PUBLIC HEALTH

Hazards of Smog

The problem of preventing harmful radioactive fall-out is like that of smoke control. Filters and precipitators can reclaim valuable wastes from industrial chimneys.

By HELEN M. DAVIS

➤ A PLUME of gray smoke curling out of a chimney used to be the symbol of home and comfort. But today a cloud of black smoke billowing out of a factory chimney pleases no one.

Hot words are flying in several localities about whose fault it is that smoke mixes with the weather to produce "smog." Each of several groups of people is trying to point to others as the real source of irritating vapors that appear mysteriously in the air with little warning.

The irritating vapors brings tears to the eyes of the man in the street. They make him cough. The lady shopper suffers the added indignity of finding her nylon stockings disintegrating into a network of "runs."

This must be a new kind of smoke. The kind that curled from grandfather's chimney didn't behave so—or did it? Grandmother didn't have nylon stockings, either. Is our new technology to blame for smog? And if so, what part of it?

Coal dust, metal fumes, acid droplets, petroleum products, both from the refineries and from exhaust gases given off by cars, trucks and buses, have all been blamed, but the scornful point also to householders who burn trash in their back yards. Everyone seems to blame the other fellow. A number of research projects have been started to try to find out what the irritating substance really is.

Coal, Oldest Offender

Oldest offender as a smoke nuisance is, of course, coal. In Queen Victoria's time in London, the government issued many regulations designed to keep coal smoke from polluting the air. These attempts at regulating combustion by law were accompanied by inquiries into the scientific causes of the "black fogs" of London. But a report to the British government by the General Board of Health in 1855 stated a conclusion not very different from the reports of similar studies which are being made today.

"Notwithstanding the great and obvious advantage of perfecting the combustion of fuel," the 1855 report reads, "and the certainty that the cost of doing so will be amply repaid by the saving effected, such is the indisposition of practical men to depart from the beaten track, that nothing but the force of law is likely to ensure the care and attention necessary to protect the public from a grievous nuisance, the manufacturers themselves from heavy unnecessary expense, and the national resources from grievous waste of fuel to the amount of millions a year."

The "care and attention" urged by this Board of Health consisted of better regulation of drafts and dampers, and taller chimneys to spread the smoke higher above the roofs. Many of the control measures advocated today are asking for the same better drafts, taller chimneys.

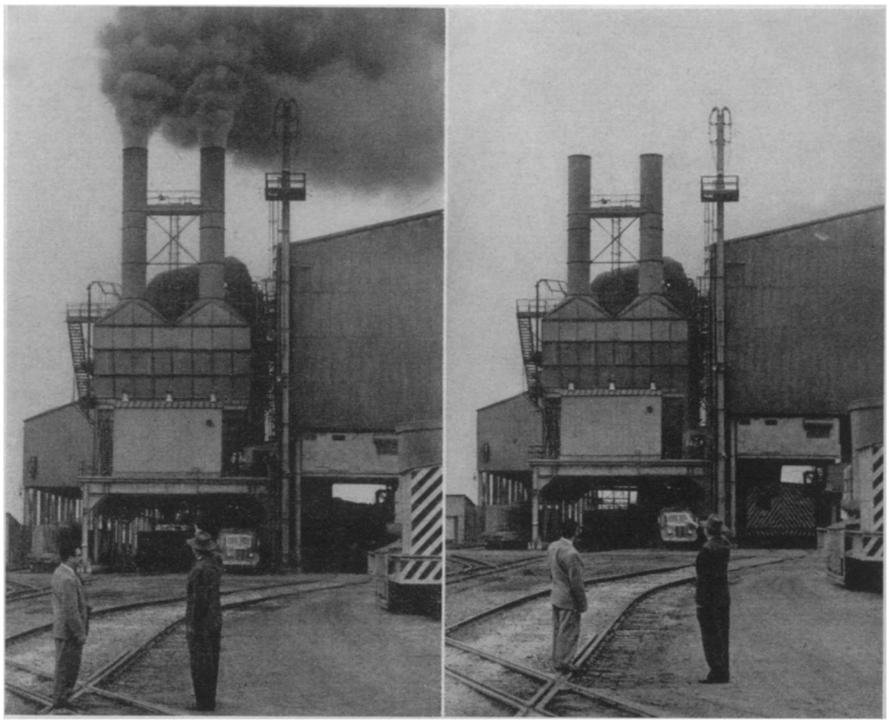
When coal is burned with a good draft of air, the black fuel is entirely consumed. Carbon dioxide, a colorless, odorless gas, goes up the chimney. Whatever rock-like material was quarried and shoveled into the furnace along with the coal is left behind as the ash.

