# Editorial

Mr M. Asoka T. De Silva

## Traditional Wisdom and Alternative Models of Development

Sri Lanka's rich heritage of creative traditional knowledge and practices, have been the force behind the most complex and indigenous irrigation system the world has seen. Technologically Sri Lanka had developed a unique wind driven iron smelting furnace, pioneering the production of the highest quality high-carbon steel the world had known commencing from the 3rd Century BC and reaching a peak during 7th to 11th Century AD. On the other hand, the small scale models of homestead farming described as Forest Gardens, are known to demonstrate the highest levels of biodiversity conservation known anywhere. It is this kind of indigenous knowledge that our ancestors used in all spheres of human activity throughout the recorded history of our civilization.

Traditions contain beliefs, customs and knowledge handed down through generations. It has specific features in a given culture, but it is also a partner with other neighbouring cultures.

Traditional Knowledge (TK) is sometimes referred to as 'Indigenous Knowledge', 'Local Knowledge', 'Folk Knowledge', and even 'Past Knowledge'. This knowledge is indigenous and local when it relates to a particular locality. It is also folk knowledge in character when it reflects the features and practices of a particular community. It is also past knowledge because it flows from generation to generation. Despite the diversity of characteristics of TK, there is a recognition that traditional wisdom in its dynamism and adoptive features, could not have survived the test of time, had it not served the basic needs for a holistic livelihood for the people, which included economic prosperity, biophysical and spiritual advancement, and contentment to live in harmony with the natural environment.

It is clear that general policies on liberalization and globalization tend to create extreme forms of inequality and deprivation in social organizations, while the consequent extravagant consumption of natural resources leads to deforestation and loss of biodiversity, creating problems of waste disposal, as well as air and water pollution. On the contrary, these very specific concerns in environment management have been eloquently addressed through foresight, understanding and knowledge by our forefathers in a past era of contended living. It is in this context that TK needs to be revived, revitalized and appropriately utilized in alternative pathways of development to rationalize the current pace of unstable and skewed development.

It is an unfortunate reality that despite the unique advances made by Sri Lanka in recent times, the rapidly increasing population pressure, and consequent environmental degradation, driven partly by global policies on liberalization and globalization, have tended to create inequality and deprivation in our own social order. In this context one sees the need for a new paradigm in national development for which the State itself may take on the onerous task of evolving alternative models of development to ensure societal equality, equity, magnanimity and harmony through the guidance of the country's traditional wisdom and knowledge.

# Indigenous Irrigation Practices

Dr P.B.Dharmasena

## Indigenous Irrigation Practices

Our irrigation heritage extends over a period of more than5000 years. Best practices of agriculture, land use, irrigation, and watershed management are still in existence showing great evidence for the technical wisdom that we had in this golden era. Pre-Mahwansa historical documents bring to our notice the initial setting of the hydraulic civilization.

It is believed that before Vijaya arrived in the island, our ancestors had built up large reservoirs and canals, which provided water for agriculture. When arrangements were being made to construct a new sluice gate during 1981 for the southern bank of the Maduru Oya reservoir, an ancient sluice gate was found at the same location selected for the sluice. According to Mahawansa this reservoir had been built by King Mahasen (273 AC), and subsequently repaired by King Wijayabahu (1055 – 1110 AC), and King Parakramabahu (1153 – 1186 AC). However, according to a popular belief, the yakshas who lived prior to the arrival of King Vijaya (6th century BC), had initiated the original design of the sluice gate (Fig. 1).

**Fig. 1. Ancient sluice gate of Maduru Reservoir**

Many ancient structures had been initially built by a certain king, and subsequently various other kings had repaired these for their use. The history sometimes tend to record one of these subsequent kings as the pioneer. One such example is the Fortress of Sigiriya which was claimed to have been built by the King Kashyapa, although it has a past history dating back to 3,000 BC. According to a chronicle Warga puranaya (one of five volumes of *Pancha Rakhkhawali*), a prince named Singhamukha had reigned even before King Ravana built this Kingdom with the support of Vishwakarma brought from India.

Whoever was the King who constructed pleasure gardens of the Sigiriya kingdom, must have been in need of water to be collected at a relatively higher elevation for irrigating

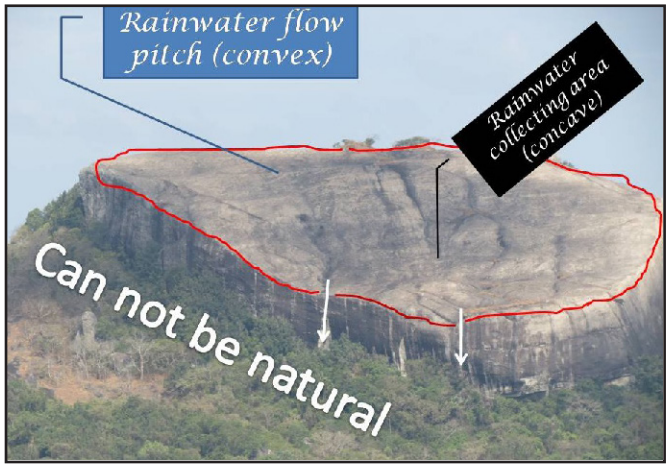


**Fig. 2. Pidurangala Rock – Ancient Rainwater Harvesting**

the gardens and providing water to ponds and fountains. This need must have been fulfilled by constructing a rainwater harvesting system close by. The top face of the Pidurangala rock breaking the natural shape and converting to a runoff flow pitch, can be believed to be the source of water to the Sigiriya kingdom (Fig. 2).

The platform area of Pidurangala rock is about 2 ha in extent. If it is assumed that 80% of monthly rainfall could be collected from this flow pitch, the volume which could be stored monthly would be as given below. For this calculation it is assumed that the present rainfall at 75 % probability in DL 1b AE region, where the Pidurangala rock is located. According to calculations, at least 10,000 m3 of water can be collected from this system. What does this mean?

This historical perception can be rejected as a myth. However, if this system can be rehabilitated, it will be able to store annually a volume of 10,000 m3 of water for the people living around the area, who are presently threatened with the chronic renal disease with unknown aetiology.

Even before Vijaya arrived in the Island, the management of water resources for irrigation had been given utmost attention by our ancestors. This can be described at various levels of water management as mentioned below.

## Inter-river basin management

There are 103 river basins in Sri Lanka, but some of them are very small in size. The basin area is over 1,000 km$^2$ only in 17 river basins. Rivers of these basins are: Kelani Ganga, Kalu Ganga, Walawe Ganga, Kirindi Oya, Menik Ganga, Kumbukkan Oya, Gal Oya, Munden Aru, Maduru Oya, Mahaweli Ganga, Yan Oya, Ma Oya, Malwathu Oya, Kala Oya, Mee Oya, Deduru Oya and Maha Oya. Most of these basins had come under the 10 ancient administrative divisions during Ravana Era . Some of these rivers are poor in water flow. Therefore the Kings had to create inter-river diversions through 'giant canals'. Examples for such giant canals are: Dambulu Oya–Malwathu Oya diversion canal (860 AD); the Malwathu Oya–Kanadara Oya diversion canal (860 AD); and the Yoda Ela–Nachchduwa feeder canal (540 AD). Remnants of these giant canal can be seen even today (Fig. 3).

## Inter reservoir water management

They found that some reservoirs could not be fed by their own catchments, but they still required them for a particular purpose. Thisawewa was built to irrigate paddy tracts of Ancient Anuradhapura Kingdom, and also to replenish the groundwater reservoir under the city. They also build Basawkkulama and Nuwara wewa for the same purpose. However, catchments

| Months | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rainfall (mm) at 75% probability** | 30.3 | 12.6 | 26.0 | 87.7 | 31.8 | 3.1 | 3.4 | 4.4 | 25.9 | 132.0 | 168.3 | 105.7 | 631.2 |
| **Runoff (m3)** | 485 | 202 | 416 | 1,403 | 509 | 50 | 54 | 70 | 414 | 2,112 | 2,693 | 1,691 | 10,099 |

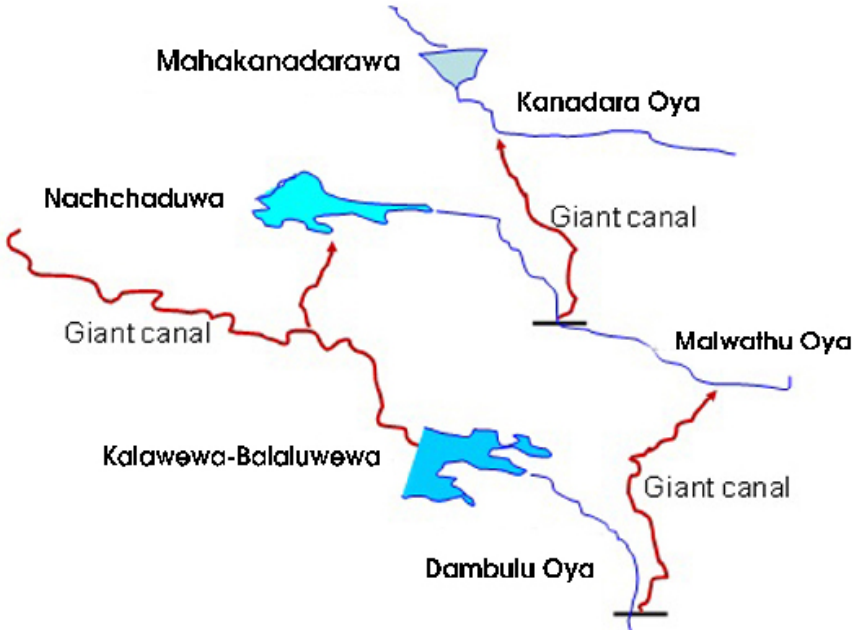


**Fig. 3. Inter river basin Giant canals (Source: Brohier, 1934)**

of these reservoirs were found to be inadequate to supply the required volume of water. Hence they transported water from other reservoirs such as Kalawewa, Nachchaduwa etc. through giant canals. These giant canals are the feeder canals of : Kalawewa – Thisawewa, Yodha Ela (470 AD); Nachchaduwa – Nuwarawewa (290 AD), Balaluwewa – Siyambalangamuwa (290 AD); and Basawakkulama – MahaVilachchiya (470 AD). Fig. 4 illustrates this further.

### Water management among small tanks

The recurrent shortages of water for agriculture, animal husbandry and for domestic use, caused by droughts and dry spells had always been a serious natural and economic setback to the rural communities in the dry zone areas of Sri Lanka since ancient times. This is indicated by many references to the drought hazard frequently found in the historical chronicles such as Mahawansa, Chulawansa etc. The ancient irrigation reservoirs and the hydraulic society that once flourished in these areas exhibited a remarkable human adaptation to the problems created by droughts, floods and seasonal water shortages.

