

**ASTROLABES  
AND  
ASTROLABE-MAKERS  
OF  
LAHORE**

*Dr. Saifur Rahman Dar*

LAHORE : 1997

Published by Library and Information Management Academy,  
B-63 Marghazar Colony, Multan Road, Lahore - 54780 (Pakistan)  
and Printed at New Fine Printing Press, Lytton Road, Lahore.

OF  
LAHORE

**Title : Facies with Spider of an Astrolabe  
made by Muhammad Muquim Lahori in 1640 A.D.  
( Lahore Museum No. M-44-1 )**

A reprint from  
Lahore Museum Bulletin, Vol. VII, No. 1-2, 1994  
under title  
**THREE RARE ASTROLABES IN THE COLLECTION  
OF LAHORE MUSEUM, LAHORE  
( Lahore : 1997 )**

## CONTENTS

Preface .....	iii
I. Brief History of Astrolabes .....	65
II. Lahore Museum Collection of Astrolabes .....	168
III. Astrolabes & Astrolabe-Makers of Lahore .....	
Conclusion .....	188
APPENDIX	
Original Terms used in this article .....	189
References .....	193
Plates .....	
Figures .....	

## CONTENTS

## PREFACE

History of Lahore has many facets. We know a lot about its rulers and their role in history. We also know enough about its monuments, though we have failed to preserve them in a dignified manner. But, as regards Lahore's contribution in the field of science, arts & crafts during the course of its history, we still know very little. During the Mughal period, Lahore was a renowned centre of miniature & fresco painting, art of book-binding & calligraphy, glazed mosaics & tiles, etc. It was also an important centre of carpet weaving, bow-making and *asturlab-sazi*.

The oriental Greeks in the 2nd century B.C., were the first to start the science of astrolabe-making. But, it were the Muslims who excelled in this science after having learnt it from the Greeks and transmitted it to the posterity. Originally, good specimens of astrolabes — both *asturlab kuri* and *asturlab sat-hi* were designed and fabricated by the scientists themselves. But, gradually, the two processes bifurcated — the design was done by the scientist himself but fabrication was left to the artist/craftsman — usually a blacksmith. This was particularly so during the 19th century. A well-known example of the 19th century astrolabe of Iran was designed by 'Abd-al A'imma but was fabricated by Khalil Muhammad. A huge and heavy astrolabe now in Lahore Museum was designed by a Hindu named Lala Sahu Mal but was fabricated by Ustad Pir Bakhsh. Both of them were residents of Lahore.

How, why & when did astrolabe-making started in Lahore, no one knows. Early history of this craft is shrouded in mystery. But this city was certainly one of the most celebrated centres of supply of this scientific instrument to whole of the Muslim world. Fifty-four per cent of the astrolabes in Gunther's exhaustive list were made in Lahore or by the astrolabists of this city. Fine astrolabes were certainly made in Lahore from sixteenth to the 19th centuries.

Lahore's contribution to arts & crafts are not confined to astrolabe designing and manufacturing. It extended with equal celebrity to several other fields of arts & crafts. Lahore *karkhana* for weaving carpets during the Mughal rule ranked equal among the two other best centres (Agra & Mirzapur) of this industry in whole of South Asia. Fine and large carpets from Lahore are now preserved in several museums of the world. The best collection of Lahore-made carpets, which I have seen, is in the Palace Museum, Jodhpur. One facsimile of a fine specimen of carpet from Shah Jahan's factory in Lahore is on display in Lahore Museum.

Another relatively little known field in which Lahori craftsman excelled was the art of bow-making. In particular, the *Chahar-kham kaman* (a bow with four-bends) of Lahore was considered to be the best in whole of Asia. *Kucha Kaman Garan* — the Street

of Bow-makers in the walled city of Lahore, still retains the memory of the residents who once excelled in this craft.

The type of glazed tiles and mosaic tiles with silica base once manufactured in Lahore are also unique in whole of the subcontinent. Both in their manufacturing technique as well as in the base material used in fabrication and in the repertoire of their motifs & themes and range & variety of colours used, the *kashi-kars* of Lahore stand head & shoulders above the tile-makers of other regions and centres such as Multan & Hala.

