

1661年的關孝和之《楊輝算法》 (1275) 抄本

Seki Takakazu's Manuscript of the *Yang Hui Suanfa* (1275) in 1661

TGSW2015, TSUKUBA

30TH SEPT. 2015

OSAKA KYOIKU UNIVERSITY 大阪教育大學

JOCHI SHIGERU 城地 茂



Important points of Studying the *Yang Hui Sunafa* for Japanese Mathematics

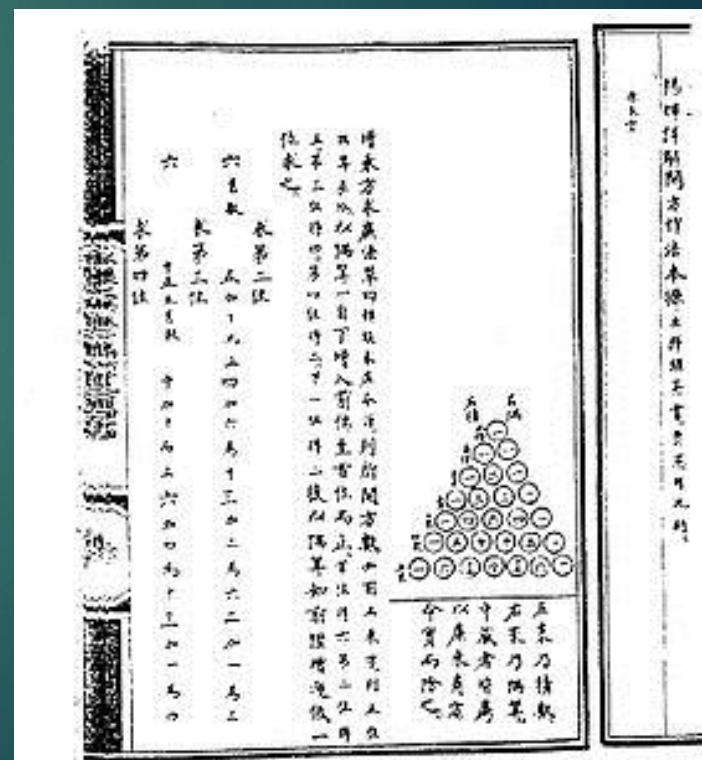
- ▶ The Best work of Japanese mathematician, Seki Takakazu (1645?-1708) was solving higher degree equations, i.e., the **Tenzan-jutsu** 點竄術 method. He published the **Hatsubi Sanpo** 發微算法 in 1674.
- ▶ The origin of setting up unknown numbers method was the Tianyuan-shu 天元術 method from Chinese mathematical book of the **Suanxue Qimeng** 算學啓蒙 (1299) by Zhu Shijie 朱世傑.
- ▶ It, however, was only setting up unknown numbers method, we must consider to solving higher degree equation.

Important points of Studying the *Yang Hui Sunafa* for Japanese Mathematics

- ▶ “Solving Equations Method” 開方術, Horner’s method (1819)?
- ▶ Seki Takakazu (1685) *Kaiho Honpen no Ho*
- ▶ 關孝和(1685)《開方翻變之法》
- ▶ ↑
- ▶ Yang Hui (1275) *Yang Hui Suanfa*
- ▶ 楊輝(1275)《楊輝算法》“Fanji-shu” 「翻積術」
- ▶ Cheng Dawei (1592) *Suanfa Tongzong*
- ▶ 程大位(1592)『算法統宗』、1592年

The Solving Method of Higher Degree Equations 開方術

- ▶ BCE 186, the Yinbuzu method 盈不足術 by *Suanshushu* 算數書
- ▶ CE 50, Open Square and Cubic Root method 開平方、開立方、帶從開平方 by the *Jiuzhang Suanshu* 九章算術
- ▶ 620, 3rd degree equations 緝古算經
- ▶ 11th C, the Triangle method 隙積術, 沈括
- ▶ 11th C, the Jia Xian, Yang Hui and Pascal's 賈憲-楊輝-Pascal Triangle.
- ▶ 1247, Zhengfu Kaifang-shu 正負開方術, 秦九韶 《數書九章》
- ▶ 1261, Zengcheng Kaifang-shu 增乘開方術, 楊輝 《詳解九章算法》, via 《永樂大典》
(at the Cambridge Univ.) ⇒

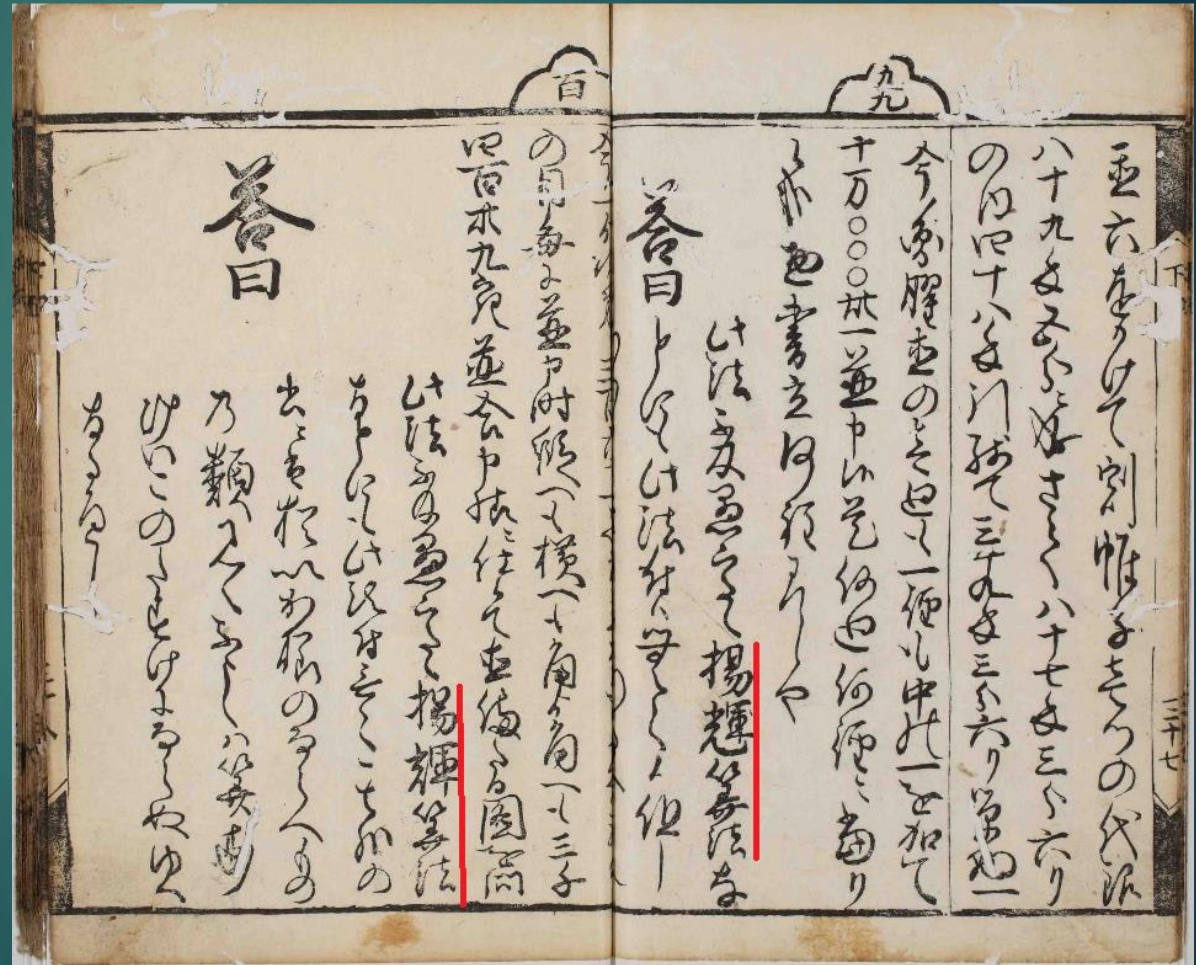


Important points of Studying the *Yang Hui Sunafa* for Japanese Mathematics

- ▶ Magic Square 方陣
- ▶ Seki Takakazu (1685) *Hojin no Ho, Ensan no Ho*
- ▶ 關孝和(1685)《方陣(陳)之法、圓攢之法》
- ▶ ↑
- ▶ Yang Hui (1275) *Yang Hui Suanfa*
- ▶ 楊輝(1275)《楊輝算法》“Fanji-shu”
- ▶ Cheng Dawei (1592) *Suanfa Tongzong*
- ▶ 程大位(1592)『算法統宗』、1592年

Evaluation of the *YHS* at the Edo period

- ▶ The *YHS* was one of the best books for the magic square at the Edo period.
- ▶ Dokaisho 『童介抄』 (Nozawa Sadanaga 野澤定長, 1664 年) at the University of Electro-Communications 電氣通信大學.



