A Preliminary Report

Air Pollution and New Orleans Asthma

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IN THE EMERGENCY CLINIC of Charity Hospital, New Orleans, La., the daily number of admissions for emergency treatment of respiratory embarrassment of an asthmatic nature has fluctuated widely for several years. The number of admissions has reached as many as 200 in 1 day, whereas the mode has been 25. These dramatic fluctuations suggested that some common environmental stress is responsible for this asthma response.

In 1958 an outbreak of asthma afflicted approximately 100 people and resulted in 3 deaths. The event, reported in the local press, reached the wires of the national news agencies. A group of Public Health Service experts went to New Orleans immediately after the outbreak to investigate the nature of the event and to determine whether or not air pollution might have been involved. As a result of this investigation, the Public Health Service contracted with Tulane University to perform a series of studies concerning these asthma attacks. This preliminary report summarizes the results of work performed through June 1962.

Investigations were conducted from January 1959 through March 1960 to determine the nature, frequency, and possible causes of marked increases in the incidence of certain respiratory conditions in the New Orleans area. The preliminary study was based on observations at Charity Hospital and weather data from Moissant International Airport for the period December 1957 through November 1958. A detailed account was published by Tulane University School of Medicine in 1960 (*1*).

During the summer months (May–July) asthma outbreaks were associated with low windspeeds and south and southwest winds. During the winter months (October–December) some outbreaks occurred when winds were from the north and northeast. These findings indicated that some air contaminant was involved in the attacks and that the source of this contaminant was most probably located upwind and not far removed from the respondents.

In the detailed study, initiated in June 1960 and terminated in June 1962 (*2*), the principal objectives were to:

1. Determine the source and nature of specific air contaminants and meteorologic conditions which led to asthma in susceptible persons.
2. Evaluate various methods for identifying sources and contaminants which are factors in producing asthma.
3. Evaluate methods to distinguish several types of asthma, and to measure severity of attacks.

Methods

As a result of the preliminary investigation, there was evidence that a source or sources of air contaminants existed along the Mississippi River in the region south or southwest of the city and that other sources might exist in the northeast region of the city. The development of methodology for determining the type and location of specific air contaminants related to

