CHAPTER 14

Human Capitalism

Parachuting cats into Borneo — Stopping the waste of people — Curitiba's web of solutions — Faster travel without freeways — Subways on the surface — Simple, fast, fun, and cheap — When garbage isn't garbage — No hunger pangs — A place for living — A symbol of the possible

WHAT DESTINATION DOES OUR SOCIETY WANT TO REACH, AND HOW WILL IT get there? Lessons in what *not* to do can often be found in cities, where most officials, overwhelmed by a flood of problems, try to cope by naming and solving them one at a time. If they are faced with congestion, their answer is to widen streets and build bypasses and parking garages. Crime? Lock up the offenders. Smog? Regulate emissions. Illiteracy? Toughen standards. Litter? Raise fines. Homelessness? Build shelters, and if that seems to fail, jail the loiterers. Insufficient budget to fund all these competing priorities? Raise taxes or impose sacrificial austerity, to taste. Disaffected voters? Blame political enemies.

Sometimes single-problem, single-solution approaches do work, but often, as previously described, optimizing one element in isolation pessimizes the entire system. Hidden connections that have not been recognized and turned to advantage will eventually tend to create disadvantage.

Consider what happened in Borneo in the 1950s. Many Dayak villagers had malaria, and the World Health Organization had a solution that was simple and direct. Spraying DDT seemed to work: Mosquitoes died, and malaria declined. But then an expanding web of side effects ("consequences you didn't think of," quips biologist Garrett Hardin, "the existence of which you will deny as long as possible") started to appear. The roofs of people's houses began to collapse, because the DDT had also killed tiny parasitic wasps that had previously controlled thatch-eating caterpillars. The colonial government issued sheet-metal replacement roofs, but people couldn't sleep when tropical rains turned the tin roofs into drums. Meanwhile, the DDT-poisoned bugs were

being eaten by geckoes, which were eaten by cats. The DDT invisibly built up in the food chain and began to kill the cats. Without the cats, the rats multiplied. The World Health Organization, threatened by potential outbreaks of typhus and sylvatic plague, which it had itself created, was obliged to parachute fourteen thousand live cats into Borneo. Thus occurred Operation Cat Drop, one of the odder missions of the British Royal Air Force.[1]

Too often, cities similarly find that the cause of their problems is prior solutions that have either missed their mark or boomeranged, like the bigger road that invites more traffic, the river channelization that worsens floods, the homeless shelter that spreads tuberculosis, and the prison that trains criminals in more sophisticated techniques. Rather, our goal should be to solve or avoid each problem in a way that also addresses many more simultaneously — without creating new ones. This system approach not only recognizes underlying causal linkages but sees places to turn challenges into opportunities. Communities and whole societies need to be managed with the same appreciation for integrative design as buildings, the same frugally simple engineering as lean factories, and the same entrepreneurial drive as great companies.

This wide focus can help people protect not only the natural capital they depend upon but also their social fabric, their own human capital. Just as ecosystems produce both monetized "natural resources" and far more valuable but unmonetized "ecosystem services," so social systems have a dual role. They provide not only the monetized "human resources" of educated minds and skilled hands but also the far more valuable but unmonetized "social system services" — culture, wisdom, honor, love, and a whole range of values, attributes, and behaviors that define our humanity and make our lives worth living.[2] Just as unsound ways of extracting wood fiber can destroy the ecological integrity of a forest until it can no longer regulate watersheds, atmosphere, climate, nutrient flows, and habitats, unsound methods of exploiting human resources can destroy the social integrity of a culture so it can no longer support the happiness and improvement of its members. Industrial capitalism can be said to be liquidating, without valuing, both natural *and* human capital — capturing short-term economic gains in ways that destroy long-term human prospect and purpose. An overworked but undervalued workforce, outsourced parenting, the unremitting insecurity that threatens even the most valued knowledge workers with fear of layoffs — these all corrode community and undermine civil society.

Previous chapters have described how the worthier employment of natural resources can protect and enhance ecosystem services. Are there also worthier ways to employ people, so as to protect and enhance social-system services? Is there a social version of the principles of natural capitalism: of resource productivity, mimicking natural processes, the service and flow economy, and reinvestment in natural capital? Are there ways to restructure economic activity that reward social enrichment and that reinvest in social systems' capacity to evolve ever more diverse and creative cultures?[3] Can reversing the waste of resources and of money also reinforce efforts to stop wasting people? How can ways of eliminating all these three kinds of waste reinforce one another? How — most challengingly — can we accomplish these goals in places where the population and its problems far outweigh available funding and time?

Basic human needs can be satisfied by a combination of products, forms of political and social organization, values and norms, spaces and contexts, behaviors and attitudes.[4] Industrial capitalism rewards only the sale of monetized goods and services, so it naturally focuses on tangible, material ways to meet human needs. To be sure, material goods are useful, and up to a point indispensable, but only so far as they serve people, not the reverse: When physical production and economic growth turn from means into ends, they yield outward affluence accompanied by inner poverties expressed as social pathologies. The shopping mall is a pale substitute for the local pub, TV sitcoms for family conviviality, security guards for safe streets, insurance for health.

The health of societies depends not only on choosing the right means to satisfy human needs but also on understanding the interlinked pattern of those means. Traditional cultures, having more limited means to satisfy human needs, tend to meet as many needs as possible with as few resources as possible. In contrast, industrial capitalism emphasizes the creation of specialized products that fight for market niches to fill needs that, as often as not, cannot be satisfied by material goods.[5] Successful societies require that each action they take answers many needs simultaneously. In effect they adopt the same design philosophy, and achieve the same elegant frugality, with which whole-system engineering meets technical demands by delivering multiple benefits from single expenditures, or lean thinking meets organizational needs by purging them of the *muda* of unneeded and

counterproductive tasks. The context is different, but the logic, purpose, and result of this social form of whole-system design are similar.

