Irrigation in India Through Ages

CENTRAL BOARD OF IRRIGATION

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FOREWORD

Irrigation in India has been practised since times immemorial. In this leaflet Shri Satya Shrava, of the Department of Archæology, has made an attempt to trace out the references in the ancient literature of India regarding the existence of dams, canals and irrigation works and the technique of distribution of water adopted by our ancients. It is hoped that this leaflet will give the reader an idea of the achievements of India in the past. India still occupies a leading position in the science of irrigation and leaflet 1 of the series describes in brief the growth of irrigation for the last one hundred years and of the magnificent irrigation works built during this period etc.

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IRRIGATION IN INDIA

THROUGH AGES

[PRIOR TO SEVENTEENTH CENTURY]

FAMINES AND IRRIGATION—EARLIEST REFERENCES

From the dawn of civilisation, India has primarily been an agricultural country. Agriculture still continues to be the main industry of its people. Vast areas are cultivated and crops raised on them twice a year. India gets uneven rainfall; there are areas getting enormous showers of rain throughout the year and there are also large tracts presenting the look of a desert and getting only a few inches of rain during the whole year. Rainfall is seldom normal in this vast sub-continent. Years of scarcity are followed by periods of excess. Sometimes there is complete failure of monsoon dragging people to the verge of a famine, and sometimes there are very heavy downpours and great havoc is caused by abnormally heavy floods.

FAMINES

The dependence of agriculture on rainfall renders cultivation precarious and there have been very serious droughts at times in the country causing severe famines which brought untold miseries to the people. *Vayu Purana* which gives genealogies of early rulers and their exploits, refers to one of the earliest droughts. In *Mahabharata* (3000 B.C.), the second great epic of India, mention is made of a very serious drought during the reign of Emperor Mandhata, of the race of Iksvakus.

Another famine occurred during the sovereignty of Trisanku, father of the famous king Harishchandra the Truthful. Severe famines are also recorded—one about the time of King Dasaratha, father of Rama, the hero of the epic Ramayana, and the other about 160 years before the Mahabharata war, during the reign of King Shantanu, ruler of Hastinapur, a city the remmants of which are to be found in a small village about 50 miles from Delhi.

Megasthenes, the Greek Ambassador to the court of Sandrakotus (Chandragupta) in circa 300 B.C., depicts quite a different picture of the agricultural conditions in India. He writes: "there grows throughout India much millet, which is kept well watered by the profusion of river-streams..... It is accordingly affirmed that famine has never visited India, and that there has never been a

general scarcity in the supply of nourishing food. For, since there is a double rainfall in the course of each year, one in the winter season, when the sowing of wheat takes place as in other countries, and the second at the time of the summer solstice which is the proper season for sowing rice and bosporum, as well as sesamum and millet—the inhabitants of India almost always gather in two harvests annually; and even should one of the sowings prove more or less abortive they are always sure of the other crop..... The fact is almost all the plains in the country have a moisture which is alike genial, whether it is derived from the rivers, or from the rains of the summer season, which are wont to fall every year at a stated period with surprising regularity;.....",

It appears that the above description refers to the period of Megasthenes' stay in India, for a severe famine is recorded in history during the last years of Chandragupta Maurya's reign.

Artificial means of Irrigation

It was to face the menace of droughts following the failure of monsoons that artificial systems of irrigation were devised here from ancient times.

Early Evidence of the Vedas

In the Vedas, the earliest sacred books of the Aryans, mention is made of wells, canals and dams. Rigveda (I. 85 10 : I. 116. 9; IV 17. 16) mentions the terms *'avata'* which signifies a 'well'. In another place (VII. 103.2) reference is made to a (dried up) reservoir in which a dry bucket is lying. Another passage mentions *'kulya'* an artificial river or canal, as reaching a lake.

In Yajuraveda also mention is made of canals and dams. They are termed as *kulya* and *sarsi* respectively.

Atharvaveda (III. 13) gives description of digging canals from the rivers. River is mentioned as a cow and canal as a calf.

Kausika Sutra (XL. 3—6) also explains the rituals of the opening ceremony of letting water into a canal. 'A gold plate was laid at the mouth of the canal on which a frog tied with blue and red threads was made to sit. The frog was then covered with moss (sevela) and water was let in.'

Evidence of Smrtis

Manu, the earliest law-giver writes in his work (VII. 196) that a king who wishes to conquer his enemy should first of all destroy the dams (*tataka*) in his territory. *Vishnugupta Kautalya* (3rd century B.C.), the Prime Minister of Chandragupta Maurya, in his *Arthasastra* or Book on Polity, gives the same advice saying, 'that when on war, the tracts of land of the enemy should be flooded with water by breaking the lakes, dams and embankments' (XII. 4). Again, while laying down rules for the demarcation of the boundaries of different provinces, *Manu* says (VIII. 248) that dams, wells pools and *prasravanas* should be constructed on the boundary lines. Further (XI. 279; 281) he ordains punishment for a man who damages any part of a dam or puts hinderances in the channels connected with it.

According to other ancient writers, the digging of a tank is regarded as the greatest of the seven meritorious acts of a man that are calculated to provide water, *viz.*, giving water, *prapa, kupa, vapi, kulya, padmakara, tataka* or dam.

Brihaspati, another law-giver and a writer on polity states that the construction and repair of dams is a pious work and its burden should fall on the shoulders of the rich men of the land. *Vishnu Purana* also enjoins merit to a person who effects repairs to wells, gardens and dams.

Rishi Narada, a great writer on polity, once came to the court of Emperor *Yudhishthira* (c. 3150 B.C.) and enquired about the welfare of his state. One of his question was, "Are the farmers sturdy and prosperous? Are there dams full of water and big enough and distributed in different parts of the kingdom, and does agriculture not depend on rains only?"

Vishnugupta Kautalya (300 B.C.) has mentioned canals and dams in different contexts. "Ordinarily, a revenue tax of one fourth of the produce was paid to the state for water used from rivers, lakes and dams and from wells worked with machines. (II. 24). During times of famine the king and his subjects took shelter near dams. (IV. 3). Water animals in rivers, canals and dams were protected and fishing was allowed under a licence. (II. 26). If privately-managed dams were neglected for five years their charge was taken over by the State. If they were constructed by public contribution, revenue for five years was remitted, and if only repairs were carried on by public effort, revenue was remitted for four years. (III. 9). According to him, one of the good features of a State is that cultivation in it does not depend on rain alone. (VI. 1).

From the above it is evident, that artificial irrigation was given supreme importance.

Evidence of classical literature

In Sanskrit literature *pranali, kulya, sarasi, nika, nala* and *nalika* are the words used for different types of canals and channels. There also occurs another word 'tilamaka'. Which denotes a "channel which leads the water from the hillside over the fields which rise in terraces one above the other." Similarly, the words 'kunda' and 'tala', are used for small and big tanks and the words *'tataka'* and *'sarsi'* for big dams. According to the lexicographer *Amara* (1st century A.D.), *kulya* is a small artificial stream. This also shows that canals were dug for the purposes of irrigation.

Hemadri in the *Danakhanda* (p. 1004) of his *Chatur-varga-Chintamani* quotes a verse from *Devipurana* which indicates difference between a *kupa* and a *vapi,* and again quotes from *Vishnu Dharmottara* that dams and *nadivahas* or small channels were used for watering the fields. *Pali, vipali,* and many more words are mentioned in *Devipurana* as quoted by *Hemadri,* in the context of water-courses.