When coal is burned with less than enough air for complete combustion, carbon monoxide, a deadly poison, is formed with or instead of the dioxide. Along with these hot gases, fine coal dust rides the draft up the chimney, and pours out as a black cloud that hovers in the upper air until spread by the wind.

Sooner or later, these fine, solid particles settle back to earth, and coat the housewives' possessions with a film of sticky black dust, no matter how carefully they were put away.

Black coal dust was believed to be the chief offender in smoke studies until, in the early part of the present century, Frederick G. Cottrell devised a means of giving a static electric charge to dust-carrying gases escaping from industrial chimneys. When this process of electrical precipitation was put into use, all sorts of valuable by-products, including sulfur compounds, potassium salts, volatile metals, and many others, were recovered from industrial stacks. These materials were saved from becoming a nuisance, and returned as money in the pocket to the manufacturers. But there were still "practical men indisposed to depart from the beaten track."

Gradually, however, sentiment built up in favor of cleaning up the air over industrial cities. Pittsburgh and St. Louis are among those which have made notable improvement. But industrialization has spread into new areas, and many new products find their way up industrial chimneys. Frantic speed-up during the war years allowed some laxity from the best practices of smoke control.



SMOKE CONTROL—Clouds of smoke billow from the chimneys of this industrial plant when the smoke abatement apparatus is turned off (left), but with the flick of a switch this nuisance vanishes (right). Such smoke control installations help avoid danger of smog.

Hazard of dirt, suffocation and poisoning from carbon fuels and industrial wastes has been with us a long time. Measures have been devised which, if conscientiously carried out, can be protective. Filters and "scrubbers" supplement electrostatic precipitation. Air contamination can be kept to a minimum when a really concerted effort is made to do it.

With the introduction of nuclear fuel into industrial power plants, hazard is increased by a new dimension of danger. Just as the film of black dust from carbon-burning furnaces permeates everything, to the housewife's despair, a similar fall-out comes from the tall stacks of atomic energy plants.

Invisible Dust

This dust is colorless, and so fine as to be nearly invisible. It adds to the total of radioactivity in our surroundings. On account of the increasing amount of radioactivity in this atomic age, we may all come to wear the indicating badges now used only in laboratories dealing with radiations on a large scale.

The mere fact that radioactive material is abroad in the air need not necessarily cause alarm. The important question is how radioactive. For the answer, sensitive instruments must be used, for we are blind, deaf and insensitive to this hazardous dimension of matter.

The "practical man" who is ignorant of the danger may disregard the advice of experts if he is allowed to. He may locate his atomic energy plant where moisture and prevailing air currents could join forces to produce the ultra-modern horror, a radioactive smog.

The seriousness of even ordinary air pollution was brought home to the American people by a spell of smog in Donora, Pa., one October day in 1948 which cost the lives of many people. "Temperature inversion" as a factor in smog formation became a familiar term when studies of this catastrophe were published.

Temperature Inversion

Normally the temperature of the air becomes lower the greater the distance above the ground. But when cool air slides under a layer of air that is warm and moist, especially after several hot, muggy days with no wind, this temperature inversion causes the fog that, mixed with smoke, becomes smog.

Deep narrow valleys are especially liable to temperature inversions in the autumn. Once a pocket of stagnant air has formed in this way it tends to remain until some decided change in the weather breaks it up. Locations where temperature inversion occurs frequently need more than tall chimneys to solve their smoke disposal problems.

The Los Angeles-Pasadena area in California is one where smog conditions occur. In September, 1946, on Friday the 13th, as it happened, a particularly bad smog was impolitic enough to occur on the very day the city fathers had chosen to open a clean-up-your-city campaign. "Black Friday," as this day of smog is remembered, started controversies over who is to control whose smoke that are still raging.