In a recent study,<sup>1</sup> I have shown as to how unique has been Lahore's contribution in the field of miniature painting right upto the middle of the 19th century. The same distinction Lahore has enjoyed in the past in several other fields of arts & crafts such as calligraphy, fresco, painting, wood carving (the earliest wood carved doors are preserved in Lahore Museum), etc.

Among so many colourful facets of this cultural capital of Pakistan, I have selected for this brief study, the subject of astrolabe-making. Although among the scholars and specialists, Lahore's contribution in this field has not remained un-noticed, but the general public has so far remained oblivious and ignorant of the contribution of Lahorites in such a distinctive scientific field as astrolabe-making. For the convenience of readers, uninitiated in the subject, I have added in the beginning, a few pages on the background history of this scientific instrument.

Other facets of the cultural milieu of the city of Lahore yet remain to be explored to their fullest extent. I hope somebody else, well-versed in these crafts, will take up such studies.

( Dr. Saifur Rahman Dar )

Lahore, the 20th May, 1997

<sup>1</sup> Dr. Saifur Rahman Dar, "Imam Bakhsh Musawwar Lahori: Discovery of a 19th Century Artists of Lahore", Journal of Research Society of Pakistan, Vol. XXX, No. 3, June, 1993.

## THREE RARE ASTROLABES IN THE COLLECTION OF LAHORE MUSEUM

### AND LAHORE'S CONTRIBUTION TOWARDS ASTROLABE-MAKING

Dr. Saifur Rahman Dar, T.I.

Lahore and Lahore Museum both have many facets which still await to be studied. Two such aspects of their history are discussed below namely some astrolabes now preserved in Lahore Museum and the contribution of the city of Lahore towards astrolabe-making. Three of these astrolabes are planispheric and two are in the form of globes. But before we describe some of these instruments, we will discuss in brief what is an astrolabe and what has been its significance in the Islamic history. At the end we will also see what has been Lahore's role in astrolabe-making.

## I

### BRIEF HISTORY OF ASTROLABES

Astrolabe<sup>1</sup> is considered to be the oldest scientific instrument in the world. It has played an important part in the history of civilization and science. A primitive type of it was known to Claudius Ptolemy (بطليموس) of Alexandria (Egypt) in circa 150 A.C.<sup>2</sup> whereas its theory dates back to the time of Hipparchus (إبرخس) of Nicaea near Istanbul (Turkey) some three centuries earlier.<sup>3</sup> It was a popular scientific instrument both in the medieval Islamic world and the contemporary Europe. Arabs, Iranians, Pakistanis, Indians and Greeks were renowned astrolabe-makers. Specimens of ancient astrolabes can be found in many museums and libraries all over the world. The Oxford Museum of the History of Science alone has over 80 astrolabes in its collection<sup>4</sup> whereas Marton & Oriol Colleges of the University of Oxford, still own five 14th century astrolabes.<sup>5</sup> The extant examples also show that whereas European astrolabes are preserved from about the 13th century, the Islamic examples date from the 10th century. It so happened that "while Europe languished in the Dark Ages, the torch of ancient scholarship had passed into Muslim hands. Islamic scholars kept it alight, and from them it passed to Renaissance Europe".<sup>6</sup>

The development form of the earliest extant astrolabes, the archaeological evidence<sup>7</sup> and the existence of literature of Greek and Syriac writers make it almost sure

that astrolabe was invented and developed before Islam. However, the extant specimens clearly prove that whereas the initial credit of inventing the theory and art of astrolabe-making must be given to the oriental Greeks in the 2nd century B.C., the credit for preserving this science and transmitting it to the posterity must be apportioned to the Muslims.<sup>8</sup> Being a popular scientific pursuit of medieval people, fine specimens of astrolabe were forged even in ancient times. Forgeries of at least one renowned astrolabe-maker, 'Abd al-A'imma, have been studied extensively.<sup>9</sup> Mostly, designer and fabricator were two different individuals. One of the well-known specimens designed by 'Abd al-A'imma was fabricated by Khalik Mohammed.<sup>10</sup> However, the best specimens were made by the scientists themselves.

