

Observations on the Environment of Seoul, Korea August-September, 1971

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The purpose for visiting Seoul was two-fold: (1) to examine the conditions and procedures in Seoul as relating to waste management, particularly solid waste management, and (2) to represent the United States at an International Conference on the Human Environment held in Seoul, September 1-3, 1971. The paper I presented at that conference is published in the proceedings of the Conference and is presently available through that source.

Solid Waste Management

My previous travel experiences having been limited to the North American Continent, the Carribean and Europe, I was not really prepared for the impact that Seoul had on me. Millions of people crowded into a relatively small, unplanned urban area, made it difficult at first to sort out the various activities that I could readily identify in other countries. Gradually an organized pattern of solid waste management began to appear and I found, much to my consternation, that the management of solid wastes in Seoul was an exceedingly effective and relatively efficient one, but completely unique from any of my past experiences. First I should point out that solid waste management in well-developed countries, such as the United States, remains a labor intensive system, both as to collection and to disposal, although the relative use of labor is much higher in collecting refuse than in disposing of it in the U.S. In Seoul the solid waste management system is even more dependent upon human labor and less upon machines and, perhaps rightly so, since what seems to be in abundance in Seoul are legs and hands and arms and muscles to provide services that in this country would be considered economically infeasible.

The organized system of solid waste collection performed by employees of the city of Seoul appears to have reasonable efficiencies and compares not too

unfavorably with door-to-door and commercial collections practiced throughout most of the developed nations. The equipment is similar to that found in many municipal systems in the United States. In talking with the Superintendent of the collection systems and with foremen in the various routing areas, it appeared that they had a fair understanding of the job that they were performing and that the work was being done with relative dispatch.

The solid wastes collected from homes, apartments, commercial business, or industries are taken to several "sanitary landfills" and deposited for disposal. Almost before the material being dumped has had a chance to reach the ground, it is picked over by men and women--some equipped with pitch forks--and all useable materials are quickly extracted from the dumped load before it is left for burial. Extracted materials include bits of plastics, (for which I could never ascertain the use) pieces of wood, (even down to match stick size, apparently for fuel), rags and bits of cloth, paper, paper products and almost anything that has value for heating purposes. Almost no tin cans or bottles appear within the dumped loads and the next paragraph will explain why these do not find their way into the collection system as they do in other parts of the world. There are probably health problems associated with the manner in which solid wastes are salvaged at land-fills, but probably the hazards are not much different than the many other public health hazards that are encountered on a daily basis in Seoul. The primary problem at the "sanitary landfills" is that they are situated in or adjacent to stream channels and at least in one instance I observed the solid waste being dumped directly into a body of water, causing pollution of that water body and making it useless for drinking purposes. There was virtually no attempt to cover the solid wastes at one land fill, although at another site, bulldozers were in evidence and some earth was being placed on the top of the refuse (apparently at the level where the land-fill was considered to be complete). In the United States, land filling to be considered sanitary land-filling would necessitate daily earth cover to prevent flies, rats,

fires, and the blowing about of paper. With the low economy in Korea, it may not be necessary to observe such niceties as daily cover; the nature of the material that is left for disposal doesn't contain much that blows around or burns so that there is a substantial reduction in problems that would be normal in the United States if land fills were not covered.

The reason that cans and bottles do not find their way into the solid waste collection is that they are almost entirely scavenged by itinerant "junk men" who travel the city streets from early morning until late at night with hand-drawn two-wheeled carts. These men are characterized by a large plastic bag of popcorn being carried in the cart and a pair of sheet metal "scissors" that they continually clang together as they travel the city streets to alert the neighborhood to their presence. As these men make their way throughout the city, persons of all ages (but principally children) bring articles of apparent value, such as tin cans and bottles and cloth, leather, plastics, etc. to the popcorn man where the wastes are traded for a handful or two of the popcorn depending on the particular value of the goods received. This system is highly effective, causes some impediment to traffic in the downtown streets in Seoul, but seems to be a custom of long standing and one that has a certain amount of charm to the tourist in that it undoubtedly brings back childhood days when junk dealers traveled the streets of the cities of the United States with horse-drawn wagons crying "rags, bottles, bones." The system is exceptionally effective in saving the metal from the cans or saving the cans as containers and returning glass bottles as refillable containers. It is totally dependent on a cheap labor market and would not be a characteristic of any country that could offer employment to relatively healthy men in occupations that would perform greater services and therefore would receive greater remuneration. The popcorn men appear to be quite well organized; they obtain their popcorn from centers located ~~in several centers~~ located in several parts of Seoul where the corn is popped

in the early morning hours and made available to the popcorn men who return in the evening with the collected goods. One such area is called "Salvation Street" by the Korean interpreter and is literally a series of crudely put together structures, each one representing the salvage of a different form of waste, such as tin cans, bottles, bones, plastics, paper, rags, etc.

