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A BRIEF CHRONOLOGICAL AND BIBLIOGRAPHIC GUIDE TO THE HISTORY OF CHINESE MATHEMATICS

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SUMMARIES

The history of Chinese mathematics remains largely unknown in the West. This situation is the result of several factors: geographic, political, and linguistic. Few Western scholars possess the necessary facility in the Classical Chinese language to seek information about Chinese mathematics from primary sources. Yet despite the deficiency, there does exist a rich, albeit dispersed, literature on the history of Chinese mathematics in Western languages. The purpose of this contribution is to call the reader's attention to this literature and to the history of Chinese mathematics in general.

L'histoire des mathématiques chinoises reste assez néconnue dans le monde occidental. Cette situation est le résultat de plusieurs facteurs: géographiques, politiques, linguistiques. Il n'y a qu'un petit nombre de spécialistes occidentaux ayant la capacité linguistique de faire des recherches sur les mathématiques chinoises en langue chinoise classique. Cependant, malgré ce défaut, il existe une riche littérature dispersée sur l'histoire des mathématiques chinoises en langues occidentales. Le but de cette contribution est de signaler au lecteur l'existence de cette littérature ainsi d'ailleurs que l'histoire des mathématiques chinoises en général.

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Die Geschichte der chinesischen Mathematik ist im Westen weithin unbekannt. Die Ursachen dieser Situation sind in geographischen, politischen und sprachlichen Umständen zu finden. Wenige westliche Gelehrte besitzen die erforderlichen Kenntnisse der klassischen chinesischen Sprache, die für selbständiges Quellenstudium notwendig sind. Trotzdem existiert, wenngleich verstreut, eine reiche Literatur zur Geschichte der chinesischen Mathematik in westlichen Sprachen. Der Zweck dieses Beitrages ist es, den Leser auf diese Literatur und die Geschichte der chinesischen Mathematik im allgemeinen hinzuweisen.

История китайской математики остается практически не известной на Западе, что вызывается различными факторами: географическими, политическими и лингвистическими. Только очень немногие специалисты на Западе владеют классическим китайским языком в достаточной степени, чтобы в исследованиях, касающихся китайской математики, обращаться к первоисточникам. При этом, и на западноевропейских языках существкет богатая, хотя и несистематизированная литература по истории китайской математики. Цель настоящей работы --обратить внимание читателя на эту имеющуюся литературу и на историю китайской математики вообще.

1. A PERSPECTIVE

Until recently, Western scholars have lacked any firm understanding of the historical contributions of the non-Western world to mathematics. Literature on the subject is sparse, and the history of mathematics as taught and studied in universities has been primarily a history of Western mathematics reflecting the legacy of ancient Greece and Babylonia. Fortunately, this situation is changing. Techniques of modern scholarship are overcoming the deficiencies and prejudices of the past in revealing the mathematical accomplishments of non-Western societies and peoples. This changing situation is especially evident in the area of Chinese mathematics.

The history of Chinese mathematics, although only partially and imperfectly understood, has often provoked controversy or inspired admiration among Western readers [Fellows 1921; Gu 1976; Struik 1963; Swetz 1979]. Early European visitors to the Celestial Kingdom, as the Chinese themselves referred to their Empire, often spoke in wonderment of the accomplishments of its institutions and peoples, but their comments were usually reserved for the humanistic and cultural aspects of Chinese life. Little attention was paid by these observers to providing a critical inspection of the Chinese sciences, an attitude the Chinese encouraged.

In traditional China, the sciences were merely techniques used to assist the imperial bureaucracy in the efficient running of the Empire. Mathematics was a tool that helped with such chores as calendrical and astrological calculation, tax collection, and the construction of hydraulic works and fortifications and, as such, was not deemed worthy of serious academic pursuit. Subjects that were emphasized in scholarly study and, indeed, whose contents formed the basis of the Chinese Civil Service examination included the Confucian Classics, music, poetry, and calligraphy. Indeed, the Chinese believed that a knowledge of these subjects made man a harmonious component of his environment.

The first Westerner to give an adequate description of Chinese mathematical accomplishments and report them to his colleagues in Europe was Alexander Wylie. Wylie, a British scholar, arrived in China in 1851 to serve as a translator of Western books for the Manchu court [Wang 1962]. Knowledgeable in mathematics, he marveled at traditional Chinese developments in that field and wrote about them in the *North China Herald* [Wylie 1852]. Wylie's comments were translated into German by K. L. Biernatzki [1856] and from the German into French by O. Terquem [1862]; thus they found their way into Cantor's *Vorlesungen über die Geschichte der Mathematik* [1880-1908], where, together with reports by E. Biot [1835, 1839] and contributions by L. Matthiessen [1876], they represented the information available to Western readers in the 19th century on Chinese mathematics.