In the developing countries of the South, such whole-system thinking is at a premium, because the new pattern of scarcity that is the cornerstone for the arguments of this book — abundant people but scarce nature — has arrived there early and with a vengeance. For the developing world, most acutely, the relevant question will be: How many problems can be simultaneously solved or avoided, how many needs can be met, by making the right initial choices? And how can those choices be linked into a web of mutually supporting solutions, creating a healthy economic, social, and ecological system that develops both better people *and* thriving nature?

WEAVING THE WEB OF SOLUTIONS: THE CURITIBA EXAMPLE

Curitiba is a southeastern Brazilian city with the population of Houston or Philadelphia. It shares with hundreds of similar-sized cities[6] a dangerous combination of scant resources plus explosive population growth. Curitiba' s metro-area population grew from about 300,000 in 1950 to 2.1 million in 1990,[7] when 42 percent of the population was under the age of 18. Another million residents are expected by 2020.

Most cities so challenged, in Brazil as throughout the South, have become centers of poverty, unemployment, squalor, disease, illiteracy, inequity, congestion, pollution, corruption, and despair. Yet by combining responsible government with vital entrepreneurship, Curitiba has achieved just the opposite. Though starting with the dismal economic profile typical of its region, in nearly three decades the city has achieved measurably better levels of education, health, human welfare, public safety, democratic participation, political integrity, environmental protection, and community spirit than its neighbors, and some would say than most cities in the United States. It has done so not by instituting a few economic megaprojects but by implementing hundreds of *multi*purpose, cheap, fast, simple, homegrown, people-centered initiatives harnessing market mechanisms, common sense, and local skills. It has flourished by treating all its citizens — most of all its children — not as its burden but as its most precious resource, creators of its future. It has succeeded not by central planning but by combining farsighted and pragmatic leadership with an integrated design process, strong public and business participation, and a widely shared public vision that transcends partisanship. The lessons of Curitiba's transfor-

mation hold promise and hope for all cities and all peoples throughout the world.[8]

At 6:00 on a Friday evening in 1972, an hour after the law courts had closed, the renewal of Curitiba began. City workmen began jackhammering up the pavement of the central historic boulevard, the Rua Quinze de Novembro. Working round the clock, they laid cobblestones, installed streetlights and kiosks, and planted tens of thousands of flowers. Forty-eight hours later, their meticulously planned work was complete. Brazil's first pedestrian mall — one of the first in the world — was ready for business. By midday Monday, it was so thronged that the shopkeepers, who had threatened to sue because they feared lost traffic, were petitioning for its expansion. Some people started picking the flowers to take home, but city workers promptly replanted them, day after day, until the pillage stopped. The following weekend, when automobile-club members threatened to retake the street for cars, their caravan was repulsed by an army of children, painting watercolors on mall-length rolls of paper unfurled by city workers. The boulevard, now often called Rua das Flores, the Street of Flowers, quickly became the heart of a new kind of urban landscape. The children of those children now join in a commemorative paint-in every Saturday morning. The city is blessed with twenty downtown blocks of pedestrian streets that have regenerated its public realm and reenergized its commerce and its polity.

Of the many initiatives that changed the city's direction, the historic boulevard's bold resurrection, just before it was to have been destroyed for an overpass, was the most emblematic. At that time nearly every city in the world was demolishing its historic core so bigger roads could handle the onslaught of cars carrying people between districts zoned for disparate activities. But in 1971, when Brazil was still under military dictatorship, the governor of Paraná State had chosen as mayor of its capital city a thirty-three-year-old architect, engineer, urban planner, and humanist named Jaime Lerner. Cheery, informal, energetic, intensely practical, with the brain of a technocrat and the soul of a poet, Lerner was selected not only for his knowledge of the city's needs but also for his supposed lack of political talent: The governor wanted someone politically nonthreatening. Unexpectedly, Lerner turned out to be a charismatic, compassionate, and visionary leader who ultimately ended his three terms, totaling a record twelve years, as the most popular mayor in Brazilian history.[9]

His terms alternated with those of three other mayors because of Brazil's single-consecutive-term limit. Since then, Lerner has been twice elected governor of Paraná. From that loftier position, he and the new mayor, his protégé Cassio Taniguchi, are seeking to coordinate the state's and city's responses to migration, sewage, and other joint issues that neither can address alone. Now Lerner is spoken of as a plausible candidate for president of Brazil. He has also helped train, inspire, and propagate a generation of disciples whose influence extends far beyond Brazil.

The effectiveness, common sense, and political resonance of Lerner's policies, and their reliance on wide participation, were made possible by earlier and vibrant public debate to form a broad and durable political consensus. As a result, all six post-1971 mayors of Curitiba, though politically diverse — one was an outright opponent of Lerner's — have followed compatible policies, each respectfully advancing prior achievements while adding his own stamp. Five of the six were architects, engineers, or planners who treated the city and its political leadership as a design problem, continuously unfolding as the city's 1965 master plan shed its rigidities and evolved to meet changing needs. Those six mayors' twenty-eight years (and counting) of good management have generated a flow of interconnected, interactive, evolving solutions — mostly devised and implemented by partnerships among private firms, nongovernmental organizations, municipal agencies, utilities, community groups, neighborhood associations, and individual citizens. Curitiba is not a top-down, mayor-dominated city; everyone respects the fact that, while it is served by leaders, many of the best ideas and most of their implementation come from its citizens. It encourages entrepreneurial solutions.

Lerner believed, as the late ecologist René Dubos put it, that "trend is not destiny." Rejecting the destruction of people-centered cities to rebuild them around cars, Lerner aimed to regain the vibrancy and diversity of the street life he'd enjoyed as a child, playing outside his Polish immigrant father's dry-goods store on the street of the main railway station. Having served previously as the president of the Curitiba Research and Urban Planning Institute (IPPUC),[10] the nucleus of the city's innovative design ideas since the mid-1960s, he and his design colleagues saw Curitiba as a living laboratory to test their novel concept; but there was no time to lose. With its human population doubling each decade but with no new vision of urbanism, the city

was rapidly developing clogged streets, bad air, and a dwindling sense of community. Lerner knew that to reverse these symptoms of excessive automobility, he had to move quickly and take risks. The revitalization of the Rua Quinze provided a symbolic focus for emerging attitudes about the purpose of both cities and their inhabitants.[11] Residents and observers consider it a model worth emulating.

