British Irrigation Works in India's Krishna Basin

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Few sights are more striking in the South Indian countryside than the contrast between irrigated and unirrigated land. It is the difference between rice paddies and sorghum, between trickling ditches and parched fields, between a densely settled landscape and a seemingly empty one. It comes as a surprise, therefore, to find that most of the large irrigation systems built over the last hundred years in India do not work well. It is commonly stated, in fact, that they deliver water to no more than half of the lands they are supposed to serve.

There has been a surge of interest during the last decade in finding ways to close the gap between the supposedly irrigable and the actually irrigated acreage of these projects; after all, the government of India, directly and indirectly through World Bank loans, has spent billions of dollars on these projects. Engineers addressing the question tend to prescribe more sophisticated physical structures, such as concrete linings to reduce watercourse seepage. Management specialists have tended, on the other hand, to advocate better monitoring systems, so that administrators can manage the flow of water, instead of simply presiding over it.[3] After a decade of reform efforts, it is clear that neither of these solutions will fix the problem, neither singly or together.

Curiously, the projects have been designed in a way that almost invites trouble. Irrigation in southern India was traditionally limited to small acreages of paddy and sugar cane, but the projects built since Victorian times have been designed instead to irrigate less demanding crops like cotton, peanuts, and sorghum. They have been designed, in other words, to provide a small amount of water to a large number of acres; they are, in one formulation, "high-tension" projects. Project farmers, however, continue to prefer the so-called "wet" crops, the water-consumptive ones like paddy and cane; only reluctantly do they plant cotton and sorghum, which, when irrigated in this part of India, are usually known as "irrigated-dry" or "ID" crops. The farmers not only prefer wet to ID crops; those men fortunate enough to hold land at the top or head end of a canal grow them. The result is that tail enders, the men at the far end of the systems, often receive little or no canal water. It is for this reason that project tours ought to begin not at the dam or at the canal headgates but at the system tails, where water shortages are generally most acute and where project officers are least likely to guide visitors.

Irrigation administrators usually defend the principle of light irrigation on ethical grounds: India, they say, is duty-bound to spread its water among as many beneficiaries as possible. Development economists simultaneously often argue that the return from a properly managed light-irrigation project is greater than the return from a smaller, heavy-irrigation project. Yet the last century has shown that these arguments, though rational, are not compelling. Powerful landowners will do what they want to do, regardless of ethical or economic arguments. With rare exceptions, the government of India has been unable to discipline them.

In many cases, in fact, it has historically often been complicit with them. This is because the projects were built at such a high level of tension that farmers were not interested in water except in drought years. The government, on the other hand, had to pay back project-construction costs. The only way to do so was to supply water for crops like paddy and cane, for which farmers were always willing to pay. The British therefore allowed heavy irrigation at the head ends of the irrigation systems they had built for famine relief. The theory was that when drought returned the canals would revert to their fundamental purpose. In practice, this did not happen. During the intense drought of the early 1970s, for example, when ripe cane was less valuable than bullock fodder, cane was still being grown at the head ends of old British projects. The justification was that any interruption of the water supply would undermine the credibility of the canal among cane growers, who would decline to replant in cane if they knew that their supplies might once again be cut off. The result, in short, was that projects built to relieve famine were foreshortened soon after completion.

Today, although light irrigation makes economic sense and there are plenty of customers for canal water, the old preference for wet crops still prevails, for cultural as well as economic reasons. The government seems powerless to check the excessive head end diversions that those crops require. The situation is all the more frustratingly because it could have been avoided by designing projects that farmers wanted and administrators could manage. The British could not stoop to ask the farmers if a proposed scheme was sound; nor, a tragedy of colonialism, would farmers have dared to respond honestly if they had. The irrigation problem in South India today is therefore a story rooted in the psychology of colonialism, and in its history may lie the seed of its solution, an appreciation of the need to consult the people who are the intended beneficiaries of these projects.

The Inheritance of the Raj

Consider the case of the Krishna River, for irrigation the great river of peninsular India. The stream begins in the Western Ghats about 50 miles southwest of Pune (in the British period, Poona) and near the hill station of Mahabaleshwar. A squat temple there encloses a stone cow standing at one

edge of a pool; from the cow's mouth a stream of water pours into the pool. Overflowing at the opposite end, water runs along a stone groove to the edge of the Mahabaleshwar Plateau and tumbles down a precipitous slope into a wide valley, the walls of which have been worked into thousands of meters of intricate, though unirrigated terraces.

Heading across the open fields of the northwestern Deccan, the river picks up the basaltic silt that inspires the name Krishna, in Sanskrit "the Black". Below Chayya Falls, however, a countryside of stacked lava flows is replaced by the eccentricity of granitic bedrock. Residual hummocks, sometimes domed, sometimes fractured into heaps of stone, rise from red-soiled and seasonally stark plains, often thicketed with mesquite, which was introduced by the British as a hardy source of fuelwood and as a substitute for dung cakes. The river meets its major tributaries, the Bhima and the Tungabhadra; enlarged, it pierces the folded ranges of the Eastern Ghats, covered with bamboo, and arrives at its delta, where it is pinched between two granitic hills. In September, at the height of the monsoon flow, the virgin river passes almost 30,000 cubic meters of water every second past this point, then splays, passes through an intensively irrigated delta, and reaches the sea through mangrove flats.