“Tianyuan-shu” 天元術 Transmitted into Japan

- ▶ Korean mathematicians studied the **Suanxue Qimeng**, **Yang Hui Auanfa** and **Xiangming Suanfa** at the National Mathematics School from 1430.

《算學啓蒙》 《楊輝算法》 《詳明算法》 《五曹算經》 《地算》

- ▶ Japanese invasions of Korea (1592–98)
- ▶ Japanese mathematicians obtained these mathematical arts?

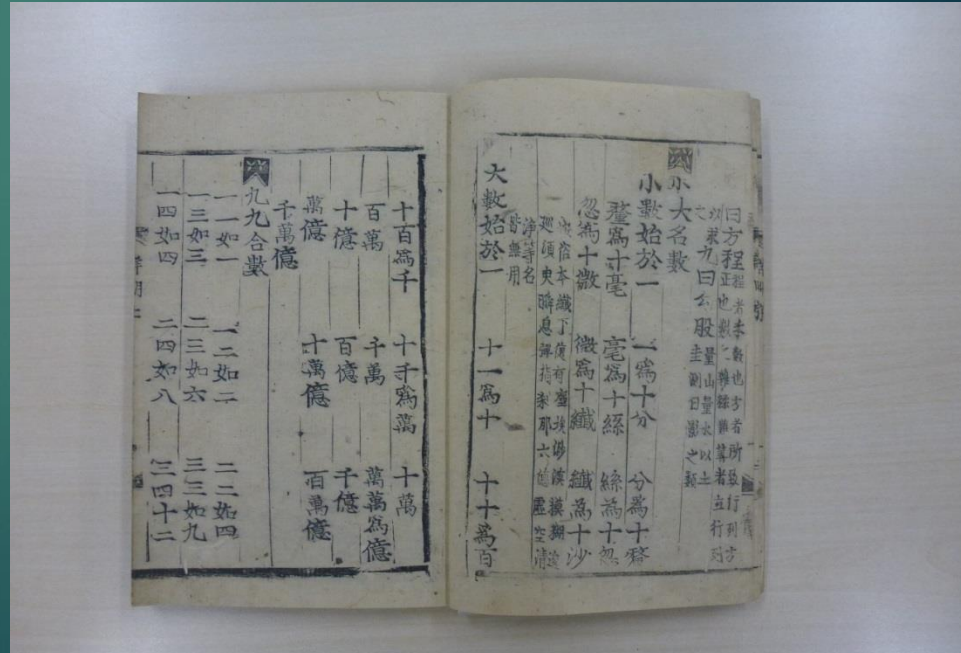
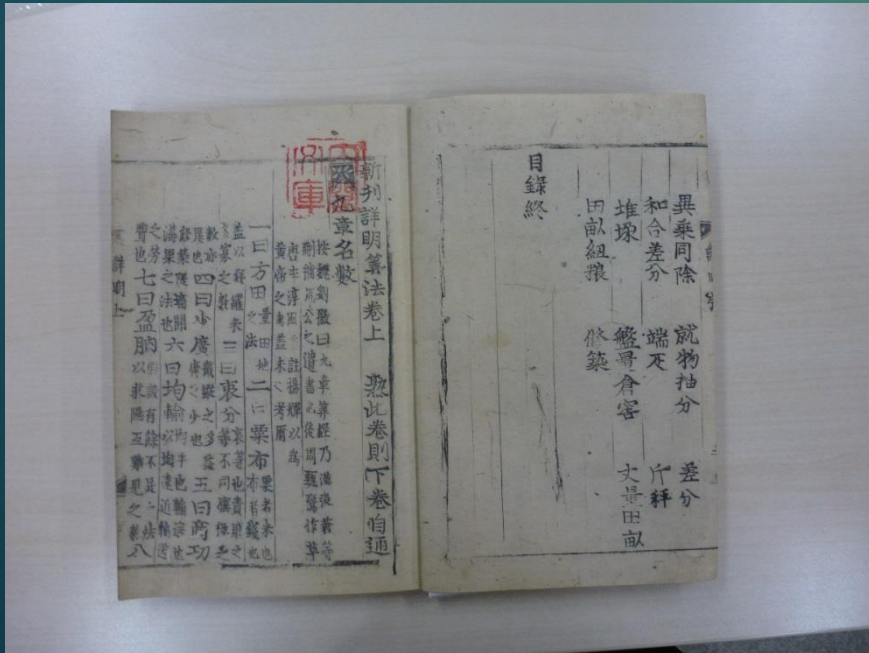
- ▶ Korean copper edition of
- ▶ *Suanxue Qimeng* kept at
- ▶ the Tsukuba Univ.



Xiangming Suanfa 詳明算法

(An Zhizhai 安止齋, 1373年)

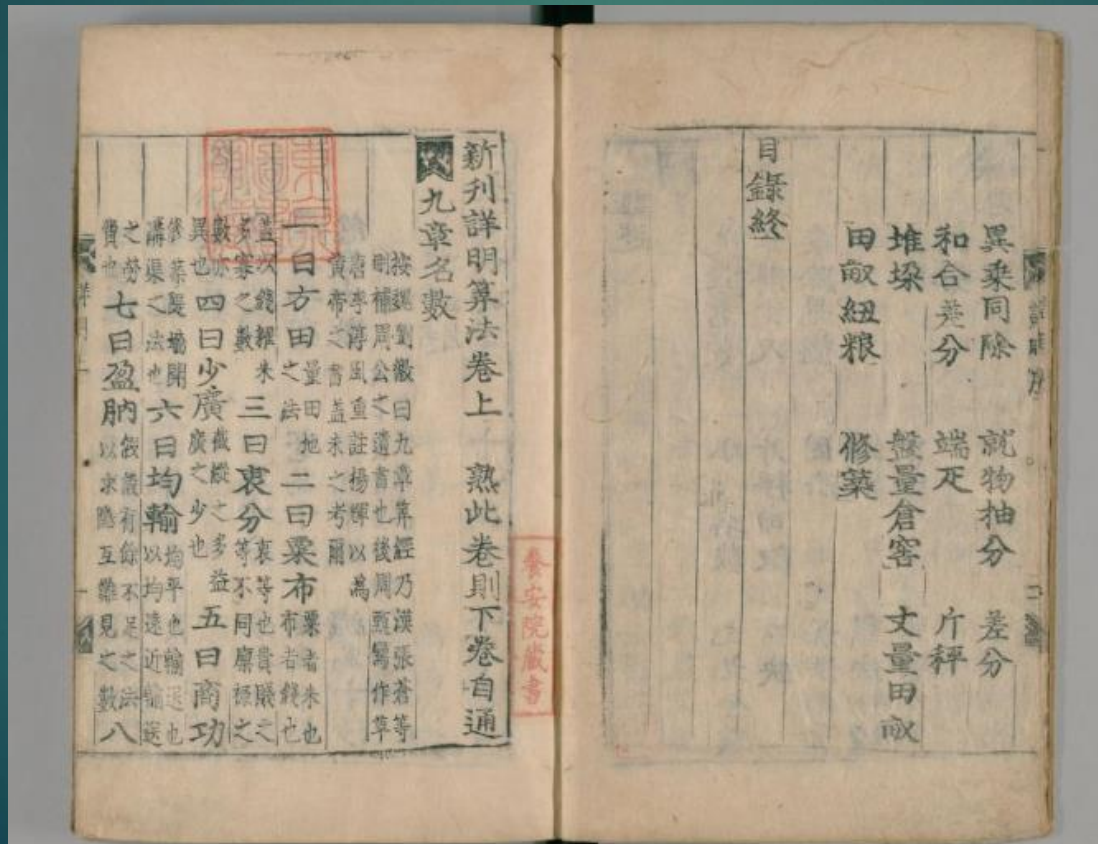
- ▶ There are two book of Xiangming Suanfa at National Diet Library and National Archives of Japan
- ▶ **National Archives of Japan**
- ▶ Mori Takasue's 毛利高標 (1760-1801) book;