There are about 14,200 small tanks and 13,000 anicuts found in Sri Lanka, feeding an extent of about 246,000 ha. This is 39 percent of the total irrigable area in the country. It contributes to the national rice production by 191,000 mt (20%).

Irrigation planning between and in the tank cascade systems was another example showing the wisdom and skills of our ancient irrigation engineers. The drainage pattern formed in the undulating topographic formation in the dry zone landscape can be classified as dendritic drainage pattern.

This ramifying nature of the drainage system has led to the formation of clusters of small tanks arranged in series, which are connected to form a system known as 'tank cascades'.

Existence of small tanks in a cascade pattern is an advantageous feature in many ways. Surface water bodies spread over an area can maintain the groundwater level closer to the land surface at least in lower portions of the


**Fig. 4. Inter-reservoir giant canals**

minor basins. It can be postulated that the absence of such a branched system of tanks could have led to a rapid depletion of groundwater due to the effect of the natural gradient of the drainage system. Therefore, if there were no tank cascade systems, the natural vegetation that could be seen today would not have been in existence in that same composition with deep-rooted large tree species appearing in various positions along the catenary slope.

Upper tanks in a tank cascade system act as buffer reservoirs to absorb flood-generating rainfall, which would otherwise cause the breaching of lower tanks. Similarly, these upper tanks are buffer reservoirs to supply water to the lower tanks when they are short of water to save the crop. Since these tanks exist not in isolation but as clusters, and are hydrologically inter-related, high level of water resource management and planning skills of individual tanks would be necessary to avoid conflicts in resource management among them.

Sustainability of the traditional tank cascade systems had been maintained in the past not only in relation to structural maintenance. Each and every component of the eco-system was given due consideration. The attention was paid not only to sustain macro-land uses such as paddy land, settlement area, chena lands, tank bed etc. but also to micro-land uses such as *godawala, iswetiya, gasgommana, perahana, kattakaduwa, tisbambe, kiul-ela* etc.

## Water management in paddy fields

Use of groundwater for irrigation was not a practice in ancient times. Their entire effort had been to innovate techniques for irrigation through surface water. Groundwater had been kept to maintain the vegetation around them and abstract water

in a very critical situation caused by drought. In responding to a drought situation people found water on river beds and in natural depressions, when digging down to a certain depth. These were temporary works. Once the drought was over, they neglected these water holes. However, they have used groundwater efficiently to protect their environment and in paddy farming. The people in the past retained a certain volume of water in the tank, which was not used for irrigation. The area called '*mada kaluwa*' (presently known as dead storage) stored water below the irrigation sluice sill level to be available during the dry season of the year for several purposes. They wanted to allow the fish population to continue their life cycle, trees around to survive, cattle to drink and people to use for washing clothes and sometimes for bathing.

The argument that can rise that our ancestors had never used groundwater for paddy cultivation, is not acceptable. They used groundwater for paddy farming without exploiting it. In the past farmers cultivated paddy only in poorly drained lands, where the groundwater table was very shallow during many months of the year. This type of field is known as *purana wela* (old field). If the groundwater table is less than 50 cm in depth, the surface soil is moist enough to raise the paddy crop. They provided irrigation water only when they experienced a very dry maha season. This is one of the reasons why they could cultivate paddy in yala season from the tank water remaining after maha season.

***Bethma govithena:***

After maha cultivation the community had to decide whether to go for a yala cultivation or abandon the paddy tract without cultivation due to shortage of water in the tank. In some yala seasons water is available but not adequate to cultivate the entire paddy field. In such circumstances people take a decision to cultivate a portion of the area, temporarily redistributing among farmers a part of the command area. This cultivation method of dividing the land is known as *bethma*.

***Thavulu govithena***

Sometimes when people realize that the forthcoming maha season is anticipated to be very poor, and the tank has no water, they decide to cultivate the upper part of the tank bed called *thavula* or *thavalla*. Farmers fenced the *thavula* area and constructed a bund along the lower boundary of the *thavula* called *maha niyara* (master bund). This bund was meant to collect and retain the limited rainwater or runoff received and to prevent sediment moving to the tank bed. Usually farmers commenced this cultivation in early November targeting the harvest to be available before the New Year ceremony in April. The tank bed soil is very fertile with high organic matter content.

***'Kekulama'***

Farmers had various indicators for foreseeing the forthcoming maha season rainfall. One was the '*binara kaluwa*', coming in mid September. If *binara kaluwa* brought a good shower, they start dry sowing their paddy fields with the residual moisture. This is because they knew that the maha season would not provide much rains to fill the tanks. This indicator was found to be true when we analyzed Maha Illuppallama rainfall data. Figure below illustrates the variation of maha rainfall with September rainfall.

***'Karahana'***

This water distributing device is said to be the oldest in the world used for controlling field level irrigation water. The device was made of a wood log which had two weir shape cuts of different sizes in depth and width. It diverted the flow in two directions with different discharges to feed two different extents of paddy fields. The *Gamarala* or *Wel Vidane* had the control on it.

***'Daha Ana':***

The ten orders of indigenous villagers
People had ten orders to obey in the village called '*daha ana*'. It covered aspects such as water security, environmental protection, food security etc. The ten orders of the villages enforced by the village headman are as follows.

i. *Diya paththayam thahanchiya* – The order is enforced in times of water shortages to prohibit water use for cultivation or pollute through other means (water security)

ii. *Niyama kanneta goithen bath* – Farmers should follow the cultivation times declared by the '*wel vidane*' (head of water management) and '*gamarala*' (village headman) and '*neketharala*' (astrologer) to avoid cultivation risks (risk evading farming)

iii. *Gaha kola satha seepawa - Binkare wathurai aibowa* – Protect the environment (forest and wild animals) to ensure water security (environmental protection)

iv. *Hithe ispasuwata dan-pin karannata - Petipas parane hadapan wadapan* – Raise and look after well the five pets (child, calve, dog, cat, chick) to make your mind free to attend to religious activities (simple life style).

v.*Akahe wehi keten - Wev amunu puropan* – Fill tanks and anicuts from rainwater (rainwater harvesting)

vi.*Ekathu pada nowi - Hari haman wedak nokaran* – Any work should be done as a group (small group concept)

vii.*Wee kurahan sambhare – Atu kotu purawan rale* – Natural disasters can cause crop failures. Thus, they should store grains for future use (food security).

viii.*Thel peni aththan – Kevum the pangngan* – To took care of being independent without waiting for external support (Self dependence)

ix.*Kem pahan dena gan – Sanuhare rekagan* – The knowledge they have gained should be practiced to ensure the sustainability (Protection of knowledge)

x. *Kawi sindu ragan – Hithata kawaddapan* – They should continue to practice their cultural traditions (Protection of culture)

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# Indigenous Knowledge : An Overview and Case Reviews

Mr. Asoka de Silva

## Introduction

When our ancestors systematically organized reservoirs and irrigation channels to cultivate lands; established human settlements; and retained the forest cover; they were skillfully managing water resources, and conserving the environment for posterity. When farmers cultivated different varieties of rice, recognizing their specific qualities on food value, palatability, and medicinal value, they were not only sustainably drawing the gifts of nature, but were also conserving a priceless biodiversity. When multi-tiered farming systems were raised for food, medicine, fuel and fodder in homesteads, they were conserving germplasm *in situ*, and simulating a natural forest cover. The sons and daughters of this small island of Sri Lanka, are the proud inheritors of this unique culture and wealth of traditional wisdom that evolved, survived or perpetuated generation after generation by a process of observation, enrichment and refinement, and validated by test of time.

Despite relegated, a vast body of knowledge remained intact with traditional communities, communicated orally or written down in ancient text (e.g. *Susrutha*), or stated in cryptic form and transmitted in practical situations through apprenticeship. It is this wisdom that nations world over are looking forward today for solace and guidance for a harmonious living environment.

## The Global Context

• The World Intellectual Property Organization (WIPO), recognizes Traditional Knowledge as tradition-based literary, artistic or scientific works; performances; inventions; scientific discoveries; designs; marks; names and symbols; undiscovered information; and all other tradition-based innovations and creations resulting from intellectual activity in scientific , literary or artistic fields

• Article 8j of the Convention on Biological Diversity describes TK as knowledge, innovations and practices of indigenous communities around the world, particularly in fields of agriculture, fisheries, health, horticulture, and forestry.

• About 45 years ago organizations such the World Health Organization (WHO) took the initiative to study the resourcefulness and impact of traditional medicine in primary healthcare. Recognizing that TK can be codified, regulated, taught and practiced. WHO defined Traditional Medicine as including "diverse health practices, approaches, knowledge and beliefs, incorporating plant, animal and/or mineral based medicines, spiritual therapies, manual

techniques and exercises applied singularly or in combination to maintain wellbeing, to treat, diagnose or prevent illness".

## Characteristics of Traditional Wisdom

The basic features of TK are, 1) Traditional Knowledge is the result of man's interaction with the environment to fulfill the needs of society, 2) The emphasis of TK has been mainly on natural resource management, agriculture, climate and water, food security, technology, genetic resources and ecosystems. 3) Traditional Knowledge sets out the framework for governing the use of resources. This knowledge accepts, recognizes, and respects nature, 4) Traditional Knowledge in most cases is not considered an individual's private property. In such instances property rights over TK are vested with a larger group that spreads beyond the present individual or groups. 5) Traditional Knowledge is not documented as in modern scientific writing. It is often transmitted through verbal forms, or is written in cryptic form that requires a specialized set of skills to decipher, and 6) Use of TK knowledge also carries with it the ethical obligations that its origins may carry.

## Case Reviews: A Cost Effective Indigenous Method for Paddy Cultivation

A refined system of paddy cultivation referred to as "*Nawa Kekulama*" was practiced by about 100 farmers in the villages of Villachchi and Galnewa in the North-Central Province. A characteristic feature of it was the technique of ground preparation with zero tillage. The weeds were slashed and removed from the "*liyadda*", but the "*niyara*" (bunds)

remained untouched. The paddy seeds were then dry-sown over the stubble, and then covered with a 3-inch thick mat of dry-paddy straw.

Where irrigation water was provided, an auspicious time and date were determined in consultation with local irrigation authorities. For rain-fed areas the time was determined through astrological considerations. In either case spiritual exercises and pirith ceremonies were conducted either by priests in the village temple, or by lay elders.

Among the rituals was the use of a new mammoty to cut the first sod (*archarya pidella*), and depositing it in the lowermost field (*liyadda*), the offering of alms to fellow villagers, and determination of the system of shared labour.