Establishing their rule over this part of India early in the 19th century, the British found a ravaged countryside. The government of Bombay, for example, sought out recollections of pre-Raj famines; the compilation that resulted speaks of children cannibalized by their parents. Employees of the East India Company, however, did not have to rely on interviews and book learning. In 1832 a Lieutenant Campbell was stationed in the delta of the "Kistna", as the Krishna was usually known during British rule. The year was one when two-fifth's of the people in the delta would perish with the failure of the monsoon, upon which their rainfed paddy depended. Campbell wrote: "hundreds die daily, literally of starvation. The swamp around the fort is found each morning strewn with the bodies of those who have died during the night; although a large body of police is kept busy collecting the dead and throwing them into a huge pit prepared for the purpose, they cannot succeed in keeping the ground clear, and numbers of bodies are left to be devoured by dogs and vultures."

Company officers often found themselves prescribing radical solutions for the destitution that they witnessed. Working in Bellary District, along the lower Tungabhadra, for example, a Mr. Pelly wrote in 1848 of the "wretchedly poor state" of the peasants and called for a reduction in the land taxes demanded of them: "nothing else", he wrote, "could restore their condition". Philip Meadows Taylor, Indian correspondent of *The Times* of London, as well as a popular novelist and the senior administrator at Shorapur, 100 miles north of Bellary, wrote in the 1840s that "neglect and oppression have done their worst in this country and whole villages which once yielded handsome revenues are little better than heaps of rubbish".[8]

Shorapur's farmers grew cotton in rotation with sorghum or millet; their technology was simple and their yields low. Moldboard plows were virtually unknown; mostly, farmers tilled with the hollow-tooth wooden harrow that even today doubles as a seed drill in South India. The high clay content of the northwestern Deccan's deep black soil made the fields nearly unworkable when wet, so the farmers harrowed in anticipation of the rains. Seeded after the retreat of the monsoon, the crops were carried to harvest by residual moisture. Erosion was high, for the fields lay naked during the rains. Runoff losses were more severe than this drought-prone area could afford.

Irrigation scarcely existed in the basaltic northwest, save for scattered wells that were hard to find and then expensive to operate with the customary bullock-cranked Persian wheels. The result was that only small acreages of high-value crops like cane and fruit were irrigated. In Mysore to the south, however, and in Telangana, the region around and east of Hyderabad, tens of thousands of tanks had been built in earlier centuries for paddy, begun in nurseries fed by water hoisted from tens of thousands of wells. With the monsoon and the filling of the tanks on this, the granitic eastern and southern Deccan, the paddy seedlings were transplanted and brought to maturity in fields below the tanks which, today, from the air, look like strings of farm ponds, with low earth dams blocking, step by step, the dendritic watercourse network. Some tanks were and are large enough to store water into the dry season, when a second paddy crop can be grown without need of wells; others are ingeniously fed by diversions from monsoon-flooded rivers.

The British were impressed. R. Baird Smith, for example, a lieutenant-colonel of the Bengal Engineers, toured Madras in 1853 and wrote that the profusion of tanks was "so truly stupendous as not to be looked at without wonder". Ten years later Major Richard Sankey wrote of Mysore that "it would take some ingenuity to discover a site within this great area suitable for a new tank". Sir Richard Temple, British Resident at the Hyderabad court of the Nizam, wrote of Telangana's tanks that "no part of the peninsula is better calculated to raise our notions of their ancient rulers". Hyderabad itself, built on the banks of a Krishna tributary called the Musi (the river of Moses), looked upstream to a watershed of 2,300 square kilometers and 788 tanks. Downstream from the city there were open-mouthed weirs, another irrigation technology of the medieval Deccan: ribbons of rubble were laid obliquely across roughly half of the river and channelled a share of the water into canals. The same kind of weir had been used along the Tungabhadra, near the ruins of the city of Vijayanagara which, as capital of the Vijayanagar Empire, had been destroyed in 1565.

It was a magnificent heritage but one on the verge of collapse. It is no surprise to find Indian observers placing much of the blame for tank dilapidation on the East India Company's failure to maintain a traditional labor force or to replace it with anything else that worked as well. But the British, too, were often

bitterly angry at their employer's record. It was Baird Smith, for example, who in 1853 spoke of "eighty years of dreary waste, varied only by the occurrence of famines or pestilence, but unrelieved by a single great work calculated to prevent a recurrence of these disasters". Explaining the neglect of tank maintenance, he wrote that "the history of our progress in India is full to repletion of such facts ... nothing whatever was done by the British Government to turn these advantages either to its own good or the good of its subjects". It is easy while reading such accounts to forget that many Deccan irrigation works had been destroyed centuries before the Company had been created.

Early Successes

The British gradually began restoring the irrigation works of the Krishna basin and undertaking new works of their own devising. Meadows Taylor, for example, supervised the reconstruction of the medieval Bonal Tank, ten kilometers west of Shorapur. In 1851 he started a second tank four miles further west at Kachaknur, but in 1857 he left Shorapur before finishing it. Much more could be done, he wrote: "hundreds of noble tanks" could be built. He conceived, too, a left-bank diversion from the Krishna and a canal bending northwards to parallel the Bhima River, an astonishing plan because just such a huge project, with more than a million acres to be irrigated, is today under construction with the assistance of the World Bank. Taylor had reluctantly seen the scheme "abandoned for want of funds, though perfectly practicable, as I had ascertained by levels."

