# ATMOSPHERIC TRADE WASTES[1]

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A DISTINCTION must be made between pollution by atmospheric trade wastes which reach levels toxic to man and those in which concentrations fall below human thresholds, do not effect health, and are simply a nuisance to our general economy. Antismoke campaigns never have real success when complaints are based on damage to health. If an odorous substance escapes into the air the complainants generally must base their plea for relief upon the nuisance resulting and not upon damage to health. But if crops, fruit trees, or cattle are damaged the offender will get little sympathy, redress is apt to be prompt and may be very costly.

## COAL SMOKE

There is an old Scotch message of good will to a young married couple: "Lang may your lum reek"—long may your chimney smoke. Smoke denoted prosperity. England, Wales, and Scotland have traditionally enjoyed the luxury of individual fireplaces for each room. No one minded having a chimney let forth thick black smoke. When their winters are moderate, as they usually are, coal is plentiful, and one dresses for their conditions; their lack of central heating is no handicap to pleasant living. But when the weather misbehaves or there is a coal shortage as during this past winter, results are very bad.

Engineers know well the fuel economy which results from burning either coal, oil, or gas in central stations, raising steam at the power house, and selling it to buildings within reasonable distance. District heating of downtown stores is now common American practice. District heating of large suburban housing projects has been enormously extended all over this country and has proved to be very popular with both the small and large householder. The result is the efficient use of the fuel and the elimination of a multitude of small household furnaces.

Increasing use of oil and gas, manufactured and natural, for domestic furnaces has shown the individual householder the conveniences of automatic heating. Coal companies are countering this obvious trend by developing automatic coal stokers for the householder—equipment long in use in power plants. What the future in this field will be in the next 20 or 30 years is unpredictable, but one thing is sure—smoke pollution is certain to be reduced and our Scotch proverb will have to be modified.

It is not a simple matter for any large community to change its heating practice. One cannot introduce by a wave of the legislative wand electrically driven locomotives into a busy city like Pittsburgh or St. Louis. It takes years of careful planning. The job of modernizing the heating practice of a British industrial community, like Manchester, is appalling. But these changes have been made in the past and many more of them will be made in the future.

The stress of war brought to us some pollution problems which could not very well have been anticipated. I know of a large manufacturer of food products whose output was nearly all taken by our armed forces. The factory had a modern oil-burning power plant which gave no trouble to the neighborhood, largely a suburban residential area. Suddenly the plant was ordered to change over to powdered soft coal because of the oil shortage. The plant applied at once for the equipment necessary for a Cottrell precipitation unit to catch the fly ash they knew would be emitted from the stack. Permission was refused on the ground that the materials necessary were needed elsewhere. The neighborhood was up in arms and protested, but Washington stuck to its edict and told the citizenry to stop complaining and to bear up patriotically with a bit of pollution. It would not hurt anyone but would, admittedly, be a trying business. Complaints were brought to the local smoke commission and samples of dust, allegedly from the company's stack, were submitted. The case was dismissed and amusingly enough was not reheard until the company unexpectedly was allowed to reconvert to oil. This change they made promptly and quite without publicity. Then to our great delight the complainants brought us into court and submitted samples of dust from the front porch of a house near the power plant. Most of the dust consisted of granite, the prevailing road rock of the district, and could not possibly have come off the stack of the power plant. When convinced the company actually was burning oil as in former years the complaints were dropped.

Examination of the dust samples in the above case showed the great difficulty in proving where fly ash came from. It is well known that fly ash from powdered soft coal consists mostly of tiny glass-like spheres, varying from colorless to black, according to the amount of occluded carbon. The actual carbon content of these spheres is very low as combustion in the power plants is efficient. But the spheres can travel miles. It is virtually impossible to tell which spherical particles come from locomotive stacks and which from power plants. Their appearance and analyses may be identical. It would be interesting to introduce a foreign chemical,

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like $BaCl_2$, into the coal as a tracer, or perhaps a radioactive isotope. Either substance would enable one to follow the spread of the ash by appropriate micro or radioactive tests. We have long wanted to carry out such studies but so far the opportunity has not arisen.

One can operate a power plant at high thermal efficiency and still have very serious pollution troubles. If the coal has 5 or 6 per cent sulfur, like some of our midwestern coals, the stack gases may emit enough $SO_2$ gas actually to burn crops. In order to avoid this the sulfur must be removed before combustion of the coal, or the $SO_2$ scrubbed out and the wash water neutralized, or made into sulfuric acid, or else sent up through a stack of sufficient height to prevent the burning of crops on the ground. There is no easy way out and certainly no cheap way. This is not an imaginary case—the problem is modern and actually has arisen. It is no great surprise to the nonferrous metallurgical industry which long ago was forced by law to account for its $SO_2$ stack emissions.

