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THE DOUBLE STELLAR HEMISPHERE OF JOHANN SCHALL VON BELL S. J. (PEKING 1634)[1]

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It is well known that the Jesuits, from the beginning of their mission in China, in order to arouse the intellectual curiosity of the Chinese and to interest them in the doctrines of the West, introduced themselves in the Middle Kingdom as bringers of the Occidental sciences and in particular of astronomy. Towards the end of the sixteenth century, the Chinese themselves were keenly feeling an urgent need of astronomy. In fact, the calendar was a political instrument of the highest value for maintaining the prestige of the empire over the numerous vassal and tributary countries; but since the scientific rules on which it was originally based had been lost, it had for years been drawn up merely empirically and hence it swarmed with errors.

When therefore the name of Li Ma-tou 利瑪竇, viz. Ri[cci] Matteo (1552–1610), began to be known in the intellectual circles of China, when his scientific works in Chinese began to make headway in the circles of the literati, the hope arose in almost all that he might be the man able to correct these errors. The calendar then current in China had last been revised by the able mathematician Kuo Shou-ching 郭守敬 (1231–1318) who had finished his revisory work in 1280, under the Mongol emperor Kubilai.[2]

1) Abbreviations used in this article:
ARSI=Archivum Romanum Societatis Iesu, viz. the Roman Archives of the Society of Jesus.
FR=Pasquale M. D'Elia S.I., *Fonti Ricciane*, Roma, I, 1942; II and III, 1949.
TV=Pietro Tacchi Venturi S.I., *Opere Storiche del P. Matteo Ricci*, Macerata, II, 1913.
LEGGE=James Legge, *The Chinese Classics*, London 1861.
MAYERS=*The Chinese Reader's Manual*, Peiping 1932.

2) Cf. O. Franke, *Geschichte des Chinesischen Reiches*, Berlin 1948, IV, pp. 591-592.

Some ten years after Ricci had succeeded in entering the Chinese hinderland, towards the middle of 1594, he received in Shiuchow 韶州 in Kwangtung a visit from the ex-Minister of the Board of Rites 禮部尙書 of Nanking, a certain Wang Chung-ming 王忠銘 who was passing through this city on his return to his native place in the island of Hainan 海南. Admiring the learning of the Italian missionary, Wang promised him that, if he should once more be appointed to his former office, he would, on his return from the island, "have to take the Father [Ricci] with him to help him correct their 'year' or calendar which they know to have become faulty in many respects."[3] In 1595 Ricci left Shiuchow and arrived on the 28th of June in Nanchang 南昌 in Kiangsi. Three years later, in 1598, Wang Chung-ming was once more appointed Minister of the Rites at Nanking and he kept his promise, taking Ricci with him to the Southern Capital, where however the latter did not succeed in settling down on that occasion.

The following year, 1599, the missionary admired at Pei-chi-ko 北極閣 in Nanking four astronomical instruments cast by Kuo Shou-ching around 1279, probably for the two Colleges charged with the education of the Mongols, one at Yenching 燕京, which afterwards was called Peking, and the other at Pingyang 平陽 in Shansi.[4]

Though Ricci was no real astronomer, this was sufficient to show him the horizons that opened to astronomy in China, and hence the chances of success there were to interest the Chinese in Occidental sciences and, subsequently, in the Christian and Catholic religion. It is more than probable that just in these years, 1594–1598, he wrote for the first time to his superiors in Rome asking them to send him "a good astronomer", i.e., a professional astronomer, priest or non-priest, of any nationality,

3) Cf. *FR.*, I, N. 417.

4) Yeh-lü Ch'u-ts'ai 耶律楚才 (1190–1243), grand Minister of Ogotai, founded in 1236 in Yenching the Institute of Compilation 編修所 and in Pingyang 平陽 the Institute of Literature 經籍所. The latter was in 1269 transferred to Peking. Cf. *Harvard Journal of Asiatic Studies*, 1950, XIII, pp. 460–461. For the instruments cast by Kuo Shou-ching (cf. O. Franke, *loc. cit.*) which were seen by Ricci in Nanking in 1596 and in Peking a few years later see *FR*, I, N. 543.

capable of predicting the solar eclipses and the course of the stars, hence to compile each year the calendar and, if possible, to correct the errors of the one in use among the Chinese.

After "many years" of waiting, he repeated his urgent request on the 12th of May, 1605, to the Assistant of the General for the Affairs concerning Portugal and its missions, Father John Alvarez: "At the end of this letter I want to beg Your Reverence for something for which I applied many years ago. It so happens that one of the most useful things that could come from there [Europe] for this court would be a Father or a Brother who would be a good astronomer.[5] And I say astronomer, for in the other matters of geometry, watches, and astrolabes, I know enough and have enough books. But they [=the Chinese] do not consider these as important as the course and the true location of the planets, and the calculation of the eclipses, in short, one who can make ephemerides [=astronomical almanacs or calendars].

"And the reason for this is that the king maintains, I think, more than two hundred persons at large expense, to make every year the ephemeris of that year. And besides this there are two colleges, one which they call of the Chinese rule, which is the more esteemed one and yet less sure of the things which it writes; the other, lower one, of the rule of the Moors, which predicts the eclipses more accurately, and about which, nevertheless, less ado is made. There are two Colleges, I say, outside of the palace of the king, and two others inside the palace, all eunuchs, and in the court of Nanking there are two more with many mandarins.[6]

"And with all this they can only calculate and have no science in their method.[7] And when their calculations are not right,

5) The documents of the time of Ricci speak commonly of "astrologer" and "astrology" in the sense of "astronomer" and "astronomy."

6) On these two Colleges of mathematicians inside and outside of the palace and on the two observatories, of the Chinese and the Mohammedans, cf. *FR*, I, N. 58 and p. 41, n. 8.

7) I.e., they can only calculate empirically without any scientific method.

they only say that their calculations were made accurately in conformity with the rules of their predecessors.

"With these world maps, watches, globes, astrolabes and other things which I have made and taught, I have here gained the name of the greatest mathematician in the world,[8] and though I have here no book of astronomy, with certain Portuguese ephemerides and repertories[9] at times I predict the eclipses much more accurately than they do. When however I say that I have no books and do not want to undertake the reform of their rules, only few believe me.

"I say then that if the mathematician of whom I am speaking would come here, we could translate our tables into Chinese, which I will do rather easily, and begin the task of emending the year,[10] which would give us great reputation, open more this entrance in China, and make our stay more stable and free."[11]

When three years later, on the 8th of March, 1608, Ricci sent to the General of his Order the Chinese translation of the *Astrolabium* and of the *Sphera* of Clavius 渾蓋通憲圖說, which had been made by Li Chih-tsao 李之藻, and perhaps a copy of the translation of the first six books of the *Geometry of Euclid* 幾何原本, recently printed by Paul Hsü Kuang-ch'i 徐光啓, he availed himself of this opportunity to point in Europe to the "fine talents of this nation", and to remind the General of the importance of the scientific apostolate as a means of leading on to the teaching of religion. Foreseeing then that, as he had written on other occasions, the Western sciences would be of great service for the apostolate among the intellectuals, he again asked for "many books of this science of mathematics and of others, and for some

8) More than once Ricci says jokingly that, on account of his scientific knowledge, he was for the Chinese like another Ptolemy. Cf. TV, II, pp. 175, 184.

9) Ricci seems to allude to the *Repertorio dos tempos conforme a nova reformação do Santo Papa Gregorio XIII* of the priest Andre de Avellar of which the old library of the Jesuits in Peking still preserves the editions of 1585, 1590, 1594, 1602.

10) I.e., the missionaries could undertake the task of correcting the Chinese calendar.

11) Cf. TV, II, pp. 284-285.

good mathematician, especially astronomer, who can continue what I have begun with my few forces, few books and little knowledge."[12]

These insistent demands over a period of so many years for a professional astronomer show how much Ricci had this matter at heart. He died meanwhile on the 11th of May, 1610, without seeing his dream come true. But the question was taken up again by his contemporaries and by his immediate successors.

Father Sabatino De Ursis, S. J., in whose arms the founder of the mission had expired and who had lived with Ricci from the first half of 1607, sent an urgent appeal on the 2nd of September of the same year to the Assistant of Portugal, Father Antonio Mascareñas, for mathematicians, particularly some astronomer, and for scientific books. He wrote: "When I first entered this mission, Father Matteo Ricci claimed me for this house in Peking. His intention was that, since I knew something of mathematics, he wanted to introduce me to the things of this science, as he did during the three years (1607–1610) which I stayed with him. But since we have no books, nothing can be done: the books which we have are the *Gnomica* of Father Clavius, his *Sphera*, and his *Astrolabium*. The truth is that, as Ricci used to say, it is necessary now to work with two hands, with the right for the things of God, and with the left for these things, things which cannot be avoided; and what has been done till now was all of this kind. Hence I propose to Your Reverence that you send us some Father who knows mathematics well, especially astronomy, and at the same time some books on some interesting subjects of this science." And at the end of his letter he alludes to the Tyrolese Christopher Grienberger (1562–1630), the successor of Clavius in the chair of mathematics at the Roman College, and adds: "I recommend myself to all, and ask Father Christopher Grienberger for some matter of mathematics, nice and interesting for these literati of China, for it will be of great service to the Lord, as I have written on other occasions."[13]

12) Cf. TV, II, pp. 342-343.

13) Cf. ARSI, *Jap. Sin.*, 14, ff. 347*v*-348*r*.