A generation after the establishment of crown rule in 1858, tank restoration began in earnest. The Madras Presidency, which had few tanks in the Krishna basin, undertook in 1886 to rebuild a dozen open-mouth weirs near Hampi, site of the Vijayanagar ruins; soon those works irrigated 25,000 acres of cane and double-crop paddy. These works, the so-called Vijayanagar Channels, still operate as the British rebuilt them, although recently a cement skin has been laid atop the rubble. Without a local sugar mill, the cane is made on the spot into jaggery, a rough brown sugar. Bullocks still drive British-style cane crushers, and cane juice still boils in simple, British-introduced furnaces. Poured on to straw mats, it dries in fly-covered, amber puddles.

A tank restoration program was begun at the same time in neighboring Mysore. Colonel J. P. Grant, Superintendent of the Mysore Revenue Survey, explained that the tanks were "the life of the people". By 1900 some 1,300 of 2,300 large tanks in the state had been repaired.

Hyderabad, known officially as the Nizam's Dominions, had 18,000 tanks, mostly in Telangana. Restoration began in 1893, largely funded by a program in which lessees undertook the work at their own expense, in exchange for a tenth of the revenues generated by the tank. By 1900 over 5,000 tanks in the

state had been restored in this way. Roscoe Allen, a Madras engineer, had meanwhile been deputed to take direct charge of the restoration of the state's larger works. All were out of repair, Allen explained a few years later, "excepting those few which have been lately repaired;" the Nizam's revenue secretary, A. J. Dunlop, added that "it was terrible to see the way in which tanks were repaired and breached before Mr. Roscoe Allen came here."

Among the tanks restored by Allen were three built in the 13th century near Warangal, east of Hyderabad, and destroyed with the annihilation in the 14th of their builders, the Kakatiya kings. Laknavaram, set in rolling, teak-covered hills, is the least known of the three. As rebuilt by Allen, the dam consists of two separate masonry segments, one with a spillway and the other with an irrigation canal that supports paddy in some of the starkest countryside imaginable, emerald fields on the slope below the canal and baking boulders, too hot to touch, on the slope above it. Pakhale, the second tank, lies in a forest that was once the Nizam's tiger preserve; as his guests at the turn of the century, Lord Curzon, the viceroy, went tiger hunting here with his American wife in a forest that is now a tiger-free weekend retreat from Hyderabad. The most striking feature of the tank is that the canals not only irrigate paddy during the monsoon but take the surplus, enough water for a second crop on a third of the project lands, and rotate it so that all project lands obtain a double crop one year in three. Come March, a third of the project land is bright green, its color heightened by numerous, brilliantly white storks fishing in the flooded fields; the adjoining land, still in stubble from the previous September, waits its turn. Ramappa, the third tank, is famous for the Ramappa or Palampet temple. Small, but set like a jewel among the paddies, the temple exterior is covered with elaborate friezes of trunk-to-tail elephants.

Allen went on to restore the open-mouth weirs and canals along the Musi. The largest of these diversions is the Asif Nahar, with a 60-mile canal. Because the Musi often carries little water, the Asif Nahar by itself cannot see paddy through to maturity. The canal's 18th century builders had solved the problem by building 19 tanks along its course--"melons on a vine," as the Chinese say in a striking image. Allen rebuilt the Asif Nahar to support 15,0000 acres of paddy; unlike the Vijayanagar Channels, however, the Asif Nahar has lately been almost choked with reeds, only fortuitously removed by villagers straining the canal for small fish. Upstream storage, built after floods devastated Hyderabad in 1908, has so reduced Musi flood levels that the river rarely reaches the weir's headgate.

In addition to these restorations, the British embarked on the construction of the delta works, a new project inspired by Arthur Cotton, who towers over the irrigation history of South India. Cotton once said of himself that he was "a man of one idea." Lord Mayo, the fourth viceroy, met him and judged him more harshly as "something of a fanatic". Cotton's idea, his obsession, was water. Addressing himself to Indian prosperity, Cotton wrote that "all that is wanted is

water; and this want supplied, everything else will almost follow of course". He had already induced the East India Company to reconstruct the ancient irrigation system at the mouth of the Cauvery in southern Madras and to undertake a comparable work at the delta of the Godavary. In 1844 Cotton came to the support of a similar scheme for the Krishna. The two hills at the delta apex had caught the eye in 1792 of a Major Beatson, who had written of the immense" advantages that might be derived by a weir between the two hills and a set of canals reaching through the delta. In 1844, Captain Buckle drew up detailed plans.

