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Kanakkathikaram

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Abstract

"Ennum Eluththum kanEnath thakum" and "Enneluththikalel" *Avvaiyar emphasises the importance of "Numbers" and "Writing" to humans in this prologue ("Moothurai"). Scholars have remarked that writing is the best of many arts in the world and that learning other arts is difficult without knowing "numbers," which is what keeps people's lives running smoothly. (Kanak, pg-1). Only a few Tamil mathematical works were written by Tamil poets between the 18th and 20th centuries. Among those math books "KanithaDeepikai, Balakanitham, Ensuvadi, Asthana Kolakalam, Ensuvadi, EnVilakkam (Numerology)" and others. According to Tamil historians, before this, there were seven books titled "Erambam, Kilaralapam, Adisharam, Kalambagam, ThiribhuvanathThilakam, Kanikarathinam, and Siruganakku" that were burnt. (Kanak, pg-2) One party also claims that after the 18th century, particularly in the last century, Tamil experts showed little interest in developing scientific Tamil. "Kanakkathikaram" specifies six categories of accounts. Historians believe the "Kanakkathikaram" belongs to the 15th century. Quantities and mathematical riddles employed in a book from 500 to 600 years ago are still utilized even today. For example, the word saree (Pudavai) is a measurement, but now we consider saree (Pudavai) as an object. A saree (Pudavai) is 18 cubits ("Muzham") in length. Did the saree (Pudavai) receive its name because of its size? Alternatively, it is debatable if the size of the saree (Pudavai) was included in the math because of the length of the saree. Likewise the fabric is known as "Vetti" in a similar way. There is a custom in our villages of "putting crore of cloth (Kodithunipoduthal)" on funeral rituals; I assumed a "crore of cloth" meant one crore of cloth, but a "crore of cloth (kodithuni)" is also a measurement of cloth. One "crore of cloth" equals 20 "vetti" or 640 "saree (Pudavai)". Similarly, my mother still measures grains and beans using "padi and koththu" even now. This article is a research consisting of the investigation into these metrics as well as the mathematical puzzles listed in the "Kanakkathikaram."*

Keywords: "Kanakkathikaram", Ancient Tamils, Mathematics, Science, Ancient Mathematics, Ancient Tamils's Life

Introduction

The term "Kanakkathikaram" gets prominence, especially in ancient manuscripts dealing with mathematics. It was blessed by "KorukkaiyoorKarinayanar". Through this

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remarkable legend, ***"Ponninaddu porunthiya puhalon puththan puthlvan Karijenpavane"*** **(Kanak. pg.1)** the facts of "Karinayanar" can be learnt. His hometown was "Korakkaiyoor" in "Cholanadu", and his father's name was Buddhan, and he belonged to the royal family. "Kanakkathikaram" begins with the framework, prayers, and modesty of the community. This comprises the items listed below. They are based on the key topics of Mathematical Genres, "Nazhikku Palam Arithal", General Mathematics, the author's compiled Mathematical Genres, and Numbers in Proverbs (Oral Literature). Among the categories of Mathematics, there are Numerology, "Mundhri", "Araikkaani", "Kaani", "Ma", Land Surveying, Technical Survey – "Mundhri", "KeezhMundhri", "MelMundhri Explanation", "Kalanju" – "Veesam", "Pilavu", "Kunrimani", "Manjadi" – Balance weight of Gold, Weight Determination – "Palam" (Strength), "Thulaam", "Paaram" – Balance weight etc.