With the first showers, or the first release of irrigation waters, the paddy seeds germinate and sprout above the mulch of paddy straw. Interestingly, even without any standing water, paddy plants were well established with no weed growth. Farmers were aware that sprouts of paddy plants unlike those of many other plants (weeds) grow as pointed shoots which can penetrate the bed of straw and grow without being hampered by weeds which do not have this capability. These farmers did not use any agro-chemicals, and with low-cost land preparation, the profitability was exceptionally high, although average yields per hectare were about 20 to 30 percent less, than with modern techniques.

*Nawa Kekulama* also has a novel system of pest management. According to these farmers, insect pests that are known to attack paddy plants, do so because there are no other plant material available for their survival. The paddy plant according to them is the least important source of food for survival of pests. Thus when the bunds or "*niyara*" are left untouched and wild, the insects tend to live on the plants

or weeds standing on the *niyara*, without unduly concerned about the paddy plant. By this means pest infestations were minimized.

However, these farmers also employed spiritual and other techniques. For instance, one pious farmer said that he picks up a few of the known insect pests, and recites a series of pirith stanza several times at a time before releasing them alive. He claimed that such pests did not return to his field again. As evidence he showed the difference between his paddy plants and the plants in another nearby paddy field, which had been severely affected by pests.

Another technique was the use of pest repellent plant material. In the Uva Province, farmers depending on ecological farming, prepared a crude paste by crushing the leaves of Neam and a plant called *Mahapatta*, wrapping it in a piece of cloth, and placing the pack near the water inlet to the paddy field (*Wakkade*). This approach apparently serves as a pest repellent.

## Indigenous Pest Control Measures for Vegetable Cultivation

Farmers engaged in ecological farming in the villages of Lunuwatte, Rahupola/ Thiyapola in Uva–Paranagama and Moneragala areas (Badulla District), resorted to rotational cropping.

The sequence in rotational cropping was common to both traditional farmers, and those who resorted to modern techniques. Typically paddy cultivation was followed by a vegetable crop such as beans, which is susceptible to insect pest infestation. Farmers practicing indigenous systems employed one or two of several simple organic treatments to repel insect pests. One common method was to dust the plants

with kitchen ash at dawn when plants were wet with dew. Another approach was to spray plants with a suspension of cattle dung in water.

Another technique was the use of crushed leaves and bark of the plant commonly known as "*mahapatta*", combined with the crushed leaves of Neam and a plant known as "*gora*". This mixture of crushed plant material was shaken with water in a large bottle and kept aside in the field for several days for "maturation". The maturation process according to these farmers, take place with dew-fall. The matured water suspension was then sprayed over the bean plants. The effectiveness of this pest control measure was quite evident in the vegetable plots of these villages.

## An Integrated Crop-livestock Farming System

The use of the buffalo as a multipurpose animal has been a traditional farming approach. Though the common use of buffalo was in draught power for ploughing and threshing, it was also used in weed control and fertilizer production. It has been known for generations that noxious weeds such as *Illuk* in coconut plantations, can best be controlled by buffalo grazing.

It has been a tradition to tether a pair of buffaloes for 10 nights to fertilize each coconut tree. This has been done even in large coconut estates, where buffaloes. were kept primarily for paddy land preparation, and secondarily for weed control.

A field experiment conducted at the Coconut Research Institute (CRI), Lunuwila, more than 50 years ago to compare the efficacy of the traditional system of organic fertilizer application with modern application of chemical fertilizers, established the fact that the quantities of buffalo dung and urine produced by a pair of buffalo heads tethered for 10 nights to a tree, provided nitrogen and phosphate nutrients in

proportionate quantities adequate for two years. However, potassium an important major nutrient for coconut was grossly inadequate. But by tradition, farmers also used kitchen ash as a supplementary fertilizer for coconut palms. It had been the age old practice to spread a 4 – gallon "oil can" full of kitchen ash round the base of the coconut palm as a supplementary fertilizer. Though the composition of kitchen ash varied, the common use of dried coconut husks (containing as much as 25 percent $K_2O$) as a fuel, in the traditional kitchen hearth enriched the ash with adequate amounts of potassium.

The conviction of the traditional farmer was that the amount of nutrients so supplied per palm by buffalo excretions and kitchen ash was adequate for 2 years. Significantly, the quantities and proportions of NPK in this combination of organic fertilizers were found to be comparable with the quantities and proportions of major nutrients (NPK) recommended by CRI for adult palms using chemical fertilizers. Thus this traditional system of organic farming became an official recommendation of CRI in the early 1960's.

## The Fading Socio-cultural Traditions of Childbirth in Rural Sri Lanka

This review is based on a presentation by R.S.H. Premkumar at a Symposium on TK in 1994, titled 'Traditional Midwifery', which depicts the fading socio-cultural traditions of childbirth in a rural society.

The central figure in this event is the "midwife", who although without formal training in the art of assisting child birth, is very well versed in its socio-cultural and procedural aspects, learnt through an apprenticeship, and through ones own personal experiences. An important feature of the midwife is the recognition and faith placed on her by the community at large in performing an onerous task, which in the modern society is performed by a highly qualified and skilled team of doctors, nurses and attendants. The traditional role of the midwife begins at an advanced stage of pregnancy, with preliminary preparations to receive the newcomer. The initial step is to sweep the improvised labour room and sprinkle turmeric (*Curuma domestica*) in the powder form or as a suspension. Although this is considered a ritual to repel 'evil spirits', in practice it disinfects the room.

She applies gently oil prepared from margosa (*Azadirachta indica*), gingelly (*Sasamum indicum*) and castor oil (*Ricinus communis*), from loins towards the epigastria. This substance is believed to give more flexibility and elasticity to muscles permitting easier contraction. Sometimes she may administer a little snuff to induce sneezing that helps to push the baby out. At the time of delivery, assisted by a few other women, several postures and positions are adopted according to the frame of the pregnant mother's body.

The placenta is severed with a sharp knife, usually the tea-pruning knife (or sometimes a pair of scissors), that had been previously treated with turmeric water and held over incense. This activity though ritualistic in the Hindu tradition, since it represents a plea for blessings of *Brahma* (the creator), *Vishnu* (the protector) and *Shiva* (the destroyer), is also a process of sterilization. The wound is then dressed with a medication made from the ash of the dung of a calf, mixed with pepper (*Piper nigrum*) and a herb known as "*vasambu*" (*Acorus calamus*). Castor oil is given to drink after the ejection of the placenta, which is then burnt outside the entrance to the house. A stone placed on top of the placenta is wrapped round with a rope to which mango and margosa leaves are clipped. This ritual is believed to

prevent evil spirits (inclusive of germs and bacteria) from entering the house. It is also symbolic, to the extent that anyone seeing this object would not enter the house, thereby ensuring hygiene and sanitation to mother and baby. This symbol is retained for 30 days, during which period the midwife assisted by older women would attend to the baby and the lactating mother.

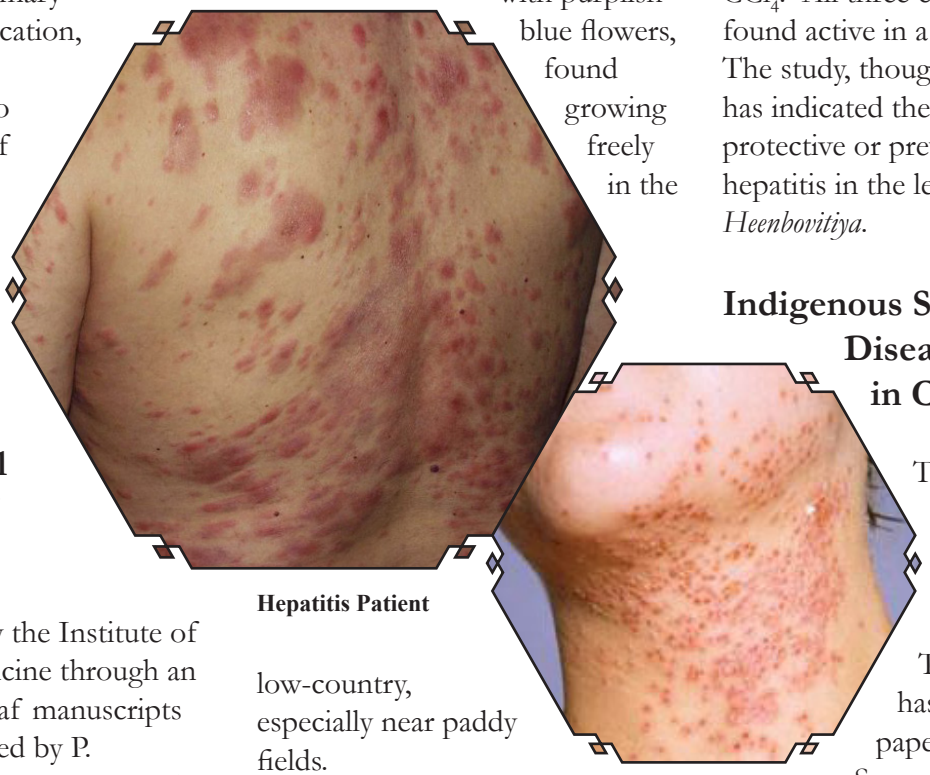
Finally there is the month-long aftercare, which is even a more exacting programme of diet management, primary healthcare, purification, and ritualistic or spiritual events to mark the entry of the mother and the newborn to the community hold.

## Ingenuity in Traditional Treatment of Hepatitis

Work initiated by the Institute of Indigenous Medicine through an analysis of ola leaf manuscripts has been described by P. Serasinghe in a paper presented at a Symposium on IK in 1994.

In 158 such manuscripts studied, eight plant species had been identified as being used as single drugs for the treatment of hepatitis, referred to in this literature as "*Kamala*". This ailment is also called "*Sengamala*", or "*Kaha Una*". Hepatitis or *Kamala*, is a viral infection of the liver causing hepatic necrosis of varying degrees. Modern treatment usually involves bed rest, intake of fluids, glucose, vitamin B and dietary measures.

The indigenous system of medicine, largely involves intake of a rice-based herbal porridge (*Cunge* or *Kola kenda*) for which *Osbeckia octandra* leaf is the commonest ingredient. *Osbeckia octandra*, locally known as "*Heenbovitiya*" is a small shrub with purplish-blue flowers, found growing freely in the low-country, especially near paddy fields.



**Hepatitis Patient**

However, a research grant awarded by Natural Resources, Energy and Science Authority (NARESA) to a team of researchers led by C. Pathirana of Ruhuna University in 1986, for a project titled "Studies of Medicinal Plants in Southern Sri Lanka", involved a chemical examination of six herbs that included *Heenbovitiya*. In this study sequential methonolic extraction of *Osbeckia octandra* leaves was done followed by chemical screening of extracts. Three compounds were identified in the extracts of which one was a mixture of three flavonoids. The products from active extracts were used for antihepatotoxic activity and liver dysfunction assessment in male albino rats of *Sprague Dawley* strain, whose liver damage was induced with an injection of $CCl_4$. All three compounds were found active in a preventive sense. The study, though inconclusive, has indicated the presence of a protective or preventive agent for hepatitis in the leaf extracts of *Heenbovitiya*.