The weir, of loose rubble, was to be four meters high and nearly a kilometer long; it would be completely overtopped during the monsoon yet could be anchored in nothing more stable than sand. Could such a weir hold? Cotton assured the Company that it could, if the stones were laid at such an angle that flood waters could not pluck them loose and if an impervious masonry wall was sunk at the face of the weir to prevent water flowing under the structure and opening channels in the sand. The other question that worried the Company was whether farmers in the delta, used as they were to rainfed paddy, would agree to buy irrigation water. Anticipating that many might not, the canals wound through nearly ten times as much land as they could irrigate. Baird Smith calculated that "were it desirable to turn the whole of this into one vast rice field, it would be necessary to provide a supply of water equal to 32,000 cubic feet per second". The actual capacity of the system was about a tenth that much. Even so, the project was huge, with a weir three kilometers long, a hundred meters wide, and canals large enough for barges. As matters turned out, moreover, irrigation was indeed welcomed by the farmers. By 1878, around 500,000 acres of paddy were being irrigated, and the Madras public works department began the first of a series of expansions, ultimately doubling its irrigated acreage. The Indian Irrigation Commission of 1901-03 wrote of this and Cotton's other delta projects on the Cauvery and Godavary that "it would be difficult to find in any country three works of similar magnitude or cost which have conferred the same degree of benefit upon the people and the state".

The weir, damaged by a flood in 1952, was immediately replaced by the Prakasam barrage, a slightly taller structure built a few meters upstream. The canals, however, remain very much as Captain Orr, Cotton's student, built them. Fitted with underpasses for natural drainage and with periodic masonry drops, they now irrigate about a million acres, still mostly in the monsoon, although there is some dry-season irrigation drawing upon recent upstream storage. Paddy is still the premier crop; it is planted, weeded, and harvested by gangs of women, while men handle the irrigation system and operate the tractors that prepare much of the land. Rotated with gram or sunnhemp, occasionally retted but usually plowed under as a green manure, the crop has lately run into competition from cane, a crop insignificant as late as 1920. Since then, sugar refineries built in the delta and electric motors to lift

groundwater when canal water is unavailable have helped cane become increasingly popular. Smaller areas are set in bananas, betel, and vegetables. Out by the sea and its sandy soils, cashews and peanuts appear next to casuarina, a fuelwood species brought to the delta in 1885 by a British officer stationed there. The delta farmers, visitors are told, worship Cotton as a god; professional engineers refer to him as a "wizard".

The First Sign of Trouble

Shortly after the completion of the delta weir in 1855, Arthur Cotton retired in ill-health to England, where he lived until the end of the century. Cotton did not abandon India, however; when famine struck Madras in 1876 he wrote, characteristically, that "the sole cause of the famine is the refusal to execute the works that will give us the use of the water that is at our disposal". He could not resist adding that water was "a proscribed word" at the India Office. His own solution, as the government of India wrote in 1922, "contemplated a navigable line 4,000 miles long, from Karachi via Cawnpore, Calcutta and Cuttack to Bhatkal, Mangalore, and Madras". Cotton had argued that railways took so long to build that India would "be starved to death" while waiting for them. The navigation canals Cotton proposed, on the other hand, would double as irrigation canals, bringing prosperity twice over. Cotton prepared astonishing maps showing how it would all work. South India alone was traversed by three canals, one starting at the lower Penner then, by excavation, reaching the Tungabhadra near Kurnool and following it upstream to that river's headwaters, where a set of locks would lower barges 750 meters to the sea south of Goa.

Although Cotton continued to advocate his "one idea", a select committee of the British parliament dismissed it in 1879 as "too shadowy and speculative". Part of the reason was that one segment of Cotton's scheme had by 1879 actually been built, with disastrous results. The Kurnooh-Cuddapah, or K-C, canal diverted water from the Tungabhadra near Kurnool and took it southwards some 200 miles to Cuddapah on the Penner. The Madras Irrigation Company had been formed in 1858 to build it with Cotton's brother as chief engineer. The company raised a million pounds in England and, backed by a government-guaranteed return of 5%, promised its investors a return of 30%. The contractors, however, were incompetent or worse, leaving the project, in the words of the Irrigation Commission of 1901-03, "crushed by the weight of its capital account". The delta works would be described as "signal monuments to the genius of Sir Arthur Cotton" by the same government of India that, provoked by the K-C canal, said that "while Sir Arthur Cotton's skill as an engineer was beyond dispute, his ability as an administrator and a financier was by no means so high."

Cost overruns were only the beginning of the project's problems. Navigation on the canal, at its headend 150 feet across by 10 feet deep, failed almost completely for, as the government wrote with rare acidity, "the canal runs

from nowhere to nowhere in particular and consequently there is nothing and nobody to carry". The government of Madras had to carry the canal's heavy financial loss, because it had bought the project in 1882 at a price that could never be repaid by canal users. The K-C canal's failure ran deeper still, in ways that would become depressingly familiar on projects to be taken up in the future. Originally planned to irrigate 500,000 acres and then built to command 300,000, the project in 1882 was actually irrigating only 5% of that figure, about 15,000 acres; as late as 1920, the figure was only 90,000.