The following are included in the section entitled **"Nazhikku Palam Arithal"**. ("Mukaththal" and "Niruththal"-(weigh) measurements such as soil, sand, paddy, rice, salt, etc.) Counting "Nazhikku - (Padi)"(sesame, paddy, rice), counting (bean, gram, pepper) measuring the weight of water, camphor, etc. (weight), and Knowing the weight of hay, straw etc. And Knowing the time by "Vaddil", the Alchemical method of making bronze and brass (detail), Knowing the size of cotton, hair end, sand, mustard, sesame, Height and breadth of Mount Meru - the size of the world, Knowing where the sun and moon are, Paddy Donation - also the tools used for weighing the paddy, and time calculations, Time, day, month, year – durations, the age range of living beings, duration of four "yugas", duration of "Deva" through time, house and temple measuring cubits rod, this and that, "IdaiIyaipu" – land and water measurement system, knowledge of the vastness of gold, (Measurement of Width), Name Lettering – Subtraction Math, Division Math, the formula of numbers – Addition Abbreviation, Multiplication, Quadrilateral Arithmetic, Details of Chess; – Multiplication Mathematics ("Mahakodi"), and Circular land area, - (Calculation of circular area using diameter), area of arc-shaped land, arrowhead land measurement, pole measurement area, changing "Kuzhi" – which means "Pit" used by the Tamils in ancient times - calculation of area by "Kuzhi", stone breaking formula, land profile - seedling hair, paddy field math, tillingmaths, Total Wages of tillage calculation, emigration number, Property Distribution, Gold Exchange Details, Gold Exchange Amount, Fixing rate of Gold, finding the weight of gold and silver mixture, and measurements of surface area, four-way data, calculation of yielded rice, "maakaani", "araikkaani", "maakkanitham", calculation and accounting for paddy (lease), types of paddy wages, paddy measuring wages, the formula for the opening of lake water, calculation of elephants entering the city, garden lizard ("onaan") account, selection of fertiled land, jack fruit account, calculation of pumpkin seed, an account of horse, details of elephants falling apart at the entrance, an account of elephants tied to a pillar, account of dismantled pearl chain, an account of pearl necklace, camphor account, knowledge of"Aanikkorvai" (gold exchange), grade code of gold, and, As for the nine kinds of gems ("Navamanikal"), the Price Value of the nine kinds of gems, Gold – weighing measurements, Valuation of nine kinds of gems (Other), Coral – valuation using fur line, Conch Valuation, weighing measurement of Gold, Gold and Silver Mixing Math, the value of

Gold exchange deviates from country to Country (“Eelam” -Sri Lanka, Bengal), Gold Value by exchanging are also referred.

Under General calculations, there are,account of Horse, account of Pearl - equal division of pearl and price, account of Pearl - equal division of price value and figure value, account of Wood apple, account of Mango, account of Pepper, account of Lemon (1, 2), account of Foot, account of “Padiyaal”, account of Dancing Women, account of Shoveling, account of Water pumping, account of Betel, account of Paddy Sale, account of Milk, account of Pearl, account of theft, account of Gem Trade, account of Cucumber, account of Servant Wages , and, it also deals with the account of employee’s wages, and Account of “Devadasi's” order, account of “padiyaal”, account of oil, account of Snacks (“Palakaaram”) eaten, account of (God “vinayakar”) worshipping elephant-faced god with flowers, account of beetles, account of sesame eaten by sparrows, account of paddy eaten by sparrows, account of sparrows, account of dividing the troops at the tower, account of porcupines being caught by dogs,account of dividing vessel - account of plate, account of village share holders (1), account of village shareholders (2), and also refers about the measurements of the oceans.

The following areas are included as the mathematical categories combined by the author: They are, ancient usage of quantities and decimal fractions, pre-historic sense of mathematics, ancient Tamil number patterns and numbers, literature included numerically, mathematics in physics, mathematics in music, music theory in “Silapathikaram”, mathematics in drama, calculations to construct drama theatre (dancing stage, “kooththu”, dance in “Silapathikaram”),“Talas”- (Rhythm) are five, Dances (“Kooththu”) are eleven, Mathematics in ancient Tamil’s living places, Mathematics in architecture, Mathematics in palaces, Mathematics in sculpture (hand stick), Mathematics in medicine, Mathematics in taste, sixty-four Arts. (Kanak. Pg. 91-92)

When it comes to Ancient Tamil’s measures, Tamil numerical order and methods of measurement, ascending numbers, large numbers (“venpa” - Song), descending numbers, ancient measures used in “Tamilnadu”, lengthwise measure, weighing measure, measure of capacity (paddy measure), common weighing measure used in Tamil Nadu, weighing mass, fractions of rupees , anatomy mathematics, and form of Life and God by “Thirumoolar” and Ninety-six Elements, Mathematics of anatomy Elements, Mathematics in shape of “Sidhandha” Medicinal Products, Medicinal Measurements, Solids, Liquids, measurement of Cloths, Accounting of Livestock, Ancient measurement of Gold in use, Account of Gold and the Standard of gold, Roman Numerals and Arabic Numerals, a system of referring to numbers that was customary in Tamil Nadu.

Numbers in “Vasai”, “vasavu” words included in Tamil numbers, song playing with the number five mentioned in “Kamparamayanam”, mathematical song using the word “kaani” utilized in fractional formula, the puns song sung by “KaalamekaPulavar” with fractional numbers, mathematics in ancient Tamils pun song, mathematics in riddles, method of writing Tamil numbers: then and now, large numbers, Multiplication formula.