With even greater insistence than De Ursis, the Sicilian Nicholas Longobardo, Ricci's successor as superior of the mission, wrote to the General himself on the 23rd of November, 1610: "If Your Paternity wants to know the most appropriate and effective means of promoting this mission, it is, in the opinion of all, to send here many and good subjects, as has been written on other occasions, and especially some good mathematicians", who should bring with them many scientific books.[14] Two years later, on the 15th of October, 1612, the same Longobardo urged the General to send mathematical books and instruments and a couple of excellent scientists. I translate from his Portuguese text: "For us it is sure that mathematics opens to us the field at which we aim. For that purpose we need all the books and instruments having to do with it, especially now when, at the request of the mathematicians of Peking, we are thinking of translating these books into Chinese. In like manner a couple of excellent scientists are necessary in order that we avoid falling into some error that could discredit us."[15]

Not only from Peking, the capital of China, but also from Macao, the Portuguese possession, and from Canton, similar letters went to Rome. Already on the 12th of December, 1599, Father Emmanuel Dias *senior* had written to the General Claudius Acquaviva that Father Lazzaro Cattaneo S. J. "and the other Fathers of the mission, had asked for a good mathematician."[16] And on the 25th of January, 1612, even Father John Rodrigues, called the interpreter or in old romanization *tsu-zu* 通事, wrote from Canton to the General this passage which I translate from the Portuguese: "Both the Fathers in the interior of China, and we who are in Macao, ask Your Paternity very urgently to seek without delay and send to this mission some Fathers who are mathematicians, well versed in this science, so that it may not happen to us to err in this point, which God may not permit."[17]

Towards the end of 1612 Father Nicholas Longobardo decided

14) Cf. TV, II, pp. 490-491.
15) Cf. ARSI, *Jap. Sin.*, 113, f. 267*r*.
16) Cf. ARSI, *Jap. Sin.*, 13, f. 358*v*.
17) Cf. ARSI, *Jap. Sin.*, 15, f. 99*v*.

to send a young Belgian missionary, Nicholas Trigault, to Rome to expose to the General and to the Pope the needs of the incipient mission. Among other things he should obtain from Christian princes of Europe a present of a large and rich scientific library, and from the General two of the most illustrious mathematicians whom the Society then had, to devote themselves to astronomy in Peking.[18]

As to the library Paul V showed himself particularly generous; he made a present of 500 thick volumes on various subjects. These were soon joined by others, bought or received as homage from the princes, the authors, or from the publishers of the main publishing houses of the time in the book centers of Rome, Lyons, Munich, Cologne, Frankfurt, etc. Various Chinese sources of the years 1620–1630 give as high a number as 7,000 volumes, besides the duplicates, for this original stock of the Jesuits' library in Peking. This number does, however, offer some difficulty. Shortly before the coming of the Communists in Peking, of these presents of Paul V, 534 works bound in 457 volumes were still preserved; 302 of them still showed on one of the two covers the gilded coat of arms of Paul V, the tiara and the keys of St. Peter, with or without the coat of arms of the Borghese family to which the Pope belonged, and on the other cover the three letters JHS, the emblem of the Society of Jesus, just as these books had come out of the bindery of the book firm Horace Cardon in Lyons.[19]

As to the "two mathematicians", several Jesuits already famous in the field of sciences offered themselves to be sent to China. Let us mention here especially Grégoire de Saint Vincent whose name will remain famous in the history of geometry, in particular with regard to conic sections and differential calculus; Christopher Scheiner who afterwards was to have a painful controversy with Galileo Galilei on solar spots; and John Cysat whose name is connected with the discovery of the nebula of Orion. None of these however was accepted. But when Trigault departed

18) Cf. ARSI. *Jap. Sin.*, 113, f. 303.

19) Cf. my article *La reprise des Missions Catholiques en Chine à la fin des Ming*, in *Cahiers d'Histoire Mondiale*, V.

from Lisbon, on the 16th of April, 1618, he took with him not only the beginning library of Peking, but also 22 missionaries among whom several were very good mathematicians. Outstanding among them were Giacomo Rho from Milan[20] and Johann Adam Schall von Bell born in the German city of Cologne.[21] Rho arrived in Macao in 1619, Schall in 1621, and both arrived in Peking shortly afterwards. They brought with them what seems to have been the first telescope to reach China, a present of the Cardinal Federigo Borromeo of Milan.[22]

They arrived at the capital of China just at the right moment. After a first project to make use of the Jesuits for the astronomical labors which China needed had been aired in 1611 soon after the death of Ricci, the matter was taken up once more in 1629. On the 21st of June of that year a solar eclipse was to take place. This served as a general test for the three competing astronomies then represented in Peking, the Chinese astronomy, the Mohammedan astronomy, as we have heard from Ricci, and now also the European astronomy of which the Jesuits were the official representatives. All were requested to put in writing in advance the forecast of the great event. The traditional astronomers predicted that the eclipse would last two hours from 10:30 to 12:30. Instead the eclipse occurred at 11:30 and lasted only two minutes, exactly as the Jesuits had predicted. There was great excitement in the responsible circles of the capital. Two days later the Privy Council of the Emperor, or the Grand Secretariat 內閣, something like our Cabinet-Council, presented to the Sovereign a report which was very unfavorable to the astronomy of the old China but lavish in its praise of the European astronomy which was designated by the name of "New Astronomy". The result, which could easily be foreseen, was that on the 11th of September,

20) On him cf. L. Pfister, *Notices biographiques et bibliographiques sur les Jésuites de l'ancienne mission de Chine*, Shanghai, 1932-1934, pp. 188-191.

21) Cf. Alfons Väth S.J., *Johann Adam Schall von Bell, S.J.*, Köln, 1933.

22) Cf. Pasquale M. D'Elia S.I., *Galileo in Cina*, Roma, 1947, p. 39. I have made several important additions to this book for the English translation which is soon to be published by Havard University Press. The translation is by Dr. Rufus O. Suter Jr. of Washington.

the monarch entrusted two very good Christians, disciples and friends of Ricci, the Doctor Paul Hsü Kuang-ch'i (1562–1633) and the Doctor Leo Li Chih-tsao (1565–1630), with the proposed reform of the Chinese calendar. They immediately requested the collaboration of the Jesuit missionaries. These were at first the Swiss Johann Schreck, Latinized as Terrentius, and the Sicilian Nicholas Longobardo. But the latter was already in his sixties and could no longer devote himself to these tasks, and the first died a few months later.

* * *

Their place was taken by two men who are outstanding in the history of the Occidental sciences in China, Giacomo Rho and Johann Schall, whom we have already met above. Assisted by a dozen good Chinese literati, they published within a space of seven years a collection of about 150 small Chinese volumes on mathematics, according to the Occidental science, and prepared the correction of the calendar of which the first copy was presented by them to the emperor on the 28th of February, 1634. During the same period they compiled a calendar which showed the movements and positions of the planets for every day of the year, and a grandiose planisphere of the stars, which is precisely the subject of the present article.

It seems that this planisphere of the stars has never been studied thoroughly by Sinologists nor consequently by astronomers. It is possible that the idea for it came to Schall from a somewhat similar work of his old teacher of mathematics, Father Christopher Grienberger, at the Collegio Romano, 1610–1615.[23]

23) In the old library of the Jesuits of Peking this book of Grienberger is still preserved: *Catalogus veteres affixarum longitudines ac latitudines conferens cum novis, imaginum caelestium Prospectiva duplex.* Altera rara ex polis mundi, in duobus haemisphaeriis aequinoctialibus per tabulas ascensionum rectarum et declinationum. Altera nova ex mundi centro in diversis planis globum caelestem tangentibus, per tabulas particulares. Utraque caelo et accuratioribus Tychonis observationibus quam simillima. Romae 1612. Cf. *Catalogue de la Bibliothèque du Pé-t'ang*, Pékin, 1949, N. 1757.

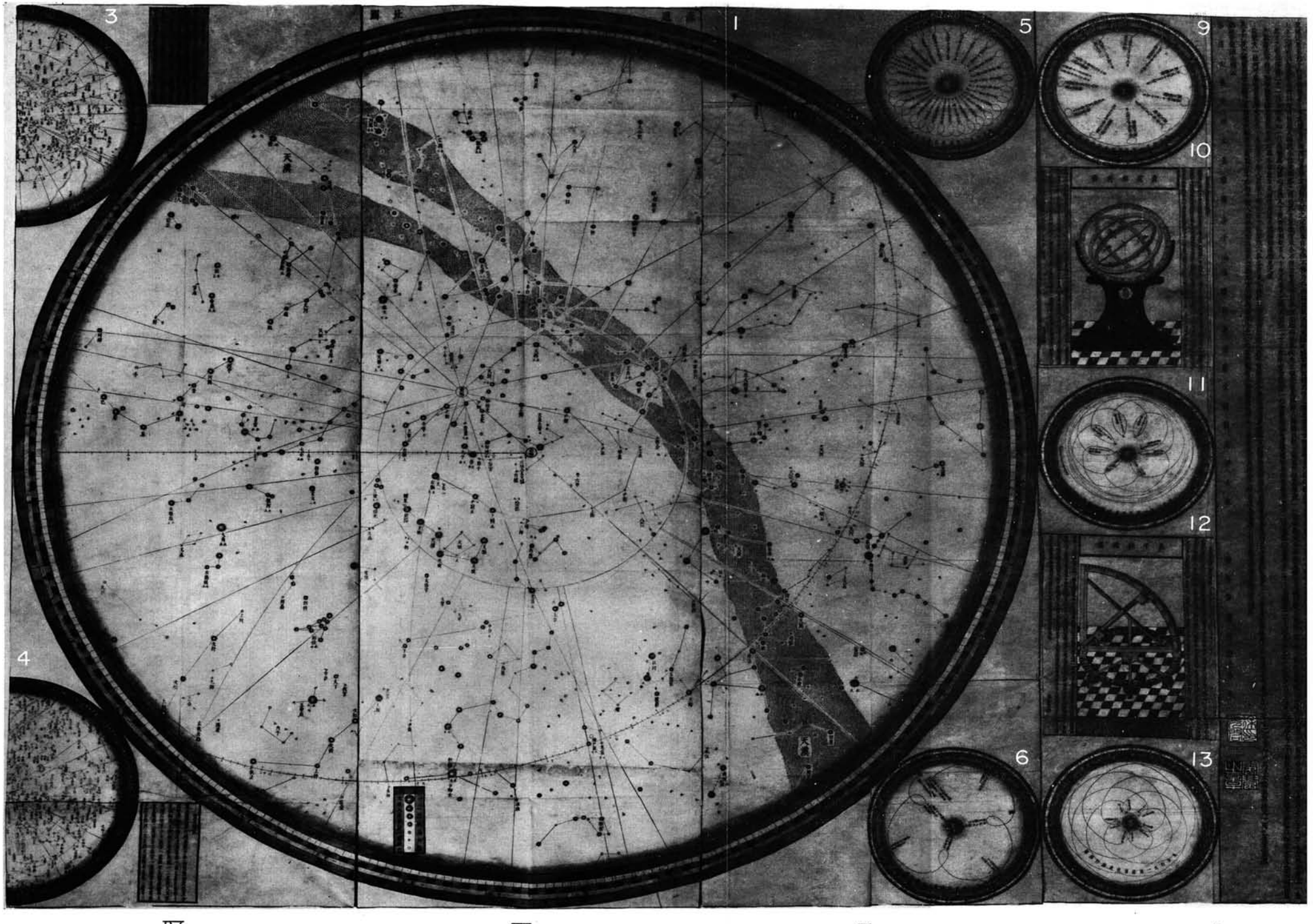

Plate I. Right half of *ms. Barberini, Orient. 149* in the Vatican Library
General Map of the Stars North of the Equator by Johann Schall von Bell S. J.