Something was clearly wrong; the success of the delta works was not being repeated. One problem was that the canal could not safely carry more than half its design discharge. More fundamentally, however, farmers declined to buy the available water. They were unswayed even when the government offered free water for five years and water at half price for another five. Observers today may be tempted to conclude that the farmers were simply unused to irrigation and that insufficient efforts were made to show them its merits. But the cotton and sorghum varieties grown by the farmers in this part of India would not have shown the response to irrigation of modern varieties. If the K-C canal farmer was to irrigate, he had to grow wet crops. As the British realized by 1900, however, wet crops made no sense either. The local populace had no taste for rice, and for many years there was no local railroad to ship the rice to market. To make matters worse, landholdings along the canal were large, suited to the traditional rainfed agriculture of the region. A man growing paddy, in other words, had to hire help, and there was little to be had. "Is the ryot [peasant] any better off for going in for rice cultivation?" the Irrigation Commission of 1901-03 asked the deputy collector in charge of the K-C canal; the answer was that "their dry crops pay them better". Another district administrator explained that the local farmer was "not without intelligence. He has tried the canal water time and time again and found that with his present system of cultivation it does not pay him to use it."

Failure Becomes Routine

British capital wanted no more of what the select committee of 1879, thinking of the K-C canal, called "fiascos of private enterprise". The government of India, too, grew cautious. As the Irrigation Commission said in its discussion of future projects, farmer participation was "just what cannot be safely depended on." Yet irrigation projects would soon be taken up on the Deccan by the government itself and, one after another, the projects would fail. Time and again, works would be built to irrigate a certain area; 30 years later, only a third of it would actually be irrigated—in wet crops, not the ID ones called for by the planners.

The spur to the construction of these projects was the famines sweeping South India in the mid-1870s and again at the turn of the century. The farmers of Kurnool were eager to buy water during the drought of 1876: the project

irrigated over 100,000 acres that season, before slumping back to less than 25,000. Judging from the K-C canal, in other words, irrigation on its face to be a reasonable kind of famine insurance to bring to other Deccan farmers. As one engineer wrote in 1893 of the K-C canal, the farmers might "hold off from applying for water till the very last moment", but water would be available when needed.

In many ways, the famine-relief policy was admirable. Lord Mayo, the viceroy who had judged Arthur Cotton so harshly, wrote in the 1860s of the famines that have "disgraced our administration." He went on to say that "we have not done our duty to the people of this land. If we are not here for their good, we ought not be here at all." Ironically, it was at the celebration held in January 1877, to mark Queen Victoria's becoming Empress of India, that Sir Richard Temple, former Hyderabad Resident and at the time Governor of Bengal, learned that the viceroy, Lord Lytton, wanted him to go south and look into reports of famine in Madras. Lytton himself became deeply involved as the famine intensified, killing 4,000,000 people in Madras and 800,000 in Bombay, before drought gave way in 1878 to heavy rains and, as Temple recalled, "myriads of rats".

Lytton explained his famine-relief policy, which guided the British as long as they stayed in India, to his Legislative Council in 1878. "Our efforts must fail if they be merely the uneducated offspring of casual impulse," he said in oblique criticism of relief camps in Madras that offered food without obligation to applicants in apparent distress. Lytton at times sounds cruelly insensitive. He writes to Lord Salisbury, Secretary of State for India, of Madras camps that are "huge popular picnics, whose inmates are at present thoroughly enjoying themselves at the Government expense". Yet in demanding work for food, Lytton was responding to appalling abuses. He wrote Salisbury, further, of the "famine babies" that are "now at a premium, as the presentation of them obliges us to admit their supposed mothers". What he had seen was a trade in starving children that were kept starving as camp tickets.

"I expected to find there," Lytton wrote of Madras, "a bad system at work, but what I found everywhere was the total absence of any system at all." Scarcely any effort was made to see that famine victims did any useful work. Perhaps they chopped prickly pear or scraped roads, but their accomplishments were insignificant. At one camp, Lytton wrote indignantly, two European officers oversaw 70,000 supposed laborers, while in Mysore no such pretences were kept up, and 120,000 people were fed gratuitously. "Their system," Lytton wrote of Madras and by extension Mysore, "is rotten to the core." Assigned to improve matters, Temple reduced famine rations to a pound of grain a day, the infamous "Temple ration," and tightened worker discipline; still, these measures lapsed as soon as Temple left Madras for Bombay, where he became governor.

It was there, in Bombay, that Lytton's own famine policy was first tried. There could be no "adequate security against famine," Lytton told his Council, until India produced a surplus, and the best way to achieve that surplus was by building railways and irrigation works. What better time for undertaking such work than during famines, when labour was available and cheap? To Lytton's satisfaction, the governor of Bombay in 1876, Sir Philip Wodehouse, was already advocating large-scale irrigation works. Thirty thousand famine victims were working on a dam on the Mutha River, upstream from Poona. To the south, on the Nira River, work began on a project that would offer, according to its designer Colonel J. G. Fife, "an abundant supply ... as a protection against famine."

At Ekruk, immediately north of Sholapur, Fife had surveyed a tank built between 1866 and 1869; he had relied for technical help, he wrote, upon "the great advocate for large storage works", Arthur Cotton. Now, with the great drought, work was taken up on another tank, west of Sholapur. This was Ashti, plans for which had been drawn up in 1869. Its construction had to wait for famine-victim labourers. In 1878, at the height of the drought, 19,949 people were employed on the project; two years later, with the famine over, the dam was finished by prison labor.