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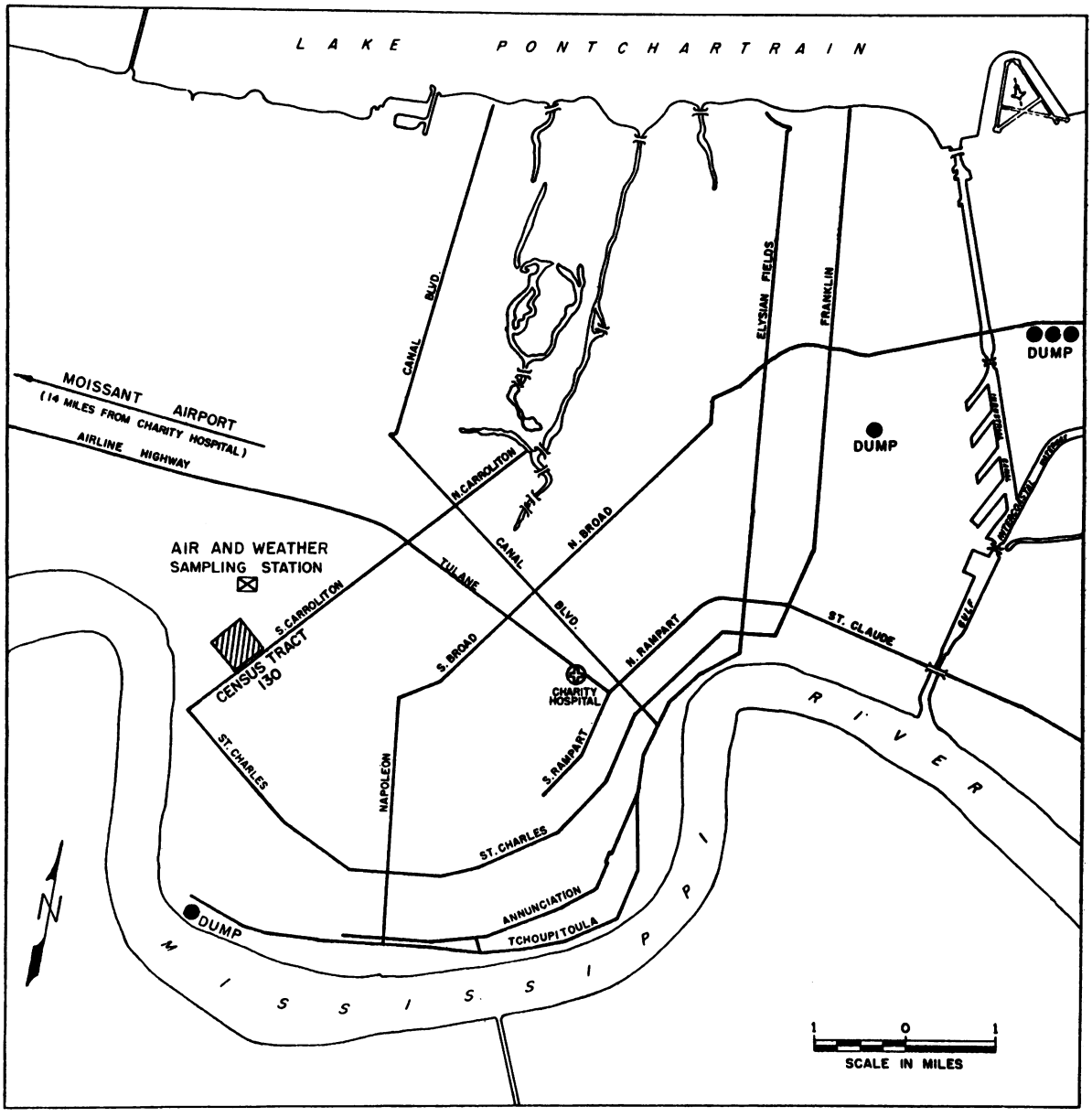
asthma was predicated on this evidence. The methodology used included studies of the following: (*a*) emission of likely pollutants in the New Orleans area; (*b*) meteorology, with special emphasis on wind speeds and directions; (*c*) air quality, including evaluation of many likely asthma-producing agents; and (*d*) the asthma sufferers.

The study of asthmatics followed two principal lines of inquiry: a further evaluation of the Charity Hospital emergency clinic admissions and a study of residents in census tract 130.

Census tract 130. A map showing the home addresses of all patients admitted to Charity Hospital for emergency treatment of asthma was used as a guide in selecting a small area for intensive study. The area chosen was in the southwest section, just a few blocks from the Tulane University campus. The study area contained 24 blocks and comprised approximately two-thirds of census tract 130 (fig. 1).

Figure 1. Location map, New Orleans, La.



A pilot study of households in these 24 blocks was completed in July 1960. It was found that about 4 percent of the population was susceptible to asthmatic attacks, and that between 50 and 80 percent of these persons had had asthmatic attacks within the past year.

A survey of this selected area was made on September 8 and 9, 1960, by a questionnaire based on the form used by the U.S. National Health Survey. This census of 1,675 persons was carried out by 20 public health nurses from the New Orleans Parish Health Department. The respondents were classified as (*a*) definitely not susceptible to asthmatic attacks, and consequently eliminated from the study; (*b*) known susceptibles to asthma; or (*c*) unknown as to susceptibility to asthma attacks. Further screening of the remaining participants was conducted by use of a clinical interview questionnaire. Subsequent to these screening operations, 67 asthma-susceptible persons were available for study.

Continuous information was then collected on those susceptible to asthma attacks. Two field nurses interviewed respondents and instructed them in the maintenance of a calendar to record symptoms and other appropriate information. The number of participants was reduced from 67 to 46 during the instructional period. The field nurses visited households weekly to correct records, ask supplementary questions, and to maintain interest among the respondents. This activity continued from October 18, 1960, through January 13, 1961, and again from May 23 through July 23, 1961. During the second period, however, additional volunteers were selected, so that 84 persons were contributing calendar information.

