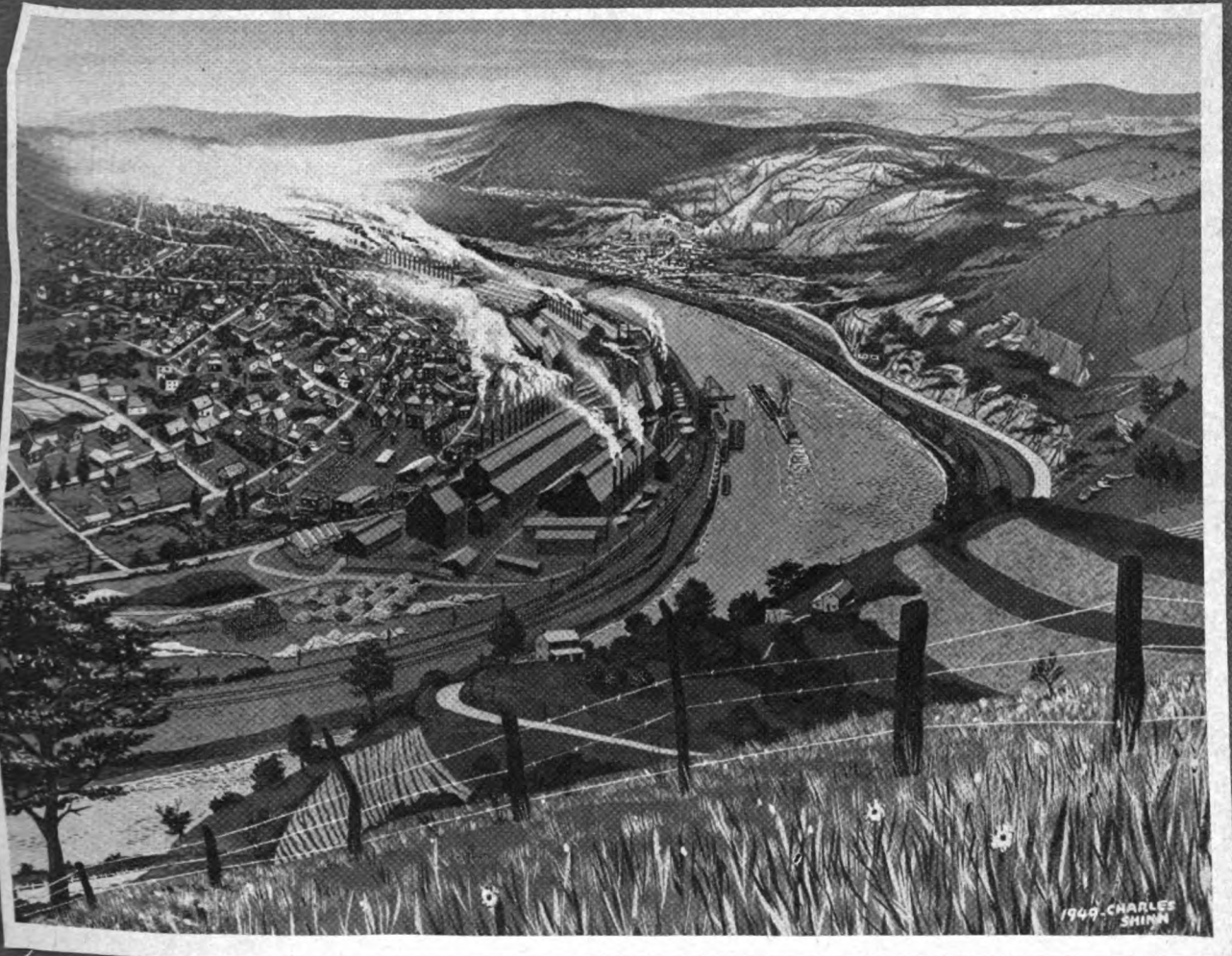


The Industrial Hygiene

newsletter

Public Health
KA
11
.B15
A375
V.9
no.11



THE DONORA STUDY

page 3

NOVEMBER 1949

INDUSTRIAL HYGIENE NEWSLETTER

Volume 9

November 1949

Number 11

Issued monthly by
FEDERAL SECURITY AGENCY
 Public Health Service
 Industrial Hygiene Division



PUBLICATIONS BOARD

Lewis J. Cralley
 L. T. Fairhall

W. M. Gafafer
 Harry Heimann

Frank Acosta Jr.
 C. D. Yaffe

MANAGING EDITOR
 Catherine W. Beauchamp

ART DIRECTOR
 Charles C. Shinn

STATE EDITORS

Arkansas—Roland E. Byrd
 California—Herbert K. Abrams
 Los Angeles County—Melvin R. Plancey
 Los Angeles City—A. M. Noyes
 Colorado—P. W. Jacoe
 Connecticut—Helen P. Cranton
 District of Columbia—Peter J. Valaer
 Florida—J. M. McDonald
 Georgia—L. M. Petrie
 Hawaii—F. A. Schramm
 Idaho—A. L. Biladeau
 Illinois—Kenneth M. Morse
 Indiana—L. W. Spolyar
 Iowa—C. L. Campbell
 Kansas—William S. Johnson
 Kentucky—Barbara H. Downey
 Louisiana—W. H. Reinhart
 Maryland—Wm. F. Reindollar
 Massachusetts—Bernice Linde
 Michigan—Bernard D. Bloomfield
 Detroit—George M. Hama
 Minnesota—G. S. Michaelsen

Missouri—L. F. Garber
 St. Louis—Alice C. Devers
 Kansas City—John Magill
 Montana—A. Wallach
 New Hampshire—F. J. Vintinner
 New Jersey—Louis F. Weller
 New York—May R. Mayers
 North Carolina—Wm. H. Richardson
 Ohio, Cleveland—Harold C. Cutter
 Oklahoma—J. P. Smouse
 Oregon—K. N. Flocke
 Pennsylvania—Philip C. Hill
 Philippines—Gregoria D. Dizon
 Rhode Island—Joseph Wurastic
 South Carolina—W. G. Crosby
 Texas—Martin C. Wukasch
 Utah—George G. Richards
 Virginia—J. C. Johnston
 Washington—Norman Scott
 West Virginia—Paul D. Halley
 Wisconsin—Edward J. Otterson

FEATURES

	Page
The Donora Study.....	3
Engineers Test CO Hazard from Parked Automobiles.....	17
Sootfall Study Made in Massachusetts.....	18
How to Carry a Thermometer Safely.....	19
Health Services in Bristol Laboratories.....	21

This publication is free to persons engaged in industrial hygiene in governmental agencies (Federal, State, or Local). For sale by Superintendent of Documents, Government Printing Office, Washington 25, D. C. Rates—\$1 a year (Domestic); \$1.25 (Foreign).

Statements made in this publication by authors who are not members of the Division of Industrial Hygiene do not necessarily represent the viewpoint of the USPHS.

Any information printed in this publication may be reprinted without permission from the USPHS. Acknowledgment would be appreciated.

Approved March 29, 1946, by Director, Bureau of the Budget, as required by Rule 42 of the Joint Committee on Printing

ANTHRAX STUDY STARTED BY USPHS

Because of a persistently high incidence of anthrax among workers handling imported wool, hair, skins and hides, the Division of Industrial Hygiene, United States Public Health Service, has initiated an anthrax study with the ultimate objective of recommending adequate control measures.

The study includes: (a) Studies on the incidence of anthrax by industry and State; (b) surveys to determine the relative extent of anthrax contamination in various types and classifications of imported animal products; (c) studies to determine the influence of residual plant contamination on the epidemiology of industrial anthrax; and (d) investigations on the development of effective, nondeleterious methods for the disinfection of imported animal products.

State industrial hygiene units and other agencies in five eastern States have been visited in order to obtain epidemiological data on industrial anthrax and to solicit cooperation in field studies. Representative industrial plants in these States were visited in order to (a) determine the type and source of materials to which infected workers were exposed; (b) determine how potentially contaminated materials are handled and processed; and (c) arrange for sampling of animal products. A limited number of samples of wool, skins and hair were collected in these plants for preliminary laboratory studies on the development of methods and procedures for the examination of such products.

The greater part of the work on the assembling of epidemiological data has already been completed and a standard case report form will be used to facilitate reporting of cases.

Cover Picture—An artist's conception of the Monongahela River valley at Donora and Webster, Pa. The original painting was made by Charles C. Shinn, art director of the *Industrial Hygiene Newsletter*.

THE DONORA STUDY



Dr. Leonard Scheele, Surgeon General, USPHS, Says:

This study is the opening move in what may develop into a major field of operation in improving the Nation's health. We have realized, during our growing impatience with the annoyance of smoke, that pollution from gases, fumes, and microscopic particles was also a factor to be reckoned with. But it was not until the tragic impact of Donora that the Nation as a whole became aware that there might be a serious danger to health from air contaminants.

Before the Donora episode there had been only one other similar incident in history. In 1930, in the Meuse Valley of Belgium, a period of intense fog in a heavy industrial area resulted in the death of 60 persons. Although several were made of those fatalities,

the Donora study is the first thorough investigation into every facet of an air-pollution problem including health effects as well as deaths.

The Donora report has completely confirmed two beliefs we held at the outset of the investigation. It has shown with great clarity how little fundamental knowledge exists regarding the possible effects of atmospheric pollution on health. Secondly, Donora has emphasized how long-range and complex is this job of overcoming the problem of air pollution—after we get the basic knowledge on its effects. This intensive piece of work by the Division of Industrial Hygiene of the Public Health Service will have its greatest value as the blueprint for our plan of proceeding to get that knowledge.

Our first step now, of course, is immediate basic research. We need to investigate, for instance, what long-range effect continued low concentrations of polluted air have on the health of individuals—not only healthy individuals, but also those with chronic diseases and the aged and children. We know nothing about the indirect effect of air pollution on persons with diseases other than those of the respiratory tract. We also need immediate research into another indisputable effect of air pollution: its ability to shut out some of the healthful rays of the sun.

When we find the answers to all of these unknowns, we can proceed to the problem of eliminating the causes. As a proof that air pollution is a health matter, as a model for future studies in air pollution, and as an important phase of our increasing efforts in the field of environmental health, this study will be invaluable.



This photograph was taken in July 1949 on a hill in Donora back of the zinc plant and across the river from the town of Webster. Donora is only one of thousands of towns, large and small, having air-pollution troubles.

The week of the smog

During the last week of October 1948 a heavy smog settled down over the area surrounding Donora, Pa. Weather men described it as a temperature inversion and anticyclonic conditions characterized by little or no air movement, prevailing over a wide area encompassing western Pennsylvania, eastern Ohio, and parts of Maryland and Virginia. This prolonged stable atmospheric condition was accompanied by fog and permitted the accumulation of atmospheric contaminants resulting in dense smog, particularly in highly industrialized areas. Smogs of short duration are not unusual and except

for discomfort due to irritation and nuisance of the dirt and poor visibility, no unusual significance is attached to such occurrences.

This particular smog encompassing the Donora area on the morning of Wednesday, October 27, it was even then of sufficient density to evoke comments by the residents. It was reported that streamers of carbon appeared to hang motionless in the air and that visibility was so poor that even natives of the area became lost.

The smog continued through Thursday, but still no more attention was attracted than that of conversational comment.

On Friday, however, a marked increase in illness began to take place in the area. By Friday evening the physicians' telephone exchange was flooded with calls for medical aid, and the doctors were making calls unceasingly to care for their patients. Many persons were sent to nearby hospitals, and the Donora Fire Department, the local chapter of the American Red Cross, and other organizations were asked to help with the many ill persons.

There was, nevertheless, no general alarm about the smog's effects even then. On Friday evening the annual Donora Halloween parade was well attended, and on Saturday afternoon a football game between Donora and

Monongahela high schools was played on the gridiron of Donora high school before a large crowd.

