# Resourceful Waste Management

## The air, water and land are becoming so polluted that some of their effects may soon be irreversible unless prompt action is taken

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➤ THE AMOUNT OF STUFF we throw away on our land, air and our water is becoming so staggering that the spectre of pollution will haunt every corporation in the country. There are two ways to go—we can go on the way we have been going and have taxes and government controls increase to "dispose" of wastes, or we can look at waste as a resource and the possible basis of huge, new industries.

Either way—a new kind of economics will emerge—on the one hand, if industry does not tackle this with its own initiative and imagination, such burdens as taxes at the source and effluent taxes will be imposed. On the other hand, if we move toward a giant industry dedicated to the reuse of residues, we can not only keep our environment clean but do so on a productive basis.

Really, an individual industry may find it hard to cope with a particular waste problem but an association of different industries can tackle the problem as a system. Symbiosis in biology in its simple form is where the tick birds ride on the rhinoceros' back and live on his parasites, thereby keeping him clean. Can we think up combinations of industrial symbiosis where different wastes can be combined at least to neutralize each other and at best to make something useful?

Pollution alone is going to affect the whole economics of industry—from original design, to different marketing concepts, abolition of the consumer as we know him, coupling collection inlets with distribution outlets, mass disassembly as well as mass production, and reuse and stockpiling of discards, instead of disposal and urban renewal.

An excess or overconcentration of anything can constitute or result in pollution. It is the excess or overconcentration of people that is the real pollution problem on earth. All of what is said below are the side effects of the major problem of people pollution.

(Dr. Spilhaus then quoted the following excerpts, slightly amended, from the National Academy of Sciences special report on resources, titled "Waste Management and Control.")

### Pollution Defined

Pollution is an undesirable change in the physical, chemical or biological characteristics of our air, land and water that may or will harmfully affect human life or that of other desirable species, our industrial processes, living conditions and cultural assets; or that may or will waste or deteriorate our raw material resources. Pollution comprises the residues of the things we make, use and throw away.

Pollution increases not only because as people multiply, the space available becomes smaller, but also because the demands per person are continually increasing, so that each throws away more year by year. As long as we want to sell more things so that people may live in greater ease, the corollary is that they will throw more away.

As the earth becomes more crowded, there is no longer an "away." One person's trash basket is another's living space.

With technological advance, the variety of goods that we use increases, too. New materials and chemicals result in thousands of new pollutants whose harmfulness is sometimes known, but sometimes only suspected.

If all the world's pollution were evenly distributed over the earth's surface, most of it probably would still remain unnoticed and perhaps harmless. But the fact is that as people live increasingly in city concentrations, their residues also concentrate there—and it is there that the problems become most acute.

It is difficult to assess the magnitude of the problem. It is estimated, for example, that even with efficient waste treatment, by 1980 our effluents would be sufficient to consume all the oxygen of all the flow in dry weather of the 22 river basins in the United States.

Chemical poisons are being produced in new forms so fast that the toxicologists cannot keep up with them. The air and waters that transport our wastes are, in many areas, at or about the saturation level that is tolerable with respect to using the air and water for other purposes. The cost of providing transport for the wastes by other means, such as sewers, increases by a staggering amount each year.

Many of the debilitating effects of a dirty environment on human beings we cannot assess, physiologically or psychologically. The hidden costs of people's lost time—and the accompanying expenditure of resources—traveling to work and returning to pleasant or perhaps only bearable homes, or to find open spaces for recreation are also increasing. The problem is of the utmost urgency because many of the effects of pollution on our environment may be irreversible or, at least, take generations to correct—even if we start right now.

No one can dictate what degree of cleanliness the environment should have. It is a matter of the informed choice of the people. Cleaning up costs money. What price are we willing to pay? How much cleanliness can we afford to buy?

These choices must be made on an assessment of relative values of the different uses to which we want to put the environment. We must balance the extra costs of the things for living comfort and convenience that our factories, power plants, cement works, oil refineries and other industries give us against the worth of reducing the unpleasant and harmful effects we suffer from the pollution of the atmosphere.

To insist on clean air is meaningless. How clean? At what cost? And for what purpose?