Astrolabe is an instrument, usually made of brass or bronze (alloys of copper & zinc and copper & tin respectively) designed to measure the altitudes of celestial bodies and to determine all kinds of astronomical and topographical relations. Actually, an astrolabe is a two dimensional model of the sky. Some of its chief uses have been to solve problems of spherical astronomy, to determine time of day or night or for prayers, to fix the direction of *qibla*, to solve simple problems of survey i.e. depth of wells, height of a building, width of a river and longitudes of various planets, etc. It is more an instrument for celestial rather than for terrestrial measurement i.e. an instrument for calculating rather than for measurement. On account of its design and enrichment of its embellishment, it is often regarded as an extension of scientific theory to art history.

Function-wise astrolabes are of two principal types:

- a) designed for use at a fixed latitude, and
- b) universal astrolabes in varying shapes.

As regards their shapes and forms, these are of three types namely:

- a) *Asturlab Kuri* (اسطرلاب كروي) or Astrolabio Redondo or Spherical Astrolabe.<sup>11</sup> Lahore Museum possesses two such astrolabes – one in the Islamic Gallery and the other belonging to Hifzur Rahman Collection in the General Gallery.
- b) *Asturlab Sathi* or *Musattah* (اسطرلاب مسطح) or Astrolabium Planispherium i.e. plain disc-shaped astrolabe. It is the commonest type.<sup>12</sup> Lahore Museum has three such astrolabes in its collection, all displayed in the Islamic Gallery.
- c) *Asturlab Khatti* (اسطرلاب خطی) also called *Asa-i-Tusi* (عصا توسی) i.e. Staff of Tusi. This Linear Astrolabe, being less accurate, was never widely used. No extant example is known. Its invention is attributed to al-Muzaffar ibn Muhammad ibn al-Muzaffar Sharfud Din al-Tusi (d. circa 610 A.H./1213 A.C.).<sup>13</sup>

To these, some scholars add a fourth type i.e. mariner's astrolabe,<sup>14</sup> but with this we are not concerned here.

Muslim contribution to astronomy and astronomy-related subjects is well-known. Like the sages of ancient Babylon, India and Greece, the sages of the early Muslim world were also great star gazers and laid the foundation of astronomy and astrology.<sup>15</sup> Right from the beginning of the Islamic history, astrolabe-making and astrolabe-reading was regarded as a noble profession. Particularly, during the Abbasid period, astrolabe-making was highly esteemed and there is a good reference to craftsmen bearing the soubriquet 'asturlabi'.<sup>16</sup> The earliest extant Arabic treatise – now preserved only in Latin text of 1276 A.C., was originally composed in circa 200 A.H./815 A.C. by an Egyptian Jew Masha-allah.<sup>17</sup> The actual earliest Arabic text still extant was written in circa 214 A.H./829 A.C. by Ali ibn 'Isa – a pupil of ibn Khalaf al-Marwarrudi. Thereafter some of the outstanding Muslim scientists like al-Beruni (363-440 A.H./973-1048 A.C.) and Nasirud Din Tusi (598-673 A.H./1201-1274 A.C.) wrote systematic and detailed treatises on astrolabes.<sup>18</sup> Antikithera astrolabe apart,<sup>19</sup> the earliest example of a developed form of a genuine astrolabe is dated 315 A.H./927 A.C. It was made by Nastulus and is in the proud collection of Kuwait National Museum.<sup>20</sup> The one dated 374 A.H./984 A.C. now in the Lewis Evans Collection, in the Old Ashmolean Museum, Oxford is the second oldest.<sup>21</sup> It is a Persian astrolabe made by two brothers, Ahmad and Muhammad of Isfahan, sons of Ibrahim. Very few Islamic astrolabes of a few centuries after the 10th century have come down to us. "Before the end of the 13th century the planispheric astrolabe was known and used from India in the east to Islamic Spain in the west, and from the tropics to northern Britain and Scandinavia".<sup>22</sup>

