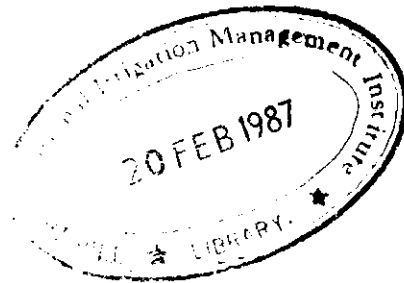


THE HYDRAULIC CIVILIZATION
OF THE ANCIENT RAJARATA
IN SRI LANKA.

A STUDY OF THE ORIGIN AND DEVELOPMENT OF THE IRRIGATION WORKS OF THE DRY-ZONE OF SRI LANKA FROM THE LATTER HALF OF THE FIRST MILLINIUM B.C. TO THE THIRTEENTH CENTURY A.D., WITH ESPECIAL REFERENCE TO THE SCIENCE OF HYDRAULIC ENGINEERING, WATER MANAGEMENT, AND TO THE CULTS AND RITUALS ASSOCIATION WITH IRRIGATION CIVILIZATION.

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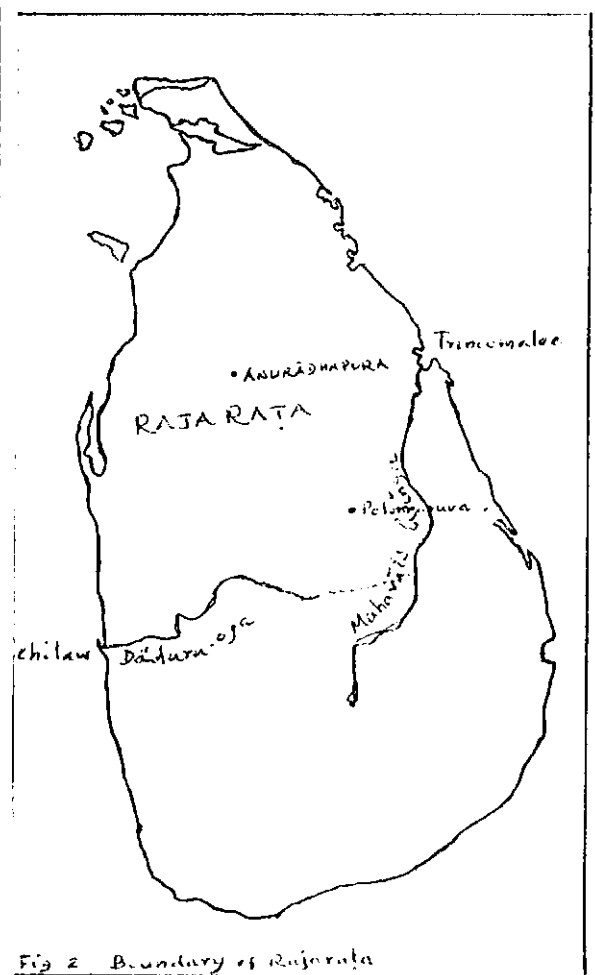
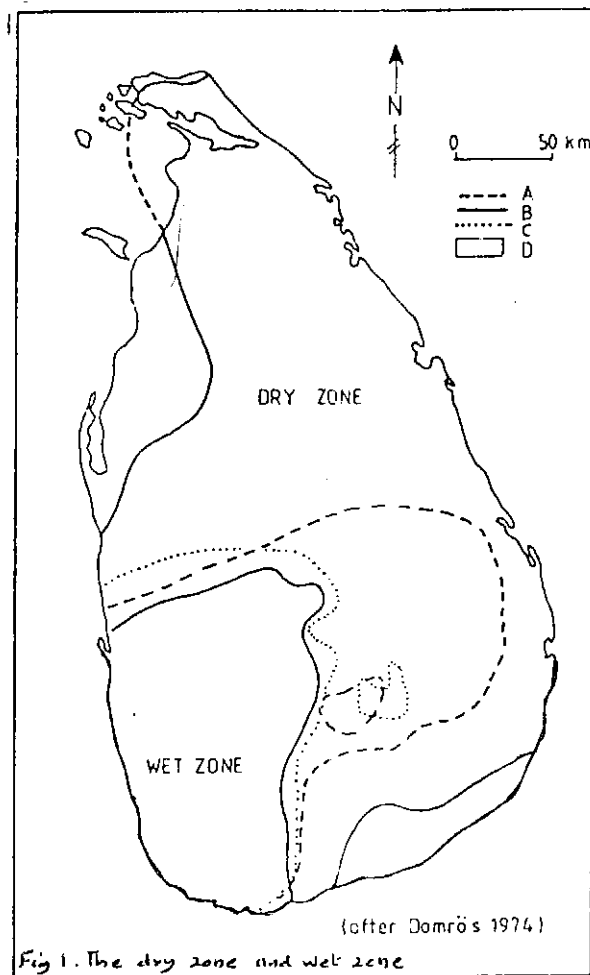
INTRODUCTION

The following discussion on the hydraulic civilization of the Ancient Rajarata in Sri Lanka is based on historical and literary evidences supported by recent research. The word "Rajarata" (Pāli: Rājaratṭa) is used here to denote a territory. Rajarata or Rājaratṭha is not mentioned by that name in the great chronicle Mahāvamsa till the ninth century,¹ but it was historically the earliest principality, the realm of the rulers at Anurādhapura until 161 B.C. when Duṭṭhagāmini Abhaya united the entire island into one Kingdom. Anurādhapura remained the capital of Sri Lanka until the tenth century A.D. Thereafter Polonnaruwa was the capital till the thirteenth century. Sri Lanka was divided into three territorial divisions in the past. The Rohoṇadeśa or Rohaṇa-maṇḍala and Malayadeśa or Malaya-maṇḍala were two principalities which are mentioned from the earliest historical times.² The demarcation of the boundaries of the last two makes it easy to define the boundaries of the

Rajarata principality. Rohana, according to historical documents, comprised all the area to the east of the Mahavali Gaṅga together with the lower Ūva and the Hambantota, Mātara and Galle district with its capital at Mahāgāma (present Tissamahārāma). The Malaya extended over the entire mountain region and its foot-hills.³ The boundary between Rājarat̥ṭha and Rohana was the Mahavali Ganga and between Rājarat̥ṭha and Malaya was the Dāduru-oya.⁴ Thus, the whole area to the north of Dāduru-oya and Mahavali Gaṅga was considered Rajarata till the thirteenth century and thereafter called pihitirata (Pāli: Patit̥ṭha rat̥ṭha). The two capitals in Ancient Sri Lanka, namely, Anurādhapura and Polonnaruva, thus belonged to the ancient territorial division called Rājarat̥ṭha or Rajarata; it is in that wide sense that we use the word "Rajarata" to define our boundaries of the present study on the ancient irrigation works, culture and society from the beginning of its history in the sixth century B.C. up to the thirteenth century A.D. It was mainly in this region that is called the Dry Zone that the irrigation works developed. The reason for limiting this study only up to the thirteenth century is given in detail in the course of the discussion. However, for the present it is relevant to mention here in brief that the Sinhala civilization reached its peak during these several centuries and collapsed thereafter.

The present study of the hydraulic civilization in the ancient Rajarata comprises three parts. The first part deals with the history of the irrigation works of Sri Lanka from the

beginning of recorded history up to the thirteenth century; the second deals with the skills and achievements of the hydraulic engineers in ancient Sri Lanka; the third section is devoted to the study of the culture developed through the hydraulic activities with aspects such as water management, taxation, rules and regulations, water cults and rituals. These items which cover a wide range will ultimately explain how the ancient Sri Lankan civilization established and developed on irrigation. The hydraulic activities coupled with Buddhism produced a unique culture in this beautiful island. The following pages are devoted to that rich legacy.





THE
HISTORY OF IRRIGATION

The traditional history of the Island of Sri Lanka as recorded in the chronicles begins in the sixth century B.C. with the miraculous coincidence of the landing of Prince Vijaya from North India who layed the foundation of the Sinhala "race" on the very day that Gautama Buddha lay dying at Kusināra.⁵ The word "Sinhala" (Pāli: Sīhala; Skt: Simhala) by which name the inhabitants have been known since then, occurs for the first time in the earliest Pāli chronicle, Dīpavamsa, which is assigned to the fourth century A.D. It says there that the inhabitants of the island of Sri Lanka were known as Sīhala on account of the lion.⁶ (Lankādīpo ayam āhu sīhena Sīhalā itī).⁷ Thereafter in many historical writings both here and abroad, we find the word Sihaladīpa applied to the island meaning the land of the Sinhalese.⁸ The Tamil word "Ilām" as found in inscriptions also corresponds to Sīhala and equals with the

Tamil word "Cinkalam".⁹ The great chronicle Mahāvamsa, which is assigned to the sixth century, has the word "Sihala" in two places,¹⁰ and further presents us with a mythical story of the formation of the Sinhala race which, according to several scholars, has its origin in some of the Buddhist Jātaka stories. Perhaps both these sources derive this main theme from a common source which is considered to be a Greek legend.¹¹ However, one is tempted to note that the word Tambapanni, which Ptolemy in the second century referred to as Taprobane, as the earliest recorded name of the island. The people who lived there were called Sinhala.¹² It should be noted that the rulers who followed after King Vijaya happened to be the kinsmen of Buddha; we must not ignore the fact that the early chronicles of Sri Lanka were elaborated by the later writers who described the three visits of Buddha to this island, a belief that was deeply rooted among the faithful Buddhists of this country. During that time the country was supposed to have been inhabited by Nāgas, Yakkhas and Dēvas. It is seen thus that the early history of the island is interwoven with the traditional belief that the Sinhala people came to Sri Lanka from North India and found their firm roots here, that the early Kings themselves were the kinsmen of the Buddha,¹³ and that the people and the country even up to present times were blessed with the sacred task of protecting and nourishing the Buddha's doctrine, a duty that can be performed as long as the Sinhala "race" remain firm in this country. Hence, the connection of the Sinhalese with Buddhism.

The story of Dutthagāmini (2nd century B.C.), the heroic King of Sri Lanka, is a clear instance of this interpretation to justify his action against a King who was a non-Buddhist and a non-Sinhalese. Thus, the idea that this island belonged to the Buddha and the island itself is the island of the true doctrine (Dhammadīpa) was firmly established. Therefore, the story of the island as can be seen and narrated is essentially one of Sinhala-Buddhism. The result of this unique combination ultimately gave rise to a civilization in South Asia which was essentially Sinhala-Buddhist. The aim of this essay is to examine the currents beneath this great flow which is seen to be its hydraulic achievements, the harnessing of the waters by its inhabitants for their sustenance and well-being.

Who the Yaksas and Nāgas said to have lived here before the coming of Vijaya and his retinue to this island of Lanka are, is something that the historians are unable to answer. But it is assumed that they were tribes of people called by those names, or they were so-called because of their "Non-Aryan" identity. Very little research has been done with regard to the pre-history of the island and even the little research which has been done so far has been conducted within an explicit theoretical framework on a vague "hit or miss" basis.¹⁴ Therefore, Lanka's prehistoric culture, as social organisation and religious beliefs are not known for certain except for little information available to us through the few excavations undertaken by the Archaeological Department in the recent past.

Though the Island's traditional history begins from the sixth century B.C. the archaeological and historical evidence of the earliest culture dates back to the 3rd century B.C. the time that Buddhism was first introduced to Sri Lanka during the reign of Dēvānampiyatissa in Anurādhapura, a contemporary of Emperor Asoka in India. One of the few examples left from the pre-Buddhist civilization in Sri Lanka is the reservoir named Abhayavāpi (tank) built by Paṇḍukābhaya in the 4th century B.C. Located in the midst of the city, it covers an area of 205 acres today and known as Basavakkulama (tank). When the first Aryan invaders landed on this island from North India, they brought with them their ancestral knowledge of paddy cultivation since as they were people whose main diet was rice. They also brought with them the knowledge of irrigation and water management.

It is generally believed that the Indo-Aryans, the descendants of the Indo-Europeans entered Northern India by 1500 B.C. through the passes in the Hindu Kush mountains and wandered across the plains of Punjab searching for pastures as they were then a cattle-breeding people. Finally they settled down in small village communities in forest clearings and gradually took to agriculture.¹⁵ To begin with, land was owned in common by the village, but with the decline of tribal units land were divided between the families and thus private properties came into being. As Romila Thapar points out, the agricultural life of the Aryan then led to trade with the clearing of the land eastwards along the Ganges Valley. At the start trade was restricted to local areas but soon extended

beyond the shore.¹⁶ The Aryans had to contend with the indigenous people of Northern India who were of non-Aryan origin and described as Panis (troublesome people) and Dāsas (slaves). The dāsas were held to be inferior because of their darker colour and spoke a different language.¹⁷

The earliest Sri Lankan chronicles credit some of those leading personages who settled down in the North Central Province for the constructing or improving of reservoirs. Land and water became the most important resources for these early 'Aryan' colonists and it is seen that they settled down in the northern Dry Zone where there was ample opportunity for cultivation. As history points out, the people in the microlithic stage of culture whom the Indo-Aryans met in Sri Lanka may have practiced slash-and-burn agriculture, but when they saw the advantages of the methods of food production that the Indo Aryan immigrants introduced, many of them must have given up their food gathering habits and themselves adopted the new methods.¹⁸

As the legendary accounts tell us, most of the early settlers founded villages in places where the rainfall is not very heavy but water was readily available. Tambapanni, on the southern bank of the Aruvi Āru; Anurādhagāma, by the Malvatu Oya; Upatissagāma, on the Kanadarā-oya; Uruvelā, near the mouth of the Kalā-oya; Vijitanagara, close to the Mahavāli Gaṅga; Dīghāyu or Dīghavāpi, on the Gal Oya; and Mahāgāma by the Kirīndi Oya are a few such places. The first tank or reservoir according to these early sources was also built in Anurādhapura.¹⁹ Most of the areas above mentioned belong to the so-called Dry Zone, where the land is generally

flat and found more suited for rice cultivation depending very much on rain.

Conventionally Sri Lanka is divided into two climatic zones, namely: the Dry Zone and Wet Zone. Depending on the annual rainfall the so-called Dry Zone comprised about 60 per cent of the land area covering the upper portion of the island, and receiving 1270-1905 mm of rainfall. The marked seasonality of rainfall creates serious water shortages during certain periods of the year. Therefore, to meet this natural challenge the early colonists developed a system of irrigation reservoirs in this Dry Zone from the early periods of history. The precise demarcation of the Dry Zone of Sri Lanka, however, remained a problem to many scholars dealing with the subject.

We are fortunate to have much evidence based on inscriptional and literary material about the irrigation works of the Island after the 3rd century B.C. and about a few of the works dated before this. This evidence no doubt proves that the early Aryan colonisers possessed a knowledge of both rice cultivation and of irrigation. The legendary personages like Anurādhā and Paṇḍukābhaya mentioned in the Mahāvamsa are credited with the construction of reservoirs in the pre-Buddhist era.²⁰ It is seen that in the 3rd century B.C. a Uparāja or a Viceroy supervised the construction of a small tank.²¹ It was King Dēvānampiyatissa in the same period who built the Tissavāpi (or Tisāvāva as it is called today) in Anurādhapura. There are also a few references to in the inscriptions belonging to the first and second century B.C. where it is mentioned that irrigational tanks belonging to individuals who were then known as parumakhas²² or their

income or the irrigational channel were donated to the community of Sangha (or Buddhist monks) for their maintenance. Thus, the village tank was a well-established feature of the Dry Zone of Sri Lanka during the dawn of the Christian era (1st century B.C.) with a well-settled agricultural population whose beliefs and practices were guided by the teachings of Gautama Buddha. These people who by then established the use of agricultural implements such as the plough for tilling the soil and other iron weapons had two methods of producing the staple diet necessary for their sustenance:

1. cultivation on patches of cleared jungles depending on seasonal rainfall; and
2. regularly worked fields depending on irrigation.

With this knowledge of irrigation, the early settlers built small-scale reservoirs in every village they occupied in order to store the water collected from heavy rainfall during the monsoons. This method helped them to irrigate the rice fields. Thus by the 1st century B.C. the village tanks (reservoirs) was a well-established feature of the Dry Zone which caused Sri Lanka to become the home of one of the most remarkable ancient hydraulic civilizations in monsoon Asia. The origin, development and decay of this civilization is a saga in the annals of man's experience in harnessing water resources for his sustenance.²³

A tank (reservoir) to a village was the main feature of the Dry Zone even early as the beginning of the Christian era. The cultivation of rice furthered the irrigational

development of the country, advancing the technical knowledge of the very early settlers. Thus we have references to weirs (āvarana - mod. Sinhalese ^{මොනුර} Amunadlam) presumably of stone, across small streams, canals (adi, ali) and reservoirs (vavi, vapi).²⁴ Historical evidence prove beyond doubt that during this period (1st century B.C.) the irrigational methods practised by the people were of two kinds.

