ISO/IEC JTC 1/SC 2/WG 2
PROPOSAL SUMMARY FORM TO ACCOMPANY SUBMISSIONS
FOR ADDITIONS TO THE REPERTOIRE OF ISO/IEC 10646[1]
Please fill all the sections A, B and C below.
Please read Principles and Procedures Document (P & P) from http://www.dkuug.dk/JTC1/SC2/WG2/docs/principles.html **for guidelines and details before filling this form.**
Please ensure you are using the latest Form from http://www.dkuug.dk/JTC1/SC2/WG2/docs/summaryform.html.
See also http://www.dkuug.dk/JTC1/SC2/WG2/docs/roadmaps.html **for latest *Roadmaps*.**

A. Administrative

1. **Title:** Proposal to add Chinese counting rod numerals to Unicode and ISO/IEC 10646
2. Requester's name: Christopher Cullen and John H. Jenkins
3. Requester type (Member body/Liaison/Individual contribution): Individual contribution
4. Submission date: 8 June 2004
5. Requester's reference (if applicable): N/A
6. Choose one of the following: This is a complete proposal

B. Technical - General

1. Choose one of the following:
   a. This proposal is for a new script (set of characters):
      Proposed name of script: Chinese Counting Rod Numerals
2. Number of characters in proposal: 19
3. Proposed category (select one from below - see section 2.2 of P&P document):
   A-Contemporary _____ B.1-Specialized (small collection) _____ B.2-Specialized (large collection) _____
   C-Major extinct _X___ D-Attested extinct _____ E-Minor extinct _____
   F-Archaic Hieroglyphic or Ideographic _____ G-Obscure or questionable usage symbols _____
4. Proposed Level of Implementation (1, 2 or 3) (see Annex K in P&P document): 3
   Is a rationale provided for the choice? Yes
   Negative numbers are indicated by overlaying a diagonal slash
5. Is a repertoire including character names provided? Yes
   a. If YES, are the names in accordance with the "character naming guidelines" in Annex L of P&P document? Yes
   b. Are the character shapes attached in a legible form suitable for review? Yes
6. Who will provide the appropriate computerized font (ordered preference: True Type, or PostScript format) for publishing the standard? John H. Jenkins
   If available now, identify source(s) for the font (include address, e-mail, ftp-site, etc.) and indicate the tools used: FontLab 4, available from jenkins@apple.com
7. References:
   a. Are references (to other character sets, dictionaries, descriptive texts etc.) provided? Yes
   b. Are published examples of use (such as samples from newspapers, magazines, or other sources) of proposed characters attached? Yes
8. Special encoding issues:
   Does the proposal address other aspects of character data processing (if applicable) such as input, presentation, sorting, searching, indexing, transliteration etc. (if yes please enclose information)? Yes
9. Additional Information:

Submitters are invited to provide any additional information about Properties of the proposed Character(s) or Script that will assist in correct understanding of and correct linguistic processing of the proposed character(s) or script. Examples of such properties are: Casing information, Numeric information, Currency information, Display behaviour information such as line breaks, widths etc., Combining behaviour, Spacing behaviour, Directional behaviour, Default Collation behaviour, relevance in Mark Up contexts, Compatibility equivalence and other Unicode normalization related information. See the Unicode standard at http://www.unicode.org for such information on other scripts. Also see http://www.unicode.org/Public/UNIDATA/UCD.html and associated Unicode Technical Reports for information needed for consideration by the Unicode Technical Committee for inclusion in the Unicode Standard.

[1] Form number: N2652-F (Original 1994-10-14; Revised 1995-01, 1995-04, 1996-04, 1996-08, 1999-03, 2001-05, 2001-09, 2003-11)

C. Technical - Justification

1. Has this proposal for addition of character(s) been submitted before? No

2. Has contact been made to members of the user community (for example: National Body, user groups of the script or characters, other experts, etc.)? Yes

   If YES, with whom? Scholars studying the history of Chinese mathematics

   If YES, available relevant documents: N/A

3. Information on the user community for the proposed characters (for example: size, demographics, information technology use, or publishing use) is included?