There is an interesting verse in the *Karmapradipa* of *Katyayana* which draws distinction between a *nadi* and *garta* based on the speed of their current. This shows that speed was one of the factors

of distinction and there may have been several other factors that were responsible for the variety of names which we find scattered in our literature.

Rain-Gauge.—To measure the actual rainfall of a certain place adequate apparatuses were devised. *Vishnugupta Chankya* writes about the construction of a special kunda or tank of definite dimensions with opening of the size of a cubit of the middle length towards the sky to serve as a rain-gauge (II. 5). The necessity of rain-gauge arose because lands were taxed according to the amount of rainfall they received every year. (II. 24).

Hydraulic Engineers.—To supervise the different departments of irrigation there was an officer called the *jala-sutrada,* or hydraulic engineer, employed in the department of *vari-gripa-karana* (water works). This officer is repeatedly mentioned in the epigraphical records of southern India. He supervised the operations in connection with the digging of canals and dams and their maintenance. Megasthenese records that the district officers, as today, "measure the land and inspect the sluices by which water is distributed, into the branch canals, so that everyone may enjoy his fair share of the benefit."

Under instruction of king Bukkaraya, of the Ist Vijayanagar dynasty, Singayya Bhatta, the Hydraulic engineer or the Jala-sutrada, who was also 'a master of ten sciences', led the river Henne, through a channel to the Siravera tank at Penugonda and gave it the name of Pratapa-Bukkaraya Mandala Channel (E.C. X, Gb. 6). A glowing tribute to the high engineering skill of those who were in charge of the construction of such colossal works has been paid by Horsley, the engineer of the Pandyan canal. "In other countries, and in India also an engineer generally works on his own lines in developing any large scheme of irrigation and naturally credits his own skill and perseverance with the success of his undertaking. Here however, I have no hesitation in saying that it has been an unmixed pleasure to me, from a professional point of view to merely follow the lines of the original constructors of the Pandyan canal and Pulpanabapoorum Poothenaur, because the evidence of their skill and almost superhuman perseverance was so marked; and I have in carrying out the works felt contented and fully satisfied to follow in the footsteps of those whom I cannot but consider to have been masters in their art and facile princeps in irrigation engineering." (I.C., p. 76).

Treatises on Dams

There were special works pertaining to the construction of canals and dams which are, however, not extant now. *Devipurana* says: "The measurements of a superior type of Palibandha are given as 200 cubits by the specialists in their treatises." The inscription referred to in the last para. also bears witness to the fact that treatises were written on the subject, which had to be mastered by hydraulic engineers. Another inscription of Bhaskara Bhavadura, Shaka year 1291 also makes mention of Brahmanas learned in the science of hydrology (pathas-shastra). (E.I. Vol. XIII. p. 108).

IRRIGATION WORKS—DAMS, TANKS AND CANALS

Fortunately, a good deal of information has survived regarding the construction of canals and dams in India during the past millenniums. Irrigation received special attention under different rulers. By a study of the vast literature and epigraphical records it is possible to get an idea of the pains the ancient rulers in India took in the construction of public works for the benefit of their subjects. In South India dams, tanks and canals were mainly used for the purposes of irrigation. Dams and tanks were provided with sluices to regulate the flow of water. Water was first let out into the main channel and then distributed into a large number of branches. The system was quite elaborate.

The Hindu kings of South India evinced keen interest in affording irrigational facilities for the increase of agricultural produce. Ruins of ancient irrigational works are found scattered all over that region and many of them are still in use. Crole, in his Gazetteer of the Chingleput district says that many of them 'now abandoned or in ruins evince the solicitude of those ancient monarchs for the extension of cultivation even in tracts not favoured by natural position or the quality of the soil. Almost every catchment basin, however small, still bears traces of having been bounded across and in many instances this was done in order to secure a paddy on a few acres of stony ungenerous soil to which all the fostering care of the British administration has induced cultivation to return. Large and more expensive projects were not neglected. Even some of them bear witness to the enlightenment of those Hindu kings while the absence of scientific instruments in those remote times compels the astonishment of the beholder.'

Below are given instances of some of the important works carried out at various times in different parts of the country.

(a) PRIOR TO CHRISTIAN ERA

I. *Bhagirathi*: Ramayana, the ancient historical work of the sage Valmiki, preserves an account of the gigantic feat of king Bhagiratha and his engineers of diverting the course of the waters of the sacred Ganga from the altitudes of the Himalayas towards the present Indo-Gangetic plain, the granary of India. This fact was pointedly mentioned by our late lamented Deputy Prime Minister Sardar Vallabh Bhai Patel in one of his recent speeches. The colossal effort of Bhagiratha has become proverbial and any gigantic undertaking is called as 'Bhagirath-effort.'

II. Rivers were dammed for the purpose of irrigation. The Kunala Jataka (prior to 4th century B.C.) mentions a dispute between two tribes for the use of the water of a dam: "The Sakiya and the Koliya tribes had the river Rohini, which flows between the cities of Kapilavastu and Koli, confined by a single dam, and by means of it cultivated their crops. In the month of Jethamula when crops began to flag and droop, the labourers from both the cities assembled together. Then Kolians said, 'Should this water be drawn off on both sides, it will not prove sufficient for both us and you. But our crops will thrive with a single watering, give us then the water." (Quoted in the Land-System in South India, by K. M. Gupta, p. 215).

III. Kharavela, (Ist century B.C.) the great king of Orissa, brought into use an aqueduct constructed by Emperor Nanda (4th century B.C.) that had been neglected for a long time.

(b) CHRISTIAN ERA TO TENTH CENTURY A.D.

IV. *Sudarsana Lake* (Circa. 300 B.C.—457 A.D.); An inscription of Rudradaman I, the Western Kshatrapa ruler, on the Girnar rock in Kathiawar records the construction and repairs of an artificial lake Sudarsana by successive viceroys of the Mauryan empire. This inscription is incised on the western side, near the top, on the same rock which contains the edicts of the great Maurya emperor Asoka as well as an inscription of the Gupta king Skandagupta, about a mile and a half to the east of the town of Junagadh in Kathiawad, and at the commencement of the gorge that leads to the valley which lies round the famous mountain Girnar.

The record reads: "This lake Sudarsana, from Girinagara, even so well joined in construction as to rival the spur of a mountain, with all rows, its embankments strong, in breadth, length and height constructed without gaps and made of stone, clay.....furnished with a natural dam, formed by.....and with well provided conduits, drains and means to guard against foul matter.....three sections.....by.....and by favourable conditions in a highly prosperous condition.

"This same (lake)—on the first day of the dark half of Margasirsha in the seventy-second—72nd-year of the king, the Mahakshatrapa Rudradaman.....when by the clouds pouring with rain the earth had been converted as it were into one ocean, by the excessively swollen floods of the Suvarnasikata, Palasini and other streams of mount Urjayat, the dam.....though proper precautions (were taken) the water churned by a storm which, of a most tremendous fury as at the time of the end of the world, tore down hill-tops, trees, banks, turrets, upper stories, gates, and raised places of shelter—scattered, broke to pieces, (tore apart) .....with stones, trees, bushes and creeping plants scattered about, was thus laid open down to the bottom of the river:—

"By a breach, four hundred and twenty cubits long, just as may broad (and) seventy-five cubits deep, all the water flowed out, so that (the lake), almost like a sandy desert, (became) extremely ugly (to look at).

".....he, the Mahakshatrapa Rudradaman, in order to..... increase his religious merit and fame without oppressing the inhabitants of the towns and country by taxes, forced labour and acts of affection—by (the expenditure of) a vast amount of money from his own treasury and in not too long a time made the dam three times as strong in breadth and length..... .....(on) all (banks).....(and so) had (this lake) made (even more beautiful to look at).