1. Small, permanent, stone dams across streams, and temporary dams probably of timber and clay at suitable sites across rivers to divert their water into channels which conveyed the water to the irrigable area; and

2. Village tanks directly irrigating the fields below their embankments.²⁵

The building of large sized reservoirs was not attempted but confined to small-scale village tanks. These were mostly owned by private people who were designated as Varihamika, lord of the lake and further belonged to the noble class called Parumakas. These people held an important place in the social life of early Sri Lanka. The word parumaka used as a title is found in a large number of early Brahmi inscriptions of the island. This word is believed to be derived from the Sanskrit word paramukha, Pāli pamukha and the Tamil perumakan. The late S. Paranavitana, the well-known Sri Lankan historian and archaeologist believed that the term parumukha occurring in the Pāli literature refers to a president of a guild or corporation during the 6th century B.C. in India and they belonged to the nobility.²⁶ Among the early settlers in Sri Lanka were the parumakas and they too

held high positions in the district administration. They were also landlords and owners of reservoirs,²⁷ and socially they were immediately below the royalty. Another category of chiefs known as gamikas are also mentioned in our early inscriptional records who also enjoyed high positions in the administration. They were also a group of nobles. The Gramanayas, who were Indo-Aryan village headmen during the 6th century B.C. in Indian history must have immigrated to Sri Lanka along with the parumakha group and established settlement under the rule of chiefs called gāmani or gamikas.²⁸ The parumaka class, on the other hand, must have been "the descendants of the same Indo-Aryan princes who established village settlements in various parts of the island in the early period of its colonization by the immigrants from North India and played a vital role in introducing a settled agricultural life and the elements of Indo-Aryan culture."²⁹ According to Paranavitana "it was the parumakas who provided the leadership in the country, began irrigation, trade, supported Buddhism, built stūpas, donated caves for the spiritual life and in short it was they who "laid the foundation for the economic, political, religious and cultural institutions".³⁰

The development of the Dry Zone with Anuradhapura as the political centre drew much attention from the population living outside. The result of this was the migration of a large population to the area under development for settlement. Thus, we see by the beginning of the 1st century B.C. a shift towards major development in the field of hydraulic engineer-

ing. The Mīnvila rock inscription mentions a canal built by Kutakaṇṇatissa (44-22 B.C.).³¹ This King is also credited with building the Balaluvāva in the Kalāvāva basin. The years immediately following were more fruitful, because the reign of King Vasabha (65-109 A.D.) marks the first step in the advance from the village tank to major reservoirs. This King is credited in the Mahāvamsa for building eleven reservoirs in addition to twelve canals.³² Mahā- and Kuḍā Vilachchiya, in Anurādhapura, Mānankāṭiya in Kekirāva, Nochchiyapatāna in Manampīṭiya and Akvaḍunna close to Habarana are some of the tanks built by Vasabha that can be identified today. These reservoirs cannot be called "large" though they were built on improved technology when compared to the earlier ones. But Ālisāra canal which is known today as Ālahāra-yōda-āla is the only canal mentioned by name.³³ This canal diverted the water of the Āmban Gaṅga at Ālahāra. The construction of a weir across this river, which is the main tributary of the Mahavāli, was a major technical feat³⁴ and the canal itself irrigated a large area downstream and probably emptied into the Kiri Oya. As the historians point out "the construction of a canal of this considerable length meant thatⁱⁿ the 1st century the Sinhalese had developed a high degree of instrumental accuracy in contouring and levelling, and had achieved success in building permanent stone dams across large rivers."³⁵ The shares of the revenues from the canal were donated by King Vasabha to a monastery in the Tissavaddamānaka district the area around the Kamdulla tank, which is about six miles north of Minnēriya.

It is this same canal that we see two centuries later becoming the feeder canal of the great Minnēri Tank built by King Mahasen. It was his Engineers who are also further credited with introducing an underground pipeline instead of the surface water flow when they conducted water to the King's bathing tanks at Anurādhapura.

Not long after this period we see irrigational tanks or reservoirs being categorised depending on their size and locality. We see from the Jētavanārāma Inscription of King Malutisa, identified as Kaniṭṭha Tissa (167-186 A.D.), that during his time there were three different categories of tanks, namely: 1. Gamikavavi - village tanks, 2. Mahavavi - (large tanks) and 3. Danavavi - (feeder tanks)³⁶ the last probably would have been large storage reservoirs from which the small tanks would have drawn their water through canals. We are fortunate enough to inherit a vast knowledge of the then existed irrigational channels and reservoirs which could be numbered to about two hundred during the period between the 1st and 3rd centuries in the Dry Zone areas in the north alone. With the new irrigation systems developing gradually in the area, paddy cultivation would have taken a prime place in the country and a large population would have been drawn to the Rajarāṭa plains or to the land of the Anurādhapura Kingdom.

An event of great significance in the early history of Buddhism and irrigation in Sri Lanka was the reign of King Mahāsēna (Mahasen) in the 3rd century (275-301 A.D.) at Anurādhapura. During his twenty-five years of rule, the

country was able to produce the largest reservoir and the tallest stūpa.

The great chronicle assigns sixteen tanks (reservoirs) and one great canal to the reign of Mahasen. Praising the victories of this great^{King}, the Mahāvamsa says:

"To make (the land) more fertile, he made sixteen tanks, the Manihira, the Mahāgama, the Challūra and the (tank) named Khānu, the Mahāmaṇi, the Kokavāta and the Dharmaramma - tank, the Kumbālaka and the Vāhana, besides the Rattamālakanda, the tank Tissavaddhamānaka, that of Velāṅgaviṭṭhi, that of Mahāgallaka, the Cira tank and the Mahādāragallaka and the Kālapāsāna tank. These are the sixteen tanks. On the Ganga he built the great canal named Pabbatanta".³⁷

The Manihirivāpi is identified as Minnēri tank which submerged 4670 acres of land and covered an area of about thirty-nine square kilometres. C.W. Nicholas commenting on the rest of the reservoirs mentioned above says:

"The existing Ālisāra (Ālahāra) canal was used as the basis of the Minnēri scheme, but the dam at the headworks and the canal had to be enlarged to divert and carry a much greater volume of water than hitherto in order to fill the great, new reservoir. The length of the enlarged and extended canal from the dam to the tank was 25½ miles. Tissavaddhamānakavāpi, called Rantisāvāva in inscriptions, and correctly identified

Codrington with the present Kavudulu tank, was also a work of Mahāsēna and nearly as large as Minnēri tank. It held up the Kavudulu oya, but it also received a supplementary supply from a canal about 6 miles long which issued from Minnēri tank. Other colossal reservoirs built by Mahāsena were Challūravāpi or Surullāvāva, present Huruluvāva on the Yān Oya; Khānuvāpi, synonymous with Kānavāpi, Kaṇāvāva and Kanādiyadora, now the large, breached reservoir across the Kaṇadarā Oya near Mihintale known as Mahakaṇadarāvāva; and Mahādāragallavāpi; probably to be identified with the breached tank now called Mahagalkaḍavala to the north of Anurādhapura. Eight of the sixteen tanks ascribed to Mahāsena can be identified with certainty, four with some degree of doubt. Whether all these great undertakings were commenced as well as completed during Mahasena's reign of 27 years is open to question, but it cannot be doubted that at whatever earlier period some of the works were designed and construction was commenced, completion was achieved in Mahāsēna's reign. The great Pabbatanta canal on the Gaṅgā (Mahavāli Gaṅga) probably flowed eastward past Dhūmarakkhapubbata (Diṃbulāgala or Gunner's Quoin), a distance of over 20 miles. The Ālahāra-Minnēri-Kavudulu scheme completed in Mahāsēna's reign was an epoch-making event in the history of irrigation in Ceylon and its

subsequent, successful operation to the great benefit of his subjects inspired them to deify him as Hat-rajuruvo, the god of Minnēri".³⁸

Scholars are not unanimous on this identification by C.W. Nicholas about ancient reservoirs. For example, there is the recent argument on the identification of the Māduru-oya reservoir in the Polonnaruva district as the ancient Mahādārāgallavāpi built by Mahāsen.³⁹ The Sinhalese literary work of the 13th century the Pūjāvāliya credits Mahāsen with eighteen reservoirs.⁴⁰ The Minnēri tank, as it existed about fifty years ago, had a capability of irrigating more than 4450 hectares of rice fields.⁴¹ It is also important to note that some of the above mentioned reservoirs such as Kanādarā, Ratmale and Māminiya are located in the Malvatu Oya basin and the Hurulu Karambakulam reservoirs in the immediate neighbourhood. This is in addition to the already existing reservoirs namely Tissa, Basavakkulama and Mahagalkaḍavala. This means that the area surrounding the capital city was brought under development due to the growth of population in the area. Prior to this period, droughts and shortages of food are recorded in the reign of several Kings such as Vaṭṭagāmaṇi (103-89 B.C.), Kuñcanāga (194-95 B.C.) Sanghabodhi (251-253 A.D.).⁴² The north east of the Island had three huge reservoirs, namely: Minnēri, Kavudulla and Ana-ulundāva. To this list of names can be added Tōpā reservoir at Polonnaruva which was built during the reign of Upatissa I (365-406 A.D.). In the surrounding areas of Anurādhapura city there appeared the Kanādarā tank which impounded the tributary of the Malvatu Oya and on the east,

the Hurulu tank which was fed by the waters of the Yan Oya. The greatest of all in the area was the greatest reservoir constructed by King Dhātusēna (459-477 A.D.) a dependable and permanent supply of water for the fields. Having constructed the Kālāvāpi presently known as Kalāvāva, he further connected it with Tissavāpi (Tissāvāva) in Anurādhapura by a canal called Yōda āḷa (Jaya Gaṅga), eighty-seven kilometres in length and developed both irrigation and agriculture in the North Western and North Central regions.

Dhātusena liberated Sri Lanka from the Tamil invaders in 473 A.D. after twenty-six years of their rule and concentrated on the agricultural development of the Dry Zone giving priority to irrigational works. We have here historical evidence to prove that the Kalāvāva may have been as a small village tank which existed prior to Dhātusēna. An inscription dated back to the 1st century discovered at Aukana in the vicinity of the present Kalāvāva reservoir marked No. 1151 in the Inscription of Ceylon has the following lines:

Kadapi vapi hamika parumaka UvahaJanakaha lene.

The meaning of it is given as "the cave of the chief UvahaJanaka, proprietor of the tank Kadapi". Paranavitana believes that the word "Kadapi" is derived from the Pāli Kālāvāpi. He says that "as early as the beginning of the Christian era there was in the vicinity of modern Avukana, an irrigation work which bore as its name, the old Sinhalese equivalent of Kalāvāva and the ancient Kalāvāva would have

been a small tank absorbed in the great reservoir that you see today and built by King Dhātusēna.⁴³

The Cūlavamsa also mentions the construction of a weir across the Mahavāli Gaṅga - one of the greatest technical achievements of the time.⁴⁴ The harnessing of the waters of the Kalā-oya (Goṇanadī) to supplement the supply of water to Anurādhapura was another prestigious accomplishment. Dhātusēna also dammed the Mahavāli Gaṅga and created fields which were permanently watered. The Mānāmatta tank presently known as Yōda vāva or Giant's tank and Pānankulam (tank) in the Mannar district are assigned to King Dhātusēna by the author of the Sinhala literary work Pūjāvāliya written in the 13th century. The water necessary for the Yōdavāva was supplied by a seventeen mile long canal which began at a dam across the Aruvi Āru (Malvatu Oya). The Sangamuvāva and the Mahaluvāva attributed to Dhātusēna are identified today as Māddēkātiya and Mā-eliya tanks in the Kurunegala district. Thus, it is seen that during this important period in the history of Sri Lanka the Dry Zone of Rajarata had begun to grow as an area of agricultural product, as a centre of political administration and as a religious centre for the devoted Buddhists in the country. The North Central and the North Western areas have become a vast stretch of paddy fields due to the efficient irrigational facilities provided by the ruling Kings through their harnessing the waters of Kalā-oya in the North-West and Malvatu-oya in the North-Central.

The reservoirs built after the 3rd century had a greater capacity to store water and the irrigation system itself was developed at this time that the farmers in certain areas could collect their harvest thrice a year.⁴⁵ This fact is further supported by Cūlavamsa when it uses the word thirodake to mean the lakes were filled with water.⁴⁶ The engineering skills of the ancient architects of the Sri Lankan irrigation system at this time had reached its peak. We will discuss some of the special features later in this essay. With the advancement of irrigation activities of ancient Sri Lanka, especially in the Rajarāṭa, we see from the pages of chronicles and in later literature supported by inscriptional evidence that more and more Kings joined their predecessors in the development project. It was felt an important duty of the King to see that people were supplied with sufficient water to cultivate their crops and the failure to do so was met with threat of giving up the crown.

The reign of Moggallāna II (531-551 A.D.) was another period of great significance. He dammed the Malvatu Oya and built three reservoirs of which the present Nāccadūva, seven miles south of Anurādhapura, is one. This large reservoir submerged 4,408 acres of land. The supply of water to this tank was supplemented by a canal six miles long and branched off from the Jaya Gaṅga constructed by Dhātusēna.

Somewhere at this time another canal about five miles was constructed to bring the waters from Nāccadiva to Nuvaravava in Anurādhapura, a reservoir probably has been built by Gajabāhu I (114-136 A.D.) and called Nakaravavi.⁴⁷

This and Tisṣāvāva seem to have been augmentation schemes that supplied water to the city of Anurādhapura during those peak days of the Rājaraṭa civilization (5th - 6th centuries). From Nuvaravāva a canal was also constructed for nine miles to bring the water to Mahagalkaḍavala.

The Cūlavamsa has given credit to Moggalana II for building a tank named Dhanavāpi by building a weir about six kilometres in length across the Mā-Oya.⁴⁸ Paranavitana has identified this as the Padaviya reservoir which has a capacity of about eighty-four million cm and covers an area of about 2,428 hectares. Thus we see the birth of Nuvarakalāviya, a name attributed to the Anurādhapura and Polonnaruwa areas symbolising the three great reservoirs: Nuvara, Kalā and Padaviya (tanks). The area was also called Vāv bāṇḍi rājjē or the "Kingdom of tanks" by the people because they saw tanks in almost every village in the



Rajarata.

Two more kings bearing the same name Aggabodhi (I and II) ruling from the Anurādhapura capital, the first King from 571-604 A.D. and the other from 604-614 A.D.) saw the further development of the irrigational activities in the country. A continuous period of nearly fifty years of rule was able to usher a new era of prosperity and development which unfortunately began to fade away thereafter due to internal and external warfare that ultimately resulted in the downfall of the Anurādhapura Kingdom during the 10th century. Among the notable contribution by Aggabodhi I, were the Kurundavāpi identified as modern Tannimurippukulam (tank) near the ancient Kurunda Vihāra in the Mullaitivu District. 2. The Maṇimekhalā (Minipe) dam on the Mahavāli Gaṅga which gave rise to the Minipe canal seventeen miles in length (extended in the 9th century) and 3. The great canal leading out of Minneri Tank.

Aggabodhi II is credited by the author of Cūlavamsa with constructing two great reservoirs in the north-east, namely Giritatavāpi or Giritale and the other Gangātataṅgavāpi or Kantale.⁴⁹ Cūlavamsa, Pūjāvalī and Rājāvalī have given him credit for building three, twelve and thirteen reservoirs respectively but for the present we are concerned only with the above two. The Giritale tank is situated between Minneriya and Polonnaruva. The most important is the Kantale tank with an area of 3,263 acres and fed by the

Minnēri tank through the extended Ālahāra canal twenty-nine miles long and built by Aggabodhi I. His successor, Aggabodhi II, was the nephew of the former. It was Aggabodhi I who "planned this project and the feeder canal constructed" but this good work was continued by building the much needed Kantale tank by his successor, a lesson that should be taken by all the modern politicians for the well-being of the people. Kantale is now one of the largest irrigational reservoirs in Sri Lanka. With its fifty-two feet six inches high embankment, this reservoir has become Sri Lanka's tallest reservoir. It is not surprising at all at this stage to see similarly large stupas and colossal Buddha images rising from the earth to speak of the multiple skills of the Sinhalese.

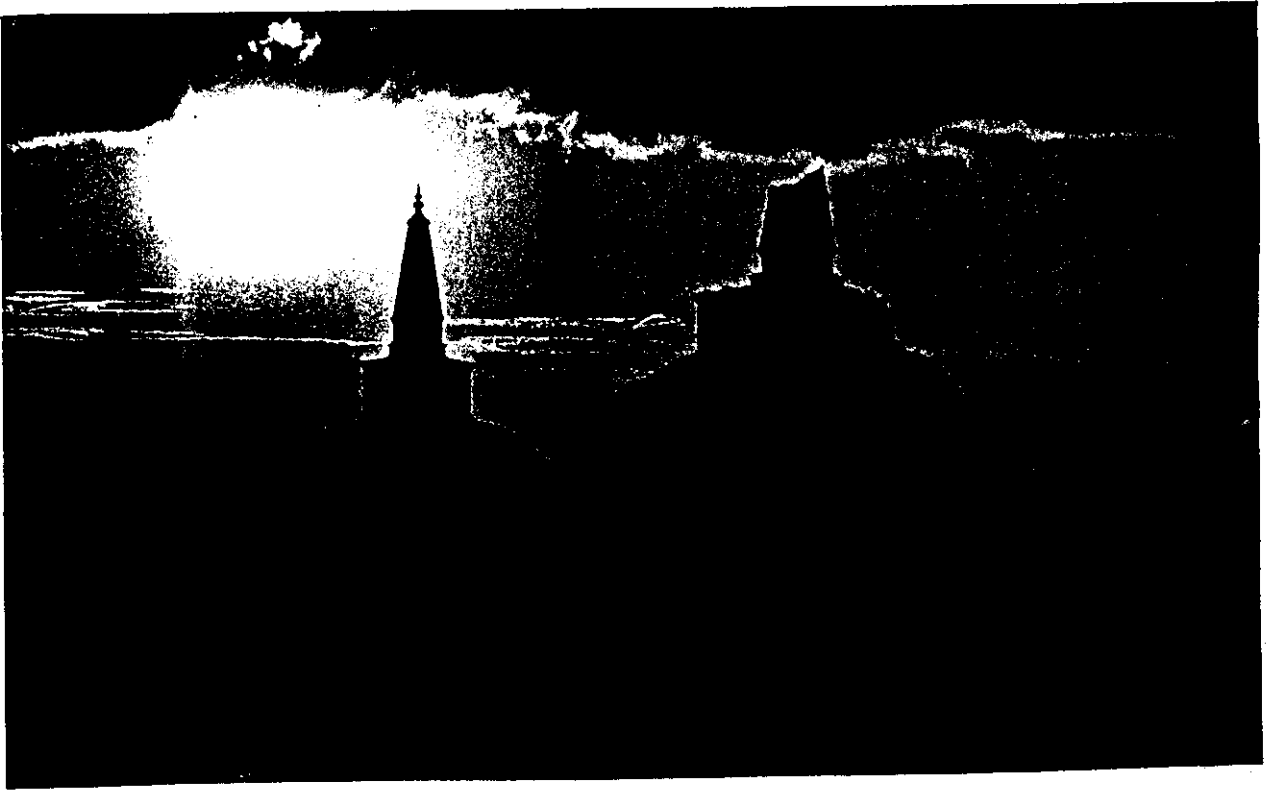
The Ālahāra canal has now become the major life stream of the area. The length of this canal from the Alahara dam on the Āmbangaṅga through the Minneri tank, to the Kantale tank is $54\frac{1}{2}$ miles,⁵⁰ the exact length of the Jaya Ganga from Kalāvāva to Tissāvāva. The Giritale tank is also fed by a branch, $4\frac{1}{2}$ miles in length, of the Ālahāra canal. Commenting on the recent development of the irrigational projects and the work of Aggabodhi II the History of Ceylon says:

"The extension of the Ālahāra-Minnēri Kavudulu scheme of Mahāsēna to include the new tanks, Kantale and Giritale, involved a prolongation of the length of canal by a further 35 miles and made necessary a substantial increase in the supply of water; this

additional supply was found by the construction of the Hottota-amuna dam on the Kalu Ganga, the main tributary of the Āmban Gaṅga, and a canal 28 miles long which carried the water diverted by the dam and discharged it into the Amban Ganga just above the Alahara dam. Had the reign of Aggabodhi II not been a short one, it is possible that he might have rivalled Mahāsēna and Dhātusēna in his accomplishments".⁵¹

By the 7th century the Sinhalese Engineers showed the world their high technical knowledge and skills of tank building and irrigation by constructing massive reservoirs and irrigational canals. But, unfortunately, the civil war that lasted more than half a century from 620 A.D. was a major set back to progress in agriculture and irrigation. The development of irrigation up to now in the two areas, one in the North Central and the other in the North East of the island, provided sustenance for a large population with the opening up of vast extends of land for cultivation and bringing in abundant harvest signifying the prosperity of the country.

