

## A REPORTER AT LARGE

## THE GANGES' NEXT LIFE

*India's holiest body of water is dangerously polluted. Will a Hindu priest and an engineer from California be able to cleanse the sacred river?*

BY ALEXANDER STILLE

SHORTLY after dawn, Veer Bhadra Mishra, a silver-haired Brahman in a traditional Indian dhoti, or loin-cloth, walks slowly and stiffly down a long, steep stairway from his temple in the city of Varanasi to the banks of the Ganges, as he has done almost every day of his fifty-eight years. All around him, along a seven-kilometre stretch of the river dominated by majestic, crumbling temples, palaces, and ashrams, the pageant of Indian life passes by. Tens of thousands of bathers, at eighty different ghats, or landing areas, plunge into India's holiest body of water. White-bearded ascetics raise their emaciated arms to salute the sun god; housewives in bright-colored saris toss garlands of marigolds to Mother Ganges, the river goddess; adolescent boys in G-strings do pushups, flex their muscles, and wash their bodies; naked children splash in the water; and families carry their dead to the "burning ghats" to cremate them and scatter their ashes on the river.

The tug of these traditions, some of which go back three thousand years, to the founding of Varanasi (also known as Banaras), the holiest city in India, pulls Mishra to the river, despite having suffered a broken thigh, which makes walking painful. But on this particular day, in early March, he remains on the bank, because of a nagging cold and also because of the poor quality of the water: it is filled with raw sewage, human and industrial waste, the charred remains of bodies, and animal carcasses. Normally, Mishra tries to perform five full immersions—five is an auspicious number, he explains. But even when he is feeling well he holds his nose as he puts his head in, and he no longer drinks the river water.

"There is a struggle and turmoil inside my heart," Mishra says. "I want to take a holy dip. I need it to live. The day does not begin for me without the holy dip. But, at the same time, I know what is B.O.D."—biochemical oxygen demand—

"and I know what is fecal coliform." He is referring to some of the scientific indices of water pollution.

For Mishra, this struggle of the heart is particularly acute because he has a complex double identity: he is the mahant—the head—of Sankat Mochan Temple, one of the principal temples of Varanasi, and he is also a professor of hydraulic engineering at Banaras Hindu University.

As a devout Hindu, Mishra views the Ganges as a goddess, a river that, because of its divine origin, is pure and purifies all those faithful who immerse themselves in her. Just as Muslims vow to visit Mecca, it is the dream of all good Hindus to visit Varanasi and bathe in the Ganges at least once in their lives. It is said that one drop of Ganges water carried by a breeze that lands on your cheek hundreds of miles away is enough to cleanse a lifetime of sins. All Hindus seek to have their ashes scattered along the Ganges at their deaths, and it is considered particularly lucky to die in Varanasi, because from there your soul will travel straight to Heaven.

But, as a scientist, Mishra cannot forget what he knows about the condition of the river water. Up in the temple complex behind him stands a state-of-the-art laboratory where bacteria cultures are being grown in special incubators in order to measure the level of pathogens at various points along the river. In some places at Varanasi, the fecal-coliform count has been known to reach a hundred and seventy million bacteria per hundred millilitres of water—a terrifying three hundred and forty thousand times the acceptable level of five hundred per hundred millilitres.

Some five hundred million people—one out of every twelve people in the world—now live in the basin of the Ganges and its tributaries. A hundred and fourteen cities dump their raw sewage directly into the river, which starts at Nepal, in the Himalayas, flows fifteen hundred miles through India and Bangladesh, and emp-

ties into the Bay of Bengal at Calcutta. Not surprisingly, waterborne illnesses—hepatitis, amebic dysentery, typhoid, and cholera—are common killers, helping to account for the deaths of more than two million Indian children each year.

What is particularly disturbing about these numbers is that they come at the end of a ten-year government cleanup project called the Ganga Action Plan—a project that most people, even in government, concede has failed. Now the government is preparing for the second phase of the Ganga Action Plan, and Mishra is trying to keep the government from repeating its mistakes: he is pushing a new plan to save the river.