In the Christian West, on the other hand, it did not come into general use until 13th or 14th century, though it was known to the Venetian scholars much earlier. Count Hermann Contractus of Vehrigen (died 1054 A.C.) is believed to be the inventor of European astrolabe. Two hundred years later i.e. in 1274 Henri Bate wrote in Belgium his famous treatise *Magistralis Compositio Astrolabii*. A century later poet and astronomer Geoffrey Chaucer, translated Masha-allah's treatise into English under the title: 'The Conclusions of the Astrolabie' for his ten years old son.<sup>23</sup> After this, scholarly as well popular treatises became too numerous to be counted here. As an example of early European – German indeed, astrolabe dated 1481 A.C. in the Museum of Strasbourg (France) is shown in Pl. I-a. For various parts of an Islamic astrolabe see Pl. I-b and Fig. 1 & 3. With the invention of telescope, the use of astrolabe became redundant in the West, but in the East its tradition and use continued right till the end of the 19th century.<sup>24</sup>

In South Asia – India and Pakistan in particular, the interest in astronomy is much earlier than even coming of Muslims in the area. Whether or not the Indian knowledge of astronomy is indigenous and earlier than that of Babylonia, the majority of scholars, both European and Indian, however, despite the pleading of Sir William Jones to the contrary, appear to have accepted as an axiom the opinion that much of Indian astronomy

and certainly Indian acquaintance with the twelve-fold division of the zodiac is to be attributed to Grecian influence.<sup>25</sup> But as regards the use of astrolabe in their present shape, it came here only with the Persians. Both Gunther<sup>26</sup> and Hartner<sup>27</sup> attest the contribution of the Muslims of Iran and Central Asia in this field. Hartner also shows how out of 165 specimens listed by R.T. Gunther, sixty-five were made by the Persians of Iran and Central Asia. Among others, twenty-seven were made by Indian Muslims, eight by Hindus, twenty-one by Arabs (Egyptians, Syrians & Mesopotamians), forty-two by Moors (Spanish Muslim & North African) and two by Jews.<sup>28</sup>

In Pakistan and India, interest in *asturlab-sazi* becomes visible during the times of Nasirud Din Humayun. He is said to have gained the knowledge of astronomy during his stay in Iran when he was accompanied by two famous scholars Ilyas Ardbeli and Abdul Qasim Giryani. He is said to have erected pavilions in which nine skies and different stars of each sky were emblematically represented.<sup>29</sup> Akbar, his son, also made full use of this science. Shah Jahan also had his court astrologers. For casting horoscope, usually, four different astrologers were needed.

In Lahore, in particular, history of astrolabe-making is traceable from the time of Humayun (died 1555 A.C.) down to late 19th century. But, during Shah Jahan's period and around, Lahore suddenly became famous for this craft. A single family for this city is traceable from the time of Humayun to Aurangzeb members of which remained busy in making numerous astrolabes which can be traced out in a number of museums of Pakistan, India, Europe and America. Sheikh Allah Dad or al-Haddad (الهداد) was the progenitor of the family whereas Ziaud Din Muhammad and Jamalud Din are the last known astrolabists in the family who flourished during Shah Jahan and Aurangzeb's times. The name of at least one other astrolabist of Lahore, Ustad Pir Bakhsh living in the middle of the 19th century is also known. But whether he has some connection with the renowned al-Haddad or Allah Dad family is not known. With all probability, the late 19th century Hindu astrolabist Jyotishi or Jotishi Dharam Chand also belongs to Lahore. About this family and the astrolabe-makers of Lahore, we will say more in part II & III below. But before we discuss role Lahore has played in the past, in astrolabe-making, let us first see what evidence of the same we have in our museums in Pakistan.

## II

### LAHORE MUSEUM COLLECTION OF ASTROLABES

Lahore Museum has in its collection three planispheric and two spherical astrolabes. All except one are on display in showcase No. 3 of the Islamic Gallery. They bear accession Nos. (i) M-44-I, (ii) M-1649 and (iii) M-44-H - all planispheric astrolabes and (iv) M-44-G and (v) A-8-I (belonging to the Hifzur Rahman Collection now on display in the General Gallery) - both globes or spherical astrolabes. Only two

of them - one datable circa 1640 A.C. and the other dated 1841 A.C. have been previously referred to in museum publications,<sup>30</sup> and dealt with in some length in a popular article.<sup>31</sup> Here we will discuss only three planispheric astrolabes.