The Mahāthūpa or Ruvanvāli Dāgāba in Anurādhapura, which was built and completed by the great Sinhala hero King Dutugāmuṇu in the 2nd century B.C., was of gigantic proportions, originally being 294 feet in diameter at the base, and nearly 300 feet in height. It was built of solid brick masonry.⁵² King Vaṭṭagāmiṇi Abhaya in the 1st century built another stupa called Uttara Cētiya or Abhayagiri Dāgāba



which was enlarged by Gajabāhu I in the 2nd Century to a diameter of 325 feet at the base and reached a height of 350 feet.⁵³ Mahāsēna, a man of inexhaustible energy who built the Minneri reservoir in the 3rd century, has the honour of building the largest Stūpa in Anurādhapura and perhaps one of the largest monuments in the world - the Jētavana Dāgāba with a diameter of 367 feet at its base and a height of about 400 feet.⁵⁴ Built of burnt brick, the weight of the Stupa is now calculated to have been approximately 1,213,000 tons with an average distributory load of 92 pounds per square inch. As the centuries passed by the colossal stūpas, the symbols of Buddhist devotion, thus grew in size

just as the reservoirs the symbols of abundant harvest and prosperity were enlarged. The resources of the Kings and people were plentiful for all. There was complete political control, there was harmony in the country in order to achieve this magnificent development. The appearance of the Buddha figure in stone in Sri Lanka for the first time after the 2nd Century A.D. is another important event. In course of time these images too attained colossal proportions. The Aukana colossal Buddha image, which ^{the writer} believes as the work of Dhātusēna, and the Māligāvela Buddha statue, probably a work of Aggabodhi, are undoubtedly great masterpieces. The Samādhi Buddha statues of great artistic value found in Anurādhapura too are magnificent products of a great civilization based on agriculture and irrigation.

The Cūlavamsa has a fascinating story about King Dhātusēna. When asked by his son Kāsyapa (who built the magnificent palace on the rock of Sigiriya) to identify his treasures, he, as a prisoner, requested that he be led to the vast reservoir of Kalāvāva. Dhātusēna thought it well to bathe in the Kalāvāva which he built and then die at the merciless hands of the assassins. Then the King betook himself to the tank, plunged as he liked therein, bathed and drank and spoke to the king's henchman. "This here, my friend, is my whole wealth" (pointing to the reservoir) (ettakamme dhanam bhoti). Kasyapa having heard this and filled with fury commanded to slay his father.⁵⁵

This description though one could argue as legendary is interesting for it shows the value attached to the reservoirs built by the ancient Kings. To King Dhātusēna there was no other treasure comparable to Kalāvāva. This is quite so when one compares the above statement with the words uttered by Kadavara who guarded the water of the Kalavāra before it was built and proclaimed that it is the only treasure he knew.⁵⁶

Rice was grown in such huge quantities that after the local demands had been met, the surplus was exported. This is quite evident from a reference in one of the early Tamil literary works belonging to the 2nd century A.D. named Pattuppāṭṭu where it is said that merchandise brought by ships to Kāvēripaṭṭanam included rice from Sri Lanka.⁵⁷ The demographic expansion in the Polonnaruva area after the 5th century with Sīgiriya as the capital of Kāsyapa (437 - 491 A.D.) and an alternative residence of the Kings with a large number of reservoirs being built around the area points towards the emergence of new economic and political forces which changed the demographic pattern and the cultural landscape of the island.⁵⁸

These achievements accomplished by the 7th century were destroyed thereafter. Though history describes the following three centuries as a "period of affluence and progress", Sri Lanka was invaded four times but was sufficiently strong enough to resist three of these attempts to conquer them and to counter invade South India on two occasions.⁵⁹ We cannot have any hopes for any development

under these conditions. The chronicles nor the inscriptions speak of irrigational development during this period of 'war and peace' except for repairs to irrigational damages. We have references in the chronicles to the strengthening of the weir of Kalāvāva by Mahinda II (777-797 A.D.), the lengthening of the Minipē canal by Sena II (853-887 A.D.) up to forty-seven miles and general restoration, repairs to the decayed bunds of all major reservoirs and large canals.⁶⁰ References to famine and scarcity of food are found in the inscriptions of Kassapa V (914-923 A.D.) and Mahinda IV (956-972 A.D.), the results of the major breakdown of the irrigation system. The 'repairs' or 'restoration' mentioned above undoubtedly refers to the damages caused to the irrigation system as a result of civil war and foreign conquest.

The Cōlas invaded Sri Lanka and ^{took} the Sinhalese King Mahinda V (982-1029 A.D.) in captivity. He died later on. Then the country ^{was} submitted to the invaders. But the Sinhalese warriors of the Southern Rohana kept on fighting the battle with the Cōlas. This war lasted for nearly twenty-five years but the Sinhalese emerged victorious at last with the ascending to the throne of Vijayabāhu I (1055-1110 A.D.). By this time, the capital of Sri Lanka had shifted to Polonnaruva from Anurādhapura after a decade of more than sixteen centuries.

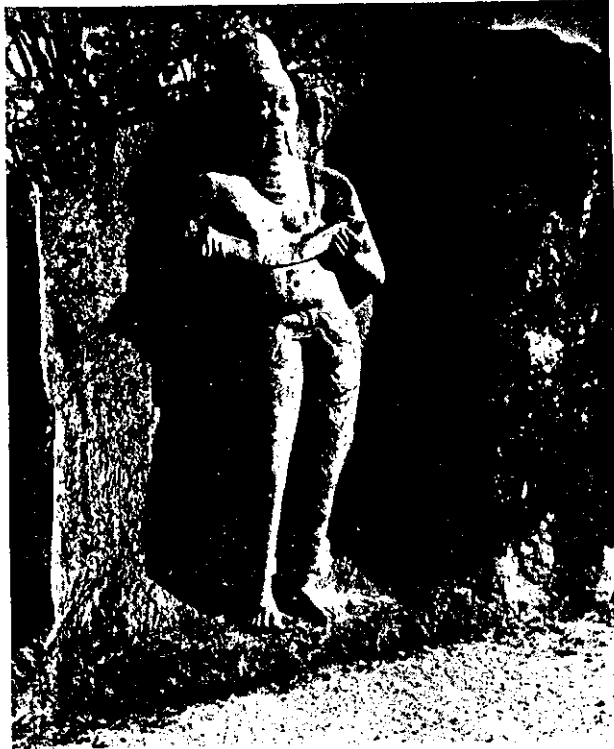
From the 7th century onwards Polonnaruva gained importance and several Kings lived there in their last days including Sēna V. This new city gained its importance in the 9th century and 10th century, due to two reasons,

namely: 1. it was a place of defence and strategy and
2. it was an area which has developed ⁱⁿ irrigation and
agriculture. The adoption of Polonnaruva as the chief
royal capital was the immediate result of the Tamil
invasions of the 10th and 11th centuries.⁶¹ The
Anurādhapura period came to an end in 993 A.D. with the
invasion of its capital.

The Cūlavamsa says that when Vijayabāhu ascended the
throne, he restored the many reservoirs and and canals which
had breached.⁶² One of the major repairs was the breached
portion of the 'Alahara canal that brought water to the
Minnēriya reservoir. This way he was able to keep the
Minneri, Kaudulla and the Kantale tanks alive. He also
restored Mahakanadarā, Nāccādūva, Māduru-oya and
Mahamadagala. This 'peace' did not last long for immediately
after the death of Vijayabāhu I in 1110 A.D. there was again
civil war in the country. This time the author of Cūlavamsa
did not fail to describe the damage of this internal warfare.
He writes that "both sides of enemies pierced tanks filled
with water, by destroying everywhere the weirs on all the
lands" and devastated the Kingdom, that it was impossible to
trace even the sites of the villages.⁶³

After years of fighting which resulted in disaster, we
see the ascending of Parakramabāhu I to the throne in
1153 A.D. at Polonnaruva. He ruled till 1186. He was
perhaps the greatest of the Polonnaruva Kings. The chronicle
puts on record a utterance he made while developing his
principality as a Prince. It says that "not even a little

water that comes from rain must flow into the ocean without being made useful to man".⁶⁴ In the Dry Zone his first major undertaking was to harness the waters of Jajjaranadi (Dāduru Oya) and so he built three dams at three different points for three irrigation schemes, namely, Kotthabaddha, Māgallavāva in Nikavāraṭiya, and Talagallavāva



about four miles east of the Dāduru-Oya. Having completed the irrigational projects on the Dāduru-Oya in the Western Province, his attention was focussed on Paṇḍuvas nuvara near Hettipola. He enlarged the ancient Paṇḍavāpi or Paṇḍavāva and called it the Parakkāmasamudda, the sea of Parākrama. The chronicle Cūlavamsa states that he restored or improved fifty-three irrigational projects as a Prince. Thirty-seven of them are mentioned by name. Almost all these irrigational projects which were reservoirs are situated in the Kurunāgala District in the North Western Province. Some

of them must have been built for flood control and not necessarily for irrigation.⁶⁵

After Parākramabāhu became King at Polonnaruva, the chronicle says that he carried out the following works or irrigational projects:

Nature of the Work	Number
1. Anicuts constructed or restored	165
2. Canals constructed or restored	3,910
3. Major tanks constructed or restored	163
4. Minor tanks constructed or restored	2,376
5. Stone sluices constructed or restored	341
6. Breaches repaired	1,753

66

Among the contribution to the development of irrigation and agriculture, the Parākramasamudra of Polonnaruva ranks first and is given a pride of place in the description of this King in the chronicle. This great reservoir was built by damming the Kāra gaṅgā identified as the Āmban gaṅga by placing a great dam between the hills at a site now called Āṅgamādilla and bringing its mighty flood of water hither by means of a vast canal called the Ākāsa Gaṅgā now identified as the Āṅgamādilla channel.⁶⁷ It also received a supplementary supply of water by canal from Giritalāvāva "through two intervening tanks and this link with Giritale tank united two gigantic irrigation systems both originating in the Āmban Gaṅga, the older system with headworks at Hottota and including Minneri, Giritale, Kavudulu and Kantale tanks, and the later

system system with headworks at Aṅgamādilla and including Parakramasamudra and the network of channel and smaller tanks under it".⁶⁸ The Hattota Amuna situated thirty miles north of Ālahāra was so important that according to tradition it was the source of the Minnēriya-Giritale-Kantale irrigation system and a subsidiary source for the Parākramasamudra.⁶⁹

The bund of Parākramasamudra at Polonnaruva as now restored is 8½ miles long and 40 feet in height and the area covered is 5,350 acres. It is worthwhile to note that this great reservoir built by Parākramabāhu I absorbed within it two earlier tanks, namely, the Topā and the Dīmbutulu. Topāvava was supposed to have been built by Upatissa I (365-406 A.D.)⁷⁰ and covered an area considerably over a thousand acres.⁷¹ The Cūlavamsa further gives us the names of seven sluices on this great reservoir and eleven channels which led water away from it.⁷²

The other tanks namely Parākkamatalāka and Parākkamasāgara, otherwise called Matisāgara are mentioned as the work of this great King. The Matisāgara must have been situated close to Minnēri Oya and was probably fed by the Godāvayī canal, the water way which is traceable 24 miles north as a continuation of the Ākāsa Gaṅgā. The Parakkamatalāka is not yet identified or traced.

In addition to the eleven channels issued by the Parākramasamudra, the chronicle also mentions of twenty-seven other canals supposed to have been constructed by Parākramabāhu the Great. It is evident from Pūjāvāliya that

one was from a dam across the Mahavāli Gaṅga at a place now known as Kālinganuvara, the Kālinga-yoda āla which was then known as Aciravati flowed west and north and terminated beyond the Minneri Oya.⁷³ Another canal known as Gomati flowed eastward past Diṃbulāgala for 21 miles and probably must have ended up in filling the Māduru-oya.

Among the major irrigational works in the ancient Rajarata restored by Parākramabāhu the Great and mentioned in the chronicle are Minneri tank, Māduru-oya, Tissavaddhamānakavāpi, Kavudulu tank, Kalāvāva and its 54 mile long canal, Jaya Gaṅga, Mahakanadarā tank, Padaviya, Nāccadūva, Yōda Vāva, Valaskāṭiya vāva, Angamu tank.⁷⁴

As estimated by C.W. Nicholas, the principal irrigation works that existed before the time of Parākramabāhu the Great and continued to function along with those which he built, the total length of the canals taken off the main rivers would have been in the 12th century as follows:

Mahavāli Gaṅga	130 miles (approximately)		
Āmban Gaṅga	195	"	"
Kalā Oya and Modaragam Āru	180	"	"
Malvatu Oya	80	"	"
Yān Oya	15	"	"
TOTAL	600	"	"

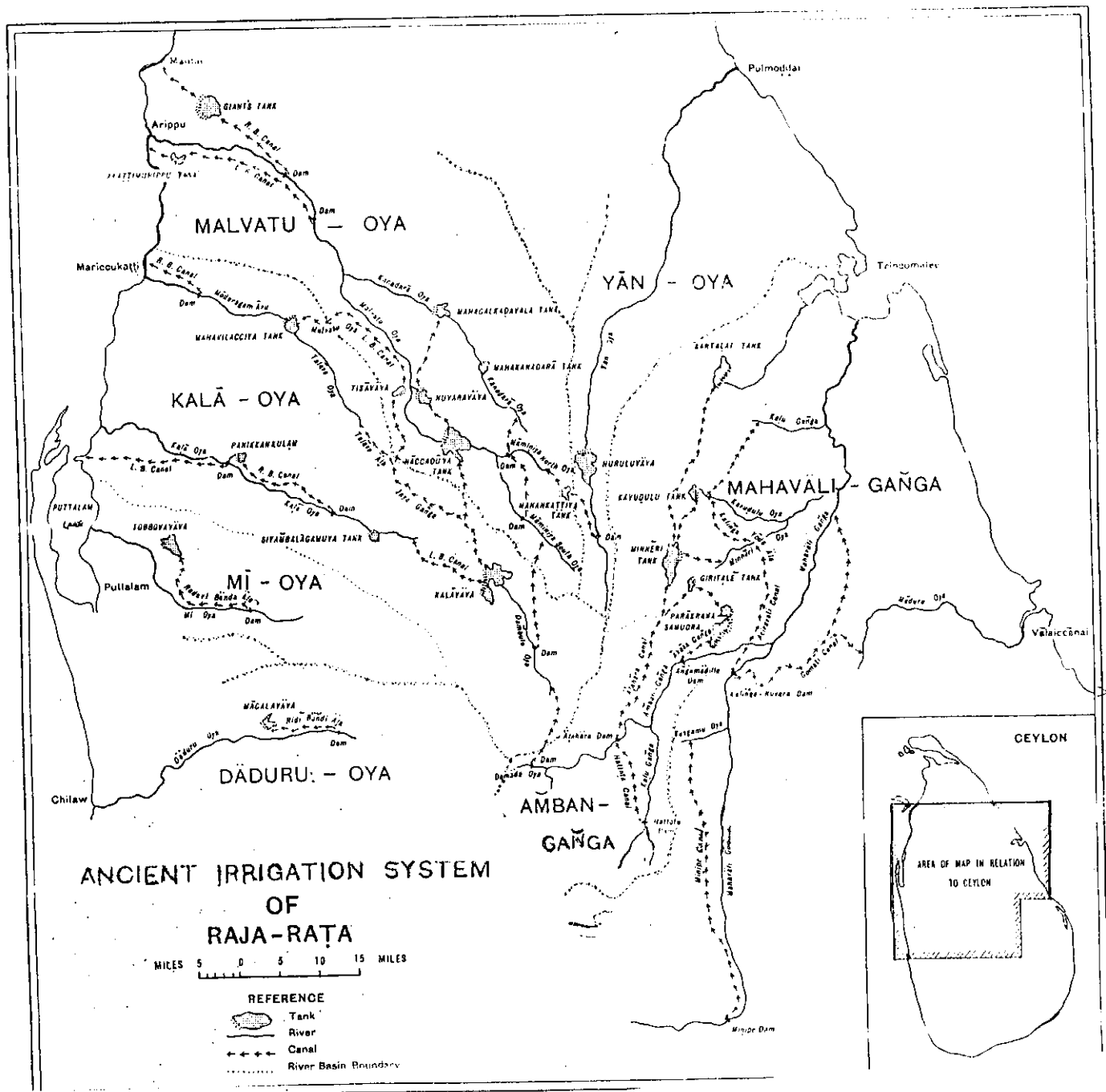
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The above brief survey of the irrigational contribution of Parākramabāhu the Great shows that he inherited a Kingdom of irrigational works but unfortunately for him they were either ruined or damaged due to negligence, a war that lasted for a

long period, and possibly due to abnormal floods. However, it was a great achievement on the part of this great King to have restored the hydraulic and irrigational glory of the past and make this island a 'Granery of the Orient' during his own life-time. There was no one comparable to him throughout the Polonnaruva Period (11-13th century) who has contributed so much for the development and unity of the country. On the other hand Parākramabāhu was not only the powerful monarch of the whole country but with the abundant resources available to him in his own Kingdom, he was also a great warrior who showed his power and capability of conquering even the neighbouring Kingdom of South India. The Cūlavamsa devotes two chapters to his contribution to Buddhist art and architecture. Many of the monuments of Polonnaruva, as Paranavitana says "arrest the attention of the visitors today are due to his energy and liberal patronage of the arts. The lofty Lankātilaka, the Tivanka image-house with its walls adorned with paintings, the impressive rock-cut images at the Gal-Vihāra, that poetry in stone, the Lotus Bath, the less romantic Silapokkarani and the Audience Hall within his palace attest to this monarch's grand conceptions and good taste in architecture and art.⁷⁶ The Demala Mahāsāya which is a incomplete stūpa started by this King would have reached 625 feet in height and would have been 450 million tons in weight had it been completed and probably become the largest monuments in the world today. This largest thūpa which Parākramabāhu wanted to build in his capital was in emulation of the Mahāthūpa (Ruvanvalisāya)