## Indigenous Systems in Disease Diagnosis in Cattle

Through the examination of a 150-year-old ola leaf manuscript, T.N. Jayatilake has described in a paper presented at a Symposium on IK in 1994, an indigenous system of disease diagnosis and treatment of diseases in cattle.

An important aspect of this treatment philosophy is the classification of cattle into a system of breeds referred to as "*Gothra*", which is the preliminary

step. The correct identification of the '*gothra*' apparently gives an indication of susceptibility to particular types of diseases.

Disease identification is by an in-depth clinical experience, comprising visual observations and the time-tested system of indigenous knowledge. Skills in diagnosis and treatment are based on careful observation of sick animals, using investigations such as behaviour, pulse rate, respiration, dryness of the muzzle, rumination, defecation, urination, movement and posture of ears, changes and reddening of the eye, movements of the eye ball, tearing, nasal discharges, gestation, lactates etc. The diseases are diagnosed in relation to the site of origin, such as the diseases of head (nervous conditions,) ear (*kannal*), intestines (*veppu*), blood vascular, and respiratory (*adappan*).

An important aspect of the treatment regime used by these physicians is the incorporation of biophysical and spiritual aspects of medication. The spiritual medication is reported by Jayatilake as an advanced system of treatment of epidemiological significance, and known to have a visible impact in bringing about an immediate cure, or prevention of the entry, or spread of contagious diseases. Subjecting animals for spiritual medications and/or casting spells for immobilization are specialized aspects that are not fully understood. It is also a traditional practice to perform rituals annually in various parts of the country to bless livestock herds, and thereby prevent the entry and spread of contagious diseases. An example quoted by Jayatillake is the so-called "*Mangara*" ritual for buffaloes practiced in the Moneragala District. In addition animals are guarded against evil spirits using "*yanthra*", "*manthra*" and "*kem*".

## Ancestral Cloth and Garment Industry

Cotton had been grown in ancient times as chena cultivation in the highland areas. It had been a major trading material from the hill country to Anuradhapura. The cotton picked from the chena lands were dried and cleaned in homesteads. The seeds were removed by passing the cotton between bars in the cotton gin. The threads suitable for spinning were then prepared by beating the cotton with a bar, and winnowing and rolling. Cotton was spun by women who gathered in large numbers to spin while they sang songs selected from Jathaka Stories.

**Weaving machines used in Sri Lanka**

The weaving machines and techniques were said to be similar to those found in India and Burma. The loom referred to as the "*Aluva*" was fitted in a loom house (*alge*), which was an open shed. In weaving the fabric, alternate threads are selected from the warp by the shuttle ropes, when the shuttle moves either way. The motion is imparted to the loom by treadle.

The garments woven in ancient times were not made by the present process of designing, cutting and stitching, but were woven on the batten as a complete item of cloth or dress. Hence the cloth and garments were of various sizes, shapes and designs. In this manner a variety of garments for men, women and chieftains, and other items such as towels, napkins, shawls, handkerchiefs, bedspreads, etc. were woven. It is significant that the size and design of the garments made were determined by the caste of the wearer (Lakdusinghe, 1999, *Vidurava*, 19 (1), pp 20-25).

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# Indigenous Architecture of Sri Lanka

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## Introduction

Architecture produced by a civilization dignifies that civilization. Architecture forms a depository of artistic capabilities, beliefs, and aspiration of the people who created it, including their technological achievements and influences they faced during different periods of history, and many more information. Any historic building is like a book, which can be read as chapters that describe the different aspects of society that created and used it. In every civilization architecture reflects the pride of that civilization or society.

Sri Lankan architecture can be looked at under three headings; religious architecture, secular architecture and architecture of the peasants. Religious architecture was created to last long, and represented the glorious creative components. The other two types covered the dignified creations of royal palaces, residences of the elite, public buildings and different types of peasant houses. It is interesting to note that on the long continuation, and in their chronological development, architecture has shown different achievements through historical periods, and the resultant influences are exhibited in their architectural expressions. Indigenous architecture in Sri Lanka had continued and survived for more than two thousand two hundred years, the remains of which are seen in many edifices constructed during the different historical periods of the country. The profession of architecture in Sri Lanka was considered so important and special that compilation of text books on architecture, took place explaining architectural theories, principles and practices that were exercised during different periods. The Silpa text "*Manjusri Bashitha Vastu Vidya Sastra*" was one of the important architectural texts complied in the 5th Century AD. This architectural text gives a complete description of designing and setting up of Buddhist monasteries, and to ascribe a spiritual standing it was dedicated to Bodhisatva Manjusri. This book gives an explanation of each and every building type found in a Sri Lankan Buddhist monastery, their building forms, settings and layouts. It gives an account of the five important sacred buildings found in a Buddhist monastery, namely the stupa, image house (*pilima yage*), Bo tree shrine (*Bodhighara*), chapter house (*Upostaghara*) and

**Ambekke ketayam**

meeting hall (*Sabha*). This book has given a description on every type of building. As an example, it says, stupas can be built in seven different shapes, namely, the bubble shape (*bubulakara*), pot shape (*ghatakara*), the shape of a heap of paddy (*dhanyakara*), bell shape (*ghantakara*), shape of a Nelli fruit (*amalakara*), the lotus shape (*padmakara*) and onion shape (*palandwakara*).

These text books provided not only information about plans, layouts, knowledge etc., but also the religio-cultural beliefs that transcend the theories that give rise to the spiritual affiliation of the building. Without this architecture silpa text, it would not have been possible to explain and understand the unique features of monastery buildings found in Anuradhapura.

Sri Lanka's indigenous architecture is composed of many facets that include traditions, their response to the climate, use of available material in the locality, design and creativity, aesthetics, proportions and composition, use of topography, rocks and boulders, response to water, astrological beliefs and to religio-cultural practices. In addition to the utility value of the building and prosperity of the user, durability and aesthetics were given priority. An architect was also considered as a priest knowledgeable in conducting rituals during construction. The architect had to be well conversant with carpentry, masonry, building materials, construction technology and astrological beliefs. It is the tradition that God Viswakarma is venerated as the guardian deity of all creations, design, crafts and construction. Therefore any work of high standing is considered a divine product created with the blessings of God Viswakarma. Architecture was taught in the tradition of knowledge transfer from master to pupil (the *Gurukula* tradition), and was mostly confined to a special guild

**Nelum Pokuna**

or caste. The architect learned his profession through apprenticeship closely associating or working with the master and also following the silpa texts.

The most significant influencing factor in the development of the architectural history of Sri Lanka was the formal introduction of Buddhism by Emperor Asoka of India in 247 BC. But the ancient city of Anuradhapura was designed on a drum (*mrudanga*) plan, and was not of Aryan origin, but by those who inhabited the country when Aryans arrived in Sri Lanka in the 6th century BC. Further, there are also large numbers of pre-historic cyst burials constructed using large stone slabs enshrining ashes of the dead, and there are many cave dwellings with cut drip ledges at the top to avoid water dripping in to the cave.

## Architecture of Anuradhapura Period

Ancient city of Anuradhapura served continuously as the capital of Sri Lanka for more than thirteen hundred years up to the 11th century AD, and the city was dominated with a large number of religious and monastic buildings. Within three centuries following the introduction of burnt clay brick technology to Sri Lanka in the 3rd century BC, the Sinhalese built the tallest brick structures in the world, the stupas. These are sacred buildings enshrining corporeal relics of the Buddha, and comprising a solid dome built on a podium paved out of square stones, terminating in a cubical masonry superstructure at the summit and a central spiral with a pinnacle terminating in a cut gem acting as a lightning conductor. There are large stepped entrances to the podium located on four cardinal directions facing four altars that are decorated with beautifully carved animal, floral and geometric patterns.

A stupa forms the dominating architectural edifice of a monastery, and the height of the dome varied from 2 to 150 meters. The monasteries in Anuradhapura were large universities. For example, Jetavana and Abhayagiriya had about 5000 monks resident in each, while Mahavihara and Mirisavetiya had about 3000 monks each. These

**Mirisavetiya**

had well designed layouts with two storey for monks residences, image houses, congregation halls, kitchens, refectories, hot water baths, hundreds of drinking and bathing ponds and many other buildings to meet monastery requirements.

Sigiriya, the landscaped fortified city established in the 5th century AD, dominated by the royal precinct built in association with a 200 meter large rock out crop, is a unique creation, and today it is a world heritage. Sri Lankan architecture is mostly landscape driven architecture, composed of an organic format in relation to an axial arrangement, associating levels in the topography, natural boulders, rocks, flights of steps, ponds with different configurations, flowing water, shaded with large varieties of trees and plants. Sigiriya is more or less a pleasure park designed for royalty, conceiving and ensuring as far as feasible the concepts of scientific conservation of the natural environment. The rock surface on the west carried the largest mural ever done by man. It covered an extent 100 meters by 30 meters in surface area with beautiful paintings of more than 600 royal ladies. The Mirror wall at Sigiriya covering the steps along the rock surface that was built 1500 years ago, continues to remain with a reflecting surface even after it had been exposed to sun and rain for such a long period. This Mirror Wall is covered with hand written poems adoring the beauty of the painted damsels and the surrounding vista, thus stamping the hand writings of thousands of visitors who had came to Sigiriya, from the 6th century to 14th century AD.

The Vessagiriya Monastery and Ran Masu Uyana, the royal pleasure park at Anuradhapura are excellent creations of the same King Kasyapa who built Sigiriya integrating the landscape, water resource and the built environment. As part of the architectural tradition stone carvings and mural paintings were used as decorative elements in all religious and secular buildings. The decorative concept in architectural work starts from the semicircular stepping stone of the entrance known as the Moonstone, and carried through a flight of steps, balustrades, columns, column capitals rising up to the pinnacle fixed on top of the ridge tiles placed on the roof.