#### Astrolabe No. M-44-I (Pl. II-V)

The earliest one in this collection, bearing No. M-44-I, is a planispherical astrolabe (*asturlab sathi*) and is made of brass (Pl. II-V). This astrolabe was donated by Mr. Masud Ilahi in memory of his father Shaikh Mahbub Ilahi, an agricultural engineer from Faisalabad and a former member of the Constituent Assembly, India. Its diameter is 16 centimeters whereas its total height, after adding to it the triangular suspensory part (*kursi* = كرسي) comes to 20.5 cm. Maximum thickness of the apparatus is 1.2 cm. The facies (*wajh* = وجه) of the astrolabe (Pl. II) comprises a raised rim called *hajra* = حجرة or limbus which surrounds a circular flat depressed surface called *Umm* = أم or mater (Pl. III a). The elaborately fabricated spider or rete (*ankabut* = عنكبوت) (Pl. III b) sets perfectly within the raised outer rim and is secured in place through a central pin or *qutb* (قطب) with the help of an animal-shaped knob called 'horse' (because of its shape) placed above the *ankabut*. The central pin which marks the position of the celestial North Pole, runs through the centre of all the plates and then goes out of the *zahr* (ظهر) or back and alidade (الاضادة) where a clip passing through a hole in the pin saves it from slipping back. Between the 'horse' (*faras* = فارس) and the *ankabut* is placed a thin washer (*fals* = فلس) which helps rotate the *ankabut* in a perfect manner. The triangular suspension or *kursi* is a fine example of metalsmith's work showing arabesque pattern of intertwined creepers and leaves in relief. The swivel (*urwa* = عروة) on top of the *kursi*, the ring (*halqa* = حلقة) passing through the swivel and the string (*'ilaka* = عتق) for suspension of the astrolabe through *urwa*, are missing in this Lahore Museum example.

"Basically, an astrolabe is a stereographic projection of a coordinate system of the heavens, from the celestial south pole, onto the Equator, adjusted for the observers latitude, and covered with the projection of a star map. The former is materialised as the *safiha* (صفحة) (Fig. 3) the later as the *ankabut* (spider) (Fig. 2) or rete of the astrolabe<sup>32</sup>." In our Lahore Museum case (Pl. II & III) the outer-raised rim (*hajra*) is marked with 72 major divisions indicated by their Arabic numerals, each divided into 5 sub-divisions making the total 360 degrees of a circle. The *safiha* on the *Umm* (Pl. III-a) comprises series of eleven concentric circles - each divided into 360 degrees corresponding to the divisions on the *hajra*. Two sets, each of three concentric circles are divided into 48 (outer) and 24 (inner) boxes each containing the name of a city either in the Middle East or Arabia, Central Asia (Asia Miana = آسيا ميانا) and South Asia such as Madina, Makkah, Taif, Halb, Qaunia, Kufa, Baghdad, Basra, Shiraz, Yazd, Qizvin, Astarabad, Sabzwar, Herat, Balkh, Badakhshan, Bokhara, Khojend, Kashgar, Kirman, Qairwan etc. - all in the outer set. Some major cities of Pakistan and India such as Daibal, Kashmir, Multan, Lahore, Thanesar, Delhi, Akbarabad, Benaras, Gwalior, Jaunpur, etc. are marked on the inner set - each city with its corresponding latitude (دوائر العرض) and longitude (دوائر الطول) in Arabic. It is in accordance with the usual practice that a *safiha* is bound to a particular

latitude, making the astrolabe to which it is attached useful at best only within 5 degrees of that latitude.<sup>33</sup>