**T**HE battle to clean the Ganges is about much more than the environmental future of a river. Just as the river is a symbol of India, its cleanup is a test of India's condition fifty years after independence, and its outcome may answer some of the fundamental questions about the country's future. Will India (and other parts of the Third World) master its problems, or will it descend into a nightmarish Malthusian struggle over diminishing natural resources? Will India find creative ways to preserve its rich cultural traditions, or will it become homogenized into the new global economy? Will its ancient rituals, such as bathing in the Ganges, survive beyond the next century?

Varanasi is one of the oldest continuously occupied cities in the world, contemporary with the dynasties of ancient Egypt or Mesopotamia. But while no one sacrifices to the Egyptian sun god Ra or to Baal anymore, some sixty thousand devotees take the holy dip each day in Varanasi, lighting fires along the shores of the Ganges to Lord Shiva, the god who is believed to have caught the river in the tangled locks of his hair as it descended to earth from Heaven.

"Please consider them an endangered species, these people who still have this faith, this living relationship with the river," Mishra says with passion. "If birds can be saved, if plants can be saved, let this species of people be saved by granting them holy water."

Mishra, as the mahant of Sankat Mochan Temple, is himself the living link to one of Varanasi's most cherished legacies. He is spiritual heir to a greatly revered Hindu saint, Tulsi Das, who in the sixteenth century wrote a famous Hindi version of the Ramayana, one of the most

important texts of Hinduism, originally written in Sanskrit. Mahantji, as Mishra is almost universally known in Varanasi (Indians add the suffix "ji" to a name to denote affection and respect), lives, with his family, in the house that Tulsi Das built, overlooking the Ganges and above the landing Tulsi Ghat. The house contains an original manuscript of Tulsi Das's Ramayana and a pair of the saint's wooden sandals. Mishra's position as mahant, which has been passed from father to son in his family for many generations, accords him a semidivine status among the disciples of Tulsi Das. As Mishra is speaking about things like biomass and biogas, a steady stream of worshippers stop by to touch his feet—a traditional sign of respect in India.

Mishra wears his status lightly. He is a person of exquisite courtesy and genuine warmth, without a hint of arrogance or self-regard. He has a handsome tan face, dark-brown eyes, an elegant head of white hair with a shock of black in the center, and a gray mustache. If his lower body is slow and awkward, from his broken thigh, his face is highly mobile and expressive, as if to underscore the Hindu belief that the body is but an imperfect vessel for the noble spirit. He smiles easily and laughs a lot, frequently at himself. He jokes about his "throne room"—the name his Western friends have teasingly given a room where he receives guests. It is in fact a modestly decorated room on the ground floor of his house, in which a large wooden platform covered with mattresses provides the mahant a place to sit cross-legged or lean back on a cushion. He dresses almost invariably in nothing but a light-blue dhoti—a single swath of cotton that wraps around his waist and covers his shoulders like a toga—and generally goes barefoot. The one exception is when he lectures at the university: then he puts on a pair of loafers and a brown Western-style suit, in which he looks somewhat ill at ease.

In 1982, after years of speaking out about the deteriorating condition of the river, Mishra founded, with two other engineers from Banaras Hindu University, the Sankat Mochan Foundation, a private secular organization dedicated to cleaning the Ganges. This has taken Mishra far from the traditional, religious role of ma-

hant and brought him into contact with politicians in New Delhi, American State Department officials, and environmentalists and scientists around the world. Overcoming a certain amount of criticism, ridicule among some Hindus in Varanasi, he has travelled to places like Sydney, New York, and San Francisco in order to attend water-resource conferences and explore alternative waste technologies. Like India itself on the eve of the millennium, Mishra is trying to incorporate what is best from the West in order to preserve the Hindu traditions that he loves.

**I**N his attempt to clean the Ganges, the mahant finds himself teamed with a seemingly unlikely partner—William Oswald, an emeritus professor of engineering at Berkeley, who is a gray-haired seventy-eight-year-old with elephantlike ears, two hearing aids, an impish smile, and an earthy sense of humor. On being told that the Hindus believed that they would go straight to Heaven if they died in Varanasi, Oswald replied, "They'll get there a lot faster if they go in that water."