Supporting medical studies. Three separate approaches were pursued to determine whether the epidemic asthma attacks in New Orleans differed from the usual forms of asthma.

1. The 84 subjects in the census tract studies were evaluated by routine clinical methods (physical examination, medical history, chest X-ray, electrocardiogram, urinalysis, skin scratch test, simple spirometric pulmonary function test, and complete blood count).

2. Serum properdin studies were performed on control and asthmatic subjects selected from the emergency room and allergy clinic. Blood specimens for analysis were obtained during attacks and remissions of asthma.

3. For 14 subjects with histories of respiratory embarrassment, sputum eosinophile counts, peripheral white blood cell counts, and peripheral eosinophile counts were made three times a week from November 29 through December 20, 1960.

These studies revealed no outstanding feature that would distinguish these asthmatics from the usual group of asthmatics appearing in an allergy clinic.

Charity Hospital admissions. The emergency clinic records for 1953–61 were used (*a*) to obtain historical details of daily and monthly frequency of asthma emergencies reported at the clinic; (*b*) to select special groups for further study on the basis of multiple and seasonal admissions, and characteristics such as age, sex, and race; (*c*) to keep under surveillance those persons affected in outbreaks, by immediate home followup after an outbreak; and (*d*) to select a group of persons affected in multiple outbreaks for continued surveillance in a season when outbreaks could be expected to occur.

Approximately 90 percent of the Charity Hospital admissions for all causes were Negroes. Similarly, about 90 percent of the asthma patients were Negroes, and practically all of these were over 12 years of age. Consequently, data pertaining to adult Negro patients only were used in this study.

Aerometric studies. The principal aerometric studies were directed toward particulate sampling, with only occasional surveillance sampling for gaseous pollutants. One principal station for both meteorologic and aerometric measurements was established adjacent to census tract 130 (fig. 1). In addition, occasional samples for various pollutants were taken at other points throughout the city.

Aerometric sampling was done routinely with high-volume (Hi-Vol) samplers and Millipore sequential tape samplers. On occasion, sampling was done also with a rotobar sampler, dustfall collectors, and a portable field test kit. The field test kit was capable of analyzing 8 gases and 10 particulates.

Three Hi-Vol samplers were operated each day. These ran serially for 8-hour periods. Hi-Vol filter samples were analyzed for total

weight and for benzene and methanol soluble fractions. The extracted filters were used for microscopic examination.

The Millipore sequential filter collected samples over 4-hour intervals. These samples were analyzed for optical density and then were subjected to microscopic examination. The rotobar sampler collected sufficient sample in 12 minutes of operation for microscopic analysis. Daily samples were taken with this device during selected portions of the study.

During a 24-hour period in January 1961, samples were collected with Millipore, Hi-Vol, and rotobar devices. Particle counts were obtained for size ranges from the lower limit of visibility (about 0.25 micron) up to 40 microns. The Millipore sampler collected particles from the lower limit to 2.4 microns. The Hi-Vol sampler collected particles most effectively in the 1- to 13-micron range, and the rotobar sampler collected particles ranging from 2.5 to 40 microns. Consequently, the Hi-Vol and Millipore samplers were supplemented with daily samples using the rotobar sampler.

Microscopy. The microscopist established counting and identification procedures for a variety of particulate substances, which were classified as follows:

1. Reddish-brown spheres—a good combustion product with a high ferric oxide content (0.3–1μ): These spheres often showed "pseudo" crosses under polarized light, and were believed to have originated from a high-efficiency coal fire.

2. Coffee and brown grain fragments—brown, irregularly shaped particles with conchoidal fractures (1–10μ): The source of the coffee particles is industrial roasting and grinding operations. Brown grain fragments are thought to be derived from the hulls of some types of grain.

3. Starch—spheroids with a center indentation called the hilum (10–40μ): With normal lighting these spheroids are translucent; however, when observed with crossed polars, a distinct, dark cross appears in the starch grain and the rest of the grain takes on a white color.