TRANSPORTATION AND LAND USE

Curitiba's best-known innovations are in "growing along the trail of memory and of transport," as Lerner puts it. "Memory is the identity of the city, and transport is the future." Transportation, he realized, is not only a way to move people but also a way to guide land-use and control growth patterns, so as to influence not just traffic routes and modes but also origins and destinations. Heretically, rather than expropriating and demolishing centrally located buildings to widen roads — the "urban renewal" that in so many cities has created a desolate, gridlocked core fed by overcrowded highways — Lerner's administration chose to adapt existing streets, losing only a few buildings throughout the city. Along the center of each of five interlinked growth axes, three parallel avenues were modified. The middle one carried express buses both ways, flanked by local traffic. The other two, one block to either side, were one-way high-capacity roads to or from downtown. This express-avenue system achieved the performance of a huge thoroughfare nearly two hundred feet wide by spreading it over three existing adjacent streets. The construction it required was completed in only four years.

Matching the density of population to the capacity to transport it, new zoning specified that the buildings nearest the bus avenues could have up to six times as much floorspace as land area, grading down to a ratio of one for properties farthest away from transit. Extra density — up to two additional stories' worth in a few specific areas with enough infrastructure to support it — was later sold by the city at 75 percent of its market value, paid in cash or land that was then reused to build low-income housing. Parks were renewed to revitalize the arts, culture, and history of the urban core. Many historic buildings were protected and refurbished; owners were reimbursed for the foregone land development rights, which were transferred to other districts. The city's rich ethnic heritage was honored and preserved. A ceremonial gate and special center was created for each main culture, operated mainly by its

descendants. Mixed use was encouraged, ensuring the availability of downtown housing and a match of densities between housing and commercial needs. The city financed a special block-long covered arcade of shops open twenty-four hours a day to help keep the downtown lively throughout the night. The urban core, relieved of commercial pressures that would otherwise generate extreme densities, was returned to pedestrian priority as the focus of a renewed sense of community. Ordinary streets remained small and human-scaled; the historically evolved patterns and varying sizes of streets meant that the ratio of street area to private land remained far smaller than in a grid layout.

The axial road/transit corridors shaped the city's subsequent evolution. But before developing those corridors and hence boosting land values, the city strategically bought nearby land in selected areas and built low-income housing on it so as to ensure affordable access to jobs, shops, and recreation. In addition, the city built schools, clinics, day-care centers, parks, food distribution centers, and cultural and sports facilities throughout its suburbs, democratizing amenities previously available only to those who journeyed downtown. It thereby reduced the need to travel and strengthened the outlying neighborhoods, which also gained a great diversity of convenient shops. Small-scale, low-income housing was blended throughout the city in an effort to foster equity and social integration. The open availability of land-use plans and rules reduced uncertainty and thus discouraged land speculation. A further recent blow was struck against speculation by introducing a public Geographic Information System that gives everyone equal access to information about all the land in the city. To help keep that database up-to-date, building permits require disclosure of job, traffic, parking, and other specifics needed for sound urban and budget planning. (The city runs mainly on property taxes.) Zoning has been based on considerations including geography, hydrology, topography, climate, winds, and cultural and historical factors — not just the tax base, political pressures, or developers' proposals.

Even with this orderly development pattern, how could a city provide its rapidly growing population with transportation without choking the higher-density areas? What Curitiba did *not* do was to turn over its destiny to traffic engineers, who seldom adequately understand the complex urban dance between land use and society, space, and movement. Instead, Lerner relied on urbanists and architects, mainly from IPPUC, all of whom approached transportation and land use, hydrol-

ogy and poverty, flows of nutrients and of wastes, health and education, jobs and income, culture and politics, as intertwined parts *of a single integrated design problem.* In addressing needs for transportation — considered as access, not necessarily as mobility — they followed a set of simple principles: Favor universal access over private cars. Support human needs; don't promote particular transport modes. Meet the requirements of the poorest. And don't spend money you don't have.

Curitiba started its transportation overhaul with buses because it *had* buses and couldn't afford anything else; but first it needed different buses. The old vehicles, originally built on truck chassis designed as much for hauling animals as people, were noisy, bumpy, uncomfortable, slow, and awkwardly high off the ground. Passengers had to crowd up steep stairs and jam through doors narrowed to discourage fare evasion. But the IPPUC architects and engineers devised a wholly new kind of bus, optimized for people, comfort, economy, and rapid flow. Their double- or (since 1991) triple-length express buses, "articulated" with pivoted sections for rounding corners, have up to five extrawide doors. Locally assembled by Volvo, they can carry up to 270 passengers, using 42 percent less fuel per seat-mile — even less per seat-*trip,* because they cover their routes in one-third the time.

Curitiba's system for *using* buses, dating back to 1928, also needed to be fundamentally reconceived, from routes to boarding procedures, administration to finance, politics to policies. A jumble of mismatched regional concessions had to be melded into an integrated and efficient transport system built on simple new technologies. Manual routing and scheduling were switched to homegrown software, later commercialized. On the express routes, buses now pull up alongside an invention of Lerner's team, called a "tube station"[12] — an elevated glass cylinder parallel and adjacent to the bus lane, entered through a turnstile, displaying clear maps, and accessible by the handicapped. Matched doors open on both station and bus. There are no stairs: Both floors are at the same height, like a subway and its platform. All the departing passengers disembark through one end of the tube station and board from the other, again just like a well-run subway. Depending on the time and route, this switch takes an average of about thirty seconds — as long as a bus conductor would need to collect fares from roughly seven passengers if they hadn't previously paid their fares on entering the tube stations. Instead, the bus needs only a driver, so it can carry more passengers, faster, at lower cost. Rush-hour express buses

leave once a *minute*. The bigger bus, wider doors, and tube station, plus automatic controls — the buses operate traffic lights to maintain their priority — achieve three times the average passengers-per-hour, and the average speed, of a traditional bus. This reduces idle capital (69 percent fewer buses do the same job), fuel, pollution, noise, and cost, and shaves about 40 minutes off a typical daily commute. The whole system is designed not just to deliver its passengers pleasantly and safely but to do so quickly, so they'll have more time for family, friends, and enjoying life.[13]

Each lane of express buses carries 20,000 passengers per hour. That's about as many as a subway carries; indeed, it's just like a subway, except that it costs at least 100 times less (tenfold less than a surface train) and can be installed in six months, not a generation. Rio built subways that carry one-fourth as many passengers as Curitiba's buses yet cost 200 times as much. By avoiding those huge capital costs, and their perpetual operating costs, Curitiba instead freed up funds for many of its social improvements.

