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27th October 2021

Jointly Organized by

Department of Biological Science, Physical Science and Computational Science

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The International conference on “Emerging Trends in Science and Technology (ETIST-2021)” is being jointly organized by Departments of Biological Science, Physical Science and Computational Science - Nallamuthu Gounder Mahalingam College, Pollachi along with ISTE, CSI, IETE, IEE & RIYASA LABS on 27th OCT 2021. The Conference will provide common platform for faculties, research scholars, industrialists to exchange and discus the innovative ideas and will promote to work in interdisciplinary mode.

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Role of Mathematics in History with Special Reference to Pallava Weights and Measures

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ABSTRACT: A Scientific study of History has become the order of day. Inscriptions offer sample scope for the scientific study of History. This paper examines how a study of Pallava inscriptions show the standards of weights and measures had existed in rudimentary form during the Pallava period and how even the modern applied mathematics could be said to have expanded upon the ancient system of measurements. This paper has special reference to land measures and weight measures that were in use during Pallava period.

KEYWORDS: Inscription, Weights, Measures, Plough, Nivartana, Pattika,Padagam,Veli, Kuli, Padi, Nali.

1.INTRODUCTION

History without Science is blind, Science without History is empty. There are so many Mathematical Calculations in Historical studies. In Tamilnadu History, Pallava period is hailed as "**Golden Age of Art and Architecture".** Their weights and measures have unique features. The Pallava inscriptions relate to gifts of land, gold and other articles of produce. A scrutiny of these records reveals a number of weights and measures. Many of these continued to be in use even during the Post-Pallava periods of the Tamil country and a few are still in vogue in Southern Tamil districts.

2. LAND MEASURES

The Prakrit and early Sanskrit inscriptions mention the extent of land measured by the "**Plough", "Nivartana"** or **"Pattika".** Originally, a plough of Land Seems to have been so much of Land as was cultivated by a man with a plough and two bullocks within a given time. Later on, this **"Plough of Land"** appears to have been standardized and used as a unit of Land measure.

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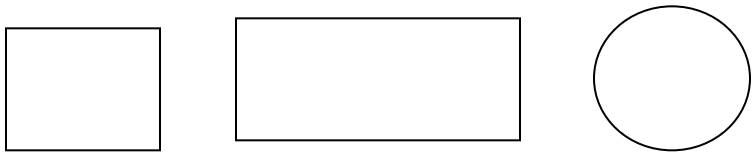
2.1. Nivartana:

In the Hirahadagalli Copper Plates where we have statements such as **'halasata sahasra',** one hundred thousand oxploughs (of land), we cannot fail to understand **"hala"** in the sense of a unit of Land measures. The term **"nivartana"** literally means '**a turning back'** and probably in the very early days, land was measured by an individual starting from a particular point and after going round the yard yield, returning to the starting point in a certain time, thus marking the exact boundary of the field covered during the course of the yard. As the Land Covered during the **"nivartana"** varied, in proportion to the swiftness of the person, walking around, some fixed unit seems to have been invented later on to define a **"nivartana".** Though it is known that a nivartana usually consists of 20 roads or 200 cubits or 40,000 **"hastas",** square of land, the Pallava inscriptions do not denote the exact measurement of the area contained in "nivartana". The Arthasastra defines a Nivartana as three "**rajjus"**.

The following curves define Nivartana:



Here Starting Point= Ending Point

2.2. Patti and Padagams:

The Chendalur plates mention pattika as a unit of land measure and it is likely that pattika is a Sanskrit term for the measure. **"Patti"** is found in the Tamil inscriptions of the Pallavas. Originally, like the 'Nivartana' Patti was also a vague unit, as it meant a pieace of Land sufficient for a Sheep-fold (Patti – a sheep fold). It is interesting to note from the evidence of the Kasakudi Plates that **Nivartana** and **Patti** are synonymous terms. It is clear that **"sarvamanya nivartana dvaya maryadaya"** occurring in the Sanskrit portion of the plates is a literal translation of **Samnya irandu Pattippadiyal**of the Tamil portion of the same grant. Besides the nivartana or pattika or Patti lands were denoted by the name **padagam** in the Tamil inscriptions. In the Tandantottam plates the name of a few **"donees"** are designated by **"padagam",** such as **Padagam Matrbhuti Sadangavit Somayajin, Padagam Swamideva Sadangavit, Padagam Rudraanandi Bhatta Somayajin** etc. Krishna Sastri thought that these Padagams are names of villages. Since padagam precedes the names of more than one donee in this grant, it is to be understood as a general name for a village and same as Paru, Parru, Padu commonly found as an ending of village names. It is thus evident that these donees were owners of villages.