The user community is limited to scholars studying pre-modern Chinese mathematical texts

4. The context of use for the proposed characters (type of use; common or rare) Rare

5. Are the proposed characters in current use by the user community? No

6. After giving due considerations to the principles in the P&P document must the proposed characters be entirely in the BMP? No

7. Should the proposed characters be kept together in a contiguous range (rather than being scattered)? Yes

8. Can any of the proposed characters be considered a presentation form of an existing character or character sequence?

Yes; some are similar to some of the "Hangzhou" numerals or Han numeric ideographs; but since this is a small set which is with overall distinct shapes and combining behavior, it would be best to encode them as a block

9. Can any of the proposed characters be encoded using a composed character sequence of either existing characters or other proposed characters? No

10. Can any of the proposed character(s) be considered to be similar (in appearance or function) to an existing character?

Yes; some are similar to some of the "Hangzhou" numerals or Han numeric ideographs; but since this is a small set which is with overall distinct shapes and combining behavior, it would be best to encode them as a block

11. Does the proposal include use of combining characters and/or use of composite sequences? Yes

    If YES, is a rationale for such use provided?

Negative numbers were indicated by overlaying a diagonal slash

    Is a list of composite sequences and their corresponding glyph images (graphic symbols) provided? No

12. Does the proposal contain characters with any special properties such as control function or similar semantics? No

13. Does the proposal contain any Ideographic compatibility character(s)? No

Chinese counting rod numerals were used in pre-modern Chinese mathematical texts in conjunction with counting rods used to represent and manipulate numbers. The counting rods were a set of small sticks, several centimeters long which were arranged in patterns on a counting board to represent numbers. Counting rods and the counting board provided a flexible system for mathematicians to manipulate numbers, allowing for considerable sophistication in mathematics.

The specifics of the patterns used to represent various numbers using counting rods varied, but there are a number of constants :

Two sets of numbers were used, for alternate columns (e.g., ones/hundreds/ten-thousands vs. tens/thousands)

Zero was indicated by a blank square on the counting board and avoided in written texts or represented with U+3007 IDEOGRAPHIC NUMBER ZERO. Written texts could also take advantage of the alternating shapes for the numerals to avoid having to explicitly represent zero.

Negative numbers could be indicated on the counting board by using rods of a different color. In written texts, a diagonal slash from lower-right to upper-left is overlaid upon the right-most digit.

The predominant use of counting-rod numerals in texts was as part of diagrams of counting boards. They are occasionally, however, used in other contexts, and are occasionally, even in modern texts, occasionally placed within the body of the text itself. Their current use is limited to discussions of the history of Chinese mathematics.

We propose encoding Chinese counting rod numerals using nineteen characters: nine even-column digits, nine odd-column digits, and one combining negation marker. There is no particular need for these characters to be in the BMP; however, because we anticipate proposing other pre-modern Chinese mathematical symbols for encoding at some future date, it may be best to encode them in a small block with some room after it for other symbols.

There is no need to account for the precise variations in shape of the counting rod numerals from time to time; this can be handled as a font difference.

Note from the figures that the precise layout of the numerals could be moderately complicated in actual texts. We consider that the default behavior would be to lay them out in a fashion similar to ideographs, and any complications for specific texts can be handled by higher-level protocols.

The nineteen characters requested are:

𝍠 CHINESE COUNTING ROD UNIT DIGIT ONE
𝍡 CHINESE COUNTING ROD UNIT DIGIT TWO
𝍢 CHINESE COUNTING ROD UNIT DIGIT THREE
𝍣 CHINESE COUNTING ROD UNIT DIGIT FOUR
𝍤 CHINESE COUNTING ROD UNIT DIGIT FIVE
𝍥 CHINESE COUNTING ROD UNIT DIGIT SIX
𝍦 CHINESE COUNTING ROD UNIT DIGIT SEVEN
𝍧 CHINESE COUNTING ROD UNIT DIGIT EIGHT
𝍨 CHINESE COUNTING ROD UNIT DIGIT NINE
𝍩 CHINESE COUNTING ROD TENS DIGIT ONE
𝍪 CHINESE COUNTING ROD TENS DIGIT TWO
𝍫 CHINESE COUNTING ROD TENS DIGIT THREE
𝍬 CHINESE COUNTING ROD TENS DIGIT FOUR
𝍭 CHINESE COUNTING ROD TENS DIGIT FIVE
𝍮 CHINESE COUNTING ROD TENS DIGIT SIX
𝍯 CHINESE COUNTING ROD TENS DIGIT SEVEN
𝍰 CHINESE COUNTING ROD TENS DIGIT EIGHT