In 1913 the first complete survey of the history of Chinese mathematics appeared in a Western language. *The Development of Mathematics in China and Japan* was written by Yoshio Mikami. Mikami was a Japanese mathematician, who until his death in 1950 continued to study the history of oriental mathematics [1]. He also collaborated in some research on Eastern mathematics with the American historian of mathematics David Eugene Smith. This association proved especially fruitful [Smith & Mikami 1914], and Smith in his own writings [1912] called attention to the mathematical accomplishments of the Chinese. His *History of Mathematics* [1923-1925] includes a balanced, albeit limited, survey of the subject. Further, he appreciated and advocated the urgent need for deeper research into the historical foundations of Chinese mathematics [Smith 1931]. He also enlisted some of his Chinese students at Columbia University in an effort to trans-

late into English some of the traditional Chinese mathematical classics. While his efforts were partially successful, the translations were never published and have since been lost [2].

Sinological research by the Italian G. Vacca also exposed varied aspects of Chinese mathematics to European audiences [Vacca 1905] [3]. However, his countryman, G. Loria, was not so receptive to China's claims of early mathematical achievement, and in a series of articles [1921-1929] the latter cast doubts on the originality of Chinese mathematical accomplishments. Among European scholars of this period writing on the history of Chinese mathematics, the most prolific was the Belgian Jesuit L. van Hée. As a trained sinologist, fluent in Chinese and with access to original Chinese sources, van Hée published his findings and translations in a series of 16 articles (1911-1933) which brought the subject to a wide audience. Although his writings have recently been criticized for their limitations of scientific and scholarly analysis [Libbrecht 1973, 319], they performed a valuable service in heightening occidental awareness of traditional Chinese mathematics.

George Sarton's *Introduction to the History of Science* [1927-1947] acknowledged Chinese mathematical achievements but also lamented the fact that no texts from the Sung Dynasty (ca. 960-1279), a time of significant algebraic activity, had yet been translated into a Western language or subjected to a critical examination [Sarton 1927-1947, 3:139]. More recently, the most detailed and scholarly survey of the whole of the history of Chinese mathematics is the exposition given in Joseph Needham's *Science and Civilization in China,* Volume 3 [1959]. Needham, using original source materials and studies by both Western and Eastern (including Chinese) scholars, has worked with a broad spectrum of varied specialists. At present this remarkable work, with its extensive bibliography, provides the most authoritative Western language resource on the subject [Libbrecht 1980]. Above all, it has been the inspiration and impetus for a new series of investigations on the history of Chinese mathematics, perhaps the most noteworthy example being Ulrich Libbrecht's *Chinese Mathematics in the Thirteenth Century: The Shu-shu chiu-chang of Ch'in Chiu-shao* [1973]. In this book Libbrecht examines the work of the Sung mathematician Ch'in Chiu-shao (Qin Jiushao) [4] (1202-1261), who, among his many accomplishments, developed general methods for solving indeterminate equations and explored the relation of 13th-century Chinese mathematics to its social milieu. Prior to the appearance of Libbrecht's work, J. Hoe had already embarked upon the investigation of Chu Shih-chieh's (Chu Shijie) *Ssu-yuan Yu-chien* of 1303. Hoe's findings were published in 1972 and 1977. Lam Lay Yong's *A Critical Study of the Yang Hŭi Suan Fa* [1977] followed. These works of Libbrecht, Hoe, and Lam attest beyond doubt that the 13th-century was a golden period of Chinese mathematics, and provide an admirable response to Sarton's lament.

Subsequently, other specialized studies have appeared, for example, E. I. Berezkina's book on ancient Chinese mathematics, *Matematika Drevnovo Kitaya* [1980], and Jean-Claude Martzloff's *Recherches sur L'Oeuvre Mathématique de Mei Wending (1633-1721)* [1981]. The most recent issue of *The World Directory of Historians of Mathematics* [1978] lists 24 Western researchers whose interests focus on the history of Chinese mathematics, and this number appears to be increasing. In particular, China's reemergence from the intellectual isolation and stagnation of its Cultural Revolution has resulted in a renewed interest on the part of its scholars in their country's mathematical heritage.

While a stronger appreciation of Chinese mathematical accomplishments is clearly beginning to develop in the West, scholars and students without training in classical Chinese must continue to rely on publications written for the most part in European languages. The chronological outline and bibliographic guide which follows has been compiled to assist such readers. The following references present a selection of introductory material available in Western languages on the history of Chinese mathematics [5].