Fractions from One to “Mundhri” (1-1320), Fractional formula, Three Quarters, Half (0.5 – ½), Quarters (0.25 – ¼), Quarter half (0.125 – 1/8), four “Maa” (0.2 – 1/5=

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1/20+1/20+1/20+1/20), three “Maa” (0.15 – 1/20= 1/20+1/20+1/20 Sri 1.20),“Mundaani” (0.1875 – 7/10) half three “veesam”“kaani”, “Irumaa” (0.1 – 1/10), “Maakaani” = “Ma” + “kaani”= 1/20 x 1/80 = 1/16 (“Veesam”) – (0.0625 – 1/16), “Orumaa” (0.05 – 1/20) Three quarter “Kaani” (0.0375 – 3/80), “Kaani” (0.0125 – 1/80), “AraikKaani” (0.00625), or (1/160), half of “Kaani” (18 % ½), lower “Mundhri” , lower lower “Mundhri” (1/02400 x 1/320), lower lowerlower “Mundhri”, Paper size, lengthwise measure and square measure from ancient times to the present, wood measures, and cm,metre, knowledge of volume, metric measures, ancient measures,stone which measures the time by the shadow of sunlight (clock), system of land surveying in the later “Chola” regime, Fraction, Tamil – list of fractional numbers in usage from “Veesam”, Fractional index numbers, Mathematics in letter sounds, short letters, symbols used in ancient times, symbols used in mathematics, symbols used in agriculture, ancient rupee symbols, almanac symbols (Kanak.sng.159), and also it refers to weight and measure symbols.

In Proverbs (Oral Literature), within the number structure there are, numbers and old songs, proverbs in “Mundhri” measure, proverbs in ”Veesam” measure, proverbs in “MaaKaani” measure, proverbs in “Kaani” measure, proverbs in quarter-measurement, half-measure proverbs, one- and one-measure proverbs, two-number proverbs, three-number proverbs, Four Number Proverbs, Five Number Proverbs, Six Number Proverbs, Seven Number Proverbs, Eight Number Proverbs, Nine Number Proverbs, Ten Number Proverbs, Eleven Number Proverbs, Twelve Number Proverbs, Fifteen Number Proverbs, Sixteen Number Proverbs, Eighteen Number Proverbs, Twenty (20 – 29) Number Proverbs, Thirty (30 – 39) Number Proverbs, Forty (40 – 49) Number Proverbs, Fifty (50 – 59) Numbers Proverbs, Proverbs in Numbers Sixty (60 – 69), Proverbs in Numbers Seventy (70 – 79), Proverbs in Numbers Eighty (80 – 89),Proverbs in number 90 (90-99), proverbs in number 100 (100-900), Thousand (1000 – 90,000) Number Proverbs, Lakh Number Proverbs, Crore Number Proverbs, Change in Tamil Number index, and it well explains the things like in the country of Mauritius, Tamil numerals are mentioned in the bank currency notes etc.

“Kanakkathikaram” and Mathematics

Tamil civilization utilized a variety of symbols to symbolize numbers. For counting, numerical quantities are used. There appears to have been no use of a sign to represent the number 0, but multiple symbols were used to represent the numbers 1 to 10, 100, and 1000. They are:

க – 1, உ - 2 , ங - 3 , ச – 4, ஞ – 5, ட – 6, ண – 7,

அ – 8, ஈ – 9, ய – 10, ர – 100, ஆ – 1000 (Kanak, pg. 4 – 24)

All the following large numerals are referred to by combinations of these. However, many of these large numbers have different names. According to how the Tamil civilization marked the large numbers, all civilizations have different names for the large numbers. For example, if you write 1 followed by 100 zeros (0), the name is Googol. When 1 is followed by 600 zeros, the British call it a centillion. If 10000 zeros are placed behind a 1, the result is tremilliatrecendotrigintillion. According to modern science, such huge quantities can be simply written in powers. That means you can write as many numbers as you like in powers of 10. **(Vijayakumar. V. V)**

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Large numbers

Most European and English number systems do not include lakhs or crores. They define lakh as a hundred thousand and crore as 10 million. There was no Lakh even in Tamil civilization; they also defined Lakh as a Hundred Thousand. However, several lakhs arrived following the northerners' invasion. “Kari Naayanaar” describes the “Yugas” and the “Devakalaam” in the following two songs.

Needusamuththiramenerilaiyai – Odivarun
Vellampiralayamjosanaikkatpamvikatpam
Kallavilumpoonkulalalkaan” (kanak.Sng)
Maahamunthanmanaijumatputhamumutpalamum
Eakamumananthamudanvenuvam – Thokai
Chalansalamumantharaijumtharakaijummeru
Valampuriminpinpulaijarmaddu”(kanak.Sng)

The large numbers that appear in this song are the following:

For all these, the index of numbers is not mentioned in the “Kanakkathikaram”. But we can identify the large numbers as mentioned above.