Likewise, power plants collecting fly ash are faced with a bothersome disposal problem. Fly ash has to be carried away and dumped. So far efforts to use it for filling, ballast, or building blocks have not been very successful.

## THE METALLURGICAL INDUSTRY

This industry looks with something like curiosity on other industries that pollute the air with trade wastes and show no particular intention of doing anything until forced by law. Postponement of corrective measures can be disastrously expensive. The time to apply corrections is when the plant is on the drawing board and not when it has been built.

The copper, lead, and zinc smelters in the United States often handle ores and concentrates containing sulfur and arsenic. These elements must be separated from the other metals, and neither one can be sent indiscriminately up the stack. Both have a certain market value, the sulfur for sulfuric acid and liquid $SO_2$ and the arsenic mostly as an insecticide in agriculture. Fortunately for the industry there is every indication that the market for sulfuric acid within areas near the large smelters is rapidly increasing while that for arsenical insecticides is holding up well.

However, it is well known that the metallurgical industry could not have disposed, in past years, of all the sulfuric acid it could have made. Inevitably much of the sulfur dioxide formed in roasting concentrates was sent up the stack. If this is to be done, it is obvious that the stack height must be great or dangerous concentrations at ground level are inevitable. This state of affairs forced the metallurgical industry to erect stacks over 500 feet high, the tallest in all industry. I know of a plant now seriously considering the erection of one over 750 feet.

Plants having such $SO_2$ problems are forced to measure routinely and to record automatically the composition of stack gases. There is nothing surprising in such a routine, which one might compare with the recording of $CO_2$ in power-plant stack gases or the recording of the calorific power of producer gas. But suggest such a procedure to the oil industry, to synthetic rubber, or to the chemical industry around Niagara Falls, Detroit, or Los Angeles and they will tell you the idea is academic.

I know of an instance in which oil refineries, built along conventional lines, were operating near a smelter which recorded $SO_2$ at ground level. When it was apparent that the refineries were emitting $SO_2$ as well as $H_2S$ and other sulfur gases, the smelter arranged its recorders to register both $SO_2$ and $H_2S$ and so proved where the guilt lay. Suggestions to the refinery during the war years that systematic ventilation of odorous processes and venting of gases up high stacks were advisable fell on deaf ears.

## THE CHEMICAL INDUSTRY

The manufacture of viscose rayon is an example of a chemical industry which has a serious atmospheric pollution problem and has consistently done something about it. Rayon plants hood all operations and exhaust large quantities of gases through stacks high enough to avoid gas concentrations which are bothersome at ground level. Also economy of operation in rayon processing suggests such hooding coupled with recovery of solvent vapors which would otherwise be vented to the atmosphere.

Every laboratory worker knows that you do not paint the inside walls of the lab with white lead paint because it soon will be blackened by $H_2S$. Discoloration of nice white lead paint jobs on the outside of houses is a familiar annoyance to plenty of chemical industries. It is known to oil companies and has even been laid at the door of rayon manufacturers who allowed their waste water to carry off $H_2S$ in solution and then had the annoying experience of having the $H_2S$ liberated at a considerable distance downstream when hot water was discharged into the same stream by another plant.

Many industries, such as the dry cleaning, lacquering, coating, embossing, and coloring of fabrics, use large quantities of volatile organic solvents. In many instances the solvents are evaporated by artificial heating and recovered by condensation in water sprays or by passage through activated carbon or silica gel. Such recovery often pays for itself and at the same time avoids the pollution nuisance otherwise resulting. An important item influencing the decision as to such solvent recovery is the fire risk.

## DUSTY INDUSTRIES

There have been several instances of pollution from the dried residue of expressed castor-bean dust that resulted in permanent injunctions against fertilizer plants engaged in that business. A certain small proportion of the general population is sensitive to that dust—so much so that minute traces can cause serious and temporarily incapacitating reactions to the sensitive individual. One of these fertilizer plants had complaints from persons living two miles away, while an-

other was closed down on complaints from a neighboring iron foundry. The offending plants surely could have been operated, without annoyance to the neighbors, if the original plant design had taken full account of the pollution risk.

This is one of the few examples I can recall of bad factory housekeeping resulting in demonstrable damage to health of persons outside the plant in question.

It is only within recent years that the manufacture of cement, one of our basic industries, began systematically to prevent the escape of dust to the neighborhood. The same comment could be made of the gypsum industry, but both handle dusts which happen to be singularly harmless if breathed. That fact will not appease the indignant housewife if the dust blows into her dining room.

The spread of coal dust from the tipple of a mine or even from a coal storage pile of a city power plant is an old story. Often it is an annoyance not easy to abate by simple means. The victims of such dust do not have to show that their health has been damaged—merely that the dust is a nuisance.