The first death attributable to the smog had already occurred, however, early Saturday morning—at 2 a. m., to be precise. More followed in quick succession during the day and by nightfall word of these deaths was racing through the town. By 11:30 that night 17 persons were dead. Two more were to follow on Sunday, and still another who fell ill during the smog was to die a week later on November 8.

On Sunday afternoon rain came to clear away the smog. But thousands were still ill, and the rest of the residents were still stunned by the number of deaths that had taken place during the preceding 36 hours. That night the town council held a meeting to consider action, and followed with another on Monday night. By this time emergency aid was on its way to do whatever possible for the stricken town.

On Tuesday morning a telephone call came to the Division of Industrial Hygiene of the Public Health Service in Washington, requesting that the Division take steps immediately to bring to bear on the Donora crisis its experience in combatting atmospheric pollution hazards. The following day a staff member of the Division arrived in



Bulletin boards in Donora and Webster announced the meetings called by citizens to discuss the smoke problem.

Donora to make a preliminary survey of what could be done.

This telephoned request to the Division of Industrial Hygiene was later formally repeated on behalf of the Borough Council of Donora, the Department of Health of the State of Pennsylvania, and the United Steelworkers of America, CIO.

The Division of Industrial Hygiene threw every available resource into an investigation of the Donora smog. Some 25 persons were assigned to the field team sent in to make an exhaustive study of what happened during the smog. Dr. Helmuth H. Schrenk was placed in general charge of the investigation, Dr. Harry Heimann was named to direct the medical aspects, and Mr. George Clayton was placed in charge of the field team in Donora. The complete report presents the results of 5 months' intensive field work by that team, the personnel assigned by the United States Weather Bureau, and many others who assisted.

A very brief summary of this study is presented in this issue of the *Industrial Hygiene Newsletter*.

The complete report of the Donora study by the Public Health Service is available from the Government Printing Office, Washington 25, D. C. Price per copy \$1.25.

A description of the Donora area

The Borough of Donora is located on the Monongahela River in Washington County, Pa., about 30 miles south of Pittsburgh. Other industrial towns in the nearby vicinity are Charleroi and Monessen upstream and Monongahela City a few miles downstream. Adjacent to Donora is Carroll Township, and the community of Webster is situated directly across the river from Donora, the latter two being connected by a bridge.

Donora is located on the inside of a sharp horseshoe bend in the Monongahela River. The area along the river bank is occupied by a steel and wire plant, and by a zinc plant. The steel plant extends for about 2 miles south of the Donora-Webster bridge, and the



The Donora burgess meets with the PHS team to offer Donora's complete cooperation.

zinc plant for about 1 mile north of the bridge along the river. The main business district lies adjacent to the plants and the residential area extends to the top of the hills.

At river bank level the altitude above sea level is 760 feet. Hills on the east bank of the river rise abruptly to a height of about 1,100 feet. The hills on the Donora side of the river rise more gradually to a height of 1,150 feet.

The population of the Donora area is about 14,000, approximately 13,000 living in Donora proper, and about 1,000 in Webster. The majority of the people are of Slavic descent with small Spanish and Negro minorities present. Of the 5,000 people gainfully employed, about

3,000 work at the steel and zinc plants.

The homes in Donora are almost all of wood or brick construction. Very few of the estimated 2,300 houses are over two stories high.

A greater part of the land in the area beyond the towns is comprised of small farms. A number of coal mines are located throughout the area.

Donora's industrial life is dominated by a steel and wire plant, and a zinc plant. The steel and wire plant had its beginning in 1900, when the construction was started of the blast furnaces, open hearth department, and blooming mill. In 1901, two looping rod mills, a wire-drawing department, and a wire-finishing department were constructed.



Donora residents who were associated with smog victims volunteer information to help the physicians piece together all contributing factors.

The finished products of the plant include wire, nails, barbed wire, bale ties, welding rods, stranded cable, welded concrete reinforcing, and woven fence. The zinc plant was built in 1915, and is of the horizontal-retort type. The products of the plant include zinc, cadmium, unrefined lead, and sulfuric acid.

Other heavy industries in the nearby area include two steel companies and one byproduct coke plant in Monessen, a steel and byproduct coke plant in Clairton, a glass company in Charleroi, a power company, and a railroad yard in Elrama.

Two railroads run through the Monongahela Valley, one on the Donora side of the river and the other on the opposite bank. The river traffic on this section of the river is relatively heavy.

A Public Health Service team goes to work

The Public Health Service team had two objectives: (1) To ascertain the cause of the Donora episode, and (2) to obtain information applicable to preventing future occurrences. During the study the team hoped to obtain additional information of a fundamental

nature which would be applicable to the general problem of atmospheric pollution.

Plans were made to investigate the three major factors: (1) Effects on people and animals, (2) contaminants, and (3) meteorological conditions. Since the full-scale study began sometime after the acute episode had subsided, it was necessary to try to reconstruct the picture from data collected after the occurrence of the illnesses and deaths.

THE BIOLOGICAL STUDIES

The biological studies covered the acute episode and the long-term effects of life in Donora, insofar as information could be secured. The physician, nurse, dentist, statistician, veterinarian, and sanitary and housing engineers worked together on these studies.

THE STATISTICIAN

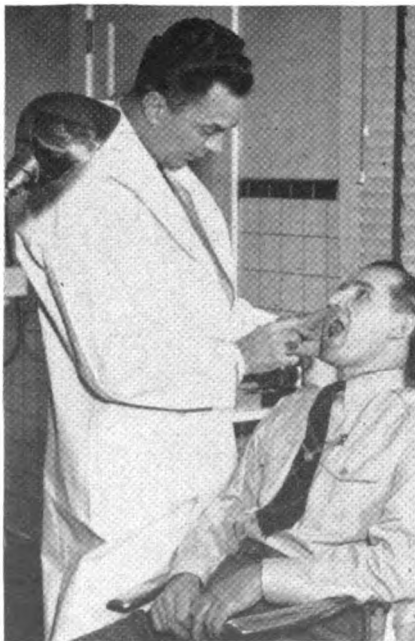
Statisticians helped to plan the main phases of the study with a view to collection of adequate and representative data with a minimum expenditure of

time and labor. They were concerned with the development of a house-to-house survey covering a population sample which would yield information relative to the effect of the smog upon the population in the Donora area. Statisticians assisted in deciding upon the location of the air-sampling stations and in the delineation of subregions which would make possible the consolidation of the community survey, air contamination and weather data.

The analysis of long-term health trends in the Donora area was primarily a statistical study of available morbidity and mortality records in that community compared with similar records in nearby communities. It was designed to show whether any causes of illness or death were more common among residents of the Donora area.

THE NURSE

Nurses of the Public Health Service played an important role in the collection of clinical and epidemiological data on the Donora smog episode. Their chief task was the conduct of a household survey that reached a total sampling of 1,308 households in Donora and nearby Webster.



A PHS dentist examined large numbers of Donora people for oral manifestations that might offer helpful evidence in solving the cause of the mysterious smog.



PHS nurses called on 1,308 families to get first-hand knowledge of how the smog affected them. Animals, too, came in for their share of attention.

Six registered nurses, with a background in industrial or public health or both, carried on the survey which was a house-to-house canvass. A complete record of all illness and deaths during the smog was obtained in an interview with the housewife or other responsible member of the household. The population of Donora is approximately 12,300 persons, living in 3,500 households. To secure a representative sample of the population, every third household was taken from a list prepared by the Donora assessor. A similar list was furnished by the town of Webster.

The data collected included a household census, with the name, sex, race, marital status and occupation of each member of the household. Special forms for recording this information and a manual describing their use were furnished each nurse.

After citizens of the area had become acquainted with the project through newspaper and radio publicity, the household visits began on December 2, 1948, and continued through March 30, 1949.

When she arrived at the home, the nurse introduced herself and told the purpose of her visit. The standard opening for the interview was the question, "Were you affected by the October smog?" This prepared the way for a discussion of previous and present health status and the other data required, which were recorded as they were obtained in the home. During the early part of the survey the nurses were charged with the responsibility of selecting from their household visits persons to be interviewed by physicians of the study team.

At the completion of the day's interviews the nurses reported to headquarters, where their filled-in forms were checked for completeness and the following items tabulated: (a) All persons affected by the smog; (b) all deaths during and after the smog; and (c) all affected animals and pets. Finally, the households for which data were completed were spotted on a large street map of the area.

THE PHYSICIAN

What was the clinical picture presented by the Donora smog incident? To answer that question it was necessary for the investigation team to make a study of individuals who had been ill



Nurses and statisticians meet in the evening to check the day's findings.

during the smog and to study the relationship of their symptoms to the factors of age, sex, race, residence, time of onset, previous health status and source and concentration of air pollutants.

Setting up headquarters in a private room in the Donora Borough Building, the physicians embarked upon a round of interviews with affected persons that ultimately reached a total of 516. These interviews, extending over a 5-week period, ran concurrently with the early part of a house-to-house survey conducted by the nurses on the team. Names of persons to be interviewed came from four sources. These were the nurses' household survey, the Donora Borough survey, a local physician's list and voluntary cases.

The technique of each interview consisted of asking the individual to talk at length about what happened to him as a result of the smog episode. The physicians then asked questions which were of a general nature so as to avoid prompting the informant.

At the conclusion of the interview, blood specimens were taken for study of their influenza antibody titer, differential white blood count, and for spectrographic analysis. At a later date chest roentgenograms of a selected series of adults were made to evaluate the part which lung disease may have played in the illness.

To round out the clinical picture the physicians sought information from every other possible source. Local doctors were interviewed concerning their findings and therapy. Visits were made to relatives and friends to obtain additional information about the affected individuals. Hospital records were reviewed and local pharmacists, policemen, and undertakers were questioned.

Further detail was added to the clinical picture by the performance of autopsies on the bodies of some of the 20 persons who had died during or shortly after the smog. As might be expected, the task of obtaining permission to conduct necropsies on the bodies of persons who had died and been buried 5 months previously presented difficulties. Such permission was granted in only two instances. In addition, one autopsy was done shortly after death by the authorization of the county coroner. These were the only ones performed on the bodies of persons who had died during or shortly after the smog. A fourth was performed on the body of a man who died 2 months after the smog and a fifth on a man who died 8 months after the episode.

THE DENTIST

Since damage to the teeth and periodontal tissues may result from atmos-

pheric pollutions of fluorides or acid aerosols, a dentist of the investigating team examined a selected group of persons from Donora and Webster, Pa.

Acid aerosols are known to cause acute symptoms of hemorrhagic gingivitis and chronic symptoms of dental erosion. Fluorides when taken in sufficiently high quantities during the tooth-development period will cause a condition known as mottled enamel. Therefore, this study was made to establish whether or not fluorides or acid aerosol contaminants were present in sufficiently high concentration to cause harmful effects on the oral structures or to produce any systemic manifestations.

For convenience the persons examined were limited to two groups—male adults and male school children. The adults were chosen from workers in one of the plants in the area and numbered 262. From the ranks of the city's students, 375 boys between the ages of 12 and 20, were examined. In addition, students from the Webster Consolidated School were also examined.

In addition to the information obtained relative to the oral picture, supplemental studies were made of the fluoride content of the drinking water used by the Donora residents and fluoride content of the bone specimens obtained from three persons and a number of animals that had died allegedly as a result of the smog.

Findings of the study covered four

main points. These were: (1) Fluoride intake during the period of tooth development by the 427 children examined was insufficient to cause mottled enamel. Fluoride exposure from sources other than water was insufficient to alter the normal inverse variation of caries attack rate and fluoride content of the communal water.

