

Primary Mathematics Study on Whole Numbers  
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ICMI Study 23



# CHINESE CORE TRADITION TO WHOLE NUMBER ARITHMETIC

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# Why China ?

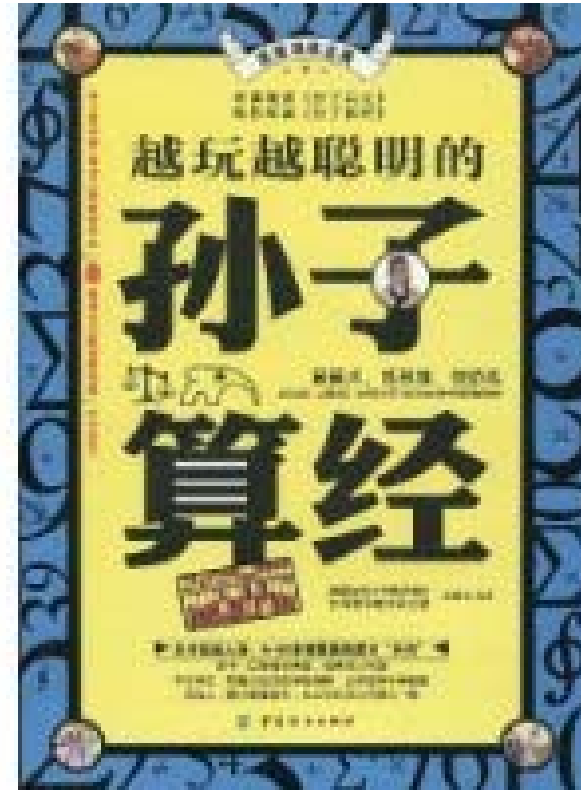
- Mathematics is called the academics of **calculation** (算術) before 1977 in China
- 算 = 竹 + 目 + 廾. The 目 portion may have originally represented counting rods or possibly an abacus = **number**
- Mathematics in Chinese is
- shuxue ( 數學 ) = **number** learning/study
- Geometry in Chinese is jihe ( 幾何 ) = how many = **number**

# Where is from Hindu-Arabic system of numerals ?

- The Hindu-Arabic system of numerals
- is more effective computation than others
- It has been adopted by countries all over the world during the last century.

# Lam and Ang (2004) told an interesting story

- The Hindu-Arabic system of writing and calculating
- derived from the old Chinese **rod numeral system**
- Chinese rod numeral system in the Sunzi Suanjing 【孫子算經】 AD 5<sup>th</sup> century .



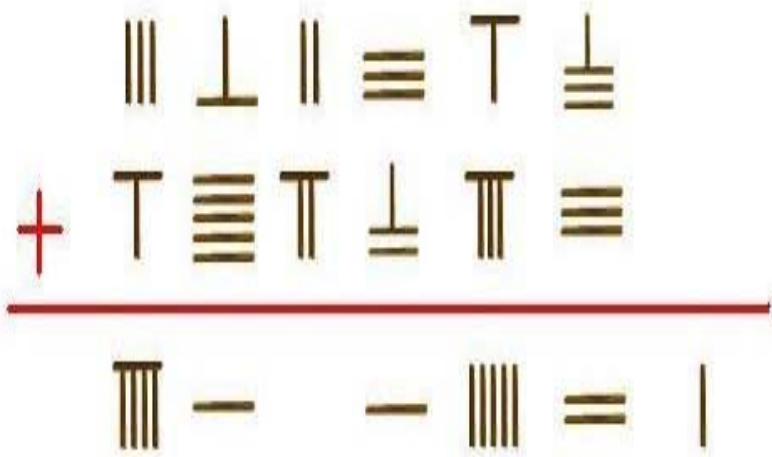
# A story: The trip of Chinese number concept /calculation procedures

- was transmitted to **India** during the 5-9th centuries,
- to the **Arabic** empire in the 10th century,
- to **Europe** in the 13th century
- by the Silk Road (see Guo, 2012)



*The Silk Road and related trade routes*

# Ancient approach /Current approach



# Chinese number concept :

1. **Place value** principle
2. Based ten principle

Follow two principles (Ross 1989)

Reflected in number name and **suanpan**

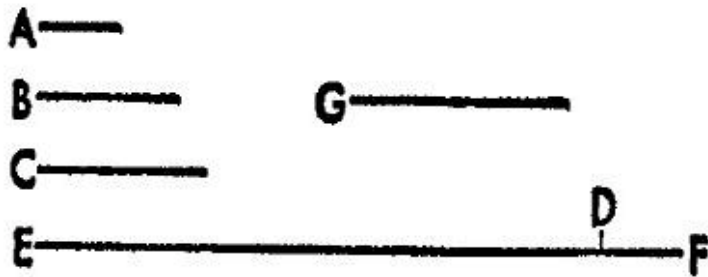
The greatest calamity in the history  
of science **was the failure of  
Archimedes to invent positional  
notation.**

The value of place value is evoked by  
this quotation from Carl Friedrich  
Gauss (Howe, 2010)



# Why not number line in China?

- **Numberline vs Suanpan (Chinese abacus)**
- **Geometry tradition vs arithmetic/Algebra tradition**



说宝网



# Why is Suanpan it useful ? **IT REFLECTS** **CHINESE CORE TRADITION**

- Place value is evidenced in Suanpan
- no place value in number line
  
- Associative law is demonstrated much more clearly than number line

# What is the difference of dominant **concept?**

- Place value in suanpan vs order in number line

# What is the difference of **addition and subtraction** concept ?

- Composition/decomposition vs counting up or down?

## Suanpan : why does Chinese invent ?

- It might be related Chinese language habit/spirit .

# What is Chinese language habit/spirit?

1. Part-part-whole structure
2. quantity words / Classifiers

# Chinese language spirit: part-part- whole

- Chinese language vs western language
- logographic vs alphabetic
- Phono-semantic compounds vs phonetic

# Chinese language spirit: part-part-whole

- Chinese sentence is part-part-whole
  - Chinese word is part-part-whole
  - Chinese **character** is part-part-whole
- 我愛數學 I love mathematics
  - 數學 number learning
  - 數 = 米 + 女 + 文



# Chinese language spirit: part-part- whole

- Abbreviated Chinese name: 十三
- Arabian number : 13
- English : Thirteen

# *The unique feature of the Chinese language:*

- *A variety of classifiers (number unit)*  
條, 把, 只.....
- *A general classifier = 个 = Ones*
- 十 = tens
- 百 = hundreds

# “ones” in Chinese daily language

- The English expression “an apple” has to be replaced in Chinese by an “ones” (ge, 个) apple.
- There are many classifiers in Chinese that have no corresponding English words.

# Chinese language spirit: algebraic thinking / Simple

- Month name in English : Jan, Feb, March,.....
- Month name in Chinese :1 Month, 2 month, ...
- Week name in English: Monday, Tuesday,.....
- Week name in Chinese: week 1,week2,.....

# Summary: Chinese Arithmetic tradition

- 1. Numeration /suanpan records both number name and number unit, which specifies the place value in a clearer way than others.
- 2. Chinese Numeration /suanpan fully follows the calculation framework in terms of place value.