Two or three years ago complaints, which rapidly reached the level of hysteria, were leveled against one of our most famous mining areas on the ground that their hills of "chat"—siliceous gangue piles—spread silica dust around the community and thus exposed the nonmining population to silicosis. Happily the industry had learned a lot about silicosis through a number of years of bad experience and was able to show that dust exposures to the nonmining population were insignificant.

## FOGS AND CONDENSATION

We all know that traces of acid mists, such as HCl, HF, and $SO_3$, are powerful fog producers. Given the right meteorological conditions, such chemicals in trifling concentrations can produce outdoor fogs dense enough to tie up traffic. If the mists condense upon vegetation and damage to crops or foliage of trees results, the seriousness of the offense is even greater. New England's fogs are famous, but the West Coast has its troubles. A radio humorist once remarked that rain was no real worry in Hollywood but that sometimes the dew was so heavy it washed away the bridges. Not far from Boston I have seen condensation of trifling amounts of HCl—from pickling steel tape prior to electrogalvanizing—cause a heavy fog in a neighboring graveyard. The acid condensation upon foliage resulted in extensive replanting of trees, grass, gardens, and vines.

Fogs rising from streams carrying warm water from factories have been known to block traffic on bridges. Definitely this falls into the same general class as fogs of industrial origin.

All of us have read how fogs were momentarily dispelled over airfields in England during the war. Naturally, we expect fog control gradually to be applied to our own peacetime airfields. If we can cope with natural fogs and the vastness they imply, certainly we should be able to dispose of the comparatively trivial fogs made by industry.

Our Rocky Mountain plateau embracing the huge area from the Texas border well up into Canada is notably dry. Much of it is wonderfully adapted to raising cattle and crops of various kinds. The early settlers, especially the Spanish, in California proved what could be done by irrigation of our arid soil. This method of farming today is common in Mexico and in many of our flat dry regions west of the Mississippi. In such areas crop damage from condensed acid mists naturally is less of a problem meteorologically than would be the case in coastal New England or around Portland or Seattle on the Pacific coast.

The aluminum industry is not old, but it has become very important and seems likely to increase. Fluorosis of cattle from eating grass contaminated by HF from the aluminum industry has lately been a very serious problem in regions near Portland and Tacoma on the west side of the Cascade Range. On the other hand, the aluminum industry's record is good in eastern United States. The difference seems to be purely climatic—near Tacoma the grass is green all year, the humidity is high, and if HF or other soluble fluorides are condensed upon leaves or grass, it is ingested by the cattle. If these same cattle eat uncontaminated hay they are unaffected by the atmospheric HF. Workmen in the plants apparently are unaffected. A similar state of affairs is reported around Ben Nevis in Scotland where serious fluorosis occurred in sheep grazing near an aluminum plant.

Unlike the nonferrous heavy metal industry the aluminum industry had no tradition of hooding its electrothermic operations and venting the fumes through central stacks. The operational changes incident to controlling such a trade waste problem are difficult to make, but damage to cattle and crops cannot be ignored.

The most vexing air pollution problems today are those of large cities. Frequently these problems are seasonal and vary greatly from winter to summer. Los Angeles furnishes a good example—a huge city extending over a tremendous area—wonderfully favored by nature, developed originally as a residential and agricultural district, then suddenly and unexpectedly transformed into a very important center for the oil industry. Today one can start from the center of the city and drive out through as unique a collection of stinks and smells as one will meet anywhere.

Not far from my own home in Cambridge we have a city dump and near it an abattoir which compete in emitting a really remarkable conglomeration of malodor. A critical sniffing trip across the marshes from Jersey City almost to Elizabeth and again from Philadelphia to Wilmington might make the Los Angeles resident feel as if his own manufacturer had learned but little of the gentle art of making bad smells. It's a shame Mark Twain had no chance to describe some of these scenes because he understood their possible implications so well. Writing about Civita Vecchia, a town a few miles northwest of Rome, he says "The people

here live in alleys two yards wide, which have a smell about them which is peculiar but not entertaining. It is well the alleys are not wider, because they hold as much smell now as a person can stand, and of course if they were wider they would hold more, and then the people would die."

The corrective measures applied by the democratic processes in our large industrial cities are slow. It's a good thing they are because no one is wise enough to formulate the answers quickly and no community can stand the expense of drastic changes. Often it's impossible to show that trifling concentrations of odorous substances in city air harm anyone, but that need not excuse their presence. I am strongly in sympathy with legislation which makes an industry accountable for its trade wastes and for their control. There is no more excuse for promiscuous air pollution than for pollution of water supplies or of soil. In the past we have been greatly favored by cheap land—we could erect a factory out on the marshes and do whatever we wanted. Industry profited by the encouragement advanced by enterprising industrial communities. But when industry interferes with general comfort of a community, its original welcome quickly is worn out. Today we have become accountable for our sins of emission and industry had best see to its housekeeping.