Measuring of Gold

One can find a clear explanation of the method of measuring gold in "Kanakkathikaram". Because of business purposes, Gold is not directly mentioned as ‘gold’, we can notice it is referred to as "Pari, Kalanju" by its other names (group index). The method of measuring (calculating) gold can be known from the following song.

Ponrumirandampilavumirandankunri
Kunrijumansadiyumainthakum – Enrum
Orunalonrakumenaothuvarenkal
Thirumathethenetheli (kanak,sng.6)

The above song says about the beauty of a woman who looks like the goddess “Lakshmi” and her words are like honey. Furthermore, it says that the weight of a single paddy is called “veesam” where, 2 “veesam”=”Pilavu”: 2 “Pilavu”=”Kundri”: 2 “Kundri”= “Manjadi”: 5 “Manjadi”= Quarter of “Kalanju” and 4 Quarter of “Kalanju”= “Kalanju”.

2 “veesam” = 1 “pilavu”
2 “pilavu” = 1 “kundrimani”
2 “kundrimani” = 1 “manjadi”
5 “manjadi” = quarter of “Kalanju”

One can observe that as mentioned above the gold calculation method and the materials used to quantify gold are still in use today. While electronic calculators are employed as measurement equipment in jewellery shops, we may still witness some modest, traditional goldsmiths utilizing“manji” seeds in their jewellery shops even today. For instance, "How much “Manjadi” of gold is this?" and "One ‘Kunrimani’ of gold" could be demonstrating the fact that "Manjadi and Kunrimani" are still in use today.

Measuring weight

To the best of my knowledge in my childhood, I have seen scales and weighing stones used in stores to measure weight, traction scales used to measure huge weights, and hourglass

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scales used to measure very heavy goods. However, electronic and electric scales are increasingly widely utilized nowadays. Further, it may also be noted that today's weights are measured in milligrams (Mg), grams (g), kilograms (Kg), and tones (t). But it can be seen that the method of measuring weight has been stated in “Kanakkathikaram”. That is, the following song, "Karinayanar" states the method of measuring the weight of an object and the materials used to estimate the weight.

Kanda kalansirandukaisakkaisaanalu
Konda palnoorukoorunirai - kanda
Iranduthulamuppathodirandam param
Thirandailamulaiyaiseppu”(Kanak.Sng.7)

The detail that is demonstrated in this song is,

2 “kalanju” = 1 “Kaisa”
2 “Kaisa” = 1 “Palam”
100 “Palam” = 1 “Nirai”
2 “Nirai” = 1 “Thulaam”
32 “Thulaam” = “1 Paaram”

Through this, it can be seen how the method of measuring weight and units of weight are demonstrated.

Measures

According to the measurements described in this book, there are land measurement, time measurement, lengthwise measurement, weighing measurement, and textiles measurement. He had also provided formulae for different computations such as the number of seeds in a pumpkin and the number of pulps in a jackfruit. His ancestors had said that there were a total of 64 formulae. But he had claimed 60 formulae only and said others as extraneous formulae.

Arupathemelnankusooththirammundenrum
Arupathe akum athanal- Kuriyai
Puramonramattavaikol
IrupathummoonrumirupathumOtarum
Orupathinmeleddolinthaonrum – Nirumiththa
Moonrumathanpinnainthum akum mukilnakaiyai
Aanraarupathavai”(Kanak.Sng.9)

That is, 23, 26, 10 – 8 = 2, 1, 3, 5, so he says there are 23+26+2+1+3+5=60 formulas in total. Only 2 is said to be “***Orupathinmeleddolintha***” which means the answer of subtracting 8 from 10, (10- 8) i.e. the answer is 2.

Calculating the number of seeds in a Pumpkin.
Keettrennimuththiththukeelarinalmari
Vettraiinchuthannilmihapperukkiparththathile
Pathi thalli moonritpahiravithaiyakum
Poosanikkaithorumpuhal” (Kanak.Sng.72)

Nobody can’t count how many seeds are there in a pumpkin easily these days. However, it is known that during the ancient Tamils era, formulae for determining the number of seeds in a

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pumpkin were discovered. For example, in the above song, the number of seeds in a pumpkin is found by counting the strips on a pumpkin, multiplying by three, six, five and halving the answer, and then multiplying it by three again.