(2) The fluoride content of the urine from persons examined from Donora was within normal limits in accordance with the fluoride content of the communal water supply, which is evidence that a fluoride exposure from sources other than water was not sufficiently high to alter this direct variation.

(3) Quantitative analyses of human and animal bones for fluoride showed that amounts stored in the skeletal structures were within normal limits which fail to demonstrate an abnormal exposure by inhalation or ingestion.

(4) Acid aerosols were not in sufficient concentration to cause detectable ill effects in the oral structures of the 262 male adults and 427 school children examined.

THE VETERINARIAN

Because the effect of the smog on Donora's animal population might yield valuable clues to account for the human illnesses, the veterinary aspects of the problem received careful attention.

Directed by a trained veterinarian physician, this phase of the study had two sources of information. These were the community survey made by nurses of the study team and persons in the community who believed they had significant information. Supplemental data were collected through conferences with local veterinarians, technicians in a local dairy cattle-breeding association, county agents of the United States Department of Agriculture, poultry dealers and the operator of a slaughterhouse. In addition, four retail milk plants were visited to determine if there were any record of decline in milk production during or shortly after the smog.

Visits by the veterinarian were made to those households which had reported to the nurses of the study team that they kept or had kept pets at the time of the smog. The veterinarian also made a random sampling of farms within a 3-mile radius of one of the plants and inspected the animals for evidence of disease.

Results of the farm studies showed that there had been no unusual incidence of illness among farm animals during the smog and that there had been no significant drop in milk production during or after that period.

A less cheerful picture was revealed for the domestic animals. In this category dogs were the most susceptible to effects of the smog, with 38, or 15.5 percent, made ill. Of this number, 10



A veterinarian examines livestock for evidence of the smog affection.



To uncover all possible clues, a food sanitarian inspects public eating places.



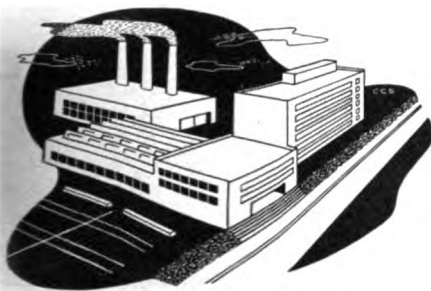
The PHS physician learns what medical supplies were sold the week of the smog.

of the animals, or 26.3 percent of those ill, died. Of 131 householders who reported that they kept cats on their premises, 12 had cats who became ill during the smog, and in three instances the cats died. Other fatalities included two canaries and two rabbits.

Conclusions reached by the study indicated that (1) the syndrome as observed among animals was of a nature which could be attributed to an irritant of the exposed mucous membranes and, more specifically, the respiratory tract; (2) among the domestic animals for which information was available the attack rate for dogs was 15.5 percent, while the fatality rate among the affected dogs was 26.3 percent; (3) the role which distemper played in the high incidence of morbidity and mortality among the dog population appeared to be considerable, but there was no way open to measure this role; (4) the economic loss due to smog effects on farm animals was minimal.

THE SANITARIAN

Since it is known that certain types of epidemic disease may have their origin in water supply, food intake and mode of sewage disposal, a study was made of these factors in the Donora area. The findings revealed, among other things, that none of these factors appeared to have contributed to the acute episode.



A summary of the findings of biological studies

1. A total of 5,910 persons, or 42.7 percent of the population, were affected by the October 1948 smog. The degree of affection ranged from slight to extremely severe. Affected persons were classified as mildly, moderately, or severely affected, dependent on the number and kind of symptoms reported, and length of disability, need for medical attention as determined by successful

or unsuccessful attempts to obtain a physician, and outcome of illness.

2. The affection was essentially an irritation of the respiratory tract and other exposed mucous membranes. Cough was a predominant single symptom during illness.

3. Classified as to degree of affection, 2,148 persons, or 15.5 percent of the total population in the area, were mildly affected, and 1,440 persons, or 10.4 percent, were severely affected.

4. Neither incidence nor severity of affection appeared to be influenced by sex, race, occupation status, length of residence in the area, or degree of physical activity at the time of the onset of affection.

5. Both incidence and severity revealed a direct relationship with increasing age. Over 60 percent of persons 65 years of age and over reported some affection from smog and almost one-half of those were in the severely affected group.

6. The population of Webster reported a higher incidence of affection of each degree than the area as a whole. Age-specific rates for Webster revealed an age pattern similar to the corresponding area pattern but at a higher level.

7. Although the onset of affection began in some instances as early as S-day (first day of severe smog), a larger number of persons became ill on day No. 2 (second day after S-day). About 40 percent of affected persons reported onset of affection between 6 p. m. and midnight of day No. 2.

8. Twenty persons died in the Donora area during or shortly after the smog of October 1948; 17 died on day No. 3.

9. Based on data available for 18 of those who died, the death rate was significantly higher in the nonwhite than in the white population, and was significantly higher for Webster than for the area as a whole.

10. The ages of persons who died ranged from 52 to 84 years with a mean of 65 years.

11. Principal past employment, duration of residence in the community, and sex played no significant part in the occurrence of fatal illnesses.

12. Only in the degree of severity and in the outcome were the fatal cases different clinically from those of the severely ill persons who did not die.

13. Preexisting disease of the cardiorespiratory system appeared as a single significant factor among the fatally ill,

although in four cases no history of any chronic disease prior to the smog was obtained.

14. In spite of the apparent association between cardiorespiratory disease and smog affection, no significant difference appeared in the occurrence of pulmonary emphysema in a group of persons who had been ill during the smog, and in a nonaffected group.

15. Epidemic influenza did not play a part in the illnesses which occurred during the smog.

16. Some relationship appeared between severity of affection and certain characteristics of housing quality.

17. In addition to the persons who became ill during the smog, domestic animals became ill and some died. These illnesses resembled those observed in the human in that there was evidence of irritation of exposed mucous membranes of the respiratory tract.

18. Studies for dental caries, dental fluorosis, urinary excretion of fluoride and fluoride content of bone revealed no evidence that there was excessive inhalation or ingestion of fluoride in the community.

19. With the exception of such episodes as that of the October 1948 smog, long-term studies of mortality records and plant morbidity records indicate that the health of the people of Donora appeared essentially no different from that of nearby towns.

20. Although bronchial asthma and heart disease appeared to be somewhat more prevalent among persons in the Donora area than in the United States as a whole, studies of mortality data, when compared with those of nearby communities, indicated that death due to disease of the heart and respiratory system was not increased in Donora.

21. Mortality records showed that crises have occurred in Donora creating occasionally higher death rates due to cardiovascular disease. These crises were probably related to atmospheric conditions.

22. Among autopsies performed there were three made on persons who died during the smog and these showed acute changes in the lungs characterized by capillary dilatation, hemorrhage, edema, purulent bronchitis, and bronchiolitis.

23. Chronic cardiovascular disease, the origin of which antedated the smog incident, was a prominent feature in the autopsies.

THE ENVIRONMENTAL STUDIES

A thorough knowledge of the sources of pollutants is essential in a study of atmospheric pollution so all possible factors which may have contributed to the October smog were carefully studied. To determine the sources of contaminants in Donora, the engineers sampled the air in and around the plants, and in many areas of the town, near the railroads, and up and down the river. Consideration was also given to sources of pollutants other than those in the immediate vicinity, such as slag heaps, mines, and gob piles. It was necessary to learn the kinds of contaminants, the amounts produced and their distribution in the general atmosphere.

The largest industries in Donora are the zinc plant and the steel plant, which together employ about 3,000 people. In these two plants, the engineers spent many hours of sampling and testing. Information was also obtained on raw materials, production methods and finished products from other industries in the Monongahela Valley.

THE ENGINEER

In an effort to measure the degree of atmospheric pollution from the zinc and steel plants, the procedure used was, in some respects, quite different from the usual methods employed by the industrial hygienist. Many of the conventional methods of air sampling would not suffice under the wide variations of conditions encountered. In most instances, each stack sampled was handled as a separate problem and equipment or apparatus was adapted for the particular stack under study.

The two plants were divided for sampling purposes as follows: *Zinc plant*—roasters, sintering plant, zinc spelters, waste heat boilers, Waelz plant, dross plant, sulfuric acid plant and cadmium plant; *steel plant*—blast furnaces, boilers and sintering plant, open hearth furnaces, soaking pits, desurfacer and boilers, and wire mill.

The atmospheric contaminants to be studied were deduced from the raw

materials used and the processes to which the pertinent materials were subjected. Raw materials and intermediate products were analyzed by the spectrographic method for the following toxic elements:

Antimony	Phosphorus
Arsenic	Selenium
Cadmium	Sulfur
Germanium	Tellurium
Indium	Thallium
Lead	Zinc

From this information, it was decided to sample for the following constituents:

Total particulate matter	Fluoride
Lead	Arsenic
Cadmium	Sulfur dioxide
Zinc	Total sulfur
Iron	Carbon dioxide
Chloride	Carbon monoxide
	Oxygen

In addition to the above, samples for the following contaminants were collected in those stacks where their presence was indicated:

Oxides of nitrogen	Stibine
Acid gases	Manganese
Hydrogen	Iron carbonyl
Arsine	

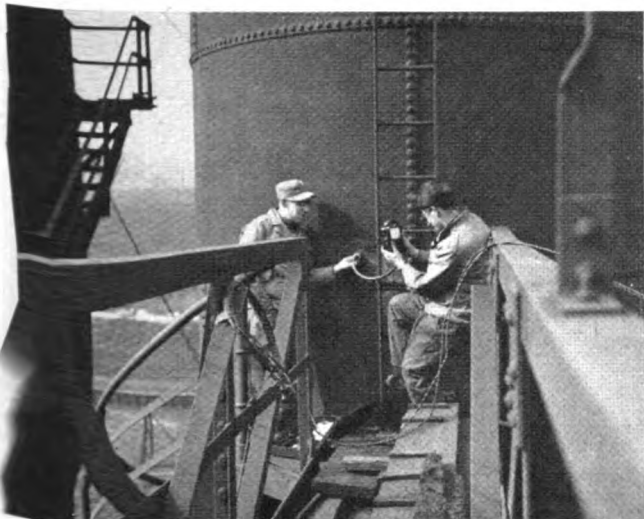
Qualitative tests for hydrogen sulfide and cyanide were made in stacks at the cadmium plant.

Much thought was given to the selection of air-sampling stations. Factors considered were major sources of contamination, altitude, density of population, location with reference to contaminants coming from outside sources and relationship of air-sampling stations to the temporary United States Weather Bureau stations established for the study. Twelve air-sampling stations were selected since this seemed an optimum number from the standpoint of the factors to be considered, and the personnel and equipment available. Of these, five were located across the valley on a line through the zinc plant, each one being associated with a major weather bureau station.

The low concentrations of airborne contaminants and the wide variety of weather conditions found while taking samples outdoors necessitated the development of a specialized technique. During the period that samples were taken, air temperatures varied from 15° to 81° F. Snow, sleet, and rain were frequent at the beginning of the study



The use of a mobile laboratory, lent the PHS by the Utah State Health Department, facilitated the engineers' research. The picture shows a Thomas Recorder.



Two PHS engineers take a static pressure reading of a stack at the steel plant for the purpose of calculating the air flow.



An engineer takes an electrostatic precipitator sample in a stack of the steel mill.

and wind speed varied from zero to 30 miles per hour.

Two automobiles were equipped as mobile laboratories. Gasoline-driven electric generators, capable of generating 500 watts at 110 volts alternating current, were used as a power source; the generators were located in the trunks of the cars. This equipment provided sufficient power to operate simultaneously the electrostatic precipitator, the standard impinger pump and a light source for the analytical work. The rear seat of the car was removed and the space converted into a miniature laboratory. This equipment was used for sampling regularly at the 12 selected stations.