Xiangming Suanfa 詳明算法

(An Zhizhai 安止齋, 1373年)

- ▶ National Diet library, Yoanin 養安院 book;

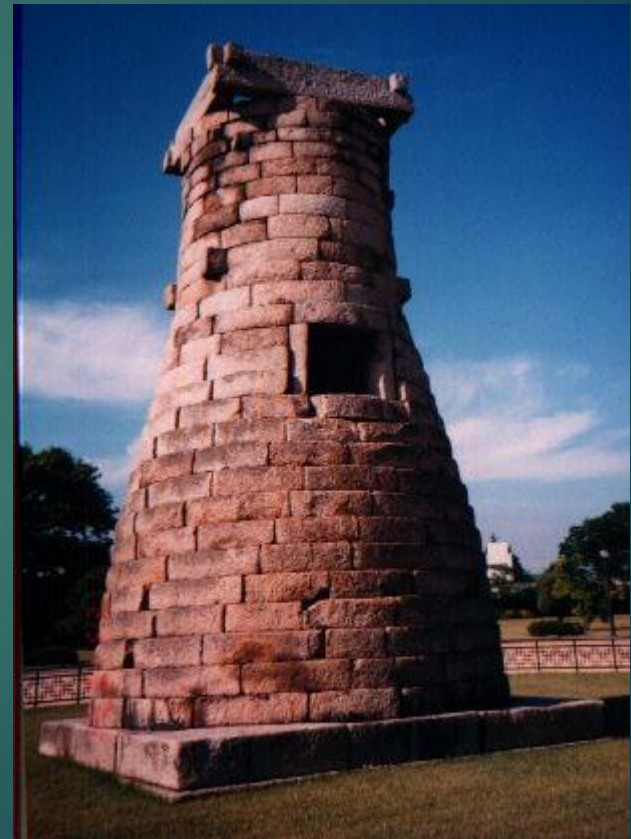


Korean Woody Edition of *Yang Hui Suanfa*

- ▶ Published in 1433 at Gyeongju 慶州, Korea
- ▶ The book A of the Tsukuba Univ.
- ▶ Yoanin 養安院 (曲直瀨正琳) Seal; (the same as the Suanxue Qimeng 算学啓蒙, Tsukuba Univ. book.)
- ▶ The book B of the Tsukuba Univ.
- ▶ Republished version; 覆刻本



King Sejong published the *Yang Hui Suanfa* in 1433 at Gyeongju



- ▶ King Sejong 世宗 (1397-1450) made the Cheomseongdae 瞻星台 (astronomical observatory) at Gyeongju, Korea.

There are 8 Set of Korean Woody Edition of *YHS*

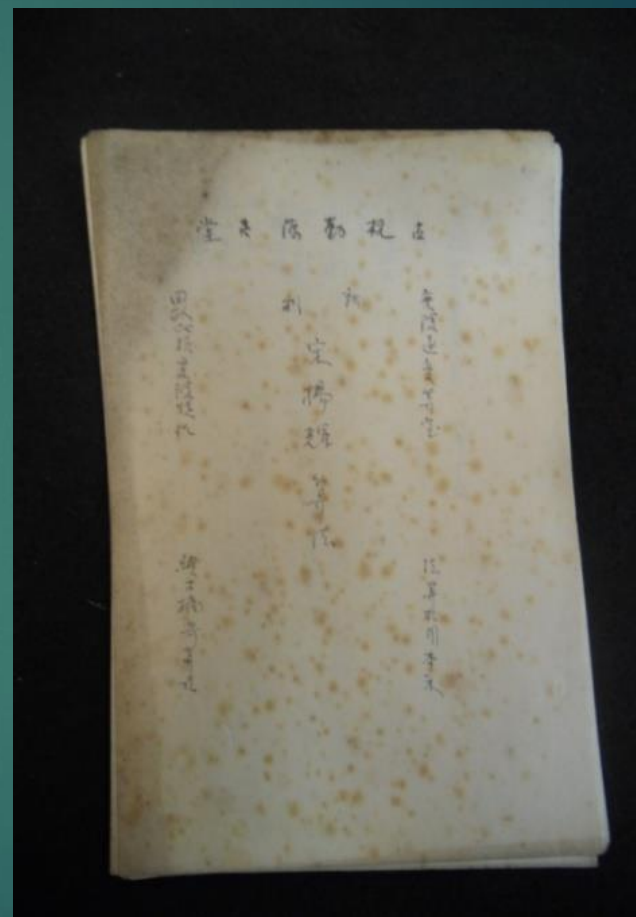
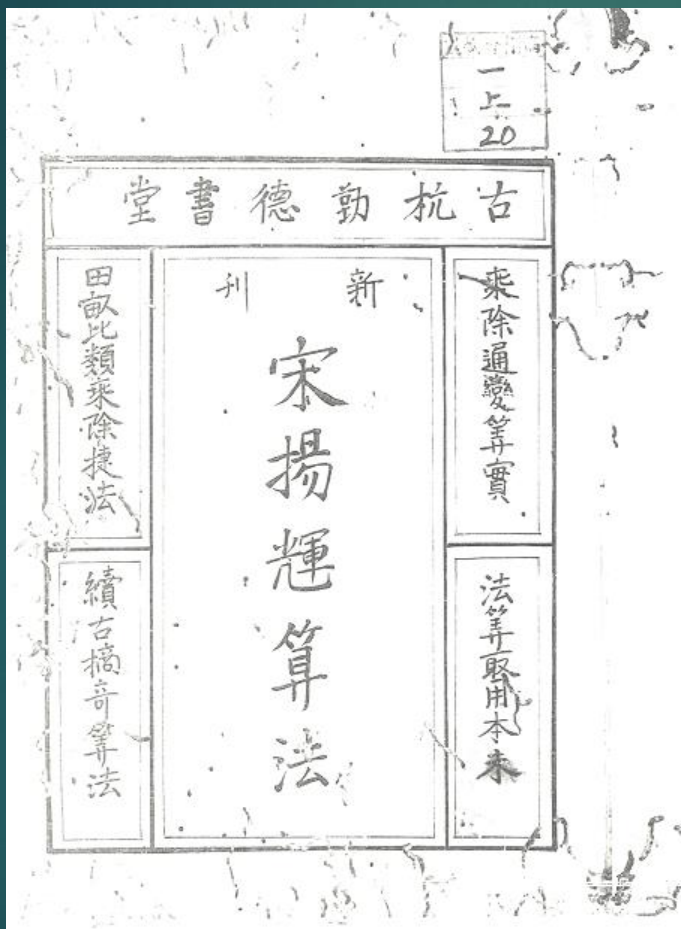
- ▶ Japanese Imperial Library 日本・宮内廳書陵部
- ▶ Tsukuba Univ. Library 日本・筑波大學圖書館 (2 set)
- ▶ Sonkei-kaku Bunko Library 日本・尊經閣文庫
- ▶ National Pales Museum at Taipei 台灣・故宮博物院
- ▶ Yonsei Univ. Library 韓國・延世大學校圖書館
- ▶ Korea Univ. Library 韓國・高麗大學校圖書館
- ▶ Korean Treasures No. 1755 大韓民國寶物1755號 未調查