𝍠 CHINESE COUNTING ROD TENS DIGIT NINE
𝍢 COMBINING CHINESE COUNTING ROD NEGATIVE NUMBER SIGN

Examples:

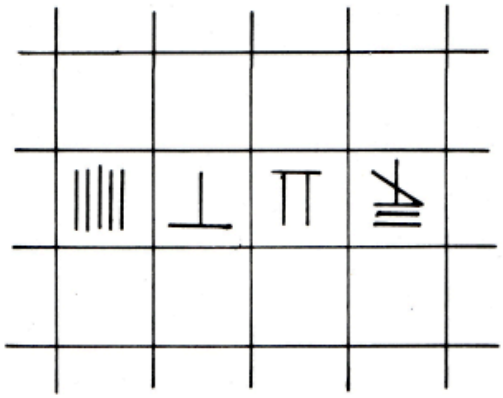


Fig. 17 Using counting-rods to set up negative numbers.

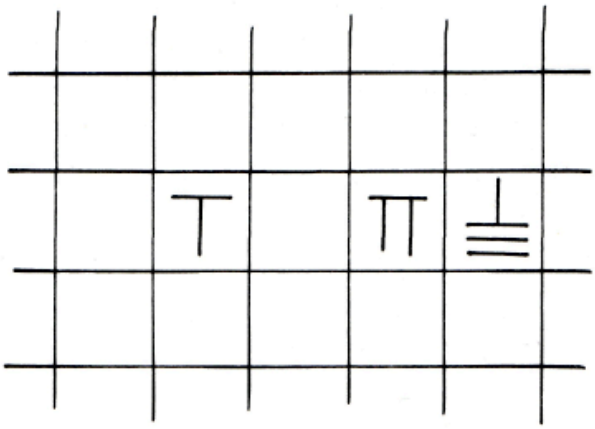
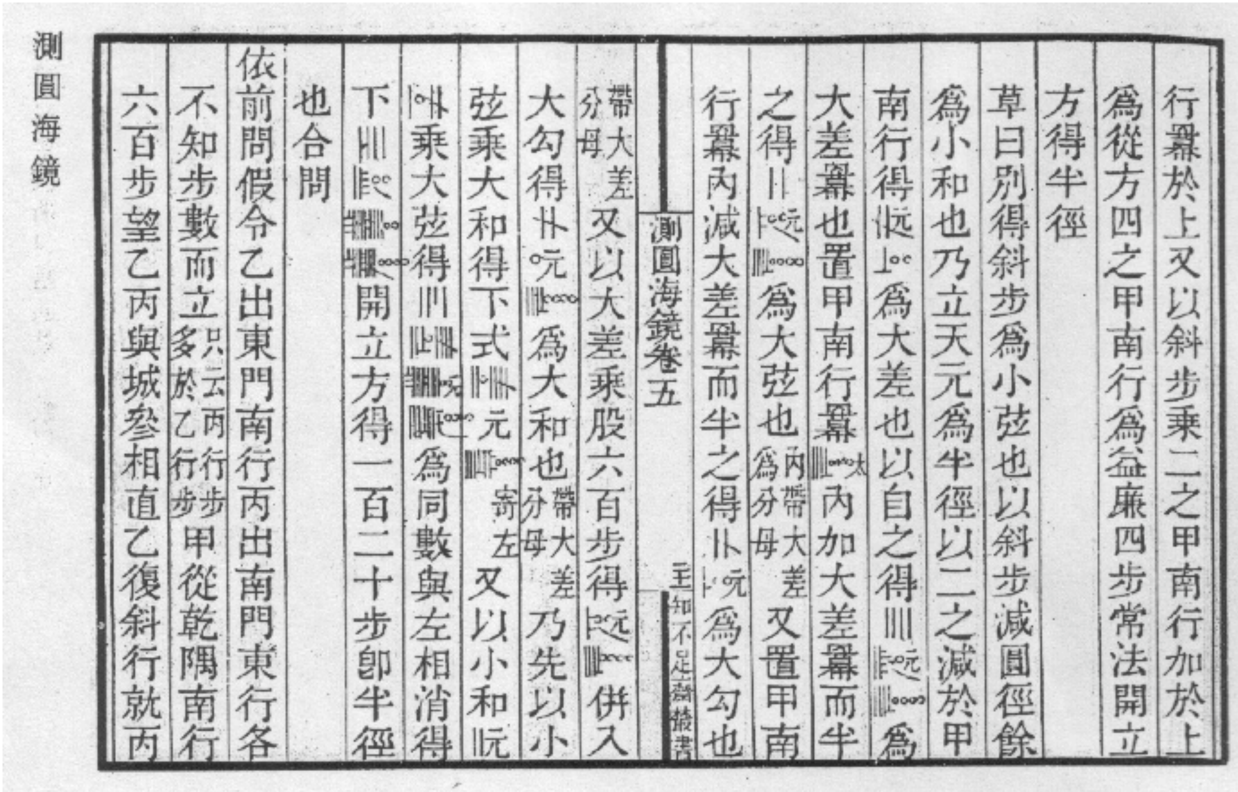