2. A CHRONOLOGICAL OUTLINE OF THE DEVELOPMENT OF CHINESE MATHEMATICS

Date	*Accomplishment*	*Person*	*Work or Artifact*	*References*
Shang Kingdom				
-1400	Decimal numeration system in use		Oracle bones	Dhombres 1978; Glathe 1932; Wang 1958
Chou Kingdom				
-300	Firm understanding of place value		Coins, computing rods	Ang 1977; Chang 1925; de La Couperie 1883; Hopkins 1916; Li 1959; Wang 1951; Graham 1978; Kogelschatz[6]
	Attempts at deductive geometry		Mo Ching (Mo Jing)[a] [Mohist Canon]	
Han Dynasty				
-200	Proof of Pythagorean theorem Use of common fractions		Chou Pei Suan Ching (Zhou Bei Suan Jing)[b] [The Arithmetical Classic of the Gnomon and the Circular Paths of Heaven]	Ang 1978; Gillon 1977; Mikami 1911a; Nòda 1933; Swetz & Kao 1977; Vacca 1905
-100	Root extraction Solution of simultaneous equations Volumes of rectilinear solids Use of negative numbers Rule of False Position Rule of Three Solution of quadratic equation		Chiu Chang Suan Shu (Jiu Zhang Suan Shu)[c] [Nine chapters on the Mathematical Art]	Adamo 1978; Berezkina 1957, 1960, 1967, 1969, 1974; Lam 1969; Swetz 1972; Vogel 1968; Wang 1956; Wang & Needham 1955
+80	Magic square of order three		Ta Tai Li Chi (Da Dai Li Ji)[d] [Records of Rites compiled by Tai the Elder]	Cammann 1960, 1962; Swetz 1978; Wilhelm 1930
+130	$\pi = \sqrt{10}$	Chang Heng (Zhang Heng)[e]	Commentary to Chiu Chang Suan Shu (Jiu Zhang Suan Shu)	Lee 1975; Mikami 1910
+190	Theory of Large Numbers developed	Hsu Yo (Xu Yue)[f]	Shu Shu Chi I (Shu Shu Ji Yi)[g] [Memoir on Some Traditions of the Mathematical Art]	Mikami 1911b
+200	Formula for solving equations of the type $x^2 + ax = b^2$	Chao Chün-ch'ing (Zhao Junqing)[h]	Commentary to Chou Pei Suan Ching (Zhu Bei Suan Jing)	Ang 1969; Gillon 1977

Three Kingdom Period				
+255	π = 3.155 or 142/45	Wang Fan[i]	Ch'ou-jen Chuan (Chouren Zhuan)[j] [Biographies of Mathematicians and Astronomers]	Mikami 1910
+263	Proto-trigonometry based on use of similar triangles	Liu Hui	Hai Tao Suan Ching (Hai Dao Suan Jing)[l] [Sea Island Mathematical Manual]	Berezkina 1974; Ho 1973a; van Hée 1920, 1932b; Wagner 1975, 1978a, b, 1979
Chin Dynasty				
+280	Indeterminate analysis; treatment of square roots	Sun Tzu (Sun Zi)[m]	Sun Tzu Suan Ching (Sun Zi Suan Jing)[n] [Master Sun's Arithmetical Manual]	Berezkina 1961, 1963; Lam 1966; Libbrecht 1977; Wang 1964
Northern and Southern Empire				
+450	3.1415926 < π < 3.1415927	Tsu Ch'ung-chih (Cu Chongzhi)[o]	Sui Shu[p] [Official History of the Sui Dynasty]	Kiang 1972; Wang 1977; Li 1956b
+468	Indeterminate analysis Formulas developed for finding the sum and number of terms of arithmetic progressions Treatment of cube roots	Chang Ch'iu-Chien (Zhang Qiujian)[q]	Chang Ch'iu Chien Suan Ching (Zhang Qiujian Suan Jing)[r] [Chang Ch'iu Chien's Mathematical Manual]	Ang 1969; Berezkina 1969; Ho 1965; Macon et al. 1982
Sui Dynasty				
+600	Formula of interpolation for equidistant intervals	Liu Ch'uo (Liu Cuo)[s]	Sui Shu	Ang 1976; Berezkina 1971; Li 1956b
T'ang Dynasty				
+625	Work with third degee equations of type $x^3 + ax^2 + bx = C$	Wang Hsiao-T'ung (Wang Xiaotong)[t]	Ch'i Ku Suan Ching (Qi Gu Suan Jing)[u] [Continuation of Ancient Mathematics]	Berezkina 1975; Schrimpf 1963
+665	Study of finite differences ("chao-ch'a")[v]	Li Ch'un-feng (Li Chunfeng)[w]	Sui Shu	Needham 1959
+718	Table of sines translated into Chinese from Indian sources Knowledge of Indian system of numerals transmitted including dot notation for zero	Gautama Siddhartha [Chuthan Hsi-ta] (Jutan Xida)[x]	K'ai-yuan Chan Ching (Kaiyuan Zhan Jing)[y] [Treatise on Astrology of the Kaiyuan period]	Yabuuti 1963