## Architecture of the Polonnaruwa period (11th to 12th Century AD)

The two centuries of the Polonnaruwa period is full of architectural edifices inclusive of great stupas, image houses, the Temple of the Tooth Relic, and palace buildings etc. Unlike in Anuradhapura, Polonnaruwa had a large number of brick structures, which still stand exhibiting the scale and magnificence of their achievements. Badda simapasada was a monks congregation / residential building comprising twelve storeys, while Parakramabahu palace was of seven storeys. Architecturally these were timber framed buildings clad with thick brick walls in the lower floors. In most of these buildings large number of stone columns in the ground floor carried the load of upper timber floors and the roof. The tall brick built image houses like Lankathilaka, Thivanka and Thuparama had vaulted roofs made out of bricks, while the taller inner walls were structurally buttressed with another thick outer wall leaving a perambulatory path in between, which was lit with windows on the outer wall. In Lankathilaka, the two front circular pillers were constructed slanting towards the centre, to display an exaggerated optical illusion of height. The outer wall surface of all these buildings were decorated with brick and stucco sculpture on bas relief forms, composed of rows of animals and *vamanas* or dancing dwarfs. The upper areas were decorated with compositions of rhythmic figures of gods and Bodhisatvas within architectural formats called

*vimanas*. All these were beautifully painted in white, yellow ocher, and red ocher. Interior walls in these buildings are covered with rows of mural paintings depicting Jataka Stories and episodes from Buddha's life. In Thivanka, such paintings are still preserved to a great extent.
The Tooth Relic temple square at Polonnaruwa was composed of many important buildings constructed in stone and brick. A Vatadage is a stupa house built in the 12th Century AD by Parakramabahu I and renovated by Nissankamalla. It is a circular building with beautifully carved stone flights of steps at four cardinal directions, and decorated stone balustrade round the building. There are three sets of stone columns placed in concentric circles around a small stupa with four large stone Buddha images facing the four cardinal directions. The conical roof of this building was lost with time. Nissanka Latha Mandapa was a pirith charting hall with decorative stone columns carved in a rhythmic lotus stem pattern. In front of the vatadage are two stone buildings built by two kings to house the sacred Tooth Relic of the Buddha.

## City Planning after Polonnaruwa.

After the 12th century AD, the architectural pattern had changed. There were three capital cities with royal residences designed and built in association with a large rocky hill with the palace complex placed on the unpenitratable hill, while the city itself was protected with concentric city walls and moats for defense purposes. The Kingdoms of Dambadeniya, Yapahuwa and Kurunegala were designed on the concept of defense named as *giridhurga* in traditional city planning.

**Sigiriya**

## Architecture of the Gampola Period

During the Gampola period (1341 - 1391 AD), a new concept of a temple-village landscape planning process was seen. The village was planned around an important temple, with the village layout comprising houses for a large number families along the main street who served the temple. Here paddy fields were also allocated to each family in consideration of their service. These temples were designed to combine both Buddhist and Hindu Shrines. In Lankathilaka and Gadaladeniya, the Buddhist image house was dominant with a smaller Hindu Shrine. In other temples like Embekke, Viegiriya, Soragune, Ukkgal Aluth Nuwara etc., the Hindu Shrine was dominant while the Buddhist image house was smaller.

The Lankathilaka image house at Gampola had the same brick built architectural style as found in Polonnaruwa, with a vaulted roof. A hundred years later it had been found that the construction materials used here was not suitable during heavy rainy weather, and hence they were covered with a complex tiled roof. Gadaladeniya image house is a stone building constructed with a South Indian temple architectural tradition under the guidance of an Indian architect. It has a larger domical roof above the Buddha image shrine and a small dome above the Vishva shrine. This stone building was also later covered with a tile roof. Embekka Dewala has a two storey shrine dedicated to God Kataragama with a timber colonnade open mandapa building functioning as the drumming hall in front. It is an important example of timber architecture with beautifully carved timber columns and a dominating decorative timber roof. Vegiriya is a cave shrine housing clay images of Avalokiteshvara, Natha and Goddess Tara, now named as Biso Bandara. The floor and the rock ceiling is lime washed in white with independent statues placed in the middle creating a beautiful spiritual space. The timber door of this shrine is beautifully carved with floral and animal patterns, while a small Buddhist Shrine is placed on one side of the drumming hall found in front. Gampola architecture is a product of the socio-cultural complexity of the people resulting from a strong South Indian influence.

## The Kandyan Period

Even though the royal capital was shifted to Kotte, closer to western coastal belt of the island supporting a strong political stability, no architectural remains have been found due to the destructions caused by the Portuguese. With the establishment of the Kandyan Kingdom in the 16th Century AD, a new culture in Sri Lankan architecture emerged. The artisan families who were serving the king during Gampola period were living in the Kandyan region, continuously practicing their crafts. Later they would have served the Kandyan Kings. The Kandyan period architecture was folk based in nature, smaller in scale but refinely decorated with paintings and carvings., This decorative quality was seen not only in buildings, but extended also to furniture, house hold items and kitchen utensils.

Among the religious buildings found in the city of Kandy and in villages of the Kandyan Kingdom, are the image houses that continued to exist as important buildings. There are three major architectural types that can be identified here.

1.Cave temples – Natural caves with a drip ledge cut along the top edge of the entrance and extending the space by adding verandas, are found placed with seated, standing and reclining Buddha images. Some of these were renovations of the Anuradhapura or Polonnaruwa period Shrines. A Makara Thorana is found above the entrance door way, or sometimes a Makara Thorana was found built as a back drop to the seated Buddha image placed on a central pedestal.

The interior walls and ceiling of these shrines were beautifully decorated with mural paintings depicting Jataka stories based on the previous births of the Buddha and different episodes of the Buddha's life. Among these, the cave number three in the World Heritage Site at Dambulla with a large number of Buddha images and paintings, is considered special. This was done in the mid 18th century parallel with the other Cave Shrine made during early periods.

**Watadageya**

2. Image Houses. These are solid buildings built on a raised plinth with clay or clay rubble walls. These buildings were covered with a timber framed flat clay tile roof with long eaves. Among these buildings the Gangarama image house at Lewella is very special. It has a seven meter high standing Buddha image carved out of a living rock and enclosed within tall thick clay rubble walls. A low level verandah with stone columns and a half wall covered three sides of the shrine, while other side remained with the balance part of the rock formation. The lower section of the inner walls up to eye level is decorated with paintings depicting different episodes of Buddhas life and Jataka Stories. Upper parts of these walls are filled with paintings of seated Buddha images drawn within hundreds of quadrangles and the ceiling is also decorated with paintings.

Small image houses in village temples were mostly constructed by the villagers under the patronage of a local chieftain. Clay walls of these small shrines were constructed on a plinth with a front verandha, which was used as a drumming hall during the performances of rituals and festivals. The inside wall facing the entrance door, formed the back drop to the main seated Buddha image. On either side along the side walls were two standing statues of the Buddha and two standing statues of Gods Saman and Upluwan or Vishnu and Kataragama. Walls are decorated with mural paintings of Vessantara Jataka and different episodes from Buddha life. The ceiling is decorated with lotus floral and geometric motifs. Thick timber door sash is pivoted and fixed with beautifully decorated iron ironmongery inclusive of a large metal door key.

3. The third type of the image houses that were built in rural settings of the Kandyan Kingdom were raised on timber platforms supported on short or tall stone

columns, timber columns or stone boulders, are identified as Tampita Vihara or temple on pillars. These are either squire or rectangular shaped in plan. The buildings with a squire plan had a front verandah and sometimes with a narrow verandah running round the shrine. Square shrines are constructed with about two meter tall pillars. In linear buildings the front verandah is much longer and was used as a drumming hall. In some buildings, there is a separate mandapa or a columned hall constructed at a later date. Inside thus Tampita Vihara building was also found a seated principal Buddha image with two standing images of the Buddha and two guardian deities. All interiors are decorated with paintings. Some of these two storey structures are climbed with a steep timber stair case.

The Temple of the sacred Tooth Relic found in the Kandy Palace complex is a very special building developed on a two storey Tampita Vihara proto type. This special shrine housing the Tooth Relic is placed on a court yard of another set of two storey buildings of the temple complex. It is a rectangular building with a raised decorated stone plinth with a stone columned verandah set along stone steps in front and on two sides. All three large door frames are in stone and are finely decorated with carvings of floral and geometric patterns. The Kandyan period moonstones are found placed at the entry point of all three flights of steps. The upper timber floor is climbed through the front hall in front of the storage chamber called *aramudala*. This floor comprises a front open hall in front of the inner shrine that houses the Tooth Relic. There is a Verandah round this building with decorated timber columns supporting the long eaves of the roof.

This building is architecturally very special because all constructional materials used in Sinhalese Architecture have been used in structural and decorative forms. In stone it has a moulded plinth and carved columns, decoratively carved door frames in timber, carved and turned out pillars, carved beams and brackets, carved roof timber as rafters. Architecture includes the use of all construction metals such as iron, brass, silver and gold to decorate the building. The turned out balustrade pillars were decorated with lac in yellow, black, red and green. Door frames and sashes in the upper floor are decorated with carved ivory and elephant bone panels. Clay tiles used are moulded with design elements. All the columns, beams, brackets, ceiling panels, door sashes and walls were decorated with paintings depicting each and every design element in Sinhala art. The centre shrine or the Vedahitina Maligawa is a unique building in Sinhala architecture. Among the palace buildings the audience hall is a very special timber building. It is of the same plan form as the council chamber that had continued down from Polonnaruwa period. It is a linear building with a raised moulded plinth, and 68 carved tall timber columns in two double rows with a wider center space. The heavy timber structure of the double pitched roof is placed on decorated cross brackets on top of all columns. The large heavy roof with long eaves is claded with flat clay tiles and two brass pinnacles at the ends of the top ridge.

The importance attached to the Kandyan period architecture is to realize the fact that this was last link of the Sinhala civilization before British took over the country in 1815. The significance of the traditional religious architecture is to understand the consideration given to the philosophy of living with the nature, climate and the environment. It must be further emphasized that apart from the simplicity in their design and use of available construction materials, they adopted a culture of maintenance and conservation of architectural patterns by repetition. The changing values among the upper strata of the society in neglecting cultural values and traditions, and the acceptance of European values influenced by the western model of educational systems, had not only changed Sri Lanka's unique indigenous architecture, but also the way of life of the people of this country.

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# Evolution and utility of Indigenous medicine

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## Ayurveda

It is said that Ayurveda or the science of life span originated in Northern India 3000 years ago. Of the systems of medicine that originated in Asia Ayurveda is more organized. It is also philosophically, theoretically and practically enriched. It is interpreted to consist of two schools namely the *Dharvanthari* tradition and the *Athreya* tradition. It is believed that the discipline of medicine in Ayurveda originated based on the super physical intuition or the wisdom possessed by the sage *Athreya*, while the discipline of surgery in Ayurveda originated based on the knowledge of the great sage *Dhanvanthari*.

The practical aspects of medicine are those taught by the sage *Charaka*. These teachings have explained all diseases, their treatments and methods of cure. The diagnosis of diseases are based on the theories *Pancha bootha vadaya, Thridosha vadaya and Saptha dathu vadaya* from which the basic principles of Ayurveda are derived. It is through these theories that the patient, disease and the treatment are logically interpreted and analysed. The various medical aspects of paediatrics, gynaecology and obstetrics, toxicology and geriatrics are discussed based on these theories.