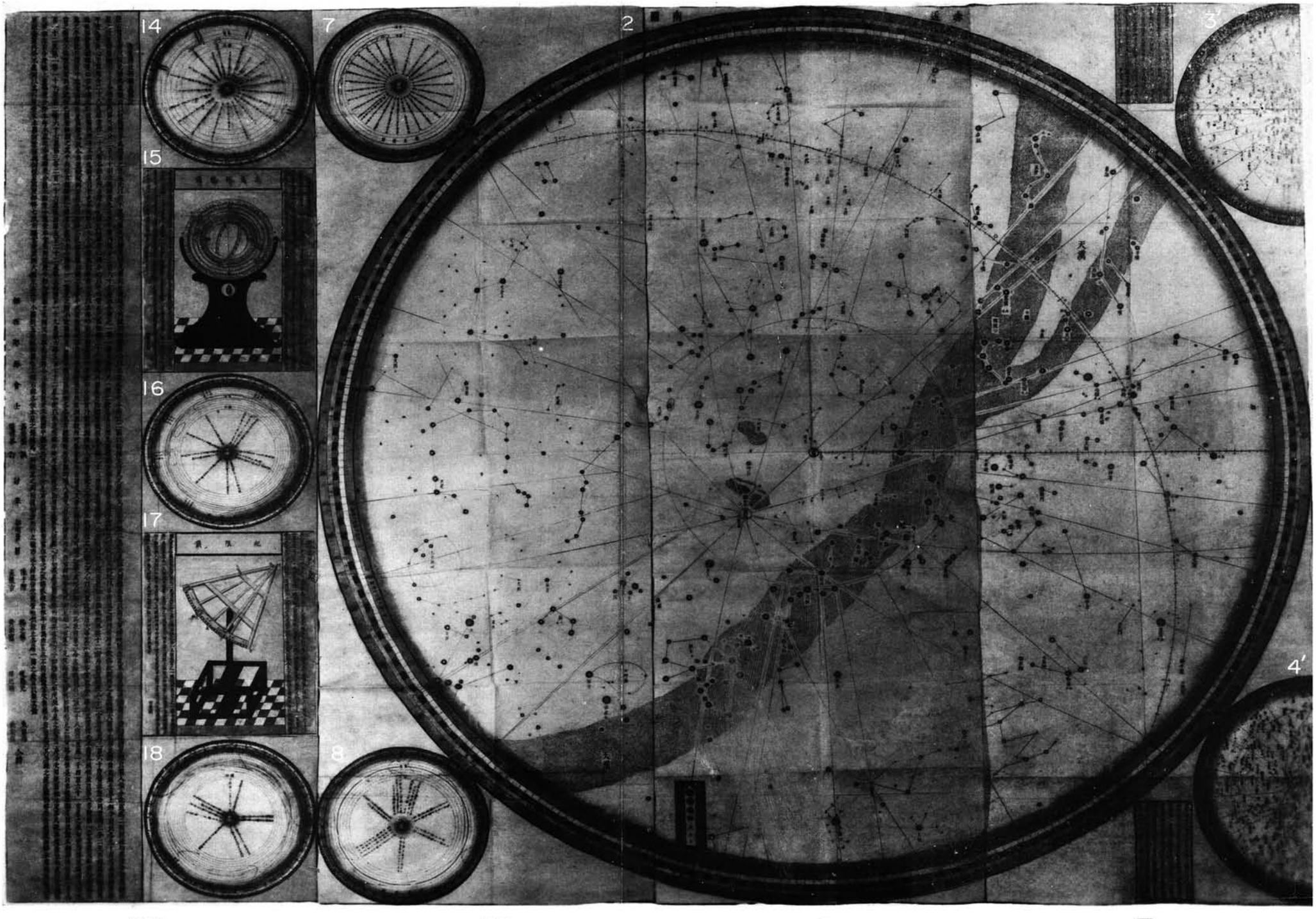

Plate II. Left half of *ms. Barberini, Orient. 149* in the Vatican Library
General Map of the Stars South of the Equator by Johann Schall von Bell S. J.

The work of Schall is a large Map of the stars in eight sections.[24] Each section is 1.685 m. high and 0.64 m. wide, including the margin, and when the eight sections are put together side by side the whole Map measures 1.685 m. × 4.46 m. The Vatican Library possesses two copies of this work of Schall. One has for years been mounted and framed and is now in the catalogue room near the window in the back; it is somewhat worn and has several unreadable characters as it has long been exposed to the air and the light; it is on ordinary Chinese paper. The other (*ms. Barberini, Orient. 149*), is not mounted and framed and hence is well preserved because it has always been folded. It is this copy which we describe here.

The planisphere is expressly presented as an edition for the Grand Secretariat 內閣藏板 of the emperor. This explains why it is colored and why it looks very fine.

The work of Schall does not bear a general title; but the real title can be discovered both in the preface on section I and in the explanation on section VIII. This is: *Two General Maps of the Stars South and North of the Equator* 赤道南北兩總星圖. We have here, then, two large hemispheres in orthographic projection showing the stars seen above and below the equinoctial

24) It would seem that Pfister, *op. cit.*, p. 180, n. 26, knows of Schall a "planisphère céleste de quatre grandes feuilles." As a matter of fact however he has never seen the work of which we treat here and was satisfied to copy its title from Klaproth, mistaking, however, *tsung* 總 *general*, for *tung* 動 *movable*. He refers to Klaproth, *Verzeichnis*, p. 183, a title which he does not explain either here or in the bibliography at the end of the volume. Perhaps he intended to refer to the *Catalogue des livres composant la bibliothèque de feu M. Klaproth, Deuxième Partie*, where on p. (39), n. 147 one reads: *Tchy tao nan pe liang tsoung sing thou, Carte des astres des deux lignes équinoxiales, méridionale et septentrionale.* But here, contrary to what we would have expected, nothing is said of the number of sections, four or eight. Instead, having listed also the "*Kouen In Thou.* Planisphère terrestre, 2 feuilles in plano," the author of the catalogue wrongly attributes the above work to Verbiest. "On a mal à propos attribué le premier de ces deux planisphères au P. Schall; l'un et l'autre sont du P. Verbiest, qui, sous le nom chinois de Nam hoai jiin succéda au P. Schall dans la charge de Président du tribunal des mathématiques et les composa vers l'an 1672 par les ordres et pour l'instruction de l'empereur Khang hi." The Double Hemisphere of the Stars of which we speak here is, however, certainly dated 1634, when Verbiest was only a boy of some ten years.

circle. The hemispheres are 1.58 m. in diameter and are surrounded by a border of 6 cm. The northern hemisphere with the north pole as its center occupies sections II-IV, and the southern hemisphere with the south pole as center, occupies sections V-VII. The sections number in Chinese style from right to left instead of from left to right.

It was not the first time that a publication of this kind had been made. Some time earlier Hsü Kuang-ch'i, in his capacity as Director of the Calendar Reform, had published a *General Map of the visible stars* 見界總星圖, a *Map of the stars twenty minutes from the ecliptic* 黃道二十分星圖, and *Two General Hemispheres of the stars at the equator* 赤道兩總星圖. But these Maps were very small, as one can easily see from a copy of the first and two copies of the last preserved in the Vatican Library (*ms. Barberini, Orient. 151 c.d.e.*). The first is a simple Chinese sheet of 0.64 m. × 1.28 m., margin included, and the last a sheet of 0.33 m. × 1.28 m. The map of the first has an internal diameter of 54 cm. and an external of 57 cm., while the hemispheres of the last have internal diameters of 22 cm. and external diameters of 29 cm. The inscriptions which accompany the Maps of both are signed by "the Jesuit from the Far West, Johann Schall" 遠西耶穌會湯若望. Given the small space available on these Maps it was evident that they could not represent the true aspect of the heavens with sufficient clarity. Hence the necessity to make something much larger, as is precisely done in the planisphere of which we are speaking.