Considering the effective and the efficient manner in which Seoul is recycling useful solid wastes, there is little that could be recommended by way of alternative disposal systems such as incineration, pyrolysis, composting, or centralized separation for salvage. The utility of such systems would be virtually nil because of the high degree of separation and salvage of useable materials already practiced and the relatively low utility of the residues that are left at the landfills after they have been picked over by the resident scavengers. These observations regarding the solid waste management of Seoul will be out-dated as the technological level of the Korean economy improves and its standard of living increases; at that time consideration should be given to more effective use of man power in solid waste management so that the man power thus made available could be better utilized for developing the Korean economy. However, in the near future it does not appear that any substantial benefit would be derived by making any significant changes in the current methods practiced for solid waste management in Seoul.

"Night Soil"

Although not strictly considered solid wastes, the sewage sludge from treatment plants in the developed countries does finally enter into solid waste management systems one way or another. It is sometimes disposed of by incineration along with solid wastes, or through mutual composting, or even through the burial of dewatered sewage sludge at sanitary landfills. Whiti; only the exception of the central area of downtown Seoul, an area provided with flush toilets, but not yet with sewage treatment for the

sewage that is thus created, the remainder of Seoul is serviced by the time-honored "honey buckets" that travel the city streets and collect the feces and urine from cisterns under the dwellings. In individual homes the cisterns are accessible through a small door at ground level on the side of the house; a small bucket on the end of a long handle can be inserted and the contents of the cistern ladled out into two larger buckets of about five gallons capacity each that are fastened to opposite ends of a pole and then carried on the shoulder back to tank trucks where the buckets are handed singly to a man on the top of the tank truck and dumped into it for carting to disposal points. This system is not unique to Korea but is common throughout the Orient and still remains very much in use in some parts of Europe, particularly rural France. In a population rampant with enteric disorders of many types, the semi-liquid contents of the cisterns is virtually deadly and can be considered one of the most serious, if not the most serious health problem in Seoul. The fecal matter and urine is usually dripped or spilled outside the house on the ground nearby where it is ladled into the larger buckets and then often dripped or spilled along the travel route to the tank truck and then again at the tank truck where spillage occurs. At apartment buildings or multiple dwellings the cisterns are usually pumped by vacuum trucks through hoses that reach from the street into the cistern and suck the contents directly into the tank truck. A modified system of piping by vacuum trucks from individual homes could possibly be worked out, however the exceedingly narrow pathways that run from streets through the residential areas of Seoul would make it necessary for the vacuum lines to be very long and in some areas such a system would not even be possible, nevertheless, until night soil cisterns can be completely abandoned, it does not appear that consideration should be given for interim solutions that would minimize hazards.

The night soil is conveyed by tank trucks or other means to large basins, approximating the size of a football field in area and having depths of 10

to 15 feet. These basins are lined with concrete blocks placed with mortar, but are undoubtedly not water tight and probably permit the liquid fraction of the night soil to leak from the basins into the ground and posing problems of potential pathogenic transfer or high nitrate levels in ground waters. The basins are not covered, but receive rain water throughout the year; the surface is said to freeze over during the winter. The decomposition that occurs certainly creates no temperatures high enough to disinfect the night soil. The primary effect of storage is to gradually lose moisture so that it can then be shoveled from the night soil basins and delivered to farmers for use in the growing of crops. Because disinfection does not occur, the cycle of reinfection is continued through the application of this dangerous material to crop lands. This appears to be one of the principal reasons for the high level of enteric disorders among the residents of Seoul, in that vegetables, fruits, and other foods that are eaten uncooked are undoubtedly carriers of organisms that will continue the cycle of reinfection. This system for handling night soil should be abandoned as promptly as can be afforded by the government of Seoul and an alternative system should be used that would be compatible with the state of technology in Korea. Officials of the City of Seoul advised me that they had under construction a Zimpro plant, utilizing the Zimmerman process of combustion in water suspension. The plan is apparently designed to satisfy the needs for about one fourth of the population of Seoul. It is my observation--and so I stated to those city officials at that time--that the process would not prove suitable for use in Seoul because of the extremely difficult technological problems that relate to the high temperature and high pressure under which water-suspension-combustion of organics occur. This system has been used with little success in the United States and in most instances has proved almost disastrous in that the maintenance, repair, replacement, and need for highly skilled mechanical and electrical technicians create almost unending problems in keeping the system functional.