Fig. 18 Using counting-rods to indicate the symbol of zero.

confusion, although in many cases – such as this one – one can easily make inference from the way the digits are written, as 678 is written as 𝍠𝍢 and not 𝍢𝍠. The first zero sign in a Chinese mathematical text appears in the work of Qin Jiushao 秦九韶 in the mid-thirteenth century AD. For example, he wrote the number 1,470,000 as 𝍢𝍠〇〇〇〇.

From page 58 of *Li, Qi, and Shu* by Ho Peng Yoke (Hong Kong University Press: 1985). The discussion in the paragraph is of how 6078 and 678 could be distinguished without a sign for 0.


測圓海鏡

行冪於上又以斜步乘二之甲南行加於上爲從方四之甲南行爲益廉四步常法開立方得半徑

草曰別得斜步爲小弦也以斜步減圓徑餘爲小和也乃立天元爲半徑以二之減於甲南行得[illegible]爲大差也以自之得[illegible]爲大差冪也置甲南行冪[illegible]內加大差冪而半之得[illegible]爲大弦也（內帶大差爲分母）又置甲南行冪內減大差冪而半之得[illegible]爲大勾也

測圓海鏡卷五　知不足齋叢書

（帶大差分母）又以大差乘股六百步得[illegible]併入大勾得[illegible]爲大和也（帶大差分母）乃先以小弦乘大和得下式[illegible]寄左　又以小和[illegible]乘大弦得[illegible]爲同數與左相消得下[illegible]開立方得一百二十步卽半徑也合問

依前問假令乙出東門南行丙出南門東行各不知步數而立（只云丙行步多於乙行步）甲從乾隅南行六百步望乙丙與城參相直乙復斜行就丙

From the *Ciyuan Haijing*.