* * *

Let us briefly describe this Stellar Map of Schall. In the center there are two large hemispheres of the stars: the *Northern Hemisphere* 赤道北圖 (Fig. 1) and the *Southern Hemisphere* 赤道南圖 (Fig. 2). Between the large hemispheres there are above and below two other much smaller hemispheres with an external diameter of 43 cm., half on the IVth and half on the Vth section. The one on top represents the *Map of the equator* 赤道圖 (Fig. 3). At right and left the Map is explained according to the ancients by Schall. The small hemisphere at the bottom

represents the *Map of the ecliptic* 黃道圖 (Fig. 4). The explanation to it on both sides is by one of the highest officials of the Bureau of Astronomy, hence one of the most intimate collaborators of Schall, a certain Wu Ming-chu 鄔明著, whose name occurs also elsewhere.[25]

At the four corners of the planisphere there are four small hemispheres, of 29 cm. diameter, at the top and bottom of the IInd and VIIth sections. At the top of the second section is the *Map of the oppositions and conjunctions of Saturn in one revolution of the planet around the sun* 塡星行天一周遲留伏逆諸行經圖 (Fig. 5) and at the bottom the *Map of the oppositions and conjunctions of Mercury in* [*three*] *revolutions of the planet around the sun* 辰星行天一周遲留伏逆諸行經圖 (Fig. 6). Parallel to these two small hemispheres are the *Map* [*of the variations*] *in latitude of Saturn* 塡星緯圖 (Fig. 7) and the *Map* [*of the variations*] *in latitude of Mercury* 辰星緯圖 (Fig. 8) at the top and bottom of the VIIth section.

The six sections II-VII which contain the two large hemispheres and the six small Maps which we have just described are framed by the two other sections, the Ist and the VIIIth, which correspond to each other.

On the Ist section are five figures of which, from top to bottom, the 1st, 3rd and 5th represent the oppositions and conjunctions of three other planets, while the 2nd and 4th represent astronomical instruments. These figures are from top to bottom:

Map of the oppositions and conjunctions of Jupiter in one revolution of the planet around the sun 歲星行天一周遲留伏逆諸行經圖 (Fig. 9);

Theodolite of the ecliptic 黃道經緯儀 with an explanation by Schall (Fig. 10);

Map of the oppositions and conjunctions of Mars in [*seven*] *revolutions of the planet around the sun* 榮惑行天一周遲留伏逆諸行經圖 (Fig. 11);

25) Cf. *Monumenta Serica*, Peking, 1937-1938, III, p. 508, n. 26.

The azimuthal instrument 地平經緯儀 with an explanation by Schall (Fig. 12);

Map of the oppositions and conjunctions of Venus in [*five*] *revolutions of the planet around the sun* 太白行天一周遲留伏逆諸行經圖 (Fig. 13).

Similarly on the VIIIth section there are five figures parallel to these, of which, from top to bottom, the 1st, 3rd, and 5th represent the variations in latitude of the three planets of which the oppositions and conjunctions were given above, while the 2nd and 4th represent two other astronomical instruments. These figures are from top to bottom:

Map of [*the variations*] *in latitude of Jupiter* 歲星緯圖 (Fig. 14);

Theodolite of the equator 赤道經緯儀, with an explanation by Wu Ming-chu (Fig. 15);

Map of [*the variations*] *in latitude of Mars* 榮惑緯圖 (Fig. 16);

The sextant 紀限儀, with explanation by Wu Ming-chu 鄔明著 (Fig. 17);

Map of [*the variations*] *in latitude of Venus* 太白緯圖 (Fig. 18).

In addition there are two long legends at the beginning of the Ist and at the end of the VIIIth sections. They are, respectively, the presentation of the work to the throne made by Hsü Kuang-ch'i, and the explanation of it made by Schall and approved by Rho who was the reviser. Contrary to custom, neither of these legends bears any date. Nevertheless the planisphere of stars can be dated with sufficient accuracy. The Preface cannot be later than the 8th of November, 1633, the date of the death of Hsü Kuang-ch'i,[26] nor earlier than the seventh lunar month of that year, August 5 to September 3, the date when Hsü received some of the titles with which he decorates himself at

26) Not the 10th, as is mistakenly said in *FR*, II, p. 251, n. *b*.

the end of the preface.[27] The Preface must, therefore, go back to September-October, 1633 — rather September than October.

The printing of the Map was finished towards the end of July, 1634. If we suppose that the printing was begun around the time when the preface was written, i.e. about September, 1633, it required the biggest part of a year. This is not surprising if we consider the large dimension of the Map which had to be carved from wood blocks. In the unpublished correspondence of Schall there is a letter from him to the Assistant of the General for the Affairs of Germany, Father Theodore de Buzu S. J., dated September 1st, 1634, in which the missionary-astronomer says that about a month before he had presented to the emperor *duo planisphaeria stellata ingentis magnitudinis* (two stellar planispheres of vast size). He had taken care to have them glued on light sheets of wood which could be folded one on the other like screens and could be easily transported from one place to another. The work was on silk and the stars were gilded. It seemed that the emperor had received the Map with much favor because, contrary to his habit, he had kept it for a long time in his private apartments. In order to give to the Assistant a concrete idea of his work, and to have him show it to the European astronomers, Schall sent him two copies of it by different routes. They were printed on paper and a little colored. On one of them Schall had translated the names of the principal stars, which would facilitate to the European astronomers the identification of all the others.[28]

27) The chronological life of Hsü Kuang-ch'i tells us that "in the seventh lunar month of the year 1633 he was raised to the dignity of Preceptor of the Heir Apparent, Minister of Rites and Grand Secretary of the Wen-yüan ko" 癸酉七月陞太子太保, 禮部尚書, 兼文淵閣大學士 (*Revised and enlarged collection of the Works of Hsü Kuang-ch'i* 增訂徐文定公集, 上首卷, pp. 6-7). See also below n. 62.

28) "Ante mensem plus minusve, una cum aliquot libris quos regi obtulimus, praesentavi duo planisphaeria stellata ingentis magnitudinis, quae in serico impressa, deauratis stellis, curavi agglutinari cratibus e levi ligno fabrefactis plicatilibus more sinensi, ita ut facile hinc inde trasferri et exponi possint, relictis superne ac infra marginibus, qui pulchre exornati gratissime totam machinam (ipsi *guey pim* [圍屏] vocant) conspectui ingerebant. Haec rex, diutius quam solet alia, detinuit in conclavi, certo argumento ea sibi placuisse.— Ut vero videat plus minusve quid rei fuerit, eadem planisphaeria in papyro impressa et coloribus aliquantulum obumbrata duabus viis mitto ad Reverentiam Vestram, adscriptis alicubi, nostris nominibus ad insigniores stellas, ut ex iis aliae omnes facile dignosci queant; si Reverentia Vestra ea ostenderit astronomiae peritis, multum mihi gratulabor...Rogo Reverentiam Vestram ut significet si haec mea cum planisphaeriis pervenerunt" (ARSI, *Jap. Sin.*, 142, 2, ff. 1*v*, 6*r*).

There can be no doubt that the planisphere we are describing is the one of these two copies which did not contain the translation of the stars. It seems that the other one, which cannot be found in Jesuit archives and cannot be identified with the Map of the Vaticana in the catalogue room, must have been lost on the way. In any case it seems beyond any doubt that while the Preface must have been composed and signed in September, 1633, the Map was published in Peking at the beginning of the second half of the following year, 1634.

* * *

The Preface of Hsü Kuang-ch'i, though printed on this Map, appears never to have been published otherwise, since it is not even known to the compilers of the *Revised and enlarged collection of the works of Hsü Kuang-ch'i* 增訂徐文定公集, and has never been translated in any Western language. The Preface is what we would expect of a Catholic literatus of the first decades of the XVIIth century. Hsü Kuang-ch'i, as a good Chinese, goes back as far as possible in the history of China in order to find there what the Chinese had done in the preceding centuries and since the earliest antiquity in the field of the calendar in general and in the field of cartography and of the study of the stars in particular. As can be seen from the prefaces and epilogues accompanying Chinese works of European missionaries of this time, the danger that some fellow-countryman might accuse the Chinese Catholics of having shamefully gone to school to a Westerner, i. e., a more or less unwelcome foreigner, thus obscuring the glories of his own country, was always present and had to be avoided at all cost, by showing the reader that for a long time more or less the same had been done in China. This is the reason why Hsü Kuang-ch'i goes back to the most ancient calendars, even to the slightest traces of the reckoning of time, to the oldest maps, and to all those who in one way or other had devoted themselves in the Middle Kingdom to the study of the stars. The final part of the Preface points out that these studies will greatly help the emperor and his officials in the government of the country. Here, then, is the text and the translation of Hsü Kuang-ch'i:

1 赤道南北兩總星圖敍

2 道有理數所不能祕者匪言弗宣有語言所不能詳者匪圖弗顯昔人云爻象敍疇之辭煩而河洛圖書之理晦圖之重於天下久矣堯典璇中星之說所云平秩作訛以授時而秩事夏有少正周有時訓秦漢已下及唐宋皆有月令詩詠定中春秋傳啓蟄而郊龍見而

1 PREFACE TO THE TWO GENERAL MAPS OF THE STARS SOUTH AND NORTH OF THE EQUATOR

2 In the Way[29] there are things which cannot be entirely covered by abstractions; they can be made thoroughly known only by words; and there are things which cannot be adequately explained in words; they can be made clear only by designs. The ancients said: The words on the lines and definitions of the hexagrams[30] and on the "orders and divisions"[31] are tiresome, while the diagrams of the *Map of the Yellow River*[32] and of the *Book of the Lo River*[33] are obscure.[34] This shows that in China maps have long been considered very important.

The *Canon of Yao* first propounds the theory of the middle stars;[35] it speaks of "disposing conveniently the labors and trans-

29) In truth, in reality.

30) See *I-ching* 易經, Hsi-tz'u shang 繫辭上; Legge, *Yi King* (in *Sacred Books of the East*, Oxford, 1899), p. 408 sq.

31) *Shu-ching* 書經, Ch. "The Great Plan" 洪範; in Legge, III, pp. 320 and 323.

32) *The Map of the Yellow River* 河圖 is the design which a horse-dragon coming out of the Yellow River is said to have borne on its back, and which is said to have suggested to Fu Hsi 伏羲 the idea of the eight trigrams 八卦. Cf. Zottoli II, Tabula V, and *Shu-ching* 書經 IV, 22/19.

33) Heaven is said to have made come forth from the Lo River a turtle which bore on its back another mysterious drawing, *The Map of Loyang* 洛圖, which would have given to Yü the Great 大禹 the idea of the "Great Plan" 洪範. Cf. Zottoli II, Tabula V, and *Shu-ching* IV, 4/3.