4. Good combustion products greater than 1μ: When all of the carbonaceous material burns properly, the product consists of globules of glassy material derived from the fusion of other materials present. These particles were much rarer than poor combustion products.

5. Spores: Two substances similar in shape but with different surface characteristics were identified in low concentrations in the Millipore samples. It is likely that these reddish-brown spherical or spheroidal particles were the same constituent, differing in origin or perhaps in fluid content.

6. Mineral fragments: The most commonly observed minerals were quartz, gypsum, calcite, and muscovite mica. Identifications were made on the basis of physical characteristics (morphology, cleavage, and fracture) and optical characteristics (color, index of refraction, and response to polarized light).

7. Pollens: Four classifications of pollens, ragweed, grass, tree, and a subdivision of tree pollen, crepe myrtle, were counted.

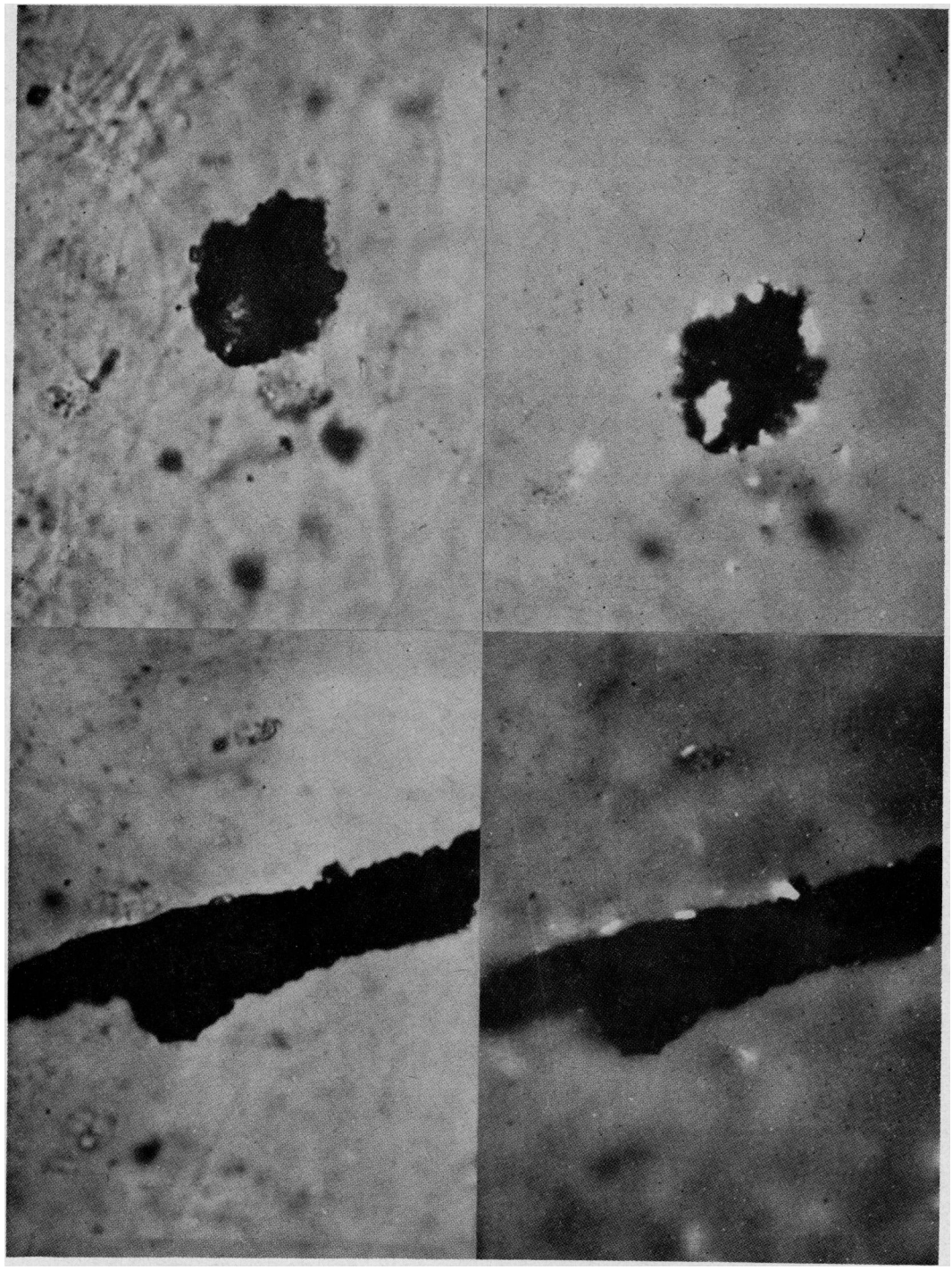
8. Finely divided siliceous material: This transparent material showed up as spots of very brilliant white light when observed with crossed polars (0.3–2μ). One possible source is the crushing of quartz to a fine state, such as in the manufacture of building materials. Silica found as inclusions in grasses and outer coatings of other vegetable growths could be another source.