The *ankabut* (Fig. 1-c) of this astrolabe (Pl. III-b) has been fabricated artistically with the usual major & minor and fragments of a third & fourth circles. An *ankabut* is actually a star-map or a reproduction of heavens. As is clear in Lahore Museum example (Pl. II), the tips of small pointers i.e. *shataba* (شطبة) also called *shazzia* (شظية), *nok* (نوك) and *namainda* (نماشده) mark the positions of the brightest stars. An off-centre circle i.e. the smaller complete circle represents the ecliptic (*daira-tal-buruj* = دائرة البروج). The outer large circle - not complete and the two parts of circles represent the celestial Equator and the Tropics of Cancer and Capricorn.<sup>34</sup> The smaller complete circle is inscribed with Arabic names of twelve signs of zodiac: al-Hamal (Aries: Farvardin)<sup>35</sup>, al-Saur (Taurus: Urdibihisht), al-Jauza (Gemini: Khordad), al-Sartan (Cancer: Teer), al-Asad (Leo: Mordad), al-Sumbalah (Virgo: Shahrivar), al-Mizan (Libra: Mehr), al-Aqrab (Scorpio: Aban), al-Qaus (Sagittarius: Azar), al-Jadi (Capricorn: Day), and al-Dalw (Aquarius: Bahman). The small hole in the outer circle of the rete was meant to receive the knob (*Mudir* = مُدير) for purpose of rotating the spider within the raised outer-rim, is now missing.

The back or *zahr* (Fig. 1-a) of this astrolabe (Pl. IV) shows division of circular space which is typical of an astrolabe. It shows the *Kursi* executed in exactly the same fashion as on the front. The *Kutb* or central pin is in the centre and is meant to hold, in place the astrolabe's second moving part, the alidade which is missing in our case. The circular disc is divided into quadrants (Arabic: *ruba'* = رُبع) by horizontal and vertical diameters - horizontal diameters called *Khat-al-Mashriq wal Maghrib* (خط المشرق والمغرب) i.e. east-west line and the vertical diameter called *Khat nisf annahar* (خط نصف النهار) i.e. mid-day line or *Khat al-ilaqa* (خط علقته) i.e. line of the cord. These quadrants are: (I) *al-rub-ash-sharqi 'l-janubi* (الربع الشرق الجنوبي) or *rub-al-irtifa* (ربع الارتفاع), (II) *al-rub-al-gharbi 'l-janubi* (الربع الغرب الجنوبي), (III) *al-rub ash-sharqi ash-shamali* (الربع الشرق الشمالي), and (IV) *al-rub al-gharbi ash-shamali* (الربع الغرب الشمالي) respectively. In our example, the quadrants I & II show a set of horizontal lines in one case and concentric lines in case of other - the former representing a set of cosines. The two graduated borders on the rim of each of these quadrants - 18 in case of outer and 90 in case of inner graduations, can be used to measure altitudes of heavenly bodies, or to determine heights of terrestrial objects.<sup>36</sup> Six signs of Zodiac (*al-Jadi*, *al-Dalw*, *al-Haut*, *al-Hamal*, and *al-Saur*) are scribed along the vertical and the remaining signs - *al-Sartan*, *al-Asad*, *al-Sumbalah*, *al-Mizan*, *al-Aqrab* and *al-Qaus* - are shown along the horizontal line of the left hand upper quadrant. Two curves mark the *meridian* (خط نصف النهار) positions given in Arabic. This represents a table of seasonal mid-day solar altitudes for various latitudes.<sup>37</sup>

The two lower quadrants, are the so-called "shadow squares" or *zill-i-salm* (ظل سلم) and are essentially cotangent tables. The remaining concentric circles contain information about the zodiac and hence are primarily of astrological significance. The

inner circle, for example, gives us names and positions of twelve signs of zodiac with corresponding names of 28 stars such as Suriya (سُورِيَا), Dubara (دُبْرَاه) etc. whereas outer circle have only the names of zodiac signs already enumerated above. The shadow square in the lower left quadrant (III), as also shown in Fig. 1-a, and as almost always refers to the gnomon divided into seven parts reckoned in feet (Arabic: *qadam/aqdam*) inscribed in the astrolabe as *aqdam mastawi* (اقدام مستوي) also called in Arabic as *zill mabsut* (ظل مبسوط) or *zill mastawi* (ظل مستوي), Latin '*umbra recta*, that is the shadow thrown by the vertical gnomon on the horizontal plane and *aqdam ma'kus* (اقدام معكوس), or *zill ma'kus* (ظل معكوس) or '*umbra versa*, that is the shadow thrown by the horizontal gnomon on the vertical plane.<sup>38</sup>

The right hand lower quadrant IV is used for gnomon divided into twelve parts recked in fingers (Arabic: *Asaba*, (pl. *Asabi*) and consequently both vertical and horizontal sections have been marked on the body as *Asabi mastawi* (اصابع مستوي) and *Asabi ma'kus* (اصابع معكوس). The outer rim of quadrants III & IV are graduated in *aqdam* or feet and *asabi* or fingers corresponding to the *aqdam* (اقدام) and *asabi* (اصابع) of the shadow squares or *zill-i-salm*.