THE CHEMIST

The analysis of samples was made in the Division laboratories at Bethesda, Md. The samples collected in Donora and sent to the laboratory required 4,000 individual determinations. A wide variety of chemical methods of analysis was required to make all of the necessary determinations. When more than one constituent was determined on a single sample, separate aliquots were taken for each such determination. The total number of samples taken at the 12 air sampling stations was as follows: Sulfur dioxide, 250; total sulfur, 267; total particulate matter, including lead, cadmium and zinc, 205; chloride, 247; and fluoride, 249. The routine sampling time for these samples was one to two hours.

The laboratory set up in the Municipi-

pal Building served principally as a preparation center for the engineers and chemists. The two automobiles, converted into mobile laboratories, were used at the air sampling stations and for other outdoor work.

Atmospheric pollution from domestic sources

To evaluate the role of domestic smoke in relation to atmospheric pollution in the Donora area, a study was made of the heating equipment of the homes and business buildings. In the Donora area there are approximately 2,300 buildings exclusive of heavy industry. Most of the buildings are relatively small and are heated by simple types of furnaces. Mine-run coal is used extensively for heating in Donora, and gas and electricity for cooking.

To decrease atmospheric pollution from this source, consideration should be given to smoke-prevention measures. For example: (1) Local building ordinances might include provisions which would assure less smoke from the heating units of all the new buildings; and (2) owners of buildings from which there is frequent dense smoke should be given the benefit of an educational program on proper firing methods.

The Monongahela River is one of the world's most important waterways in terms of tonnage of freight transported on it. Consequently, boats were considered as contributors to the atmospheric pollution and a study was made of fuel consumption of boats during

passage through the Donora area. Two-thirds of the boats are coal-burning steamboats, and one-third are Diesel powered.

During the period of the Donora incident, there was an average of 22 boats per day as compared to an average of 32 boats per day for the rest of October. This decrease probably was due to the smog, since conversations with steamboat men revealed that all but the radar-equipped boats had great difficulty in navigating the Donora-Webster bend in the river during that period.

A study was made on the air pollution from trains that pass through Donora daily, as well as the switch engines which work there continuously. Air pollution from automobiles and trucks was also estimated.

Sanitary engineers conducted an evaluation of housing to provide information on the descriptive characteristics, quality and important deficiencies of dwellings in the Donora area, in an attempt to ascertain possible relationships between housing conditions, and illnesses and deaths occurring at the time of the smog. Weather-tightness and general state of repair of dwellings were considered of special importance. Included in the 241 dwellings inspected were 20 homes which served as residences of persons deceased during the smog. The engineers found that housing conditions in the Donora area compared reasonably well with conditions in other urban communities of similar size in the United States.

THE METEOROLOGICAL STUDIES



A PHS engineer holding a cup anemometer, taking wind velocity measurements.

Realizing the critical importance of weather in producing smog conditions, the Public Health Service requested the United States Weather Bureau to study the micrometeorology of the Donora area. The purpose of the meteorological study was (1) to investigate the physical processes which cause rapid dilution of the industrial airborne waste products or their retention in dangerous concentrations in the Monongahela River Valley at Donora; (2) to determine the general weather type favorable to retention of airborne contaminants in the Donora area in order that the onset of these periods may be forecast; and (3) to correlate the meteorological findings and the air sampling analyses.

Based on a detailed analysis of the data obtained on atmospheric pollutants and meteorological conditions, the following program to prevent recurrence of affections from unusual smog conditions is presented:

1. An alert shall be issued when an anticyclone of an extent similar to the one of October 25-30, 1948, approaches the eastern United States, is slowly moving, and shows indications of stagnation.

2. A warning to take preventive measures such as outlined below, shall be issued when the following conditions occur simultaneously for 1 day and show no indication for improvement.

a. An anticyclonic model as in (1) moves to the eastern United States;

b. Valley stability factor as determined by valley top and bottom temper-

atures and defined by $\Delta\Theta/1,000$ feet becomes and remains greater than 5.5°F .;

c. Valley winds less than 5 miles per hour and upper air winds less than 10 miles per hour;

d. Moderate to dense fog in the valley continues some time past noon.

The industries in the Donora area and adjacent communities should curtail production during a stable-stagnant valley air condition as outlined above. The extent, to which production should be curtailed is dependent on the extent to which measures are instituted to control atmospheric pollutant; the greater the control attained, the less the curtailment that will be needed.

A committee of interested persons should be formed to carry out this recommendation and establish a program of action.

A summary of the findings of atmospheric studies

1. The zinc spelters are major contributors to the atmospheric pollution load with special reference to particulate matter and carbon monoxide.

2. The amount of contaminants discharged from the zinc spelters during the "test period" was approximately twice that which occurred during the "curtailed production" period.

3. The zinc plant waste heat boiler stacks are major contributors of atmospheric pollution with special reference to particulate matter and sulfur dioxide.



In a makeshift laboratory and study set up in the Municipal Building, the engineers and chemists delve into many scientific books for information that will contribute to the solution of air pollution questions.

4. The zinc plant sintering operation is a major contributor to the atmospheric pollution load with particular reference to sulfur dioxide.

5. The acid plant is the main source of discharge of oxides of nitrogen into the atmosphere.

6. The contribution of the zinc ore roasters, Waelz plant, zinc dross and cadmium plants to the general atmospheric pollution load of the valley is not considered significant.

7. The blast furnace department, including the sinter plant, is a major contributor to the general atmospheric pollution load with special reference to particulate matter and carbon monoxide.

8. The open hearth furnace stacks are significant contributors of particulate matter to the atmospheric pollution load.

9. The blooming mill and wire mill, including nail galvanizing, are not considered important contributors to the general atmospheric pollution of the valley.

10. The blooming mill and steel mill boiler stacks are major sources of sulfur dioxide.

11. Domestic heating systems and local steam locomotives are significant contributors to the general atmospheric pollution of the valley with special reference to carbon monoxide, sulfur dioxide, and particulate matter.

12. The distribution of concentrations in the general atmosphere of sulfur dioxide, total particulate matter, zinc, lead, and cadmium showed variations which may be roughly correlated with sources of contaminants.

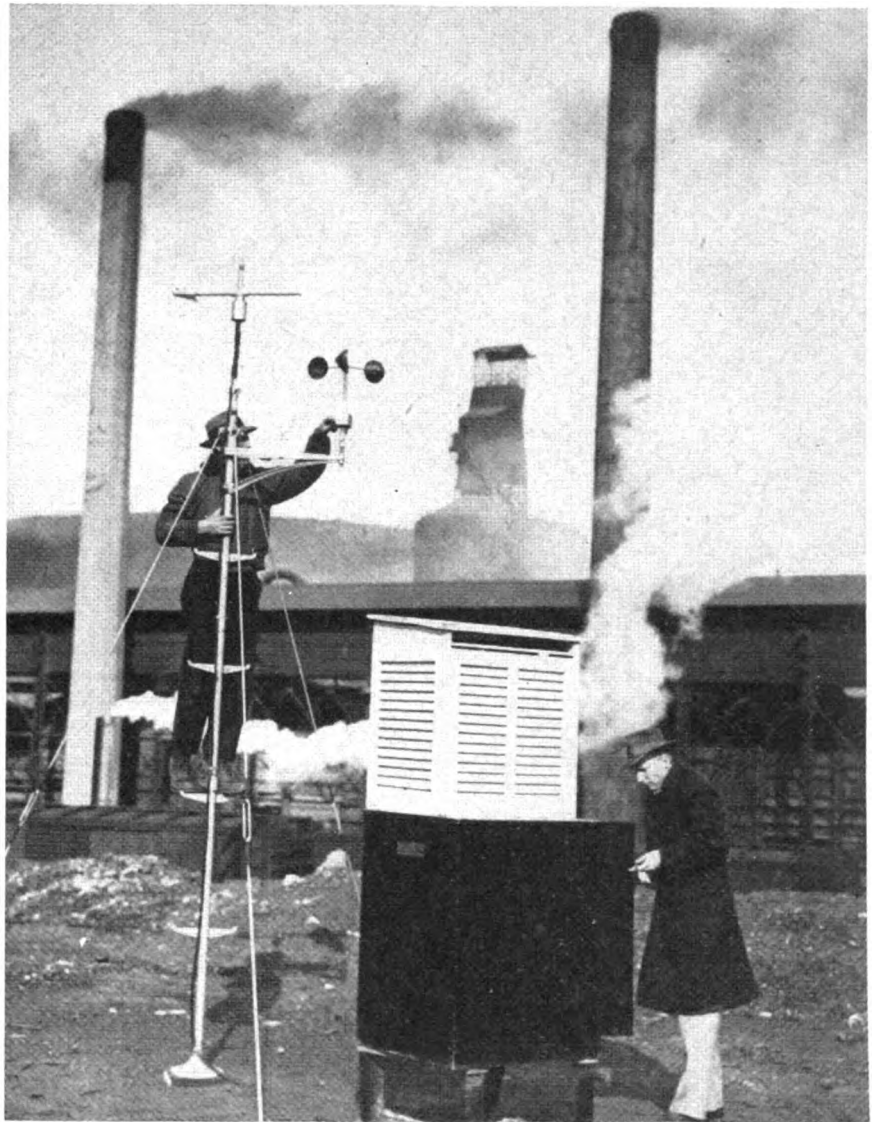
13. Sulfur dioxide showed the most even distribution, indicating the wide distribution of sources of sulfur dioxide.

14. Total particulate matter showed even distribution with the exception of the areas closest to the zinc plant, which were higher than the others.

15. Concentrations of zinc, lead, and cadmium were highest in the vicinity of the zinc plant.

16. Air-sampling station No. 4 (representing an area in Webster directly across the river from the zinc smelters) showed higher concentrations for all contaminants than the other stations.

17. Concentrations of various contaminants when considered by time of the day indicated that the greater air stability at night and fluctuation in



The United States Weather Bureau cooperated on the study to determine wind velocity and direction.

plant operations influenced concentrations found.

18. Low concentrations of chloride, fluoride, and oxides of nitrogen were found in the general atmosphere.

19. Samples of particulate matter obtained from home filters in Donora and a home filter in Monessen showed no significant difference in the composition of the samples with the exception of sulfur. A higher concentration of sulfur was found in the particulate matter collected during the smog period than in samples obtained from filters in operation after the smog.

20. A combination of a high degree of atmospheric stability and stagnation was found to be necessary and sufficient to cause an accumulation of airborne pollutants in the valley at Donora.

21. Local micro-turbulences within the valley at night appeared to distribute the particulate matter evenly throughout the valley as determined by morning visual observations.

22. Wind speeds during windy periods within the valley were lower than those at hill top with the decrease being greater for cross-valley flow than for parallel-to-valley flow.

23. Similarity of average concentrations at all stations for various wind directions for sulfur dioxide, total sulfur, and total particulate matter showed multiple sources of these contaminants while definite high concentrations of zinc and cadmium were found only downwind from the zinc plant (except for variable, low speed wind periods), indicating a single source for these elements.

24. In general, a greater percentage of higher concentrations was found in the wind speed range of 0-3 miles per hour and the next highest in the 10-22 miles per hour range; lowest values being found in the 4-9 miles per hour range.

25. The concentration of contaminants showed no significant relationship to relative humidity or temperature.

26. A definite relationship was found to exist between the concentration of contaminants and atmospheric stability.

What the evidence indicates

The data presented in the biological studies indicate that the clinical syndrome was characterized essentially by irritation of the respiratory tract which was especially severe in elderly persons and those with known chronic cardio-respiratory disease. The data indicate, furthermore, that this condition was not due to an accidental occurrence but rather resulted from the accumulation of atmospheric pollutants during an unusually intense and prolonged stable air condition. While the weather alone cannot be blamed for the episode, the fact that it played a significant role cannot be denied.