+727	Interpolation formula for nonequidistant intervals	I-Hsing (Yi Xing)[z]	Hsin T'ang Shu (Xin Tang Shu)[aa] [New Official History of the Tang Dynasty]	Ang 1979; Li 1956a
Five Dynasty Period				
Sung Dynasty				
+1086	Determination of circular arc length; Method of interstice volume	Shen Kua (Shen Gua)[ab]	Meng Chi Pi T'an (Meng Xi Bi Tan)[ac] [Dream Pool Essays]	Siu 1981; Swetz 1977
Kin and Southern Sung Dynasties				
+1247	Solution of numerical higher equations Solution techniques for indeterminate analysis Circular symbol for zero introduced	Ch'in Chiu-chao (Qin Jiushao)[ad]	Shu Shu Chiu Chang (Shu Shu Jiu Zhang)[ae] [Mathematical Treatise in Nine Sections]	Ho 1971a; Libbrecht 1973
+1248	Notation of numerical equations The T'ien-yuan (tien yuan)[af] notation	Li Chih (Li Zhi)[ag]	Ts'e Yuan Hai Ching (Ce Yuan Hai Jing)[ah] [Sea Mirror of Circle Measurements]	Ho 1973b; van Hée 1913; Yushkevitch 1968; Yushkevitch & Rosenfield 1960
+1275	Numerical magic squares and circles Decimal fractions Methods for solving quadratic equations	Yang Hui[ai]	Yang Hui Suan Fa[aj] [Yang Hui's Methods of Computation]	Berezkina 1965; Cammann 1962; Ho 1976; Lam 1968, 1969, 1972, 1974, 1977; Vygodsky 1960; Wang 1956
Yüan (Mongol) Dynasty				
+1280	Cubic interpolation formula Spherical trigonometry Method of finite or divided differences	Kuo Shou-Ching (Guo Shoujing)[ak]	Yuan Shih (Yuan Shi)[al] [Official History of the Yuan Dynasty]	Gauchet 1917; Nakayama 1969; Mikami 1913
+1299	Algebraic sign convention Methods of recording large and small numbers	Chu Shih-Chieh (Chu Shijie)[am]	Suan Hsueh Ch'i Meng (Suan Xue Qimeng)[an] [Introduction to Mathematical Studies]	Ho 1971b; Lam 1979
+1303	"Pascal Triangle" of binomial coefficients Advanced considerations of arithmetic and geometric progression and series		Ssu Yuan Yu Chien (Si Yuan Yu Jien)[ao] [Precious Mirror of the Four Elements]	Hoe 1972; van Hée 1932a; Konantz 1924; Lam 1980

Ming Dynasty				
+1550	Advances in theory of equations Improved formulas for arc and circle segment computation	Ku Ying-Hsiang (Gu Yingxiang)[ap]	Ts'e Yuan Hai Ching Fen Lei Shih Shu (Ce Yuan Hai Jing Fen Lei Shi Shu)[aq] [Classified Methods of the Sea Mirror of Circle Measurement] and Hu shih Suan Shu (Hu shi Suan Shu)[ar] [Calculations of Arcs and Segments]	Mikami 1913
+1593	Abacus Mathematics *Gelosia* method of multiplication	Ch'eng Ta-Wei (Cheng Dawei)[as]	Suan Fa T'ung Tsung (Suan Fa Tong Zong)[at] [Systematic Treatise on Arithmetic]	Biot 1835; Hummel 1944; Needham 1959
+1607	First six books of Euclid translated into Chinese	Matteo Ricci, Hsu Kuang-Ch'i (Xu Guangqi)[au]	Chi Ho Yuan Pen (Jiho Yuan Ben)[av] [Elements of Geometry]	Bernard-Maître 1935; d'Elia 1942-1949, 1956; Venturi 1911
+1614	Written arithmetic introduced	Matteo Ricci, Li Chih-Tsao (Li Zhicao)[aw]	T'ung Wen Suan Chih (Tong Wen Suan Zhi)[ax] [Treatise on European Arithmetic]	
Ch'ing (Manchu) Dynasty				
+1653	Logarithms introduced	Nicholas Smogulecki, Hsueh Feng-tsu (Xue Fenzu)[az]	T'ien Pu Chen Yuan (Tien Bu Zhen Yuan)[ay] [True Course of Celestial Motions]	van Hée 1914; Kosibowiez 1929
+1669	Plane and spherical geometry	Adam Schall von Bell	Hsin Fa Suan Shu (Xin Fa Suan Shu)[bb] [Mathematical Methods of the New Calendrical System]	Bernard-Maître 1938; Väth 1933
+1713	Compendia of Mathematics compiled (van Vlacq's logarithm table reproduced)	Under Emperor K'ang Hsi (Kang Xi)[bc]	Lu Li Yuan Yuan[bd] [Ocean of Calendar Calculations]	
+1715	Treatise on the summation of power series	Ch'en Shih-jen (Chen Shiren)[be]	Shao-kuang pu-i (Shao Guang Bu Yi)[bf] [Supplement to Diminishing Breath]	
+1720	Revived interest in ancient mathematical accomplishments	Mei Ku-Ch'eng (Mei Gucheng)[bg]	Chih Shui I Chen (Chi Shui Yi Zhen)[bh] [Pearls Recovered from the Red River]	van Hée 1926a,b; Hummel 1944; Martzloff 1981; Mikami 1929
+1817	Theory of equations	Li Jui (Li Rui)[bi]	K'ai Fang Shuo (Kai Fang Shuo)[bj] [Theory of Equations]	

+1845	Theory of logarithms	Tai Hsu (Dai Xu)[bk]	Tui Shu Chien Fa (Dui Shu Jian Fa)[bl] [Simple Methods of Logarithms]	
+1850	Translation of European mathematics works	Li Shan-Lan[bm]	Tai Wei Chi Shih Chi (Dai Wei Ji Shi Ji)[bn] [Analytical Geometry and Calculus]	Hummel 1944; Swetz 1974
+1856	Complete translation of Euclid appears		Chi Ho Yuan Pen (Jiho Yuan Ben)	
+1859	Text of European algebra translated		Tai Shu Hsueh (Dai Shu Xue)[bo] [Elements of Algebra]	