Mishra and Oswald were brought together by Friends of the Ganges, a San Francisco-based group of environmentalists who have been working closely with the Sankat Mochan Foundation to help find a solution to Varanasi's water-pollution problems.

Oswald is the pioneer of a kind of "back to the future" approach to modern urban waste, called Advanced Integrated Waste-water Pond Systems, in which sewage is treated in a carefully engineered series of natural algae ponds. Waste decomposes naturally in water through a combination of microbial fermentation and photosynthesis. It works like this: In a pond, bacteria grow on sewage and, in the process, decompose it into its elements—carbon, nitrogen, hydrogen, oxygen, etc. Algae in the pond assimilate these nutrients and, as their green biomass grows, produce oxygen through photosynthesis. Algae are the most efficient producers of oxygen on the planet: they supply more than one and a half times their weight in oxygen, and are the largest single source of atmospheric oxygen in the air we breathe. The oxygen that algae produce sustains the aquatic life of a pond or a river; fish both feed on algae and breathe the oxygen that algae produce; bacteria also use the oxygen to keep the process of decomposition going in a self-sustaining cycle of creation and decay.



Oswald is to algae what Michael Jordan is to basketball. When he and I first met, in Delhi, he excused himself in advance for not remembering my name: "For every new person's name I learn, I forget the name of an alga." Back in the late sixties, at the request of the United States Air Force's space program, Oswald invented something called the Algatron—a system for growing algae in space to provide oxygen for astronauts. Although it has been tried out only on mice in a California laboratory, Oswald proved, in principle, that you could create a self-sustaining ecosystem in a weightless environment. In his view, algae are among the great unacknowledged heroes of the planet. Algae and bacteria have a symbiotic relationship that performs miracles in converting toxic or disease-carrying waste into oxygen, new plant life, and valuable protein for other forms of life to feed on.

Oswald's system is not a utopian environmentalist's fantasy. Before the age of mechanical treatment plants, ponds were one of the primary means of taking care of sewage. They are cheaper than mechanical treatment plants and clean wastewater more thoroughly, but they generally require more land. As a result, most major United States cities have switched to mechanized plants in recent decades, relegating pond systems to smaller cities and towns—some seventy-five hundred of them throughout the United States.

Oswald has devoted his life to devising pond systems that improve on nature's by handling waste in an accelerated fashion while using less space. He has created a system that moves water, by means of gravity and paddle wheels, through a linked sequence of ponds, each with its own special environment, meant to encourage a particular kind of waste treatment. The first group of ponds are dug very deep, in order to create a dark, sunless environment without oxygen, where anaerobic bacteria decompose the heavier solid wastes. The second group are shallow, so that all the water is exposed to sunlight in order to encourage algae to grow through photosynthesis and kill off harmful bacteria. The third ponds are deep, still ponds, in which the algae settle and can be easily "harvested," to be fed to pigs or chickens, or else left in the water for fish farming. In the final phase, the water passes



into large, reservoirlike ponds from which it will be reused in irrigation.

This technology appears ideally suited to India, one of whose most abundant resources is sunlight. And it seems fitting that the scientific key to the modern problems of Varanasi, one of India's most ancient cities, could be one of the most ancient and also one of the simplest life-forms: algae.

In 1994, Mishra travelled to Northern California and visited three pond systems built by Oswald. Last summer, Earl Kessler, a member of the State Department's Agency for International Development, or AID, sent a delegation as well. Kessler was sufficiently impressed to commission both Oswald and Mishra's Sankat Mochan Foundation to prepare a feasibility study for a waste-pond system at Varanasi. Last spring, Oswald and his partner, Bailey Green, an acquaintance of mine, were scheduled to fly to India in order to complete the study and try to win Indian government support for the plan, and I decided to accompany them.

When we arrived, Mishra and two of his close colleagues at the foundation presented the American engineers with a surveyor's map they had prepared of the area where the ponds would be constructed,

with carefully traced markings for ground elevation and soil composition. Oswald and Green have proposed a system of thirty-two ponds in a dried-up river channel near the island of Dhab, downstream from Varanasi. They spread the map on a table in a guesthouse overlooking a grassy lawn where a colored tent and a marigold-festooned stage were decked out for the foundation's annual festival of *dhrupad*—the most ancient form of Indian classical music—which was to begin later that evening.