Curitiba is widely believed to have the finest bus system, if not the finest public transportation system, in the world. More than 1,250 buses of 9 varieties are matched to their specific duties so as to leave fewer empty seats. Two hundred forty-five carefully integrated radial, loop, and connector routes of 12 color-coded kinds, linked by 25 terminals, blanket the entire city and its environs. The buses make 17,300 daily trips on nearly 500 route-miles, covering 230,000 bus-miles per day — a distance of nine times around the world. The British *Guardian* newspaper reported that Curitiba's efficient bus service "makes London seem antediluvian. Bus jams never happen, vandalism is unknown" — even to the beautiful but deliberately fragile glass tube stations — because of pervasive civic pride. People could easily evade the bus fare, too, by walking into either open end of the terminals, but they don't, because they reciprocate the city's palpable respect.

The bus system is entirely self-financing from fares; the city contributes only the streets, stations ($4.5 million for all 200-odd stops), and lights. It sets the fare, routes, schedules, and operating standards. The forty-five-U.S.-cent fare covers all other costs, including the $45 million fleet of buses, plus a profit to the ten private operating firms. The rate structure repays one percent of the operator's fleet investment per month — a strong incentive to reinvest. Financial controls on the operating companies are strict, audited, open to public inspection, and

easily understood. The two-page operating license is revocable at any time, a deterrent that helps eliminate bad entrepreneurs. Banks unwilling to invest in other cities' buses are comfortable with Curitiba's.

The bus system succeeds both financially and socially because it gets the basic incentives right. The division of total fares between the ten bus companies rewards not how many people they carry but *how many miles of route they cover,* so they have an inducement to be comprehensive, and not to indulge in destructive competition over routes already well served. The flat-rate, unlimited-transfer fare (each rider averages 1.4 segments) effectively uses shorter commutes by the middle class to subsidize longer commutes by the poor. This is one of many reasons why a poor person in Curitiba typically enjoys a higher standard of living than a poor person in São Paulo, who has essentially the same purchasing power but must spend over twice as much of it on transportation.

The Curitiban bus system is the most densely traveled in Brazil, carrying three-fourths of all the city's commuters — 1.9 million passengers per weekday, more than New York City's — with 89 percent user satisfaction.[14] By 1991, the system's attractions had encouraged enough switches from car to express-bus commuting to increase bus riders and decrease car drivers by about one-fourth. The same survey showed that 28 percent of bus users do have cars but choose not to commute in them despite the rarity of congestion.

Curitiba still has a half million cars — one for every 2.6 people, the highest rate of automobile ownership in Brazil except in Brasília itself, which was specifically designed around cars. Yet Curitiba also has no traffic problem, for thanks to benign neglect of cars, Curitiba now enjoys Brazil's lowest rate of car drivership and cleanest urban air. It saves around 7 million gallons of fuel a year, and uses one-fourth less fuel per capita than other Brazilian cities to achieve better access. Not bad for starters — and imagine the results that could be obtained with Hypercars and Hyperbuses.

And Curitibans have a multitude of mobility options beyond cars and buses. The city has over 2,200 taxis, two-thirds radio-dispatched and 90 percent driver-owned. Cyclists use 100 miles of well-designed, traffic-separated bike paths of two types — level for the leisurely, hilly for the athletic — all integrated with streets, buses, and parks. Special buses, taxis, and other services are provided for the handicapped, including travel to 32 specialized schools.

WATER, WASTEWATER, AND GREEN SPACE

Designing land-use in conjunction with transport reduced congestion and smog, saved energy, revitalized neighborhoods, and solidified civic spirit. But the success of the plan depended also on a less visible dimension: water. Curitiba lies between two major rivers and contains five smaller ones. For two centuries, people and rivers lived in harmony. But in the 1950s and 1960s, migrants from failed coffee plantations — displaced by mechanically harvested crops like soybeans — started settling in floodplain shantytowns. Meanwhile, impervious surfaces and other encroachments on natural drainage caused worsening floods through the city center. Multimillion-dollar channelization projects proved of minimal benefit. The problem had become acute when Lerner first took office. His designers decided to switch from fighting flooding to exploiting the water as a gift of habitat. They passed stringent riparian-zone protective laws, turned riverbanks into linear parks, and used small ditches and dams to form new lakes, each the core of a new park. This "design with nature" strategy stopped the flooding, and cost far less than traditional flood-control methods. Now, planners quip, heavy rains just make the ducks in the parks float a meter higher. Unused streamside buildings were meanwhile turned into sports and leisure facilities. Community groups sprang up to protect the parks, use them for environmental education, and integrate this into school programs. The flood-control greenways also worked well as antipollution buffers from nearby slums.[15] A strategic objective throughout has been to protect the giant Iguaçu basin from serious contamination, since this river within the city provides nearly all of the metro area's drinking water. Sixteen parks, cherished as public assets, form the first line of defense for this vital water resource.

At the same time, the city introduced a five-yard setback requirement (intended as a space for gardens) for all new buildings outside the core. It limited residential construction to 50 percent of a site's area, and banned impervious paving of open space. It provided permanent protection for vegetation in the low-density one-third of the city, and tax relief for woods and gardens: Over 1,100 private woodlands are now registered, and the tax-relieved private green space exceeds four square miles. All these features allow rainwater to soak in where it falls, and massively greened the city. Curitiba also planted hundreds of thousands of trees everywhere: "We provide the shade, you provide the water." The trees are the city's lungs, cleaning the air and blocking noise.