GLOSSARY OF PROPER CHINESE NAMES

a 墨 經
b 周髀算經
c 九章算術
d 大戴禮記
e 張 衡
f 徐 岳
g 數術記遺
h 趙 君 卿
i 王 蕃
j 疇 人 傳
k 劉 徽
l 海島算經
m 孫 子
n 孫子算經
o 祖 冲 之
p 隋 書
q 張 丘 建
r 張丘建算經
s 劉 焯
t 王 孝 通
u 緝古算經
v 招 差
w 李 淳 風
x 瞿曇悉達
y 開元占經
z 一 行
aa 新 唐 書
ab 沈 括
ac 夢溪筆談
ad 秦 九 韶
ae 數書九章
af 天 元
ag 李 治
ah 測圓海鏡
ai 楊 輝
aj 楊輝算法
ak 郭 守 敬
al 元 史
am 朱 世 傑
an 算學啓蒙
ao 四元玉鑑
ap 顧 應 祥
aq 測圓海鏡分類釋術
ar 弧矢算術
as 程 大 位
at 算法統宗
au 徐 光 啓
av 幾何原本
aw 李 之 藻
ax 同文算指
ay 天步真原
az 薛 鳳 祚
bb 新法算書
bc 康 熙
bd 律曆淵源
be 陳 世 仁
bf 少廣補遺
bg 梅 穀 成
bh 赤水遺珍
bi 李 鋭
bj 開 方 説
bk 戴 煦
bl 對數簡法
bm 李 善 蘭
bn 代微積拾級

NOTES

1. It has been reported that upon his death, Mikami left a 1000-page unpublished manuscript on the history of Chinese mathematics. Inquiries to the Japanese National Academy have failed to verify the existence or disposition of this manuscript.

2. T. H. Chen translated some of the work of Mei Ku-Ch'eng (Mei Gucheng) and Li Chih's (Li Zhi) *Ts'e Yuan Hai Ching* (Ce Yuan Hai Jing) for Smith. A search of the D. E. Smith Archives at Columbia University failed to locate these translations.

3. Vacca has been credited with a translation of the *Chou Pei Suan Ching* (Zhou Bei Suan Jing) [Needham 1954, 3:796], however, it does not exist under the reference given. Vacca did translate some passages from the *Chou Pei* [1905], but apparently not the whole work.

4. Proper Chinese names have been romanized both in the Wade-Giles system, which has been in use in Western literature up until the 1970s, and in the currently popular Pingyin system (in parentheses). Reference to a glossary of appropriate Chinese characters is given by superscript letters.

5. Kurt Vogel compiled a briefer but similar bibliography in 1977. For more detailed bibliographic comments, including references to non-Western materials, see Needham [1959] and Libbrecht [1973].

6. There is a particular scarcity of Western literature on Chinese geometry. However, Hermann Kogelschatz of the Deutsches Museum, Munich, has several studies on the subject under way and will soon publish some of his results.

REFERENCES

Adamo, M. 1968. La matematica nell 'antica Cina. *Osiris* 15, 175-195.

Ang, T. S. 1969 *A study of the mathematical manual of Chang Ch'iu-chien*. Unpublished M.A. thesis, University of Malaya, Kuala Lumpur.

——— 1976. The use of interpolation techniques in Chinese calendar. *Oriens Extremus* 23, 135-151.

——— 1977. Chinese computation with the counting-rods. *Kertas-Kertas Pengajian Tronghua* 1, 97-109.

——— 1978. Chinese interest in right-angled triangles. *Historia Mathematica* 5, 253-266.

——— 1979. *I-Hsing (683-727 A.D.): His life and scientific work*. Unpublished Ph.D. dissertation, University of Malaya, Kuala Lumpur.

Berezkina, E. I. 1957. Drevnekitajski traktat 'Matematika v devjati knigach. *Istoriko-Matematičeskie Issledovanija (IMI)* 10, 423-584.