Important Manuscript of *YHS*

- ▶ Shinminato Imizu City Museum, Toyama, Japan 射水市新湊博物館
- ▶ 關孝和抄本、中田高寬再抄、石黒信由藏
- ▶ The Japan Academy Library 日本学士院 石黒準太郎1913年写本
- ▶ The IHNS, Chinese Academy of Science 中國科學院自然科學史研究所
- ▶ 三上義夫抄本
- ▶ Aki-takata City Museum, Hiroshima, Japan 安藝高田市歴史民俗博物館
- ▶ 三上義夫抄本
- ▶ Kyoto Univ. Library ? 京都大學 藪内清藏書本
- ▶ Yonsei Univ. Library, Korea 延世大學校圖書館
- ▶ 綠雨堂 Library (republished for modern Korean) 未調査

Seki's Manuscript (1661)

14



▶ Shinminato 中田高寛 (1773/1779)

三上義夫 (about 1913)



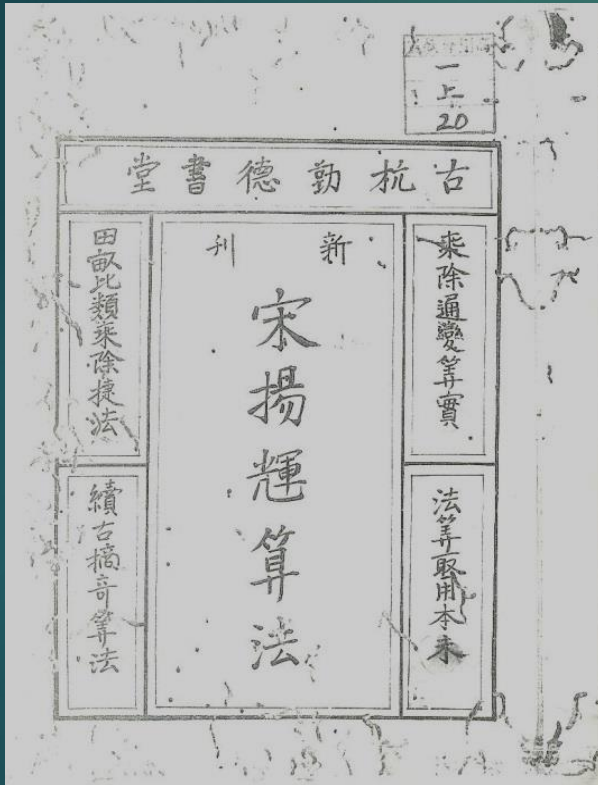
安芸高田市歴史民俗博物館

When Did Seki Hand-copy the *YHS*?

- ▶ Koju Bunko (中田高寛、about 1773)
- ▶ 寛文癸丑(1673)→辛丑(1661)
- ▶ The Japan Academy (石黒準太郎、1913年) 辛丑
- ▶ Yabuuchi 藪内清(?) 癸丑(1673)
- ▶ Tomb of 中田高寛 School of 中田高寛 at Toyama



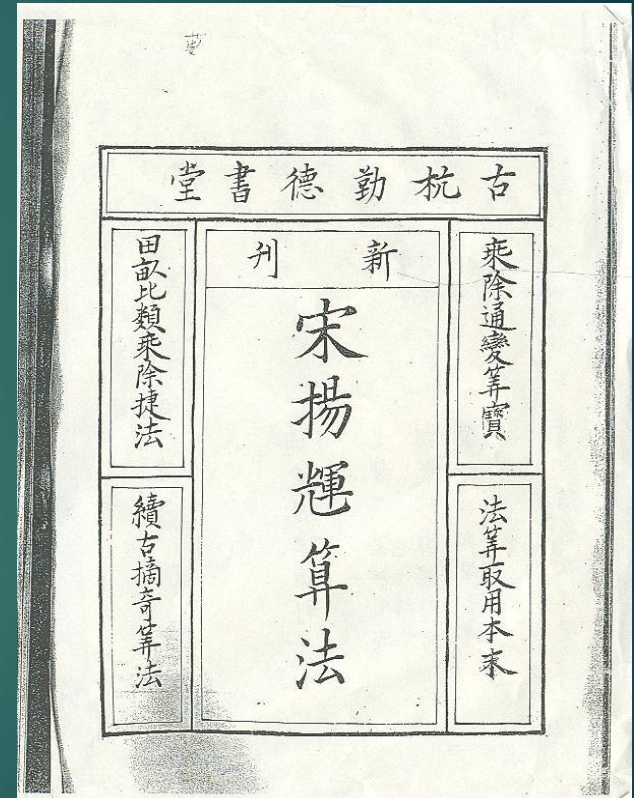
When Did Seki Hand-copy the *YHS*?



▶ 高樹文庫本



中田高寛署名



藪内清蔵書

模写本

When Did Seki Hand-copy the *YHS*?

寛文辛丑仲夏下浣日訂寫訖
關孝和

寛文辛丑

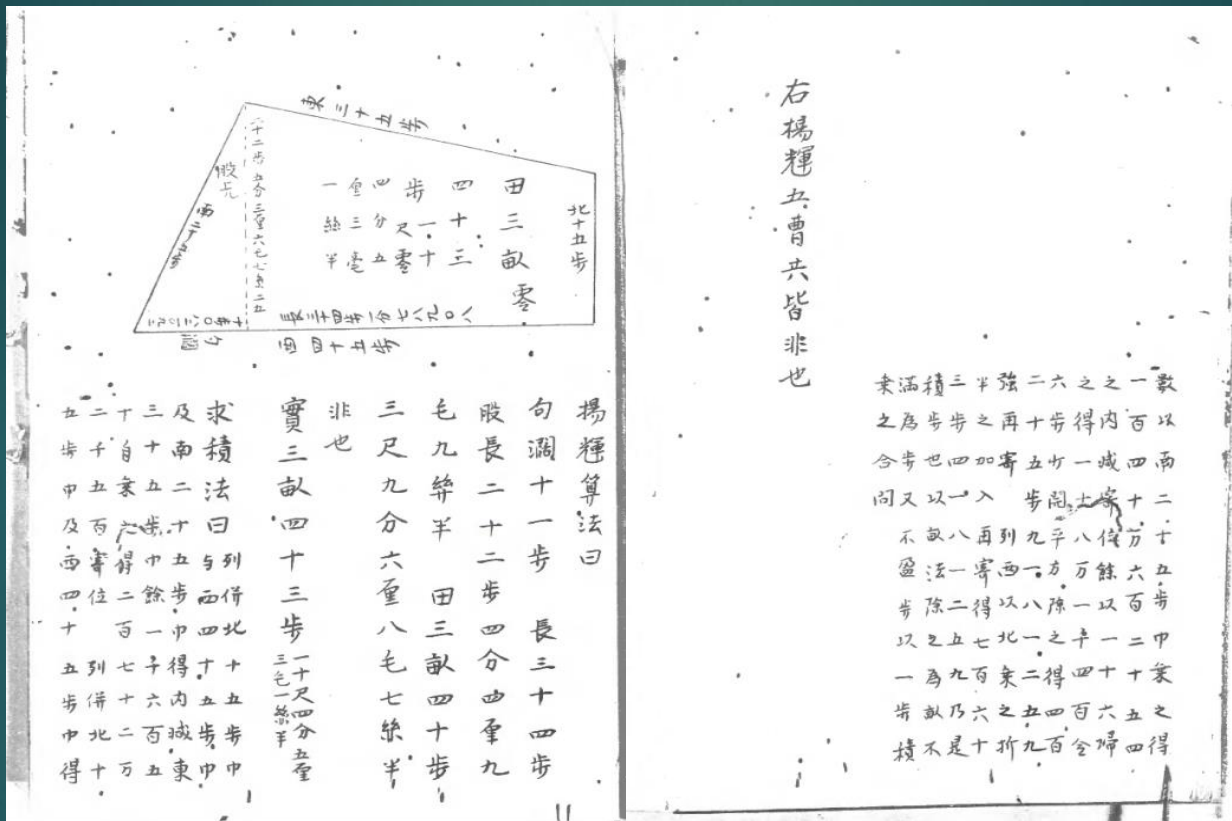
宣德八年癸丑五月日
慶州板刊

▶ 関孝和年紀(1661年)