Allow "A" to represent the number of strips in a pumpkin. According to the song, multiplying it by 3, 6, 5 and gives "90A" and half of that gives "45A". Multiplying it by three again gives “130A”.

If we use A = 6 (135 * 6 = 810) as the number of strips in a pumpkin, then multiplying 135 by six gives 810. As a result, the number of seeds in a pumpkin is estimated to be 810.

Detail of elephants splitting at the entrance

Rearing elephants in the palaces is a usual thing. It is common to take the elephants outside of the stables for several reasons, including tying them in the stables, giving them water, bringing the elephants outdoors for bathing, and taking care of the elephants. The following song describes the way of taking the elephants outside for those purposes as well as the method of calculating them. In that song,

Panthumathiludaiyanparventhanvasalukku
Parththamathiladaivevasalukku – Aththineer
Unnappompothumvarumpothum nan sariyai
EnnunkolElandirunthu (kanak.Sng.67)

A fort in a town called “Madhilaapuri” had ten walls. The number of gates to the first wall is “f”(1), the number of gates to the second wall is (2), the number of gates to the third wall is “ᖴ” (3), the number of gates to the fourth wall is (4), Number of gates to the fifth wall is “U” (5), Number of gates to the sixth wall is “R” (6), Number of gates to the seventh wall is “v” (7), Number of gates to the eighth wall is “m” (8), Number of gates to the ninth wall is “$” (9), and the number of gates to the tenth Wall is “a” (10). So when the elephants go out to drink water from all the ten entrances, all depart together at the first gate of the fort mentioned before, and then divided into two at gate number two, divided into three at the third gate of the wall, divided into four at the fourth gate of the wall, divided into five at the fifth gate of the wall, divided into six at the sixth gate of the wall, divided into seven at the seventh gate of the wall, divided into eight at the eighth gate of the wall, divided into nine at the ninth gate of the wall, and divided into ten at the tenth gate of the wall and once they finished drinking water from the lake, on return it is mentioned that they arrived as predicted. Because of this, how the elephants were counted and how the elephants were counted is highlighted.

Distance Scale

As one can see, multiple measures are used to quantify distance by people. But, only kilometre units are used nowadays. It can also be shown that previous metrics such as mile, hearing distance, and “Yosanai” were utilized in the earlier period. However, while considering the "Kanakkathikaram" era,

Vaiyanuthoolpanchumarirmunainunmanal
Eddinvaliyellameattiyeavviralin
Saddamithampannirandusaan (Kanak. Sng.33)

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In the song, it is mentioned that 8 atoms (scruple) equal to "Kathireluththukkal": 8 "Kathireluththukkal" equals to "Panjitrukkal": 8 "Panjitrukkal" equals to Hair end: 8 Hair end equals Micro sand: 8 Micro sand equals to Small Mustard seeds: 8 Small Mustard seeds equal to Sesame: 8 Sesame equals toPaddy: A finger contains 8 paddies: Finger equals to twelve span: A span is two cubits: a small measuring rod equals to twelve cubits: a measuring red rod equals to 4 small measuring rod: a calling distance is equal to 500 measuring red rod: 4 times of calling distance is equal to "Kaatham": A "Yosanai" consist of 4 "Kaatham": hundred and fifty thousand of "Yosanai" equals the distance to the sun: double of this equals to the distance of galaxy. Through this, we can see that during the period of " Kanakkathikaram", "atom", "Kathireluththu", "Panjittu", hair end, micro sand, small mustard, sesame, grain, finger, span, cubits, small measuring rod, red measuring rod, calling distance, "Kaatham", "Yosanai", star, distance to the sun, galaxy were some of those measurements were used at that time.

Location of the Sun and the Moon

The Indians of the "Vedic" period possessed knowledge of astronomical concepts, the path of the sun, the seasons of the moon, and the movement of the planets. This is the finest illustration of the brilliance of astronomical science in the ancient Tamils' age. In Tamil Nadu, some scientists carefully examined the sun and wind conditions and informed people about them. They even forgot their meal as they continued to study the atmosphere (Astronomy in Literature, p.g.27). Similar to this, we can observe that "Kanakkathikaram" provides a clear explanation of the positions of the Sun and Moon.

Mannalavaimattiyathuvankathirkalvanalavam
Ennalavaikkondareyampiye – Ennin
Perukkaveealkadalinmattalaiyonronrin
Perukkameealkadalinpeedu (Kanak.Sng.17)

The distance of the sky over where the sun moves is double the size of the earth: if it doubles it is the distance over which the moon moves. Thus, it is believed that the texts say that the seven worlds are at a double distance from one another – where that distance is told in the unit of "Yosanai"- which was a measurement used in the ancient Tamils Era. we can see that the measurement of "Yosanai" is used and the method of measurement is highlighted.