Research programs have been undertaken to try to find the substance in smog that causes eye irritation. Such suspects as acrolein, hydrogen persulfide, elemental sulfur and mineral oil droplets have been squirted at volunteer martyrs to science. Tears have been shed, but the ultimate quintessence of smog has yet to be synthesized 100%.

Studies of the smog problem have turned up surprising sets of statistics of what the minor constituents of the atmosphere may be. One authority says that from one to two thousand tons of hydrocarbon materials are released into the air each day in the Los Angeles region. These hydrocarbons come from evaporation losses during gasoline manufacture and from the products of incomplete combustion in automobile engines. Other combustion processes are said to give off oxides of nitrogen to the amount of 200 to 300 tons daily. A similar amount is probably present in the exhaust gases. Ozone in the air is said to shorten the life of rubber, including automobile tires, on the West Coast more than in other places. And householders burn thousands of tons of trash.

Atomic Plants

But what of the switch to power from nuclear fission?

Atomic energy, as it is now being harnessed, substitutes the heat from nuclear fission for the heat of combustion. Combustion of coal, gas or petroleum products results mainly in carbon dioxide, a non-poisonous gas which cools rapidly to the surrounding temperature and is ultimately used by plant life with the aid of photosynthesis.

Although an atomic reaction is often called a furnace, its method of operation and its results are entirely different. When isotopes of thorium, uranium or plutonium fission, they give off in quantity new radioactive elements otherwise so rare as to be almost non-existent. These bring only trouble to the plant or animal that assimilates them.

These fission products are "hot" in the sense of the physicist's slang, meaning that they are disintegrating by giving off a great deal of atomic radiation. If they give this radiation off fast, anything in the neighborhood receives a lot of radioactivity in a short time. This can be very harmful. If, on the other hand, fission products are formed which give off their radiation slowly, it will last a long time. Some radioactive isotopes recently set free in the world will take a longer time to die down to relative inactivity than the time man has inhabited this earth so far.

The effect of radiation on man or other living creatures adds up. But the sum is an algebraic one, with plus and minus terms. Every cell is constantly turning over a great number of atoms, building food into its structure, discarding wastes. Thus even

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a relatively heavy dose of radiation can be repaired quickly if stable atoms are available to replace the "hot" ones. But the body can make no choice in this matter, for it has no way of distinguishing between a stable atom and a radioactive one of the same species.

The body does not even use much discretion in distinguishing between atoms of chemically similar elements. It will build a handy atom of radioactive strontium, a dangerous fission product, into living bone instead of the more normal stable calcium. That strontium atom will bombard all the tissues around itself with its radiations, and may stay in the bone for a long time.

Every radioactive isotope has its own characteristic rate of disintegration. All disintegrate according to the same law. Half of the radioactivity dies away in a period of time peculiar to that atomic species of element. For one the time may amount to microseconds, for another thousands of years. There are all sorts of rates in between.

Many fission products have short half-lives and are very "hot." One way of disposing of these, so far, is to waft them up a very tall chimney so they may be spread far and wide by the wind. Since they are very fine particles, they take a long time to settle back to earth. By that time the worst of their radioactivity has had time to die away. What is left may not be greater than the "background" in which we live constantly.

However, as atomic energy installations increase the problem will become like that from present-day industrial plants.

The potential hazard to life will be enormously greater. Today's "practical men," like those of a century ago, raise a political hue and cry against efforts to make them stop wasting their own resources. Before they are entrusted with the makings of radioactive smog, our best technical effort must be used to prevent that damage before it has a chance to happen.

Science News Letter, May 7, 1955

• Books of the Week •

For the editorial information of our readers, books received for review since last week's issue are listed. For convenient purchase of any U. S. book in print, send a remittance to cover retail price (postage will be paid) to Book Department, Science Service, 1719 N Street, N.W., Washington 6, D. C. Request free publications direct from publisher, not from Science Service.

ALUMINUM PAINT AND POWER—Junius David Edwards and Robert I. Wray—*Reinhold,* 3 ed., 219 p., illus., $4.50. Research and technological progress in this industry has made revision necessary.

AMERICAN AGRICULTURE: Its Structure and Place in the Economy—Ronald L. Mighell—*Wiley,* Census Monograph Series, 187 p., illus., $5.00. Based mainly on the 1950 Census of Agriculture and related material prepared in the Bureau of the Census, Commerce Department and the Agriculture Department, this book is addressed to the lay reader who is interested in agriculture.