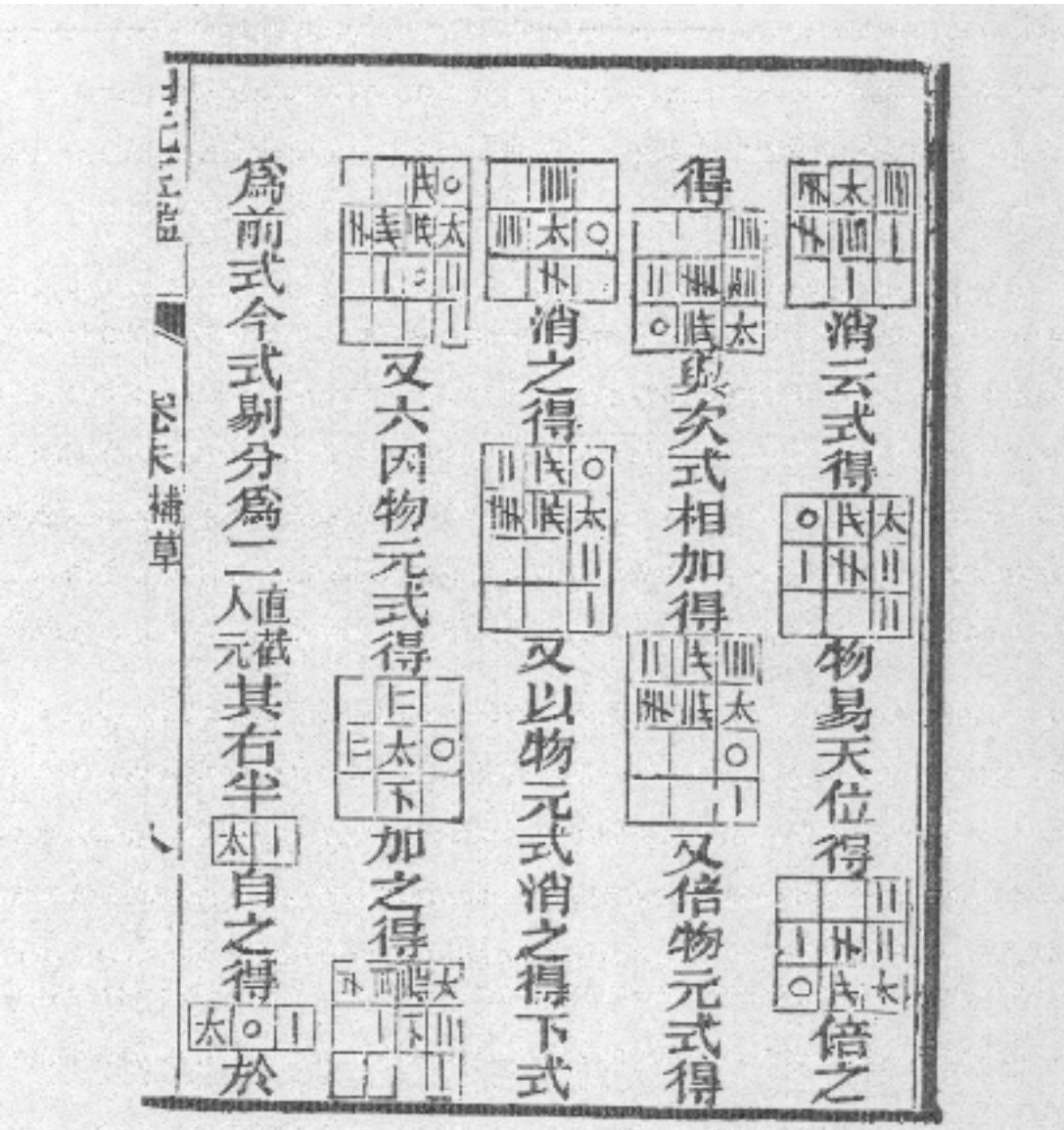
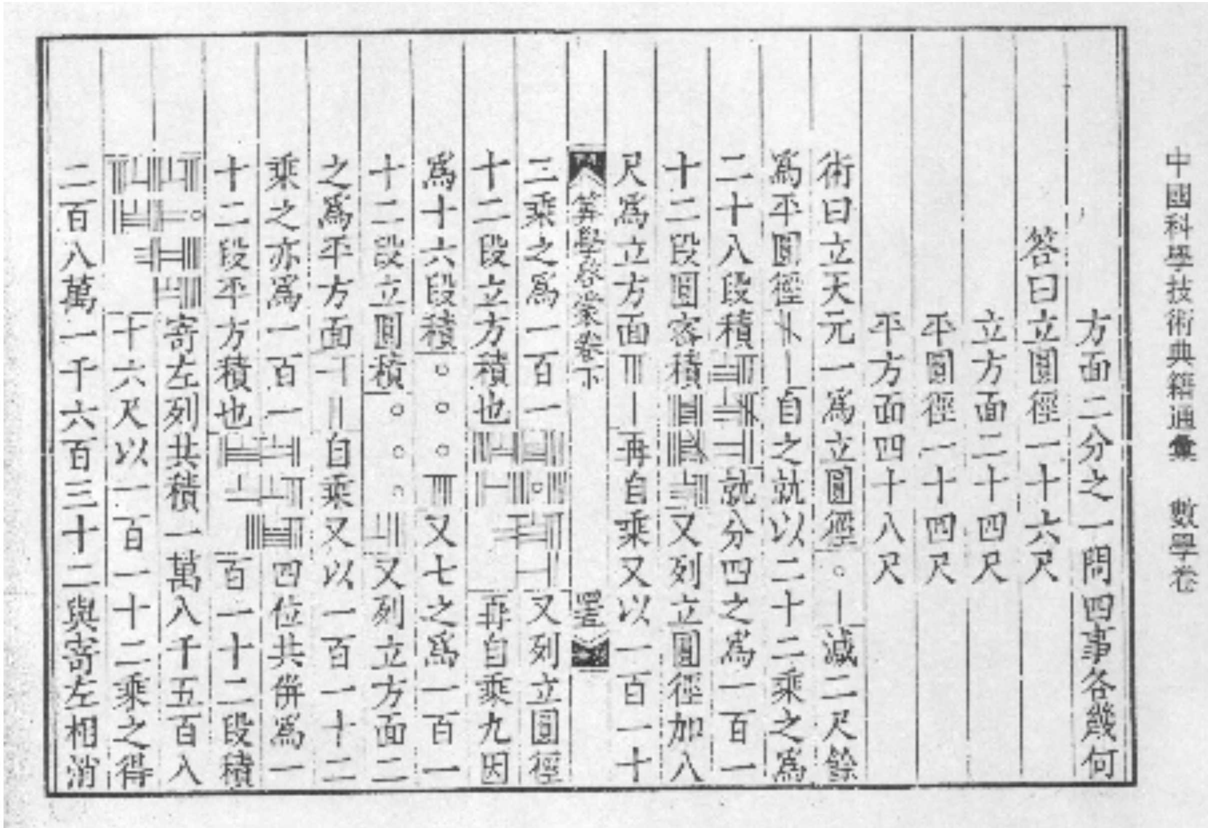