*Susrutha* is considered the father of surgery. He taught that those disease which cannot be cured by phamaceuticals (medicinals) may be cured by surgery – by dissection of the body cutting off and removal of the organs and grafting by the use of sharp and blunt surgical tools.

Ayurveda has eight components and the examination of the patient and the disease is done accordingly. The science of Ayurveda teaches not only about the health of humans, but also about the diseases of animals and plants, and the ways to control them. The Ayurveda for animals has separate sections for dealing with elephants, horses etc. (*Gaja* Ayurveda, *Ashwa* Ayurveda and so on). When analyzing the historical

information it is seen that the development of the theoretical basis of Ayurveda had been inspired and influenced by the *nyaya* and *vaiseshika* philosophies and the vedic literature such as r*aghva vedaya. Yajuivadaya* and *atharvanvedaya.*

Also they seem to have possessed a knowledge of physics and chemistry acquired through the various philosophical teachings which existed in ancient Bharatha (India).

When comparing the basic teachings and concepts it is seen that Ayurveda was more advanced than those of the western system of medicine based on the teachings and beliefs of Hipprocrates.

It seems that the indigenous system of medicine in Sri Lanka is an amalgamation between the traditional indigenous system of medicine which was characteristic of Sri Lanka and the Ayurveda system. Traditional indigenous medical practitioners use the theories of *Vatha, Pitha* and *Kapa* as the basis for diagnosis of diseases. In addition *Pancha bootha vadaya* and *Saptha dhathu vadaya* are also used for diagnosis.

However in the traditional indigenous system of treatment it is seen that more consideration is given to the hot-cold concept than to the *Thridosha* concept. This hot-cold concept can be considered as the basis of the traditional indigenous system. The *ying yang* concept in the traditional Chinese system of medicine and traditional Korean system are similar to this, in that both systems also interpret that dissases are caused by two interconnected concepts. It appears that most of these concepts are based on the changes that take place in the environment. Specially in a country such as Sri Lanka where clearly demarcated seasons do not exist, there is a very hot environment as well as six months with less rain and a cool environment. People in the past may have indentified the disease conditions accordingly. It appears that thay have been enthusiastic to treat the diseases to neutralize these conditions.

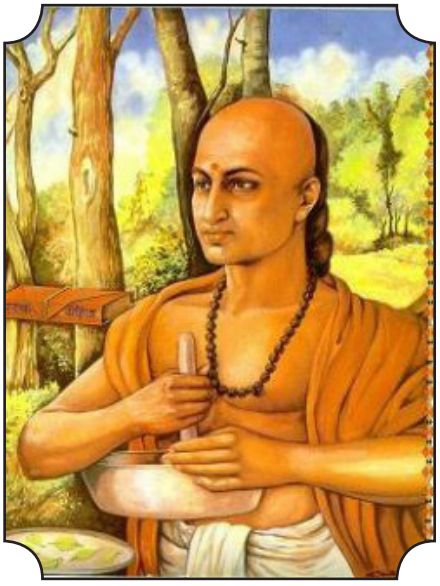
When studying the traditional indigenous medical literature, it is seen that methods by which diseases were diagnosed, the practices recommended to be followed, and the medicine to be used are recorded in the form of verses rather than as prose. This may be because in this form it is either easier to recall or to conserve this knowledge from generation to generation.

It is seen that the Sri Lankan traditional system of medicine uses many prescriptions which are not widely known in Indian Ayurveda. While most of the medicines used in the Indian Ayurved system are the spice plants growing in India, the main medicinals used in the traditional indigenous system in Sri Lanka are Aralu (*Terminaia ehebula*) Bulu (*Terminalia belliriea*) and Nelli (*Phyllanthus emblica*) as the main ingredients. At the same time the traditional system in Sri Lanka uses a large number of medicinal plants which are indigenous to Sri Lanka. These plants are not mentioned in the Indian system of Ayurvedic medicine.

Eventhough orthorpaedics, treatment of snake bites, Hydrophobia, Epilepsy and

malnutrition (*Mandamal*) are not prominent disciplines within the Indian Ayurveda system, they are given more prominence and seem to possess many methods of treatment in the traditional indigenocs system of Sri Lanka. With respect to orthopaedics and treatment for snake bites, it is possible to observe differences in the series of medicine used and the recommended practices to be followed depending on the respective geographic regions. For example it is seen that the medicines and the bandaging techniques used for the treatment of fractures in the Nuwara Kalaviya region (Anuradhapura) are different from those of the Sabaragamuwa and Ruhuna provinces. This shows that the traditional, knowledgeable learned people in the respective regions have acquired this knowledge with their practical experience, and modified it as required.
In addition to the methods developed, and the experiences gained, the *Siddha* system of medicine which is related to the Dravidian culture, are used in the indigenous Sri Lankan system. The *Siddha* system has the basic principles of the North Indian Ayurveda system of medicine and has been influenced by it. However regional differences can be seen in the use of medicinal plants. Sulphur and rock materials are also used in these medicines. Among those Sri Lankans who are followers of Islam, the Unani system of medicine is widely used. Unani system originated in the ancient Persian civilization. There are many differences between the Unani system and the medical traditions which originated in the Indian region.

The Unani system seems to have an interpretation somewhat different to the philosophical interpretations in Ayurveda, Siddha and the traditional indigenous systems of medicine, which employ the philosophical interpretations such as *Thridosha Vadaya*, *Saptha Dathu Vadaya*



and *Pancha Bootha Vadaya* in the diagnosis of diseases. The Unani system seems to possess a *Chathushvadi* concept to determine the cause of disease, and to interpret them instead of the *Thridosha Vadaya*. In the Unani system the bodily activities are interpreted to be of four different types, *Sapra, Sauda, Balba* and *Koon*. Disease and disease conditions are analysed depending on the interpretations based on the four *chathusvadi* concepts. The medicinals are also adopted accordinaly. There is very little of plant based medecinals in the Unani system, while more attention is paid to the use of medicinals with soil minarals. The main factor that has influenced this difference is that the Unani system originated in the Arabian region with an environment devoid of plants. So it can be observed that the processes of treatment have been adopted according to the ecosystem. Later with the development of chemistry, the minerals that are used in the Unani system have been used to prepare western pharmecuticals, and also the properties of the chemical elements have been interpreted accordingly. Historical records show that the learned medical practitioners such as Avicenna have worked to enhance the Allopathic (Western) system of medicine based on the Unani system.

Therefore it is clear that the systems of medicine have evolved around culture and environment in the respective countries. It is possible to understand that the traditional indigenous system of medicine in Sri Lanka and the present day indigenous practices in medicine, have all evolved with usage, development, and spread through the various ethnic and cultural entities. It is not incorrect to say that any system of knowledge is cultural.

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# Indigenous Knowledge Behind the Sinhala System of Agriculture

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The agriculture methods and practices that have evolved in accordance with the climate and geographical diversity associated with the land in Sri Lanka is known as the agriculture of the Sinhala people. It is possible to observe that the basis has been to pay a great deal of attention to maintain the wealth and well being of the people, through food production and food security practices. However during the later stages of the Anuradhapura period the surplus of the food produced was used to pay the taxes and also for export. This can be seen as the development of an economic system and commercial attitude which was not in keeping with the basic objectives. However there were no significant changes in the agricultural technologies. If there were any transformations they were seen only with respect to irigational aspects. There is a distinct difference between this traditional Sinhala system of agriculture and the 'chemical' agriculture as practiced today. The purpose of this document is to point out these difference and their eco-friendly effects on the environment.

## Weed control and Application of fertilizer

When we consider the traditional knowledge embodied in the cultivation of paddy, which is the main economic crop of Sri Lanka, we can understand the many principles associated with it. One of these is the effortless manner by which weed control and incorporation of ferfelizer was carried out. Weed control was based mainly on land preparation. The basic methods followed in weed control are, keeping the cultivated land separated into small plots (*liyadda*), submerging the plots with about one inch depth of water (this is called '*hisnan bedeema* or maintaining the water level so as to partly submerge the rice plant in water) and draining the water intermittently.

The ancient farmer carried out digging the mud with the mammoty, plouging, and treading by cattle as a means of land preparation. With digging shallow rows are made in the mud. The same thing happens with ploughing. During treading by cattle spaces are created to retain a certain amount of water when the hoof sinks into the mud. The farmer did not keep the field completely covered with water. The shallow rows were filled with water only to half their depth, so that after a few days micro organisms begin to grow under anaerobic conditions.

Due to the anaerobic condition the soil becomes alkaline. The farmer recognize the condition by splashing into the field a mouthful of betel chew kept in his mouth. The farmer observes the extent of 'conditioning' (*padamveema*) of the mud depending on how the red colour of the betel chew changes due to the alkaline nature of the betel, arecanut and the chunamb mixture of the betel chew. The alkaline environment prevents the growth of weeds and inhibits harmful micro organisms. It is customary to keep the plots submerged with water after the second round of ploughing and sow the paddy soon afterwards. The soil returns to the natural state after sowing the paddy. Two days after sowing the plot is submerged with water for about 12 hours; then four days later it is submerged with water for about 12 hours. Then two days later it is submaged for 24 hours; after 7 more days the plot is flooded with water for a duration of 3 days and once again after 14 days the plot is flooded with water for 7 days. This process helps to control the emergance of weeds such as '*kudametta*' (*Timbri stylis spp*). By this time as the paddy plants have grown tall weeds do not emerge as they do not receive sunlight. The field develops an acidic condition because the field is flooded and then drained empty again and again. More attention is paid to the proper laying of the 'saline canals' (*Kivul Ela*) when sowing is done so that the alkalinity or acidity is made to flow and drain down three canals. During this period earthworms and other worms begin to grow bringing up or churning the mud to the surface. In this 'worm infested' soil the essential plant mutrients including nitrogen containing nutrients are present in the correct proportions. This is so in the suspended silt too and enhances the fertile nature of the soil. During the treading (*Medaweema*) by buffaloes their hooves mix the mud and bury the weeds in the mud.

Weeding by hand (*Neleema*) is done about two weeks after sowing the paddy, which is the traditional practice and during this process when the mud is loosened, it is observed that the paddy plants begin to form tillers. Some farmers mix carbon dust (soot) scraped off the traditional chimney shelves (*Dum messa*) and put it into the water outlets (*Wakkada*) of the plots. The farmers in the Gampaha district claim that this is a method of weed control. When applied to the paddy field the soot is trapped in the water amongst the paddy plants, and temporarily prevents the growth of weeds. However, when chemical weedication are used weeds are completely destroyed. By this 'deadly' process beneficial microorganisms are also destroyed. Using this type of destructive methods render the soil infertile.

## Pest control

From a study of the ancient ola leal records we can discern that the farmers were in possession of a vast body of traditional knowledge to control pests

pertaining to paddy cultivation. In addition, the farmers also communicated their knowledge by word of mouth, from generation to generation. The main means of communicating this knowledge was through folk songs (*Seepada*) recited to overcome the loneliness and solitude while engaged in agricultural activities. In the collection of folk verses called '*Kamath Hella*' the following is mentioned regarding pests.

