The Public Health Aspects of Solid Waste Disposal

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IT HAS BEEN SAID a number of times in recent years by competent experts that this country is at least 10 years behind in coming to grips with the problem of environmental health.

These men—scientists and public administrators—point to the explosive expansion of our chemical industry, the surging trend toward living in cities or metropolitan areas, and the continued growth of our whole industrial complex, with its accompanying effect on the general environment.

These three movements, it is explained, have aggravated in increasing measure our problems of water pollution, air pollution, and radiation hazards and have created the need for additional work in occupational health safeguards, restaurant sanitation and general milk and food purity activities, and research into the dangers of the use of pesticides, among others.

Although I am certainly in agreement with the general assertion of our 10-year lag, I think it fair to say that in some of these fields of activity, such as water pollution control, our greatly increased efforts in recent years may have put us less than 10 years behind. In other fields, however, we are considerably more than 10 years behind. In this category I would certainly put the general problem of solid waste collection and disposal.

With its complexities, it may seem to some a little hard to classify solid waste disposal as an environmental health problem. The discussion proceeds almost immediately to the difficult questions of economics, engineering and city planning aspects, and other nonhealth angles.

It is necessary to remind ourselves, I believe, that disposal of solid wastes is fundamentally a health problem. Just as we who are concerned with this problem are conscious of the fact that no really new or radically different ideas have emerged in waste disposal operations for half a century, so we must also remember that 42 years ago one of the pioneers (*1*) in the field laid down three basic requirements for waste disposal; the first was "the absence of danger to public health." And it still holds true. In other words, the barriers and difficulties we face here are economic and engineering and jurisdictional, but the reason we are concerned is the protection of the public health.

Let us examine for a moment the nature of the various health factors that create our concern.

The most prevalent disposal system of serious danger to health is, of course, the open dump, with its flies and rats. Typhoid fever, cholera, summer diarrhea, dysentery, tuberculosis, anthrax, and opthalmia, as well as intestinal worms, can be transmitted by flies. The importance of adequate refuse handling in controlling those communicable diseases was long ago recognized.

The control of fly breeding through adequate garbage collection, elimination of garbage dumps, and proper disposal of feces are the first rules for the control of typhoid fever (*2*).

In addition, plague, murine typhus fever, leptospirosis, rat-bite fever, trichinosis, food poisoning, richettsialpox, lymphocytic chorio-

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meningitis, and rabies can be transmitted by rats and mice, while malaria, yellow fever, dengue, mosquito-borne encephalitis, and filariasis can be transmitted by mosquitoes.

Poor refuse handling commonly provides food for flies, cockroaches, and domestic rodents. Open cans and bottles catch and hold water in which mosquitoes can breed so that many individual citizens unknowingly but actively encourage the proliferation of these disease-carrying pests.

Many experts in this field have pointed out that garbage is usually the chief source of food for rats in urban areas (*3*). Food-handling establishments and grocery stores are particularly attractive to rats, but many rat infestations are supported entirely on improperly stored garbage. Limitations on food, water, or harborage are the only determinants to the size of a community's rat population.

The ability of flies to quickly find and oviposit on any suitable material, including garbage, is well known. The infestation of garbage in containers was studied in detail at Phoenix, Ariz., and it was found that *Phaenicia pallescens* adults displayed the ability to enter a garbage container through openings as small as one-eighth of an inch in diameter (*4*). Other studies (*5*) revealed that as many as 70,000 flies were produced per cubic foot of garbage exposed to ovipositing flies.

When flies infest garbage, the larvae are usually concealed in the garbage or in the lower part of the can so that the householder ordinarily is unaware of their presence. Although many of these larvae are carted away when the refuse is collected, studies have shown that during warm weather large numbers of larvae migrate from the cans before the refuse is collected. Campbell and Black (*6*), for example, found that an average of 1,128 fly larvae per can per week migrated from 30 refuse cans to pupate before the combined refuse was collected at Concord, Calif. During the 2 years of study, a maximum count of 23,208 larvae was obtained from one can in a single week. Of interest was the fact that low counts were obtained consistently from only two cans, apparently because one householder used a garbage grinder and the other always wrapped the garbage in newspapers.

The fly-infested refuse that is ordinarily collected during warm weather must be carefully handled to prevent fly production. In compacting the cover material at sanitary landfills to prevent fly emergence, a California study (*7*) showed that there were four essential factors to consider: soil that can be compacted, suitable equipment for compacting the soil, adequate range of soil moisture, and adequate thickness of cover.

Although no reasonable amount of uncompacted cover would prevent emergence (since house flies have emerged through 5 feet of uncompacted cover) only a 6-inch layer of compacted cover was sufficient to prevent fly emergence.

In addition to disease transmitted by vectors, air pollution is becoming a more serious problem. Open dumps, where burning is used to reduce the volume of solid wastes, almost always produce large quantities of smoke and odors. Improperly designed and operated municipal incinerators also contribute significant quantities of objectionable air contaminants. Added to these sources, backyard trash burners, on-site incinerators, and on-site open burning of bulky refuse contribute additional air contaminants in most communities.