▶ 寛文辛丑(1661年)

朝鮮版本年紀(1433年)

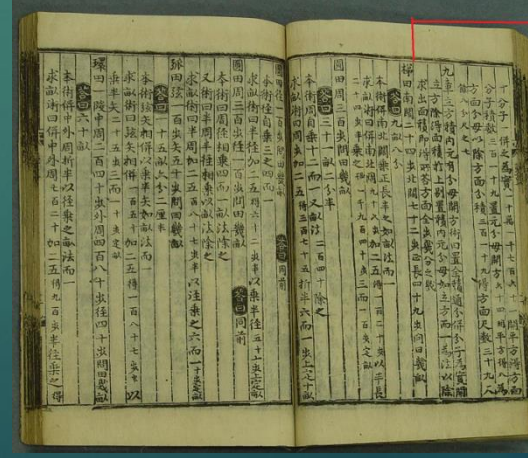
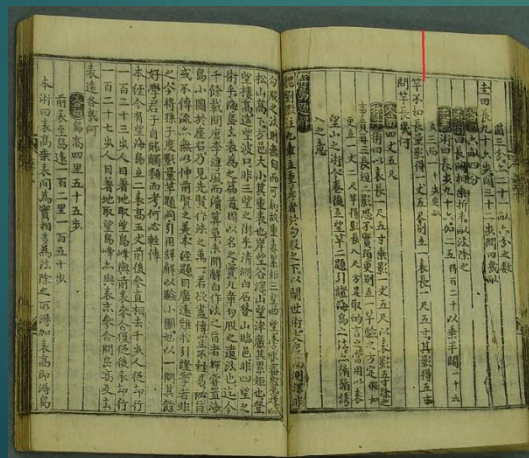
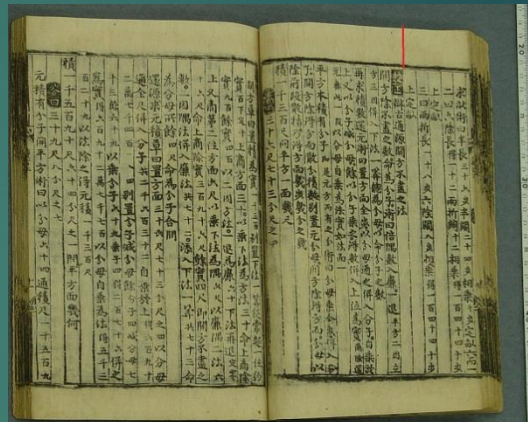
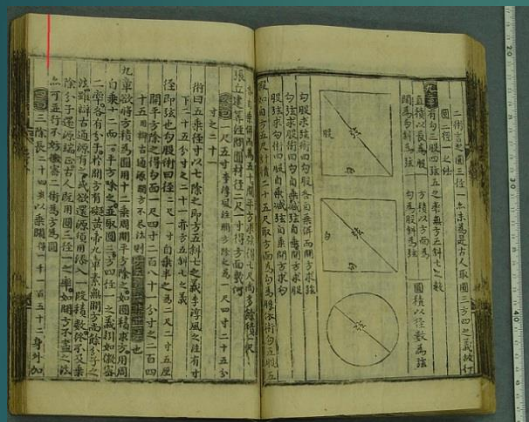
Proofreading by Seki Takakazu