"When in this matter the Mahakshatrapa's counsellors and executive officers, who though fully endowed with the qualifications of ministers, were averse to a task (regarded as) futile on account of

the enormous extent of the breach, opposed the commencement (of the work), and when the people in their despair of having the dam rebuilt were loudly lamenting (the work) was carried out by the minister Suvisakha." (D.B. Diskalkar, Selections from Sanskrit Inscriptions, Vol. I, Pt. II, P. 15).

As is clear from the above, this Sudarsana lake was destroyed by a storm during the reign of Rudradaman I, in A.D. 150. All the water having escaped, the lake, instead of being '*sudarsana*' or of pleasant look, became '*durdarsana*' or of ugly appearance. The lake had been originally constructed during the reign of the Maurya Chandragupta and was perfected under the Maurya emperor Asoka. The benefits of irrigation to be derived by damming this lake were in the mind of king Chandragupta who took steps in constructing it even in the remotest province of his empire. An important fact about this beneficial lake or dam is that without any major repairs it continued in tact approximately for 400 years. The masonry work must have been very strong. It was restored and made more beautiful than ever (*sudarsanatara*) during the reign of Rudradaman I under whose orders this work was carried out by the provincial governor Suvisakha.

About 300 years after its repairs the lake again burst out during the reign of Gupta king Skandagupta. The record of its second repairs is also inscribed on the same rock on the north-west face. The restoration of the embankment of the lake took two months. The lake now no longer exists and it is not known when and how it was destroyed.

V. In Cholamandala Sàtakam we find a reference to the construction of a great dam, known as the Kal Anai or the Grand Anicut. This was a solid work of masonry laid in brick and stone.

VI. In the southern India early Chola rulers (1st century A.D.), were the pioneers in the construction of dams, etc. King Karikala I, who is identified with the quasi-historical Karikala Chola of Tamil literature and is claimed by the Chola Kings of Tanjore as one of their ancestors, evinced keen interest in the irrigation methods and agriculture. River Kaveri was in floods every year causing tremendous havoc in the kingdom and he hit upon the idea of controlling its water by providing dams and embankments. In his singular and great achievement thousands of Ceylonese labourers were employed to which some of the Ceylonese resented. According to Mahavamsa, we hear of an aged woman complaining to Gajabahu that among the 12,000 persons taken away by Karikala for making the embankment of the Kaveri, was her only son. (Silappadikaram, p. 35).

According to Pattinappalai, a Sangam worker, Karikala was the founder of the capital Kaveripattinam. He was also known as Kaverinadan or the Lord of the Kaveri tracts, due to his taming the violent river. He was also the originator of a sort of festival known as the first freshes of the Kaveri.

Shri V. R. R. Dikshitar writes: "It was indeed a singular achievement of a monarch who had the long vision of brightening the rural life of his kingdom and consequently increasing the popularity of his state. So the king came to be known as Karikala Peruvalattan," (I.C. Vol. XII, p. 72).

King Karikal was a man of genius. Besides constructing the embankments of the Kaveri, he dug a number of channels, canals, tanks and bunds, in some of which he took the help of other kings.

There were different methods of irrigating the fields, such as the pecottah, the bucket, the palm-leaf basket, which are still used in rural areas of South India. The Silappadikaram says that with the taming of the river Kaveri, these were no longer required.

VII. *Talagunda tank (1st half of the 6th century A.D.)*—In the Telugu and Kanarese areas of South India, construction of tanks was quite as common as in the Tamil tract. The Kadamba king Kakusthavarman built a tank at Talagunda in the Shimoga district of the Mysore State. (E.I., Vol. VIII, p. 36). It is written: "King Kakusthavarman has caused to be made this great tank, a reservoir for the supply of abundant water."

VIII. *Mahendra-tatak (circa 1st half of the 7th century A.D.)*—This tank is situated in the village Mahendravadi in the north Arcot district, on the bank of which was constructed a monolithic cave dedicated to Vishnu by Mahendra Varma I who reigned about the 1st half of the 7th century. About this tank it is written: 'Mahendravadi has a fine tank, the date of the construction of which is not known. The tank must originally have been larger than that of Kaveripakkam and served lands some seven or eight miles distant. The bund is enormously high and might be restored to its original height in which case a great extent of land could be brought under irrigation.' (I.C., Vol. XII, p. 74).

IX. *Paramesvara-tataka (circa 2nd half of 7th century A.D.)*—Nine miles north-north-west of Conjeevaram, in the Chingleput district, construction of another tank is mentioned. It is situated in the village of Kuram which is mentioned in an inscription stating that 108 families, studying the four Vedas were residing there. (S.I.I., Vol. I, p. 154). This tank was constructed by Paramesvara-varman—a great grand son of king Mahendra Varman I and was provided with a feeder-channel from the river Palar.

X. *Tiraiyaneri-lake (circa 1st half of the 8th century A.D.)*—In the Kasakudi copper-plate grant of Nandivarman Pallava Malla, reference is made to the construction of a big lake named Tiraiyaneri about 10 miles to the east of modern town of Conjeevaram and it was enjoined that river channels and irrigation channels could be dug from it for irrigation purpose (S.I.I., Vol. II. pt. III, p. 360). A town of the same name was situated on the banks of this lake. At present the village (town) is called Tenneri. This lake was evidently built by a Pallava king or prince named Tiraiyan, whose age is not so far ascertained. Mr. Sewell wrote in 1882 that some stones in the tank-bund bear inscriptions, one of which in Tamil, records that one Tattacharyar dug the tank. (List of the Antiquarian Remains in the Presidency of Madras, Vol. I, p. 188). However, Nandivarman was the opponent of Vikramaditya II, the Chalukya king, whose known dates range from 733-34 A.D. to 746-47 A.D. Hence this reservoir must have been constructed by the 1st half of the 8th century.

XI. *Kaveripakkam tank (circa 710 to 775 A.D.)*—Constructed by Nandivarman III, the Pallava king at Kaveripakkam in the Walaja taluk, it is situated at the place where Clive gained a victory over Raja Sahib and his French allies in 1752. This is an extensive tank having a bund about four miles long, stretching from north to south. In the district Manual of North Arcot (Vol. I, p. 438) a fabulous origin is assigned to it, *viz.*, the desire of a certain recluse to construct a reservoir at the spot.

XII. *Vayiramegha tataka (circa 775 to 826 A.D.)*—This tank at Uttiranmerur in the Chingleput district which is 10½ miles north-west of Madurantakam on the South Indian Railway, was probably built during the time of Pallava kings. Its construction is, however, not specifically mentioned in any of the numerous inscriptions found at the place. It seems to have been named after the king, during whose reign it was built and whose name or title was Vayiramega. This tank existed during the reign of the Pallava king Dantippottarasar, as in the 9th year of his reign provision was made for the removal of silt by a private individual (No. 74 of 1898). After its construction by the king its management and repairs seem to have been entrusted to be looked after by village authorities or private individuals.

Much care seems to have been taken for the maintenance of this tank. Even the successors of the Pallavas, the Ganga-Pallava rulers, and others, took keen interest. A number of records register endowments in favour of this tank. One of the inscriptions of Dantivikramavarman (early 9th century) who is identical with Dantiga, ruler of Kanchi, states that on the failure of certain ryots to pay the dues on their holdings, the village assembly paid the amount but instead their lands were taken over for the benefit of the tank for three years. It was also provided that to get back their lands the defaulters should pay up all their dues. In case they could not buy them back, these were to be sold for the benefit of the tank. Any body objecting to such a course had his lands similarly sold, while the man himself was treated as a village pest. Any arbitrator objecting to it should be banished. Six records of the time of Kampavarman and another undated record also mentioned about the endowments to this tank consisting of land, grain, or cash, proceeds from which were to be utilized for removing silt and repairs to the bund. The earliest of these records a transaction relating apparently to another tank and imposes on those who violate it a fine to be credited to the funds of the Vayiramegatataka.