In my conversations with top officials in Chicago as relating to the use of the Zimpro process for that city, they all decried their decision to install the Zimmerman process at one of their major plants and wished most heartily that they never invested money in such a difficult and delicate process. The process was apparently sold to the city of Seoul by the Japanese and if it is to be functional, the Japanese must provide the technicians or must train Korean technicians to a very high level of technical competence in order to keep such a plant operative. Such plants are capable of oxidizing the organics that are carried by water suspension and to completely sterilize the waste so that all disease hazards are eliminated; however, the sludge that is created by the process is very hard to dewater and has no commercial value, has no utility for fertilizer and is difficult and expensive to dispose of.

Alternative to the Zimpro process would be the construction of anaerobic sludge digesters such as are commonly used in the United States for the disinfection and transformation of characteristics from raw fecal matter and urine into a humus that has passed a test of public health safety in the United States for many decades. Such sludge digesters utilize a portion of the methane produced by the digestion to heat the contents to about 92 - 95 degrees Fahrenheit. The decomposition period varies from 15 to 30 days. Such digesters are exothermic producing more heat energy than is needed to maintain the temperature and a substantial surplus of methane to be used for other energy purposes. Once the night soil has been digested to a point of stability or cooked until the pathogens and parasites have been destroyed, it could be windrowed after drying in open ponds, and then safely used by farmers as a soil amendment. The likelihood that the sludge would retain more than one or two percent nitrogen is not great and the material would serve principally to maintain the tilth of the soil, to improve the water-holding characteristics of the soil, and to provide trace minerals.

Another alternative would be to compost the night soil along with the solid waste that have no utility. The process could be as simple as the one demonstrated by the United States Government at Johnson City for the Tennessee Valley Authority or it could involve the retention and mixing of the wastes during compost in vats or tanks as has been practiced successfully at Houston, Texas, and San Juan, Puerto Rico. There have been a number of successful operations of large-scale composting plants throughout the world and, since a composting operation can be successfully maintained at temperatures of 150 degrees Fahrenheit to 160 degrees Fahrenheit, the obvious advantage for disinfecting the wastes can be seen. Composting also better holds the nitrogen and a compost from night soil and solid wastes could probably be produced in the range of 2 to 3 percent nitrogen.

Air Pollution

It was an unpleasant surprise to find photochemical smog in Seoul, virtually identical to that that I left in Los Angeles. The meteorological conditions are very similar and the high use of gasoline-driven vehicles for public transportation in Seoul already accounts for serious levels of eye irritation and lung congestion. A rapid transit system that would eliminate individual cabs, cars, busses, and trucks would do much to alleviate both congestion of traffic and air pollution in Seoul. Others have noted and commented on this, but yet another aspect of the air pollution problem may be worthy of mention. Anthracite coal, mined and mixed with mud for distribution as briquettes for heating homes in Seoul, contains several percent sulfur and contributes not only to some 500 deaths by asphyxiation in Seoul yearly from carbon monoxide, but creates irritating levels of sulfur-oxides within the city. At the International Conference on the Human Environment it was stated that Korea plans to import crude oil for energy to meet the country's needs; however, the anticipated source would have from four to five percent sulfur. An alternative that should be explored is the gasification

of the coal and piped transmission to Seoul and other population centers. The technology for coal gasification is apparently now suitable for full-scale use; the Bureau of Mines, United States Department of Interior, would be a valuable source of information concerning the use of that system in Korea. The desulfurization of coal prior to gasification or the desulfurization of the gas subsequent to gasification would be necessary in order to provide a safe fuel source for Seoul.