From other inscriptions we learn that a padagam is used in the sense of cultivable land. Later on from kampavarman's inscriptions we obtain the measurements of a **Padagams** as 240 kulis of lands.

The following table describes the land measures Nivartana and Patti

Table:1

S.No	Land Measure	Cubits	inches	cm
1	1 Nivartana	200	3600	8800
2	1 Patti	200 long	4200	10400

2.3. Veli and Kuli:

"**Veli"** and **kuli** were the most common land measures. **"Veli"** probably has its origin in a man's fencing or putting up a **"veli"** around his field. Kuli is a unit of square varying with different times and districts, from 144 square feet to 576 square feet. From an inscription of Nripatungavarman we get the information that a kuli at that time consisted of 81 square feet. It is said that 27,000 kulis of land were divided among various people each square being measured by a twelve-san rod. Therefore, it should have been that a kuli measured 81 square feet (12*9¨) = 81 square feet.

In measuring lands, kols or rods of different sizes, were used is evidenced by the mention of **Nalusan Kol**, **Panniru-Sankol** and **padinaru san kol**. The custom of naming field seems to have been prevalent in the Pallava days as it still does in certain parts of the Tamil districts. The fields that were distinguished by these proper names are the following:- **Vinnakkavilagam nilan, Alanjirkkalam putti, Toluner – Velinilam; Anaippundalattu Seruvu** and **Valayapparaicceruvu.**

Table:2

S.No	Land Measures	Acres	Cent	Sq.feet
1	Padagam	0.551	55.1	24000
2	Kuli	0.0023	0.23	100
3	Veli	6.43	643	280065.08

The above table illustrates the land measures Padagam, Kuli and Veli.

2.4. MEASUREMENT OF CAPACITY

2.4.1 Padi and Nali:

There were numerous measures named differently and each denoted a different standard. In Tiruvorriyur there was a nali known by the name **karunali** and rice was measured by that. **Nalvanali** is mentioned in an inscription of **Tellarru Nandi** and **Manayanali** in an inscription of Nripatunga from the Chengalpat district. It is evident that 'Measures' were also named after persons eminent in the time. **Narayanali,** which is presumably a corruption of **Narayananali,** is recorded in two inscription of Nandivarman's and another of Nripatunga's. The **Pirudimanikka Uri** was evidently named after **Nripatungas queen.** With regard to **Videlvidugu ulakku** it is clear that it was the measure sanctioned by the government of the time and therefore that it was a standard measure.

The smallest denomination of the measurement of capacity expressed is a **"pidi**", a handful in the supply of ghee and oil. Ghee, oil, milk and curd are measured by the **Sevidu** or **Sodu, Alakku, Ulakka, Uri and Nali.** The first two items as we learn were only measured and not weighed. In one of **Nripatunga's inscription**, **Sevidu or Sodu** is expressed both as a weight and as a measure of capacity. It is said that two **Sevidus** of kayam and **one "Sevidu**" of ghee were supplied. **Sevidu** is usually taken to be 1/5 of an **Ulakku** and 360 grains in weight. **Padi** and **nali** are found to be synonymous terms to express measures.

In modern times **padi** and **nali** indicate different capacities. **Padi** (Madras) measure contains 8 **olocks** while **nali**is stated to contain ¼ of a measure or half a Thanjavur measure.In the Pallava age rice and paddy were measured by the **nali, marakkal, kuruni, padakku, kadi** and **Kalam**. The standard measure **por-kal** was used for measuring paddy in Mamallapuram in the eighth century and figures were in the record of Nandivikramavarman.

