THE GARBAGE PROJECT
&
"THE ARCHAEOLOGY OF US"

by
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(Note that references -- at the end -- are not in the text of this version)

"BURIED ALIVE: The Garbage Glut" was the cover headline of *Newsweek*, November 27, 1989. "Are We Throwing Away Our Future with Our Trash?" had been the title of the "American Agenda" segment of *ABC Evening News with Peter Jennings* on December 2, 1988. In the late 80's the amount of garbage America generated had reached crisis proportions for the media and its public. The vast majority of refuse was sent to landfills, and those landfills were filling up and closing down. Where was the garbage to go?

Concerned citizens, convinced that action had to be taken without delay, quickly identified garbage culprits among the discards that visibly shocked them everyday--litter. Editorials in prestigious newspapers, such as *The New York Times*, echoed popular perceptions that fast-food packaging, disposable diapers, and plastic grocery bags were singularly responsible for "straining" our landfills. Public officials in communities nationwide proposed banning the accused perpetrators. In the meantime, into what kinds of holders were responsible folks to put their burgers, hot coffee, groceries, and infants? Oddly enough, the answer was not clear because in all the commotion there had been few facts presented about what was in garbage and landfills. It was at this point that a new kind of archaeologist, a *garbologist* who studies fresh garbage, was able to unearth a few relevant facts that began to fill the information vacuum that surrounded our discards.

At this time, workers around the country were regularly digging into landfills to install methane vents, but no one paid much attention to the refuse that was exhumed in the process.

After all, it was just smelly, disgusting garbage. The smell and look of discards were not deterrents to archaeologists, who always expect to get their hands dirty. To archaeologists, in fact, contemporary garbage was a gold mine of information. No society on earth had ever discarded such rich refuse, much of it packaging which identified the contents it once held by brand, type, cost, quantity, ingredients, nutrient content, and more. Yielding to this temptation, between 1987 and 1995, archaeologists from the Garbage Project at the University of Arizona systematically excavated, hand-sorted, measured, and recorded thirty tons of contents from fifteen landfills located across North America -- from California to Toronto and from the deserts of Arizona to the everglades of Florida. The information that resulted from these digs was unexpected. **[map of U.S. with sample landfills indicated]**

In contrast to all of the concern directed at fast food packaging and disposable diapers, the archaeological data demonstrated that both items *together* accounted for less than 2 percent of landfill volume within refuse deposited over the last ten years. Even more surprisingly, because of industry-wide "light-weighting" -- that is, making the same form of item but with less resin -- plastic grocery bags had become thinner and more crushable to the point that 100 plastic bags consumed less space inside a landfill than 20 paper bags. If all three items at the center of public concern had been banned and were not replaced by anything, the garbage archaeologists were certain that landfill managers would not have noticed the difference.

At the opposite end of the contents' spectrum were materials that occupied large portions of landfill space but received little public attention. Construction/demolition debris (C/D) was one. Because of definitional issues, C/D was not even included in the EPA's national estimates of the refuse that goes to MSW (municipal solid waste, or standard community refuse) landfills. Like the EPA, the Garbage Project tried to avoid the issue of C/D in MSW landfills. In fact, the Garbage Project's one sampling bias was an attempt to avoid areas where C/D was concentrated

because it could easily disable expensive drilling equipment. Nevertheless, C/D accounted for 20 percent or more of excavated MSW by volume and was the second largest category of landfilled materials recovered by the Garbage Project. The largest category occupying landfill space was paper. This was true for refuse buried in the 1980s as well as for refuse dating as far back as the 1950s because in most landfills paper seemed to biodegrade very slowly. As a result, by volume nearly half of all of the refuse excavated by the Garbage Project has been newspapers, magazines, packaging paper and non-packaging paper, such as computer printouts and phonebooks.

Not long after the Garbage Project's first reports of its landfill digs, the energy directed at passing bans was largely redirected toward "curbside recycling." A number of communities began placing emphasis on reuse and recycling programs for C/D. Paper recycling promotions often stressed the need to keep paper out of landfills because it didn't biodegrade as quickly as once hoped. An association of States Attorneys General determined from dig data that several products which claimed to be "biodegradable," including some brands of disposable diapers and plastic garbage bags, did not biodegrade in landfills, and the false advertising of these products was eradicated. All of this was evidence that some crucial views of garbage held by policy planners, the media, and the public had changed -- and that *garbology* had been validated as a new kind of archaeology.

