

SAW Three-Month Workshop:

Mathematical Practices in relation to the Astral Sciences

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Karine Chemla 林力娜

(Sphère, CNRS & University Paris Diderot, ERC Project SAW)

&

Li Liang 李亮

(Institute for the History of Natural Sciences, China, & ERC Project SAW)

PROGRESSIONS, MOTIONS AND CHANGES IN THE ASTRAL SCIENCES OF ANCIENT CHINA

Abstract: Numerical progressions are one of the key topics dealt with in the surviving mathematical writings composed in Chinese until the 7th century. They also occur in writings on astral sciences that survived from about the same time period. More precisely, in the latter writings, we find them in two types of contexts. The description of the motion of celestial bodies involved numerical progressions. Moreover, the description of how some entities, like the length of solar shadows, changed over time, also put progressions into play. The presentation aimed at investigating the relationship between mathematical writings and writings on astral sciences using the topic of progressions as a test case. It also aimed at determining whether specific developments had taken place in the context of these two types of activities and how, if any, they had circulated from one to the other.

The first part of the talk was devoted to how progressions were used to approach the change in time of some key data. Such uses of progressions relate to how knowing an overall change, or a change over some time periods, or else some key terms of a progression, one could determine all the terms of the progression using assumptions or information on its nature. This was in particular the case when the third century commentator on *The Gnomon of the Zhou* (completed in 100 BCE or in the early years of the 1st century CE) composed a table of solar shadows at 24 specific points forming an equal division of the tropical year. Zhao Shuang discarded the table that had been inserted in *The Gnomon of the Zhou*, arguing that it did not carry out an equal division of the year and that it used coarse values to proceed. Apparently,

the procedure he suggested instead was more direct than the one that according to the information he gives was put into play, which used the daily change of the length of the shadow. Interestingly, the mathematical classic *The Nine Chapters* (most probably completed in the 1st century CE) solves an identical problem, for which it gives a roundabout procedure, while Zhao Shuang's procedure is the same as the one described by Liu Hui in his commentary on *The Nine Chapters*. The description of calendrical systems that we find in specialized monographs composed for official histories shows progressions used in the same way. Analysis displays how, for specific changes with time in the lunar velocity or the solar motion, practitioners used progressions in quite different ways, opting sometimes for regular progressions and sometimes for progressions whose patterns of change with time is not obvious.

The second part of the talk dealt with the changing types of progression used in the description of the planetary motions recorded in the same specialized monographs. Again, in *The Nine Chapters* one finds similar patterns of motion for bodies in contexts in which conjunction is at stake. In such contexts, the problem consists in getting the sum of a progression knowing its terms. The 8th century calendrical system "Great expansion" by Monk Yixing contains procedures of that type which are quite similar to those found in *The Nine Chapters* and its commentaries.