As they pored over the map, Oswald worried about possible hitches in the successful completion of the pond project, which, if it should be carried out, would be the largest of his career. "Are you sure that a dike that is seventy-five metres above sea level will be high enough for the monsoon?" he asked. During the last thirty years, Oswald had seen many ambitious pond projects in the Third World evaporate for a host of technical, political, and financial reasons. But, after fifteen years of work, the mahant was anxious that the project's momentum not be slowed by needless details. "We will show that Oswald's pond system can work even in India," he said grandly.

"I don't want to be a hero," responded Os-

wald the pragmatist. "I just want to be right."

The musicians outside began to tune up their instruments, and the conversation about the soil composition of the proposed pond site continued to the drone of sitars. The musicians played until six-thirty in the morning, and as we lay under our mosquito nets later that night ancient ragas ran through our waking and sleeping thoughts.

THE following afternoon, we set off by boat down the Ganges to examine the site where the ponds would be constructed. There were about twenty of us on a long, flat, beat-up wooden boat with a put-put motor and a canvas sheet stretched over us for protection against the midday sun. Besides us visitors and the mahant, the passengers were mostly volunteers from the Varanasi area, devotees of the temple who also donated their time to the Clean the Ganges campaign. (The foundation can afford only two full-time staff members. Its laboratory was provided through the efforts of the Swedish chapter of Friends of the Ganges, and one of Mishra's household servants doubles as a laboratory assistant.)

Because Tulsi Ghat is at the far south end of Varanasi, the trip took us in slow

motion past the entire city. The ghats rise up dramatically out of the water, at the top of tall stairways, and so serve as a kind of two-way theatre: people on the ghats observe the activity on the river below, while those passing by in boats observe the doings of people up above.

Although Varanasi is the chief center of Hindu learning and culture, almost every religious practice and every region of India are represented along the river. There is a ghat for the Dandi Panth ascetics and a ghat leading to a temple surrounded by erotic Nepalese sculptures. There are pagodalike ghats reminiscent of southern India, and fortresslike ghats, which recall the Mogul conquerors of the north. Some ghats are old and are built of sombre, earth-colored stone; others are made of modern concrete and are painted white, yellow, pink, red, or green.

Along with all the different religious practices, all the different forms of pollution along the Ganges were similarly evident. There were ghats where herds of water buffalo cooled off in the water. At others, washerwomen rinsed out their laundry on the shore while a rainbow of colored saris lay drying on the steps. Hinduism contains many rituals of purifica-

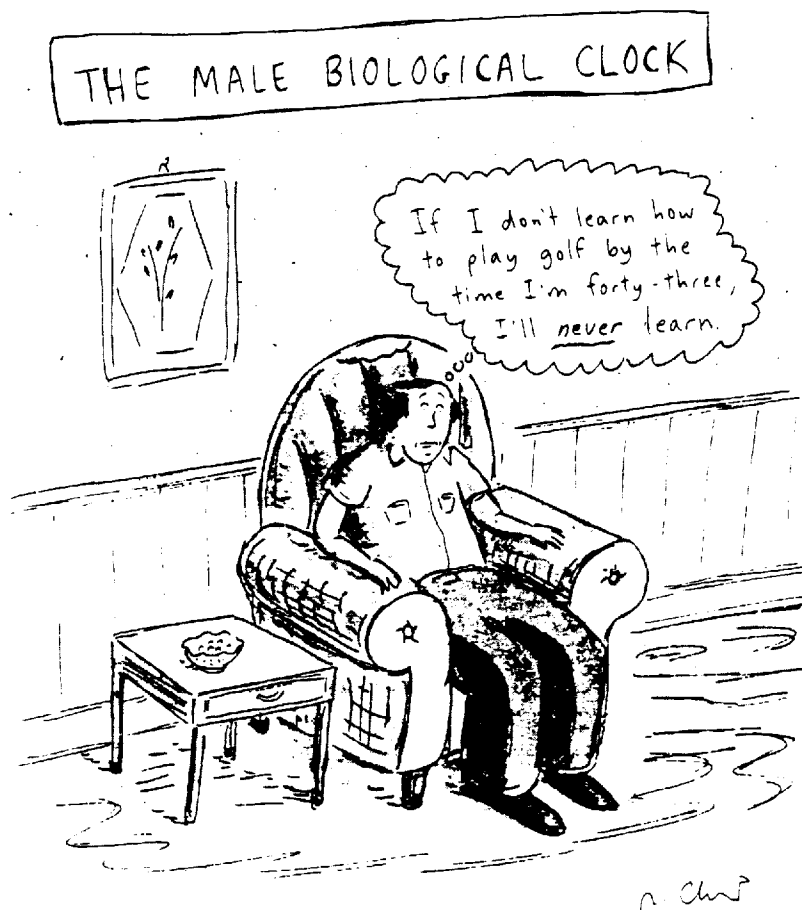
tion and hygiene, including a prohibition against using soap in the Ganges, which is widely ignored.