XIII. *Gudimallan-tank (circa 775 to 826 A.D.)*—This tank with a sluice was situated at Gudimallam near Renigunta railway junction in the North Arcot District. It is referred to in an inscription of the Ganga-Pallava king Dantivikaramavarman (No. 226 of 1903), which registers a gift of land, the income from which was to be spent in removing silt from a second tank in the same village. Those who look after the gift are assured of acquiring the merit of performing a horse-sacrifice.

XIV. *Dharampuri-tank (878-79 A.D.)*—A mutilated inscription of 878-79 A.D. at Dharampuri, in the Salem district mentions repairs to a tank by a private individual during the reign of the Nalamba-Pallava king Mahendra (No. 348 of 1901).

XV. *Tandalam-tank (circa 2nd half of 9th century).*—At Tandalam, 4½ miles west by north of Arkonam junction is a tank for which a sluice was built by some Pallava Maharaja (E.I., Vol. VII, p. 25). The inscription and the sluice belong to the Chola period, but the tank is probably older. It is written: "The lord of the beautiful goddess of the (lotus) flower (i.e., Lakshmi), Pallavamarayan, who is believed by the excellent goddess of the Tamil country, graciously constructed a sluice for the tank at Tandalam in Poliyur-nadu."

XVI. *Ukkal-tank (circa 9th century A.D.)*—At Ukkal, in the Arcot taluk of the same district, was a tank for which a donation of paddy was made during the reign of Kampavarman identical with the Ganga-Pallava king of the same name, mentioned above (S.I.I., Vol. III, Pt. I, p. 9.) This endowment was entrusted to the annual supervision committee of the village. In the 4th year of the reign of Rajendra Chola I, the Chola king (1015 A.D.), the village assembly sold some land to the tank. The income from the land was to be utilized for the up-keep of two boats assigned to the tank by a private person. Dr. Hultzsch considers that the boats were intended for crossing the tank. (S.I.I., Vol. III, pt. I, p. 15). But their primary object seems to be to remove silt as we have already seen in other cases.

XVII. *Solapuram tank (circa 9th century A.D.)*—At Solapuram near Vellore in the same district, a tank seems to have been constructed during the reign of Kampavarman mentioned above. This tank was called Kankavallieri and a temple of Vishnu was also built in the village about the same time (E.I., Vol. VII, p. 194).

XVIII. *Chitramega-tataka (circa 9th century A.D.)*—This tank is mentioned under the name of Chitramega-tataka in two Chola inscriptions. (Nos. 39 and 40 of 1887-88, S.I.I., Volume IV, p. 137.) The cave and the tank came into existence during the Pallava times and were so named after the title of a king.

XIX. *Colavaridhi (914-915 A.D.)*—Parantaka I, the Cola, granted a field in favour of the Colavaridhi tank, situated at Sholinghur which is seven miles from the Madras Railway Station of the same name in the North Arcot district. (E.I., Vol. IV, pp. 221-225).

XX. *Vinamangalam tank (920-21 A.D.)*—Udayendiram grant of the 15th year of the above king mentions a feeding channel of the tank at Vinamangalam, a station on the Madras Railway next to Ambur on the Katpadi-Jalarpet line.

XXI. *Sodiyambbakam and Takkolam tanks (circa 937 A.D.)*—Two more inscriptions of the same king (S.I.I., Vol. III, pt. I, p. 19; and No. 8 of 1897) mention two tanks at Sodiyambbakam and Takkolam.

XXII. *Tank of Vira-Narayana (1st half of the 10th century)*—Under the Cholas, Parantaka I, also called Vira-Narayana founded the town of Viranarayan Catuvedimangalam—modern Kattumannar-Koyil (South Arcot District), eight miles west of Gangaikondacholapuram in the Trichy district and constructed a tank. It is kept in a fairly good condition and affords irrigation facilities to a good part of the modern Chidambaram taluka.

XXIII. *Nangavaram tank (circa middle of 10th century A.D.)*—At Nangavaram in the Kulittalai taluka of the Trichinopoly district a tank was built, reference to which is found in two inscriptions (Nos. 342 and 343 of 1903). The former of these, records a sale of land during Chola king Rajakesarivarman's rule by the village assembly to a private individual. This was done to defray expenses of removing silt by plying a boat in the tank. An idea as to how the income from this land should be spent is given in the latter.

XXIV. *Chikhallapur tank (977-78 A.D.)*—At Chikhallapur in the Kolar district construction of this tank is menticned in the year 977-78 A.D.

XXV. *Uyyakkondan or Myyakondan channel (985-1013 A.D.)*—The Uyyakkondan channel was constructed by Rajaraja I. It leaves the river Kaveri at a distance of some miles above Trichinopoly and flowing across the greater portion of that taluk and through the town itself, eventually falls into a large tank in the village of Valavandankottai, about 10 miles to the east of Trichinopoly. It is an interesting ancient irrigation work. At the head sluice of the channel are two inscriptions. One of these records repairs done to the channel after a breach. It belongs to the 28th year of the Chola king Kulottung III, corresponding to 1205-06 A.D.

XXVI. *Tank at Bahur (985 to 1013 A.D.)*—An inscription of Rajaraja I refers to a big tank at Bahur near Pondicherry. Villagers had agreed to contribute to the revenue of the tank (No. 178 of 1902). The committee for 'Supervision of tanks' in the village levied the contribution and agreed to arrange to remove the silt annually. If any of the inhabitants of the locality refused to contribute his share, the reigning ruler was authorised to impose penalty to be credited to the tank fund and have the work carried out.

(C) 11TH CENTURY TO 17TH CENTURY, A.D.

XXVII. *Arikesari Mangalam tank (1010-11 A.D.)*—Another inscription, dated 1010-11 A.D. of the same ruler refers to breaches in the tank at the village of Arikesari Mangalam. The tank must have been constructed earlier. This tank had been granted to a temple. An officer of the king is said to have repaired the tank, apparently at the expense of the temple.

XXVIII. *Gangaikonda Cholapuram tank (1012-1044 A.D.)*—To commemorate his victories in the North, Rajendra Chola excavated a big tank near his capital Gangaikonda Cholapuram. This tank was consecrated with the sacred water of the river Ganges carried so far away to south was poured into it. The Tiruvalangadu plates refer briefly to this event and mention, "this lord constructed in his own dominions as a pillar of victory (a tank) known by repute as Cholagangam which was composed of the water of the Ganges". The tank exists even to this day having an embankment of about sixteen miles long and provided with the necessary sluices and channels for the irrigation of a large area.

XXIX. *Bhojpur Lake (circa 11th century A.D.)*—This marvellous lake was 250 suqare miles in area. W. Kincaid wrote about it in December 1888. "About twenty miles south of the city of Bhopal

are the remains of the city of Bhojpur, not far from which is situated the ruined or uncompleted temple of Bhojpur. The temple evidently was built some little time subsequently to the formation of the lake on the shore of which it stands, and most likely after the city of Bhojpur had become a place of importance. The ruins of this large town stand close by. It seems to have fallen into decay in the fifteenth century, on the destruction of the dam and subsidence of the waters of the lake.