A RATIONALE FOR THE GARBAGE PROJECT. For as long as there have been archaeologists, there have been guesses about what these behavioral scientists would discover if they were to analyze their own society's refuse. While often humorous, such speculations are, in fact, based on a serious rationale: If archaeologists can learn important information about *extinct* societies from patterns in ancient garbage, then archaeologists should be able to learn important information about *contemporary* societies from patterns in fresh garbage. The pieces of pottery,

broken stone tools, and cut animal bones which traditional archaeologists dig out of old refuse middens provide a surprisingly detailed view of past lifeways, just as all the precisely labeled packages and the food debris and the discarded clothing and batteries in modern middens reveal the intimate details of our lives today. If indeed there are useful things to learn from *our* garbage -- things which can enrich human lives and minimize the undesirable environmental consequences of the industrialized world -- why wait until *we* are all dead and buried to find them out? Garbology now! At least that is what Dr. Bill Rathje and a group of students thought when they founded the Garbage Project at the U of AZ in the Spring of 1973. Today, Rathje and the Project, including co-director Wilson Hughes who was one of the founding students, are still thinking along these same lines.

What has set the Garbage Project apart from other behavioral science researchers is that all of its studies have been grounded in the hands-on sorting of quantifiable bits and pieces of garbage in place of collecting data through interview-surveys, government documents, or industry records. In other words, the Garbage Project is studying consumer behaviors directly from the material realities they leave behind rather than from self-conscious self-reports. The excruciating level of detail Garbage Project student sorters use to record data (including specific brands, types, and costs of products; weight and volume by material composition of detailed package and commodity type categories; and much more) has also set Project studies apart from those conducted by engineering consultant firms and even by solid waste managers.

Over the last 23 years the Garbage Project has literally immersed itself in fresh refuse placed out for collection and in materials exhumed from landfills. Fresh discards are recorded in order to study food waste, what people eat and drink, recycling behaviors, household hazardous wastes, packaging discards, and even the relation between fluoride and tooth decay. In 1987, when the Garbage Project added the excavation of landfills to its research repertoire,

investigations focused on the composition of landfilled wastes, the rate of breakdown of these materials within landfills, the contribution of residential hazardous wastes to the leachate (or fluids) which leak out of MSW landfills, and the impact of various waste reduction strategies -- recycling, composting, "source reduction" (which just means "using less stuff" in the first place) -- on what wastes are landfilled.

FRESH SORT RATIONALE AND METHODS. The Garbage Project's first data collection format, the "Regular Sort" was designed to sample and record household pickups of fresh refuse (a *pickup* is all of the materials placed out by a single household on one regular refuse collection day). From the beginning, the anonymity of household samples was rigorously protected. **[Regular Sort and Weight Sort Recording Forms and Code Sheets]**

Solid waste managers have been characterizing wastes separated by material composition (paper, plastic, glass, etc.) and recorded by weight since the 1880s. To these traditional measures, the Garbage Project added a series of innovations, including records from package labels (brand, cost, solid weight or fluid volume of original contents, specific type of contents, packaging materials) and more detailed breakdowns of refuse categories, such as "food waste" (separated into "once-edible food" versus "food preparation debris" and both identified by specific food item). Because of their exacting level of detail, the Regular Sort data files which document residential refuse are ideal for analyzing the role of specific household behaviors in generating wastes. Today, the Garbage Project's fresh refuse records, compiled from the long-term ongoing study in Tucson, AZ, and short-term studies in five other cities, form a one-of-a-kind database which currently encompasses 23 years of time depth.

FRESH SORT RESULTS. Garbage Project studies of fresh refuse have consistently documented a few basic patterns in the way we interact with the material world around us:

First, what people say they do and what they actually do are often different. For example, while respondents rarely report to interviewers that they waste any food at home, two decades of Garbage Project studies have documented that households generally waste about 15 percent of the solid food that they buy. Such mis-reports characterize a broad range of household behaviors. In other words, people who are interviewed or fill out surveys do not accurately report how much food they waste, what they eat and drink, what they recycle, or the household hazardous wastes they throw away.