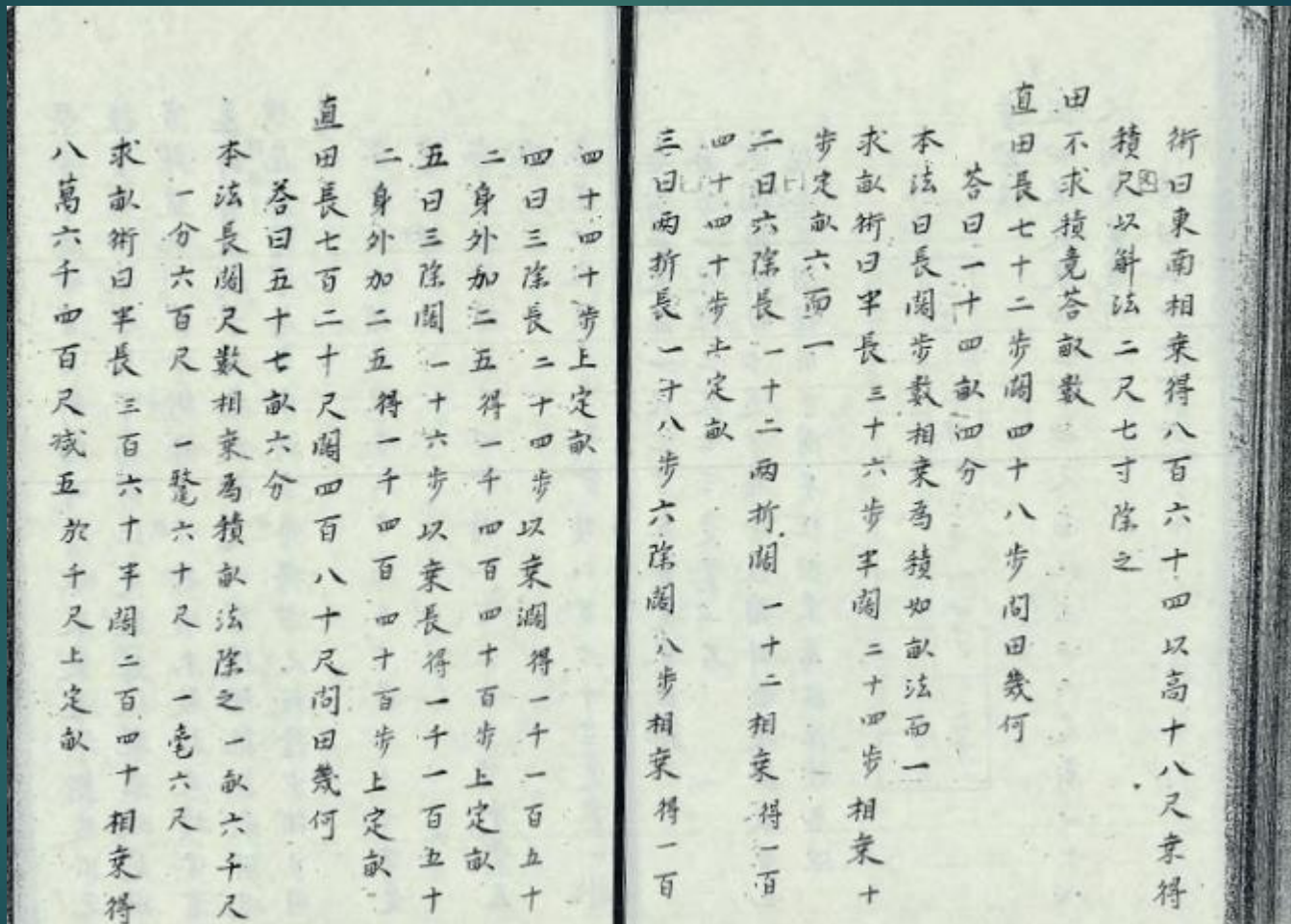
► 高樹文庫本 第2冊「田畝比類乘除捷法」下、3丁表裏

Proofreading by Seki Takakazu

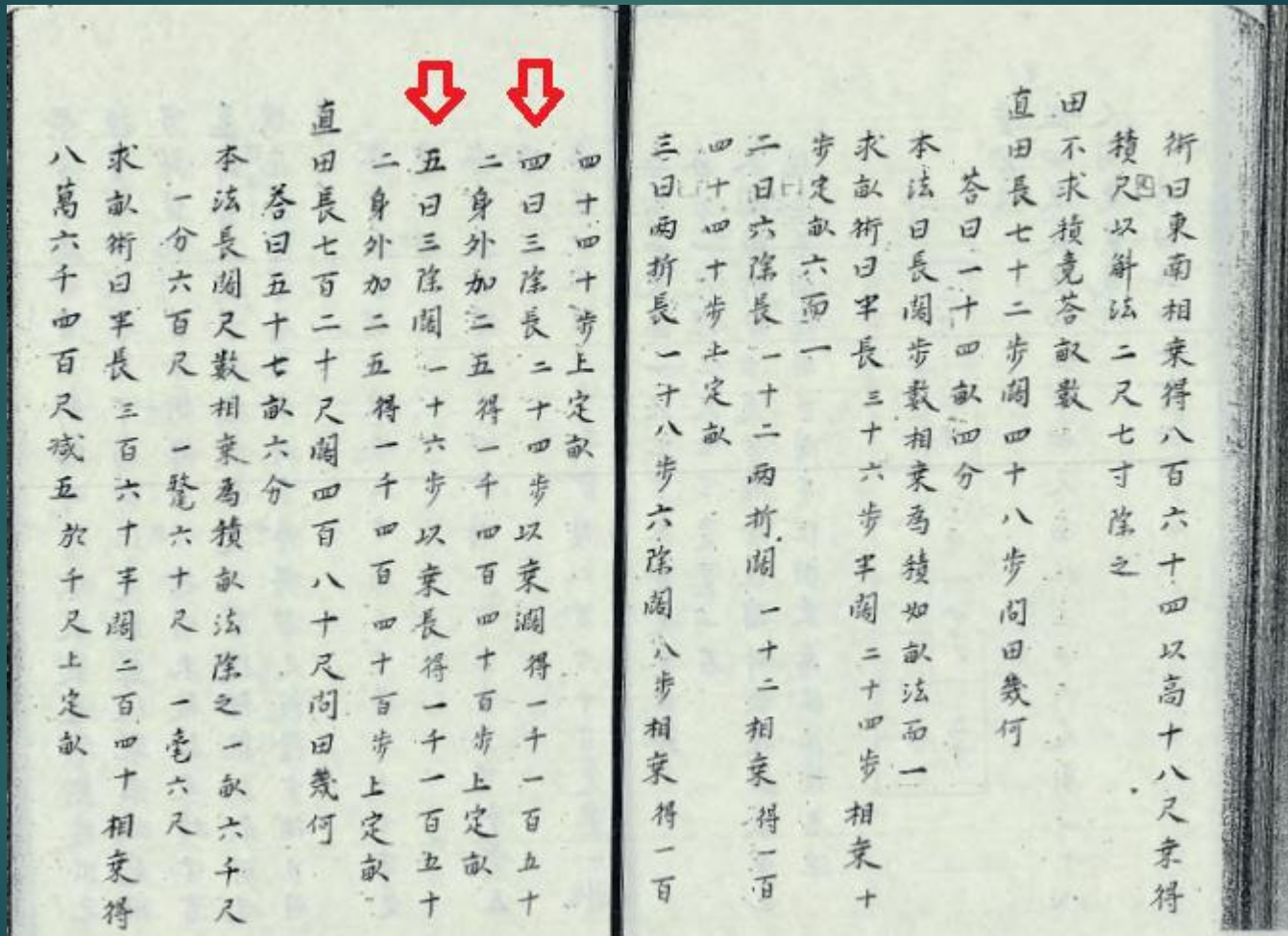
▶ All of Korean edition, the pages are out of order. (「續古摘奇算法」)