After a few minutes, we slowly passed the first of the burning ghats. At all hours of the day and night, the funeral pyres burn on the shore, with family members circling the fire and saying prayers. When the firewood has been consumed, the remains of the dead are consigned to the river to begin their journey from this world to the next, but in some cases the bodies may not have been fully consumed. On the average, about forty thousand traditional funerals are performed on the banks of the Ganges at Varanasi each year. In addition, about three thousand other dead bodies—those of people too poor to afford a funeral—and about nine thousand dead cattle are tossed into the river annually. As part of the government's Ganga Action Plan, close to twenty-nine thousand turtles were released at Varanasi a few years ago, in the hope that they would consume any decomposing body parts. But the turtle farm is now empty, and there are no turtles in the river. Many people suspect that they were poached for food.

The government cleanup, however, did include the building of an electric crematorium at one of the two main burning ghats, in order to cut back on the traditional funerals. The program seems to be working, for the lines in front of the brick crematorium are much longer than the ones in front of the firewood sellers. This, in Mishra's view, is an instance of India's adaptability. "The reasons are economic," he explained. "A traditional funeral today will cost between fifteen hundred and two thousand rupees, and the charge for the electric crematorium is seventy rupees."

THE traditional forms of Indian life visible along the shores of the Ganges—the funeral pyres, the water buffalo, the washerwomen—are not the principal source of pollution at Varanasi. Looking closely, even along the bathing ghats you can see large sewage pipes draining directly into the river. The city's trunk sewer, which was built by the British in 1917, is strained beyond capacity. As recently as fifty years ago, the population of Varanasi was just over a quarter million; now it is a million four hundred thousand, and growing.

Upon leaving Varanasi, we reached a point where the Varuna River meets the Ganges, and there the surface of the water was bubbling like soup on a low flame—



raw sewage turning into methane gas. Just a mile or so up the Varuna is a huge new pumping station, which is supposed to transport Varanasi's sewage to a large treatment plant a few miles downstream. Able to handle but a fraction of the city's two hundred million litres of sewage per day, the plant pumps the sewage of Varanasi up several hundred yards, only to dump the bulk of it into the Varuna, where it then travels right back to the Ganges.

A few miles farther downstream, there was a sudden explosion of algae blooms, in such unnatural quantities that for several hundred yards the Ganges took on the unhealthy appearance of a swamp. It is here that the Indian government has placed its treatment plant, but the plant only performs what in the waste business is called "primary treatment"—the equivalent of going through just the first of Oswald's four ponds. Because the plant's "cleaned" effluent is still full of sewage and harmful bacteria, it, together with the hot Indian sun, stimulates the growth of far more algae than the natural resources of the river can absorb. As they decompose they consume, rather than create, oxygen, putting a strain on the marine life of the river. This condition shows up when the oxygen level of the water is tested in a laboratory: biological oxygen demand, or B.O.D., is one of the principal measures of water pollution. Where pollution places a high demand on oxygen, less is available for fish and other organisms.