9. Poor combustion products greater than 1μ: Inefficient combustion processes will produce this material. Counting was limited to particles greater than 1μ because of the great profusion of smaller ones. As collected, the material appeared as semi-opaque, dark-brown to opaque-black, irregular particles, often feathery in appearance.

10. Poor combustion products with associated silica: Because most of these particles were larger than 4μ, they were identified only in the rotobar and Hi-Vol samples. Two classifications could be made. In one, silica appeared to be embedded within the combustion product. A somewhat larger portion of the particles consisted of poor combustion product with silica particles more or less closely attached to the surface (see items 8 and 9 above and fig. 2).

Meteorology. Special meteorologic observational data for the microclimatology of the study tract were provided by an Aerovane wind-recording system and a hygrothermograph operated at the station adjacent to census tract 130.

Figure 2. Poor combustion particles with associated silica



Hourly wind speed and direction, wind direction trace type for atmospheric stability estimates, temperature, and humidity data were obtained from these instruments. Other meteorologic data were obtained from the U.S. Weather Bureau stations at the Moissant International Airport and the Post Office Building, 600 Camp Street.

Results

In the census tract studies, conducted for two periods of about 2 months each, interviewers obtained information regarding time of onset and the course of asthma attacks. The various measures of air pollution were compared with the number of asthma attacks in census tract 130. No statistically significant relationships were disclosed. Furthermore, no statistically significant relationship was discovered between the number of asthma onsets in the census tract 130 studies and the number of asthma admissions at the emergency center.

The daily number of adult Negroes with asthma admitted to Charity Hospital emergency clinic was compared with all of the measured atmospheric pollutants. Regression calculations for coffee, starch, and poor combustion products against asthma admissions showed that the slope of the linear regression line was not significantly greater than zero at the 95 percent confidence level (see table). Data for the other pollutants also showed no apparent relationship except for poor combustion particles containing siliceous material.

The daily number of asthmatic Negroes admitted to the clinic was compared with the daily count for poor combustion particles with associated silica for the periods October 20 through December 20, 1960, and May 24 through July 23, 1961. For both periods the slope of the linear regression line was significantly greater than zero at the 95 percent confidence level.

The daily adult Negro admissions for both summer and winter periods thus appear positively related in time to the count of poor combustion particles in association with silica.