"The great Bhojpur lake was without doubt the largest and most beautiful sheet of fresh water. It covered a valley which presents the most remarkable feature that, though it is so extensive, only two breaks occur in its wall of hills,—one a little more than one hundred, the other about five hundred yards wide. Both of them were spanned by very remarkable dams, consisting of an earthen central band faced on both sides, outer and inner, with immense blocks of stone laid one on the other without mortar, but fitting so truly as to be watertight, the two faces sloping inwards from the base. The lesser opening was closed by a band 87 feet in height, and 300 feet thick at the base, or even more the greater, by one in places 40 feet high, and about 100 feet broad on the top; and, though the first-mentioned bund is now a complete wreck, the latter is intact and still continues to turn the river Kaliasot into the Betwa, and from its top the old bed of the stream is recognisable. The lesser but higher band was broken by Shah Hussain, the greatest of the Mandu kings, for the purpose of utilising the bed of the lake; and, though tradition relates that he never personally benefited by this act, the fact of the present fertility of the valley, still growing the best wheat in the country, proves his practical statesmanship, however much we may regret the loss of a water storage of such rare size and beauty for India. The Gonds who live in the thick jungle still surrounding this valley, tell us that it took an army of labourers three months to destroy the dam, while three years elapsed before the lake was emptied, and thirty before its bed was fit for human habitation.

"I do not know that the story of the construction of this lake by Raja Bhoj of Dhara has ever been written. It is an interesting tradition. It runs that Raja Bhoj was stricken with a severe illness, some say leprosy, which the court physicians failed to remedy. He therefore had recourse to a holy recluse, who lived at a distance, but was widely famed for his miraculous cures. The monk, after considering the case and performing many incantations and examinations of signs and omens, gave the following oracular decree: that the king would die of the disease, unless he was able to construct a lake so great as to be the largest in India and fed by 365 streams, or a stream for every day in the year. By bathing in such a lake, on a certain day, at a certain hour he would be cleansed not otherwise. The king, it is related, gathered together men learned in all the sciences, and settled in his capital by reason of his liberal patronage, and consulted them. They recommended that skilled engineers should be sent along the valleys east and west and the Vindhyan range, which lie near Dhar, to explore the country and report upon the feasibility of such a lake being constructed. And it is said that, after a long and weary investigation and many hopeless failures and

immense expenditure, they discovered the valley, subsequently enclosed, in which there happened to be the head-waters of the holy river Betwa. But, alas, only 359 springs and streams fed the waters flowing through the valley. The difficulty was, however, eventually overcome by Kalia, a Gond Chief, pointing out the missing river, which with its tributaries, made up the number, and was accordingly named. to this day, Kalia's river, or the Kaliasot.

"This tradition preserves two important facts, i.e.: (1) That the drainage area of the sources of the Betwa was insufficient to fill the valley through which it flowed and which it was intended to enclose. (2) That the lake thus formed was of unusual size. A study of the local topography and the remains of the works, clearly proves that the engineers of those days undoubtedly understood that the drainage area of the Betwa and its tributaries was insufficient for their purpose, and that they skillfully supplied the deficiency by turning into the Betwa valley the waters of another river, which, rising twenty miles to the west, and flowing naturally outside the hill-enclosed valley, would increase the drainage area by at least five hundred square miles. This was accomplished by the creation of the magnificent cyclopean dam on which stands the old fort of Bhopal, and which previous to the Bhopal dynasty, was covered with finely sculptured Jain temples. From the storage lake thus obtained, a river flowed at right angles to its former course round the hills into the Betwa valley, and became a most valuable feeder to the constructors of the great lake, because it carried the surplus waters of the storage lake into the larger lake for three full months after the close of the rains. This river is the Kaliasot.

"To test the tradition as to the lake's unusual size, emphasised by the local saying, *tal ho to Bhopal tal sab dusre talaya*—"if there be a lake it is Bhopal lake; all others are ponds",—a line of levels was run from the waste weir or ancient outfall to the Bhopal railway levels and thence other lines were projected. These, when plotted on sheets 16, 17 and 26 of the Bhopal-Malwa Topographical Survey Maps, proved that the ancient lake covered the valley to the extent of two hundred and fifty square miles—its bed lying as shewn in the accompanying map—and must have formed the largest, as it did the most beautiful, lake in the peninsula of India, giving one unbroken sheet of water save where islands added to its beauty. It was in places a hundred feet deep; and on all sides it was surrounded by high hills covered with verdure to the water's edge, except at the clearings around the towns that soon sprung up on its shores. A ramble among these, discovers that the wavelets of five hundred years have left their marks, and one is struck by the many inlets and picturesque outer valleys, which, when filled with water, must have appeared almost like separate lakelets and must have been of weird beauty.

"The waste weir, discovered by the writer in one of these rambles, lies buried in almost impenetrable jungle, and is certainly worth a visit. It is a cutting through the solid rock of one of the lower hills on the east side. It is at the blunt apex of a triangular valley, opening from near the great dam, and is probably two miles from it in a direct line. Its position, so far from the dam, affords another

proof of the practical ability of the Hindu engineers of the time; for any error in levels would have quickly destroyed the dam, which though stone-faced on both sides, was filled in by earth, and could not long have withstood an overflow. There are signs on its rocky and unbroken sides which show that high water mark was within six feet of the top.

"The second and lower but longer band already mentioned was thrown across the only other opening of this remarkable valley, and by its construction the Kaliasot was turned off from its course at right angles into the Betwa. It is so covered with jungle that it escaped even the keen eyes of the Topographical Survey Officers. It is constructed in like manner to the other one, but is still unbroken. Its top is used as part of the high road from Bhopal to Kaliakheri.

"Before concluding it is worth noting that the name of Dip, a village on the small hill about half-way between Bhopal and the Narmada, and on the northern borders of the valley—now a station on the Bhopal State Railway,—first attracted my attention to the traditions of the great size of the lake, which had been considered by Europeans to be much exaggerated. If the name meant anything it must mean 'island', being a corruption of the Sanskrit dvipa; and if the hill on which the village stands was an island, then the traditions only testified to what was true. The surveys I have alluded to, prove that the entire hill on which Dip stands really was an island, perhaps two miles in length, and that the northern shore closely touched the hills which alone separated the larger lake from its storage lake—the present lake around the modern city of Bhopal. I am of opinion also that the name of this city is derived in the manner related by Gond tradition, *viz.*, Bhoj-Pal, 'the Pal or band of Raja Bhoj'. And the reason why this band became to recent generations more famed than the great Pal near the city of Bhojpur, is I take it, that the Bhopal Pal, constructed exactly like the others, but immensely broad for its length and heights, became a holy shrine of Buddhist temples, constructed on it a broad top, which temples were all no doubt ruined when the founder of the Bhopal family wanted materials for the construction of the fort and walls of the citadel. The city of Bhojpur probably rose so rapidly, from its salubrious position to importance, that it gave its name to the great lake which really was the cause of its existence." (I.A., Vol. XVII).

XXX. *Almanda tank (circa 11th century A.D.)*—The copper-plate grants registering the grant of land, of the Eastern Ganga King Anantavarman, of the year 304, mention the consecration of a tank. This tank was perhaps near about Almanda, in the Sringavarapukota taluka of the Vizegapatam (Visakhapatanam) district (E.I., Vol. III, p. 20).

XXXI. *Raja-tataka (circa 11th century A.D.)*—The Achyutapuram copper-plate grant of Indravarman of the year 87, which registers the grant of a village to a Brahman, refers that this village was situated near the Rajatataka or 'The King's Tank' the water of which the donee was permitted to utilise. (E.I., Vol. III, p. 127). This grant was made on the occasion of the consecration of a tank, which was considered to be quite an important ceremony.