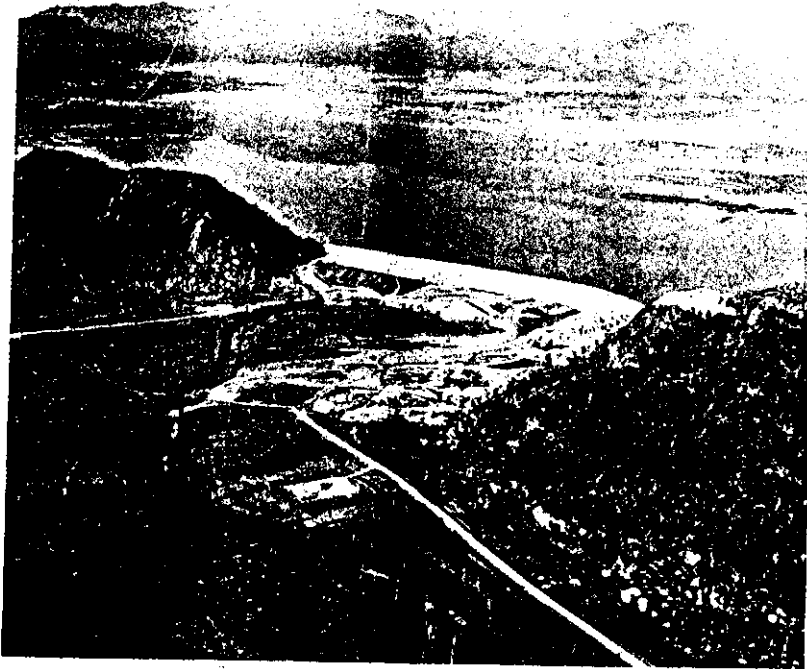
of Anurādhapura. All these religious and cultural achievements of Parākramabāhu, no doubt were the results of the agricultural prosperity reached through his irrigational activities in the country. In other words it was a religious and cultural reawakening achieved through irrigation.

His successor Nissankamalla (1187-1196 A.D.) unfortunately takes credit for some of the tanks supposed to have been built by his predecessors. After having effected some repairs, this King renamed Parākramasamudra as Nissamka-Samudra. Similarly, he takes credit for building a tank named Pāndivijayakulama (Galmatiyānāvava) in a single day. The tank Paḍavāpi was another of his irrigation works but we learn from the chronicle that Parākramabāhu himself enlarged and provided it with a sluice.⁷⁸ However, there were no new irrigation works after the reign of Parākramabāhu the Great. As the historian say, "within ten years of his death in 1186 the Sinhalese Kingdom began to crumble under a succession of civil war and external attacks, and by the end of the 13th century its past glory was only a memory. During this period of about a century, the vast and complete irrigation system, the greatest achievement of the Sinhalese people, passed into ruin and desolution."⁷⁹



ENGINEERING
ACHIEVEMENTS IN
HYDROLOGY AND
IRRIGATION

Having discussed in brief the long history of irrigation in Sri Lanka from its beginning up to the 13th century or to the downfall of the Rajarata



civilization with its two nuclear capitals first at Anuradhapura and secondly at Polonnaruva where, the great monuments of Sinhala-Buddhist culture are yet to be seen either as ruins or as living monuments, we will now focuss our attention to some of the engineering skills of the ancient Sinhalese in tank building and irrigation acitivities.

At the very beginning, we have said that the early colonizers came to Sri Lanka from North India, they brought with them their rudimentary knowledge of rice cultivation and of irrigation.⁸⁰ As time went on they started their agricultural life in a more settled way, with pastures along the river beds. ^{The}organised agriculture was not yet a part of the life of those early people of the mesolithic age who lived in caves or thatched huts, supported themselves by hunting, and buried their dead in urn burial pots. The Aryan colonizers who brought with them the knowledge of irrigated rice culture must have continued to practice the slash and burn cultivation or swidden agriculture in their initial stages but subsequently changed their methods of cultivation due to the expansion of settlements and demographic growth. The expansion of such settlements are identified in Kalā-Malwatu basin and in the Mahavāli river basin in the north eastern province at the early stages of migration from North India.

The demographic expansion along the river and stream is witnessed by the presence of a very large number of rock and cave inscriptions and supported by the chronicles. The early period beginning from the 6th century B.C. and ending

in the 1st century A.D. may be considered the first phase of the early settlement patterns in the Dry Zone and elsewhere. In the Dry Zone the rainfall received was not more than 50 to 75 inches per year and as such it was sufficient only for one crop of rice cultivation. This resulted the necessity for building small-scale reservoirs in the settlement areas to store water for more production. This was achieved by the descendants of the pioneer settlers by damming non-perennial streams and rivers or building embankments to retain water in natural depressions.⁸¹ Such tank building at the village level must have taken place even earlier than the 4th century B.C. as a collective effort of the villagers making it a communal product for the benefit of all. The Samantapāsādika, a commentary written to Vinaya Pitakā in the 5th century A.D. mentions an instance of communally owned (Sabbasādhāraṇa) reservoirs and its water.⁸² However, there were instances where tanks were owned by individuals as we have explained elsewhere and these tank owners in the 1st century were called Vapi-hamika meaning lords of the tank. One of the traditional land and water management systems which has developed on the basis of catchment ecosystems is the system of 'tank chains' or 'tank cascades'. A cascade is a connected series of tanks organised within a micro-catchment of the Dry Zone landscape, storing, conveying and utilizing water from an ephemeral rivulet.⁸³ The greatest preponderance of these reservoirs are found in the Anurādhapura district. Where the small-scale village tanks are concerned, there are two opinions regarding their origin. One school thought

that the origin of irrigation in Sri Lanka was due to Aryan irrigation from north-western India.⁸⁴ The other group thought that its origin was purely local. The reason for the second argument was that the earliest immigrants were nomadic wanderers who gradually took to the domestication of plants and, since the land on which they settled was dry and barren "they were compelled to device artificial means for storing the monsoon rains" in "simple ponds".⁸⁵ However, R.A.L.H. Gunawardane argues that megalithic folk appear to have been among the earliest migrants from India to Sri Lanka and it seems likely that they brought with them several cultural traits including the use of iron, the domestication of the rice plant and a rudimentary irrigation technology including the art of constructing small-scale reservoirs. Archaeological excavations carried out at places such as Gurugalhinna and Kirimāṭiyāhinna in the Anurādhapura District which are on close proximity to minor-scale irrigation works are given as examples in support of his argument.⁸⁶

Water for thirsty croplands was conserved by means of small-scale village tanks or reservoirs. For this purpose people were collected and they excavated large tanks. Sometimes the King paid for the labour involved for construction or dredging.⁸⁸ Therefore the ancient irrigation activities were not the sole responsibility of the State and neither the property of the State alone. Many of them had private ownership. Early Brahmi inscriptions dating back from 3rd century B.C. up to the 1st century A.D. are found in the thousands in the Dry Zone and they record donations,

mostly cave dwellings to the Buddhist community of monks. This points to a very wide distribution of Buddhist religion within the island, a feature of the early hydraulic civilization with a tank for every village.

The early Aryan settlers in Sri Lanka, like their relatives in North India, probably "raised water from wells by water-wheels for their agricultural lands and later by means of artificially excavated canals which conveyed water to the fields from natural sources of supply".⁸⁹ This fact is sufficiently proved by the descriptions found in the chronicle when it says that the early Aryan settled down in the river and stream basins.⁹⁰ The references found in the early Brahmi inscriptions to reservoirs (vavi, vāpi) channels (adi or ali) and anicuts (avarana) presumably of wood or stone to dam small streams further support this argument.⁹¹ The construction of reservoirs or tanks originated as the second phase of the irrigational development in Sri Lanka from the 4th century B.C. Within two centuries they developed their skills both in irrigation and rice cultivation. By the 1st century B.C., the village tank directly irrigated the rice fields below their embankments.⁹² A society based on a one tank-one village ecological pattern which was born in the 1st century B.C. continued for another three centuries developing its own technology. By the 1st century A.D. we are able to see its progress. During the reign of King Vasabha (65-109 A.D.) he built twelve reservoirs and the Ālahāra canal which marked the first attempt ever at

diversion of water to a distant locality. The reservoir built by Vasabha can be called "medium size" the largest had perimeters of about two to three miles. The weir built across the Amban Ganga, a main tributary of the Mahavāli Gaṅga, ^{at} Ālahāra ended in Kiri Oya, irrigating a distance of about thirty miles. These achievements mean that by the dawn of the Christian era, the Sinhalese living

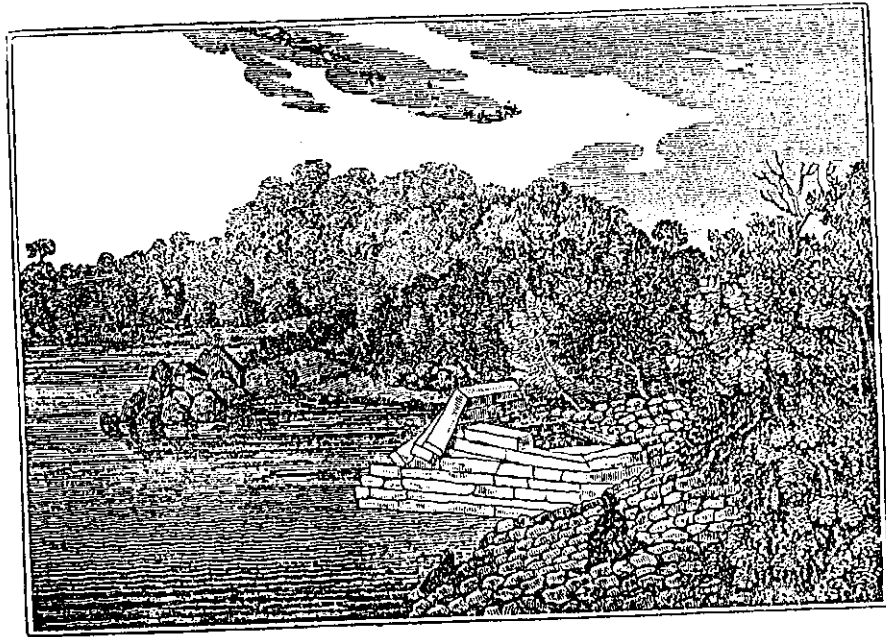


A section of the canal system

on a tiny island in South Asia were able to build reservoirs to conserve water and further take water to distant places through canals for cultivation. This is no doubt a technical achievement. The skills of the early Irrigation Engineers are further obvious when they attempted a major diversion of a river, which needed knowledge and skill of instrumental accuracy in contouring and levelling" as well as a high degree of ability to build stone dams across large streams and rivers. Vasabha's Engineers were of no mean capabilities. They were the first to lay underground pipe lines to conduct water to the bathing tanks at Anurādhapura. This was the

the anicut at Ālahāra was another significant contribution. The remains of the ancient spill-water measures seventy-six yards in length and rose to a height of forty feet above water level in normal times. The construction of a canal from the Mahavāli Gaṅga is another achievement in irrigation during the reign of Mahāsēna. This canal is identified as Pabbatanta stretching towards Dīmbulagala for a distance of about twenty miles. As Gunawardhana has observed these irrigation works spread over a wide region and attributed to this King represent a mighty initiative to harness the water resources of the Dry Zone and further represent the beginning of major irrigation works involving the application of labour resources in this field on an unprecedented scale and reflect the advances that irrigation technology had made in Sri Lanka.⁹⁶ A further achievement in this field is that the large scale reservoirs in Sri Lanka were built several centuries earlier than in South India and it may probably be true that the knowledge and skill of the Sinhalese Irrigation Engineers were tapped by both North and South Indians in later times. The presence of large-scale reservoirs in South India are seen only from the 7th century while Kalhāna's Rājatarangani ^{of the 12th Century} says that the King of Kashmir invited the Sri Lankan hydraulic Engineers to build tanks there.⁹⁷ Not long after constructing the huge tanks the country - especially the Dry Zone - was able to produce three harvests of paddy per year, namely: 1. ^{pita dada} (main harvest) (~~pita dada~~), 2. akala (off season) and 3. made (intermediate). This is recorded in the Tonigala inscription of King Sirimeghavanna (303-331 A.D.).⁹⁸

KANTALAI TANK.
Reproduced from wood-cuts in Davy's "Travels in Ceylon"
1821.



The Bund and the "Biso-kotwa".

1st century and marks not only changes in the sphere of irrigational achievements but also of demographic pattern. The growing population in Rajaraṭa with increase in agricultural output brought in prosperity to their life and culture. This underlined the need for the development of irrigational activities in the region. The development and prosperity so gained are further evident by the introduction of money circulation during this century and the diplomatic relationship established by Sri Lanka with the rest of the world.⁹³

The science and practice of irrigational activities were accelerated because of natural disasters and hardships that the country had to face during famine and drought. The need to conserve water to prepare for such situations was strongly felt. We have references in the chronicles and other literary works about severe droughts and famines during this important period. During the reign of Vattaḡāmaṇi (89-77 B.C.) the whole country has suffered from such severe drought and famine that Sammohavinodini the Pāli commentary says that nearly twenty-four thousand Buddhist monks died due to this serious famine and a large number left the country giving up their monasteries in Anuradbapura. The food shortage became so severe that the monks lived on water lily stalks and people on human flesh.⁹⁴ The 14th century Sinhala literary work Saddharmālaṅkāraya refers to this famine as Bāminītiya Sāya. Another such famine took place again one hundred years later during the reign of Kuncaṅga (187-189 A.D.). The Mahāvamsa refers to this as ekanālika famine. The third famine occurred during the reign of

Sirisañghabodhi (247-249 A.D.). The Mahāvamsa and the Elu Attanagalu Vamsaya⁹⁵ refer to this famine which must have caused immense difficulty to the people who suffered from epidemic disease due to prolonged drought and famine. The Drought and famine are caused by nature. But people should not die of starvation when means to cultivate even during the periods of drought can be achieved through storing large quantities of water in huge reservoirs. In the meantime we see new developments taking place in the irrigation system. As we have observed earlier by the 2nd century we see three kinds of tanks or reservoirs being maintained in the Rajarata namely: 1. Village tanks (Gamikavavi), 2. Large tanks (Mahavavi), and 3. Feeder tanks (Danavavi). With this development, we next witness a significant stage of development of irrigation work in Sri Lanka in the 3rd century with the reign of King Mahāsēna (Sinh. Mahasen) in Anurādhapura. He constructed 16 tanks and one long canal. Going through the list of reservoirs and the areas situated, one gets the feeling that King Mahāsēna while developing the North-Western part also concentrated in developing the North-East around Polonnaruva area for effective colonization. He tapped the waters of Dāduru-Oya in order to develop the South-West of the Dry Zone and further harnessed the waters of Mahavāli Gaṅga and the Āmban Gaṅga together draining off more than four thousand square miles. The Minneriya reservoir harnessed the water supply mainly from the Ālahāra canal which was the largest ever built up to that time, a much needed task to be performed by irrigation Engineers to widen the capacity of the Ālahāra canal. The improvements carried on

It is appropriate at this juncture to comment on some technical achievements of the early Engineers.⁹⁹ The major irrigation works in Sri Lanka began with the emergence of the State. One of the major inventions of the period was the cistern sluice some time before the 2nd century A.D. The Pāli Samantapāsādikā commentary written to the Vinaya Pitaka in the 5th century speaks of the cistern sluice. It is named "udaka niddhamana tumba", meaning the cistern which drains out water.¹⁰⁰ R.A.L.H. Gunawardhana has pointed out that this word occurs in Tamil Nādu inscriptions of the 10th and 11th centuries as tumbu meaning a sluice. This similarity of the words led him to believe that the cistern sluice developed previously in Sri Lanka and may have influenced the development of hydraulic technology in South India.¹⁰¹ We find the Sinhala word bisokotuva¹⁰² meaning queens enclosure being used for a sluice from the 10th century which originally denoted the valve apertures of the piston sluices. The piston which was referred to as the pestle is termed mohol in Sinhalese during this century deriving its etymology from the Sanskrit word musala. The earliest word used for the bisokotuva seems to be kundalam meaning circular aperture of the sluice valve. Thus the phrase musala-pavesana kundalena samannāgataṃ occurring in the Jātaka could be translated as "fitted with a ring (circular aperture) through which the pestle was inserted". Thus the inner function of the sluice was through a piston valve. The Jātaka Atuva Gōtapadaya written in the 12th century refers to this piston that looked like a pestle as raj mohol, meaning a King's pestle and not merely as a simple