One-sixth of the city is wooded. Two nurseries provide 150,000 tree and shrub seedlings and 2.2 million plant seedlings per year. Without a permit, no one may cut down a tree, even on his or her own land, and the permit requires replanting two trees for every one that is removed.

Complementing the private gardens and woods is public green space, which in 25 years, even as the city's population grew 2.4-fold, expanded from five to 581 square feet per person — four times as much as the UN recommends or New Yorkers enjoy. The city protects nearly seven square miles of parks, nine forests, a Botanical Garden, five Environment Gardens, two Environmentally Protected Areas totaling five square miles along major rivers, 282 squares, and 259 pocket gardens. Curitiba's CD-ROM catalogs the 242 species of birds known and the 48 more suspected to live in the city; many have fled into the city's parks from encroaching suburbs. There's a profusion of amphibians and mammals and 50 kinds of snakes, and once-native species of various animals are being reintroduced. After a month's residence in the city, author Bill McKibben reported that "From every single window in Curitiba, I could see as much green as I could concrete. And green begets green; land values around the new parks have risen sharply, and with them tax revenues."

INDUSTRY AND COMMUNITY

Curitiba's economy was traditionally that of an agricultural market town and food processor. But in the past 20 years it's become an industrial and commercial powerhouse as well, linked to other cities in South America by rail, road, and two airports — one of them highly computerized and the second-largest in Brazil. Situated 190 miles southwest of São Paulo, Curitiba lies within 800 miles of the producers of 70–80 percent of Brazil's GDP, and nestles between the capitals of Brazil, Argentina, Uruguay, and Paraguay — a total market of 200 million people.

Mayor Lerner realized early on that to serve and employ its burgeoning population, the city would need to balance its commercial and service businesses with new light and medium industry. Before land speculators could move in, the city therefore planned in 1972 and bought in 1975 sixteen square miles of land, six miles west of downtown Curitiba, for its Industrial City. To ensure affordable housing near the jobs, it preinstalled low-income dwellings, schools, services, cultural facilities, streets, bus links (including a special one to the largest poor neighborhood), and protected open space: Nearly as much of the

Industrial City is occupied by woods as by factories. The city then recruited more than 500 nonpolluting industries, which provide one-fifth of its total jobs — 50,000 directly and 150,000 indirectly. To encourage firms to reduce, reuse, and recycle, they're all required to dispose of their solid wastes on their own land. Workers can walk or bike to work from their nearby homes at no cost and use their monthly transport vouchers to buy bikes. Companies are attracted by Curitiba's marketing cachet. International firms are well represented, partly because of the high quality of life: Executives reckon they save twenty commuting hours a week compared to what they would experience in São Paulo, or nine years per lifetime.

Curitiba didn't begin its urban development significantly richer or poorer than other cities in southern Brazil. In 1980, its per-capita GDP was only 10 percent above the Brazilian average. But by 1996, that margin had surged to 65 percent. More important, the effectiveness of municipal services had increased poor citizens' monthly household income from, say, $300 to the equivalent of $400 or even $500. What created this huge margin of advantage for poor Curitibans? Not direct transfer payments from the city's municipal budget, which in 1992 stood at a quarter billion dollars for a city of 1.3 million, or $156 per capita — one-eighth that of Detroit. Rather, Curitiba's funding for social services is spent more effectively than in probably any city in the North.

The municipal government is dedicated to solutions that are *simple, fast, fun, and cheap,* to what McKibben calls "constructive pragmatism." Lerner, convinced that hope is sustained by visible change for the better, inculcated a culture of speed: "Credit cards give us goods quickly, the fax machine gives us the message quickly — the only thing left in our Stone Age is the central governments." City Hall's credibility in Curitiba comes from its creating a big park in only twenty days, or launching a vast recycling program within months of its conception. Curitibans have also come to expect what is too often a rarity in Brazil: transparent, honest, and accountable government. Any politician foolish enough to stray from these ideals would be promptly skewered by the wags of the Boca Maldita — a picturesque section of the Luiz Xavier mall devoted to public grousing. The real and powerful deterrent is that the city has built what planner Jonas Rabinovitch calls "genuine mechanisms . . . to give broad-based legitimacy to its interventions. One example: People

vote for the improvements they would like to see in their neighborhood when they pay property taxes."

Since the rapidly changing value of the inflation-prone national currency can be hard to calculate, some Curitiban commentators measure urban investments in a novel unit: the cost of asphalting one kilometer of street, or about a half million dollars. For example, a tube station costs the equivalent of 0.5 km; a Lighthouse of Knowledge, 0.2 km. The latter is a brightly colored, 52-foot-high, lighthouse-shaped library of about 7,000 volumes, including the *Lições Curitibanas* — a ten-volume text on Curitiba's history, culture, civics, and environment that's a fundamental element of all primary schooling. Poor students obtain their set in exchange for recyclable garbage. Its print run of enough copies to instruct at least a third of a million children (over four years) sounds like a good use of the cost of 3 km of asphalt. The Lighthouses are also gaining Internet connections, and house Brazil's first public terminals. The top of each Lighthouse is a nighttime watchtower containing a light and a policeman, keeping the neighborhood safe for the children to come and go. Lighthouses of Knowledge are sprouting around the city, with the aim of having one within walking distance of every child's home.

In Curitiba, everything is recycled. A gunpowder magazine became a theater. A mansion was converted into the planning headquarters, an army headquarters into a cultural foundation, a foundry into a popular shopping mall, and the oldest house into a publications center. The old railway station became a rail museum, and a glue plant a Creativity Center where children make handicrafts (which the city's tourist shops then sell to fund social programs). A quarry became a famous amphitheater and a cable-and-polycarbonate-birdcage opera house (built in 60 days). A garbage dump was converted into the noted 11-acre Botanical Garden that is home to 220,000 species, and another derelict quarry into the Free University of the Environment. Constructed of old tires and utility poles, the Free University provides courses for everyone — shopkeepers, building managers, journalists, teachers, homemakers, and (mandatorily) taxi drivers — on the land-use and environmental issues related to their work.