This discovery, of course, is not a great surprise. It is common knowledge among behavioral scientists that any methodology which depends upon the accuracy of answers that people give to interviewers or on surveys suffers from problems of informant bias: [1] respondents may not be able to accurately and quantitatively recall specific behaviors, such as how many ounces of green beans they ate the day before or how often they discard a half-full container of pesticide; and [2] even if respondents can accurately recall behaviors, such as beer drinking or changing the oil in their cars, they may not want to admit to the specifics.

At this point it is important to note that systematic sorts of garbage avoid informant biases. Refuse data are quantitative: packaging and commodity wastes can be weighed, measured for volume, and chemically analyzed, and their labels can be read for further information, all without relying upon the memory or honesty of respondents. When refuse is identified by specific household (vs. only recording the generating household's census tract), the Garbage Project obtains permission for its sorts from the discarders. Even under these conditions of self-awareness, Project analyses show that, except for fewer alcohol containers, discards adhere to the same patterns found in garbage collected anonymously at the census tract level.

While independent of informant-based distortions, refuse analysis is susceptible to other forms of bias. The most obvious one is garbage disposals, and the Garbage Project has conducted studies to develop correction factors for ground up food. Another is people who carry recyclables to drop-off buy-back centers. With the possible exception of aluminum cans (which some people still recycle on their own), this problem has been greatly reduced by the curbside collection of recyclables. At this time, in addition to each sample household's refuse, the Garbage Project also collects and sorts the household's recyclables (and then turns them in for recycling). A more serious limitation to refuse analysis is that patterns of behavior are only identifiable at the household level; identifying the behavior of individuals within households is highly problematic.

Overall, the advantages of garbage sorting as both an alternative and quantitative measure of behavior outweigh its limitations, and the first pattern identified -- that self-reports differ from refuse records -- has opened up a broad new research arena.

Second, if the first pattern is no surprise, the second pattern identified is a pleasant one: the differences between what people report they do and what they actually do often follow systematic regularities. This conclusion was drawn from a number of Garbage Project studies which were designed to verify consumer responses to various kinds of diet questionnaires by comparing self-reports about food use against packaging and food debris in fresh refuse. One specific self-report/refuse regularity the Garbage Project has documented is the "good provider syndrome": a female adult reporting for a household as a whole has a tendency to over-report everything the household uses by 10 to 30 percent or more. Another regularity is the "surrogate syndrome"**:** to find out how much alcohol is consumed by household members, do not ask a drinker; drinkers consistently under-report their alcohol consumption by from 40 to 60 percent. Instead, ask a non-drinker; non-drinkers report accurately what drinkers drink.

Unlike the other two, the ***third*** documented pattern was full of surprises: the differences between respondent reports and the material remains in refuse frequently indicate directly opposed behaviors; to be more specific, respondents normally report rational behaviors while their actual behaviors often appear irrational. One of the best examples of this kind of counter-intuitive relationship between self-reports and refuse occurred during the highly publicized "beef shortage" in the Spring of 1973. At this time, when consumers were complaining bitterly about high prices and erratic availability, the Garbage Project was recording the highest rate of edible beef waste it has ever documented.

Several other instances of this kind of counter-intuitive report/refuse pattern have been documented. In 1977, the Garbage Project gave meat fat its own separate category. Using the long-term Tucson database, the Garbage Project determined that in 1987 people began cutting off and discarding much larger than normal quantities of the separable fat on fresh cuts of red meat; at the same time they also bought less fresh red meat. Both actions seemed to be responses to a 1986 National Academy of Science study that was widely reported in the media and identified fat from red meat as a cancer risk factor. There was just one problem. The consumers under study replaced the fresh red meat in their diet with processed red meat which contained large quantities of hidden fat -- salami, bologna, sausage, hotdogs, etc. -- so that the level of fat intake in the diet did not fall; instead, it stayed the same or rose. Similar diet changes were also identified by garbage sorts in a retirement community (Green Valley [AZ]) and in Marin County [CA].