Fig. 78. A page from Ting Chhü-Chung's edition of the *Sza Yuan Yü Chien* of Chu Shih-Chieh (+1303) showing the 'matrices' of the *Thien Yuan* algebraic notation. The middle frame in the first column on the right is analogous to the example given on the opposite page (right-hand diagram), showing $xy^3 - 120y - 24y + 2x^2 + 2x$.

From *Science and Civilisation in China*, vol. 3.


中國科學技術典籍通彙　數學卷

方面二分之一問四事各幾何

答曰立圓徑一十六尺

立方面二十四尺

平圓徑一十四尺

平方面四十八尺

術曰立天元一爲立圓徑。減二尺餘爲平圓徑自之就以二十二乘之爲二十八段積就分四之爲一百一十二段圓容積又列立圓徑加入尺爲立方面再自乘又以一百一十三乘之爲一百一又列立圓徑十二段立方積也再自乘九因爲十六段積。。。又七之爲一百一十二段立圓積。。。又列立方面二之爲平方面自乘又以一百一十二乘之亦爲一百一四位共併爲一十二段平方積也百一十二段積寄左列共積一萬八千五百八千六尺以一百一十二乘之得二百八萬一千六百三十二與寄左相消

算學啓蒙卷下

From the *Suanxue Qimeng*.

沈钦裴的四元术补草

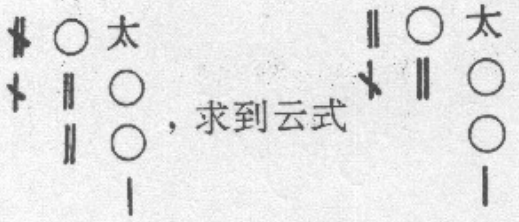
朱世杰的“假令四草”为四元术之范例，然约而不详。清代罗士琳、沈钦裴、陈棠等，都曾为其补草，他们的工作有利于读者理解朱世杰的思想。其中罗士琳草影响较大，但相比之下，笔者以为沈钦裴草更符合朱世杰原意。现根据北京图书馆藏抄本，将沈钦裴《四元玉鉴细草》中“两仪化元”、“三才运元”、“四象会元”三题的细草照录如下。为便于读者比较，将朱世杰的草一并给出。