The central government, in New Delhi, has recently spent about a hundred and fifty million dollars building Western-style high-technology wastewater plants along the Ganges, like the one we just passed, which are particularly ill-suited to Indian conditions. The treatment facilities run on electricity, and when the power goes out—as happens several times a day in many Indian cities—they stop operating. Similarly, the plants become overwhelmed during the monsoon season and simply shut down. Even when they are working, the facilities are so expensive and so difficult to operate that many of the cities say they cannot afford to maintain them.

In Varanasi, sewage is backing up into people's toilets or forming fetid puddles in their yards and in the streets. Local residents became so enraged about a year ago that they forced a city water engineer to stand for several hours in a pool of sewage in order to better acquaint him with the problem.

After decades of supporting this type of expensive, high-technology project, the United States State Department is now a proponent of "sustainable technology"—projects like Oswald's ponds, which cost less, use little electricity, and can be maintained with relatively little training by local people. (The pond system designed for Varanasi is estimated to cost between ten and sixteen million dollars, as opposed to twenty-five million for the city's mechanized treatment plant, which handles only a quarter to a third as much waste.)

In 1985, the government in New Delhi also adopted Western waste-treatment technology without considering the radically different ways that people use the rivers in India. It is still common in Europe for sewage-treatment plants to discharge partly cleaned effluent into rivers, but the inhabitants of London and Paris would not dream of bathing in or drinking out of the Thames or the Seine. "They have made such blunders," the mahant said. "It is like a theme park of failed technology."

ALTHOUGH our trip downriver to the island of Dhab was only about ten miles long, it took us nearly five hours, because the boat kept running aground. With each successive stop, more members of our party were out in the river pushing the boat and fewer of us were in it. The small Western contingent was calculating the probability of catching some dread tropical disease if it was forced to take an unanticipated holy dip to reach shore.

The Ganges is generally a mile wide throughout its course, but it becomes shallow in the dry months leading up to the summer monsoon. The problem has grown worse in recent years as more and more river water has been diverted for irrigation. Throughout our journey, we saw large pipes sucking water out of the Ganges toward distant fields. While India has twenty per cent of the world's people, it has only four per cent of the world's fresh water. With its population approaching a billion, the country is scheduled to overtake China as the world's most populous nation, and its future growth could mean mass starvation. Some three hundred million Indians are already classified as "Food Insecure"—a bad monsoon away from starvation.

Under these circumstances, wars over

water—a prospect that haunts the twenty-first century—have already become a reality in India. India and Bangladesh have come close to breaking off diplomatic relations over the use of Ganges water. As in 1994 the Indian state of Haryana simply diverted a sizable portion of New Delhi's water supply, claiming it needed the water for irrigation. The struggle for water can only get worse as India's growing urban population demands Western standards of plumbing. The seventeen five-star hotels of New Delhi consume eight hundred thousand litres of water daily—enough to fulfill the requirements of a million three hundred thousand slum dwellers, who have no plumbing whatever. And as the number of flush toilets increases so will the amount of sewage.

As I was contemplating the prospect of ecological Armageddon during our on-again, off-again voyage in the shallow waters of the Ganges, we heard the distant sound of a brass band. A large crowd was massed on the banks of the island of Dhab, and, even though it was nearly sunset and they had been waiting all afternoon, they greeted the arrival of the Sankat Mochan Foundation and its Western guests with triumphal music and wild jubilation.

Dhab is one of the pockets of rural India that have been largely left out of the past fifty years of development: it has no electricity and no year-round bridge to the mainland. About ten miles long, Dhab, with a population of forty thousand, has a curious geographical configuration: it is an island during the rainy season and a tenuous part of the mainland the rest of the year. As the course of the Ganges gradually shifted over centuries toward the southeast, it exposed a former channel to the north of the island, which can be crossed during the drier months of the year but still floods during the summer. This wide former river channel is sandy and infertile, and has no proper road. It is here that the Sankat Mochan Foundation would like to put its system of wastewater ponds. The plan also involves building three main roads across the dikes of the ponds to connect Dhab to the mainland—roads that cable could be laid in, providing the electric spark that would connect the people of Dhab to the rest of the world.

Amid cries of "Hail to the gods!" we climbed up the banks of a shore thick with