A third case involved household hazardous wastes. In 1986 Marin County sponsored a "Toxics Away! Day" to collect household hazardous wastes, such as used motor oil and unused pesticides. The Garbage Project recorded residential refuse two months after the collection day and compared it to household discards sorted before the collection day. The results were

completely unexpected**:** there were nearly two times *more* potentially hazardous wastes recorded in the refuse *after* the collection day than there had been before. The data clearly demonstrated that all of the increase in hazardous wastes was due to the discard of large quantities of items from only a few households (such as 3 or 4 half-full cans of paint or several full containers of pesticide in one just pickup). The Garbage Project's interpretation was that the media surrounding the collection day made people aware of potentially hazardous commodities in their homes. For those who missed the collection day, however, no other appropriate avenue of discard had been identified. As a result, some residents disposed of their hazardous wastes in the only avenue available to them -- their normal refuse pickup. The same pattern was verified in subsequent studies in Phoenix and Tucson. The lesson learned: communities which initiate hazardous waste collection days should inform residents of future collection times or of other avenues for appropriate discard.

These kinds of counter-intuitive interview/refuse patterns indicate that consumers may not be aware of how much their reported behavior differs from their actual behavior, and that the Garbage Project is beginning to document a previously unmeasurable phenomena in the deep-structure between what people think is happening and what is really going on. Such studies have already led to some general principles of the differences between people's awareness of their behavior and their actual behavior.

General Principles and Theory: Principle 1 of Food Waste and Waste in General. One principle originated with an explanation for the high rate of beef waste recorded during the nation-wide "beef shortage." The Garbage Project's interpretation was that consumers responded to the hype surrounding the shortage by purchasing meat when they found it in unfamiliar cuts (usually cheaper) and quantities (usually larger). Improper preparation and improper storage of these abnormal cuts and quantities resulted in waste. One year later, a

"sugar shortage" produced a strikingly similar pattern in residential refuse -- the waste of sugar and sweets doubled while both were expensive and in short supply. Recording these patterns led to the proposal of *principle 1 of food waste*: the less food use behavior varies over time, the less food is wasted. The principle explained why common sliced bread, which is usually consumed at one or more meals a day, is wasted at a rate of less than ten percent of purchase, while less-frequently consumed specialty breads, such as hotdog rolls, biscuits and muffins, are wasted at a rate of more than thirty-five percent. It also explains why Hispanics waste less food than Anglos**:** while prepared Hispanic foods are diverse, their basic ingredients are relatively few compared to the larger variety of foods in common Anglo diets. These and other patterns that can be deduced from *principle 1 of food waste* have implications for shopping and meal planning as well as for the design of pre-prepared foods and food packaging.

A form of corroboration for *principle 1 of food waste* came from an unexpected source. In 1986, the Garbage Project conducted the EPA's first study of household hazardous wastes in New Orleans and Marin County. One clear pattern in both communities was that potentially hazardous household commodities involved in regular maintenance tasks were wasted at much lower rates than those, such as paints and stains, which are used sporadically and were often wasted in bulk. This last discovery, confirmed in every subsequent Garbage Project household hazardous waste study, led to the realization that *principle 1 of food waste* also covered hazardous discards and was more properly *principle 1of waste*.

The Rationality Principles of Food Use Self-Reports and of Self-Reports in General. The Garbage Project has conducted half a dozen self-report/refuse comparison studies which were designed to cross-verify different interview-survey methods to record diet. Patterning in the results has led to *the rationality principle of food use self-reports,* which explains the general relationship between self-reports and refuse in a logical manner: if a food is perceived as good

for a person, it will be generally over-reported; if a food is perceived as "bad," it will be generally under-reported. This principle is valuable to diet researchers because it provides a unique insight into how consumers feel toward specific foods (for example, older persons who lived through World War II under-report all major sources of fat except one -- butter, which was considered a highly nutritious and valuable commodity when it was rationed during WWII); in addition, the Garbage Project's quantitative data gives diet researchers a sense of the directions and magnitudes of distortions in consumer responses to food questions.

The Rationality Principle of Food Use Self-Reports matches so well with patterning in counter-intuitive behaviors that it may both be a form of a general *Rationality Principle of Self-Reports*: consumers generally envision and self-report their personal behaviors in ways which seem rational from the standpoint of their personal world view in place of self-reporting their actual behaviors which are often somewhat irrational. This principle implies that most people will self-report that they recycle far more than they actually do, just as they report what they perceive to be a generally balanced diet and do not bother to mention recent splurges on high-fat meats or over-blown desserts. If substantiated, the implications of this principle for understanding the relationship between attitudes and behavior and for changing both in directions that will increase conservation, improve health, and decrease environmental degradation are enormous.