Following analysis and study of all available data, it does not appear probable from the evidence obtained in the investigation that any one substance, such as sulfur dioxide, *by itself* was capable of producing the syndrome observed. However, a combination of two or more of these substances may have contributed to that syndrome.

It is well known that one substance may influence the physiologic action of another, and it is possible that there was a summation of the action of the individual irritant constituents which

produced an effect greater than would be anticipated for any one of the individual constituents. Moreover, there is evidence which indicated that the effect of irritant gases can be enhanced by adsorption on particulate matter. In addition to enhanced action, gases may be carried deeper into the respiratory tract than they would normally be carried in the absence of such particulate matter. This action then would carry the noxious substance into the lower levels of the respiratory system where the more damaging effects would be produced.

It is known that irritant gases exert their effect in the respiratory tract depending largely on their solubilities; that is, compounds which are highly soluble exert their effect in the upper respiratory tract while compounds which are less soluble exert their primary action in the deeper parts of the lung. A gas, therefore, such as sulfur dioxide which would normally exert its primary action in the upper part of the respiratory tract might produce more serious effects if it were transported to the deeper parts of the lungs, as for example, by particulate matter. Both solid particulate matter and liquid particulate matter (fog) were present in the atmosphere in large quantities during the October 1948 episode.

Another influencing factor to be considered is carbon dioxide, which was a significant contributor to the over-all atmospheric pollution load. Because carbon dioxide is a respiratory stimulant, it may have contributed to the effects produced by other contaminants by virtue of the increase in depth of respiration which it induces.

SUMMARY

It seems reasonable to state, on the basis of the previous discussion, that while no *single* substance was responsible for the October 1948 episode the syndrome could have been produced by a combination, or summation of the action, of two or more of the contaminants. Sulfur dioxide and its oxidation products, together with particulate matter are considered significant contaminants. However, the significance of the other irritants as important adjuvants to the biological effects cannot be finally estimated on the basis of present knowledge.

It is important to emphasize that in-

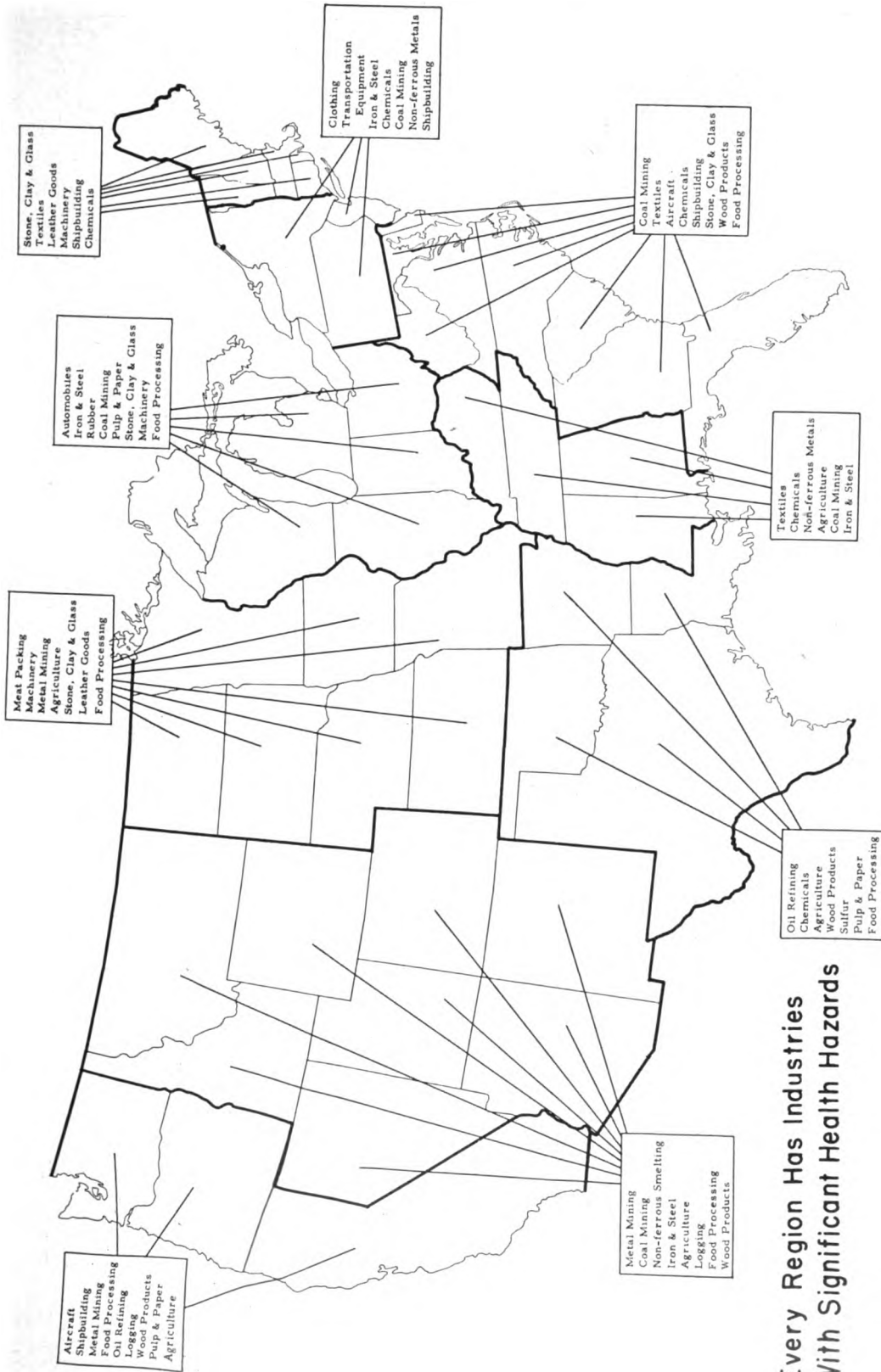
formation available on the toxicological effects of mixed irritant gases is meager and that data on possible enhanced action due to adsorption of gases on particulate matter is limited. Further, available toxicological information pertains mainly to adults in relatively good health. Hence, the lack of fundamental data on the physiologic effects of a mixture of gases and particulate matter over a period of time is a severe handicap in evaluating the effects of atmospheric pollutants on persons of all ages and in various stages of health.

What can be done to prevent another "Donora"?

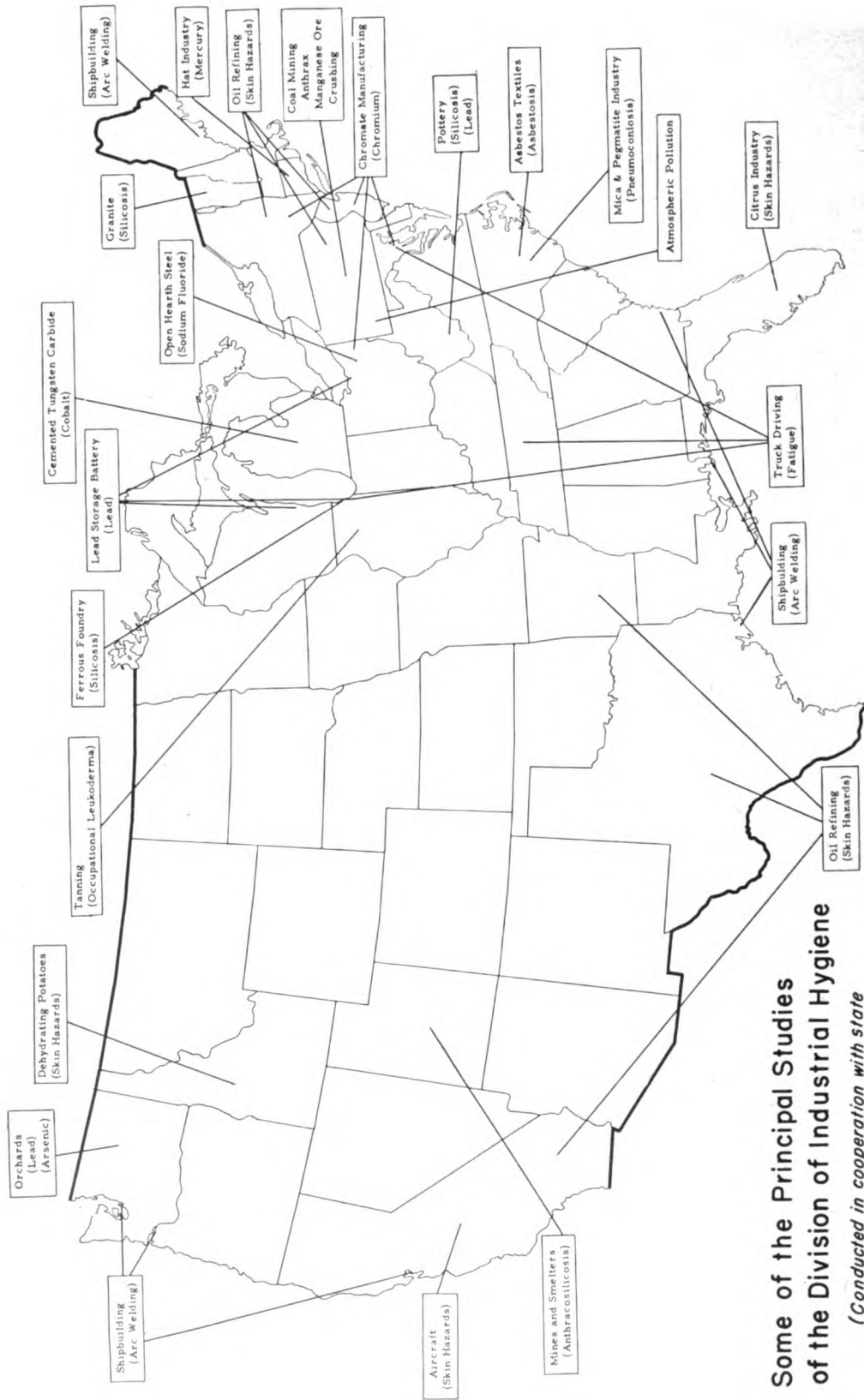
The following recommendations were made by the Division of Industrial Hygiene:

1. Reduce the gaseous contaminants, especially sulfur dioxide and particulate matter, discharged from the sinter plant Cottrell stacks.
2. Reduce the particulate matter and carbon monoxide from the zinc spelters.
3. Reduce the particulate matter and sulfur dioxide discharged from the waste heat boiler stacks.
4. Reduce the discharge of oxides of nitrogen and acid mists from Gay-Lussac stacks.
5. Reduce the amount of particulate matter and carbon monoxide from the waste blast furnace gas.
6. Reduce the amount of carbon monoxide discharged from the stove and sinter stacks.
7. Reduce the amount of particulate matter discharged from the sinter plant and open-hearth stacks.
8. Reduce the amount of particulate matter discharged from the waste heat and blast furnace boilers and the sulfur dioxide from the waste heat, steel and wire plant boilers.
9. Reduce the amount of particulate matter discharged from domestic heating systems, steam locomotives and steamboats.
10. Establish a program of weather forecasts to alert the community of impending adverse weather conditions so that adequate measures can be taken to protect the populace.





Every Region Has Industries
With Significant Health Hazards



**Some of the Principal Studies
of the Division of Industrial Hygiene**
*(Conducted in cooperation with state
industrial hygiene agencies)*

STATE AND LOCAL NEWS



FLORIDA

Atmospheric Pollution.—The number of complaints about atmospheric pollution has increased considerably this past year. Among them a complaint which was connected with the emission of fumes from a plant producing elemental phosphorus proved to be most profitable in that it resulted in a prolonged study of working conditions within the plant, as well as an investigation of the atmospheric pollution outside the plant. As a result, the division personnel acquired considerable knowledge about this potentially hazardous type of industry while at the same time they were able to suggest changes which resulted in elimination of the complaint.