"There is the disease of the yams '*Kokkanawa*' is a disease *Unapathaya* is mother disease Observe these various diseases"

The chances of the rice plants being infected with worm disease are many. With the infestation by the caseworm or '*Kokkanawa*' the leaf turns white and is destroyed. The retention of water in the soil with excessive rain is a reason for the growth of these worms. This worm is about 6mm long and is basically the larval stage of a moth. The larvae are hatched out of the eggs after about 4 days and then spends about 20 days in the larval stage. They are transmitted by water.

Chemical Methods Scientists use strong pesticides containing the active ingredient dimethoate to destroy this harmless moth. Applying this chemical also destroys the beneficial organisms such as the dragon fly and the lady bird beetles which feed on some pests of the rice plants. Thus the biological population of the paddy field is reduced and in turn the damage caused to the rice plants by the pests is increased. If due to some reason an epidemic of leaf hoppers suddenly develops, in an environment devoid of the useful organisms, then the leaf hoppers will multiply in an invasive manner. The ultimate result would be that the entire field of rice plants will turn brown and will be destroyed.

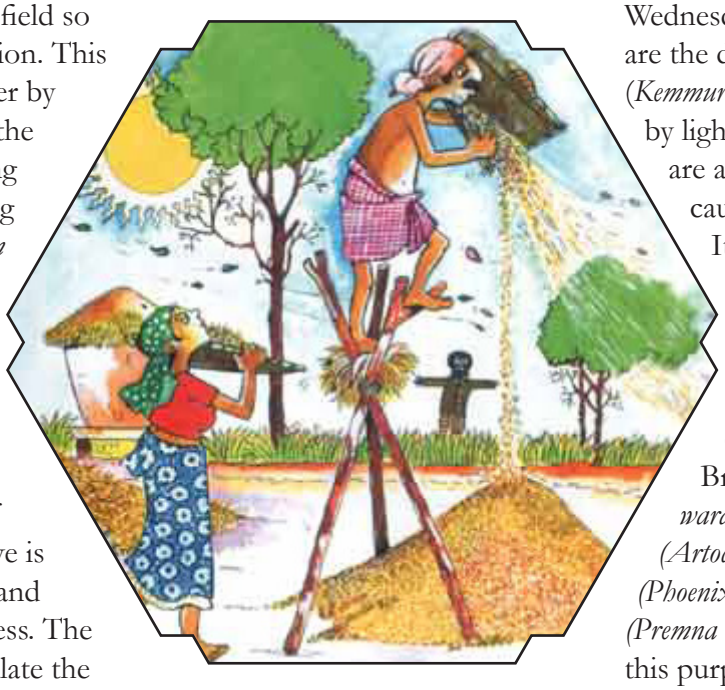
## Application of ash as a traditional pest control measure

Traditionally ash treatment was employed to control pests such as the case worm, leaf rolling caterpillar and stem borer. This method involved draining the water out of the paddy field, allowing it to dry, and early morning of the following day strewing the ash on to the rice plants, while the morning dew is still on the leaves. The ash from the fire place (hearth) is sieved and used for this purpose. The ash sticks to the rice plants as well as to the body of the case worms. When the ash sticks to the worm, specially in between its body segments, the worm is unable to control itself and falls off the plants to the soil, or it collects towards the basal parts of the plants. When the field is flooded with water the next morning after the ash treatment, most of the worms die.

In the olden days there were plenty of fresh water fish in the paddy fields, and they fed on the worms. Usually on the third day the farmer sweeps or brushes over the rice plants starting from the higher plots to the lower plots, with a bunch of croton (*C.laccifer*) branches. The rough hairs of the croton branches weaken the worms, and they as well as their eggs fall in to the water and are eaten by the fish.

Damage by the shootfly causes the "silver shoot" disease or '*Unapathaya*' disease. This is not a serious problem in traditional agriculture. The life span of the shoot fly is four days. The

beneficial organisms living among the rice plants eat up these flies and their larvae. What is required is to maintain the environmental conditions of the paddy field so as to retain their population. This can be understood further by turning our attention to the folk songs popular among the Sinhalese. The singing of the *Goyam Kavi, Nelum Kavi* (Weeding Songs) and *Kamath Kavi* (Threshing Songs) with their various rthythms stimulate the various energy sources such as mental energy of the farmers. The objective is to make the work easier and lighter, and dispel tiredness. The other method is to stimulate the energy sources by the chanting of '*Manthra*'. There are a few other methods such as lighting of lamps and the use of plants emitting various chemical substances. For these we use the term '*Kem Pahan*' when referring to such activities. The traditional agriculture knowledge is quite varied. The objective is to achieve productive result by unifying or coordinating this knowledge. If it is a paddy field the main objective is to bring unification between the farmer and the field. If this is not brought about there will not be an useful result of the '*Kem* Practice' (*Kem Krama*) employed. This is essential in order to use the astrological principles such as '*Karanaya*' to avoid damage by wild animals. For this to be successful with good results it is necessary to prepare a 'cultivation calender' for the whole field as an entirety. The ancient people cultivated the habit of identifying the various behavioural characteristic of

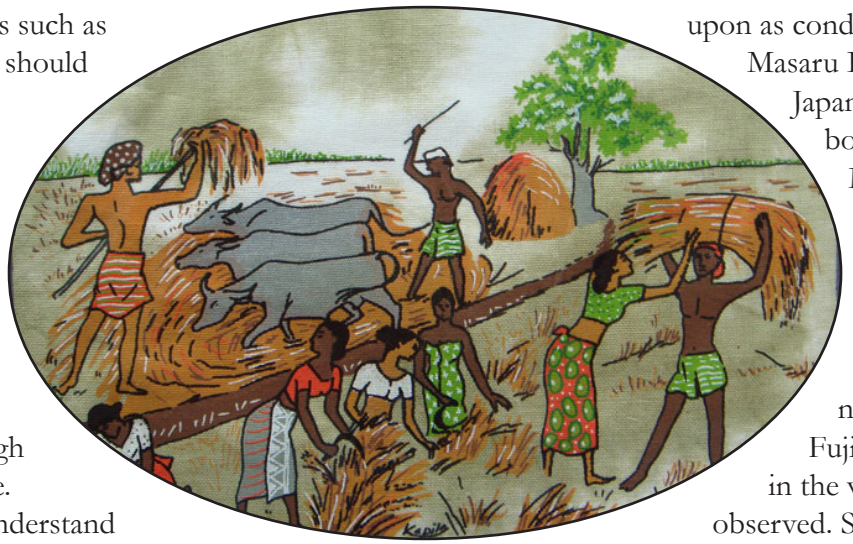


animals. The veddhas have a good understanding of the behaviour of wild animals because of their relationhip with the environment. The animal that causes most damage to chena cultivation is the wild boar. The farmers developed a detailed understanding of the behavior of the wild boar. Chanting of '*Manthra*' was a key component is *kem* practices that were frequently used to ward off herds of wild elephants. This became a necessary protection when persons encounter wild elephants on their way to a chena. Cattle also damage paddy fields and vegetable plots due to the negligence of the owner of the cattle. Farmers had various methods of protection in such instances.

Two methods are mentioned for seeking protection of the farm, by the practice called '*Kem Pahan*'. There is a belief that *Kem* practice should be performed on Wednesdays and Saturdays which are the days set out for this vitual (*Kemmura* days). In this methods by lighting of lamps the insects are attracted to these and cause their death naturally. It is said that in order to get protection from wild animals the following '*Kem*' should be performed on '*Kemmura*' days.

Branches of the plants *wara (Calotropin gigontea)* Jak *(Artocarpus helerophyllus)* Indi *(Phoenix zeylanica)* and *Midi (Premna obtusitohia)* are used for this purpose. These are referred to as *Kemini (Kem stakes)* in the stanzar of the publication title '*Kamath Hella*'. The first stage of this process is to smoke these branches at a height above the height of a man. The smoke is produced by burning coconut shells and a resin in a pan. The following morning smoking is done again by using the three branches mentioned above. (each bunch should contain one type of branch only). Then the three bundles of branches are fixed or 'planted' in three places at the edge of the field. This has to be done in such a manner that the bundles are placed along the path of wind direction and then in the opposite direction. It should be ensured that the person remain silent while holding the bundles of branches. The farmer should also refrain from visiting the field

for a period of 24 hours (*Wara Thunak*). If it is a paddy field it is better to perform this '*Kem*' when the rice plants have just begun to produce the spathes. It is necessary that the spathe has at that stage split open exposing at least a minimum of three sprigs of paddy seeds. Those having experience say that if it is a chena plantation of cereals such as millet, all the plants should begin to form the ears simultaneously. When this '*Kema*' is carried out, damage by flies is also prevented. Other '*Kem* chantings' against flies are also said to be successful through this same procedure.
It is important to understand the special characteristics of the leafy branches that are used here. Plants with latex such as calotropis and Jak generally possess insecticidal properties. Using all three types of branches together enhances this property. Directing the smoke windwards facilitates the newly generated energy to be directed outwards. The subsequent "planting" of the branches against the wind prevents the real odours from spreading outside. Then the energy inducted is not lost. It may be a little difficult to logically understand this action. However there is evidence to show that the farm was protected from many dangers by fortifying it with this "energy". Many types of "*manthrams*" were recited to prevent damage caused by wild animals. It is generally recognized that the energy inducted by the chanting of these '*Manthra*' prevented harm by insects and diseases. This ancient knowledge has been developed as a process of retaining the unifying basis of nature.



## A logical explanation about "*Manthra*"

Four Palmyrah (*Borassm flabellifer*) leaves partly eaten by beetles are taken and the *manthram 'ohm Namo Neela Neela Eswahang'* is etched on the leaves with a stylus and carbon dust is applied to the etching, and then the '*manthram*' is recited 324 times. Then the four pieces of leaves are placed in four cylinders of bamboo stem. These are then closed with stoppers turned out of morinda wood. Then they are buried in the four corners of the chena or the paddy field. This should be done between 12 midnight and I am. After that one should refrain from going to the field for the next 18 hours (or three *waruwas*)
Modern day society does not have much faith or belief in these *manthrams*. However everyone knows about the effectiveness of pirith chanting and of the pirith threads. But people are reluctant to make use of *manthrams*. They are considered as superstitious beliefs or are looked down upon as condemed sciences.
Masaru Imato living in Japan has published a book Titled "The Message of Water". As mentioned in this book, in an experiment where various types of music was played near the waters of the Fujivara dam, a change in the water has been observed. Subsequently the Pirith chanted to various samples of water by the Buddhist monk Kato Hokai have been examined. It is reported that they were able to observe the water becoming bright and turning into crystals. In a subsequent experiment when rough music and unpleasant words were used, the brightness of the water disappeared. This ia a new discovery. It can be considered the effectiveness of the power of *manthrams*. All this confirms that the vast knowledge possessed by the ancient farmers has been developed and maintained on a systematic basis.