One scientist (*8*) noted recently that, according to data collected in statewide air pollution surveys, "burning dumps cause air pollution problems in about 25 percent of the urban communities of the country. . . . They are the most frequently reported cause for localized air pollution problems."

Another study (*9*) investigated the source and nature of air contaminants which produce asthma in New Orleans. 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 associated with silica. All possible sources of this material were not examined; however, air samples taken at a dump in the summer of 1961 revealed large quantities of this particle.

Water pollution is also becoming a serious factor in this picture. Wherever refuse is deposited on land, the impact on surface waters or subterranean aquifers may be significant.

The available information concerning the ef-

fects of refuse fills on the quality of the adjacent ground water has been organized and reviewed by a research contractor for the California State Water Pollution Control Board (*10*). This study was done because the drinking water supply of a major city was becoming objectionable. The study showed that there are three basic mechanisms by which refuse fills can pollute the ground water: (*a*) direct horizontal leaching of the refuse by ground water, (*b*) vertical leaching by percolating water, and (*c*) the transfer of gases produced during refuse decomposition by diffusion and convection.

Further investigations were recommended on gas production and movement, leaching rates, percolation, and methods of controlling the movement of gas and water in landfills.

In an earlier study by the California State Water Pollution Control Board (*11*), it was concluded that the movement of water through incinerator ash dumps will leach soluble salts and alkalies from the dump. An investigation at a sanitary landfill (*12*) proved that ground water in the immediate vicinity will become grossly polluted by continuous or intermittent contact with deposited refuse.

Bacterial and organic contamination may be very limited in range, but chemical pollution, that is, mineral salts, may travel some distance before the effects of dilution are evident. Although the passage of landfill leachate through sand or gravel may be expected to improve conditions so far as bacterial and organic pollution is concerned, chemical pollution can be expected to reach the ground water along with percolating water. Therefore, proper location and operating practices that prevent supersaturation of a fill are essential, thus compounding the problem of the engineer out searching for new ground for landfill operations.

From an occupational health and accident prevention standpoint, solid waste handling presents additional formidable problems. A study (*13*) of the Department of Sanitation of New York City, found that arthritis, cardiovascular diseases, muscle and tendon diseases (particularly muscle ailments affecting the back), skin diseases, and hernia could all be classified as occupational diseases of refuse collectors. Sanitation workers were also found to have an extremely high injury frequency rate, exceeding that of all other occupations previously studied, with the exception of logging. The study report also observed that "the rate was more than twice as high as that for firemen and policemen, and surpasses even that of stevedores."

These statistics are even more startling when the methods used for selection of these men are considered. New York City sanitation candidates must first pass a qualifying written examination, then a physical examination, and finally a series of tests to determine physical fitness. The physical fitness tests were compiled by the head of the physical education department of New York University to determine endurance, agility, strength, and coordination. The tests (*14*) consisted of a qualifying lift of a 120-pound weighted can to a 4½-foot shelf; followed by (*a*) an 80-pound dumbbell military press with each hand; (*b*) a 60-pound abdominal lift; (*c*) an agility test, consisting of broad jump, hurdle, fence trap, and scaling an 8-foot wall; (*d*) a 120-yard run against time with a 50-pound dumbbell in each hand; plus (*e*) a coordination test in which the candidate operated a specially constructed mock-up of a sanitation truck.

Some indication of the rigorous selection made with such a testing procedure was given in the following records of a 1939 test: 85,000 men filed for the job; the final list contained the names of the top 7,800 candidates of the 22,000 men who survived all phases of the examination.

Many fires and home accidents are caused by poor refuse handling practices. Discarded items that are not properly stored for collection are also particularly attractive to children. Unsanitary and unsafe conditions in yards and family refuse storage areas have resulted in literally thousands of minor and severe accidents. In one case, a 13-year-old boy and his friend were playing in the alley behind his house. In the trash, they found some old milk bottles with "some fluid" in them. One of the boys struck a match and threw it into one of the bottles. The resulting explosion caused third-degree facial burns and required long-term hospitalization.

While the accident aspect of our problem is in a sense minor, it illustrates the manner in which the whole problem is growing. Our data

have shown that the increasing use of pesticide products in the home and various new miracle drugs—so-called because of their potency—has resulted in correspondingly greater amounts of these materials in the solid waste load and more accidents such as I have just mentioned.

I hope that these varied examples demonstrate that we believe this problem to be an integral concern of the whole environmental health picture. In its budget to the Congress, the Public Health Service has taken steps recently to make the solid waste activities a separate and distinct area of Federal activity, organizationally, and also in the area of research grants.

Many people are already at work on this problem. Manufacturers who have been making incinerators for decades are trying to improve the efficiency of their machines. Others are working on composting and similar methods. We wish them all good luck. But we also believe that a vast reservoir of experience and knowledge exists in our city and county government officials and professionals. We believe that if this conference can bring that knowledge and skill together with young researchers for a joint effort we can lay the ground work for real results.

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