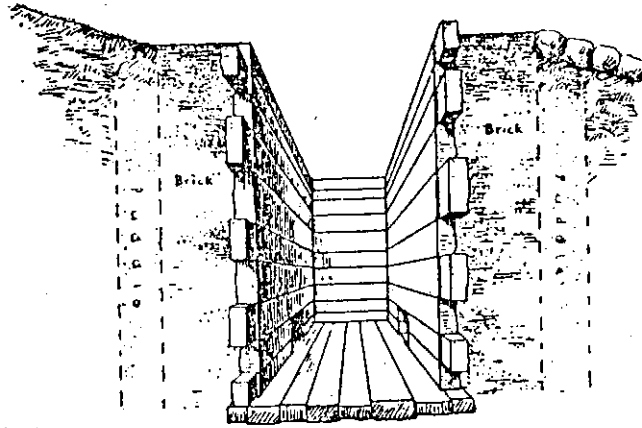
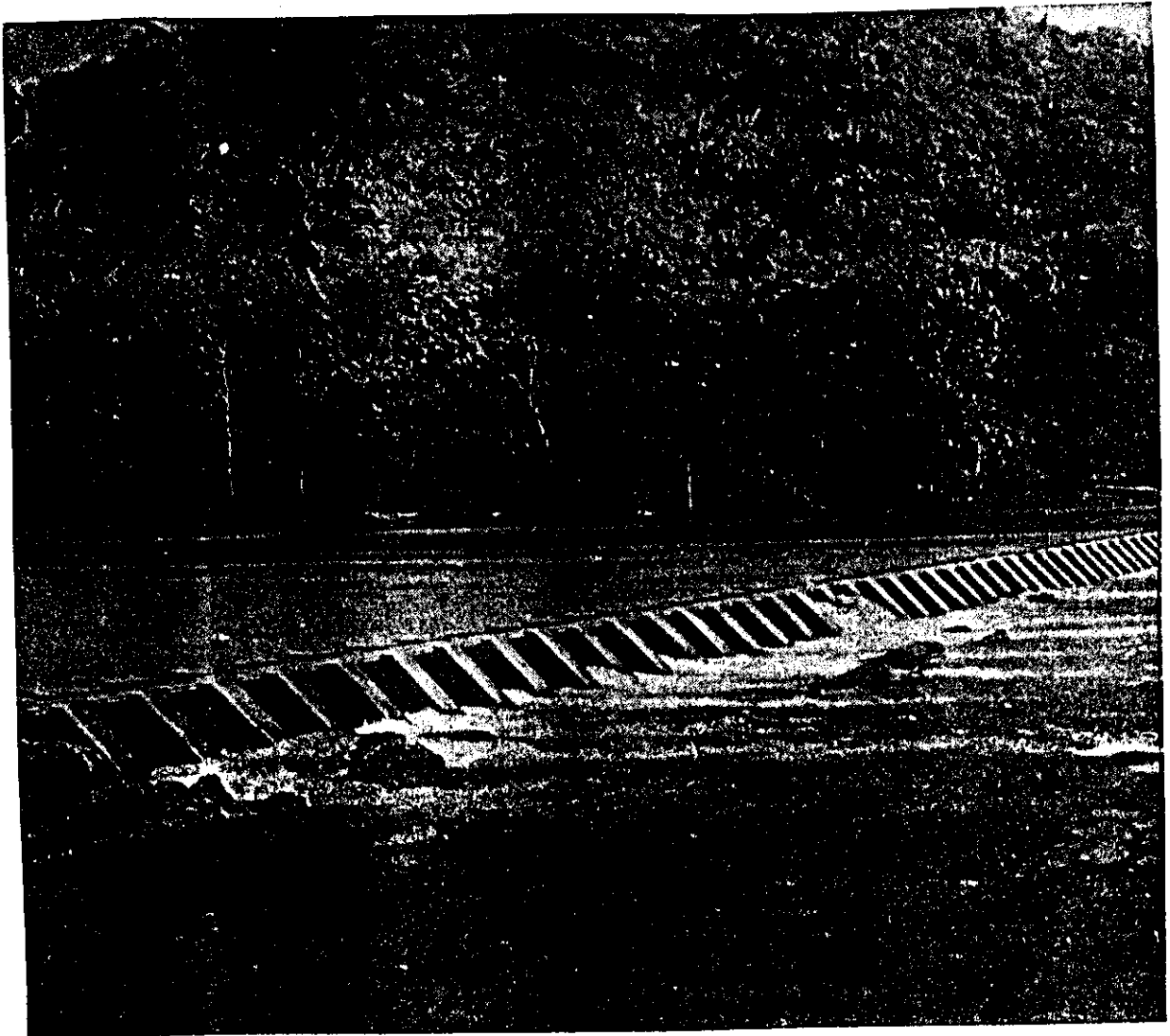


FIG. 126. Bisōkoṭuwa. N. Low-level Sluice.
(One end removed.)



MINIPE DAM - built by Aggabodhi

pestle. This type of piston sluice was in operation during the reign of Mahinda IV (956-972 A.D.) is evident from an inscription at Vessagiriya where it is described in detail the arrangements that the King instituted for the distribution of water from the Tissa tank at Anurādhapura.¹⁰⁴ R.A.L.H. Gunawardhana has given us a correct translation of the text found in this inscription which the original publisher Wickramasinghe has left untranslated. According to the present version the phrase "Mohol naṅgā radsoro peretā satara riyanak diyat hinduvū diyakātā pahan munduna (pā)nenatāk dahak nātivā diya pavatvanu . . ." is translated as "having raised the piston, water should be allowed to flow without interruption until the top of the stone erected near the inlet of the sluice to mark the water level of four riyan becomes visible." Gunawardhana thinks that this type of piston sluice was operated only in South India which shows a transfer of technology during this period and that the cistern sluice was clearly the most popular type of sluice in the island.¹⁰⁵ The only one cistern type sluice that he discovered in South India was at Ponneri, which belonged to the Cōla period and was built into the embankment of the reservoir as in Sri Lanka. This piece of evidence clearly shows that the technology was imported to Tamil Nadu during the Cōla rule in Sri Lanka in the 10th and 11th centuries. This sharing of technical knowledge between the two countries during the late Anurādhapura and early Polonnaruva period is very important in the history of irrigation in Sri Lanka.

A further discussion on the cistern sluice, which marks a significant stage of technical development in the hydraulic

engineering in Sri Lanka in the dawn of the Christian era, is relevant and most important. The nature and function of this type of sluices found in the ancient tanks are described by a few Englishmen in the nineteenth century who had travelled to the Dry Zone either as students of ancient Sinhala culture or as Irrigation Engineers attending to their routine business. One was a British Surgeon John Davy in the company of the then Governor Robert Brownrigg just after the establishment of British rule in 1815 and the others Walsh Wrighton, R.A. Powell, T.I. Piggot, H. Parker, and C. Woodward as Irrigation Engineers. Besides their accounts there are also quite a number of irrigational reports by various writers both local and foreign on the subject and these reports are available to us in the Irrigation Department of Sri Lanka.

The regulation of the outflow of water stored in the reservoirs as in the Minneri was a challenge faced by the early Engineers in addition to their responsibilities of designing and constructing large reservoirs which needed master skill. The sluice that played the most important role in regulating the outflow of water known today as bisokotuva are still found in many of the ancient reservoirs such as the Minneri, Kantale, Parākramaśamudra, Vāhalkaḍa, Nāccadūva and so on. Parānavitana interpreted this Bisokutuva as "serving the purpose of breaking the force of the current in the water taken out of the reservoir through the sluice".¹⁰⁶ John Davy described this regulator at Kavuduḷḷa tank as a "square well, with walls formed of large stones some of which are twelve feet by four neatly cut and most nicely adapted to

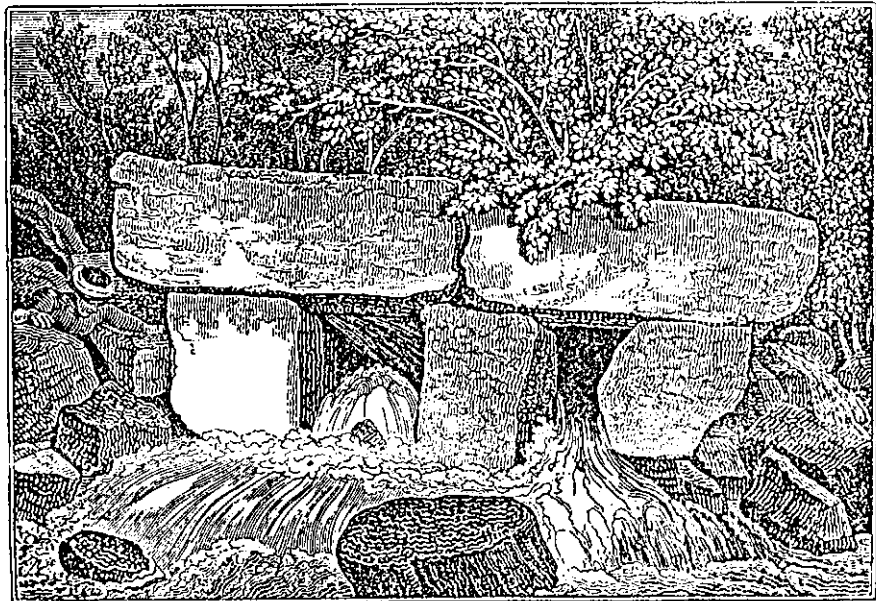
each other".¹⁰⁷ He comments on the outlet as well.

"The great outlet or sluice is constructed with much art and of vast strength; the channel is beneath a platform of masonry that projects into the lake about six feet beyond the line of the embankment and is about twenty four feet long. It is built of oblong stones from five to seven feet long well wrought and nicely adapted to each other without cement. The top of the platform is flat; it contains a small cylindrical well, communicating directly with the channel below, and in which the water, in passing, rises of course to the level of the lake. The water passing through the embankment appears gushing out in a noble stream through two apertures formed by a transverse mass of rock supported by three perpendicular masses. The transverse mass, which is non cracked in two, is about twelve or fourteen feet long, and four or five thick; and the other masses are of proportionate size. The water rushing out in a considerable volume with great force, dashing among rocks beneath, in a deep gloomy shade produced by overhanging trees, makes altogether a very striking scene."¹⁰⁸

The above description was made by Davy in respect of Kantale reservoir. The best description on these ancient sluices was given by Irrigation Engineer Parker as an admirer of ancient civilization. He says

"Since about the middle of last century, open wells, called Valve-towers when they stand clear of the embankment and valve-pits when they are in it, have been built at numerous reservoirs in Europe. Their duty is to hold the valves, and the lifting-gear for working them, by means of which the outward flow of water is regulated or totally stopped. Such also was the function of the bisokutuwa of the Sinhalese engineers; they were the first inventors of the valve-pit, more than 2100 years ago.

It will be readily understood that in an age when iron casting was unknown and even the smallest plates of iron could be heated only with difficulty in the early forges, no iron or iron bound sluice



The Sluice.

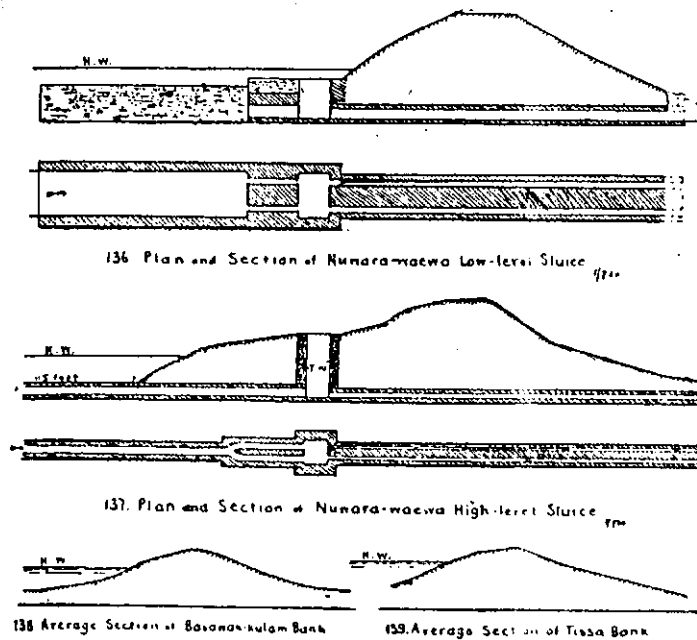
valves were made; and that it must have been no easy task to control the out-flow of the water at reservoirs which had a depth of thirty or forty feet, as was the case at several of the larger works. Yet the similarity of the designs of the bisokoṭuwas at all periods proves that the engineers of the 3rd century B.C. if not those of an earlier period, had mastered the problem so successfully that all others were satisfied to copy their designs.¹⁰⁹

In a sluice the most important element is the cistern. It is built into the inner face of the embankment of the tank or reservoir either in the shape of a square (eg: 8 x 8 ft.) or as a rectangle (eg: 8' x 7'; 11' x 15'; 12' x 14'). The inner face is generally lined with dressed stone slabs neatly fitted together. They cover masonry work built of brick laid in clay or lime mortar, the thickness of which vary from 3 to 7 feet. The height of the cistern also varied. For example the Nāccadūva reservoir was 16 feet and the Nuvaravava was 14 feet. The inlet of the cistern was of the same level as the floor of the cistern and connected the reservoir through a channel. The Nuvaravava reservoir had a inlet channel measuring 2¾ feet high and 2½ feet wide and extended to a distance of 25 feet from the cistern and divided into two channels measuring each 3 feet high and 2 feet wide. The inlets of sluices are generally short channels. But there were exceptions like at Nuvaravava. Normally there were two conduits to discharge the water out

of the cistern and sometimes covered on the outer side with a 'clay puddle' to make the whole structure water tight. The section of the sluice channels which traverse the embankments had stone or brick walls. Connecting on the mortice holes found on the floor of the cistern, Parker suggested that they could have been "meant to receive tenons of vertical posts, that regulated the water with wooden doors or valves, which might slide vertically in wide grooves."¹¹⁰ This suggested the idea that there was the possibility of controlling the outflow of water from the reservoir with the help of these valves or doors in the cistern. Gunawardhana, while commenting on mechanism says, "the cistern sluice with its sliding doors or valves marks a substantial step forward from the 'stop-log' sluices which were widely known in the ancient world" and further "it was a means of controlling not only the quantity of the outflow of water but also the pressure at which it was released and thus it made the construction of large reservoir worthwhile and their maintenance possible".¹¹¹

Finally we can say that discovery of the cistern sluices as a means of regularizing the water from the reservoirs to the fields through channels was undoubtedly a remarkable contribution of the ancient Irrigation Engineers of Sri Lanka to hydraulic science in the 2nd century A.D.

It was this invention alone as Parker says "which permitted the Sinhalese to proceed boldly with the construction of reservoirs that still rank among the finest, and greatest works of the kind in the world".¹¹²

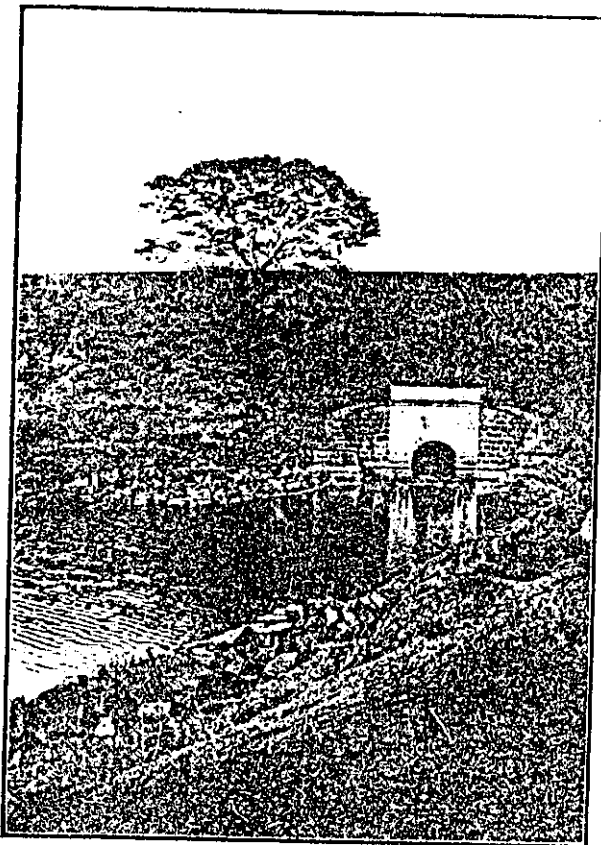


Figs. 136-139. Nuwara-waewa Sluices, and Anuridhapura Banks.

The second method of draining the water out of a reservoir was through a spill. A spillway was mainly constructed for the excess water to follow out which otherwise could cause damage to the reservoir and the embankment during floods. This spillway in ancient times was called in Pāli Nibbāhana Udaka (Mod. Sinh. vāna) that which unload water.¹¹³ (Considering the modern Sinhala word *Imvāna* suggest that the old Sinhala word used around the 3rd century for a spill was daka-vāna and for a sluice ^{was} daka (damana) tuba). An example of a spill is seen even today at Kalāvāva. Natural rock formation was felt ideal for sites to construct spills.

It is clear from the history of the development of hydraulic system in Sri Lanka that in the subsequent century King Dhātusēna emerging as a giant tank builder. His greatest contributions are Kalāvāva and the channel constructed to join this with Tissavāva in Anurādhapura and the construction of a weir across the Mahavali Ganga. Moggallāna II in the 6th century dammed the Malvatu Oya and built three reservoirs. The Nāccadūva tank was one of them and according to historians Padaviya was another. Aggabodhi II in the early 7th century is credited with building Giritale and Kantale tanks both in the North-eastern part. This shows the importance of the region as a future centre of administration and Polonnaruwa as an emerging capital.

The location of reservoirs which are seen today establishes the fact that the ancient Engineers were aware of the geological formation of the sites. Parker noted that the dam of the Mahagalla reservoir had been located at a place where the river narrowed to flow over a rocky bed.¹¹⁴ The Kavuduluvāva was sited on a natural quartz formation.¹¹⁵ Minimizing the work of constructing large reservoirs with dams was another consideration in those days. Therefore the selection of the site was very carefully done. The folk stories associated with some of the ancient reservoirs further illustrate this point. The gigantic Minneri reservoir as we see today was created by building just one embankment which is only a kilometre long. The embankment built to impound the waters at Kalavava was 5.6 kilometres long and rose to a height of twelve metres. An area of



Block by Survey Dept.