Proofreading by Seki Takakazu²⁰

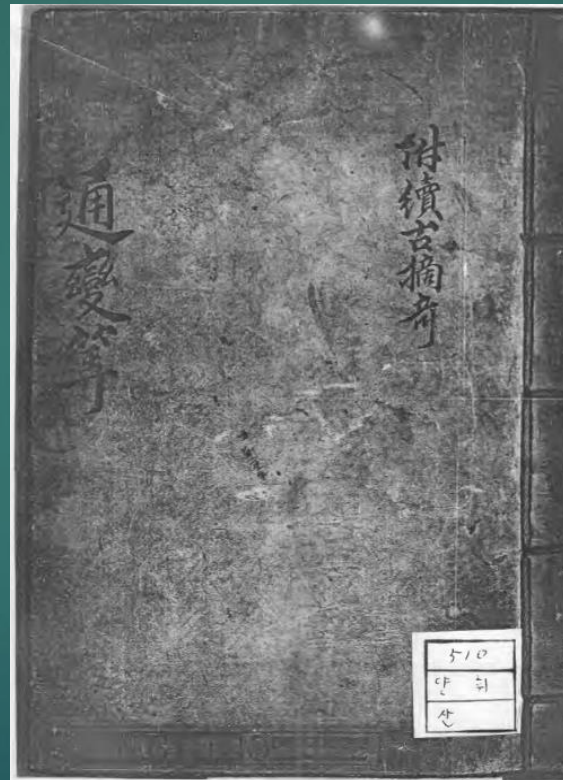


Proofreading by Seki Takakazu²¹

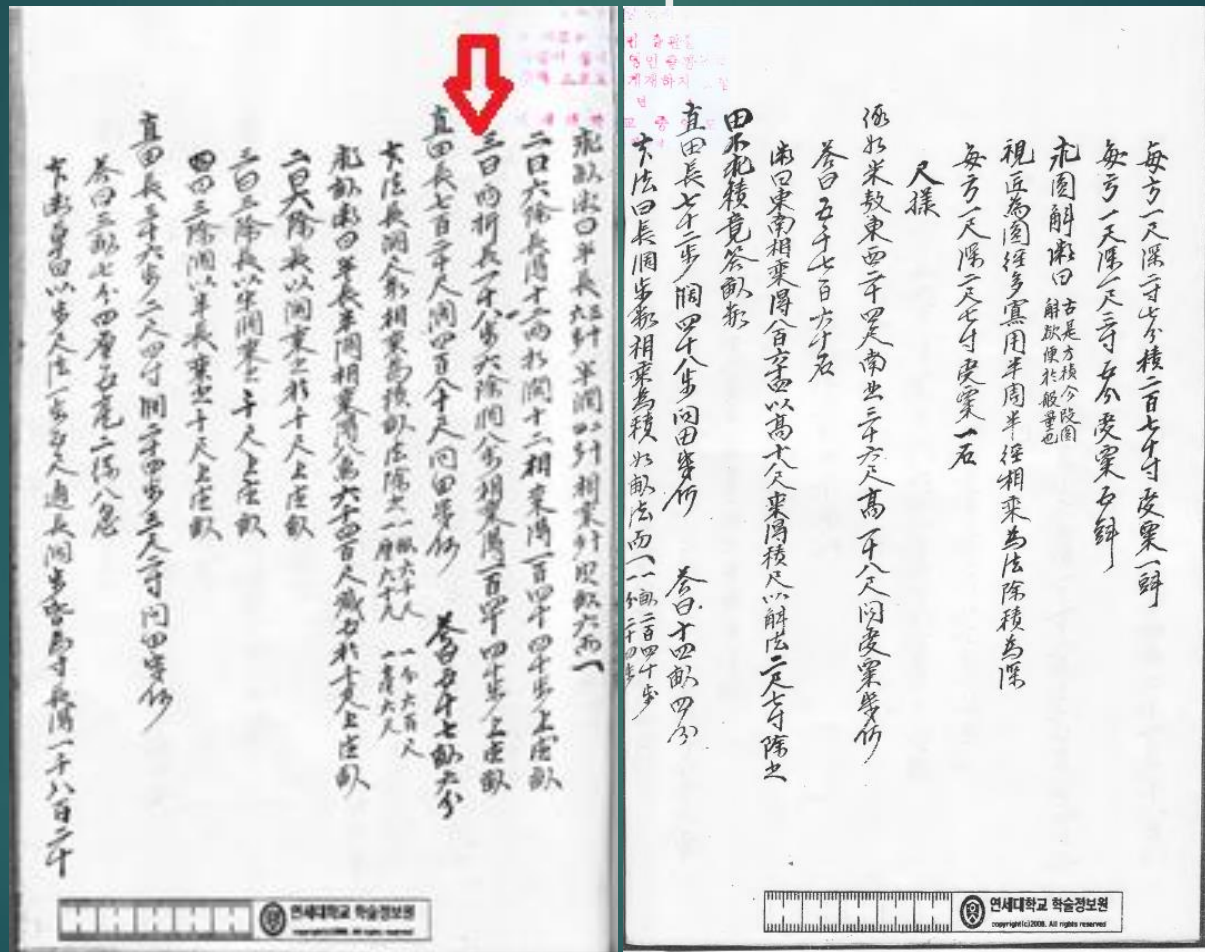


The Manuscript of YHS kept at the Yonsei Univ.

- ▶ Only surface of 「乘除通變算寶」 and 「續古摘奇算法」,
after 1840?
- ▶ 宜稼堂叢書



The Proofreading at the Yonsei manuscript



▶ 関孝和の校勘とは異なる修正

Conclusion

- ▶ There is no copper version of *Yang Hui Suanfa*.
- ▶ The pages of woody edition are out of order.
- ▶ Seki's proofreading was not the same with the Yonsei manuscript.
- ▶ There is/was no good book at least 1661.
- ▶ Seki Takakazu, 16 years student, proofread by himself.

Treasure in Korea, No. 1755

25

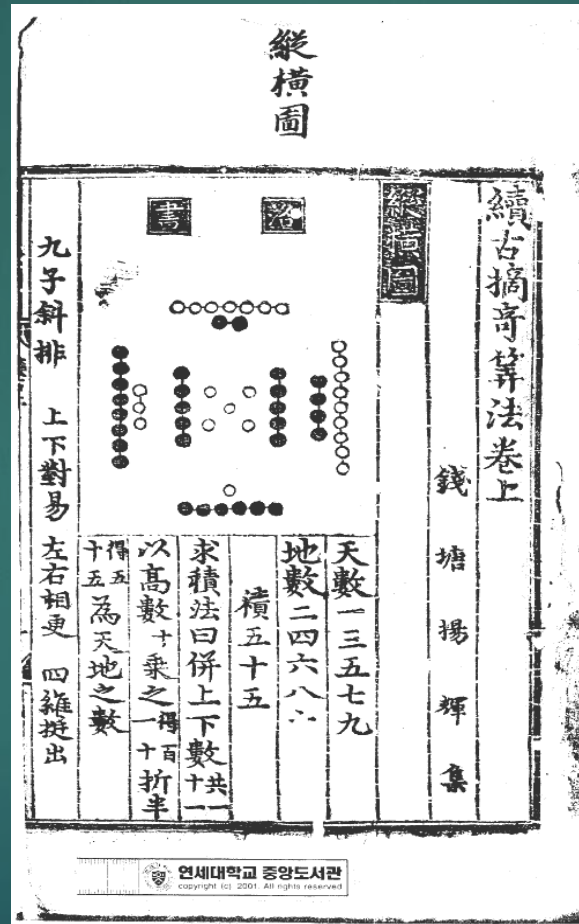


▶ No. 1755

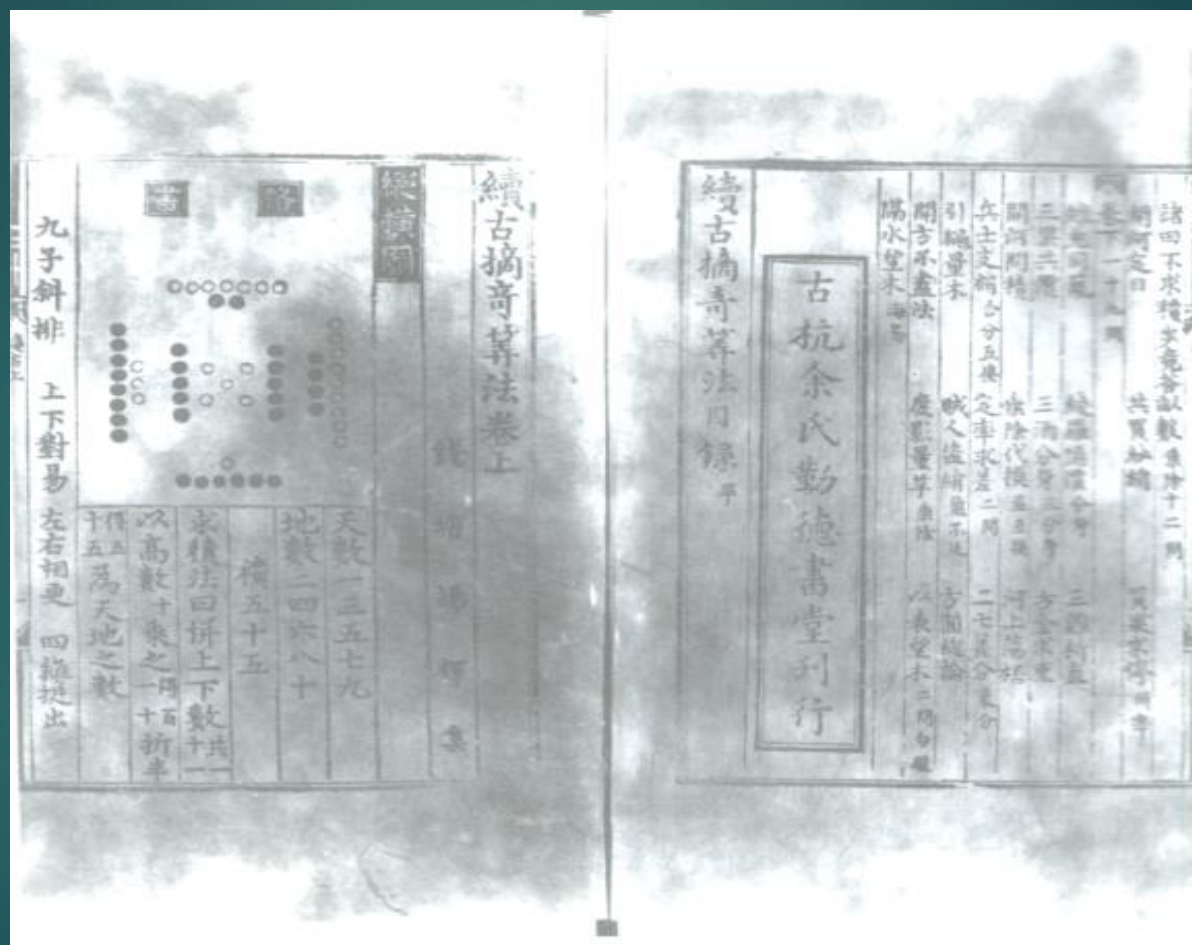


Tukuba Univ.