一、两仪化元

今有股幂减弦较较与股乘勾等，只云勾幂加弦较和与勾乘弦同，问股几何？

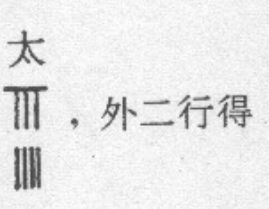
答曰：四步。

草曰：立天元一为股，地元一为勾弦和，天地配合求之，得今式



，求到云式

，互隐通分消之，内二行得式



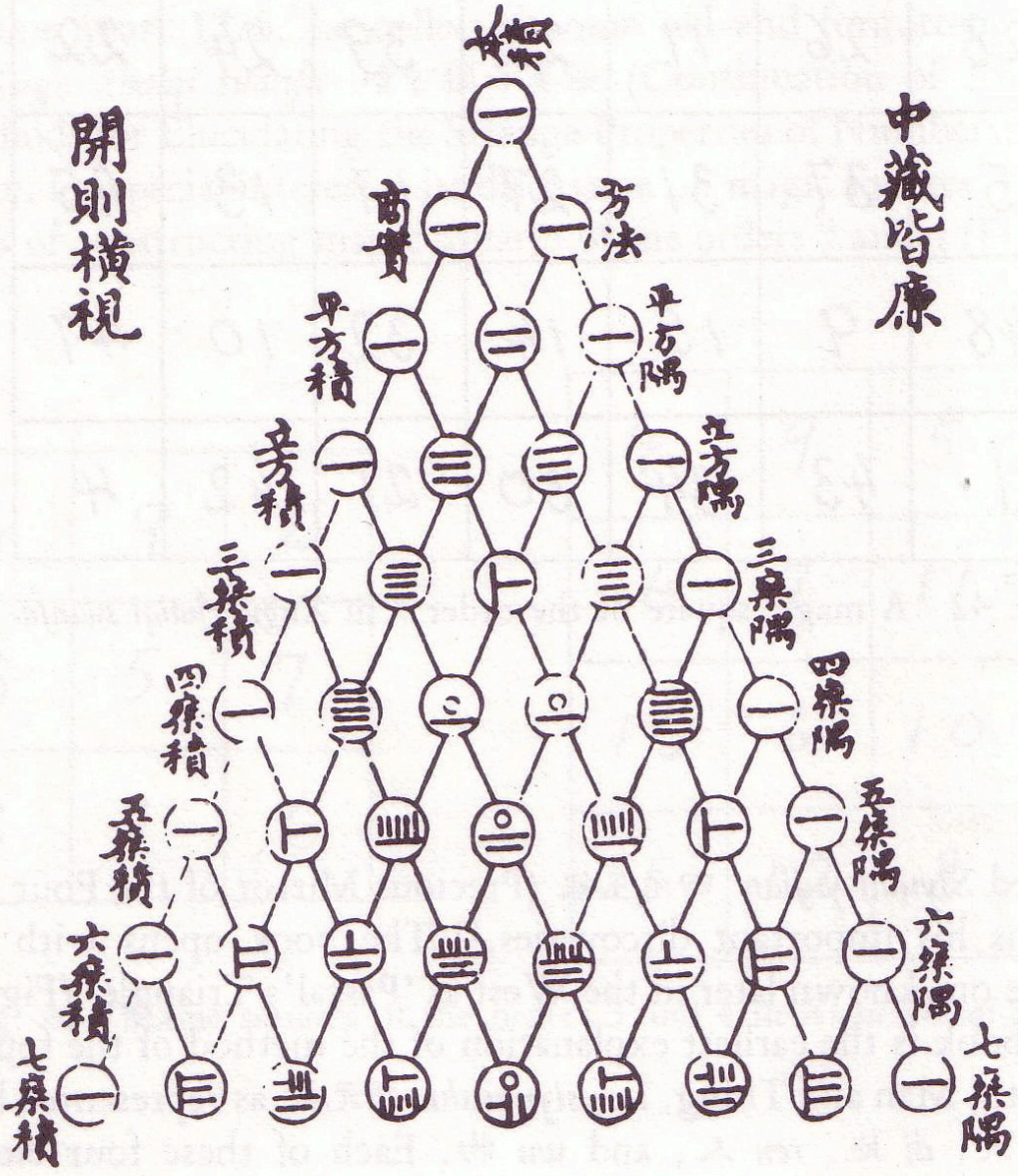
，外二行得

。两位相消，得开方式

。平方开之，得股四步，合问。

From the *Siyuanshu Bucao*.
On the next page is Pascal’s triangle using counting rod numerals.

古法七乘方圖


開則橫視
中藏皆廉
商實
方法
平方積
平方隅
立方積
立方隅
三乘積
三乘隅
四乘積
四乘隅
五乘積
五乘隅
六乘積
六乘隅
七乘積
七乘隅