Even before man there were occasional excesses of natural pollutants, such as too much volcanic ash or too much water. A little solid material in the air—salt nuclei and dust—is essential for natural rain. Too much—a great dust storm—is a pollutant. Too little water causes droughts and famine; too much results in floods and famine. So it is with man-made pollution.

There is a necessary and right amount of each pollutant that society

will tolerate; and because of the varied uses of land, air and water, the right amount is not the same everywhere. Higher tolerances may be desired where the community wishes to exploit the benefits of industrialization—but not too high. Lower tolerances are a goal for recreational areas—but not impossibly low.

The right amount of pollution must be planned with criteria set somewhere in between the ideal of complete cleanliness and the havoc of uncontrolled filth. The right amount involves a calculable risk to society. It depends on where we are, what use we want to make of the environment and what quality of cleanliness we can afford or can manage to pay for.

In assessing the right amount, we must consider the capacity of the environment to assimilate residues, and this varies widely with the geography, geology, hydrology and meteorology of the locality. Certain areas which are frequently overlain with stagnant air are pollution-prone. Others, with frequent high winds and low humidities, can cope with much more of our effluents. The difference between a stagnant situation and a windy situation at one and the same place may increase the amount of pollutant resident there by an amount anywhere from a thousand to ten thousand times.

Where the residues are potentially reusable natural resources, such as discarded iron, the right amount can be great if it is concentrated and stored instead of being allowed with increasing entropy to be dispersed irretrievably, such as by rusting. The right amount can be greater, at least temporarily, if what we do to the environment is reversible.

If we stopped polluting a part of our environment, how long would it take nature or engineering intervention to restore conditions to the state we would like them to be? For example, iron, a non-renewable resource concentrated in ores over millions of years by geological processes, if allowed to corrode or disperse is irretrievable. But polluted rivers may be cleaned naturally after the polluting practice is stopped.

The degree of irreversibility comes into the disposal of containers, too. The latest aluminum cans, unless collected, will litter and pollute long after the earlier steel, "tin," cans rust away. Many plastic wrappings and containers will plague us much longer than paper and cardboard litter.

To make these choices, criteria must be established based on objective measurements of the effects, including the time to correct our mistakes—reversibility. Evaluation of these measurements must give us a variety of criteria that we can apply to various uses of the environment. Then once people have decided by choice the priority they wish to put on these various uses in their particular community, standards can be set.

The difficult job of deciding the right amount of pollution must be approached from a systems point of view. First, it depends on the social system. An economically well developed country, such as the United States, even though it has masssive industry, can afford to set higher standards of cleanliness than less developed countries which are beginning to be industralized. In smaller communities it depends whether they choose to devote themselves to agriculture, tourism, industry or whatever else.

Los Angeles Times

HEAVY SMOG—A heavily trafficked Los Angeles freeway is shrouded in smog.

The systems approach must also consider the interrelationship of land, air and water. Too often municipalities get rid of solid wastes by incomplete burning, which may solve the land disposal problem but fouls the air. We must consider the assimilative capacity of water, air and land as an entity—something that has a unitary and self-contained character—and in relation to the plants and animals that live there. The assimilative capacities vary with such things as the tidal flushing of bays, the flow of rivers and the windiness of the locality.

For example, meteorologists now say that Appalachia is one of the most pollution-prone areas in our country. But long before any industrialization, the mountains were called the Smokies because so stagnant was the air that the terpines exuded by the trees hung visibly over them, even then. If this area is to be industrialized, activities should be restricted to those which will not produce excessive burdens of waste.

There are all kinds of technical improvements and systems that are available right now, and that are different from the age-old procedure of just spreading our refuse around in the hope that it will not be noticed.

If we applied what we now know to get more complete combustion in incinerators, power plants and automobiles, just this would go far to reduce air pollution. In cities, at least, the massive producers of pollution are concentrated, and we could experiment on more complete ways of collecting and concentrating residues at the source. It is more difficult with moving sources, such as automobiles.

We know many ways to transport our solid refuse besides the conventional ones—dry sewers, for example—or if water is used, loading it to a maximum with the wastes so that there is a minimum of dilution.

A city is like a person, it does not consume much of anything, especially after it has stopped growing. All kinds of material and food come in and are transformed and used. The converted materials and the residues must go out.