The Maharajab of Mysore, observing these and a half-dozen similar projects on the Bombay Deccan, soon embarked on a project to outdo them all. This was the Marikanave Project, today known as Vanivilasa. It lies on the Hagari, a tributary of the Tungabhadra that flows through a drought-blasted territory southwest of Kurnool. A dam had been considered here as early as 1801, but nothing was done. Detailed plans were drawn up finally in 1855, but by then the Krishna's delta works were complete, and Madras objected to Marikanave as a threat to the delta's water supply. The objection was ultimately withdrawn in 1894, and work began in 1898 on a magnificent masonry dam, more than 40 meters high. Robert Buckley, an engineer with the Indian public works department, wrote of the reservoir at Marikanave that it was "by far the largest in India, and, as regards its gross capacity, the largest in the world," slightly larger than even Egypt's Aswan Dam (this refers to the early or low dam built at Aswan by the British, not the later one built by the Russians.) The dam, out of the way and seldom visited, stands today as a monument to a government trying to help its people.

Yet none of these projects has ever done much to help the farmers they were built to serve. In 1875 Colonel Fife told an American visitor that the dam upstream from Poona would irrigate 75,000 acres; by 1900, the actual figure was a tenth that much.[45] There had been, it turned out, no demand for light irrigation in years of normal rainfall. This was the story of the K-C canal all over again, except that in this case local gardeners were eager to lease project land from its owners, provided they could grow sugarcane with perennial irrigation. The government faced a dilemma, for the only way it could raise

irrigation revenues with which to pay off the project cost was by selling water on terms contrary to those for which the project had been built. The Inspector-General of Agriculture described the results to the Irrigation Commission of 1901-03. The project, he said, had created a "class of speculative landholders" that had "been largely benefited" by a project that did nothing for most of the farmers it was meant to serve. There was no turning back, either, no cutting off the water supply of the cane growers at the project's head end; any attempt at doing so, as one officer put it, would undermine the "canal credit." It was for this reason that when drought struck the Deccan in 1970 this project remained in cane, while tail-end farmers were reduced to joining relief-gangs employed on road projects and new irrigation undertakings.

The Nira canal, south of Poona, was opened in 1892 with the explanation that "in the event of a famine, nearly the whole of the available supply ... would be required for the irrigation of the ordinary dry-crop" grown on the project's 200,000 acres.[48] Cane became popular in the 1890s, then declined with the labor shortages accompanying a plague attack. The crop was forbidden during the drought at century's end, but in 1902 good rains reduced the demand for light irrigation from 17,000 to 3,000 acres. Cane then became so popular that waterlogging grew serious; an engineer wrote that the rule obliging farmers to rotate their crops so that no more than a third of their land was in cane at any one time was skirted by farmers growing five cane crops in a row, so that the soil was "worthless for many years to come."

The pattern of cane dominance and tail-end shortages became a familiar one. Colonel Fife had fitted his tank at Ekruk, near Sholapur, with three irrigation sluices. One was for a low-level canal that, with a year-round water supply, could support cane; the two other sluices were for higher-level canals for ID crops. Fife had expected the project to irrigate 7,000 acres and 12,000 acres of ID crops; the project was modified while under construction to irrigate 10,000 acres of cane and only 7,000 of ID crops. Both estimates proved too optimistic. By 1889, less than 3,000 acres were being irrigated, thanks in part to diversions for domestic use in Sholapur. Recently, the project's irrigated area has fluctuated near 5,000 acres. The water supply is sufficient to irrigate much more land than that, but cane is taken on about a third of the land, and the balance is chiefly in rotational crops. The longer of the high-level canals, extending 18 miles and intended for light irrigation, is permanently closed beyond Kilometer 5.

Ashti Tank, to the west, was designed to irrigate about 8,000 acres in equal proportions of cane, monsoon irrigated-dry crops, and winter irrigated-dry crops. The engineer who built the tank, fearing that this wet-crop inducement might not guarantee project participation, laid out the canal to serve three times as much land as the canal could supply. Experience had taught, he wrote, how "essential it is to the early financial success of a work" to build a canal system long enough that the canal supply would finally be taken up.

Despite his efforts, the Ashti tank has never irrigated more than a third of its service area. A stone monument stands near the dam; brass letters are working loose from lines that begin "V R et I" for Victoria, the Queen-Empress; the engineer in charge of the project was recently surprised to find an unused water tunnel so far from the actually irrigated land that he had never before noticed it.

Vanivilasa, the Marikanave Project of Mysore, has fared no better. The Prime Minister of Mysore wrote in 1898 that "no doubt the work will supply the famine protection so badly wanted." A British engineer in 1910 kept up the brave front: "a more prosperous future is expected," he wrote. The initial plan of providing 100,000 acres of light irrigation had already been replaced by plans for a power station, never built, and a low-level diversion weir to irrigate 24,000 acres of wet crop, or 45,000 if the farmers used water sparingly. The concession failed for the same reason that heavy irrigation had failed on the K-C Canal; the project was more than 60 miles from the nearest railroad, and even cane could not bear the transportation costs of such a remote place. The government sanctioned a contract for 4,000 acres of cane to be grown by an English sugar company, but nothing seems to have happened. Finally, in 1958, a sugar mill opened nearby, attracting coastal Tamilians who now grow 5,000 acres of cane, 2,500 of paddy on salinized lands, and about 5,000 of rotational crops.