The following are the measurements of capacity

1. 1 sevidu = 360 grains
2. 1 pidi = 2 sevidu = 720 grains
3. 1 olock = 5 sevidu = 1800 grains
4. 1 ulakku = 2 olock = 10 sevidu = 3600 grains
5. 1 uri = 2 ulakku = 4 olock = 20 sevidu = 7200 grains
6. 1 padi = 2 uri = 4 ulakku = 8 olock = 40 sevidu = 14400 grains

3.WEIGHTS:

Gold weights such as kalanju and manjadi are used as weight measures during the Pallava times in the country. Many inscriptions including Pandya inscription talk about **"Kalanju"** a weight measure for Gold. Altekar observes that the name Kalanju is derived from a climber caesalpine, the weight of whose seeds varied between 45 and 50 grains. The average weight of early gold coins also varied between 45 and 50 grams. Gold coins were also used as units of measure during Pallava times. Many inscriptions, literature and actual findings bear testimony to this.

Weight measure for Gold = Kalanju = 4550 grams.

3.1. Sribhara and Srinidhi:

The coins (in the catalogues of coins of Elliot and Desika-chariyar) bear the legends '**Sribhara',** '**Srinidhi**' and the bull. The Pallava king Rajasimha (Narasimhavarman II) was regarded as having assumed the titles of '**Sribhara**' and '**Srinidhi**'. The drawings of these coins (in plate 1 of Elliot Nos. 32, 34, 37) and the characters in them are old enough to fit the age suggested. In addition, the bull was not only the Pallava emblem in general but was a special favourite of **Rajasimha** who was an ardent Saiva wearing Siva as his crest **(Sivachudamani).**

The second list of Desikacharya refers to certain coins bearing the legends of either **Sribhara or Srinidhi** on the obverse and a fish or double-fish on the reverse. The fish or the double fish clearly indicates the recognition of Pallava supremacy by the contemporary Pandya king. Examples of silver coins of the Cholas which bear both Pandya and Chola emblems, the fish and the bow, confirm the view given above regarding the Pallava fish coins. The bull and fish coins bearing the legends '**Sribhara' and 'srinidhi'** were of great political significance. Some Gold coins with the figures of a crab and tortoise were introduced in the Pallava coins. It is presumably to indicate the commercial and sea-going activities of this period.

3.2. Ship-coins:

Coins with two-master ships almost always found in the Coromandel Coast have been assigned to the Pallavas by **Sir Walter Elliot.** One such coin with the legend '**Sri-Pulumayi'** is described by **Rap son** in his work on the Coins of the Andhra dynasty. Since the coins in Elliot's list carry a bull, the adoption of the ship symbol in such coins explains the maritime activities of the Pallavas which were considerable.

3.3. Gold coins – evidence of Epigraphy:

Epigraphical evidence definitely proves that gifts to temples were made in the form of gold weight and gold coins. Tamil inscriptions of the later Pallava kings make frequent references to **Kanam, Palangasu**, **Tulaippon** and **Videlvidugupon.** The term '**pon'** in these records indicates a gold coin of a certain definite weight. **Palangasu** was considered to be of greater fineness than the current coin. **Tulaippon** contained a hole at the centre certifying the genuineness of the Gold used in striking the coin. **Videlvidugu,** the Pallava mark (to indicate the royal seal), was used in the coin "**Videlvidugu-tulaiyitta sempon".**

4. CONCLUSION

Epigraphic evidences for weights and measures belonging to Pallava period suggest that the intellectual leaps in the field of mathematics have its origins in the simple measuring systems of the ancient world. So it goes to prove that early man's systematic treatments of pattern and quantities have led to the modern applied mathematics.

REFERENCES

1. Chanakya, Arthasastra: Book II, Chapter XX.
2. The Director General Archaeological Survey of India, Epigraphic Indica Vol XX Janpath, New Delhi, 1983.
3. The Director General Archaeological Survey of India, South Indian Inscription Vol I**.** Janpath, New Delhi, 1991.
4. Proceedings of the Madras literary society, 1961.
5. The Director General Archaeological Survey of India, Epigraphic Indica Vol X**.,** Janpath, New Delhi, 1983.
6. Dr. Minakshi. C, Administration and the social life under the Pallavas**,** University of Madras, 1977.

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