The input is by rail, truck, and ship; the residue output is by garbage-scow, truck, sewer, or by natural river or wind. This means that many rail cars and trucks are loaded only one-way—in. Can we not separate and package residues and use this dead-heading transport to take them out?

The question of "where to take them" has also to be answered. Should we strew all useful organic wastes on sterile desert land? Should we build mountains of scrap iron on flatlands where a hill that might be mined in the future could be an asset in the meantime? Surely we can find ways to use clean waste heat to intervene constructively in the ecology of our waters.

There is no opportunity to experiment and test innovations on a large enough scale. The massiveness and urgency of the problem justify large-scale experiments even in new experimental cities or in any of the dispersal plans to solve the problems of the cities. New and different engineering systems must be built and tried.

## Why Save the Cities?

Trying to save the cities? What for? Urban renewal—should it not be urban dispersal, thus reducing the fundamental cause—concentration and excess.

(Dr. Spilhaus then cited a cover of TIME magazine, showing the Secretary of Housing and Urban Development, as

an example of the kind of urban renewal being done that will lead to more slums within less than 50 years. The cover showed a sleazy brick building with a broken window in a dark shadow on one side, rebuilt and repainted with a venetian blind in the window on the other side.)

The problem of the city is excess, which is pollution. Too many cars for the roads, too many children for the school buildings, too many people going at the same time—there and then back—for any present mass transportation system, too much sludge for the sewers.

Building to meet all these needs is always behind—like Alice in Wonderland, we run fast but continually run behind. Radical new solutions are required.

We have huge Federal highway programs—building more of the same and generating more space for more cars to clog. The provision of school and university buildings to impound the flood of students preoccupies educational administrators—so that they develop what has been described as an "edifice" complex and have not time to think about education. We have a large Federal concern about mass transportation, yet radically new ideas are rejected because they do not mesh with the existing mess!

Most consideration of waste proposals are studies of what the burden is if we continue to go the same way we have gone in the past. And most such studies end up with the conclusion that we will never catch up. Here too we need to try radically different solutions.

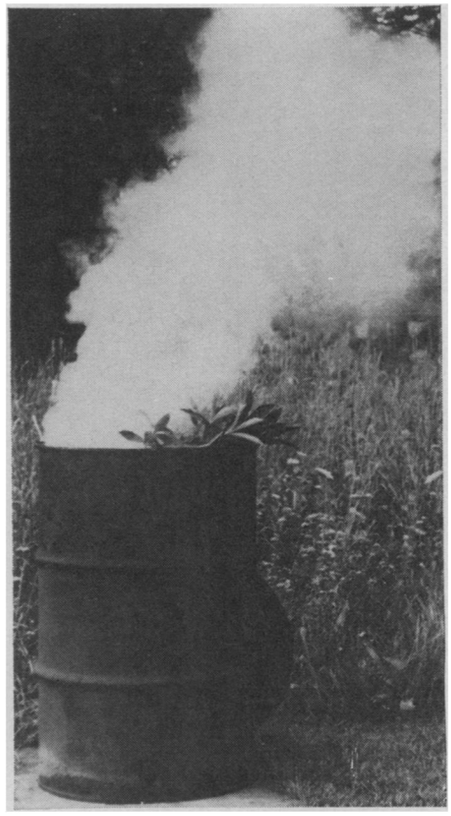
At the same time we are mass producing cities in the United States and developing countries are mass producing them even faster. These cities continue to grow like organisms, in part healthy, in part cancerous.

With population increasing at 3 million a year in this country alone, we are building the equivalent of 12 new cities of one-quarter of a million people each year. Shall we build new cities or shall we just continue the costly business of so-called urban renewal—allowing unorganized growth in cities that are already too large, thus creating the slums of tomorrow?

We have learned in the United States that before one mass produces anything one should build experimental prototypes—why not build an experimental city? Exempt from old-fashioned codes, built like any experimental model where if an idea fails, it can be disassembled and reworked. Experimental cities built on the concept that a city is a machine for living and working and, like any machine, is designed for a certain capacity. When it reaches full capacity, you add another machine for living and working—another city and do not overload the one you have.