The modern sluice of Kala Wewa and the
Jaya Ganga in the foreground.

about 1740 hectares was thus brought under the reservoir to fill with water. The Nāccadūva reservoir was created by building a weir about 1.6 kilometres long and 10.5 metres high across the Malvatu Oya and covering an area of 1600 hectares. The Nuvaravāva (tank) has a embankment of five kilometres long and covers an area of 1196 hectares. The Padaviya reservoir was built by creating a weir about 6 kilometres in length across Mā-Oya covering an area of about 2428 hectares. The embankment of the Kantale reservoir constructed on the Per Āru is only 1.6 kilometres long and covers an area of 1320 hectares. When the author of Cūlavamsa speaks of impounding the waters of Malvatu Oya in between the mountains (pabbata majjhato) by King Moggallana¹¹⁶ it praises the high proficiency of the Engineers who considered the physical formation of the land area and the environmental, material, thus minimizing the construction work while ensuring durability and strength in building great reservoirs. The wave action (mod. Sin. rālapānāva) on reservoirs and its earth embankments were recognized by the ancient Engineers and they provided forthwith a pitching of stone to counteract the effect of it.

The construction of channels and canals was another great achievement of the ancient Sinhalese Engineers along with the building of weirs across streams and rivers. The harnessing of the waters of streams like Malvatu and Ālahāra was long practiced. The Minnēriya tank, as we have already seen, drew its water resource mainly from the Ālahāra canal during the reign of Mahasen. The Kavuduluvāva was filled with the waters of Kavudulu-oya. The Ālahāra anicut,

seventy-six yards in length and rising to forty feet above water-level and the cutting of a canal from the Mahavāli Gaṅgā for a distance of about twenty miles towards Dīmbulāgala were some of the irrigational achievements during the reign of Mahāsēna. After two centuries during the reign of Dhātusēna, we are able to see a major phase in the irrigational network of the Dry Zone. The harnessing of the waters of Kalā-oya for the Kalāvāva and reservoirs further north like Tissa, Nuvara and Mahādarāgalla through a canal called Jayagaṅgā and further feeding the way-side village tanks along its eighty-seven kilometres (5 $\frac{1}{4}$ miles) course is another great achievement of this era. This canal irrigated an area about 180 square miles in extent. The Irrigation Engineers have already calculated that Kalavava was on an higher elevation than Anurādhapura and constructed the canal in such a skill manner as to have the gradient of about ten centimetres in a kilometre (six inches to a mile). This masterpiece of work is considered as one of the brilliant achievement of the Irrigation Engineers of ancient Sri Lanka.

The Ālahāra canal, probably constructed during the 1st or 2nd century, was further improved. The Mahavali waters was tapped by Dhātusēna by impounding the great river in the 5th century. In the western Dry Zone, King Dhātusēna built Yodavāva by building an embankment extending to about seven miles in length. It is fed by a canal seventeen miles from Malvatu-oya. Aggabodhi II in the beginning of the 7th century built the Minipē dam on the Mahavāli Gaṅgā which again gave birth to the Minipē canal for a distance of about 17 miles

but later extended in the 9th century. Aggabodhi II in the 7th century was another great patron of irrigation works. Besides the building of Giritale and Kantale reservoirs, he built a canal 29 miles long from the Minneri tank to feed Kantale reservoir. "The total length of canal from Ālahāra dam on the Āmban Gaṅga through Minnēri Tank, to Kantale tank was now 54½ miles. The Hattoṭa-Amuṇa (dam) on the Kalu Gaṅga the main tributary of Āmban Gaṅga, and a canal 28 miles long which carried the water diverted by the dam and discharged it into Āmban Gaṅga just above the Ālahāra dam".¹¹⁷

In the second decade of the 7th century the main irrigation works which were then functioning and given in the University History of Ceylon are as follows:

River diversion schemes:

1. Hottōṭa-amuna on the Kalu Gaṅga - canal to Āmban Gaṅga - Ālahāra dam - Ālahāra canal - branch canal to Giritale tank - main canal to Minnēri tank - canal - Kavudulu tank - canal - Kantale tank.

Total length of canal, 75 miles.

2. Dam on Mahavāli Gaṅga - Pabbatanta canal, as extended by Dhātusēna.

Length of canal, probably 30 miles.

3. Maṇimekhalā (Minipē) dam on Mahavāli Gaṅga - Minipē - Minipē canal.

Length of canal probably 17 miles.

4. Dam on Malvatu Oya - canal - Giant's tank
(Yodavāva).

Length of canal, 17 miles.

The total length of the major canals was well over 250 miles.¹¹⁸ King Sēna II in the 9th century extended the Minipē canal a total length of about 47 miles. The Minipē inscription of the 13th century describes this canal as "like unto a noble son given birth to by the queen named Mahavāligam̄.". The same King built a dam on the Malvatu Oya near Maradankadavala from which a canal about 12 miles long carried water to Mahakāṇḍarā tank. For three centuries the building of large reservoirs, dams and canals went into a decline though a few are mentioned. By the 10th century the artificial canals taken off the principal rivers are as follows:

Mahavāli Gaṅga	132 miles
Aṃban Gaṅga	197 miles
Kalā Oya, Modaragam Āru and other rivers	177 miles
TOTAL ...	<hr/> 506 miles ¹¹⁹ <hr/>

The remarkable event in the evolution of hydraulic engineering in Sri Lanka during the decline of the Anurādhapura period and the rise of the Polonnaruva Kingdom in the 10th and 11th centuries was the transfer of irrigation technology between Sri Lanka and South India. As we have pointed out earlier the idea of the piston sluice seems to have been introduced to the island from South India and the cistern sluice from Sri Lanka to South India. But both the countries seem to

have not accepted the borrowings but preferred to follow their independent traditions. An example for this is the location of the sluice. In Sri Lanka the sluices were located in the embankment but in South India they were located on the beds of the reservoirs, a considerable distance from the embankment.¹²⁰ The transfer of this technology took place during the height of Cōla occupation in Sri Lanka.

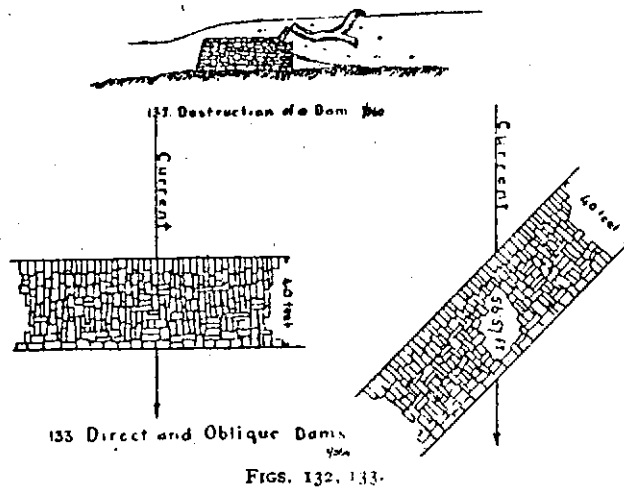
During the Polonnaruva period in 1153 A.D. when Parākramabāhu I ascended the throne a new era of peace, and development was born. In the chronicle it is stated that this King constructed or restored 165 dams, 3910 canals, 163 major tanks and 2376 minor tanks. The Parākramasamudra the great reservoir at Polonnaruva is a proud contribution to the irrigation system by this King. The bund of this reservoir as now restored is 8½ miles long and 40 feet high and covers an area of 5,350 acres. The opening up of the Kālinga canal by further extending the Pabbatanta canal built by Mahāsēna, this King had made a valuable contribution to the irrigation of the medieval Sri Lanka and exhibited the advancement of technology as well. "Not only were the earth works unprecedented in scale but also the stone masonry of these irrigation works involved," as Parker noted, "the handling of stone blocks up to about ten tons in weight".¹²¹

A decree issued by Mahapā Dāpula (918 A.D.) at Dorabāwila refers to twelve great reservoirs (dolos maha vā) in his times which falls to the 10th century. Gunawardhana identifies them as Yōdavāva, Pāvātkulam, Mahakanadarāva, Nuvaravāva, Nācçādūva, Kalā, Vavunikkulam, Padaviya, Vāhalkada, Kantale, Kavudulu and Minnēri. He further says that it is interesting

to note "that five of these were in the Malvatu basin while a sixth, the kalā was linked to the Malvatu system" and the remaining three, namely, Mahagalkaḍavala, Tissa and Basavakkulam reservoirs were also located in the same river basin which amounts to Malvatu being the most intensively exploited river system in the island during this period.¹²³

This account of the engineering skill of the ancient Sinhalese is not complete without reference made to the early dams built across the streams and rivers. Only a few of the old dams remain today such as the one at Minipē and Ālahāra. Of particular interest both to engineers and archaeologists was the discovery at Māduru Oya of an ancient dam of dimensions remarkably similar to the modern dam on the site originally selected for building the same. During the construction operations the ancient outlet sluice, constructed with great intricacy of brick and dressed rock was discovered. It has been dated as being more than 1600 years old. Commenting on the engineering skill of the ancient people one scholar has said that "raising the level of the ancient reservoir would have required the installation of some mechanism in the high level sluice to regulate the flow of water through it. It was for just such a situation that the ancient hydraulic engineers of Sri Lanka invented the valve pit and bisokotuva and yet there is no evidence of any such mechanism in the sluice".¹²⁴

One reason for the destruction of these early dams must have been the volume of water that passed over the anicut or dam especially during the rainy season carrying large trunks



of trees with a force sufficient to destroy anything but the most massive masonry. Henry Parker had a very useful observation to make in this regard. He says

"The body of water which is approaching a dam built across a river extends considerably below the level of the crest; but immediately before arriving at the up-stream face of the masonry the lower part of the moving water rises so as to pass over it. With it rise any bodies that were being carried near the surface, such as large trunks of dead trees, these are tilted obliquely upwards, and at that angle may strike the upper stones of the face of the dam. In that case, when the water is rising with great velocity and the tree trunk is very large there is great probability that one of the stones of the top course will be displaced. It is in this manner that the ancient

Sinhalese masonry dams have been breached almost without exception.¹²⁵

While commenting on the breaches of dams he also made a point in favour of the technical ability and the high efficiency of the early hydraulic engineers. Referring to Kirindi-oya dam he says that "the astonishing fact that instead of being taken across the river by the shortest possible line, as one would expect, it was built at an oblique angle, which, from the traces I saw, I judged to be nearly forty-five degrees from the direct line. There is a possibility that this does not prove that the principle of the oblique dam, and of its greater discharging power than one built square across a river the knowledge of which was only acquired in comparatively recent years in Europe - was understood in Ceylon in very early times".¹²⁶

The Alahara dam is one of the earliest and most important achievements of the irrigation history in the Island, which provided water to the great reservoirs in the north-east. The precise engineering skill shown in preparing the rock to receive the foundation of the large bund across the Āmban Gaṅga was well received by the recent irrigation engineers. R.L. Brohier says:

"The Āmban Gaṅga is formed by the confluence at or near the village of Āmbana, of four or five considerable streams, taking their sources in the south and west parts of Mātale. Thence it is called the Āmbangaṅga. A range of hills, commencing from a spur of the Laggala mountains,

extends in a northernly direction to the left or southern bank of the river nearly opposite the present village of Alahāra. At a point where this range approaches within a distance of 200 yards from the river, a large embankment of earth, with stone revetments, commences, and extends for about 130 yards, terminating in a wing wall about 15 feet in height. Here begins a large spill water, the length of which was probably about 90 yards and from its extremity ran, at an obtuse angle, the great stone bund; this extended across the stream until it joined an immense earth embankment, with stone revetments, averaging 60 feet in height which still exists, and leads to the mouth of Mahāsen's canal".

"The remains of the spill water measures 76 yards in length. This brings us to the edge of the river and it is evident, that was continued for some 12 or 14 yards further, to the rocky foundation in the bed of the river on which the great stone bund was built. The breadth at the top, at its southern end, is 29 yards and at the northern end, where it has been carried away, 33. Its height above the level of the waters at ordinary seasons, is about 40 feet. It is built throughout of huge blocks of hewn stone embedded in chunam (lime) which still remains interstices".¹²⁷

For nearly two thousand years the irrigation engineers of this small island maintained such a high standard of knowledge, technology and skill in the science of hydraulogy that non of the neighbouring or even distant lands could not match the progress that Sri Lanka made during these by gone centuries. But, by the 13th century all these achievements failed due to several internal and external forces which ultimately brought about the downfall of a great civilization in South Asia based on hydraulogy and Buddhism. However, as Parker observed "it was this invention alone which permitted the Sinhalese to proceed boldly with the construction of reservoirs that still rank among the finest and greatest works of the kind in the world".¹²⁸

Shortly afterwards the capital was shifted from Polonnaruva to Daṁbadeniya in the North-West where extensive progress was made in agriculture and irrigation especially during the reign of Parākramabāhu the Great. The collapse of the Rajarāṭa civilization was completed by the 13th century but the complete breakdown of the irrigation system took a gradual process due to the characteristic attachment of the Rajarāṭa peasants to their ancestral land. Probably they decided to remain there under whatever difficulties to continue their agricultural life depending much on their "karma" or destiny as the western^{ers} interpret it. The bund of the Kavudulla reservoir remained till 1680 A.D.¹³⁰ The embankment of the Minnēriya tank remained a nearly perfect condition even in 1848 when Sir Emerson Tennent visited there.

The place was only overgrown with lofty trees.¹³¹ But after several centuries of negligence one cannot expect glory that was in the past and the grander that was Rajarata to remain unchanged. The abundant of the area by a substantial number of peasants, silting of reservoirs, famine and malaria, the collapse of the social and political order which affected the maintaining of the irrigation system and South Indian invasions, can be some of the reasons for the de-population of the Dry Zone.¹³² By the middle of



Mādurū-ōya :
ancient outlet sluice

of the thirteenth century the great city of Polonnaruwa had almost been abandoned and the Rajarata Kingdom had fallen. The wonderful hydraulic civilization of the Malvatu—Mahavāli valleys had come to its end. Whatever the English writers have seen in their travels at the end of the 19th century - only silted reservoirs, broken down canals, the ruins of the old cities, a few of the old dāgābas and Buddha images remained.



WATER MANAGEMENT
CULTS AND
RITUALS

In this third and final part of the essay, we hope to deal with some aspects of the hydraulic society that will help us to understand the importance of the irrigation works in ancient Sri Lanka. The influence and effect of the irrigation activities on the culture and the beliefs of the people, water tax, and water management are some of the aspects that will draw our attention in this study.

We have already gained some knowledge of the great irrigation works of Sri Lanka and their importance to the economic life of the people. A "settled agricultural life, though not very well organised coupled with the use of iron weapons and implements including the plough for tilling have been the main feature of the original Sinhalese".¹³³ Some knowledge of primitive irrigation appears to be another feature of the initial stages of their colonization though they continued with their swidden

crops. They experimented with rice culture, utilizing their primitive methods of irrigation techniques depending on the weather condition and manpower resources. In the Dry Zone, the Kalā, Malvatu and Mahavāli river basins became the pasture lands of these early settlers as they could easily tap the water resources available to them during the dry seasons. These ^{early} settlers gradually developed methods of conserving water in a storage tank which was called a vapi or vavi (Skt., Pāli: Vāpi) which means a tank ^{or} reservoir. As time went on and rice cultivation became more popular, such tanks appeared in about all the villages in the Rajarata either as the common property of the villagers or as private property. As we have noted at the beginning such private owners were called Vapi hamika in the early Christian era. In and around the capital of Anurādhapura, relatively medium size reservoirs were built to meet the demands of the citizens for their domestic use. By the first century, three such reservoirs, namely Tissavāva, Basavakkulam or Abhayavāva and Nuvaravāva had already been constructed for this purpose. Farming had become another feature of the agrarian life of the peasants, as evidenced by the Brāhmi inscription found at Avukana with a reference to private property rights over pasture land.¹³⁴ The Mahavamsa also refers to cowherds in Dighavāpi¹³⁵ and a caste of cowherds in the pre-Christian era.¹³⁵ With the development of the irrigation facilities the life of the farmers became more and more prosperous. Again, more and more people too were attracted to the Dry Zone for settlement. A number of reasons can be given for this development. The

availability of large extents of land, fertile soil, water, forest reserves, pasture land and cleared forest for the cultivation of other varieties of food grains are important. The Kalā-Malvatu basin became the central attraction for the colonizers who flocked to Rajarata in search of fortune and a peaceful life. A new faith, Buddhism, which had been introduced to Sri Lanka in the 3rd century B.C. had by now begun to guide the lives of these people. The patronage necessary for the development of Buddhism was amply supplied by the Parumakas and the maharajas, the ruling class. From their solitary caves the community of Buddhist monks had begun to guide the spiritual lives of the people. In the capital/^{of}Anurādhapura Buddhist monasteries, centres of learning and worship began to appear with the royal patronage and the ~~encouragement~~ and support of the people. We see a very large number of early inscriptions in this regard in the cave dwellings. The pious devotees had donated parks and cave dwellings for the monks of the four quarters as a whole and not to a particular individual. The monk's personal property was limited to his robes, begging bowl, razor and a few other items. As they had no income to maintain themselves, in this way they retained their purity of life and their goal of the giving up of the wordly life.