XXXII. *Sindhuvalli tank (1106-07 A.D.)*—A tank along with a sluice was built at Sindhuvalli in the Mysore district during the rule of the Chola King Kulottunga in the year 1106-07 A.D. (No. 3 of 1895).

XXXIII. *Periyavayakkal-sluice (circa 1219 A.D.)*—The head-sluice of the Periyavayokkal at Musiri in the Trichinopoly district was built of stone during the reign of Chola King Rajaraja III. (No. 70 of 1890).

XXXIV. *Pakhal Lake (Middle of 13th century)*—The Pakhal lake is situated 30 miles north of Warangal and was constructed by Jagadala Mummandi, a son of Bayyana-Nayaka, minister of the Kakatiya king Ganapati, about the middle of the 13th century. (A.R. on Epigraphy, 1902-03, para. 12).

XXXV. *Anantaraja Sagara or Porumamilla tank (1369 A.D.)*—This huge tank was built by Prince Bhaskara *alias* Bhavadura of the 1st Vijayanagara dynasty. It is situated about 2 miles to the east of the village called Porumamilla in the Badvel taluk of Cuddapah District and is elongated in shape, being 7 miles long and 2½ miles wide. The bund consists of four natural hills, connected by 3 short earthen dams, rivetted with Cuddapah slabs. The western flank thus consists of practically the range of hills which runs north and south between Porumamilla and Badvel. The total length of the artificial bund is about 4,500 ft. and total length including hills about 14,000 ft. At the deepest portion the bund is 12 ft. wide at the top and 150 at the bottom and about 33 ft. deep. The tank has two sources of supply,—one natural and the other artificial. The latter was constructed only recently. The natural feeder is a stream called the Maldevi river. The reservoir is provided with four sluices, two of which have been repaired in recent times and provided with screw gear and there are five weirs.

The inscription on two slabs set up in front of the ruined Bhairava temple at Porumamilla throws ample light on the tank building activity of that time. The inscription gives complete details of this tank and place and time of construction. It is also stated that for two years, 1,000 labourers were working daily on the tank and the dam, and 100 carts were engaged in getting stones for walls which formed a part of the masonry work. Besides the author mentions the twelve *Sadhanas* (means) of Porumamilla tank and six *doshas* (defects) of tanks in general.

The following is the translation of the verses and lines giving these *Sadhanas* (means) and *doshas* (defects):—

V. 37. (i) A king endowed with righteousness, rich happy (and) desirous of (acquiring) the permanent wealth of fame, (ii) and Brahmana learned in Hydrology (pathas sastra), (iii) and ground adorned with hard clay, (iv) a river conveying sweet water (and) three *yojanas* distant (from its source), (v) the hill parts of which are in contact with it, (*i.e.* the tank), (vi) between these portions of the hills a dam (built) of a compact-stone wall, not too long (but) firm, (vii) two extremes (srimga) (pointing) away from fruit (giving) land (phala-sthira) outside, (viii) the bed extensive and deep, (ix) and a quarry containing straight and long stones, (x) the neighbouring fields, rich in fruit (and) level, (xi) a water course (*i.e.* sluices)

having strong eddies (bhrama) on account of the position of the mountain (adri-sthana), (xii) a gang of men (skilled in the art of) its construction,— with these twelve essentials an excellent tank is easily attainable on (this) earth.

V. 39. While (i) water oozing (?) from the dam, (ii) saline soil, (iii) (situation) at the boundary of two kingdoms, (iv) elevation (*kurma*) in the middle (of the tank) bed, (v) scanty supply of water and extensive stretch of land (to be irrigated), (vi) and scanty ground and excess of water: (these are) the six faults in this (connection).

This shows that the science of building dams was well advanced in those days.

XXXVI. *Phirangipuram tank (1409-10 A.D.)*—This tank was built near Phirangipuram in the Guntur district by the Reddi princess Suramitra (No. 162 of 1892).

XXXVII. *Haridra dam (1410 A.D.)*—An interesting record, dated 1410 A.D., refers to an irrigation channel, built during the reign of the Vijayanagara king Devaraja I, son of Harihara II. The river Haridra was dammed, by certain Brahmans at their own expense and a channel was also led through the same land. This was within the boundary of a temple. It was laid down that of the land irrigated two-thirds should be for the God and one third for the Brahmans who had financed the construction. Expenses on repairs were also to be met in the same manner; similarly the distribution of water. Sometime after, the dam was breached. This does not seem to have been built in brick and mortar. The Brahmanas were in great distress. The unlimited merit of rebuilding it was explained to a military officer who agreed to defray the expenses. It was accordingly restored in 1424 A.D.

XXXVIII. *Narasambudhi tank (circa 1489 A.D.)*— About 1489 A.D. during the rule or Narasimharaja Maharaja, a valley in the Anantpur district was converted into a tank and named Narasambudhi Tank (710 of 1917).

XXXIX. *Nagalapur tank (circa 1520 A.D.)*—The building of a tank by the Vijayanagar king Krishnaraja with the aid of Joao de la Ponta, a Portuguese engineer, is referred to by Paes, the Portuguese traveller, who stayed at Vijayanagara for some time during the reign of the above king. This tank was to provide irrigation facilities to the fields and supply water to the new city of Nagalpura founded by him. As a result of this great irrigation project, many improvements were made in the city and many rice fields and gardens were brought under cultivation. This is a contemporary account and he says: "The king made a tank there which as it seems to me has the width of a falcon and it is at the mouth of two hills so that all the water that comes from either side or the other collects there; and besides this, water comes to it from more than three leagues by pipes which run along the lower parts of the range outside. This water is brought from a lake which itself overflows into a little river. The tank has three large pillars handsomely carved with figures; these connect above with certain pipes by which they get water when they have to irrigate their gardens and rice fields. In order to make this tank, the said king broke down a hill

which enclosed the ground occupied by the said tank. In the tank I saw so many people at work that there must have been fifteen or twenty thousand men looking like ants so that you cannot see the ground on which they walked, so many there were, this tank the king portioned out among his captains each of whom had the duty of seeing that the people placed under him did their work and that the tank was finished and brought to completion".

Nuniz refers to the same tank and says that "Krishnaraja gave the lands irrigated by the new tank free for nine years in order that the improvements of the land might be completed".

According to Mr. Sewell the tank was built in 1520 A.D. and that it "is the large lake, now dry, to be seen at the north western mouth of the valley entering into the Sandar hills north-west of Hospet, the huge bank of which has been utilised for the conveyance of the high road from Hospet to the southern taluks".

XL. *Korragal and Basaanna Channels (1521 A.D.)*—In 1521 A.D., the Vijayanagara king Krishnaraja built the great channel at Korragal on the Tungabhadra and also the Basavanna channel. These are still in use and of great value to the country (Bellary District Manl., p. 231).

XLI. *Siva Samudra (1531-32 A.D.)*—In 1553 a big tank was formed from the river Arkkavali which serves even today as source of water supply to the Bangalore city. (E.C. IX, N.L. 31).

Canals in Northern India—In the northern India, conditions differ considerably from those in the south. The rivers are rain as well as snow fed and continue to flow throughout the year, though the supply in winter is very much reduced. The country is also more or less plain. Hence the necessity of dams or tanks did not arise. Canals were, however, taken off direct from the rivers for irrigation purposes and flowed for 3 to 4 months during the monsoon season when the rivers were high and ample supplies were available. These canals were called inundation canals and their remnants are still to be seen at many places. Some of them still continue as in the Muzaffargarh and Dera Ghazi Khan districts of the West Punjab and also in Sindh in the Dominion of Pakistan. A large number of them have since been abandoned or partly or wholly incorporated in the existing canal systems. A mention is, however, made here of two important canals built in the Punjab.