The Size of the Ocean

Referring to the area and the location of each sea "Karinaayanaar" mentions as follows. That is, coming first is the saltwater sea. The diameter of this is one lakh "Yosanai" – (which was the measuring method in use during the ancient Tamil period) and this is called "Sambuththeevu (Island): coming next is the Black liquid sea. Its diameter is two lahks "Yosanai". Its name is "Saanmaliththeevu". Then the sea of liquor which has a diameter of four lakhs "Yosanai" and its name is "Bilaksath Island": Next to this is the sea of Ghee, the cross-section of this sea is eight lahks "Yosanai", its name is "Kraunjat Island". Next to this is the sea of curd, which has a diameter of sixteen lahks "Yosanai" and this is called as "Kusaththeevu", next to this is the Holy Milk sea where the god "Thirumaal" lives, diameter is thirty-two lakhs "Yosanai", and its name is "Saagaththeevu (Island)", Then the freshwater sea, which has a diameter of sixty-four lakhs "Yosanai", its name is "Budhabkarath Island",

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and the last is "Chakravalari Giri". Its diameter is three crores and eighty million "Yosanai" .The circumferences for this is seven crore and ninety three lakh "Yosanai". Thus the meaning is given according to the great texts. (Kanak. pg. 34). Based on this we can see the diameter, radius, and area of the sea. And the use of large numbers can also be seen as mentioned.

The size of the world

Through the **"*AndappakuthiyilUndappirakkam*"** song by **"**Thirumoolar" it is stated about the world, about the nature of the world; the structure of the world and the number of planets there. Similarly in "Kanakkathikaaram", this song

Kalakerulahanaduththonriyamameruch
Silaikolaththenkuvithamenil – Iyalnerum
Aararumayiramiyosanaimookuththettka
Noorathukathamnuval (Kanak,sng.19)

It is worth remembering that the world is well described in the song. In this song, it is said that "Mahameru" has four angles and four corners. And the eight directions were extended to the distance of six thousand "Yosanai", and it changes to six thousand and six following that it further changes to three thousand and four. And the books say that the world will be a hundred and forty-four thousand feet height. Here the height and angle of the world are explained and it can be known that it is measured by "Yosanai"- which was a measurement method used in ancient times by the Tamils.

Knowledge of Devakaalam – (time duration of gods)

Here the time definitions and durations of the Vedic era and Yugas which were written in the "Kanakkathikarma" are mentioned. For example,

Ennunchsathuryucshmeerayiramkoodil
Nannunchsathurmuhaththonnalahum – Pennainke
Iyaruthinkaleaalirandumanathe
Poiyathanoorumpuhum (Kanak, sng.99)

The above song is called **"*Thirumahalitkuoppanavale!"*** - (similar to Goddess "Thirumakal"!)As mentioned above, the four yugas consist of a duration of two thousand, "Nanmukhan" – the four-faced god has the longest life span. If this life span completes a duration of one hundred, the age of "Aadinanmukhan" will come to an end, and the total years of the four "Yugas" will be forty-three hundred and twenty thousand. This is called "Mahayugam". If this "Mahayugam" completes duration of eighteen, then "Manu" will get the dominion, if the dominion of"Manu" completes a duration of seventy-four, dominion will be given to"Indian". If this dominion of Indra completes duration of two hundred and seventy, it will be one day to "Naanmukhan". If it completes thirty days, then it will be a month. If these months complete twelve, it is one year. If these years complete a hundred, "Nanmukhan's" lifetime will be over. If a duration of three hundred and sixty goes like this, it will be the cataclysm period for "Aadi Nanmukhan". "Thirumal" will be a boon if the cataclysm lasts for a hundred years. If this auspiciousness goes a hundred, a hair will fall out of the body of the hairy "Mahairudi". If 10 crore hairs fall out of this hairy"Mahairudi", "MeenasaMahairudi" will lose one scale on his body. In this way, if one crore scales fall off

for "MeenasaMahairudi", that is one minute for "BharathuvasaMahairudi", and if thirty crores go for this "BharathuvasaMahairudi" like this, "Mahasaththi" will untangle her hair. Thus, it can be seen that if seven hundred and eighty crores of "saththis" are finished untying the head hair, "Uruthramakali", who is close to the Lord, for her it will be one minute.