Yonsei Univ. Woody Version Book



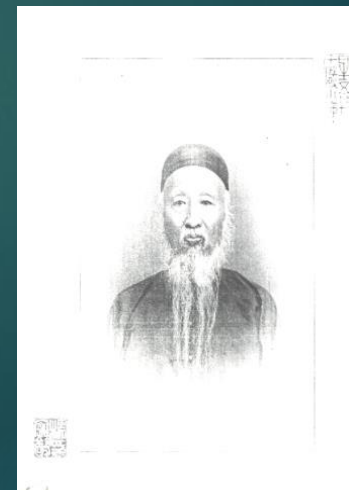
Sonkeikaku (Burned)



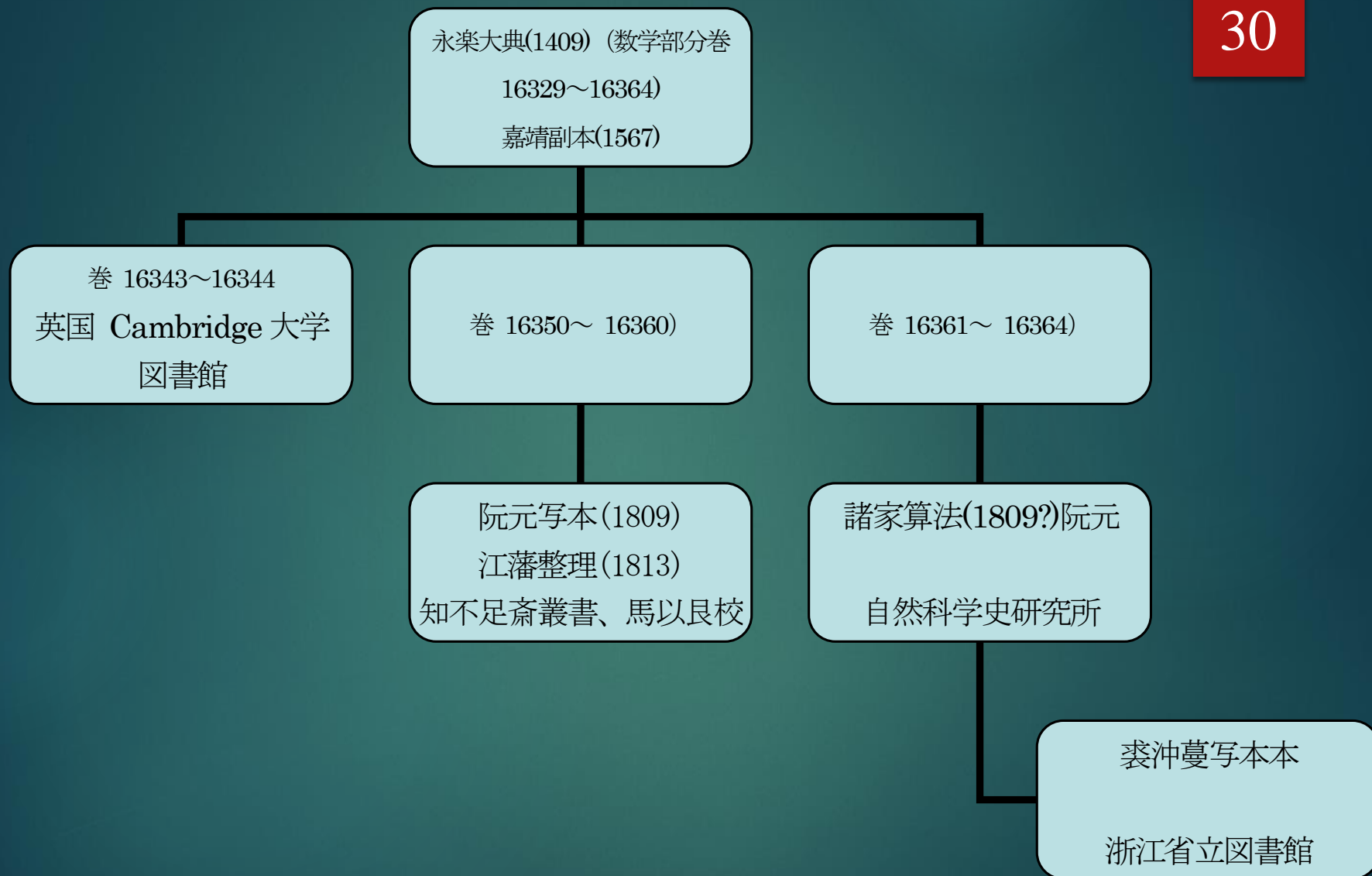
The Palace Museum at Taipei

28

- ▶ Yang Shoujin 楊守敬 (1839-1915) bought in 1880 in Japan.
- ▶ ↓
- ▶ (National Beiping Lib. 北平圖書館 (now National Lib.))
- ▶ ↓
- ▶ The palace Museum at Taipei







Seki's PV

- ▶ (1642年3月? 江戸小石川 生??)
- ▶ **1645年?** 江戸 天守番組屋敷?
- ▶ 1661年以前 養子(内山家→関家)『楊輝算法』を写本
- ▶ 1665年 甲府藩・小十人組番士(100俵)
- ▶ 1674年 『発微算法』著
- ▶ 1680年 甲府藩・小十人組組頭(200俵)
- ▶ 1682年 甲府藩・賄頭(200俵10人扶持)
- ▶ 1683年 『解伏題之法』著
- ▶ 1684年 測量、『甲州万力筋松本村御検地水帳』
- ▶ 1699年 絵図作成
- ▶ 1701年 甲府藩・勘定方用役(勘定頭差添)(300俵)
- ▶ 1704年 幕府・西之丸納戸組頭
- ▶ 1708年10/24 (グレゴリオ暦12月5日) 没

Reference

- ▶ 三上義夫(1932-4)「関孝和の業績と京坂の算家併に支那の算法との関係及び比較」『東洋学報』20: 217-249, 20: 543-566, 21: 45-65, 21: 352-372, 21: 557-575, 22: 54-99. 『数学史研究』(1944), 22: 1-51, 23: 53-109.
- ▶ 李儼(1930;1954)「宋楊輝算書考」『図書館学季刊』1930-1:1-21. 李儼(1933;1954)所収.
- ▶ 熊極生(1955)「楊輝五五図浅釈」『数学通説』1955-9: 22-26.
- ▶ 燕星(1955)「楊輝弧矢公式質疑」『数学通報』1955-3: 38-39.
- ▶ 巖敦傑(1964)「宋楊輝算書考」 銭宝琮(1964b;1985) 149-165.
- ▶ 児玉明人(1966)『十五世紀の朝鮮刊銅活字版数学書』自家版.
- ▶ 平山諦(1988)「朝鮮算書目録」『数学史研究』116: 53-57.

- ▶ 城地茂(1996c)「東亞高次方程的發展」『科學史通訊』14:34-43.
- ▶ 城地茂(1996d)「清代抄本『諸家算法』初探」龍村倪・葉鴻灑(編)『第4屆科學史研討會彙刊』33-46.
- ▶ 城地茂(1999)「江戸時代日本數學家之思想與幻方研究」張嘉鳳・劉君燦(編)『第五屆科學史研討會論文集』95-138.
- ▶ 城地茂(2003)「楊輝算法傳説再考」『(京都大學)數理解析研究所講究録』1317:71-79.
- ▶ 城地茂(2004)「中田高寬写・石黒信由藏『楊輝算法』について」『(京都大學)數理解析研究所講究録』1392:46-59.
- ▶ 城地茂(2005; 2009)『日本數理文化交流史-関孝和と「楊輝算法」』台北:致良出版社.

- ▶ 城地茂(2014)『和算の再発見』化学同人 34。
- ▶ 真島秀行(2009)「関新助孝和のある甲府分限帳の記載について」日本数学史学会創立50周年記念講演会。