XLII. *Old Jumna Canal or Firoze Shah Tughlaq's Canal (end of the 14th century)*—Most valuable of all the public works of Firoze Shah Tughlaq were the canals, one of which, the Old Jumna Canal is still in use. He brought water to his new settlement near about Delhi and at the same time irrigated the intervening tracts. About this canal it is written: "The canal that Sultan Firoze Shah during the time he reigned at Delhi, had made to branch off from the river Jumna, in the vicinity of pargana Khizrabad, whence he brought it in a channel 30 Imperial kos long to the confines of pargana Safidun, which was his hunting seat, and had only a scanty supply of water, had, after the Sultan's death, become in the course of time ruinous. Whilst Shahabud Din Ahmad Khan held the

government of Delhi, during the reign of the Emperor Akbar, he put it in repair and set it flowing again, with a view to fertilize the places in his jagir, and hence it was called Nahr-i-Shahab; but for want of repairs, however, it again stopped flowing. At the time when the sublime attention was turned to the building of this fort and palace, it was commanded that the aforesaid canal from Khizrabad to Safidun should be repaired and a new channel excavated from the latter spot to the regal residence, which also is a distance of 30 Imperial kos. After it was thus prolonged, it was designed the Nahr-i-Bihisht". (Elliot and Dowson, History of India, Vol. VII, p. 86).

XLIII. *Canal from the River Ravi (1627-1656 A.D.)*—Shahjahan revived and extended the irrigation works in northern India, which had been first constructed towards the end of the fourteenth century by Firoz Shah. When the emperor arrived at Lahore towards the close of 1639 he was visited by Ali Mardan Khan, who had been familiar with canal system at Kandahar and suggested tapping the Ravi where it emerged from the hills to water the country as far as Lahore. Ali Mardan Khan's works have been incorporated in the modern systems known as the Bari Duab, the Rohtak and the Western Jumna Canals. (Cambridge History of India, Vol. IV, p. 201).

MAINTENANCE OF WORKS AND DISTRIBUTION OF WATER

The maintenance and repairs of irrigation works are as important as their construction. The tanks, channels, sluices and dams which were not built of brick, stone and mortar, required great care in periodical cleaning to maintain them in good condition. There was danger of the openings getting choked and consequential damage to the work itself. Frequent removal of silt also was most essential. These works had to be repaired after excessive rainfall which damaged the embankments. Maintenance of such beneficial works was considered a meritorious act. A passage in an inscription of 1413 A.D. states: "a ruined family, a breached tank or pond, a fallen kingdom, whosoever restores or repairs a damaged temple, acquires merit fourfold of that which accrued from them at first". (E.C. Vol. VII, Sp. 30).

Details regarding the maintenance and repairs of big dams are not forthcoming. The records are lost. But some information can be gleaned from the inscriptions about the maintenance and repairs of small tanks and canals in the inscriptions of South India.

MAINTENANCE.—Boats were used to remove the silt from dams. An inscription of the year 1367 A.D. mentions how a tank in the Arasikere taluk was maintained. "A buffaloman with his cart was permanently appointed for such work and it was ordered that for oil, wheel, grease, crowbar, pickaxe, etc. every cart load of the original tenants had to pay two taras and likewise every load of arecanut, betel and oranges had to pay at the same rate."

Removal of silt in a tank was made from endowments given specifically for the purpose. For the repair of breaches in tank-bunds and other accidental damages beyond the control of the villagers,

money was often obtained from private or State donation. An inscription states: "According to the command of Udaiyar Devarasa Udaiyar, one Akkadeva made arrangements to have the silt removed once a year from the tank at Tenmahadevamangalam in North Arcot. To meet the expenses a small quantity of paddy on the cultivable land collected from the villagers was used." In another record four carts for one tank and two for another are said to have been kept for putting the earth on the bunds annually and keeping them in good condition. In A.D. 1375 one Yadava-Narayana gave to all the Brahmanas of Laksminarayanapura, the property of those who died without heirs in the village for the maintenance of the tank of the place (E.C. XI, Dev. 70).

A part of the income from dams and canals also was used for their maintenance. The right of fishing was leased to bidders. The income was spent on the maintenance of the dams including their deepening by removing silt.

There were special instructions to a fisherman who was incharge of this work: "He should look after the dam and the channel, so that the water flows to the pond without running to waste, and in case there was any deficiency of water in the dam and the pond, inform the temple authorities and the villagers of this and with the help of the unpaid labourers (vettival) of the village raise the dam and take care of it; that he should receive for this work *ma* of tax-free land (specified), *tuni* and four *nali* of paddy from the cultivated lands of the village and a bundle of unthreshed paddy containing about a *kuruni;* that he should supply the temple authorities with one padi or *kari* every day; that he should pay annually a channel tax (*vaykkal pattam*) of six *panam;* that in place of Pasipattam he should defray the expenses of a festival in the temple; and that in case a large quantity of fish was obtained when removing silt from the pond, he should supply *kari* in addition to the stipulated quantity". (I.C., p. 78).

REPAIRS.—Repairs were never neglected for a long time. In 1396, Mallappa Vadayar, who was a local chieftain, ordered the cleaning of a channel which had been blocked.

The river Kaveri was generally in flood during rains. In 1402-03 A.D., there was very heavy rainfall and the demarcation boundary lines in the lands near Valuvar in the modern Tanjore district were washed away by the floods. The lands fell fallow and tenants abondoned the villages. Immediate action was taken by the rulers who looked into the restoration of the channels and boundary banks and thus rehabilitated the villages. Similarly, in 1422 A.D., the dam constructed on the Haridra by Bukka Raja gave way and Naganna Vodayar, Minister of Deva Raja, got money from Cama Nrpala, the comamdner-in-chief, of the army, and soon restored the breached dam (E.C. XI, Dv. 29). Such instances could be multiplied to show that the state was always prompt in affecting repairs to irrigation works.

MUNICIPAL SUPERVISION.—Local administrative bodies like the village assembly are often mentioned as making provision for the maintenance of irrigational works. Managements of local

temples also looked after their maintenance. In a village in the Mysore district, the local bodies had agreed to keep a cartman for the proper maintenance of the tank, who was like a municipal employee. At times these bodies collected a small local tax called in an inscription as Eri-ayam. This was utilised for maintenance. Fines for certain offences were also used for this purpose. Contributions in kind were often made by the village assemblies. The assembly of Parundur, had agreed to supply 150 kadi of Pancavara paddy for the maintenance of the tank. The interest in the endowments is often mentioned in inscriptions as having been used for this purpose. In cases where no endowments existed or where they were not properly managed and where no priviate individuals were charitable enough to undertake repairs at their expense, the village assemblies could grant some land either near the tank to be repaired or from the waste land of the village, over which they seemed to have enjoyed undisputed ownership, as an inducement to undertake the work. In course of time the cultivable waste of villages must have dwindled down, and in cases where no private enterprise or charity was forthcoming to repair the tanks, it must have been undertaken at the joint expense of the villagers, as they were all to benefit by it. Thus apparently arose the custom of Kudimaramat in southern India. According to the Madras Manual of Administration this term means "contribution of labour for petty repairs to irrigation works, which the ryots are bound to give by immemorial custom. There is a law now for enforcing it or collecting its value". (A.S.I.A.R., 1903-04, p. 211).