Between the rim and the 'shadow squares', are again three concentric circles, the inner-most graduated with 12 divisions each assigned a zodiac sign - six to *al-aqdam* and six to *al-asabi* sections. On the body of this astrolabe are two inscriptions, but to this we will return anon.

In addition to the main body, just discussed above, there are five thin discs or *safaih* or tympanum each worked on both sides. Only one of these has been illustrated at Pl. V. It is divided into four quadrants. Concentric to the celestial north pole (hole in the centre) are three circles each marking the Tropic of Capricorn (outer-most), Equator (the middle one) and Tropic of Cancer (the inner-most). The vertical lines drawn from the Tropic of Cancer, all crossing the Equator and touching Tropic of Capricorn (curves marked by Arabic alphabets from 'و' to 'ي' and from 'ر' to 'س') are the hour angle lines (عرض ساعاته). The lines drawn from the horizon line (above the words (عرض ساعاته) and touching the circle of Tropic of Capricorn after cutting the hour angle lines at right-angles are the lines of Equal Azimuth (Also see Fig. 3).

At the bottom of the *safiha* i.e. (*ash-shamal* side) there is a rectangular cut to fit in perfectly on the *mumsik* (ممسك) - a projecting bit of metal on the *hajra* which prevents the disc from rotating. One of the discs has four such cuts i.e. *mumsik*. Zenith (ض) is a little south of 10° east-west (المشرق-المغرب) line. Taking it as centre, a number of concentric circles have been drawn which represent *al-muqantars* (المقنطرس) with the outer-most circle marking the position of horizon and all *al-muqantars* running parallel to it. A comparison of this with the schematized drawing of a *safiha* shown in Fig. 3 will make it more clear.

As already said above, there are two inscriptions on this astrolabe. The main inscription, on the backside or *zahr* below the 'shadow-square' reads: (Pl. IV)

صنعة محمد مقيم بن عيسى بن الهداد  
اسطرلاب همايوني لاهوري

**Trans:** Work by Muhammad Muquim, son of 'Isa, son of Allahdad (Allah Dad), royal astrolabist of Lahore.

The other inscription on the outer surface of the rim reads:

مالك اقل العباد محمد هاشم بن محمد باقر تبريزي

**Trans:** Owner, the weakest of creatures, Muhammad Hashim, son of Muhammad Baqir of Tabriz.

No date is inscribed on the body of the astrolabe. However, Lahore Museum records says it was made in circa 1640 A.C. The guess is not very far off the mark as we will see by its comparison with another astrolabe of Muhammad Muquim now in the National Museum of Pakistan, Karachi.

#### National Museum of Pakistan

Astrolabe No. N.M.1959-407 (Pl. VI)

(Now transferred to Islamabad Museum, Islamabad)

The Karachi Museum astrolabe bears accession number N.M.1959-407 (Pl. VI). It was purchased in 1959 from G.N. Malik, a resident of Lahore.<sup>39</sup> It measures 10¼ or 25.63 cm. in diameter and is hence larger than Lahore Museum astrolabe which is only 16 cm. in diameter. Dated inscription on the backside reads as follows with three dates:<sup>40</sup>

صنعت اضعف العباد محمد مقيم بن عيسى  
ابن الهداد اسطرلاب همايوني لاهوري في  
سنة ١٠٠٤ ايزدجردى في سنة ١٩٣٩ رومى .

**Trans:** "Made by the weakest of the servants Muhammad Muquim, son of 'Isa, son of Allah Dad Asturlabi Humayuni Lahori in the year 1047 A.H., 1007 Yazd Jardi, 1949 Rumi."