Some refuse studies produce surprises even without interview comparisons. A 1993 study looked at the causes of tooth decay using dietary information from refuse data. The results demonstrated that although Hispanic children had consistently higher tooth decay rates than non-Hispanics, Hispanics did not eat more foods that promote tooth decay or discard any fewer worn toothbrushes or dental floss or consume less fluoride than non-Hispanics. Overall, this suggests that increased tooth decay in Hispanic populations may be based more on biology than behavior.

A General Link between Population Size, Level of Technological Development, Quantities of Garbage Generated. Given our garbage disposal woes, the key question is: how fixed or elastic is the link between human behavior and garbage generation? This is essentially an archaeological question. For 100 years, archaeologists have been studying refuse in an attempt to count people with it, and the Garbage Project has done the same thing.

The U.S. Census Bureau has long been aware of the criticism that its interview-survey methods lead to significant undercounts of ethnic minorities, especially young adult males who may be undercounted by 40 percent. In 1987 the Quality Assurance Branch of the Census Bureau funded a study to determine whether the Garbage Project could count people based on the types and quantities of residential refuse they generate. The answer was: yes. For any unit of time, the overall weight of total refuse discarded (minus yard wastes which vary markedly between suburbs and inner cities) and the total weight of all plastics discarded vary directly with the number of resident discarders. In fact, after the application of appropriate per person conversion rates in well-documented test areas, the weights of both total refuse and total plastics are each within five percent of the actual number of residents. The Garbage Project now stands ready to cross-verify census counts with a method which does not violate subjects' anonymity.

When Garbage Project results are placed in line with those of other archaeologists, they indicate that increases in technological development lead to increases in garbage generation rates per person. This suggestion has brought the Garbage Project back to the question stated above**:** Is contemporary population size and level of economic development so directly linked to the generation of large quantities of garbage that the relationship is unlikely to change anytime soon? The specifics of a further study based upon this question will be discussed after the Landfill Sort data format has been described below.

LANDFILL SORT RATIONALE & METHODS. Garbage Project analyses of landfilled refuse developed out of a traditional archaeological research question: direct interpretations of waste generation behaviors are possible with Fresh Sort data because the refuse can be assigned a precise provenience (a household pickup within a specific census tract) and date of discard. But what kind of interpretations of waste generation behavior would be possible if the refuse had already been transported to a landfill, mixed with other refuse, and buried? And how does the refuse within a landfill change because of what archaeologists call "natural formation processes" -- high moisture content, long-term pressures from the weight of overlying refuse, degradation (metal rusting due to chemical interactions), biodegradation (organic materials disintegrating due to the attack of micro-organisms), and more? With these questions in mind, the Garbage Project set out in April 1987 (by chance, just about the same time the Mobro 4000 "garbage barge" set sail) to sample, sort, and record refuse excavated from landfills.

To begin a dig, the Garbage Project staff stratifies a selected landfill site by the date and type of refuse depositions; refuse is then systematically collected within sampling strata. Refuse samples are taken at approximately 3-meter intervals within 1-meter-diameter cores drilled by bucket augers (well depths up to 32 m.) and trenches cut by backhoes (maximum depth 7 m.). All recovered materials are screened and hand sorted into one of forty categories based on material composition and function (phonebooks, newspapers, PET plastic soda bottles, tinned-steel cans, and more). Each category is measured for weight and volume. Additional studies record the moisture content of artifacts and the concentrations of heavy metals and complex organic compounds. The Garbage Project has now conducted comprehensive digs at 2 landfills in Arizona, 2 in California, 2 in Illinois, 3 in Florida, 1 in New York (New York City's Fresh Kills Landfill on Staten Island), 1 in New Jersey, and 4 in Metro Toronto.