Supervision Committees

It would be of interest to know how the maintenance and repairs were supervised. In each village there was a committee for the "supervision of irrigation works". At Uttarmallur in the Chingleput district, there are two inscriptions belonging to the beginning of the 10th century, which furnish full details about the constitution of village assemblies and the mode of selection of members to them. The village assembly consisted of several committees, of which the committee for "supervision of tanks" was one. This body consisted of six members who held office for 360 days and then retired. If any one who served on the committee was guilty of any offence, he was removed at once. The duties entrusted to each of these committees are nowhere clearly laid down. But it may be presumed that all endowments made in favour of tanks were entrusted to the committee for supervision of tanks and the members invested the money endowments in the best possible way. They perhaps utilised the money in reclaiming waste land and cultivating it, in order to pay the interest on the endowment from the produce. They had apparently to look after the cultivation of lands granted to tanks. The income from both these sources was applied to meet the charges for the annual or periodical removal of silt in tanks and for repairs, so far as funds would permit. Fines to be credited to the tank-fund were levied by them.

Private Enterprise

Besides the local bodies, public spirited private individuals willingly offered themselves and took much interest in the main-

tenance of irrigation works. A lady made a gift of gold for a boat, which was perhaps to be used for removing silt. "In the 24th year of Tribhuvanacakravartin Kullottunga-Chola (i.e. apparently the Chola King Kullottunga III), corresponding to 1201-02 A.D., there was a famine in the village and rice was very dear. Two persons built a tank with a sluice at the village out of their private funds, cleared the forest and reclaimed some land. In return for this they got some land apparently as in'am from the temple authorities of Tiruvannamalai. Subsequently one of the donors died and the other became poor. The tank which they built, breached in several places, and the land which they had reclaimed fallow for a long time. The supervisor declared his inability to repair the tank, and appointed a third person to look after it. This person neglected her duties for several years. The heirs of one of the original donors declared they were unable to fill up the breaches in the tank or to build a sluice for it, and renounced their rights over two-thirds of the land granted to them in favour of a number of people, who had to repair the tank at their own expense. There is another instance of a chief who financed the repairs which breached in seven places on the and the same day on account of heavy rains at Somangalam in the Chingleput district in 1189-90 A.D. Next year also the tank overflowed and breaches occurred at two places which were again repaired by the same chief. Next year the bund remained in tact. But for its further security the same donor made an endowment, out of the interest of which the village assembly agreed to carry out the intentions of the donor and deposit a certain specified quantity of earth on the bund annually.

But it appears that such private effort was forthcoming only in cases where the people were put to much hardship for want of proper irrigation facilities, due to the local source having fallen into disrepair. In such cases it was not unusual that the ryots affected by such inconvenience made arrangements among themselves to provide the necessary labour for deepening the river beds or removing the silt.

If more than one person attended to the repairs, the water from the source was enjoyed in proportion to the expenses incurred by the different parties. "Thus according to an inscription of 1410 A.D. the annual repairs and other expenses in connection with the wells and other irrigation sources formed under a channel were shared proportionately and it was agreed that the water of the channel was to be distributed in the same proportion".

State Help

The State also helped private enterprise. "In 1541 A.D. when the residents of Tirumadihalli repaired the breaches in the tank at their village, the Government granted them one khandugga or kattukodaga. Likewise in 1636 A.D. when one Mekalabomma of a particular village in the Kolar District repaired the breaches in the tank in his village he was granted 1/4 parts of the wet lands near the breaches as a dasavanda. (E.C. XI. Bg., 71)."

But as days passed the bonds that kept the village communities intact loosened, the State itself took over the supervision of the maintenance of the irrigation works. Under the Vijayanagara rulers, references are found in epigraphical records to the government making provision for the maintenance of tanks.

DISTRIBUTION OF WATER.—Distribution of water is a difficult problem. The proportion and supply of a turn of water from a particular irrigation source were sought to be amicably and satisfactorily settled in those days. An inscription of Parakesarivarman Uttam Chola, found at Konerirajapuram mentions the following Vyavasthaa, (declaration regarding the grants): "These lands shall (enjoy the privilege of) being irrigated by channels dug out as (per rules) for the distribution of water. Others shall not cut and dig out diversions from these channels nor put up small piccotas, nor bail water by baskets, nor obstruct (the flow) with cross-banks. The water (thus made) available must not be wasted; that water must be economically used". (S.I.I., Vol. III, Pt. III, p. 311).

Again in the Tiruvalangadu plates of the 6th year of Rajendra Chola I, are mentioned the following conditions on the use of water: "(the lands) of this village shall be irrigated by canals dug (proportionately) as per water assigned (from those canals): others (who are not tenants of the devadana lands) shall not be permitted to cut branches from these canals (Karangaru), dam (the passage of water) across, put up small piccottas, or bale (out) water in baskets. The water (thus) assigned shall not be wasted. Such water shall be (appropriately) used for irrigation (after) being regulated. Channels and springs passing across the lands of other villages to irrigate (the lands of) this village shall (be permitted to) flow over the boundary line and to cast up (silt). Channels and springs passing across the lands of this village to irrigate (the lands of) outside villages, shall (also be permitted) to flow over and cast up (silt)". (S.I.I., Vol. III, Pt. III, p. 437).

It was laid down that the cultivators for whom the canal was not intended should not cut open branch channels from it, and canals flowing across other villages to irrigate the lands should be allowed to flow over the boundary line and to cast up the silt. An inscription of 1228 A.D. (No. 90 of 1916) mentions the sale of water and also specifies the method by which the water was to be taken through a breached tank to another for purposes of irrigation.

Mutual Feuds

Feuds and hostilities between adjacent villages or between hostile factions were often responsible for damage to irrigation works. Very often pacts were made not to damage trees, wells and irrigational works. Breach of the agreement was punishable with the confiscation of a portion of the lands of the culprit to the local temple. A damage of this kind was considered as heinous an offence as the destruction of a child in embryo or man-slaughter. The offender was to be drowned by trying a heavy stone round hi sneck.

Feuds between two neighbouring villages arising out of the supply of water are also mentioned. In 1456 A.D. such a quarrel had to be settled amicably in the presence of Mahapradhani Arasar (Tipparasar)

(357 of 1923). During the reign of Vira Narasimhayya Maharaja an agreement was made between the residents of three neighbouring villages Madalinilagam, Silaiyur and Kandidu, in the Chittoor district regarding their respective rights of taking water for irrigation from the channel called Sadaswakona (419 of 1925). At times higher authorities had to interfere if local authorities failed. An apigraph of 1259 A.D. refers to an order from the king Sundara Pandya to the temple authorities prohibiting them from taking water from Idankalikaman for purposes of irrigation. (See 405 and 406 of 1916; see also E.C., IV, N.G. 49).

Another interesting point worth mentioning is that whenever private lands were acquired for constructing irrigation works, the owners were provided with other lands, in compensation (397 of 1909). Also serious consideration was given by the authorities to the objections raised for the acquisition of any land for the construction of any particular work. When a channel was dug near Tirumalai by the authorities, the residents of the locality raised a serious objection to its completion on the ground that it was detrimental to the best interests of the village. The locality in question was therefore inspected by the Sthanattar and Adhikari Vejnarasar and the work was stopped on finding that the objections were legitimate.

ABBREVIATIONS

A.S.I., A.R.—Archaeological Survey of India, Annual Report.

E.C.—Epigraphia Carnatica.

E.I.—Epigraphica Indica.

I.A.—Indian Antiquary.

I.C.—Indian Culture, Vol. XII.

S.I.I.—South Indian Inscriptions.

419 of 1925—Serial number in the epigraphical report of the year mentioned.

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