The future of the Buddha Sāsana, the dispensation, became the responsibility of the royalty. To safeguard and develop it was the duty of the King. One can recollect how the great Sinhalese hero King Duṭṭhagāmini threw himself in this regard. King Mahinda IV (956-972 A.D.) in his

MAHAVĀLI GAṅGA

ĀMBAN GAṅGA

KALĀ OYA
AND
MĒDARAGAM ĀRU

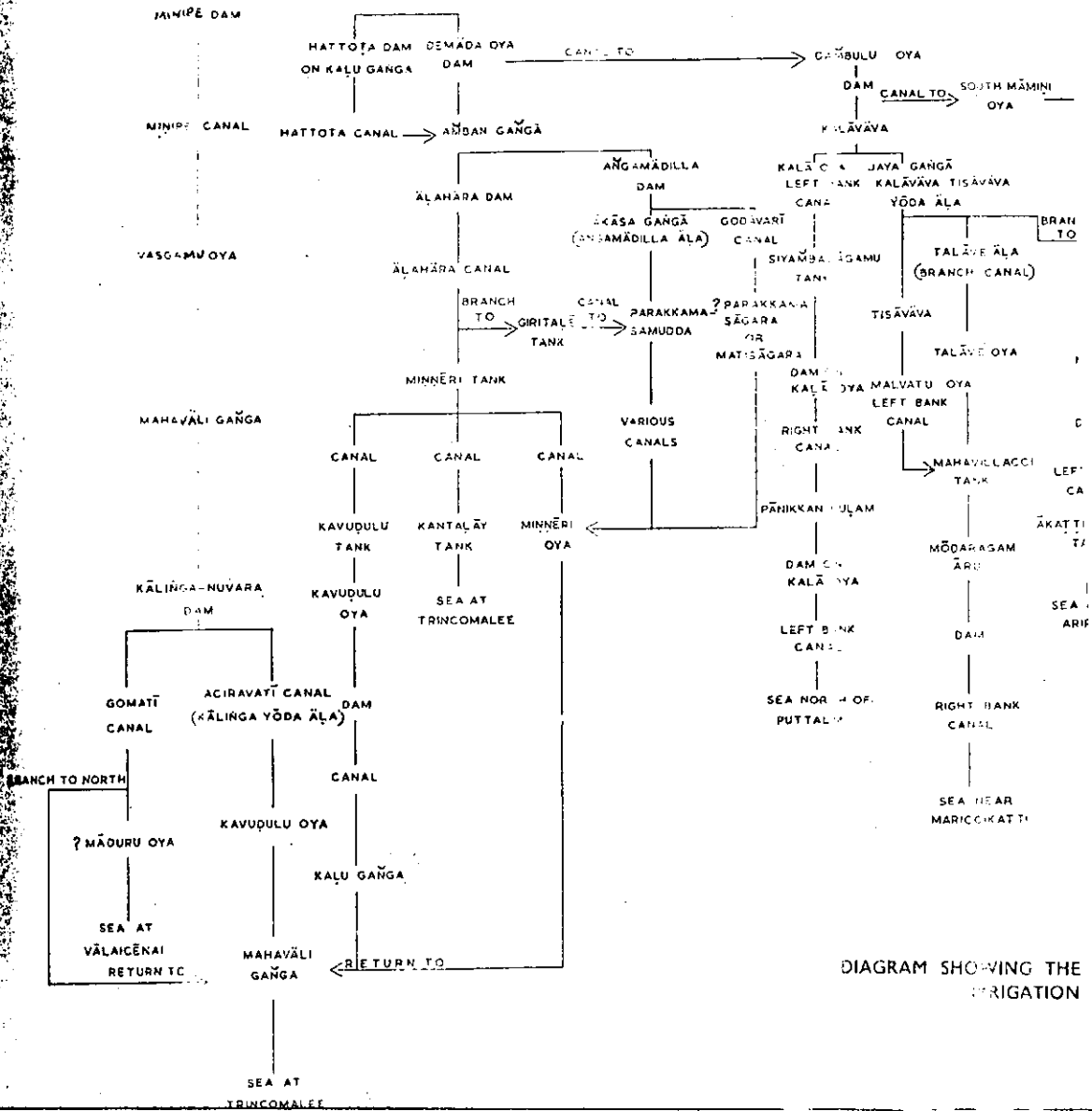


DIAGRAM SHOWING THE IRRIGATION

inscription at Abhayagiri monastery says that "the Ksatriya lords devoted to the Buddha, who of yore have received the assurance made by the Omniscient Lord of Sages, the pinnacle of the Sākya clan, that not but Bodhisattvas would become Kings of prosperous Lanka".¹³⁶ This clearly shows the commitment of the Sinhala Buddhist Kings towards the wellbeing of the Buddha sāsana. In return the Sangha, the community of monks, too became involved with the royalty as the latter sought the guidance of the Buddhist monks in their administration of the country. Thus the whole exercise became reciprocal.

As time went on the granting of lands to Buddhist monasteries by the Kings and the nobles for the members of the Sangha in order to derive revenue therefrom became a practice and sometimes such land was even granted to individual monks as in the case of Vaṭṭagāmini Abhaya's making a donation to Thera Mahātissa of Kupikkala. (This incident led to the establishment of Abhayagiri Vihara against the Mahāvihara in Anurādhapura). This practice of donating lands to individuals clearly goes against the ideals of early Buddhism. But circumstances forced the early Kings to do things that go against the Vinaya rulers. Parānavitana says:

"It is said that, during the severe famine which prevailed then the monks found it difficult to maintain themselves in Ceylon, ^(Sri Lanka) for there were very few to give alms, and were forced to go abroad. Perhaps it was thought that, if the Sangha enjoyed a regular income from lands which were vested in

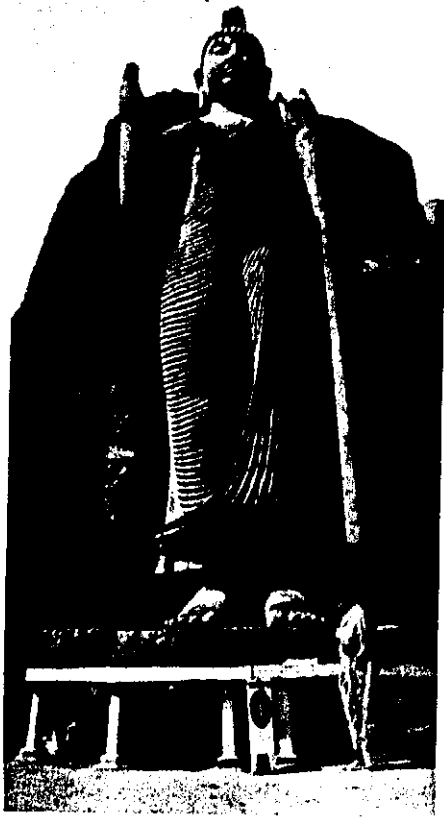
the monasteries, provision could be made to tide over difficult times like that, so that they had not to depend on uncertain liberality of supporters who would be few when the power passed into the hands of those hostile to the religion, like the Brāhmana Tiya".¹³⁷

This practice of granting land became an accepted norm. Beginning gradually, it spread very fast throughout the whole country. By the second century B.C. we see not only that lands had been gifted to the monasteries, but also irrigational canals, reservoirs and even the income from the irrigation projects has been given for the benefit of the monks to obtain their four requisites. Examples can be cited from early Brahmi inscriptions to this regard.¹³⁸

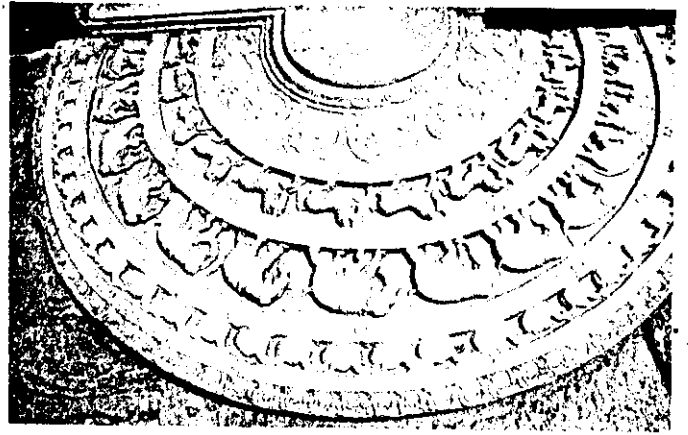
The Dūvegala and Nā-ulpota inscriptions of Lañjatissa (119-109 B.C.) record a grant of tracts of land and of an irrigation reservoir to a monastery.¹³⁹ The Molahitiya-Velegala inscription has registered a gift of villages including reservoirs made to the ancient Pilipavata monastery by the chief queen of King Kuṭakannatissa (44-22 B.C.)¹⁴⁰

Ritigala rock inscription records a gift of a paddy field by ^{Abhaya} Gāmini/or Bhāṭikatissa (22 B.C. - 07 A.D.).¹⁴¹ The Dūvegala rock inscription of Lañjakatissa again mentions a gift of two categories of revenue of tanks, lakes and of a channel at Kalahanagara in Polonnaruva.¹⁴² Another inscription from Ritigala records the names of tanks granted by the same King and his minister for the benefit of the Saṅgha.¹⁴³ The Bakki-ala slab inscription of King Bhāṭikatissa (22-07 B.C.) records a tax levied on water (daka bali) used here for

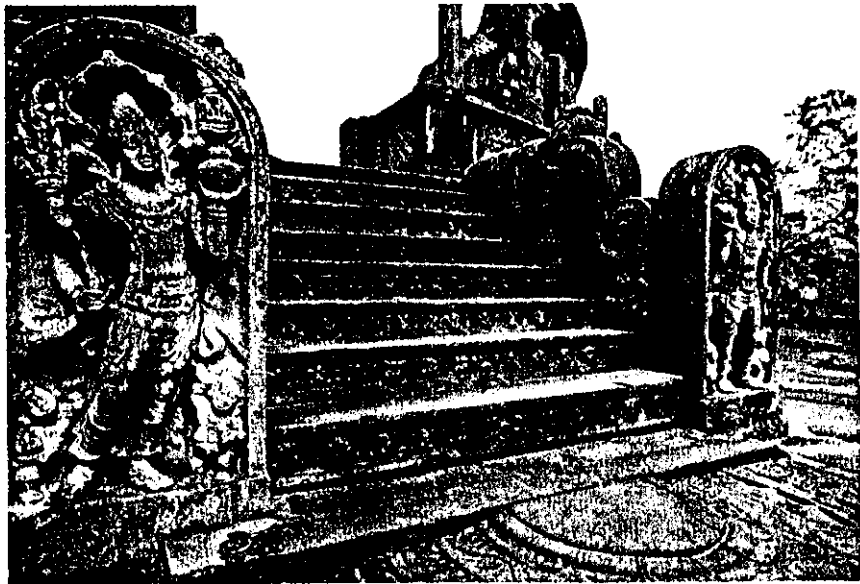
daka-baka and daka-pati) had been donated for the purpose of providing the requisities to the community of monks.¹⁴⁴ A rock inscription at Kantaka-Cetiya at Mihintale of the same King records the donation of two categories of revenue of tanks to the Kantaka-Cetiya.¹⁴⁵ The two categories of revenue mentioned here and above refer to water tax (daka-pati) and that from the proprietor's share (bojaka-pati). The Perimayankulama Rock Inscription in Anuradhapura of King Vasabha (67-111 A.D.) records that this King and Nāga gave the water revenue and the share of fish (majibaka) caught in the channels for the purpose of spreading carpets of antelope skins in the meditation hall.¹⁴⁶ This same King is recorded as having presented the rights to dues from major irrigational projects like the Alahara canal to Mucela Monastery and further gifted a reservoir which could irrigate thousand karisas (about 16,000 hectares) to a monastery. With irrigation and agricultural development in the country we see the donation made during these periods alone increasing both in extent and value.¹⁴⁷ Thus we see that the Buddhist monks who are supposed to have given up worldly life getting themselves overloaded with the responsibility of administrating the temple property and thus becoming alienated from their spiritual life. Sometimes, this is not due to their fault but because they become victims of a circumstance. Where irrigation activities ~~are~~^{were} concerned, we see from the above examples, that monks are gifted with more and more reservoirs and channels or both and with tax revenue. In this regard it is interesting to note that the commentator Buddhaghosa in the fifth century making a



Anuradhapura



Moon Stone



Vata-dā-ge - Polonnaruwa

classification on a Vinaya rule that concerns the relationship between a monk and a cultivator who use irrigation water from reservoirs belonging to the monastery. It says:

If people, bent on helping the Sangha, construct an irrigation reservoir on the land belonging to the Sangha, and thenceforth provide "allowed articles" (utensils allowed to be used by the monks) from the proceeds of the crops raised with the water from the reservoir, it is permissible to accept them. And when it is requested, appoint a Kappiyakāraka (a person whose duty was to procure the necessities of the Sangha and offer them) for us, "it is in order to appoint one. And if these people, being oppressed by the tax demands of the King, were to give up the land and go away, and if others who occupy their land do not give anything to the monks, it is permissible to stop the supply of water; but this should be done in the ploughing season and not in the crop season. And if the people were to say, "Reverend Sir, even in the past people raised crops with water from this reservoir," then they should be told "They helped the Sangha in such and such a manner, and provided the Sangha with such and such articles". And if they say "we, too shall do so," it is permissible to accept what they offer.¹⁴⁸

The collection of dues from canals, fields and forests belonging to the Sangha followed similar procedures. As time passed by we see that the major and important monasteries

amassing more wealth for their maintenance and the Saṅgha itself becoming more involved with the administration of the monastic property.¹⁴⁹ Thus, the Vinaya or the conduct of a monk in latter times became a debatable question. Late in the Anurādhapura period we observe from several inscriptions such as from the Jētavanārāma Sanskrit inscriptions and the Anurādhapura slab inscription of Kassapa V about the conduct of the monks being regularised in the form of royal decrees. An organisation and a working of the administrative system for the monasteries was felt necessary now. The main monasteries at Anurādhapura at the time, were Mahāvihāra, Jētavanaya, Abhayagiriya and Cētiyagiri monastery at Mihintale. The Tablets at Mihintale provide us a fairly detailed accounts of the monastic administrative system where both lay person and monks sat together in a Committee.¹⁵⁰

RULES AND REGULATIONS, TAXES AND OFFICIALS

Rules and regulations, taxes and officials concerning the irrigational works in the country during the period under our discussions are found in inscriptional and literary sources. As we pointed out earlier, the word used for the irrigation dues was daka baka, derived from the Sanskrit udaka bāga meaning water share. This was collected from the cultivators who made use of the irrigational reservoirs or canals. The lease, of the right to fish in a reservoir or in a canal was called maji bika, derived from the Sanskrit matsya bāga or share of the fish. The sluice in a reservoir was the controlling point of the outlet of water. Therefore the owner of a reservoir, whether it

belonged to an individual or the State, was able to regulate the issue of water. An instance of withdrawal of facilities from those cultivators who failed to pay water taxes was cited above from Samantapāsādikā written in the 5th century based on the Sinhalese commentary written a few centuries earlier. It seems reasonable to think that some of the small reservoirs and canals were owned by individuals while the large irrigation works were built by the Kings. Thus we have three types of ownership namely: 1. the State, 2. the private owner (vāpi hamika), and 3. the community of monks. All these seem to have enjoyed and exercised power and influence over the society through their rights and ownership. The above mentioned Samantapāsādikā, further gives us an account on the theft of water and fish from irrigation works, and Among offences the damage to weirs and lay down in this regard the procedure for determining responsibility and compensation for lost and damage to the property.

It must be noted that with the change and development of monastic life in Sri Lanka the Buddhist monks were enjoying the requisites from the income derived from irrigation works and fields. They were compelled to be conversant with the rules and regulations concerning village irrigation works, which were in operation at the time. Failing to observe these common rules and regulations regarding water management and tax probably would have led the monks being liable to a charge of theft, an offence for which the punishment was expulsion from the order.¹⁵¹ In discussing these offences, Buddhaghosa goes into detail to explain the

manner in which that offence could be committed in the course of utilization of water from reservoirs.

Paranavitana was also of the opinion that these regulations found in Samantapāsādikā throw indirect light on the standard of legal conduct in vogue among Village Committees in Sri Lanka during the fifth and preceding centuries,¹⁵² and further the conditions of the village reservoirs and channels in the early days.

People sometimes can be selfish and even cause injury to others for their own achievements. The proprietors of irrigation works who derived the income therefrom, were sometime prevented by many devious methods adopted by people. The following passage from Samantapāsādikā shows us an instance in which illegal acts were committed by villagers both for causing loss to others and also to the irrigational works.

With regard to the matter of breaching the dams (of reservoirs), he who has breached a dam with trees growing thereon has committed a dukkata offence, as it is a stratagem for theft, and the offence is committed at each blow. One who breaches the dam by taking his stand inside the reservoir and working outwards, completes the offence where the outer extremity is reached. When cutting inwards from outside the act is completed when the inner extremity is reached. When breaching from inside as well as from outside, leaving the middle, the act has been committed

when the middle is reached. If any person after having weakened the dam (of a reservoir) drives cattle thus driven come and cause the dam to be breached with their hoofs, it has to be held that the breach of the dam had been caused by that person himself. If any person, after having weakened the dam, drives cattle into the reservoir, or causes the village children to drive cattle (into it) and the dam gets breached by the waves raised by such cattle, or (if a person) asks the village boys to sport in the water, or frightens boys who are sporting in the water, and the dam gets breached by the waves raised by them; or fell or cause some one close to fall down, a tree growing in the water inside the reservoir, and the waves raised thereby breach the dam, the dam has been breached by that person himself".¹⁵³

As regard to the regularity of water it says:

If any person after having weakened the embankment of a reservoir, obstruct the floor of water at the place where the water flows down, provided for the safety of the reservoir or closes the cistern through which water flowed out, or constructs a ridge in such a manner as to lead to this place (reservoir) the water which would flow to another place, or straightens the canal, or breaches the reservoir belonging to himself situated above another's reservoir, so that the water rushes in sweeping the embankment

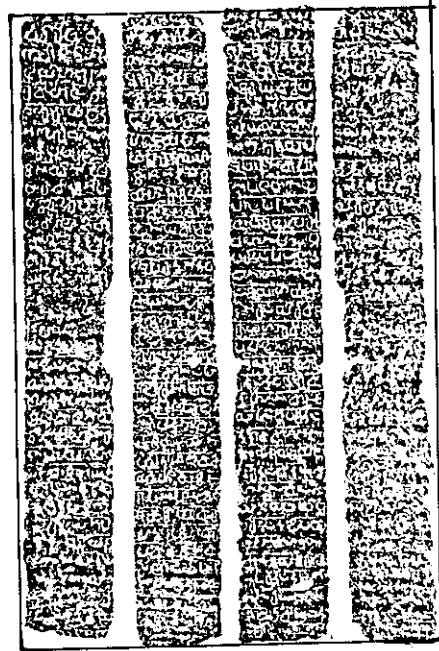
away, (if the embankment is breached through any of these means), it is to be taken that it has been breached by that person himself. In all such cases, action has to be taken on considering the amount of water that has flowed out. The same law applies to a person who opens the channel along which water flows out and leads out water.¹⁵⁴

The rules and regulations were introduced not only with regard to water but also to the fish in reservoirs and channels. From the description given by Buddhagosha it is quite clear that "in ancient times, where a reservoir irrigation channel or sheet of water was held to be owned by an individual, the fish therein was considered to be the property of that individual and any other person appropriating such fish by whatsoever means was liable to be held as ~~as~~ having committed theft".¹⁵⁵ The large and State owned reservoirs probably would have been administered by the King and regulations for such were enforced. For example we see from the Basavakkulam Pillar Inscription of King Sena II (813-887 A.D.) that the King had prohibited fishing in that reservoir, the reason for it been the sin committed by taking away the life in any form. This is further proved by the presence of Mahāvihāra - the great monastery by the side of the reservoir.¹⁵⁶ Granting protection to all beings in the great irrigation reservoirs by King Nissanka Malla in the 12th century,¹⁵⁷ can be a continuation of the above practice by a pious King.