——— 1960. Arifmetičeskie voprosy v drevnekitajskom traktate 'matematika v devjati knigach. *Izvestija Istorii Nauki i Techniki v Stranach Vostoka* 1, 34-55.
——— 1961. O matematičeskom traktate Sun'-czy *IMS* 13, 219-230.
——— 1963. O matematičeskom trude Sun'czy. *Izvestija Istorii Nauki i Techniki v Stranach Vostoka* 3, 5-70.
——— 1965. On the early history of decimal fractions. *Actes du XI^e Congrès International d'Histoire des Sciences*, 157-159.
——— 1967. Antičnye matematiceskie metody v Kitae. *Organon* 4, 105-107.
——— 1969. O traktate Czan-czjanja po matematike. *Fiziko-matematičeskie Nauki v Stranach Vostoka* 2, 18-27.
——— 1971. O matematičeskich metodach drevnich. *Istorija i Metodologija Estestvennych Nauk* 11, 172-185.
——— 1974. Dva teksta Lju Chueja po geometrii. *IMS* 19, 231-273.
——— 1975. Wang Hsiao-t'ung. *IMS* 20, 329-371.
——— 1980. *Matematika Drevnovo Kitaya*. Moscow: Nauka.
Bernard-Maître, H. 1935. *Matteo Ricci's scientific contribution to China*. Peking: Vetch.
——— 1938. L'Encyclopédie astronomique du Père Schall, Ch'ung-Chen Li Shu (+1629) et Hsi-Yang Hsin Fa Li Shu (+1645); La réforme du calendrier Chinois sous l'influence de Clavius, Galilée et Kepler. *Monumenta Serica* 3, 35-77, 441-527.
Biernatzki, K. L. 1856. Die arithmetik der Chinisen. *Journal für die Reine und Angewandte Matematik* 52, 59-94.
Biot, E. 1835. On Pascal's triangle in the Suan-fa t'ung-tsung. *Journal des Savants*, 270-273.
——— 1839. Note sur la connaissance que les Chinois ont eue de la valeur de position des chiffres. *Journal Asiatique* 8, 497-502.
Cammann, S. 1960. The evolution of Magic Squares in China. *American Oriental Society Journal*, 116-124.
——— 1961. The Magic Square of Three in old Chinese Philosophy and religion. *History of Religions* 1, 37-80.
——— 1962. Old Chinese Magic Squares. *Sinologica* 7, 14-53.
Cantor, M. 1880-1908. *Vorlesungen über die Geschichte der Mathematik*, 4 vols. Leipzig.
Cheng, C. T. 1925. The use of computing rods in china. *American Mathematical Monthly* 32, 492-499.
Dhombres, J. 1978. *Nombre, mesure et continu: Epistémologie et histoire*. Paris: F. Nathan.
d'Elia, P. (ed.). 1942-1949. *Fonti Ricciani; Storia dell' introduzione del cristianismo in Cina*, 3 vols. Rome: Libreria dello Stato.
——— 1956. Presentazione della prima Traduzione Cinese di Euclide. *Monumenta Serica* 15, 161-202.
Fellows, A. 1921. China's mathematics--the oldest. *China Review* 1, 214-215.

Gauchet, L. 1917. Note sur la trigonométrie sphérique de Kouo Cheou-King. *T'oung Pao* 18, 151-174.

Gillon, B. 1977. Introduction, translation, and discussion of Chao Chün-Ch'ing's Notes to the Diagrams of Short Legs and Long Legs of Squares and Circles. *Historia Mathematica* 4, 253-293.

Glathe, A. 1932. *Die chinesische Zahlen*, Mitteilungen der deutsch Gesellschaft für Natur und Volkskunde Ostasiens.

Graham, A. C. 1978. *Later Mohist logic ethics and Science*. Hong Kong: The Chinese University Press.

Gu, J. Y. 1976. Der grosse Beitrag altchinesischen Matematik zur Weltkultur. In *Mathematik in China*, W. Ruppert, ed., No. 6, pp. 117-137. Vienna: Berichte des Osterreichischen Chinaforschungsinstituts.

van Hée, L. 1913. Li Yeh, mathématicien Chinois du XIIIe siècle. *T'oung Pao* 14, 537-568.

——— 1914. Première mention des logarithmes en Chine. *T'oung Pao* 15, 454-457.

——— 1920. Le Hai-Tao Souan-King de Lieou. *T'oung Pao* 20, 51-60.

——— 1926a. The Ch'ou Jen Chuan of Yuan Yuan. *Isis* 8, 103-118.

——— 1926b. The great treasure house of Chinese and European mathematics. *American Mathematical Monthly* , 502-506.

——— 1932a. Le Précieux miroir des quatre eléments. *Asia Major* 7, 242-270.

——— 1932b. Le classique de l'île maritime, ouvrage chinois du III^{e} siècle. *Quellen und Studien zur Geschichte der Mathematik* 2, 255-280.

Ho, P. Y. 1965. The lost problems of the Chang Ch'iu-chien Suan Ching, a fifth-century Chinese mathematical manual. *Oriens Extremus* 12, 37-53.

——— 1971a. Ch'in Chiu-shao. *Dictionary of Scientific Biography (DSB)* 3, 249-256.

——— 1971b. Chu Shih-chieh. *DSB* 3, 265-271.

——— 1973a. Liu Hui. *DSB* 8, 418-425.

——— 1973b. Li Chi. *DSB* 8, 313-320.

——— 1976. Yang Hui. *DSB* 14, 538-546.

Hoe, J. 1972. *A problem in the Siyuan Yujian: The jade mirror of the four unknowns*. University of Waikato, Hamilton, New Zealand.

——— 1977. *Les systèmes d'équations polynômes dans le Siyuan Jujian (1303)*. Paris: Collège de France, Mémoires de l'Institut des Hautes Études Chinoises, Vol. 6.

Hopkins, L. C. 1916. The Chinese numerals and their notational system. *Royal Asiatic Society of Great Britain and Ireland Journal* 68, 737-771.

Hummel, A. W. 1944. *Eminent Chinese of the Ch'ing period*, 2 vols. Washington, D.C.

Kiang, T. 1972. An old Chinese way of finding the volume of a sphere. *Journal of the Mathematical Association* 56, 88-91.

Konantz, E. L. 1924. The precious mirror of the four elements. *China Journal of Arts and Science* 2, 304-310.