LANDFILL SORT RESULTS: CONTENTS. Before Garbage Project digs, virtually all studies of fresh garbage measured solid waste components by weight. But weight was irrelevant to the key garbage problem of the 1980s and 1990s -- that landfills are increasingly becoming "landfulls." To determine what items are contributing the most to the filling of landfills, from its first dig the Garbage Project measured the volume occupied by all excavated items. In addition to these dig data, the Garbage Project designed a compaction machine to simulate the way materials are crushed by refuse collection equipment and long-term burial. The EPA has now decided to add volume calculations, based largely on Garbage Project data, to its regular reports on the generation of MSW within the U.S. Garbage Project crush calculations also comprise a critical component of LCA (Life Cycle Analysis), which is commonly used by environmental engineering consulting firms, private companies, and others to evaluate the environmental impacts of current or proposed products and their packaging.

Garbage Project landfill excavations have also been used to quantify the impact of recycling programs on the volume of wastes reaching landfills. As some recycling revenues decreased and the costs of curbside collection rose in the late 1980s, many local governments were interested in determining the extent of the costs "deferred" by recycling activities, such as the expense of siting and constructing new landfills. In 1991 a consortium of governments and businesses in Metro Toronto funded the Garbage Project to excavate three landfills and one 1950s "dump." The resulting Project report estimated that the "Blue Box" curbside recycling program has conserved some 20 percent of landfill space in the Toronto area since it began in 1982.

BIODEGRADATION IN LANDFILLS. Another set of findings from the Garbage Project's digs underscores, especially for the public, the need to recycle and compost materials to keep them out of refuse. Many people have assumed that organic materials, such as newspapers,

simply biodegrade in landfills. The recovery of 2,425 datable, readable newspapers from landfill excavations dramatically changed that view, especially since the relative proportion of newspapers varied little between materials deposited anywhere from five to forty years before exhumation and in environments which received anywhere between 11 and 80 inches of rain a year. The one exception was Fresh Kills Landfill that was started in 1948 when refuse was deposited in a tidal swamp on Staten Island with no liner. Under these conditions, refuse layers from the late 1940s and from the 1950s are now largely devoid of organic materials, including newspapers.

Garbage Project data indicates that a substantial quantity of "raw" organics -- food and yard wastes -- biodegrade within the first fifteen years and are the source of most landfill methane. Finding that in every study landfill (other than at the bottom of Fresh Kills) forty percent or more of the space is comprised of fifteen to forty year-old newspapers and other paper items, some grass clippings and even a few heads of lettuce and carrots was somewhat of a surprise for archaeologists and microbiologists. Once again, what people thought was happening to our refuse and its real fate were two different things. And no wonder. Archaeologists work mainly in open sites where degradation and biodegradation are usually rapid; most microbiologists conduct their research as experiments in laboratories. Both open sites and laboratory settings are quite different from the land disposal sites that have been filled with refuse over the last twenty to forty years. In order to increase understanding of the field dynamics of biodegradation and methane generation, with its fifth dig, the Garbage Project initiated cooperative research relationships with microbiologists and environmental engineers at the University of Oklahoma, the University of Wisconsin, Madison, and Proctor and Gamble's Environmental Research Laboratory in Cincinnati. While it is clear that biodegradation cannot

be taken for granted in landfills, a process has begun to systematically and scientifically define the parameters of how the contents of landfills change through time.

HAZARDOUS WASTES AND LEACHATE. The same sort of process of defining parameters within micro-environments inside landfills is underway for the study of heavy metals. The basic data are heavy metal concentrations derived from assays of finely screened materials collected from all Project landfill samples. Such information from inside landfills is rare and is being cited, usually in combination with the Garbage Project's reports on hazardous wastes recorded in fresh residential refuse, in a series of Superfund litigations in cities across the country, including Los Angeles, Phoenix, Denver, and Boston.

The Garbage Project has its own plans for integrating fresh and landfill data on hazardous wastes in MSW. The heavy metal assays of fines are being compared with detailed item by item lists (such as 2 light bulbs, 1 drain opener can, two newspapers, etc.) of the refuse identified within each 150 lb. landfill sample. The goal is to determine the rate of movement of heavy metals and other hazardous wastes into the landfill matrix. One preliminary study of sources of lead has already produced a potentially important preliminary finding. While lead levels were consistent in most matrix samples which were deposited before 1985, the discarded dry-cell batteries, light-bulbs, and lead solder-seam cans which were suspected of contributing the lead were highly sporadic in their occurrence. Only newspapers appeared consistently in refuse samples. A link between lead levels in fines and lead in old newspaper newsprint that was proposed by the Garbage Project was supported by additional analysis results. In 1985 lead was reduced significantly as a constituent of newspaper inks due to rising public concerns over heavy metals. It seems more than coincidental that the lead levels in landfill fines samples dropped dramatically at the same time. This example illustrates both the potential of Garbage Project

studies to isolate sources of hazardous waste in landfills and of source reduction responses to reduce hazardous wastes in new commodities.