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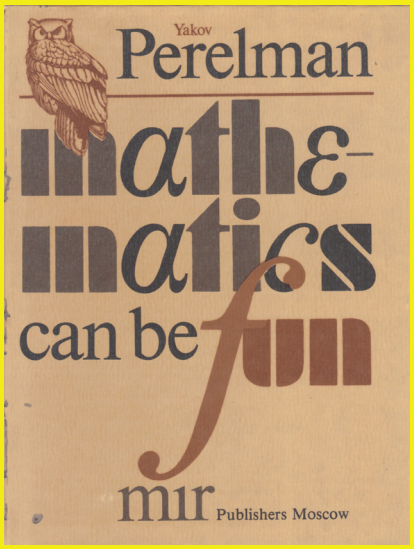


**Continued....**

Part by part of this book will be published in the Vidurava issues for the benefit of the readers.

In June 2014 issue we published Questions 1 - 8 of the above publication. In this issue, you can read Questions 9- 13.

**9. Matches**

The man emptied a box of matches on the table and divided them into three heaps.
"You aren't going to start a bonfire, are you?" someone quipped.
"No, they're for my brain-teaser. Here you are-three uneven heaps. There are altogether 48 matches. I won't tell how many there are in each heap. Look well. If I take as many matches from the first heap as there are in the second and add them to the second, and then take as many from the second as there are in the third and add them to the third, and finally take as many from the third as there are in the first and add them to the first-well, if I do all this, the heaps will all have the same number of matches. How many were there originally in each heap?"

**10.The "Wonderful" Stump**

"My puzzle is the one I was once asked by a village mathematician to solve," the next person began. "It was really a story, and quite humorous at that. One day, a peasant met an old man in a forest. The two fell into a conversation. The old man looked at the peasant attentively and said:
"'There's a wonderful little stump in this forest. It helps people in need.'
"Does it? What does it do, cure people?'
"Not exactly. It doubles one's money. Put your pouch among the roots of the stump, count one hundred and-presto!-the money's doubled. It's a wonderful stump, that!'
"Can I try it?' the peasant asked excitedly.
"Why not? Only you must pay.'
"Pay whom and how much?'
"The man who shows you the stump. That's me. As to how much, that's another matter.'
"The two men began to bargain. When the old man learned that the peasant did not have much money, he agreed to take I ruble 20 kopecks every time the money doubled.
"The two went deep into the forest where, after a long search, the old man brought the peasant to a moss-covered fir stump in bushes. He then took the peasant's pouch and shoved it among the roots. After that they counted one hundred. The old man took a long time to find the pouch and returned it to the peasant.
"The latter opened the pouch and, lo! The money really had doubled! He counted off the ruble and 20 kopecks, as agreed upon, and asked the old man to repeat the whole thing.
"Once again they counted one hundred, once again the old man began his search for the pouch and once again there wa a miracle-the money had doubled again. And just as they had agreed, the old man got his ruble and 20 kopecks.
"Then they hid the pouch for the third time and this time too the money doubled. But after the peasant had paid the old man his ruble and 20 kopecks, there was nothing left in the pouch. The poor fellow had lost all his money in this process. There was no more money to be doubled and he walked off crest-fallen.
"The secret, of course, is clear to all-it was not for nothing that the old man took so long to find the pouch. But there is another question I would like to ask you: how much did the peasant have originally?"

**11. The December Puzzle**

"Well, comrades," began the next man. "I'm a linguist, not a mathematician, so you needn't expect a mathematical problem. I'll ask you one of another kind, one close to my sphere of activities. It's about the calendar." "Go ahead."
"December is the twelfth month of the year. Do you know what the name really means? The word comes from the Greek 'deka'-ten. Hence, decalitre which means ten litres, decade-ten days, etc. December, to all appearances, should be the tenth month and yet it isn't. How d'you explain that?"

**12. An Arithmetical Trick**

"I'll give you an arithmetical trick and ask you to explain it. One of you-you, professor, if you like-write down a three-digit number, but don't tell me what it is."
"Can we have any noughts in it?"
"I set no reservations. You can write down any three numerals you want."
"All right, I've done it. What next?"
"Write the same number alongside. Now you have a six-digit number."
"Right."
"Pass the slip to your neighbor, the one farther away from me, and let him divide this six-digit number by seven."
"It's easy for you to say that, and what if it can't be done?"
"Don't worry, it can."
"How can you be so sure when you haven't seen the number?"
"We'll talk after you've divided it."
"You're right. It does divide."
"Now pass the result to your neighbor, but don't tell me what it is. Let him divide it by 11."
"Think you'll have your own way again?"
"Go ahead, divide it. There'll be no remainder."
"You're right again. Now what?"
"Pass the result on and let the next man divide it, say, by 13."
"That's a bad choice. There are very few numbers that are divisible by 13. You're certainly lucky, this one is!"
"Now give me the slip, but fold it so that I don't see the number."
Without unfolding the slip, the man passed it on to the professor.
"Here's your number. Correct?"
"Absolutely." The professor was surprised. " That is the number I wrote down…. Well, everyone has had his turn, the rain has stopped, so let's go out. We'll know the answers tonight. You may give me all the slips then."

**Answer 9 - 12**

9. This problem is solved from the end. Let us proceed from the fact that, after all the transpositions, the number of matches in each heap is the same. Since the total number of matches (48) has not changed in the process, it follows that there were 16 in each heap.
And so, what we have in the end is:

| First Heap | Second Heap | Third Heap |
|---|---|---|
| 16 | 16 | 16 |

Immediately before that we had added to the first heap as many matches as there were in it, i.e. we had doubled the number. Thus, before that final transposotion, there were only 8 matches in the first heap In the third heap, from which we took these 8 matches, there were:
16+8=24
Now we have the following numbers:

| First Heap | Second Heap | Third Heap |
|---|---|---|
| 08 | 16 | 24 |

Further, we know that from the second heap we took as many matches as there were in the third heap.
That means 24 was double the original number. This shows us how many matches we had in each heap after the first transposition:

| First Heap | Second Heap | Third Heap |
|---|---|---|
| 08 | 16+12=28 | 12 |

It is clear now that before the first transposition (i.e. Before we took as many matches from the first heap as there were in the second and added them to the second) the number of matches in each heap was:

| First Heap | Second Heap | Third Heap |
|---|---|---|
| 22 | 14 | 12 |

10. This riddle, too, can best be solved in reverse. We know that when the money was doubled for the third time, there was I ruble 20 kopecks in the pouch (that is the sum the old man received the last time). How much was there in the pouch before that? The peasant had paid the old man his second ruble and 20 kopecks. Therefore, before the payment there was:
1.20+0.60=1.80
Further: 1 ruble 80 kopecks was the sum after the money had been doubled for the second time. Before that there were only 90 kopecks, i.e. What remained after the peasant had paid the old man his first ruble and 20 kopecks. Hence, before the first payment there were 0.90+1.20=2.10 in the pouch. That was after the first operation. Originally, therefore, there was half that amount, or 1 ruble 5 kopecks. That was the sum with which the peasant had started his unsuccessful get-rich-quick operation.
Let us verify:

Money in the pouch:

After the first operation....
1.05 x 2 = 2.10

After the first payment....
2.10 - 1.20 = 0.90

After the second operation....
0.90 x 2 = 1.80
After the second payment....
1.80 - 1.20 = 0.60

After the third operation....
0.60 x 2 = 1.20

After the third payment....
1.20 - 1.20 = 0

11. Our calender comes from the early Romans who, before Julius Caesar, began the year in March. December was then the tenth month. When New Year was moved to January 1, the names of the months were not shifted. Hence the names of certain months and their sequence:

| Month | Meaning | Place |
|---|---|---|
| September | (septem-seven) | 9th |
| October | (octo-eight) | 10th |
| November | (novem-nine) | 11th |
| December | (deka-ten) | 12th |

12. Let us see what happened to the original number. First, a similar number was written alongside it. That is as if we took a number, multiplied it by 1000 and then added the original number, e.g.:

872872 = 872000 + 872

It is clear that what we have really done was to multiply the original number by 1001.
What did we do after that? We divided it in turn by 7,11, and 13, or by 7x11x13, i.e. by 1001.

So, we first multiplied the original by 1001 and then divided it by 1001. Simple, isn't it?

Before we close our chapter about the brain-teasers at the holiday home, I should like to tell you of another three arithmetical tricks that you can try on your friends. In two you have to guess numbers and in the third, the owners of certain objects.

These tricks are very old and you probably know them well, but I am not sure that all people know what they are based on. And if you do not know the theoretic basis of tricks, you cannot expect to unravel them. The explanation of the first two will require an absolutely elementary knowledge of algebra.

13. The Missing Digit

Tell your friend to write any multi-digit number, say, 847. Ask him to add up these digits (8+4+7)+19 and then subtract the total from the original. The result will be: 847-19=828.

Ask him to cross out any one of the three digits and tell you the remaining ones. Then you tell him the digit he has crossed out, although you know neither the original nor what your friend has done with it.
How is this explained?

Very simply: all you have to do is to find the digit which, added to the two you know, will from the nearest number divisible by 9. For instance, if in the number 828 he crosses out the first digit (8) and tells you the other two (2 and 8), you add them and get 10. The nearest number divisible ny 9 is 18. The missing number is consequently 8.
How is that? No matter what the number is, if you subtract from it the total number of its digits, the balance will always be divisible by 9. Algebraically, we can take a for the number of hundreds, b for the number of tens and c for the number of units. The total number of units is therefore:
100a+10b+c.

From this number we subtract the sum total of its digits a+b+c and we obtain:
100a+10b+c – (a+b+c)=99a+9b=9 (11a+b).
But 9(11a+b) is, of course, divisible by 9. Therefore, when we subtract from a number the sum total of its digits, the balance is always divisible by 9.

It may happen that the sum of the digits you are told is divisible by 9 (for example, 4 and 5). That shows that the digits your friend has crossed out is either 0 or 9, and in that case you have to say that the missing digit is either 0 or 9.

Here is another version of the same trick: instead of subtracting from the original number the sum total of its digits, ask your friend to subtract the same number only transposed in any way he wishes. For instance, if he writes 8247, he can subtract 2748 (if the number transposed is greater than the originals, subtract the original). The rest is done as described above: 8247-2748=5499. If the crossed-out digit is 4, then knowing the other three (5,9, and 9), you add them up and get 23. The nearest number divisible by 9 is 27. Therefore, the missing digit is 27-23=4.