By the time famine struck in 1896, Lytton's policy was so firmly in place that the famine commission visiting Bombay found that large-scale irrigation works were relied upon "not only as the backbone but as almost the entire framework of the system of relief work." A huge tank was now begun, for example, at Visapur, southwest of Ahmednagar. Work proceeded slowly, for the workers disappeared with the passing of the drought; the tank was not finished in fact until 1926, and then only with prison labor. When the project was finally opened in 1929, moreover, the old story of farmer disinterest repeated itself. The tank's service area had been divided into three 25,000 acres zones, each of which was to receive two light waterings, one year in three. Not surprisingly, the farmers disdained to participate: the completion report of 1936 called them "apathetic" and said that unless the rains fail entirely "there is almost no demand for water." What was the government to do? It proceeded to contract to deliver three-fourths of the tank's water to a sugar company that would use it on 350 acres of cane. The contract was adjusted in 1974; today, half the tank water is used for cane and half on about 5,000 acres of rotational crops.

Work meanwhile began on enlarging the Nira project with a new, far larger dam and a right-bank canal system to complement the old one on the left bank. True to form, the plans called for light irrigation; no one, it seems, asked how the right-bank canal water would be used in normal years or how, if cane were once established, it could be forbidden in times of drought. Work simply went ahead on elegant masonry works that looked as though they ought to do

much good for an area that the Irrigation Commission had considered "more urgently in need of" irrigation "than any other part of India". The new dam was completed in 1928 and was soon linked to a 100-mile right-bank canal, designed to protect 450,000 acres. Impressive masonry bridges cross the canal today, the keystones of their arches cut with the date each bridge was built, but only a third of the project land receives canal water, and the head end areas are thick with cane.

An Attempt at Reform

Lord Curzon told his legislative council in 1900 that "it cannot truthfully be said, even by the most envenomed of opponents, that we have looked helplessly on." He was right, of course, but the projects undertaken in this part of India at least could hardly be judged successful. Could they be set right? The Irrigation Commission of 1901-03, appointed by Curzon and chaired by an engineer who had worked in Mysore during the famine of the 1870s, recommended that no farmer in an irrigation project receive more water than the amount needed to irrigate a fourth of his land. Managing such a system, the Commission granted, would be difficult: "it is not supposed that a Government officer can carry out so fine a distribution of water". The job was one, the Commission wrote, for the farmers themselves, joined in organizations to apportion water. The Commission's recommendation was ignored, although many engineers today believe it is worth trying, especially now that the irrigation of ID crops is attractive. Making it work, however, would be exceedingly difficult, because head enders would do their adept best to take more than their entitlement.

The irrigation reform actually introduced by the British in the Krishna basin was a different and an ingenious one, conceived by a bright young engineer. M. Visvesvaraya is well-remembered in India today as a renowned engineer and eventual prime minister of Mysore but at the turn of the century he was merely the engineer in charge of the Mutha and Nira canals. Was there, the Irrigation Commission asked Visvesvaraya, some middle ground between the existing cane monopoly, with dried-up canals at the tail ends of the distribution system, and the reservoirs that remained full year after year, because farmers along the canals declined, unless the monsoon failed, to buy water for irrigated-dry crops? Visvesvaraya answered that the Bombay Deccan projects should be worked "on productive lines. We should not lock up water on the chance of a famine." He implied that future Deccan projects ought to be much smaller than existing ones, with comparatively small service areas devoted to heavy irrigation, instead of with large areas with long canals for light irrigation rarely wanted by the farmers.

For the existing projects, Visvesvaraya had two suggestions. First, he said, in times of drought the farmers with failing rainfed crops could work in the cane fields. The Commission did not dispute his argument but apparently did not

accept it either, perhaps because cane growers with hired labour in place could hardly be expected to hire hundreds of thousands of additional workers who were victims of famine.

Second, Visvesvaraya proposed what became known as the "block system" of irrigation. This system, much modified, remains in force on much of the northwestern Deccan today. The scheme began as a variation of a rotation used in hundreds of small Western Ghat projects built informally, with weirs often no more than a meter or two high. The farmers who built these weirs were also the men who owned the irrigable area the weirs served. This land was divided into fourths, and each fourth was cropped homogeneously, no matter how many men held land within the tract. Each fourth was on a compulsory cycle of paddy followed by cane, followed by wheat, followed by sorghum or another small grain. The genius of the system—reminiscent of the open fields of medieval Europe--was that all the participating landowners obtained some heavy irrigation; unlike farmers on the government canals, in other words, all the farmers shared in the most profitable crop, cane. Significantly, the idea of the blocks came from the farmers themselves, not British experts.

The problem with the block system on the Mutha and Nira canals was that the government canals were unable to bring enough water for cane on a fourth of the entire service area. Visvesvaraya proposed, therefore, that villages be allowed instead to form "cane blocks" covering a third of their cultivated lands. Here alone, in the cane blocks, would the government provide enough water for periodic cane; farmers would be forced to fallow their other lands, unless they had wells. Even with this severe restriction, there wasn't enough water for tail end villages to have cane blocks, but they would be allowed to request water for irrigation of ID crops. If they failed to do so, villages with cane blocks could request light-irrigation supplies for land outside the cane blocks.