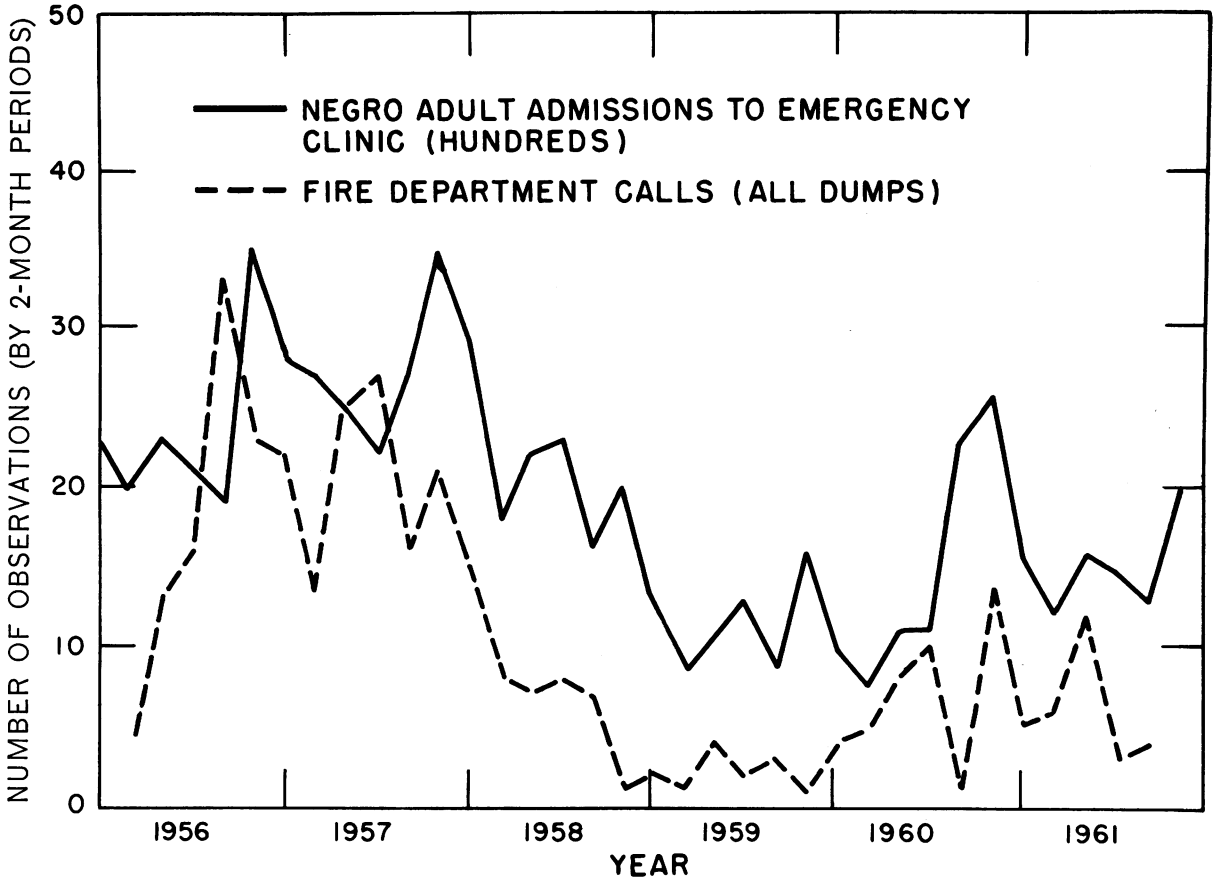
Poor combustion particles could arise from almost any inefficient combustion process. The siliceous material on the surface or embedded in particles appeared similar to that found in conjunction with exceedingly hard parts of common plants such as the hulls of grain and in the stems of grasses. Likely sources of this material were two city dumps, one located at Agriculture Street in the northeast section of the city and the other on the Mississippi River batture, just upstream from Audubon Park in the southwest section of the city. Both dumps were closed for dumping operations in 1959, but both have had a long history of subterranean burning, especially during the later portions of the annual dry periods (spring and fall). Subterranean burning has been almost continuous in the Agriculture Street dump. On the other hand, subterranean combustion at the Audubon dump has been rare in recent years, except for 1957.

A portable rotobar sampler was taken to the Agriculture Street dump in the summer of 1961. Direct sampling from smoke plumes of

Correlation between asthma and environmental factors, New Orleans, La.

Variables	Number of observations	Time period	Slope of linear regression line significantly greater than zero at 95 percent confidence level
Coffee vs. asthma admissions	47	May 24–July 23, 1961	No
Starch vs. asthma admissions	37	May 24–July 23, 1961	No
Poor combustion vs. asthma admissions	52	May 24–July 23, 1961	No
Poor combustion and silica vs. asthma admissions	59	Oct. 20–Dec. 20, 1960	Yes
Poor combustion and silica vs. asthma admissions	51	May 24–July 23, 1961	Yes
Dump fire calls vs. asthma admissions	34	Feb. 1956–Sept. 1961	Yes

Figure 3. Relation between asthma and dump fire calls, 1956–61, New Orleans, La.



subterranean origin revealed large quantities of poor combustion particles in association with silica.