Kosibowiez, E. 1929. Un Missionaire Polonais Oublié, le Père Jean Nicolas Smogulecki S. J., missionaire en Chine an XVII^{e} Siècle. *Revue d'Histoire des Missions* 6, 335-360.

de La Couperie, T. 1883. The old numerals, the counting rods, and the Swan-Pan in China. *Numismatic Chronicals* 3, 297-340.

Lam, L. Y. 1966. On the Chinese origin of the galley method of arithmetical division. *British Journal for the History of Science* 3, 66-69.

——— 1968. The Yang Hui Suan Fa, A thirteenth century Chinese mathematical treatise. *Chung Chi Journal* 7, 171-176.

——— 1969. The geometrical basis of the ancient Chinese square-root method. *Isis* 61, 96-102.

——— 1972. The *Jih yung suan fa*: An elementary arithmetic textbook of the thirteenth century. *Isis* 63, 370-383.

——— 1974. Yang Hui's commentary on the Ying Nu chapter of the *Chiu Chang Suan Shu*. *Historia Mathematica* 1, 47-64.

——— 1977. *A critical study of the Yang Hui Suan Fa, a thirteenth-century Chinese mathematical treatise*. Singapore Univ. Press.

——— 1979. Chu Shih-chieh's *Suan-hsüeh Ch'i-meng (Introduction to mathematical studies)*. *Archive for History of Exact Sciences* 21, 2-28.

——— 1980. The Chinese connection between the Pascal triangle and the solution of numerical equations of any degree. *Historia Mathematica* 7, 407-424.

Lee, K. P. 1975. Development of π in China. *Bulletin of the Malaysian Mathematical Society* 6, 40-47.

Li, Y. 1956a. The interpolation formulae of early Chinese mathematicians. In *Proceedings, 8th International Congress of the History of Science, Florence*, pp. 70-72.

——— 1956b. Tsu Chung-Chih: Great mathematician of ancient China. *Peking Review* 24, 34-37.

Libbrecht, U. 1973. *Chinese mathematics in the thirteenth century: The Shu-shu chiu-chang of Ch'in Chiu-shao*. Cambridge, Mass: MIT Press.

——— 1980. Joseph Needham's work in the area of Chinese mathematics. *Past and Present* 87, 30-39.

Loria, G. 1922. Documenti relativi all'antica matematica dei Cinesi. *Archeion* 3, 141.

——— 1929. *Storia delle matematiche dall' alba della civilt'a secolo XIX*, 3 vols. Turin ("L'Enigma Cinese." Vol. 1, Chapter 9).

Loria, G., & McClenon, R. B. 1921. The debt of mathematics to the Chinese people. *Scientific Monthly* 12, 517-521.

Macon, N., Chang, I. L., & Seaton, J. 1982. *Suan Ching of Chang Ch'iu-Chien (Suan Ching Shih Shu: The ten mathematical classics of ancient China*, Vol. 1). Frederick, Md.: University Publications of America.

Martzloff, J.-C. 1981. *Recherches sur l'oeuvre mathématique de Mei Wending (1633-1721).* Paris: Collège de France, Memoires de l'Institut des Hautes Études Chinoises, Vol. 16.

Matthiessen, L. 1876. Zur Algebra der Chinesen. Anszug aus einem Briefe an M. Canto. *Zeitschrift für Mathematik und Physik* 19, 270-.

Mikami, Y. 1909. A remark on the Chinese mathematics in Cantor's Geschichte der Mathematik. *Archiv Der Mathematik und Physik* 15, 68-70.

——— 1910. The circle-squaring of the Chinese. *Bibliotheca Mathematica* 10, 193-200.

——— 1911a. Arithmetic with fractions in old China. *Archiv for Mathematik Og Naturvidenskab* 32, 75-82.

——— 1911b. Further remarks on the Chinese mathematics in Cantor's Geschichte der Mathematik. *Archiv Der Mathematik und Physik* 18, 209-218.

——— 1913. *The development of mathematics in China and Japan.* Leipzig: Teubner.

——— 1929. The Ch'ou-Jen Chuan of Yüan Yüan. *Isis* 11, 124-126. (A critique of van Hée article [1926a].)

Nakayama, S. 1969. *A history of Japanese astronomy: Chinese background and Western impact.* Cambridge, Mass.: Harvard Univ. Press.

Needham, J. 1954-. *Science and civilization in China,* 7 Vols. (mathematics contained in Vol. 3). Cambridge: The University Press.

Nòda, C. 1933. An enquiry concerning the *Chou Pei Suan Ching.* Kyoto, Academy of Oriental Culture, Kyoto Institute (Toho Bunka Gakuin Kyoto Kenkyusho Memoirs No. 3).

Sarton, G. 1927-1947. *Introduction to the history of science,* 5 Vols. in 3 books. Baltimore: Williams & Wilkins (Chinese material 3:2100-2140).

Schrimpf, R. 1963. *La collection mathématique "Souan King Che Chou" contribution à l'histoire des mathématiques chinoises des origines au VII^e siècle de notre ére.* Unpublished dissertation, University of Rennes.

Siu, M. K. 1981. Pyramid, pile and sum of squares. *Historia Mathematica* 8, 61-66.

Smith, D. E. 1912. Chinese mathematics. *Popular Science Monthly* 80, 597-601.