THE BIOLOGY OF THE AMPHIBIA—G. Kingsley Noble—*Dover,* 577 p., illus., $4.95. An unabridged republication of a book originally published in 1931.

CANCER THROUGH THE AGES THE EVOLUTION OF HOPE—Francelia Butler—*Virginia Press,* 147 p., illus., paper, $1.00. The history of our knowledge of and our superstition about cancer from Biblical times to the early part of the 20th century.

CIGARETTES = LUNG CANCER?—Pat McGrady—*Public Affairs Committee,* Public Affairs Pamphlet No. 220, 28 p., illus., paper, 25 cents. The science editor of the American Cancer Society surveys the scientific evidence in the cigarette-lung cancer controversy.

FOURTH ANNUAL REPORT ON STRESS—Hans Selye and Gunnar Heuser, Eds.—*ACTA,* 749 p., illus., $14.34. Published annually to review the important problems and results of clinical and laboratory research in the fields of biological stress.

GREATER REUSE OF INDUSTRIAL WATER SEEN—Richard D. Hoak—*Mellon Institute,* 5 p., illus., paper, free upon request to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. By 1975 industrial water requirements will be 170% greater than in 1950, thus making industrial reuse a major factor.

A HANDBOOK OF SAILING BARGES: Evolution and Details of Hull and Rigging—F. S. Cooper—*Adlard Coles (John de Graff),* 112 p., illus., $2.50. Describing and illustrating the detail of hull, rig and fittings of sailing ships.

LAND JUDGING—Edd Roberts—*University of Oklahoma Press,* 120 p., illus., $2.50. "There is no doubt," the preface states, "that land judging is as important as livestock judging, and perhaps more basic and fundamental, in this epoch of our agricultural development."

LIFE SCIENCE: A College Textbook of General Biology—Thomas S. Hall and Florence Moog—*Wiley,* 502 p., illus., paper, $6.50. Designed to be used for a one-year biology course or a course which offers botany and zoology in sequence. Beautifully illustrated.

METHODS FOR EVALUATION OF NUTRITIONAL ADEQUACY AND STATUS—Harry Spector, Martin S. Peterson and T. E. Friedemann, Eds.—*Advisory Board on Quartermaster Research and Development,* 313 p., illus., free upon request to Quartermaster Food and Container Institute for the Armed Forces, 1819 West Pershing Rd., Chicago 9, Ill. A symposium sponsored by the Quartermaster Food and Container Institute.

MONKEYS—Herbert S. Zim—*Morrow,* 64 p., illus., $2.00. Telling children about many varieties of monkeys found the world over.

PLASTICS IN BUILDING—Charles R. Koehler, Ed.—*Building Research Institute,* NAS-NRC Publication 337, 149 p., illus., $5.00. Comprising the views expressed at a conference conducted by the Building Research Institute, October 27 and 28, 1954, concerning the past, present and future uses of plastics in the building industry.

POPULATION GENETICS—Ching Chun Li—*University of Chicago Press,* 366 p., illus., $10.00. Primarily an exposition of some of the fundamental principles and theorems established in this field.

PRACTICAL ELECTROACOUSTICS—Michael Rettinger—*Chemical Publishing Co.,* 271 p., illus., $10.00. Describes and analyzes the essential units of audio-communication equipment for those who desire to obtain a broad idea of the principles and practices of applied electroacoustics and who wish to have a variety of working formulae and design curves.

THIS IS THE BEAGLE—George D. Whitney—*Practical Science Publishing (Garden City),* 252 p., illus., $3.95. A veterinarian describes the care of this breed of hunting dogs from the selection of a puppy to the training of a field champion.

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PHYSIOLOGY

Bird's Eyes Superior But Man Uses His Better

➤ SOME BIRDS have far better eyes than does man, Prof. Samuel R. Detwiler of Columbia University told the American Philosophical Society in Philadelphia.

But man can make far better use of his eyes because they are connected to a brain with superior visual cortex which enables him to make visual judgments and interpretations impossible to the bird, Prof. Detwiler said.

Many deviations in the structure of the eye in various animals, birds and fishes fit these creatures for their different environments, he said, particularly the light-collecting devices of night-prowling animals.

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