34) Both words and diagrams, or pictorial representations, are needed; they are mutually supplementary.

35) The middle stars are the stars, or rather constellations, which are in the middle of the sky, or culminate on the equinoxes and on the longest and shortest day. See Legge, III, p. 19 sq.

formations."[36] For the purpose of ordering activities by communicating the times (of the year),[37] the Hsia had the *hsiao-cheng* calendar,[38] the Chou had the *Seasonal Instructions,*[39] from the Ch'in and Han down to the T'ang and Sung, all (dynasties) had the *Monthly Regulations.*[40] The *Book of Odes* sings of (the constellation) *Ting* being in the center;[41] the *Commentary of Tso to the Spring and Autumn Annals* says: at the season of the "emergence of insects from their burrows" the border sacrifice

36) The author of this Preface goes back to the first Chinese calendar which may be of the end of the 3rd millennium B.C. I have given an Italian translation of it in my book *Galileo in Cina*, Rome, 1947, p. 75, n. 1. "Labors and transformations" stands for "the labors of the east" 東作 i.e., of spring, and "the transformations of the south" 南訛, i.e., of summer; and the two seasons, resp. the labors of them, stand for all four seasons, resp. their labors, which include also "the completing labors of the west" 西成, i.e., of autumn, and "the changes of the north" 朔易, i.e., of winter. See *Shu-ching* I, 1/4, 5; Legge, pp. 19-21.

37) Here the author puts together the text of *Shu-ching* I, 1/3 敬授人時 meaning "to confer or communicate accurately the seasons for the labors of men" and the commentary to it where it is noted that 人時 means 民事, i.e., the labors in the fields. Cf. Couvreur, *Chou King*, p. 3.

38) This is an allusion to the "small beginning or calendar of the Hsia" 夏小正 (少 stands for 小) of which Ssu-ma Ch'ien speaks at the end of Ch. 2 of the *Shih-chi* 史記 (cf. Chavannes, *Les Mémoires Historiques de Se-ma Ts'ien*, I, p. 171). This calendar has been preserved in the *Rites of the elder Tai* 大戴禮記. It has been translated into English by Mr. Douglas, and into French by Biot in *Journal Asiatique*, 1840, pp. 551-556. Wylie writes on it: "One of the most interesting sections in it [=the *Rites of Tai*] is the *Calendar of the Hsia dynasty*, which, if genuine, and the probabilities are strongly in its favour, presents us with an astronomical document 2,000 years older than the Christian era." (*Notes on Chinese Literature*, p. 6).

39) The "Seasonal Instructions" 時訓 is a chapter in the *I Chou-shu* 逸周書 (*Ssu-pu pei-yao* ed., *ch.* 6, f. 2). The preface at the end of the work (*Chou-shu hsü* 周書序 *ibid., ch.* 10, f. 5*r*) ascribes this chapter as well as the preceding one, titled *Chou-yüeh* 周月 (the "Months of the Chou") to the Duke of Chou; it says: "The Duke of Chou established the correct meaning of the beginning of the year under the three successive dynasties [the Hsia 夏, Shang 商, and Chou 周] and composed the 'Months of the Chou'; he characterized the coming of the 24 solar periods of the year in order to elucidate the seasons and composed the 'Seasonal Instructions.'" 周公正三統之義作周月; 辨二十四氣之應以明天時作時訓.

40) The "Monthly Regulations" 月令 form Ch. 4 of Book I of the *Memoirs on the Rites* 禮記. Cf. Couvreur, *Li Ki*, I, pp. 330-410.

41) *Shih-ching* 詩經, Part I, Bk. IV, Ode VI; Legge, IV, p. 81.

3 雰又云凡馬日中而出日中而入蓋人君出政視星施行人臣// 宜
4 猷戴星出入乘時急民用之前其關於世道人心非細故也我// 太
祖高皇帝專設靈臺郎辯日月星辰躔次及論曆法曰惟以七政行

to Heaven was offered; at the season of the "appearance of the dragon" the sacrifice for rain was performed,"[42] etc. It says further: Ordinarily the horses were led out of their stables at the (vernal) equinox, and brought back at the (autumnal) equinox.[43] For in fact the ruler operated the government according
3 to the stars, and his helpers // rendering their meritorious services came and went with the stars overhead; using the (proper) times they zealously advanced the needs of the people,[44] convinced that the matter concerned not a little public conditions and morals.
4 // The august founder of our dynasty[45] instituted special Directors of the Observatory who should distinguish the orbits of the sun, the moon, the stars and the zodiacal spaces.[46]

42) *Tso-chuan* 左傳, Duke Huan 桓公 5; Legge, V, p. 46. According to Legge, the period of *ch'i-chih* 啓蟄, or awakening of the insects, corresponded to the first month in the year of the Hsia, and to the third in the year of the Chou; and *lung-hsien* 龍見, or appearance of the dragon, to the fourth month of the Hsia and to the sixth of the Chou. Two more seasons and sacrifices are enumerated.—The *Monthly Regulations* 月令 say that in the second month of spring 仲春, which corresponds to the second lunar month, hence for us to March, "day and night are equally divided [=equinox]. The thunder makes itself heard, and it begins to lighten. The hibernating insects all begin to move; they open the outlets of their hiding places and begin to come out" 蟄蟲咸動, 啓戶始出. Cf. Couvreur, *Li Ki* I, p. 342. Indeed a Chinese festival, corresponding to March 5, is called "awakening of the insects" 啓蟄 or 驚蟄; it marks the time when the insects reawake from hibernation.

43) *Tso-chuan*, Duke Chuang 莊公 29; Legge, V, p. 116; Couvreur, *Tch'oen Ts'iou et Tso Tchoan* (1914), I, p. 199. The *Tso-chuan* observes that the reason why the *Ch'un-ch'iu* records that the Duke "in spring repaired his stables" is that labors of this kind were usually not undertaken at this time of the year but rather when the horses were not in the stable, i.e., between the vernal and autumnal equinoxes.

44) Allusion to *I-ching*, Hsi-tz'u shang 繫辭上:是興神物以前民用; Legge, *Yi King*, p. 372: "(The sages) instituted (the employment) of these spirit-like things, as a provision for the use of the people."

45) The *Hung-wu* 洪武 emperor (1368-1397).

46) According to the *Chih-kuan chih* 職官志 (*Treatise on officials*) in the *Ming-shih* 明史, *ch.* 75, there were two Directors of Observatories 靈臺郎. When the Bureau of Astronomy was reorganized in the sixth month of *Hung-wu* 3 (1370) the Directors of the Observatory were to "distinguish the fields occupied by the sun, the moon, the stars, and the zodiacal constellations for the purpose of prognostication. The *Pao-chang cheng* 保章正 was specially charged with recording the changes in the lines of heaven, and with distinguishing good and evil omens." See Ku Ying-t'ai 谷應泰, *The Ming History in topical form* 明史紀事本末 *ch.* 73, 修明曆法. The particulars of the imperial decree from which this quotation was taken are not in the *Ming shih-lu* 明實錄. In the same decree one might possibly find the words of the emperor about the making of the calendar which are quoted next by Hsü Kuang-ch'i.

度無差爲是// 聖神欽若至意千秋若揭惟是古來爲圖甚多而深
切著明者蓋鮮夫星之定位原自分秒不移乃於經緯度數溷而莫
辯按圖者將何據焉昔之論星者有甘德郭璞宋均郭守敬諸賢皆

Speaking of (the making of) the calendar he said: In the Seven Rulers[47] following their courses without fail, (you) ought to see something // divine and spirit-like; hence reverently direct your mind to the thousand years and announce them.

But though very many Maps have been made from antiquity, few were those which were precise and clear. Though the position of the stars does by nature not change even one minute or second — when the degrees of longitude and latitude are confused and not distinct on what shall those who consult the Maps rely?

Those who in ancient times treated of the stars, such as the learned Kan Te,[48] Kuo P'o,[49] Sung Chün,[50] and Kuo Shou-ching,[51]

47) The "Seven Rulers" are the moon, the sun, and the five planets. Cf. *Shu-ching* II, 2/5; Legge, III, p. 33.

48) A *Catalogue of Stars* 星經 is attributed by tradition to Kan Te 甘德 and to Shih Shen 石申, men who lived in the IV-III centuries B.C. The version which has come down to us has been revised during the T'ang dynasty (618-907). Of this work Wylie says: "The figures of the several constellations visible from the latitude of China are given, with a short description, and astrological notes to each" (*Notes on Chinese Literature*, p. 116). Cf. Wieger, *La Chine à travers les âges*, Sienhsien, 1920, p. 519.

49) This personage who lived from 276 to 324 is a Taoist astrologer who is said to have given origin to geomancy 風水. Of him Giles writes: "In his youth he is said to have received from one Kuo Kung 郭公 a black bag, containing a treatise from which he learnt natural philosophy, astronomy and divination." (*A Chinese Biographical Dictionary*, London, 1898, N. 1069, pp. 408-409). Cf. O. Franke, *Geschichte des Chinesischen Reiches*, Berlin-Leipzig, 1936, II, pp. 283-285; C. Pétillon, *Allusions Littéraires*, pp. 533-534.

50) On Sung Chün 宋均, a high functionary of the Later Han dynasty (died A.D. 76), see Giles, *A Chinese Biographical Dictionary*, No. 1831, p. 700; Wieger, *La Chine à travers les âges*, p. 389. The *Combined Indices to twenty historical bibliographies* (No. 10 of Harvard Yenching Institute, Sinological Index Series) III, p. 44, list 21 works which have been transmitted under the name of Sung Chün, among them one entitled *Yao-jui hsing t'u* 妖瑞星圖 (Map of ill and lucky stars), 1 *chüan*, which is mentioned in the *I-wen chih* 藝文志 of the *Sung-shih* 宋史 (*ch.* 206; K'ai-ming ed., 4998.3). Strangely enough the biography of Sung Chün in the *Hou-Han shu* 後漢書 (*ch.* 71; K'ai-ming ed., 0790.1-2) is silent about any literary activity of Sung. Chinese critics have noted that Sung Chün was frequently confused with Sung Chung 宋衷 (also written 宋忠) who lived at the end of the Later Han dynasty and was one of the collaborators of Liu Piao 劉表 in the compilation of the *Wu-ching chang-chü* 五經章句; see *Hou-Han shu*, *ch.* 104 (K'ai-ming ed., 0866. 4). Indeed several of the titles of works attributed to Sung Chün are also ascribed to Sung Chung; see *Combined Indices to twenty historical bibliographies* III, pp. 40-41.