The power, and authority yielded by the monasteries of those days with an abundance of wealth in the form of land

and irrigation works donated to the monastery by generations of members of the royalty and intended to be permanent further demanded an organisation to administer the monastic property during the 8th and 9th centuries. This shows that the Buddhist clergy was the most powerful sector in the society who even had the privilege to advise and guide the ruler of the country.

In early Brahmi inscription belonging to the dawn of the Christian era we find two terms ananika and adikaya being used to interpret as an irrigation engineer and a functionary in charge of work relating to canals.¹⁵⁸ The right to irrigation was a privilege enjoyed by the Buddhist monasteries. The Vessagiriya Slab Inscription of Mahinda IV (956-972 A.D.) clearly puts it on record. When a dispute ^{the} between/royal officers and the employees of the Isurumuniya monastery concerning the rights to water from the Tissa reservoir was brought to the notice of the above King, he decided in favour of the monastery and set up an edict for the future guidance of his men. According to this royal decree precedence was given to the fields of the monastery as well as the gold fish park, to the nursery and to the ponds in the park in the distribution of water from the reservoir, without interruption until the stone pillar set up in front of the sluice gate at the depth of four cubits appeared above the water level. If the crop should be destroyed through the negligence of the royal officials to supply water, the damage will be born by the King himself.¹⁵⁹ According to another inscription at Polonnaruva by the same King the royal officials who supervised the agriculture known



in those days as Velvāssan and Velkāmiyan (till recently these officers were called Velvidānes) were asked to refrain from interfering with the irrigation rights of the monastery.¹⁶⁰ With these rights, the monasteries were free to maintain irrigational works in their possession and also enjoy the privilege of rights to State reservoirs and canals. These feudal, elements introduced to Buddhist monasteries by early 'pious' Kings brought about a complete reverse of the goals of the monk who has once given up his life as a layman in search of truth and to be detached from the worldly pleasures.

The maintenance of the major irrigational works was one^{of} the responsibilities of the State in the latter times. In a decree of Mahapā Dāpūl (918 A.D.) the "office of the twelve great reservoirs (dolos-maha-vātān) was empowered to commandeer the labour of the villagers whenever necessary".¹⁶¹

This also reminds us that by the 10th century twelve great reservoirs in the Rajarata were considered as national treasures. In another inscription at Mihintale belonging to the reign of Sena II (853-887 A.D.), we also find an officer called vā-vājārama equal to a Inspector of Reservoirs whose duty must have been to look after the maintenance of the reservoirs. The Kondavattaran Pillar Inscription of Dappula V (924-935 A.D.) states that for an offence connected with the flooding of the fields the fine of two akas (one eighth of a gold coin) will be levied and for an offence connected with ploughing, the fine will be a kalaṇḍa (gold coin), and for the offence of having ploughed late, the fine will be five kalaṇḍas.¹⁶² The laws regarding the paddy fields intended for the cultivator-tenants must have necessarily been introduced for the better management of water resources during a period of turmoil and war in the country.

These conditions can be well compared with the earlier periods when the village reservoir was considered a common property of the community. Since the irrigational works were the property of the village community, the water was also distributed equally without giving advantages to certain people. How the people benefitted by this scheme is quite easily understood from a description given by Buddhaghosa in the Samantapāsādikā. It says

"All men in the community have a proprietary right to the water, in the reservoir, for crops are raised on land below it (reservoir). In

order to feed the crops, the main channel issues forth from the reservoir and goes through the fields. The water in that channel, too, when it flows along it, is common property. From that main channel, smaller distributory channels branch out and supply water to individual fields. The water from such feeder channels is not allowed to be taken by persons other than those whose fields they serve. In seasons of drought, when the supply of water in the reservoir is reduced, water is distributed to each field by turns. If any (owner of a field) whose turn had come does not receive water, his crop will be dried up. Therefore, one should not receive water in the turn of another. Where a person diverts the water into his own channel dishonest intention, from the distributory channel or the field belonging to another or allows the water to flow into waste land, he has committed an offence. In the case of one who, reflecting that his own turn will come very soon, but in the meantime his crops are drying up, blocks the course of water to the field by another, and leads the water into his own field, he also has committed an offence. Should one place obstacles for the passage of water, before the water had come to the intake of the distributory channel belonging to another, while the channel is still dry and the water had not yet issued from the reservoir, so that the water, when it comes out of the reservoir, comes into his own field, there is no

illegality if the obstruction is placed before the water had issued forth, but one is liable to fine if it is done after the water had started flowing. There is no offence committed by one, should one go to the reservoir, open the sluice-gate and lead water into one's own field. Why? Because his field depends on the reservoir".¹⁶³

The above passage clearly show that the village reservoir in the early centuries of the Christian era was considered a common property belonging to the village community and as such selfish persons were prevented from deriving undue advantages in the supply of water from reservoirs, which were owned by the entire village community.¹⁶⁴ It was for the proper water management that officers were appointed in the latter times especially in the 9th and 10th centuries, ^{as the demand} for water had increased, due to population and agricultural expansion coupled with the State participation in reservoir and channel building. It was felt necessary at this time to control the use of water due to scarcity caused by prolonged drought and again due ^{to} some misfortune such as a foreign invasion.

WATER CULTS AND RITUALS

One of Sri Lanka's greatest writers of modern times, Martin Wickramasinghe, once said that we try to understand the Sinhalese people only by looking at their ancient ruins such as the Stūpas, Buddha statues, stone pillars and monasteries. These ruins suggest only one aspect of their civilization. The greatest achievement of the Sinhalese civilization is still found among the ruins in the ancient

capitals and they are the great reservoirs which symbolises the skills and abilities of the Sinhalese. The early Sinhalese Kings built monasteries and Buddha statues only after constructing the great reservoirs for the agricultural people of the country and it is only after developing the country that the artist found the liberty and freedom of the mind to build works of religious and aesthetic importance.¹⁶⁵

This statement is true when you study the great religious achievement in the past, The daily feeding of thousands of Buddhist monks required a surplus in agricultural output and the cost of building ~~large~~^{large} stupas, colossal Buddha statues, monasteries and reservoirs and channels of imposing magnitude required a sound economy. All these would have been impossible to achieve had there not been ample food to feed the people and make them happy in their daily life so that they could contribute their share of work towards the development of the country. The population at the time in the Dry Zone as Farmer suggested must have been greater than at present.¹⁶⁶ At the time ^{of} Fa-Hien, the Chinese traveller monk's visit to Sri Lanka in the 5th century ~~he says that~~ there were five thousand monks at the Abhayagiri monastery, three thousand at Mahāvihāra in Anurādhapura and another two thousand at Cētiyagiri in Mihintale.¹⁶⁷ The total amount of monks then residing in the Rajarāṭa would have been at least twenty ^{five thousand and they all had} ~~thousand~~ to be fed daily. Lying to the south of the Jētavana stūpa is a refectory or dining hall of the monastery. The rice-boat (Sinh. dan-oruva) or trough we see there even today was to feed the above number

of monks at Jetavanārāma on surrendering a salāka or ticket in exchange for his meal. Such troughs are still found in places like Mihintale.

The life of the early peasants therefore very much depended on water. The reservoirs must be full to cultivate during the off seasons. Before, rain water had been the only hope of the people living in the Dry Zone. They therefore pleaded to the gods and deities for rain. In accordance with Buddhist religious customs and practices, they initiated rituals that they thought would bring down rain for timely cultivation.

The early Aryans who migrated to Sri Lanka continued a practice ~~of~~ their beliefs and rituals even after settling down here. One such belief and practice was associated with rain. The god who was propitiated for the purpose was the Vedic god named Parjanya. The early Aryan settlers performed such rituals on mountain summits and one such was the Jetthamūla festival held on the full-moon day of June and celebrated even in the 3rd century B.C.¹⁶⁸ The Sinhala word poson for this festival is apparently derived from the name of the god Parjanya. The god propitiated at the Jetthamūla asterism was this God of rain - Parjanya called Pajjuna in Pāli and Podona or Poson in Sinhalese.¹⁶⁹ That this was apparently a water festival celebrated by the kings and the people and continued even ⁱⁿ the 10th century is evidenced by an inscription of Kassapa V (914-923 A.D.).¹⁷⁰

As we have pointed out earlier, the people believed that one of the responsibilities of a king is to ensure rain for cultivation and a righteous ruler is capable of delivering the needs of his people and ensure the happiness of his subjects. The Anguttara Nakāya says that the stability of the social system as well as the proper functioning of the whole universe depend on the conduct of the King.¹⁷¹ Therefore, the author of Cūlavamsa is justified when he says that the gods always send rain in the correct season when Sena IV as a just king was ruling.¹⁷²

As pointed out above, the King was under obligation to his subjects to produce rain during a time of severe drought.¹¹³ The story of the righteous King Sivasangabo (247-249 A.D.) is a case in point. It is said that when a severe drought was causing distress to his people, the King forced the gods who control the weather to rain down in torrents by resorting to what may be called Satyakriyā or taking penance.¹⁷⁴ Another important act of Satyakriyā is reported in the same chronicle associated with the reign of the Tamil ^{King}/Elāra during the 2nd century B.C. This time it was about rain. The ^{chronicle}~~chronicle~~ says:

"An old woman had spread out some rice to dry it in the sun. The heavens, pouring some rain at an unwanted season, made her rice damp. She took along the rice and complained to the King. The King having heard about the rain in an unwanted season dismissed the woman, and in order to decide her cause underwent a fast, thinking: 'A King who observes justice surely obtains rain in due season'.

The guardian deities who received offerings from him overpowered by the fiery heat of (the penance of) the King went and told the four great Kings of this (matter). They took him with them and went and told Sakka. Sakka summoned Pajjunna (Parjanya - the god of rain) and charged him (to send) rain in due season.¹⁷⁵

The Sacred Bo-tree (Sri Mahā Bodhi) at Anurādhapura was another important object of veneration to the Buddhists in Sri Lanka ever since it was planted in the 3rd century B.C. The pious Kings and the people always believed that it had the power to cause rain when and if pleaded for. From the very day of the planting of the ~~planting of the~~ Sacred Bo-tree in the 3rd century B.C. four maidens were entrusted with the duty of pouring water on it and successive rulers continued to maintain this ritual which can be called a fertility cult. Thus, both the rulers and the ruled, being dependent on agriculture, ~~they~~ ^{very} piously believed that the sacred Bo-tree could ensure rain for successful cultivation and could guarantee fertility of the soil. Even today during a drought and famine the people in the Rajarata organise themselves and perform the age old ritual of bathing the Bo-tree by taking in a procession the waters of the Tissa reservoir in Anurādhapura. This procession is called the pān perahāra or water procession. After this ritual is performed, rains are experienced thus bringing relief to the people.

It was during the height of such a belief on the efficacy of the sacred Bo-tree that the Tooth Relic was brought to Anurādhapura from Kāliṅga during the reign of Kīrti Sri

Mēghavanna (303-331 A.D.) and deposited in Abhayagiriya, a rival institution of the Mahāvihāra to which the Sacred Bo-tree belonged.¹⁷⁶ In order to awaken the minds of the people to the same power residing in the Tooth Relic, this King arranged an annual festival in honour of the Relic with a decree that ~~the~~^{it} ~~relic~~ should be brought out every year in procession and an exposition held for the people. These rituals and ceremonies continued to be performed side by side at both the places till the downfall of the Anurādhapura Kingdom in the 10th century. Thereafter, the sacred Tooth Relic assumed importance after the change of the capital to Polonnaruva in the beginning of the 11th century. Godakumbura, corroborating this incident, says that "the Bo-tree could not be taken to the new capital whereas the Tooth Relic was removed. This sacred object was endowed with the powers of making rain and the belief developed among the Sinhalese people that he who possessed this Relic had the rightful and legitimate claim to the Sinhalese throne."¹⁷⁷ The cult of the rain making power of the Tooth Relic has now given a new concept to the kin^gship which has continued throughout the centuries till the British took over the rule in 1815 A.D. To illustrate the power of the Tooth Relic and how it was felt by the King and his subject a description found in Cūlavamsa is presented here relating to a great calamity that took place during the reign of Parākramabāhu II (1270-1272 B.C.) at Dāmbadeniya. It says

"Through the influence of evil planets a great heat arose in Lanka by which everything was burnt up, when the corn withered and a famine was inevitable and the host of the people were filled with great anxiety, the King ordered a splendid festival in Dambadeniya. He gathered the monks and having caused them to chant pirit (sacred scriptures) and bear the sacred Tooth Relic around the town in fitting manner with the firm resolve 'The heavens shall rain'. Thereupon great clouds gathered on every side flashing with lightning and again and again thundering so that it was a bliss for the ears of the people and it began to rain, destroying the glowing heat, driving away famine, beautifying the country and reviving the corn".¹⁷⁸

The annual Asala festival held today in Kandy and the exposition of the Tooth Relic are continuations of this old belief and ritual.¹⁷⁹ The chanting of Pirit or Buddhist Scriptures is another important ritual that assured rain. An example of pirit chanting to effect the weather occurred in the 3rd century A.D. during the reign of Upatissa I (365-406 A.D.) when there was a drought and pestilence. On this occasion the great King invited the Buddhist monks to go around the city reciting the Ratana Sutta throughout the night and sprinkling water.¹⁸⁰ The chronicle says that on the following morning a great cloud poured rain on the earth".¹⁸¹ A similar incident is reported during the reign of Sena II (853-807 A.D.).¹⁸²

(Cobra)

The cult of the nāga is another important aspect of belief associated with water. Several sculptural stones with the nāga figure on it have been discovered on the bunds of ancient irrigational reservoirs and even in bathing ponds. Nāga is associated with water. Therefore the idea of



The Cobra stone ("Naga gala")

erecting slabs of stones with the figure of the nāga by the side of reservoirs was to ensure their supply of water. They are also identified as guardians of wealth. The guard stone found in ancient sites both at Anurādhapura and Polonnaruwa have the figures of multi-hooded anthropomorphic cobra king or nāgarāja conveying the idea of both protection and prosperity or "guardian of water ^{and} of treasure."¹⁸³ A fine example of nāgarāja figures is still found in the Kuttampokuṇa in Anurādhapura.

Kings who built reservoirs and channels were held in high esteem by the people. As a result, some of the earlier Kings like Mahāsēna were deified after their death. Today the deified Mahāsēna is acclaimed the overlord of Minneriya and call him Hat Rajjuruvo or Mahasen Deiyo or Minnēriyā Swaamy.¹⁸⁴

There are also certain objects associated with water, which if deposited under water, would bring good luck. This belief of the ancient people is further supported by the archaeological findings in Anurādhapura where at the bottom of the Kuṭṭampokuna or the twin pond belonging to the 8th or 9th century was a stone casket. Inside this was a bronze box in which were deposited a figure of a crab, or a tortoise, [^]shell and two fish all in bronze. They are generally called jalaja vastu or objects of water for all these animals live in water.¹⁸⁵ The idea of depositing these objects under the water may have been with the hope that the waters would not dry up and the animals would continue to live in the waters. The continuous presence of the water treasure must have been the sole object of this deposit.

These cults and rituals explained above continued to be observed and practiced by the members of the society in Sri Lanka. Buddhism originally did not support such ideals but encouraged one's salvation from the suffering of the world through personal endeavour. Thus Buddhism accommodated the original beliefs and practices that the early Aryan settlers brought to Sri Lanka from India and continued to practice them in their daily life especially when they were faced with some calamity or danger or wanted the help of an

invisible power to protect them and grant their pleas without having to wait for births to fulfill ^{Their wishes depending on ones} ~~in the karmic~~ Karma cycle. Water for cultivation was an immediate necessity and in such a situation the people sought the intervention of the Vedic god Parjanya, the sacred Tooth-Pellic, the sacred Bo-tree, the power of the Buddhist doctrine and even from the animals associated with water. The harmonious blender of the inter-religious thought and practice is visible even today in the annual Āsala pageant celebrated in Kandy in the months of July-August as an age old ritual to pay homage to Buddha and to gods and goddesses and plea for rain water for the welfare of mankind.

The long history of irrigation in Sri Lanka with its proud achievements from the beginning of the 4th century B.C. up to the present time of its long civilization is a saga in the annals of man's experience in harnessing water ~~water~~ for his maintenance. Through his long arduous journey from the remote past to the present which has now taken two thousand five hundred years, we are able to see that the Sinhalese civilization gradually reached its climax beginning from the 1st century and continuing through the 5th Century A.D.

The history of the Sinhalese civilization is the history of the irrigation works of Sri Lanka. The wonders of Sri Lanka were the incomparable hydraulic achievements of the ancient Sinhalese. Irrigation and agriculture enabled them to build gigantic stūpas towering above the ocean of lakes, colossal Buddha images and monasteries on rocks as a glittering symbol of their devotion to Buddha - their faith and guide.

Sir James Emerson Tennent said in 1859 in his Ceylon that "no people in any age or country had so great practice and experience in the construction of works for irrigation".

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45