The Federal government has built cities—de novo—Los Alamos, Huntsville and the Manned Space Center. These are artificial, single-purpose communities. We need, in order to get the experimentation necessary, to solve these problems of excess—to build an experimental city with the proper mix of people, industry and government, recreation and work; a city where we can experiment with new legislative and institutional practices. Only in this way will we have a laboratory for tackling our problems of excess.

As long as a large fraction of the money for running a city comes from real estate taxes, we have a built-in, ever-expanding spiral for further concentrating cities. To broaden the tax base, more people must be brought in so that higher and higher rise buildings must be built. Then to take care of these people, more sewers, highways and schools must be built, resulting in the need to further increase taxes, and so the process repeats itself. Industrial experience shows that it is often far more economical to build a new plant in a new location than to keep patching an old overgrown one. So, as long as the extra 12 million have got to be housed, educated and put to work each year, it may be far more economical to concentrate on urban dispersal in comparatively small new cities.



Albert Starkweather

PEACEFUL POISON—A single smoldering trash can seems innocent, but fumes drifting across the yard contain lethal chemicals that can wither flowers, stain house paint and endanger health.

## There Is No Consumer!

But at the same time, work must be started toward the ultimate system that closes the loop back from user to resource and reuse. Our whole economy is based on taking natural resources, converting them into things that are consumer products, selling them to the consumer and then forgetting about them.

There are no "consumers"—only users. The user employs the product, sometimes changes it in form, but does not consume it—just discards it. Discard creates residues that pollute at an increasing cost to the consumer and to his community. But if we close the loop from user back to resource so as to remake the discards, we approach an ultimate solution.

For example, a product such as an automobile could be designed in the first place with return-to-factory for remaking and reuse in mind.

Ideally, the system would be completely closed. All water would be purified and reused; all solid wastes would be sent back as resources for making more things. How can we distribute the added costs of reuse or of discards so as to provide incentives to steer manufacture toward directing original design toward maximum reuse, or minimum cost of discard?

We could design automobiles so that the steel could be separated more easily from the other materials. We might stimulate research on degradable paper, cardboard or other containers.

Should we tax glass bottles severely? Federal law forbids the reuse of liquor bottles, for instance.

May the future not bring a law requiring, instead, that they be re-used?

## Institutional and Social Aspects

In practice there will always be certain remaining residues—hopefully smaller and smaller fractions—that are unusable. These, instead of being dispersed, should be concentrated in residue mountains or caves. Residues would be separated as to type so that, in the event of discovery of a future use, they could easly be mined.

The technological problems, however, are not the main ones. We need new public policies and institutional arrangements before we can attempt many of the technological innovations.

When we looked at the Delaware River estuary basin, the Pennsylvania-New Jersey-Delaware complex, an area of about 5,000 square miles, it had about 500 municipal and county administrations and 5,000 civic organizations with conflicting interests.

The Delaware River itself is said to be "too thick to swim in, too thin to plow."

Watersheds are not outlined by state or other political boundaries, yet the problem of water pollution is one common to a watershed demarked by nature. Air pollution, similarly, is wafted across state and even international boundaries.

This points the way to defining and combining jurisdictions covering the area of the problem rather than accepting the limits of jurisdiction of individ-

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# • SCIENCE SHORTS •

## A miscellany of happenings and information in various fields the world over

The United States accounts for five percent of the world's annual commercial *fish* catch.

Massachusetts took its first population *census* in 1765, 15 years before the Commonwealth was officially established.

A February census of *Roos's geese* on their California wintering grounds reported 30,400 of the small birds once mistakenly thought to be in danger of extinction.

The grizzly *bear* is virtually gone from most of the United States, remaining only in a few areas such as Yellowstone National Park.

Continuous, steady *driving* even at relatively low speed, is likely to get a person to his destination faster, and more safely than spurts of speed interrupted by dangerous stops and starts.

*Emphysema* incapacitates one of every 14 wage earners between 45 and 60 years old.

Yearly Social Security pension *expenditures* for chronic respiratory diseases exceed $80 million.

Geologists surveying several Mediterranean and Middle Eastern countries will use remote *sensing techniques* to collect data on dry lake beds for natural landing areas.

Since the first reported case of congenital indifference to *pain* was made known in 1832, less than 50 such cases of lack of sensitivity have been diagnosed.