The fire department has been called to extinguish dump fires from time to time. Thus, the number of fire department calls for this purpose might be considered an approximate indicator of dump burning. The number of fire department calls to the several dumps for the period February 1956 through September 1961 in relation to the number of adult Negroes with asthma admitted to the clinic is shown in figure 3. The slope of the linear regression line for these data was significantly greater than zero at the 95 percent confidence level.

Summary and Conclusions

A series of investigations was carried out by Tulane University under contract with the Public Health Service to determine the source and nature of air contaminants which produce asthma in New Orleans, La.

Daily admissions to Charity Hospital emergency clinic for treatment of asthma ranged from 3 to 200 during the period 1953–60. The modal number of daily admissions was 25. Analysis of data from the clinic which pertained to asthma and analysis of data from the U.S. Weather Bureau station at Moissant Airport disclosed that asthma outbreaks were most commonly associated with winds of low speed from the south and southwest. Occasional outbreaks occurred with wind from the north and northeast.

A number of air pollutants were collected and analyzed and their prevalence was compared with the prevalence of asthma outbreaks. A statistically significant relationship was found between the daily asthma admissions at Charity Hospital emergency clinic and the prevalence of one air pollutant, a poor combustion particle

with associated silica. No relationship was shown between concentrations of other pollutants and the number of reported asthma attacks.

It would appear either that the poor combustion particle with associated silica produces asthma or that it travels in consort with asthma-producing agents. This particle could arise from combustion processes in which siliceous material is present and burning is inefficient. All possible sources of this material were not examined; however, samples taken at one dump in the summer of 1961 revealed large quantities of this particle.

In order to carry this investigation to conclusion, the emissions from the dumps will be analyzed to identify the specific materials involved, and these materials will be evaluated with respect to their allergenic properties. Continued research is underway through additional contract studies by Tulane University Medical School and by the Public Health Service's Division of Air Pollution laboratories in Cincinnati, Ohio.

If subterranean burning in the dumps could be stopped, and this is recognized to be a substantial undertaking, it would be possible to compare the current seasonal asthma rate with rates for previous years and to determine whether cessation of dump burning brings about a reduction in asthma in New Orleans.

NOTE: *In a recent episode in New Orleans (October 1962), reported in the national press, more than 300 persons sought treatment and 9 asthmatics died during 1 week.*

REFERENCES

(*1*) Lewis, R.: Meteorologic aspects of New Orleans asthma. Tulane University, 1960.

(*2*) Lewis, R., Gilkeson, M. M., and Robison, R. W.: Air pollution and New Orleans asthma. Tulane University, 1962, 2 vols.

Impairments From Accidents

Accidents cause more impairments among Americans than any disease, according to Dr. A. L. Chapman, chief of the Division of Accident Prevention, Public Health Service.

U.S. National Health Survey figures show that about 75 percent of all amputations result from accidental injuries. Among males, accidents have caused five times as many amputations as all other causes combined, as well as more than half of all impairments of limbs or torso.

Of about 3.5 million cases of visual impairment, more than 500,000 were caused by accidents. Of about 6 million cases of hearing impairment, about 400,000 resulted from accidents. Three times as many males as females have visual and hearing impairments caused by accidents.

Accidental injuries caused 14.6 percent of the 100,000 cases of paralysis in the United States. Among persons under 45, about 20 percent of paralytic cases were caused by accidents.

Dr. Chapman noted that accidents are the fourth leading cause of death in the total population and the first cause of death in the age group 1–35 years. Commenting on the increasing participation of health agencies in accident prevention, Dr. Chapman said, "I am convinced that the historic public health approach—research, epidemiologic investigation, demonstration, and application—will pay off in accident prevention as dramatically as it has in the conquest of the communicable diseases."