——— 1923-1925. *History of mathematics,* 2 Vols. New York: Ginn & Co.

——— 1931. Unsettled questions concerning the mathematics of China. *Scientific Monthly* 33, 244-250.

Smith, D. E., & Mikami, Y. 1914. *A history of Japanese mathematics.* Chicago: Open Court.

Struik, D. J. 1963. On ancient Chinese Mathematics. *Mathematics Teacher* 56, 424-432.

Swetz, F. J. 1972. The amazing *Chiu Chang Suan Shu*. *Mathematics Teacher* 65, 425-430.

——— 1974. The introduction of mathematics in higher education in China 1865-1887. *Historia Mathematica* 1, 167-179.

——— 1977. The "Piling Up of Squares" in ancient China. *Mathematics Teacher* 70, 72-79.

——— 1978. Mysticism and magic in the number squares of old China. *Mathematics Teacher* 71, 50-56.

——— 1979. The evolution of mathematics in ancient China. *Mathematics Magazine* 52, 10-19.

Swetz, F. J., & Kao, T. I. 1977. *Was Pythagoras Chinese? An examination of right triangle theory in ancient China*. University Park, Pa.: Pennsylvania State University Studies No. 40.

Terquem, O. 1862. Arithmetique et algèbre des Chinois, par M. K. L. Biernatzki, Docteur à Berlin. *Nouvelles Annales Mathématiques* 1, 35.

Vacca, G. 1905. Sulla matematica degli antichi Cinesi. *Bollettino di Bibliografia e Storia delle Scienze Matematiche* 8, 97-102.

Väth, A. 1933. *Johann Adam Schall von Bell, S. J. Missionär in China, Kaiserlicher Astronom und Ratgeber am Hofe von Peking, ein Lebens-und Zeitbild*. Cologne: Veröffentlichungen des Rheinischen Museum in Köln, No. 2.

Venturi, P. T. (ed). 1911-1913. *Opere storiche del P. Matteo Ricci*, 2 Vols. Macerata: Giorgetti.

Vogel, K. 1968. *Neun Bücher arithmetischer Technik*. Braunschweig.

——— 1977. Bericht über neuere, in westlichen Sprachen erschienene arbeiten zur Mathematik der Chinesen. *Prismata* (Festschrift für Willy Hartner).

Vygodsky, M. J. 1960. Proischošdenie "pravila dvuch ložnych položeny." *IMS* 13, 231-252.

Wagner, D. B. 1975. *Proof in ancient Chinese mathematics: Liu Hui on the volumes of rectilinear solids*. Unpublished thesis, University of Copenhagen.

——— 1978a. Liu Hui and Tsu Keng-chih on the volume of a sphere. *Chinese Science* 3, 59-79.

——— 1978b. doubts concerning the attribution of Lui Hui's commentary on the *Chiu-Chang Suan-Shu*. *Acta Orientalia* 39, 199-212.

——— 1979. An early Chinese derivation of the volume of a pyramid: Liu Hui, third century A.D. *Historia Mathematica* 6, 164-188.

Wang, L. 1956. *The "Chiu Chang Suan Shu" and the history of Chinese mathematics during the Han dynasty*. Unpublished dissertation, Cambridge University.

——— 1958. The development of decimal fractions in China. *Actes du VIII^{e} Congress International d'Histoire des Sciences*, 1, 13-17 (Florence-Milan 1956).

——— 1964. The date of the Sun Tzu Suan Ching and the Chinese remainder problem. *Proceedings of the Tenth International Congress of the History of Science* 1, 489-492.

——— 1977. A new suggestion on Tzu Ch'ung-Chih's method of finding the value of π and its significance in the history of mathematics. *Papers Far Eastern History*, No. 16, Department of Far Eastern Studies, the Australian National University.

Wang, L., & Needham, J. 1955. Horner's method in Chinese mathematics; its origins in the root-extraction procedures of the Han dynasty. *T'oung Pao* 43, 345-401.

Wang, P. 1962. Alexander Wylie's influence on Chinese mathematics. *Proceedings of the Second Biennial Conference of the International Association of Historians of Asia*, 777.

Wang, Y. C. 1951 *Early Chinese coinage*. New York: The American Numismatic Society (Numismatic Notes and Monographs, No. 122).

Wilhelm, R. 1930. *'Li Gi' das Buch der Sitte des älteren und jüngeren Dai*. Jena: Diederichs.

Wylie, A. 1852. Jottings on the science of the Chinese arithmetic. *North China Herald*, August-November.

Yabuuti, K. 1963. The Chiuchih Li: An Indian astronomical book in the T'ang dynasty. *Chugoku Chisei Kagaku Gijutsushi no Kenkyu (Tokyo)* 493-538.

Yushkevitch, A. P. 1968. Issledovanija po istorii matematiki v stranach vostoka v srednie veka: itogi i perspektivy. *Acts of the International Mathematics Congress* (Moscow 1966), 664-680.

Yushkevitch, A. P., & Rosenfield, B. A. 1960. Die Mathematik der Länder des Ostens in Mittelalter. *Sowjetische Beiträge zur Geschichte der Naturwissenschaft (Berlin)*.