Letter from the Desk of David Challinor
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When I first moved to Washington in 1966, all the weekly garbage picked up by the city was hauled to the Kenilworth dump on the south bank of the Anacostia River in D.C.'s northeast section. Every afternoon city sanitation department workers burned the trash unloaded that morning. Needless to say, downwind air pollution was rife and for years those living nearby complained to the city without avail. In 1967, the District of Columbia gained a measure of self-government and Walter Washington was appointed mayor. The next year a seven-year-old boy burned to death while scavenging for salvageable items at the dump and the outcry was sufficient to stop the burning and ready the dump for closure. Some dumping continued under a "sanitary landfill" program until finally, in the early '70's, the area was capped with soil and converted into a park. This month's essay considers the increasing difficulty in disposing of the detritus generated by our affluent culture and reports on what some communities and cities have done to ameliorate the problem.

When dumps are capped with a half-meter or more of soil, some anerobic bacterial decomposition of the buried organic matter begins and methane gas is produced. This gas, a major constituent of natural gas, is odorless and flammable. For some years after Kenilworth's closure, the National Park Service drilled shallow wells to tap the methane for heating its greenhouses adjacent to the nearby Aquatic Gardens.

Meanwhile, as global population rapidly increases (tripling in my lifetime to 6.7 billion today), the question of trash disposal becomes evermore acute. Current measures to reduce waste are insufficient and it is politically unlikely that the federal government will take action. It will be up to the States to do so, and California has taken the lead as it has on other environmentally destructive pollutants such as vehicle emissions. In Mill Valley, across the Golden Gate Bridge from San Francisco, households are limited in the total volume of weekly trash, and segregated recycling is strictly enforced. Improperly separated waste or excessive volume is simply not collected.

Biodegradable plastics help reduce solid waste; I was recently pleased to read a note from the shipper of a fragile object that the box's ubiquitous "peanuts" were water-soluble. I was skeptical, but the description proved accurate when I dumped a handful into a water-filled bowl and watched with astonishment they disappeared. The development of this soluble new packing material is a significant step forward as long as the dissolved peanut has no harmful effect on water quality.

Soluble plastics are a minute component of the solid waste problem, but it is an effort worth expanding. Seemingly innocuous solutions, such as dumping trash offshore, soon backfired. New York City, for example, used to barge its solid waste about 11

miles offshore for disposal, but the practice ceased in the 1980's when beaches were closed to swimming because so much contaminated waste washed ashore. Ocean dumping of the treated sewerage sludge continued, however, by hauling it 100 miles farther off shore. Between 1981 and 1992, some 40 million tons of wet sewerage sludge (solids remaining after treatment) were released near the edge of the continental shelf in 6000' of water. The location was politically ideal for it epitomized "out of sight, out of mind."

No one had any clear idea of what effect this material might have on deep-ocean life until a long-term monitoring program sponsored by the National Undersea Research Program (NURP) began. The results of the investigation were not good. From over 200 cores taken along the dumping site, scientists found greater and far more diverse deep-ocean life than had previously been observed. After six years of sampling, they discovered that the dumped sludge had indeed a profound effect on marine life at depths from 1,000 to 2,000m. Sludge had penetrated at least 5cm (2") downwards from the surface of the original sea bed from the burrowing of benthic organisms. Among the contaminants found in the core samples was silver concentrated at 20 times greater than the surrounding uncontaminated area. Residues of toxins from synthetic detergents and animal feces were common. Starfish, sea cucumbers and urchins were ten times more prevalent than in uncontaminated adjacent areas and urchins were consuming the sludge's organic matter. Thus any long-term, widespread sludge dumping would drastically alter ocean bottom life by favoring those animals that consumed this new source of organic matter.

Sampling continued even after dumping ceased in 1992; levels of silver and other contaminants gradually declined. This decrease led proponents of ocean dumping to advocate renewal of the practice, but cautious scientists pointed out that PCB's, for example, although gradually lowering in intensity, still remained dangerous. Furthermore, ocean currents stir up the surface particles of sludge and spread them in a southerly direction.

Various other disposal schemes were tried, including towing enormous barge loads of trash to third world countries as far away as West Africa, where it was hoped the local officials could be persuaded monetarily to accept the unpopular cargo. Although a few shipments were successfully unloaded, the local consequences of such action were soon recognized and the practice ceased. Now New York and other seaboard metropolises ship their fetid trash by truck and rail to the Midwest to fill abandoned quarries and similar excavations large enough to make such disposal worthwhile, but ideally remote enough to avoid complaining neighbors. This practice, too, has a finite life because potential landfills are scarce. Even when buried, the inside pages of newspapers and magazines can be dug up and easily read decades later. Incinerating trash is still common and although it reduces volume, it also fouls the air.

Some island nations, such as Singapore, are prosperous and disciplined enough to try innovative disposal methods. A short distance south of the main island and within its territorial waters is Semakau (mangrove) Island; since 1999, the incinerated waste from

Singapore's 4 ½ million people has been deposited there in diked, water-tight cells extending eastward. What makes this effort so effective is that it is the logical culmination of an aggressive campaign to reduce and recycle household and commercial waste. What cannot be recycled is incinerated in four relatively new plants.