51) Cf. above n. 2.

亦青藍之互出今予獨依西儒湯先生法爲圖四種一曰見界總星
圖一曰赤道兩總星圖一曰黃道兩總星圖一曰黃道二十分星圖
6 業已進// 上公之海寓似無遺義茲所刻則因前圖尺幅狹小位次
聯絡之間恐於天象微有未合不便省覽復督同事諸生鄔明著輩
從先生指授製爲屏障八面繪以兩大圖就中每星每座一一依表
點定分布旣寬體質自顯則斜正疎密之界殆和盤托出矣故以赤
道爲界圖各一周外分三百六十度內分三百六十五度四分度之

were like azure and blue which surpass each other in turns.[52] Now making exclusively use of the method of the Western scholar Mr. Schall, I have drawn four Maps:

A General Map of the visible stars;
Two General Maps of the stars at the equator;
Two General Maps of the stars at the ecliptic;
A Map of the stars twenty minutes from the ecliptic.

6 All these Maps have already been presented to // the emperor, and when they were published to the empire there seemed to be no further criticism.

The reason why I now print [this Map] is that, as the size of the preceding Maps was very small, some of the positions and combinations might slightly differ from the [real] skyscape, and the Maps might, therefore, not be convenient for consultation. I therefore again urged my colleagues Mr. Wu Ming-chu etc., to make, according to the instructions of the (same) gentleman (Mr. Schall), eight screens on which two large Maps are drawn in which every star and every constellation has been fixed in conformity with the catalogue [of stars]. Since [the stars] are [here] distributed on a wider space, their structure naturally stands out more clearly, and it is completely manifest whether the intervals are inclined or rectangular, close or remote.

Therefore the equator was taken as limit. The perimeters

52) The exact expression would be: The azure issues from the blue but is superior to it 青出於藍而勝於藍. This is said of a disciple who surpasses his master. Cf. Pétillon, *Allusions Littéraires*, p. 533. The original expression is taken from the *Works of Hsün Tzu* 荀子集解, where at the very beginning of *ch.* 1 or 勸學篇, around the year 236 B. C., we read: 君子曰, 學不可以已, 青取之於藍, 而青於藍. The meaning is the same as that of the above sentence. Here the author wants to say that there had been progress in Chinese astronomy.

7 一是// 爲天之經剖渾體二之一以北極爲心一以南極爲心緜心至
邊九十度兩極相距百八十度是爲天之緯其去極二十三度半有
奇復作一心者黃道極也從黃道極出曲線抵界者十二宮也從心
至界分二十八直線者二十八宿各距星所占度分也又各有斜絡
赤道上下廣狹不等疑若白練者則俗所稱雲漢是也南極圖自//
8 見界諸星外尙有極旁隱界諸星舊圖未載此雖各省直未見而從
9 海道至滿剌加國悉見之我// 國家大一統何可廢也因是測定星
若干爲座若干增入星若干增座若干俱等以六各各有黃赤經緯
度各各用崇禎戊辰年實躔度分與他測有經無緯有經緯無隨時

of both Maps are outside divided into 360 degrees, and inside
7 into 365 degrees and a quarter. These // are the longitudes of heaven. They divide the whole firmament into two halves. One of these has as its center the north pole, and the other the south pole. From the center to the circumference there are 90 degrees, and consequently the two poles have a distance of 180 degrees from each other. These are the latitudes of heaven.

At a distance of $23^1/_2$ degrees and a fraction from the pole there is another center, viz. the pole of the ecliptic. The curved lines which go from the pole of the ecliptic to the circumference indicate the twelve spaces of the zodiac. The 28 straight lines which go from the interior to the circumference indicate the degrees occupied by the large stars of the 28 constellations. These stars are also all connected by slanting lines.

Above and below the equator there is a strip which looks like white raw silk, now wider now narrower. This is what is popularly called the Milky Way.

8 In the southern hemisphere // beyond the visible stars there are the stars in the zone of invisibility near the pole. These stars do not figure on the old Maps. But, though they are not directly visible from our various provinces, they are all visible from the coast down to Malacca. These parts belong to the
9 sphere of sovereignty of // our country; how can the stars visible there by excluded?

Because of this reason, we observed a certain number of stars which formed a certain number of constellations and added a certain number of stars and a certain number of constellations.

隨地測候活法者迺別且不直此也圖之上下隙爲黃赤總圖左右
隙爲五緯圖以至分者合之合者分之具有本論總期與天一而已
10 儻是圖塵// 皇上乙夜之觀憬然悟天體之眞洞然晰經緯之道羅
星斗於胸中授人時於指掌爲諸臣者鑒郎官列宿尙書北斗之任

All stars are divided into six classes. Each single star has its degrees of longitude and latitude in relation to the ecliptic and to the equator. For all stars the degrees of their actual orbit in the year 1628 were used. [Hence these Maps] differ notably from those which are provided with circles of longitude but not of latitude or, if they have both, do not possess a method of observation which can be modified according to time and place. And this is not the only difference.

In the spaces above and below [between the hemispheres] there is the *General Map of the ecliptic* and the *General Map of the equator*. In the spaces at right and left there are *Five Maps of the degrees of latitude* which permit reuniting what was separated and separating what was united. [And all these maps] are provided with pertinent explanations. In all, our only objective was to conform with heaven.

10 If this Map "defiles" // the emperor's glance in the second watch at night[53], so that he in amazement becomes aware of the true state of the heavenly bodies, gains a clear insight into the nature of the lines of longitude and latitude, and arranges the stars within his mind, he will be able to announce the seasons to the people just as [easily as] if he pointed to the palm of his hand[54] —; and if the mandarins see reflected in the various constellations, in the five "shang-shu" stars[55] and in the north star (Dipper) the grave functions of the different officials, devote themselves strenuously to their duties, in discharging their office emulate the care with which Mars guards the Dipper, and strive to bring about the happy omen of the Five Planets gathering in the constellation

53) The "second watch" corresponds to the hours 22 and 23 (10 to 11 P.M.).

54) Cf. *Confucian Analects*, Bk. III, Ch. XI; Legge I, 22-23.

55) According to the *Treatise on Astronomy* 天文志, of the *History of the Chin Dynasty* 晉書, five stars in the northern circumpolar group (see below, nn. 63,66) bear the name of "shang-shu" 尙書, stars. Cf. *Tz'u-hai* 辭海 *sub shang-shu*.

之重效職布公時厘熒惑守斗之慮求致五星聚奎之祥而共奏泰
11 階六符於無艾乎則是圖之有裨於//朝廷世道詎小補云//賜進士
12 第光祿大夫柱國太子太保禮部尙書兼文淵閣大學士奉勑督修
曆法 徐光啓題

of K'uei,[56] and are able to report together to the throne that the six omens of the T'ai-chieh (Exalted Terrace)[57] indicate unen-
11 ding happiness — would then the benefit of this Map for // the court and for public morality be only a small contribution?

12 Hsü Kuang-ch'i, Doctor of the First Class, *Kuang-lu ta-fu*[58] and *Chu-kuo*,[59] Grand Guardian of the Heir Apparent,[60] Minister of Rites,[61] Grand Secretary of the Wen-yüan ko,[62] Mandatary of the Emperor for the Reform of the Calendar.

* * *

With this introduction of Hsü Kuang-ch'i on the first section tallies the explanation of Schall on the eighth section. The text and the translation of it, run as follows:

56) The *P'ei-wen yün-fu* 佩文韻府 (*sub* 聚奎) quotes two instances of this phenomenon from the *Sung-shih* 宋史. In one quotation it is said that the phenomenon was followed by "great peace in the empire" 天下自此太平.

57) *T'ai-chieh* 泰階 is identical with *san-t'ai* 三臺, the "Three Terraces," six stars which are a part of Ursa Major; see Mayers, p. 322. Their various combinations and colors were considered as so many omens; among them were six lucky ones, the *liu-fu* 六符. The *treatise on literature* (*I-wen chih* 藝文志) of the *Han-shu* 漢書 lists already a work *T'ai-chieh liu-fu* 泰階六符.

58) *Kuang-lu ta-fu* 光祿大夫 was under the Ming the honorary title (封贈) conferred on civilian functionaries of the first rank, second class (從一品); see *Ming hui-tien* 明會典 (Wan-yu wen-k'u 萬有文庫 ed.), *ch.* 6, p. 134. The higher degrees of these honorary titles could be conferred only by special imperial decree; *ibid.*

59) *Chu-kuo* 柱國 ("pillar of the State") was under the Ming the title for meritorious service (勳級) conferred upon functionaries of the first rank, second class; it was second only to the titles of *tso* 左 *chu-kuo* and *yu* 右 *chu-kuo* conferred upon functionaries of the first rank, first class; see *Ming hui-tien*, *ch.* 10, p. 255.

60) "Grand Guardian of the Heir Apparent" was the third highest of six titular "Ministers to the Heir Apparent." The set of titles paralleled that of the Grand Preceptor, etc., to the emperor, titles corresponding to the titles of the six highest Ministers of State of antiquity. See Mayers, *The Chinese Government* (1878), p. 14, Nos. 137–142. All these titles were merely honorary.

61) Also a merely nominal title.