INDIANA

Personnel.—Robert McGlasson, chemical engineer, joined the staff July 1. Mr. McGlasson is a recent graduate of Purdue University.

LOS ANGELES, CALIF.

Ceramic Plant.—A firm producing artware occupied a corrugated metal structure originally designed for grain milling. Neither engineering control of health hazards nor efficient production was attainable in this outmoded building without major expenditure.

Fortunately, a quite modern plant was recently vacated about 100 yards away. The ceramic plant leased the building and, at the suggestion of the State Division of Industrial Safety, requested engineering consultation from this division so that production lay-out could be most effectively synchronized with the necessary dust control equipment.

On the basis of several recommendations made by the division, equipment will be placed otherwise than was originally planned to facilitate dust control. Management also requested a thorough study of dust concentrations when all equipment is in place and operating.

Too seldom is the above experience encountered in practice. Obviously planning prevention of health hazards before process lay-out is categorically

fixed, permits the best type of engineering controls at a minimum expenditure.

Blasting in Tunnel.—Tunneling operations for the Franklin Canyon sewer project were slowed down when hard veins of rock were encountered. No appreciable headway could be made with the pneumatic drills, so the private contractor decided on blasting. Since ventilation had to be carried about 150 feet into one shaft of the horizontal tunnel, it was uncertain how soon it would be safe for workers to reenter the shaft, after blasting.

At the request of the safety engineer for the Board of Public Works a series of air tests were made, and it was found that measurable quantities of carbon monoxide and oxides of nitrogen persisted at the face of the cut, 40 minutes after the charge had been set off.

On the basis of our findings, several improvements in the arrangement and operation of ventilating equipment were made, in order to provide a safe environment for the tunnel workers.

Mental Hygiene.—Employees of one of the large insurance companies, requested of their newly established medical department, assistance in problems of mental health. The medical director, in turn, requested through our nurse consultant, help in providing the service for employees in his firm. Accordingly a meeting was arranged in which the company's medical director, the health department psychiatric consultant, and members of this division will try to create a mental hygiene program. By means of lectures, individual counseling, and available motion pictures it is hoped that sufficient benefit will be derived by the employees to make this a model mental hygiene program for other industries in this city.

MICHIGAN

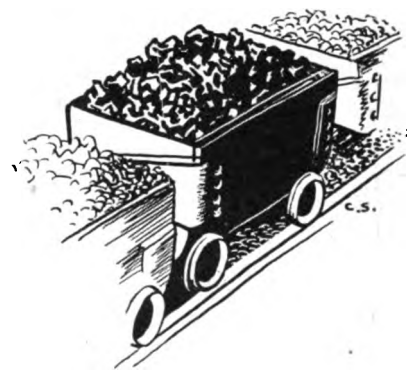
Personnel.—As previously announced in the *Newsletter*, Dr. Kenneth E. Markuson has resigned his position as director of the Division of Industrial Health and has joined the staff of the Connecticut Department of Health.

The Division of Industrial Health,

Michigan Department of Health, recently made the following additions to its staff: Dr. John M. Lynch, industrial health physician; Charles Holland, chemist; Henry Thomas, ventilation draftsman; Irving Davis, engineer; Russel Scovill, engineer; Dale Burgess, engineer; and James C. Barrett, engineer. The Division also announces the resignation of one of its industrial nursing consultants, Miss Winifred Devlin, R. N., who is joining the Commissioned Corps of the United States Public Health Service. Her duties will be that of industrial nursing consultant in the Division of Industrial Hygiene.

Bernard Bloomfield has recently returned from Harvard University where he completed requirements for an M. S. degree in industrial hygiene.

Administration.—The Division has recently started an industrial health orientation course for the new members of the staff. The first class was held on July 25, 1949, and will be held every Monday for 18 weeks thereafter. The subject matter includes toxicology, industrial ventilation, microscopy, radioactivity and radioactivity measurement, sampling procedures, atmospheric pollution, etc.



MINNESOTA

Nurses.—In May, 70 industrial nurses from Minnesota, surrounding States and Canada, met for 2½ days for the Ninth Annual Continuation Course in Industrial Nursing, sponsored by the Medical School of the University of Minnesota and the Division of Industrial Health of

the State Health Department. Leaders in industrial medicine, industrial nursing and labor spoke on a wide variety of subjects of interest to industrial nurses. A feature of the course was a dinner meeting to which the nurses invited their medical directors. Dr. W. J. Fulton of the General Motors Corporation, was the speaker at the dinner meeting.

Carbon Monoxide.—Recently, the Division of Industrial Health was called on to determine the cause of illness among a group of rock drillers preparing footings for a large building. The symptoms of the men were suggestive of carbon monoxide, although there was no obvious source of carbon monoxide in the excavations. Tests for oxygen, combustible gases and carbon monoxide were made in a number of the excavations. The only indication out of order was a trace of carbon monoxide in one excavation. The compressed air feeding the pneumatic tools used at this location was checked and found to contain about 200 parts per million of carbon monoxide. Several bad leaks were found in the exhaust system of the air compressor serving this line, and the exhaust stack terminated so close to the air intake of the compressor that carbon monoxide was being drawn in with the air. This compressor was taken out of use until repairs were completed on the exhaust system, and the exhaust stack extended away from the air intake.

Conference.—At a recent State-wide meeting planning the forthcoming Governor's Industrial Safety Conference, a Committee on Industrial Health was added to the existing committees. The acting director of the Division of Industrial Health was selected as secretary of the Engineering Committee of the Conference, as well as a member of the Industrial Health Committee. The Governor's Conference on Industrial Safety is patterned after the President's Conference which was held last Spring in Washington.

Dry Cleaning.—The Division of Industrial Health has completed a study of the solvent hazards in all of the dry cleaning establishments in the State using halogenated hydrocarbon solvents. Samples were taken in 126 plants. Approximately 10 percent of the plants were found to have excessive solvent concentrations in the air. A recheck of these plants showed that almost all of

the plants had carried out the recommendations offered, and either eliminated the hazard completely, or greatly reduced the hazard. It was interesting to learn during this study that almost all the people who had used carbon tetrachloride for some time, complained of illness at some time or another due to either chronic or accidental acute exposures to the solvent.

NEW JERSEY

Personnel.—Marie A. Sena, M. D., M. P. H., has been appointed acting chief of the Section on Adult and Industrial Health by Geoffrey W. Esty, M. D., Director of the Bureau of Constructive Health. Dr. Sena has been an industrial hygiene physician in the New Jersey Department of Health since 1944.

OREGON

Legislation.—Under the provisions of recent legislation, the Oregon State Board of Health is now preparing to certify fumigation chambers which will use hydrogen cyanide for the fumigation of bedding and upholstered items and materials. The Bedding and Upholstery Section of the Oregon State Board of Health is responsible for the adequacy of the fumigation and the Industrial Hygiene Section will be responsible for safeguarding the health of the operators and the public. The use of hydrogen cyanide for chamber fumigation of bedding and upholstered articles has not previously been advocated in Oregon.

Personnel.—Mr. Frank P. Terraglio has been appointed laboratory assistant in the Industrial Hygiene Section, Oregon State Board of Health. Mr. Terraglio is a native of Portland and a member of the 1949 class of the University of Portland, majoring in chemistry.

PENNSYLVANIA

Parathion.—In line with the warnings concerning parathion that have been issued by various agencies and manufacturers, the Pennsylvania Bureau of Industrial Hygiene has prepared a one-page bulletin on the subject. This is being distributed to all known mixers and processors of the substance in the State and is also available to users of insecticides containing parathion. In addition, a news release has been issued by the Pennsylvania Department of

Health calling attention to the toxic properties of parathion and insecticides containing it.

ST. LOUIS, MO.

Personnel.—Robert M. Brown, formerly chief of the Industrial Hygiene Section, Health Division, has become associated with Yale University as instructor in public health (occupational medicine) at the Institute of Occupational Medicine and Hygiene. Mr. Brown had been in immediate charge of the industrial hygiene activities of the health division since January 1942. Under his guidance and supervision the services of his section increased rapidly and his staff grew in number from three engineers to four engineers, a physician, a nurse, and three sanitarians.

Dr. B. W. Lewis was named acting chief of the section and Mr. J. E. Molos was promoted to chief engineer.

SOUTH CAROLINA

O. D. Legislation.—The last session of the General Assembly of South Carolina passed an amendment to the Workmen's Compensation law. This amendment provides compensation for occupational diseases. The Industrial Commission is charged with responsibility for administering the act which becomes effective December 15, 1949.

TEXAS

Parathion.—A bulletin concerning the precautions in handling and use of highly toxic insecticides, especially parathion, has been issued by the Industrial Hygiene Section. The recommendations are based on those furnished by the United States Public Health Service.

Personnel.—Two engineers were added to the industrial hygiene staff during the month, Alton H. Diserens and Walter G. Martin. The latter will be assigned to the Tyler district office, and Mr. Diserens will continue in the central office for a time and will later be assigned to the coastal area.

WASHINGTON

Administration.—The State of Washington Health Department budgets were drastically curtailed coincident with the last session of the State legislature and change of administration. In keeping with these and with future

budget cuts by executive order it has been necessary to make adjustments in the Industrial and Adult Hygiene staff personnel and activities. Changes in the industrial hygiene services are planned with a view to maximum continuation of services but with greater emphasis on indirect phases.

Medical School.—It is the policy of the University of Washington Medical School that its students shall receive some instruction in public health matters. The State health department cooperates in this program by providing some instruction in various phases of public health. As part of this program the Industrial and Adult Hygiene Section is assisting by giving brief indoctrination in industrial hygiene to a small group of senior medical students each month. The first of these groups recently had a seminar with members of the staff of this Section and a second group will have had similar instruction by the time this is printed.

Personnel.—Dr. Lloyd M. Farner, chief of the Industrial and Adult Hygiene Section of the Division of Preventive Medical Services, Washington Department of Health, resigned as of July 1 to accept an appointment as medical administrative consultant to the State Board for Vocational Education. Dr. Farner will serve as liaison officer between the medical profession and the State vocational rehabilitation program and will coordinate the board's work with other State agencies. Until a full-time medical director is employed to take Dr. Farner's place, Dr. J. L. Jones, chief of the Division of Preventive Medical Services, will serve as acting head of the section.

WISCONSIN

Air Pollution.—The Industrial Hygiene Division is experiencing an increasing amount of air-pollution problems. Complaints vary from odors from fertilizer and rendering plants to the age-old problem of smoke.

Another problem of increasing importance is that of aiding in the investigation of explosions. In most cases, it has been possible to identify the gases present, and in situations where possible legal action is involved, the tests are confirmed by sending samples to a commercial laboratory specializing in mass spectrometry.

ENGINEERS TEST CO HAZARD FROM PARKED AUTOMOBILES

By H. L. Williams, E. F. Hoover, and I. B. Williams
Bureau of Industrial Hygiene
Pennsylvania Department of Health

Various types of fresh-air-intake vents used in connection with the heaters of many 1949 model automobiles are located under the radiator grill at the front of the car. It was suspected that the use of such equipment, when parked behind a car whose motor was running, might produce a serious carbon monoxide hazard inside the rear car if its doors and windows were closed.

To determine the extent of this hazard, a number of cars of different makes, all using this type of heater, were tested. The cars to be tested were parked at various distances behind another car in which the motor was running. They were first parked bumper-to-bumper, with the distance between the cars increased after each test until no carbon monoxide was found inside the rear car. Concentrations were determined with a carbon monoxide indicator, the doors and windows of the cars being kept closed during tests.