These Singapore plants suck the foul air from the receiving pits into the combustion furnace. Carbon exhaust from the stacks was initially high but has dropped and remained level as recycling became more efficient. When the bund (dike) enclosing a cell has been completed, the water is pumped out and the bottom lined with plastic sheeting to prevent any toxic material in the incinerated residue from escaping into the sea and the surrounding mangrove swamps. Of the eleven cells completed, four have been filled with residue to about 6 ½' above sea level and capped with a layer of soil. Theoretically, an expanded cell system should be able to handle Singapore's incinerated trash for the next 40 years; by then, government planners anticipate their recycling and waste elimination program will be operating so successfully that landfills will be obsolete. This may indeed be possible, for Singapore is a wealthy community that is obsessed with cleanliness—steep fines are rigidly enforced for throwing a candy wrapper on the street. Meanwhile, the filled pods are being landscaped and are currently a popular tourist attraction.

Not many communities can emulate Singapore's waste disposal operation because of the huge capital investment required. Nonetheless, as increasing prototype trash recycling and disposing programs develop, costs should decline and improvements increase. Meanwhile, in the U.S. and other prosperous countries, relatively few people worry about waste disposal until it becomes visible enough to close a beach. Perhaps we have become inured to trash. However, the cost of not taking care of our trash lies in public health, and the cost is high. After all, does not most of the world live in squalor with no regular garbage collection or even sanitary sewers? As an optimist, I like to think we can change our lifestyle to solve this pressing problem.

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P.S. Information on the results of ocean dumping came from Collie, Marcia, Julie Russo. "Deep-Sea Biodiversity and the Impacts of Ocean Dumping." National Oceanographic and Atmospheric Administration (2000).

The Singapore program description came from Band, Eric. "Garbage of Eden." *New Scientist*. (14 April 2007): 39-41.

Addendum: With reference to last month's essay on vultures (May 2007), I thought you might be interested in this article from the May 11, 2007 International Herald Tribune.

Meanwhile: Lose the vultures, and lose the soul, By Bachi Karkaria

Friday, May 11, 2007

MUMBAI: As an Indian Parsi Zoroastrian, I'm proud to belong to a tiny minority widely admired for its material success and its philanthropy.

But I feel a closing sense of siege. The vicissitudes of modern life are threatening our group's ethnic identity and ancient ways.

The vulture, our main accomplice in death for nearly 4,000 years, excites a largely morbid curiosity about our sect. Parsis are descended from Zoroastrians who, 1,200 years ago, fled religious persecution in Persia after the Muslim conquest and emigrated to the Indian subcontinent. Zoroastrianism reveres all elements, especially fire, so we don't cremate our dead, or pollute the earth with burial.

We offer our dead to vultures, laying the bodies in so-called Towers of Silence - high-walled, slatted pits shrouded in mystique and sylvan acres that are known as Doongerwadi, or hill groves, which the Parsis set up on the outskirts of their Indian settlements. The practice may seem macabre, especially in as Westernized a community as ours, but it is swift and eco-friendly.

Now these ancient funeral rites are doomed because the population of the South Asian vulture has plummeted by 97 percent in 15 years. The killer is Diclofenac, a livestock drug developed in the early 1990s. Even minute traces in cattle carcasses causes kidney failure in the giant scavenging birds. The Indian government banned Diclofenac in May 2006, but the move came too late for the vultures - and for the Parsis.

Mumbai, the community's stronghold, is the epicenter of the problem. Solutions for disposing of the dead at the city's historic and spectacular Doongerwadi have ranged from an abortive effort to breed vultures in captivity at an on-site aviary to installing giant solar concentrators.

Because entry into the actual, consecrated towers is forbidden to all except the indigent and socially excluded class of pall-bearers, we lulled ourselves into believing that these solar discs were indeed dehydrating bodies to a speedy conclusion.

Last August, however, our community was stunned by the publication of photographs by Dhun Baria, who had taken photos of the Doongerwadi where the body of her deceased mother had been placed a couple of months earlier. Shattered by what she saw, she stuffed the photographic evidence into community mailboxes from where they swiftly found their way into the larger, national media.

Traditionalists denounced the photos as fakes and Baria was verbally savaged as a pawn in the hands of reformists. But that was only the equivalent of shooting the messenger.

The controversy generated by the August photographs heightened the community's paranoia. It exposed our problems to the outside world, and increased the risk of an official, or private, takeover of our exclusive properties. Mumbai's Doongerwadi, established in 1672, sprawls over what is now the highly valuable, 54 acre property of Malabar Hill.

So, how can we honor both the dignity of our dead, and a tradition dating back to our ancient roots? A growing but still-small number of Parsis have reluctantly opted for the electric crematorium - ugly, soulless, and run by insensitive municipal corporations.

Reformers have failed in their attempts to set up an exclusively Zoroastrian crematorium within Mumbai's sanctified Doongerwadi grounds. Aggravating the angst is the fact that those choosing any method of disposal other than the Towers of Silence are denied the ultimate rite - prayers for the soul's safe passage.

Parsi Zoroastrians in other areas have opted for other rites. In Delhi, where no Doongerwadi exists, the dead are buried in their own cordoned Zoroastrian cemeteries. The long-established community in England buries its dead at the Brookwood cemetery in Surrey. Parsi Zoroastrians in North America, Australia and New Zealand usually opt for exclusive ash-scattering grounds. Die-hard traditionalists back home denounce this heresy, but there's no choice.

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