Knowing the duration for "Yugas"

Irunoottoruparathudanarayiraththai
Irunalirumoonrinnalil – Nirumiththa
Pinniranduthannilperukkilthirumathe
Nannumorunaaluhaththin seer (Kanak,sng.23)

Through the above-mentioned song in the "Kanakkathikaram", the duration of years for all the 4 "yugas" such as "Greta Yuka", "Tretayuga", "Duvaparayugam" and "Kaliyuga", is mentioned as below, multiplying two hundred and sixteen thousand years by the following numbers respectively eight, six, four and two - seventeen hundred and twenty-eight thousand years which is the result of multiplying by eight equals to years of "Gretayuga", and twelve hundred ninety-six thousand which is the result of multiplying by six equals the years of "Tretayuga", eight lahks and sixty-four thousand years which is the result of multiplying by four equals the years of "Dvaparayuga", and four lakh thirty-two thousand years which is the result of multiplying by two equals "Kaliyuga" years. It is mentioned that the total year of these four yugas is forty-three lakh twenty thousand years and it is called "Chatur Yuga". Through this, it can be seen that the four yugas and the duration of those "yugas" have been highlighted.

Knowledge of Time

A "Naazhikai" refers to a period. Time measurement is used today in terms of seconds, minutes and hours. In "Kanakkathikaram" this period (time) measure is mentioned,

Nimainodimaththirainermuttithanai
Inai guru pattumuyirenrar – Anaiyauyir
Aarusanikammeerarahumvinadi than
Aarupaththenalikaiyam (kanak.sng.20)

By the song, it is mentioned that a second consist of two blinks by the eyes: two snaps of the fingers together a tablet. "Guru" has two tablets: a life contains two "Guru": "kshanikam" has 6 lives, a second contains 12"Kshanikam" and time has seconds. In other words, the words "Kan Imai"-blink by the eyes, "Kai Nodi"- a snap of the fingers, "Maaththirai"-tablet, "Guru", "Uyir"-ife, "kshanikam", "Vinaadi"-second, "nazhigai"-hour are used here to measure the time. Also, it can be seen that the "tablet size" mentioned here is used in Tamil grammar today to classify the duration of letters.

(KuzhiAlavu) Pit Size

Measurements such as feet, meters, centimetres, and millimetres are used more nowadays to measure the depth of the pit when digging a pit. But it can be seen that the following method is used to calculate the size of the pit in the "Kanakkathikaram". that is,

Sirakolmuthatkolsempathiyipathi
Neriyahakkanirandamaddum – serisoolalai
Nallamulamonrinmelsalumpidikaliru

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Solluvarevallarthuninthu (Kanak,sng.36)

and

Alantha kai nankumalavarinthukooddip
Pilanthuperiyathanalmaari – valanthikalum
Maddinatrikkamakaniyitkalikkasa
Siddorvilankumkuli" (Kanak,sng.37)

In the first song, there is a line saying' சிறுகுழியளக்குமிடத்துமுழமுஞ் சாணும் பிடியும் கொள்க", which says when digging a pit they use "Span" and "cubits" measurements where only king and the people are measured by 8 span unit and the pole used to measure the depth of that pit will be 4 span in length. In the second song it is worth remembering the methods of measuring pits and the method of assessing pits through equations are stated.

Relationship between the measurements Cubits, span and finger

When it comes to the cubit, the span, the finger and the relationships between these, there is a situation where small measurements have to be converted to larger measurements over a stage because as the unit of measurement increases, it is difficult to indicate by small measurements. Hence the units of measurement change. For example, converting 1000 grams = 1 kilogram is the same. The "Kanakkathikaram" explains such a relationship as follows. That is,

Vaiyanuthoolpanchumayirmunainunmanal
Iyellunelludaneavviralam – peivalaiyai
Eddinvaliyellameattiyeavviralin
Saddamathampannirandusaan (Kanak,sng.33)

One "Ainthai" consists of micro sand (1 or small mustard). Sesame equals 8 mustard seeds, a paddy equals 8 sesame seeds together, and a finger equals 8 paddies. 12 fingers indicate a span. Similarly, in ancient Tamils measurement methods, one cubit consists of two spans. They have used such a small calculation for architectural to varying degrees of elongation.

1 cubit = 2 span
2 span = 12 finger
Therefore, 1 cubit = 24 finger

When we convert the calculations which are in the form of cubits and span into finger measurement we can convert that calculation using the above method.

Calculation of Garden Lizard

Everyone can look in amazement as soon as they read the heading "Calculation of garden lizard". But this is a mathematical puzzle. This type is also one of the mathematical calculations included in "Kanakkathikaram".

