy patients. In use, it is radiographed several times with a variety of techniques representative of those used for the normal range in patient size. The radiographs and data are filed for later reference. At some prescribed time, say a year later, the wedge is again radiographed, using the same nominal techniques. If the radiographs match those made the year before, it may be concluded that no significant change has occurred in the equipment or materials used. If the radiographs do not match, the techniques or processing are modified until a match is obtained or film interpretations are made on the basis of the variation. In this manner, it is possible to maintain a given diagnostic film quality even with a variety of changes.

This must not be considered the final answer to highly technical or scientific activities requiring carefully standardized techniques but constitutes a tool, particularly adaptable to field use, that affords a large degree of uniformity in procedure and results. It is obvious that the stepped wedge should be composed of a substance similar to bone and soft tissue in terms of radiographic qualities. However, the more it approaches the realistic, the more complicated is its application to the problem. It is better to have a simple, practical procedure with some assurance that it will be applied than a more refined one which will be neglected because of the need for interpreting exact measurements.

The device permits a practical degree of standardization for studies, film, developer, equipment, or technique changes. It serves to check on radiographic quality, demonstrating gradual deviation that might accrue through virtue of technique, processing, or photographic deterioration. More finite comparisons are permitted through the use of a densitometer, plotting a series of curves in relation to the respective circumstances.

An epidemiological roentgen study in itself is unique, and the standardized X-ray techniques, utilized to facilitate the studies, constitute an unusual approach to clinical research. The device itself is a practical approach to a number of common problems routinely encountered in radiographic installations where volume warrants its use.