62) The members of the Grand Secretariat were named — and ranked — after various palace halls, namely, the Chung-chi tien 中極殿, the Chien-chi tien 建極殿, the Wen-hua tien 文華殿, the Wu-ying tien 武英殿, the Wen-yüan tien 文淵殿, and the Tung-ko 東閣, the Chung-chi tien marking the highest, and the

1 赤道南北兩總星圖說

2 從古圖星者以恒見圈爲紫微垣以恒隱圈界爲總圖之界過此以南不復有圖矣西曆因恒見圈南北隨地不同故以兩極爲心以赤道爲界平分南北二圖以括渾天可見之星焉此兩法所繇以異也蓋渾天圓體赤道以南天度漸狹而在見界總星圖則漸廣形體相違

1 EXPLANATION OF THE TWO GENERAL MAPS OF THE STARS SOUTH AND NORTH OF THE EQUATOR

2 Since antiquity those who drew the Maps of the stars made of the circle of the stars that are constantly visible the circumpolar group of the north; and they made the boundary of the circle of the stars that are constantly invisible also the boundary of the general Maps. South of it nothing figured any more.

Since, however, the circle of the constantly visible stars varies in the south and north according to localities therefore in the Western calendar one takes the two poles as centers and the equator as boundary and divides [the firmament] equally on two Maps, one of the north and one of the south, in order that it might comprise all the visible stars of the firmament. This is the basic reason for the difference of the two methods.

The firmament is in fact of spherical form. Hence the degrees of heaven south of the equator become progressively more narrow. But on the [old Chinese] *General Maps of the visible stars* they

Tung-ko the lowest rank. See *Ming hui-tien, ch.* 2, pp. 10–11. Hsü Kuang-ch'i entered the Grand Secretariat in the fifth month of the fifth year of Ch'ung-chen 崇禎 (1632, between June 18 and July 16) with the title Grand Secretary of the Tung-ko. In the tenth month of the same year — between November 12 and December 11—he received the title of Junior Guardian of the Heir Apparent 太子少保. In the seventh month of the following year (1633, between August 5 and September 2) he was promoted to Grand Guardian of the Heir Apparent 太子太保 and Grand Secretary of the Wen-yüan ko; he died in the tenth month of the same year (between November 21 and December 19). See *Ming-shih*, ch. 110, *Tsai-hsiang piao* 宰相表 (chronological tables of the Ministers of State). On the history of the Wen-yüan ko which was first a library and then became a place where the members of the government met, cf. Harrie Vanderstappen, "Painters at the Early Ming Court and the Problem of a Ming Painting Academy", in *Monumenta Serica*, (Nagoya, Japan) XV, 1956, p. 281.

3 諸星難以載入惟分赤道爲二則經緯相應理勢相應而諸// 星之
位置錯落無不了了分明矣兩圖外周分三百六十則赤道經度也
是名平度內周分三百六十五度四分度之一準一歲太陽行天一
周之數是名日度凡造器測天推步演算先用平度特爲徑捷測算
旣就以日度通之則所省功力數倍故兩用之也其兩大圖中左右正
4 對出直線至界上細分南北各九十者爲赤道緯度亦// 平度也更
從心至界周分二十八直線者依二十八宿各距星所占度分也諸
直線雖從心得分必以中州常見之圈距極三十六度爲內圈是乃

[actually] become progressively wider. On such Maps representation and reality are at variance, and it is difficult to put down the stars [satisfactorily]. But if [the firmament] is divided into two at the equator, then the longitudes and latitudes agree with each other, truth and appearance agree with each other, and
3 // the position and distribution of the stars becomes entirely clear.

The external perimeter of the two Maps is divided into 360 parts which are the degrees of longitude of the equator; they are called "ordinary degrees". The internal perimeter is divided into 365 degrees and a quarter; these correspond exactly to the number of complete revolutions of the sun on the heaven within one year; they are called "solar degrees". Those who make instruments and observe the heavens make their calculations in [two] steps. They first make use of ordinary degrees to get on quicker, and after this calculation is finished they square it with solar degrees. In this way they save much labor. For this reason both [kinds of degrees] are used.

The straight lines in the two large Maps which run contrariwise to the circumference and are both minutely divided into 90 degrees in the north and in the south, indicate the degrees of
4 latitude relative to the equator; they, too, // are "ordinary degrees".

There are, furthermore, 28 straight lines which go from the center to the circumference; they divide the firmament according to the degrees occupied by the large stars of the 28 constellations. These straight lines ought to be drawn from the center; but it is customary to make a special interior circle of the stars 36 degrees from the pole which are constantly visible in middle

所謂紫微垣也去極二十三度半有奇復作一心者黃道極也從黃道極出曲線抵界共十二者乃黃道經度分十二宮者也其三百六十度黃赤度分同者獨二分二至四線爲然餘各有// 參差而黃道經緯度必依平儀爲形故廣狹漸有不同也論星以芒色分氣勢以大小分等第而等有六各以本等印記分別其間內有旁加小圈者乃新所測尙未入表者也此六等皆依本視徑推其本體之大小以成象設使居天等其距地亦等儻遠近不等則其實徑必不隨其視

China, the so-called *Tzu-wei yüan*.[63]

At a distance of 23½ degrees and a fraction from the pole there is another center, viz. the pole of the ecliptic. The curved lines which go from the pole of the ecliptic to the circumference — all together 12 — are the lines of longitude of the ecliptic which divide the 12 signs of the zodiac. Of the 360 longitudinal lines of the ecliptic and the equator only two — or, if divided into two by the poles, four lines — coincide. All the rest // are different.

Since the lines of longitude and latitude of the ecliptic have to be drawn with the azimuthal instrument, their width is progressively distorted.

As for the stars they are divided, according to the color of their rays, and according to their size, into various classes. There are six such classes. All stars are distinguished from each other by the symbol of their particular class.[64] Those marked by a small circle at their side are those which have been observed only recently and are not yet listed in the catalogue of the stars. These six classes are obtained by inferring from their apparent diameter their actual size, and representing them accordingly. Suppose that their position in the heavens is the same, their distance from the earth is also identical. But if their distance is not the same, then their real diameter certainly does not correspond to the apparent one. In that case the difference in distance between stars of the sixth

63) The girdle of 15 stars around the north pole, the "middle" of the "Three Stellar Groups"; see *infra*, n. 66.

64) These six magnitudes and the nebulae are symbolized on the lower part of the IIIrd and VIth sections on the large hemispheres.

6 徑故以第六等較第一等其遠近距當得數萬大// 地之半徑此外復有中虛者舊疑非星因稱爲氣今用遠鏡窺測皆星也因恒時不見姑爲圈以識之各等中或有微過或不及其差無盡匪目所能測匪數所可算者也自古司天文者大都以可見可測之星求其形似聯合而爲象因象以命名雖舊圖有三垣二十八宿三百座一千四百

class and of the first class should amount to several tens of
6 thousands of times // the radius of the earth.

Beyond these stars there are other bodies [which seem to have] an empty core. Formerly it was suspected that they were not stars [at all], and hence they were called vapors [nebulae]. But now that they are observed by the telescope[65] [it has become certain that] they are all stars. Since normally [without telescope] they cannot be seen, they have here been marked by circles to make them known.

In any class [of stars] some go a little beyond [the size of their class], while others do not quite attain it. The differences are endless and cannot be made out by the [naked] eye nor calculated in numbers.

Since antiquity astronomers have generally tried to find out the figures the visible and observable stars resembled when put together, and have given them the names of these figures.

The old Maps carry the three groups of stars,[66] the 28 [Chinese] zodiacal constellations,[67] 300 constellations and 1461 stars which bear names; they follow books which have been handed

65) Another proof, it seems, that the telescope had arrived in China in the first decades of the 17th century.

66) The Chinese divided the stars into three groups 三垣. The first group, the northern circumpolar one 紫微(中垣), of which Schall has spoken at the beginning of this explanation, comprised 15 stars around the north pole; the second was that of the space within stars in Leo and Virgo, with Coma Berenices, etc., called 太微(上垣), which comprised 10 stars; the third was that of the space bounded by Serpens, etc., called 天市(下垣); it comprised 22 stars. Cf. Mayers, No. 74, pp. 324-325.

67) See the names of these constellations and their correspondence in European astronomy in Mayers, No. 313, pp. 376-379.

7 六十一有名之星如世所傳巫咸丹元子之// 書之類然不能盡圖者尙多就所已圖者細測之其中尙在有無疑似之間者亦復不少今

down for many generations, such as those of Wu Hsien[68] and Tan
7 Yüan-tzu.[69] // But there are still many among these stars which could not be placed on the map [with certainty]. Even among those which are marked a close observation reveals not a few are more or less doubtful. On our map we have not dared to insert stars without a practical observation of each single one.

68) A certain Wu Hsien 巫咸 is named among the astronomers, or astrologers, of old, in *ch.* 27 of the *Shih-chi, T'ien-kuan* 天官; he is said to have lived during the Shang dynasty. See Chavannes, *Les Mémoires Historiques de Se-ma Ts'ien*, III, p. 403; and *ibid.*, I, p. 191 and n. 1. In connection with Maps of stars Wu Hsien is mentioned in the *treatise on astronomy* (*T'ien-wen chih* 天文志) in the *History of the Chin Dynasty* 晋書, *ch.* 11 (K'ai-ming ed., 1102. 2): "At the time of Wu-ti 武帝 [=Ssu-ma Yen 司馬炎; 265-290 A.D.] the grand astrologer (*t'ai-shih ling* 太史令) Ch'en Cho 陳卓 combined the Maps of stars composed by the three schools of Kan (Te 甘德), Shih (Shen 石申; on these two see above, n. 48, and Chavannes, *op. cit.*, I, pp. 402-403, *et al.*) and Wu Hsien. (The new Map or description of the stars) comprising altogether 283 constellations and 1464 stars became the official canon," of which the chapter proceeds to give a summary. Of the treatises on literature in the official histories only the *Ching-chi chih* 經籍志 of the *History of the Sui Dynasty* 隋書 (*ch.* 34; K'ai-ming ed., 2450. 3) lists a work connected with the name of Wu Hsien, namely, the *Wu Hsien wu-hsing chan* 巫咸五星占 in 1 *chüan*; see *Combined Indices to twenty historical bibliographies*, II, p. 125.