Curitiba's buses get recycled, too. The average vehicle in service is only 3.5 years old, compared with the Brazilian average of eight and the legal limit of ten. Curitiba's depreciated buses often become mobile

job-training centers. Parked in the slums and reoutfitted, they are called *Linha do Oficio* ("The Jobs Route" or "The Line to Work"), and staffed by locally recruited, frequently rotated teachers who offer training in more than forty in-demand trades or disciplines to more than 10,000 people a year, mainly on nights and weekends. A three-month course costs only two bus tokens — less than a dollar. Other recycled buses become clinics, classrooms, baby-sitting centers, food markets, soup kitchens, and coaches for weekend excursions in the parks.

These innovations owe much to the staffing of the city's municipal departments. They're often led by women and are heavily populated by architects — professional problem-solvers — rather than by the more traditional sorts of bureaucrats skilled at explaining why problems can't be solved. The interdisciplinary charrette — the architect's standard design process — is Curitiba's primary problem-solving mechanism. Conceptual tests of new ideas lead quickly to their application. Risks are taken in the expectation that mistakes will be made, quickly detected and diagnosed, and corrected. When budgets can't support an entire new program, it's launched anyway so that learning can begin while more resources or economies are sought. Failures are frequent, hard lessons constant, struggles to improve unrelenting. Guided by the reservoir of experience in IPPUC and by the collective wisdom of its diverse citizenry, Curitiba experiments and improves as assiduously as any startup company. From the outside, it may look easy, but it's not. Rabinovitch emphasizes the many challenges that Curitiba's government has regularly faced. The *process* by which it seeks to overcome them, however, through persistent application of whole-system thinking, is far more important than particular successes.

CHILDREN AND HEALTH, GARBAGE AND NUTRITION

Many of Curitiba's children and adolescents have concerns as fundamental as where their next meal is coming from. As an island of decency and success in a slough of despondency, the city gave rise by the early 1990s to some 209 slum areas, containing one-ninth of its population, which were starting to suffer from diseases borne by rats and contaminated water. By Lerner's third term (1989–92), he therefore faced a doubled population and heightened social challenges. His response was to redouble Curitiba's long-standing efforts to support its poorest citizens, especially its children, who were the special concern of the city's First Lady.

The city's emphasis on its children starts with discreetly provided family-planning advice and continues with early prenatal and postnatal care. Medical improvements have cut infant mortality by nearly one-fifth in four years. By 1996 it was still slightly over twice the U.S. average, but one-third the Brazilian average, the lowest in the country, and being steadily reduced. Poor children receive regular visits from health workers and obligatory free checkups, recorded in a personal health book, until age five. Preventive health care is emphasized throughout the schools, day-care, and childhood/teen centers. The city has 88 health stations, five of which operate round-the-clock. Each has a drugstore that distributes 81 commercial and traditional medicines for free — 3 million doses per month, covering four-fifths of the most common conditions, and bulk-purchased to save packaging costs.

Because health depends critically on sanitation and nutrition, Curitiba found a creative way to fund both by turning garbage into value. Experts warned that when the city exceeded a million inhabitants, it would need not only subways but also a costly mechanical plant for separating its 800 daily metric tons of garbage. On both scores, Curitiba chose a different path. The 1989 "Garbage That Isn't Garbage" initiative led more than 70 percent of households to sort recyclables for thrice-weekly curbside collection by the green trucks of the private firm that won a public competition for the franchise. Organics go in one plastic bag; paper, metal, glass, and the like in another. Two-thirds of the separately bagged recyclables are recovered and sold. This loop-closing offset over half the system's operating cost, which previously often represented the largest item in the municipal budget. Sorting stations, built from secondhand parts, hire the homeless, the disabled, and recovering alcoholics. Landfill use has been reduced by one-sixth in weight, and even more in volume. Groundwater is protected from contamination by leaching garbage. Curitibans' paper recycling alone saves 1,200 trees a day.

The city also funds a Garbage Purchase Program[16] from what it would otherwise have paid to collect trash in the poorer neighborhoods, where normal collection was next to impossible because trucks couldn't reach unpaved alleys. Now, in the "Green Exchange" project, a small truck pulls up in one of more than 100 squatter sectors of the city and rings its bell. Tens of thousands of the area's citizens respond by bringing bags of garbage to swap for food: 60 kilograms of trash earn 60 tickets, enough for a month's food (or bus tokens, school notebooks,

or Christmas toys) for an entire family. Two kilos of recyclables earn one kilo of food. Similar exchanges, all totaling close to 100 metric tons a month, occur at schools and factories. McKibben quotes the ticket book's cover: "You are responsible for this program. Keep on cooperating and we will get a cleaner Curitiba, cleaner and more human. You are an example to Brazil and even to the rest of the world."

These food exchanges address many needs at once. The rice, beans, potatoes, onions, oranges, garlic, eggs, bananas, carrots, and honey they supply are seasonal surplus produce bought from local farmers, helping keep them on the land. Public health is served by encouraging the clearance of litter from hard-to-reach land, mainly near the rivers. That effort is supplemented by a temporary-jobs-for-cleanup program called "All Clean," funded by the city but organized by 135 neighborhood associations, which hires unemployed or retired people who need the income. With cleanup, too, comes community pride: vegetable gardens, dug by out-of-school children and coached by now-employed peasants, sprout from former dumps. All these initiatives rely not on capital-intensive mechanization but on public participation.

Nutrition is improved not just by Green Exchange but by diverse efforts reaching many of the city's 700,000 poorest residents. Some families can get garden plots in the suburbs, through the neighborhood-association-centered Community Orchards Program, to grow food for their own use and for sale. One such program has established farms next to day-care, school, and neighborhood association buildings where city agronomists provide seeds, materials, tools, and advice. Another effort organizes restaurants and others to distribute meals and surplus produce to the needy. The City Department of Health offers instruction in homegrowing medicinal plants. To help the poor stretch their budgets and to discourage price-gouging, the city has tried a computerized phone system that informs shoppers of the current prices of 222 staples in the dozen largest supermarkets. Family Warehouses even bulk-buy food, toiletries, and cleaning goods for resale to low-income families at 30 percent below retail.