From the viewpoint of farmers in villages with cane blocks, the scheme offered reliability, because the blocks, once formed, were guaranteed water for six years. From the project-manager's viewpoint, the blocks would help ensure that water no longer ran to waste in years when normal rainfall reduced the request for light irrigation but when cane growers, frustrated at the uncertainty of the supply available to them, lost interest in the project. From the social welfare viewpoint, the block system offered something distinctly better than cane concentration in a few hands; farmers in many more villages might share in the benefits of heavy irrigation.

Although Bombay engineers would later write that the block system offered "advantages for farmers and administrators" and that it was "an enormous success," in fact the system ran into such serious difficulties that it had to be modified radically. Visvesvaraya acknowledged that "perhaps the most difficult part" of the block system was that the farmers in each cane-block village would have to agree on a land exchange allowing each landowner to acquire land

within the cane block. Local revenue officers warned that the farmers would never agree to such an exchange. The warnings proved accurate. What could be done? Reluctantly, the irrigation department revised the idea of a cane block from a village-based unit to an individual-farmer unit. Farmers on the Nira and other Bombay projects were, and are today, given the opportunity to apply for cane sanctions, valid for six years. Security is fostered, for the landowners know that they will obtain water for cane. To the relief of the irrigation engineers, the water is used. At the same time, however, the equity that was at the heart of the reform has been forgotten, for most farmers do not have the capital to grow the minimum sanctioned area of a half-acre of cane. Project benefits go, in short, to the wealthy, who become more wealthy. A portrait of Visvesvaraya as premier of Mysore gazes from the dining-room wall of many an inspection bungalow in South India. While in that post, Visvesvaraya attempted to introduce the block system at Marikanave, too, but in his autobiography he acknowledges that the system never worked even there.

The Sequel

With the opening of the Nira right-bank system in 1928, the construction of irrigation works in the Krishna basin slowed until independence in 1947. Indian engineers today are fond of looking back, comparing what the British left them with what has been accomplished since then, and dismissing the British works as insignificant. Unfortunately, most of the works built in the Krishna basin since 1947 have not only been ones that the British considered but have been executed as the British would have built them, as high-tension systems rationing water for the light irrigation of extensive areas.

The Irrigation Commission of 1901-03, for example, had recommended studies of a huge project that might be built on the lower Tungabhadra, immediately upstream from the Vijayanagar Channels, and of another giant undertaking in the Eastern Ghats, one that could extend far upstream the tract of irrigated land beginning in the delta. Both projects were subsequently considered in detail. The author of the report on the Tungabhadra Project, Archibald Mackenzie of the Madras Engineers, wrote in the famine-relief tradition when he argued that "it is inconceivable that our descendents will forever allow all the water to run waste into the sea. No one can travel in Kurnool District without believing that almost any conceivable sums are well laid out in such a cause." Work did not begin on the dam until World War II, and canal water began flowing only in 1953. Yet one of the two canals on the right bank of the project follows Mackenzie's 1903 alignment precisely and operates with huge tail end shortages.

Downstream, the great Nagarjunasagar Dam, studied in 1912, was dedicated by prime minister Nehru in 1954; canal water began flowing nine years later. As on the Tungabhadra Project, and on other projects undertaken more recently,

light irrigation was prescribed. The results were disastrous, because the head end farmers took wet crops and left the tailend farmers with water shortages so severe that one engineer with the U.N.'s Food and Agriculture Organization has spoken of "anarchy."

It is possible, of course, that these modern troubles might have appeared if the British had never built a mile of canal in India. The government of India might have embarked entirely on its own on building light-irrigation schemes in the name of social justice or in the pursuit of theoretical economic efficiency. Still, after the record of British failure, the government of India after 1947 might have been expected to recognize that there was something fundamentally and obviously wrong with what the British had tried. The government might have looked back at the British irrigation works and wondered at the obstinacy that led the Raj to continue building projects that were crippled the day they were finished. The real culprit might have been recognized as the weakness of the political institutions needed to ration water. Difficult as it is to imagine an English officer in India seeking advice from the natives whom it was his mission to lead, it remains true that those natives could have predicted the outcome of building high-tension systems. If the British had learned from them, or discovered this elementary fact on their own, alternative famine-relief schemes could have been tried, such as publicly-funded groundwater developments or research into drought-resistant crop varieties and water-conserving farming methods. These steps would not have been panaceas, but neither would they have amounted to digging ditches that would never carry water.

India after 1947 did not ask these questions. No doubt it was in a hurry and wanted to forget the British, not reconsider their methods. The result, however, was that no effort was made to prevent India from falling into a variation of the colonial trap. Instead of foreign masters who could not seek advice from villagers, India now developed a bureaucracy that was even more hierarchical and dismissive of the people it served. The Irrigation Commission of 190l-03, for example, wrote that "cultivators may be trusted to know their own interests better than the authorities…." The Royal Commission on Agriculture heard in 1927 from Harold Mann, longtime principal of the Poona College of Agriculture, that "progress will most effectively be made by ... working from the cultivator's point of view. ... " A second Irrigation Commission, on the other hand, submitted a report in 1972 and paid not even lip service to the importance of listening to project beneficiaries. New schemes are meanwhile under construction, and wet crops are generally to be forbidden on them. Field engineers know that the rule will be ignored and that the tail ends of the canals they're busily digging will never carry water. In a companion paper, "Irrigation Developments in the Krishna Basin Since 1947," I consider those developments in detail.

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