Let us add here that, as Ricci states that Leo Li Chih-tsao 李之藻 translated into Chinese a treatise on the *Constellations of the Stars* (*FR*, II, N. 631) which is supposed to bear the title of *Ching-t'ien-kai* 經天該 some (for instance Fr. H. Verhaeren C.M., *Notes bibliographiques concernant la littérature chrétienne de Chine*, 1947, pp. 148-157; "Le King T'ien Kai, abrégé d'uranographie", in *Bulletin Catholique de Pékin*, 1947, pp. 553-562), have surmised recently that Li Chih-tsao did nothing else than introduce Western astronomy into the old *Pu-t'ien Ko* 步天歌, formerly known perhaps under the title of *Pu-hsing Ko* 步星歌, by Tan Yüan-tzu. Cf. Fang Hao 方豪, *History of the Relations between China and the West* 中西交通史, IV, p. 9. The whole question is perplexingly entangled and needs further and thorough investigation.

69) A work *Tan Yüan-tzu pu-t'ien ko* 丹元子步天歌 is listed in the treatises on literature of the *Hsin-T'ang-shu* 新唐書 (*ch.* 59; K'ai-ming ed., 3769. 3) and the *Sung-shih* 宋史 (*ch.* 206; K'ai-ming ed., 4998. 4). The *Hsin-T'ang-shu* ascribes the work to Wang Hsi-ming 王希明 of the T'ang dynasty, but according to Cheng Ch'iao 鄭樵, in *T'ung-chih* 通志, *T'ien-wen lüeh* 天文略 (*ch.* 38; *Shih-t'ung* 十通 ed., p. 525. 2) the author was Tan Yüan-tzu, "a secluded scholar 隱者 of the Sui dynasty whose (real) name is unknown". The *Ssu-k'u ch'üan-shu tsung-mu t'i-yao* 四庫全書總目提要 (*ch.* 107; Comm. Press ed., pp. 2216-2217) prefers to leave the authorship uncertain. The work describes in seven word lines the Three

則非一一實見之測不敢圖間有舊圖未載而臨測時各各俱有經緯度者亦無妨增入焉又自見界諸星而外尙有南極旁隱界諸星雖各省直未見從海道至滿剌加國悉見之胡可略也惟是向來無象無
8 名因以原名飜譯共得星一千八// 百一十二其第一等一十六星第二等六十七星第三等二百一十六星第四等五百二十二星第五等四百一十九星第六等五百七十二星今欲以赤道經緯平度考

Occasionally there were stars which did not figure on the old maps but, since during observation they were found provided with their degrees of longitude and latitude, nothing prevented us from adding them here.

Moreover, beyond the stars in the zone of visibility, there are still those in the zone of invisibility in the vicinity of the south pole. Though they are not directly visible in the various provinces of China, yet all are seen from the coast down to Malacca. How could they be neglected? But, because hitherto they were not combined into figures, they bore no name; therefore words transliterated from their original names have been used here.

8 The stars amount to 1812, // of which 16 are of the first magnitude, 67 of the second, 216 of the third, 522 of the fourth, 419 of the fifth, and 572 of the sixth.

If one now wishes to find the ordinary degrees of longitude and latitude relative to the equator for the position of a star, one uses the following method. One places a ruler with level sides from the center of the Map across that star to the border;

Stellar Groups (三垣; see n. 66), the 28 constellations (二十八宿) and the stars belonging to them; because of its lucid arrangement it was for centuries considered as one of the best works in the field. It was copied into various astronomical works compiled under the auspices of the Manchu emperors, and issued in an official edition. The Maps of the work are said to have been in complete accord with actual observations. See *Ssu-k'u ch'üan-shu tsung-mu t'i-yao, loc. cit.* The *Tz'u-hai* 辭海 (*sub Pu-t'ien ko* 步天歌) adds that the official observations made in the years K'ang-hsi *jen-tzu* 壬子 (1672), Ch'ien-lung *chia-tzu* 甲子 (1744), and Tao-kuang *chia-ch'en* 甲辰 (1844) were all made on the basis of this work. While the old lists all give 1 *chüan* for the work, the copy reviewed in the *Ssu-k'u t'i-yao* had 7; this shows, according to the authors of the *Ssu-k'u t'i-yao*, that the original work had been subjected to additions and changes.

某星度分法用平邊界尺從圖心引切某星至圖邊得所指某宮某
度分卽崇禎元年戊辰本星之赤道經度分次用規器依元定界尺
9 從赤道量至本星以爲度用// 元度依左右分度線上量得度分卽
本年本星之赤道緯度分簡本圖度分復查本宮表所註度分卽知
繪圖立表測天三事悉皆符合至量黃道度赤道圖中無定法且此
所分止有黃經度因緯度當依宮次之弧線弧線當依平面儀曲直
名不同故隨宮次曲線內查恒星則其居線之遠近雖能略指黃道
10 度而終未密也若日月五// 星距黃度內外不遠則以其行度查在
本圖何宮宿與何恒星同度卽得七政所躔宮度其兩大圈左右共
十小圈則五星經緯圖也左經右緯各依本星之遲速爲一周雖星

here one finds indicated a certain constellation and a certain degree. This is the equatorial longitude of that star for the year 1628. Next one uses a pair of compasses, and measures on the ruler in the above position the distance from the equator to
9 the star, // and determines the corresponding number of degrees on one of the graduated lines at left or right. The number thus obtained indicates the latitudinal degrees of the equator of the star for the same year. If one examines the degrees given on the Map, and checks with the degrees marked on the table of the pertinent constellation, one recognizes that these three things: the drawing of the Map, the compiling of the table, and the observation of the sky, are in complete agreement.

For the measuring of the degrees of the ecliptic on equatorial Maps there is no exact method; and actually the divisions on the Map have been limited to the longitudinal circles of the ecliptic. For the degrees of latitude would have to be made on the curves of the zodiacal boundaries; and these curves again have to be made with the azimuthal instrument and are therefore distorted. If one therefore tries to determine a fixed star in relation to the curved [boundary] lines of the zodiacal spaces, though the distances from its position can in a general way indicate the ecliptical degrees, they remain inaccurate.

10 If the sun, the moon, or the five // planets are not far distant from the interior or exterior of the ecliptic, then one can look on the Map for the constellation or the fixed star which have the same degrees [position], and then one has the section of the

之周而復始者所行之轍非故大約遲留伏逆皆相似故止各繪一周之歲月以槩其餘

11-12 極西耶穌會士 湯若望 羅雅谷 譔訂 訪舉 鄔明著 圖 陳于階 孟履吉 楊之華 黃宏憲 祝懋元 程廷端 朱國壽 張寀臣 仝測

heaven through which the Seven Rulers[70] are passing.

The small Maps at right and left from the two large Maps — all together ten — are the Maps of the longitudes and latitudes of the five planets, at the left the longitudes and at the right the latitudes. Each [planet] completes a revolution according to its proper velocity. Though the orbits which the planets follow on their endlessly repeated revolutions constantly differ from the former ones, yet on the whole their oppositions and conjunctions all resemble each other. Therefore only the period of one revolution has been sketched. From there an approximate estimate of the rest can be formed.[71]

11-12 Composed by Johann Schall / Revised by Giacomo Rho } Jesuits from the Far West. Map drawn by the *fang-chü*[72] Wu Ming-chu.

70) Cf. n. 47.

71) The ideas which Schall has summarized in this *Explanation* were resumed by him and further developed in his *Treatise on the Fixed Stars, Guide to the Calendar* 恒星曆指 which is part of the great collection *Books on the Calendar according to the new European method* 新法曆書. The *Treatise*, in which Ptolemy is frequently mentioned, was originally to have 3 books 卷; but a fourth one was added as appendix under the title *Explanation of the Map of latitudinal and longitudinal circles of the fixed stars* 恒星經緯圖說. Here the two Stellar Hemispheres are reproduced in the form of a book, and major particulars on them are given which take up the whole fourth book. A copy of the first two books was offered to the Vatican Library as early as July 6, 1643, by Father Alvaro Semedo S. J., the procurator of the mission who had departed from China in 1636. The particulars of the gift were noted by an intelligent librarian on one of the two small volumes which are now found in the *Prima Raccolta*, III, 338, of the Vatican Library. Any further study of the *Double Stellar Hemisphere* would have to take into account this *Guide to the Calendar* which must be more or less contemporaneous.

72) *Fang-chü* 訪舉 was the name used for scholars, especially *chü-jen* 舉人 (licentiates, or graduates of the second degree), who were recommended for their character and abilities by the local authorities and appointed to positions which were ordinarily open only to *chin-shih* 進士, or third degree graduates. See *Ming hui-tien* 明會典, *ch.* 13, pp. 330-331.

Observations made in common by

Ch'en Yü-chieh	Meng Lü-chi
Yang Chih-hua	Huang Hung-hsien
Chu Mao-yüan	Ch'eng T'ing-jui
Chu Kuo-shou	Chang Ts'ai-ch'en.

* * *

This is the Double Stellar Hemisphere which Father Schall composed and printed in Peking in the years 1633–1634, and which until now has remained unexplored by scholars.

Actually only somebody who is both a sinologist and an astronomer could make an adequate study of the Map. But since it is difficult to find these qualifications in one and the same person, and since an astronomer could not study it without the help of a sinologist, we have preferred to begin with the sinological part.

Even so not everything has become clear. Several points still remain obscure. But we foster the hope that now it will be possible for astronomers to orientate themselves in this study.[73]

In this way it may be possible some day to bring complete clarity into a work which honors the science of the learned missionaries of the XVIIth century.

Pontifical Gregorian University, and State
University of Rome, April, 1959

73) I am deeply grateful to the editor for several suggestions and corrections. Sincere thanks are also due to Fr. John Ch'i Shen-chung 齊愼終 S. J. for his help to supply the Chinese text with punctuation-points.