EDUCATION, DAY CARE, AND JOBS

With nearly 100 children born daily, Curitiba must spend 27 percent of its budget on education. Its 120-odd schools, many reused for adult education at night, have achieved one of Brazil's highest literacy rates

(over 94 percent by 1996) and lowest first-grade failure rates. Environmental education, too, starts in early childhood and is not just taught in isolation but integrated across the core curriculum. A top priority of the city since 1971, it portrays the environment not just as parks but as the place and the social setting that forms tomorrow's citizens. Dozens of Centers for Integrated Education operate near conventional schools, providing half of each student's instructional time from better-trained teachers.

Schooling is only one element in an extensive network of child-oriented social services. More than 200 day-care centers, free for lower-income families and open 11 hours a day (long enough to support working parents), are situated next to many schools and provide four meals a day for some 12,000 children who would otherwise wander the slums while their parents were away at work. (Their hunger pangs could also lead them, as in other Brazilian cities, to sniff glue — an ultimately fatal practice. Curitiba recently tackled this addiction by working with the leading manufacturer to add a foul-smelling substance to its glue, a step that has gone far toward eliminating glue-sniffing nationwide.) The centers also offer instruction in caring for younger children and growing vegetables. Many companies and individuals receive tax waivers for sponsoring day-care positions through vouchers, helping to finance new centers. One measure of the community's solidarity is that through patient negotiation, without police involvement, local gangs that initially committed some vandalism to the day-care centers ended up getting involved in their work. Similarly, when gangs initially tore up flower beds at the new Botanical Garden, interpreting their vandalism not as a venting of hostility but as a cry for help led to hiring them as assistant gardeners.

Boarding schoolchildren can work part-time from their own dormitories, delivering newspapers and magazines (which also promote literacy); half their earnings are banked for them until they're older. Or they can work in a uniformed service either delivering packages or carrying parcels for shoppers in the street markets. Working schoolchildren can also get school support, sports, culture, and computer courses. Older children are given apprenticeships, entry-level jobs, and job training, often in environmental skills — forestry, ecological restoration, water pollution control, public health. They can earn half the minimum wage in parks, flower shops, and private gardens. The

Program for Childhood and Adolescence Integration (PIÁ — a pun on *pía,* Guarani slang for "kid"), an 8-to-6 effort for school dropouts aged 7–17, has 64 centers. Half teach with an environmental emphasis, reaching more than 4,000 children. Altogether, PIÁ serves some 30,000 children. As in the city's other social programs, loop-closing abounds: For example, kids learn gardening by growing flowers (the city provides the seeds), sell them to city parks, earn money and self-respect, gain skills, and qualify for real jobs.

Curitiba's few hundred street children — far fewer than in other Brazilian cities — are registered and are well known to street-smart social workers, who seek to win their trust and enroll them in the many programs, shelters, and foster arrangements that offer food, love, and support. Children who stay in school are given scholarships in the form of family food baskets, and can get part-time entry-level jobs plus health care, transportation, and job training.

STRAGGLERS AND ARRIVALS

A similarly impressive range of efforts supports the homeless and the needy elderly and disabled, with many programs achieving multiple aims. For example, Dial Solidarity stands ready to pick up any second-hand furniture and appliances, which will be repaired by apprentices in carpentry and upholstering, then resold at nominal cost in street markets in the neediest neighborhoods (or sometimes donated). The oldest slum contained for a time a traveling circus tent in which children made toys — for themselves, day-care centers, and others in need — out of recyclables. The toys were based partly on prototypes created by industrial design students: A plastic mineral-water bottle turned into a toy tube station. Programs for the elderly ("Third Age") are designed not as mere recreation but as a foundation for an independent and active life, promoted by such physical activities as yoga, dance, and physiotherapy.

Another key goal is to give an economic role to marginal and potentially alienated or resentful individuals — integrating them as active, self-reliant citizens with pride in their contribution to the community. Job markets match up employers with qualified applicants, but the seventeen hundred peasants arriving monthly from the countryside, though offered basic orientation, often have trouble finding work. The city is trying to organize a thousand poor handcart collectors of recyclables to help them get a fair price. Shoeshiners and street vendors are similarly organized and offered good sites at regular times: Rather than

being expelled or harassed, Curitiba invites them to take their place in the fabric of the city, licenses them, and gives them the status, stability, and business advantage of stalls and pushcarts.

In a 170-household pilot project, some poor families constructed their own decent cottages with municipal long-term land-and-materials financing, at a cost equivalent to two packs of cigarettes a month. With a dwelling upstairs and a shop downstairs, these small "trade villages" brought vital services into the slums, fostered dignity, and turned their residents into active citizens with a stake in their neighborhood. Lerner is now leading Paraná State toward a policy of providing microcredit and land tenure in new rural villages that are expected to receive one-fourth of the state's landless peasants by 1999, delaying by at least a generation their flow to the city.

Nonetheless, that flow has continued to overwhelm Curitiba's ability to house migrants in some 14,000 low-income dwellings dispersed through existing neighborhoods. The city therefore recently created a new district, planned to lodge up to 30,000 additional migrant families. Since many peasants arrive with building skills, the city created a build-it-yourself program that gives each poor family a plot of land, a title deed, building materials, two trees — one fruit, one ornamental — and an hour's consultation with an architect. The custom design, with advice on the sequence of later room-by-room expansion, bears no additional cost and yields a vastly better result than impersonal cinder-block hovels. Each house's uniqueness in layout, appearance, and even building technology (samples of which line a Technology Street) signals the personal validation of each of the neighborhood's new citizens. And among the district's first building projects was the tube station linking it into the rest of the city. As Lerner says, a city with ghettos — ghettos of poor or of rich — isn't a city. Despite its Teutonic heritage of conservatism, Curitiba doesn't begrudge its generous help for the poor, because it's frugally and effectively carried out. Nor do taxpayers complain that government can't work, because their government so clearly does. Curitiba is a city short on cynics and long on citizens.