When the cars were parked bumper-to-bumper, the highest concentration of carbon monoxide found in the test car at the end of 1 minute's time was 650 parts per million parts of air. Several readings of 300 parts per million were found. The lowest reading recorded at the end of 1 minute was 250 parts per million. With the test car parked 2 feet behind the car with motor running, a high concentration of 300 parts per million was encountered at the end of 1 minute.

After 2 minutes, a high reading of 950 parts per million and a low reading of 500 parts per million was recorded. At the end of 3 minute's time, with the cars in the same position, a high reading of 1,500 parts per million was reached. This was the maximum that could be recorded with the testing instrument, and it is probable that the concentration was higher than that indicated.

Carbon monoxide concentrations of over 500 parts per million were found in all of the rear cars when parked as far as 4 feet apart for 2 or 3 minutes. No carbon monoxide was found inside the test cars when they were separated by a distance of 8 feet. The concentrations found varied with the type of car parked in front. Less carbon monoxide was encountered behind some cars with flanged tailpipe extensions. Additionally, the tailpipes of some cars projected at an angle toward the right or left and little carbon monoxide was encountered when the engines of such cars were run.

The results of these tests would seem to indicate that a serious hazard exists when cars having the above-mentioned type of heater are parked under the conditions outlined. The instruction manuals of some of the car manufacturers contain a warning against the use of car heaters when parked behind another car. Other manufacturers apparently fail to recognize that such a hazard exists.

PILOT REPORTS ILLNESS FROM PARATHION DUST

An aerial crop-dusting service applying parathion, a thio-phosphate, to cotton crops in the Rio Grande Valley reported that one pilot suffered ill effects from probable inhalation of the dust. This pilot reported that on one particular day, after applying two loads of parathion, a feeling of weakness, drowsiness, and tingling which he

described as similar to the effect of taking an overdose of sedative, was experienced. The next day the mucous membranes of his mouth and nose were inflamed as if sunburned. Following this experience the use of parathion was discontinued by this service.

The Industrial Hygiene Section, Bureau of Sanitary Engineering, Texas State Department of Health, is giving wide publicity to this and other cases of illness resulting from the use of insecticides throughout the agricultural regions of the State of Texas.

SOOTFALL STUDY MADE IN MASSACHUSETTS TOWN

In cooperation with the city health department, the Division of Occupational Hygiene and Sanitary Engineering of the Massachusetts Department of Labor and Industries has just completed a study of the sootfall in the town of Holyoke.

Sampling points were selected in 12 localities, representing the industrial, business and residential areas of Holyoke, three of the Willimansett section of Chicopee, believed to be receiving soot from Holyoke, and a control station at Amherst.

The soot-collection apparatus consisted of a wooden stand 3 feet in height, to which was fastened by means of a copper wire a glass jar 6 inches in diameter and 8 inches in depth. Inside the jar were 2 inches of distilled water, except during the winter months when glycerine was mixed with the water to prevent freezing. Each jar was replaced every 30 days and taken to the laboratory for analysis. In addition, the density of the smoke was spot tested by means of the Ringelmann chart.

The analytical results were expressed

in tons per square mile per month. Tables were prepared, showing the amount of sootfall at each station, the sootfall components, effect of season, and comparison of total solids with those of other American cities.

The findings indicate that industrial stacks are the major contributors to the nuisance, with the railroad which operates in the area sharing the responsibility in a minor degree. Since the sootfall in the residential area in summer is of a similar character to that of the industrial area, probably the pollution in the residential area in summer is caused by effluents from industrial plants; while during the winter it is materially affected by effluents from the residents' chimneys, particularly since oil-burning equipment gives off large quantities of carbon and little ash. Also, the likelihood that certain sections of Willimansett are being deluged with the contaminants from Holyoke was confirmed.

A questionnaire survey of Massachusetts cities and towns, exclusive of the

metropolitan smoke abatement district and the Cape Cod area, showed that six cities and seven towns have accepted the provisions of sections 132 to 136 of chapter 140 (Ter. Ed.), General Laws, which permit cities and towns to formulate their own smoke-abatement programs.

It was recommended that communities ally themselves on a regional basis in order to attract more competent personnel, which they might not be able to do individually. Also, the officials of a smoke abatement program should invite an expert organization such as Bituminous Coal Research, Inc., of Pittsburgh, who are qualified to assist with some practical pointers on smoke abatement.

Authors of the report made following the study are Francis J. Murphy, a graduate student at the University of Massachusetts, and John B. Skinner, Harold Bavley and Richard I. Chamberlin, director and engineers, respectively, of the Massachusetts Division of Occupational Hygiene.

CARBON TET USED FOR CLEANING CAUSES ILLNESS

By Noall E. Walter,
Washington State
Department of Health

Although the poisonous effects of carbon tetrachloride and specific instances of its toxic action have been reported frequently, it is apparent that reminders still are in order. Here is another case which should serve as a good object lesson. It is interesting in that it has not only industrial but also domestic ramifications.

This is the situation of a driver for an oil delivery company who in his spare time cleaned oil furnace burner nozzles. The small oil delivery company gave its customers extra service by cleaning the burner nozzles of their furnaces. Provisions were made in the shop to use carbon tetrachloride which loosened the tar and gum so the carbon could be removed easily.

Cold winter weather increased the number of services to be made. In order to reduce this backlog, one of the drivers took home several of these nozzles with the necessary quantity of carbon tetrachloride to clean them on Sunday in the basement of his home. This would save heating the shop.

After a busy day cleaning these nozzles in the poorly ventilated basement of his home, he became very tired and developed a headache. Also, the wife and two children had similar symptoms. Next morning the same characteristic headache prevailed but nevertheless each took up his daily tasks again.

During the day additional carbon tetrachloride was used at the shop to clean the burners. However, additional symptoms appeared during the day and a doctor was called in. The driver was immediately hospitalized. After two days of hospitalization the driver was released with little or no damage but with a greater appreciation for the toxicity of carbon tetrachloride. The family was treated at home for a day or two until normal.

HOLIDAY TO GIVE COURSE IN TEXAS

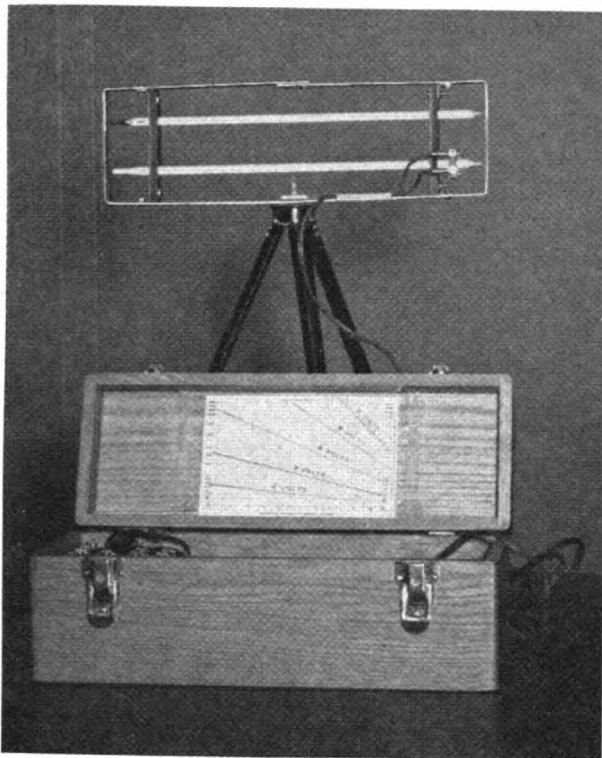
A week's course in the use of radiation measuring instruments will be given in Austin, Tex., January 9-13, 1950, by Mr. Duncan Holaday of the Division of Industrial Hygiene, Public Health Service. This will be the seventh time Mr. Holaday has held this seminar for industrial hygienists. He gave the course three times in Washington, D. C., once in New York, and twice in California.

The Industrial Hygiene Section of the Bureau of Sanitary Engineering, Texas State Department of Health, is providing facilities and arranging for living quarters for the men who attend. Mr. Norman Modine from the Public Health Service, Washington, D. C., and instructors from the biophysics department of the University of Texas will assist Mr. Holaday.

Inquiries concerning the course may be addressed to Dr. George W. Cox, State Health Officer, Austin, Tex.

HOW TO CARRY A THERMOMETER SAFELY

The heated thermometer anemometer, because of its wide range and accuracy, can be of great value in measuring air flow. However, as delivered by the manufacturer, it was inconvenient to use, and the thermometers were especially vulnerable to breakage. Both of these disadvantages have been eliminated by supporting the thermometers in a rectangular metal frame made to fit inside the top of the case. The thermometers are held by two thick rubber strips which provide shockproof mounting. The assembly can be removed from the case and set up on a light camera tripod in a few seconds. The tripod can be used as an extension rod to hold the thermometers at the face



of grilles which are otherwise inaccessible.—Peter J. Valaer, Industrial Hygienist, Washington D. C. Health Dep't.

WISCONSIN HOLDS SIX INDUSTRIAL HEALTH CLINICS

The six 1949 Industrial Health Clinics held in Wisconsin consisted of plant tours of selected industries and the correlation of such tours with a series of scientific papers directly related to the field of industrial health.

It is apparent that industrial management is extremely anxious to better acquaint physicians with their industrial health programs and problems and it is the purpose of the clinics to interest the many physicians who derive part of their practice from industrial sources. The clinics were planned under the direction of the Committee on Industrial Health in cooperation with the various county medical societies. The choice of plants represented a

wide diversification of industrial activity and the utmost of cooperation to make the meetings successful was offered by the industrial plants utilized.

The choice of speakers for the various industrial clinics was determined by the types of manufacturing processes viewed. Some of the subjects covered were, "Back Strains and Sprains" by Dr. Stack, Northwestern University; "Handling the Cardiac in Industry" by Dr. Kurtz of Madison; "Treatment of Hand Injuries" by Dr. Frackelton, Milwaukee; "Industrial Fatigue" and "Control of Welding Hazards" by Dr. Enzer, Milwaukee, and "Brucellosis" by Dr. W. D. Stovall and Dr. John Brown of the University of Wisconsin Medical School.

Seven hundred and forty physicians, nurses and others were in attendance. It is hoped that the plant tours can be developed further in 1950 to carry out

the objectives of getting the physicians, industrial nurses, labor and management together as a "team" to give joint consideration to the welfare of workers in industry.

Anyone interested in organizing this type of in-plant clinic may receive information by writing Mr. Roy T. Ragatz, Assistant Secretary, Committee of Industrial Health, State Medical Society of Wisconsin, 704 East Gorham Street, Madison, Wis.

DIVISION ANNOUNCES PERSONNEL CHANGES

Several changes have been made recently in personnel assignment in the Division of Industrial Hygiene, United States Public Health Service.

Dr. Lewis J. Cralley is the new chief of the Environmental Investigations Branch, replacing Dr. H. H. Schrenk, who resigned to accept the position of research director for the Industrial Hygiene Foundation. Mr. Joseph E. Flanagan is now head of the Cooperative Health Services Branch, the position previously held by Dr. Cralley.

The Division has announced the addition of an atmospheric pollution unit to the organization. The Atmospheric Pollution Unit, which is a part of the field section of the Environmental Investigations Branch, is headed by George D. Clayton and forms the nucleus for a program which the Division is developing.

PHS PERSONNEL NEWS

A course in the medical aspects of nuclear energy given at the Army Medical Center September 19-23 was attended by the following men: Charles D. Yaffe, senior sanitary engineer, Wilfred D. David, S. A. surgeon (R) and Charles J. Buhrow, assistant surgeon.

Dr. Mary Claire Whitmore, assistant surgeon (R) is a new assistant to Dr. Paul C. Campbell, dermatologist, Clinical Investigations Branch. Dr. Whitmore is a graduate of the University of Texas.