A palm tree of 32 cubits tall, which is 32 x 24 = 768 fingers tall. A garden lizard climbs 1 inch and descends 4 fingers a day. That is, 12 fingers up and 4 fingers down which means it climbs 8 fingers per day.

So our calculation can now be modified according to our modern mathematical methods If a garden lizard climbs a palm tree 768 cm high by 8 cm per day, how many days will it take to climb the tree?

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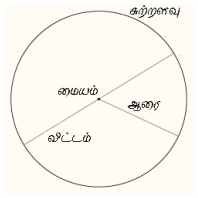
768 cm = 768 fingers,

Distance climbed by the garden lizard per day =8 cm

So, it takes 768/8 = 96 days to cross the 768 cm distance.

So the answer to this puzzle is 96 days. The answer is that it would take the garden lizard 96 days to reach the top of the 32-cubit high palm tree.

Area of the circle



An ancient text called "Kaakkaippaadiniyam" explains the area of a circle. "Kaakkaippaadiniyam" is an amazing mathematical book which was written by "Kaakkaippaadiniyaar" who lived in the pre-"Tholkaappiyar" era (Tholkaappiyar's period is 711 BC.) In which the area of a circle is given in the form of a song. "DevaneyaBaavanaar" has mentioned that book "Erambam" was the oldest Mathematical book and now it had disappeared (Ka. Vadivel). Apart from that "Kaakkaippaadiniyaar" and "Karinaayanaar" have written many books on mathematics. This song is placed as the 46th and 49th song of "Kanakkathikaaram".

Vaddaththaraikonduviddaththaraithakka
Saddenaththonrumkuli (Kanak,sng.46)

and

Viddaththaraikonduvaddaththarai
Thakkasaddenaththonrumkuli (kanak,sng.49)

In the above song,

"*Vaddaththarai*" = Circumference of a circle (2=2πr/2=πr)
"*Viddaththarai*" = Diameter(2=2r/2=r)
"Fop" (area) = Circumference X Diameter
I.e. Area of a circle = πr x r= πr2

We can see that it is mentioned as written above.

Circumference of a circle

The circumference of a circle is explained in the ancient text "Kanakkathikaram". In this text, he stated the circumference of a circle in the form of a song.

Viddamathanaiviraivayiraddiththu
Maddu naan mathavanilmariye – Eddathanil
Ettiyeseppiyadilerumvaddaththalavum
Thottumeppoonkodineesol (Kanak,sng.50)

That is,

***Viddamthaniviraivaiiraddiththu* :- Doubles the diameter = 2r+ 2 r+=4r (Diameter = 2r)**
***Maddu naanmathavanilmariye*:- Multiply by 4**
***Eddathnilettiye* :- Multiply by 8**
***Seppiyadi*:- Divide by 20**
Circumference of the circle = (4r x 4 x 8) / 20 =32 / 5 r= 2 (16/5) r =2 π r
Where π = 16/ 5 =3.2 (this is a somewhat accurate derivation)

Circumference of the circle we use today = 2πr. It is truly mind-blowing to know that our ancestors knew the formula hundreds of years ago.

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Summary

Through his songs, in “Kanakkathikaram” the author successfully brings attention to the mathematical concepts that were part and parcel in the lives of the ancient Tamils. It is seen in this book that mathematics is not only presented in calculations but also a variety of contexts, including conversations, tales, riddles, proverbs, and everyday activities. It does not specifically handle addition, subtraction, multiplication, or division. But you can also find these things in a hidden way in the songs. However, it also discusses excellent computations, including difficult calculations to understand, strategies for solving them, and magic squares. But the sums solved through magic square are excellent. As can be seen, magic squares are a great way to enhance the growth of the brain. It is a method of question and answer of intelligence. The digits used in the "Kanakkathikaram", are seen as symbols. Additionally, it appears that the digit zero (0) was not utilized separately in this instance. Further calculations were also discovered to be more challenging than the ones in use nowadays. Although there are essentially no differences between the calculations used in "Kanakkathikaram" and the calculations used in the current days, the language used is difficult to understand fully.

Conclusion

The things to consider when learning "Kanakkathikaram" include learning about mathematics in the early Tamil culture and how they computed calculations mentally using oral formulae (oral songs). Considering that all of the songs described here are intended to be jokes, riddles, and informal dialogues. When considering everything all together, it is important to keep in mind that "Kanakkathikaram" is a representation of how specialized and advanced science was in the life of the ancient Tamils.

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Reference words
sng – Song
pg – Page
Kanak – "Kanakkathikaram"

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