IDENTITY AND DIGNITY

Strengthening civil society is the focus of many other important programs in Curitiba. The larger bus terminals contain "Citizenship Streets" — clusters of satellite municipal offices that bring City Hall to its constituents where they change bus lines. (Suburban "neighborhood

City Halls" came even earlier.) The Citizenship Streets also offer information on training, business loans, and job opportunities; the largest one is even integrated with a street market. This decentralization of services to the most local possible level reflects the user-friendly, customer-service orientation of all municipal services. Their design is streamlined to save citizens' time, so that a sick mother, for example, can schedule a clinic or specialist appointment, day care, and any other required support with a single phone call. The 4,500 beds at 36 hospitals, and 1,700 daily doctor's appointments, are also centrally dispatched for users' convenience.

Another strong emphasis, from childhood up, is the availability of public information, on the sound principle that "the better citizens know their city, the better they treat it." The city's array of telephone- and Web-based resources and hotlines — and the responsiveness of the city workers and volunteers taking the calls — would do credit to a metropolis ten times its size. There are hotlines not just for kids at risk, potholes, and gas leaks but also for air, water, noise, land pollution, ugliness, and bandit tree-cutting. The social lines alone handle 28,000 calls a day — six per citizen per year. The resulting sense of participation is so ingrained that instead of graffiti scrawled on public walls, Curitibans politely tape poems to utility poles. In comparison with Americans who often don't know their next-door neighbors, Curitibans consider one another all neighbors, and in contrast with their historical reserve, are starting to show signs of downright gregariousness. As McKibben puts it, this vibrant city is "a habitat, a place for *living* — the exact and exciting opposite of a mall."

These, then, are some of the ways in which Curitiba's creative, coherent, highly integrated design approach turns isolated problems — public transport and housing, trash and food, jobs and education — into interrelated generators of new resources and social cohesion. Even a task like mowing the parks' grass reflects the goals of an integral philosophy: Instead of running noisy, smelly, oil-consuming mowing machines, a municipal shepherd moves his flock of thirty sheep around as needed. In due course, the wool and the sheep too are recycled, turning surplus grass into more income for social programs.

SYNTHESIS

Teasing apart the strands of the intricate web of Curitiban innovation reveals the basic principles of natural capitalism at work in a particu-

larly inspiring way. Resources are used frugally. New technologies are adopted. Broken loops are reclosed. Toxicity is designed out, health in. Design works with nature, not against it. The scale of solutions matches the scale of problems. A continuous flow of value and service rewards everyone involved in ever-improving efficiency. As education rejoins nature and culture to daily life and work, myriad forms of action, learning, and attitude reinforce the healing of the natural world — and with it, the society and its politics. For Curitiba has discovered a way to transcend natural capitalism, supplementing its principles and practices with others that start to achieve what we may call human capitalism. Walter Stahel notes that traditional environmental goals — nature protection, public health and safety, resource productivity — can together build a sustainable *economy.* But, he adds, only by adding ethics, jobs, the translation of sustainability into other cultures — and we would add, citizenship — can we achieve a sustainable *society*.[17]

But how, finally, is the city working? In early-1990s surveys, over 99 percent of Curitibans said they wouldn't want to live anywhere else, 70 percent of São Paulo residents thought life would be better in Curitiba, and 60 percent of New Yorkers wanted to leave their glittering city. Among Curitiba's noteworthy achievements,[18] benchmarked annually to spur further gains, are 95 percent literacy, 96 percent basic vaccination, 99.5 percent of households with drinking water and electricity, 98 percent with trash collection, 83 percent with at least a high-school education, three-fourths of households owner-occupied, one-third the national average poverty rate, and 72-year life expectancy. Curitibans enjoy 86 percent weekly newspaper circulation, 25 radio stations, 14 cable and TV stations, three orchestras (even a famous harmonica orchestra), 20 theaters, 30 public libraries, 74 museums and cultural buildings. The Culture Foundation's monthly program of events, generally with free or very cheap admission, exceeds 40 pages. With a 1996 per-capita GDP of only $7,827 — 27 percent of America's — Curitibans have created what the well-traveled Bill McKibben calls "one of the world's great cities."

Of course, Curitiba has significant problems still ahead of it: A third of metro-region houses are unsewered, 8 percent of its citizens still live in slums (compared with one-third in Rio), and nearly half its children are not yet completing grade school. Because of its success, Curitiba attracts much of the surrounding misery of southern Brazil, and cannot possibly handle all of it. But on the whole, its imperfections are of

the variety that McKibben quotes from the Brazilian newsmagazine *Veja:* "It rains a lot, the streets are slippery, and drivers still go through red lights. Its virtues, however, are unbeatable."[19]

Curitiba doesn't present itself as a turnkey model for literal replication, for no two cities are alike enough for such copying to work. Rather, Lerner calls his city "not a model but a reference."[20] Perhaps its most impressive achievement is that a simple philosophy and persistent experimentation and improvement have created a First World city in the midst of the Third World — breaking what Lerner calls the "syndrome of tragedy" that paralyzes progress, and replacing it with dignity and hope. Curitiba's central political principle since 1971 has been consistent and profound: to *respect* the citizen/owner of all public assets and services, both because all people deserve respect and because, as Lerner insists, "If people feel respected, they will assume responsibility to help solve other problems." Closing the broken loop of politics, this principle recycles the poor and hungry, the apathetic and illiterate, into actively contributing citizens.

Lewis Mumford called cities a "symbol of the possible."[21] On the southern plateau of Brazil, one city has hauled itself out of tough circumstances by the strength of good design. Its design mentality treats a wide variety of needs not as competing priorities to be traded off and compromised but rather as interlinked opportunities for synergies to be optimized. In Curitiba, its results show how to combine a healthy ecosphere, a vibrant and just economy, and a society that nurtures humanity. Whatever exists is possible;[22] Curitiba exists; therefore it is possible. The existence of Curitiba holds out the promise that it will be first of a string of cities that redefine the nature of urban life.