INTEGRATION OF REGULAR SORT AND LANDFILL SORT DATABASES. A number of recent consumer surveys have determined that for the vast majority of the public "source reduction" is a poorly defined or undefined term. If this is the case, then "source reduction" seems doomed to failure, and recycling materials after they have been created is the only viable means of minimizing the quantity of wastes in need of disposal. Recycling is clearly the first step in efficient solid waste management, but recycling alone has limits and does nothing in the face of demands by many populations world-wide for *increasing* consumption. Given this situation, many concerned groups, including the NRC (National Recycling Coalition), are emphasizing source reduction as a concept whose time has come. In this environment, it is important to evaluate source reduction's potential to significantly minimize waste generation in a way which will interest the public in, and educate the public to, contributing personally to that potential.

With this goal in mind, the Garbage Project is currently involved in a comprehensive study which integrates its Fresh Sort database with its Landfill Sort database. Already the study has indicated source reduction's potential in the form of results which are likely to attract the public's attention, largely because they contradict current beliefs that refuse is growing out of control because of over-packaging. The Garbage Project's digs have determined, for example, that in the early 1950s packaging was more than half of all wastes landfilled by volume. Today, packaging is less than one third of the volume of the refuse deposited in landfills. Fresh sorts of residential refuse have likewise documented that the packaging discarded per person has not increased in the last twenty years; instead, it has decreased slightly. The major reason for this change is not recycling, but partly industry source reduction -- making lighter, more crushable

packages and marketing more products as concentrates and, more recently, refillables -- and partly consumer purchases in response to these innovations, such as light-weight PET 2-liter soda bottles in place of glass bottles. When completed, the fresh/landfill refuse data record of waste minimization achieved through source reduction is likely to provide striking images of change which will help to make source reduction a more *conscious* consumer practice and not just a meaningless term. If this occurs, then the link between technological development and increased garbage generation will be bent, if not broken altogether.

GARBAGE PROJECT STUDENTS AND STAFF. The Garbage Project is essentially just systematic records compiled by hands-on sorting of household garbage. While many people find the results of Project studies interesting, most of them also find the sorting process itself revolting. In fact, a few market researchers realized in the 1950s that household refuse contained useful information, but after repeated experiments they found that they could not pay people to sort refuse. Those hired either quit quickly or kept sloppy records. Who would possibly be willing to rummage through someone else's smelly trash and keep accurate records of its contents? That is a good question.

The answer is a matter of public record; *Rubbish!* (a 1993 paperback book by W.L.Rathje and C. Murphy, published by HarperPerennial) contains a list of more than 900 university students and others who sorted refuse with the Garbage Project between 1973 and 1991. The intimate view these and subsequent sorters have had of the materials which are discarded from households much like their own has provided them with a unique perspective; and while they do not preach to others, they are enthusiastically dedicated to providing everyone possible with the same insights they have won from residential refuse by their hand sorts.

In attempting to share its results, the Garbage Project has focused most directly upon schools, museums, and other avenues to students. The rationale is that young people can do the

most with the information the Project has acquired. Currently, the Project is most proud of two endeavors. The first is the compilation of a *WRAP (Waste Reduction Alternatives Program) Resource Manual* to be distributed to schools throughout Arizona and the U.S. The manual is designed to help both students and teachers learn how their individual behaviors produce significant quantities of garbage and how they can each make changes which will greatly decrease that garbage. The second endeavor resulted in "The Garbage Dilemma," an interactive video on permanent display in the Science in American Life Hall at the Smithsonian's National Museum of American History. The video was the product of cooperation among the Garbage Project staff, the Smithsonian's design staff, and the Chedd-Angier Production Company. Schools and museums -- not landfills -- are the kinds of environment where the Garbage Project hopes all of its results will eventually come to reside.

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