Crossbred yearling *rams* lived 20% longer than purebred Hampshire and Suffolk rams in tests in Glenn County, Calif., but the mortality of all the yearlings was a high 82% before the fifth breeding season.

Commercial power production at the *Hoover Dam* on the Colorado River began 30 years ago.

Chicken and turkey *feathers* contain 85% protein and are ground into "feather meal" to be used as a high-protein supplement in poultry feeds.

A total of 34,827,066 *hunters* and *fishermen* in the United States spent a record $138 million on licenses and permits during fiscal 1965.

Dairy scientists are trying to determine the reason why some white Italian *cheese* occasionally turns out to be pink.

In Switzerland in the early 17th century, the nuptial bond between royal families was culminated when the bride and groom broke a *pretzel* as they would a wishbone, the one with the largest piece supposedly getting his wish for their happiness.

India's Southwest *Monsoons* account for about three-fourths of the country's annual rainfall.

The physical bulk of *braille* literature is reduced by half using rotary machines that print solid plastic dots instead of traditional, hollow ones.

Prescription pharmaceutical *manufacturers* are the largest industrial employers of health-related research workers in the United States, employing 16,400 persons in 1965.

In an electric eel's *tail*, 5,000 to 6,000 voltage-generating cells, each with a capacity of .1 volt, generate electricity equal to 500 to 600 volts.

The fastest continental freight *train* in the United States, the Blue Streak Merchandise, travels from East St. Louis to Los Angeles, 2,452 miles, in 50 hours and 30 minutes, averaging 49 miles per hour including stops.

The Soviet Union has set *tea* self-sufficiency as one of its long range agricultural goals.

Greek smokers purchased a record 31.2 million pounds of *cigarettes* in 1965, an increase of nearly five percent from the 29.8 million pounds in 1964.

The U.S. Government is reopening its weather station on Ice Island T-3 floating about 350 miles north-northeast of Point Barrow, Alaska.

Fossil records show that *camels* existed in Africa and Asia three million years ago, but new fossil finds suggest camels were in North America 40 million years ago.

The large herds of fur *seals* that live off the Pribilof Islands, outside the Aleutians, were almost extinct until the close of the 19th century when they were protected by the United States after it bought the islands from Russia.



## Waste Management

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ual local and state governments. It is too easy to move to the other extreme and say that, because air and water cross state lines, all criteria, standards and enforcement with respect to pollution must be Federal. In fact, all levels of government—Federal, state and local—must play a role. Our concern here is for industry to take the initiative itself so that a minimum of jurisdictional control at any level is necessary.

It comes as a bit of a shock but we must get the word "consumer" out of our industrial vocabulary. The industry must re-consume its own residues after the "user" is finished with it. If American genius can mass produce automobiles and work out a magnificent distribution plan, cannot American genius, on a private enterprise basis work out collection, mass disassembly and reuse?

The trite reason always given for not doing so is that it is not economical, but the fact is that people are now paying staggering amounts for inefficient waste collection that does not even half solve the problem. If we close the loop from user back to the factory, the costs of waste management which are now hidden would be part of the cost of using and, I suspect, would be far less than what we pay today.

Closing the loop in this way is an entirely new industrial concept and will mean vast changes in original design, not only for marketing appeal and usefulness but for disassembly, reprocessing and reusefulness.

Basically, under this system, we would not be buying anything—we would be renting it. But when you think it over, this is not so different from what we do today with rapid obsolescence. The overt increase of rental systems is an indication that this is acceptable procedure already for users.

Waste collection, the reuse of waste as a resource, is an industrial activity that must grow. Whether it grows healthily in the private sector or whether government takes it over depends on what action your industries take.

The manufacturers' traditional job and successful enterprise has been through supplying people with the things that contribute to the "ease" of their living. A filthy environment loaded with the discards of ease causes "dis-ease"—sometimes in the physical sense, more than likely contributes to mental disease, but unquestionably to the larger definition of dis-ease as opposed to ease. Manufacturers must increase the scope of their job and consider what happens to their product after use—if you do not do it yourselves, government will do it by default.

Furthermore, with growing social consciousness, things that were luxuries, yesterday, rapidly become the human rights of tomorrow. And just as education has become a human right, so will the luxury of living in a decent environment.