Miss Winifred Devlin, formerly of the Michigan State Health Department, is a new member of the staff of nursing consultants.

Jobside Chats With Charlie

People Live Longer Than They Used to—and Can Work Longer



The boys gave Ed Brady a big send-off today. He had just turned 65 and said that he couldn't neglect his fishing any longer—so he quit. It's hard to see the old fellow go. Seems like a part of the plant is going with him—he knew so much about everything. Come up with a question, and there was Ed with the answer.

There was another time that we almost said "goodbye" to Ed. That was 15 years ago. Only, that time, there were no hearty handshakes and pats on the back and gifts of fishing reels. Ed wasn't "retiring" 15 years ago. He was just down for the count. A doctor told him he had heart trouble and to "take it easy." So Ed thought he was headed for the life of a night watchman. But the Boss had another angle.

"Look, Ed," he said, "we can't afford to let you quit. Your experience is worth money to us. We'll figure something out."

After talking to the Doc again, Ed shifted to a sitting job that used his know-how and saved his energy. He

changed his life after hours, too—quit bowling, rested a lot, and saw the Doc regularly. He griped about the new "rules" for a while, but before too long he acted as if he was having a good time in his second life. On the job he earned his brown envelope as much.

Ed is quitting today because he wants to—still going strong. If he hadn't "eased up" 15 years ago, he might not have lived to tell any fish stories.

It's no secret that people are living longer in this country than they used to, and that there are more in the "over 45" class than ever before. It's no secret either that chronic diseases like heart trouble, high blood pressure, diabetes, and arthritis hit the "over 45's" more often than others. Folks who earn their living have cause to worry, but the problem needn't be as bad as it seems.

Chronic disease doesn't have to put a man on a dole. It can put him on the road to a longer life if he eases up. "Over 45" is the must time for annual medical check-ups. But they won't do any good unless you follow the doctor's advice about work, exercise, and rest. There will be plenty of time for useful jobs and happy living. If you don't believe me, ask Ed Brady—unless he's too busy fishing.



Evidence Is Lacking To Prove Efficacy of Ammoniated Dentifrices

By Dr. H. T. Dean,
National Institute
of Dental Research

The clinical evidence available at the present time is inadequate to show what effect, if any, either ammoniated dentifrices or the use of chlorophyll preparations will have on human tooth decay.

The laboratory experiments published thus far are only suggestive that these dentifrices might have some effect toward reducing caries, but it is also possible that in some cases caries might be increased by their use.

The ability to inhibit acid formation in saliva glucose mixtures is possessed by a great many chemical substances and in this respect neither the ammoniated dentifrices nor chlorophyll are outstanding. The data on the effects of these compounds on salivary lactobacillus counts cannot be accepted as conclusive. There is no scientific basis on which the use of these compounds could be recommended for general use today.



This small exhibit was displayed at the Industrial Health Conference held in Houston, Tex., October 6 and 7. Samples of the INDUSTRIAL HYGIENE NEWS LETTER were given to the physicians, nurses, engineers, and educators who were interested in subscribing to the publication.

Health Services in the Bristol Laboratories

Like many other great scientific discoveries which have benefited mankind, the discovery of penicillin by the British scientist, Alexander Fleming, resulted from an accident, in this case, a speck of mold falling on a culture dish. In regular research, this ordinarily calls for discarding the dish as being contaminated. The sharp eyes of Dr. Fleming noted, however, that where the mold grew, the organism he was working with was destroyed and its growth prevented. Further investigation by Dr. Fleming and his coworkers together with contributions from the other fields of scientific endeavor has resulted in the penicillin industry as we know it today.

At the Thompson Road plant of Bristol Laboratories approximately 700 workers are engaged in the production of penicillin. The health and safety of these workers is of prime importance so that conservation and wise use of human resources may be made.

Facilities

The medical department is located in a brick building which also houses the office personnel. The physical facilities consist of a waiting room, the doctor's and supervising nurse's office, a treatment and examining room with cubicles for physiotherapy treatment and a small rest room.

As you enter the waiting room, you are impressed by the statistical graphs posted on the bulletin board showing time lost, with the cause, from sickness absenteeism. A pamphlet rack with well-chosen health subjects also displays a large card telling the employees to use the medical department's services. Below are small cards noting the services offered by the medical department such as guidance in nutrition, periodic physical examination, information on community agencies, and others. The fact that each service is printed on a separate card is impressive and catches the eye immediately. The idea of displaying the services offered by the medical department, similar to the display of the product manufactured by the company in the main hall of the building, is a clever one.

By Veronica Donnelly, R. N.,
Division of Industrial Hygiene,
New York State Department of Labor

Personnel

Dr. L. P. Ransom, the plant physician, visits the plant for 3½-hour periods a week and is on call at other times. Periodically he reviews and signs standing orders for the nurses. Two registered professional nurses are on duty during the working hours. Miss M. V. Lynch, R. N., is the supervising nurse, whose unusual education and experience qualifications are reflected throughout this excellent health program. The medical department is administratively under the Director of Personnel who in turn reports to the Executive Vice President.

Medical Program

Medical service available to the employees includes preplacement and periodic physical examinations and examination following an illness of 4 weeks' duration or as indicated. Immunizations, emergency, and first-aid treatment of occupational injuries and such minor medical services are given as may be necessary and feasible for keeping the employee on the job. Health counseling and health education are part of the health program.

The preplacement examination includes a careful history, chest X-ray, Wassermann test, and for those over 40 years of age, an electrocardiogram. All of the plant inspectors have an eye examination by an ophthalmologist.

Periodic physical examinations are offered to the employees on a voluntary basis every 2 years. If 40 years of age or over, an employee may have periodic physical examination annually. The findings of these examinations are confidential with the medical department. If a transfer of work is necessary the employee is advised to request the transfer.

The nurse also makes home and hospital visits to employees who have reported illness. The value of the home visits may be judged from the following.

One of the male employees reported ill. When questioned regarding medical care, the man doubted that any doctor would come to such a poor place. A physicians' building was nearby and the nurse secured the promise of one of the doctors to make a call following his office hours. The worker's condition improved and the length of his illness no doubt was shortened because of prompt medical care.

Approximately 9,000 visits are made to the medical department each year. These visits represent health care of all kinds including diagnosis, treatment and advice, physical examinations and follow-up.

Records

An individual folder is kept for each employee and a Kardex system for all visits to the medical department. Statistical reports with a brief narrative describing the activities of the medical department and recommendations for improvements are sent to management each month. Studies are made from time to time to learn better methods of maintaining the health of the employees and increasing production for the industry.

Health and Safety Education

The medical department is active in health education. A health article appears in each issue of the plant newspaper. Posters on health and safety subjects are displayed and changed frequently. Pamphlets on health topics are available in the waiting room. Whenever the nurse attends a lecture pertaining to health which she thinks would be helpful to the employees, she posts a notice on the bulletin board stating that she has attended such a lecture, gives the topic discussed and invites the employees to seek help with problems in this field. The medical office also cooperates with the Veterans' Medical Office and assists veterans in obtaining help from that source.

The safety program as it affects employees is concerned primarily with the prevention of accidents arising out of employment. The handbook for employees warns that safe areas for smoking "are determined by a New York

State Labor Department inspector" whose decisions must be followed rigidly. Instructions are included for the control of solvents used in the extraction and washing operations to derive the penicillin from its broth—especially chloroform which is toxic and amyl acetate which presents a potential fire hazard. The book also outlines general rules for fire protection, disposal of fluorescent lights, and other protective measures.

Classes in the Bureau of Mines first aid are being given for all employees. These classes include 30 employees at a time, divided into 2 groups and cover a period of 6 weeks with 2 hours for each session.

There is also a health and safety committee made up of employees, foremen, and department heads. The personnel director, representing management, and the supervising nurse are guests at each meeting. The nurse also meets with the foremen at periodic intervals to discuss the nature and control of accidents.

Sanitation

The nurse and the doctor make plant tours periodically to make recommendations regarding improvement of sanitary facilities and control of environmental sanitary conditions. All recommendations made by the medical department are sent to management in memorandum form and management has given 100 percent cooperation in carrying them out.

Group Health

The program has been designed to afford regular full-time employees a reasonable degree of protection against the loss of income and the heavy or unusual expenses generally attendant upon the following:

Section I. Accident and sickness:

- Short-term disability.
- Long-term disability.
- Permanent disability.

Section II. Medical Care:

- Hospital accommodations and services.
- Surgical operations.
- Physician's care in the office, home and hospital.
- Laboratory and X-ray examinations.
- Nursing service.

Section III. Loss of Life.

Section IV. Unemployment.

All benefits under the plan are provided without any cost to the employee. In addition, protection against unusual medical expenses with respect to eligible dependents of employees are made available at an extremely low cost. No distinction in service is made between occupational and nonoccupational sickness or accidents. To avoid duplicate payments for the same loss, provision is made to deduct from the benefits provided under the plan any amounts (but not more than the amount determined for each benefit) recoverable from Workmen's Compensation benefits for each particular item. For example, if the Workmen's Compensation award is greater than the benefits provided under the plan, the employee receives the larger amount.

Other Activities

This plant has cooperated with the State Labor Department not only in the control of health hazards but in many other ways. During the past year, student nurses have been assigned to this plant to observe the functions of the medical department and to gain knowledge of the duties and responsibilities of the industrial nurse.

A clean, modern, low-cost cafeteria is maintained in a separate building on the grounds. This cafeteria serves healthful lunches to both shop workers and top executives.

NURSE'S QUESTION GETS PRACTICAL ANSWER

In the Industrial Nursing Q & A column of *Trained Nurse*, July 1949, a nurse asks this question: "The company where I have been employed for 6 years has recently laid off a number of employees and is curtailing certain activities as an economy measure. The medical department staff has also been cut and there is talk of further reduction in personnel or elimination of the department entirely. Could you advise me of ways in which I could prove to management the value of the medical department?"

Answer: "When a company is in the process of an economy drive, finances are usually given precedence over good will, and other intangible benefits of service departments. Consequently, a

suggested approach would be from a financial angle.

"This is a particularly good example of the value of adequate and complete records. Such records will provide the basis for compiling a report which could be submitted for management's attention.

"The report should contain factual data concerning Workmen's Compensation experience and costs involved. A comparison year by year over a period of several years, giving the average number of employees each year, will show the effect, if any, on the reduction of compensation insurance costs.

"Effects on group insurance or other health plans for employees can be compiled in the same manner.

"The absenteeism experience is particularly important. A study of year by year experience of man-hours lost can be interpreted in terms of dollars and cents.

"Thought should also be given to the cost of referring cases needing first-aid or other services, that can be rendered by the plant nurse, to outside sources and also the cost and inconvenience of time lost by employees in such instances. This can also be applied to compensation cases handled in the medical department that need redressings, treatments, and other services.

"It would be impractical to try to include details of the various financial factors which could be considered since each industry and medical department may differ in many respects."

RECOMMENDED READING

BROWN, E. W.: Recent development in the field of education in industrial medicine. *South. M. J.* 42: 591-597 (July) 1949.

BROWN, E. W., and VAN WINKLE, WALTON, Jr.: Present status of aluminum in the therapy and prophylaxis of silicosis. *J. A. M. A.* 140: 1024-1029 (July 23) 1949.

McNICKLE, R. K.: Air Pollution. *Editorial Research Reports.* 2: 545-555 (August 26) 1949.

MEIKLEJOHN, A.: Contribution of the employment history to clinical diagnosis. *Lancet.* 2: 360-362 (August 27) 1949.

Various authors: Papers presented at General Motors conference, April 4, 1949. *Indust. Med.* 18: 353-398 (September) 1949.