Gunther has published two astrolabes, both made by Muhammad Muquim of Lahore (his No. 72, Pl. XLVII & No. 78). The one bearing No. 72 bears an inscription as follows:

صنعة اضعف العباد محمد مقيم بن  
عيسى بن الهداد اسطرلاب همايوني  
لاهوي سنة ١٠٥٣ هـ .

**Trans:** "The work of the weakest of servants, Muhammad Muquim son of 'Isa son of Allah Dad Asturlabi Humayuni Lahori, year 1053 A.H./1643 A.C."<sup>41</sup>

The Karachi Museum astrolabe of Muhammad Muquim, though larger in size, offers more delicate brass work both of the spider or *ankabut* and of the *kursi* which is a brass work of arabesque pattern of running stylized foliage (Pl. VI). The knob (*mudir*) attached to *ankabut* or rete and the ring (*halqa*) passing through the swivel (*urwa*) are also intact. The outer raised rim has the same usual 72 divisions with a sub-division of five each - making the total 360°. The *safiha* on the *Umm* is identical to the detachable *safiha* belonging to Lahore Museum No. M-44-I and shown in Pl. V. The *ankabut* of the two are absolutely different from each other. The only common feature of both is the names of 12 zodiac signs on the inner circle of the rete or spider. In the centre of the *kursi* there is an inscription which reads " زغفور منقرت أميدارم ". The back is divided into usual four quadrants, with lower half having half a square & circle as *zill-i-salm* and graduation naming stars like *Atarad*, *Mushtari*, *al-Zohra*, *Marikh*, *al-Qamar* etc. The astrolabe has five additional plates each engraved on both sides.<sup>42</sup> According to Mr. G.R. Kaye one astrolabe also made in 1053 A.H./1643 A.C. by Muhammad Muquim ibn 'Isa ibn Allah Dad, Usturlabi Humayuni of Lahore was in 1921 part of the collection of Dr. Lewis Evans in the Ashmolean Museum, Oxford.<sup>43</sup> It is same as Gunther's S. No. 72, p. 197 fig. 99. Like the National Museum, Karachi/Islamabad Museum, Islamabad, astrolabe of 1047 A.H., this Oxford astrolabe of Muquim Lahori also bears two dates - one in Hijra (1053, both in letters and figures), and the Rumi or Seleucid date of the year 1955. It also bears a later date 1221 A.H./1806 A.C. There is another astrolabe, dia. 5½ inches, in the Spitzer Collection of the British Museum, London, which has been prepared by Muhammad Muquim of Lahore in 1070 A.H./1659 A.C. (Gunther No. 78, p. 210). Obviously the author of these five or six astrolabes is one person and hence the date assigned to Lahore Museum is not very wide off the mark.

But who was this Muhammad Muquim son of 'Isa son of Allah Dad? No information about him is available in history books nor any other astrolabe bearing his name and genealogy has so far been published. However, we know that Muhammad Muquim belonged to a family of renowned astrolabe-makers of Lahore. Maulana Sayyid Sulayman Nadvi writing in 1935<sup>44</sup> failed to locate anyone with the name Muhammad

Muquim of Lahore among the astrolabe-makers of Lahore. He did establish four generations of a family headed by Allah Dad (not al-Haddad) of Lahore in the following descending order:

Shaikh/Mulla Allah Dad  
Hafiz/Mulla 'Isa  
Mulla Qayim Muhammad  
Ziaud Din Muhammad

i.e. Ziaud Din Mohammed son of Qayim Muhammad son of Mulla 'Isa son of Sheikh Allah Dad. There is no mention of Muhammad Muquim in this genealogical table. Nabia Abbott, quoting Gunther informs us that on one of the astrolabes it is mentioned that 'Isa had two sons.<sup>45</sup> But their names are not mentioned. Nabia Abbott has read on various astrolabes in American Collections and those published by Gunther four personal names: Muhammad Muquim, Mohammed Qayim, Qasim Muhammad and one simply 'Mohammed' - all claiming themselves to be sons of one 'Isa or Hafiz 'Isa. But as she herself remained doubtful about her reading she left the issue inconclusive. Even an oriental scholar of the stature of Maulana Ilmud Din Salik while writing as late as 1962,<sup>46</sup> remained silent on this issue and confided himself to the genealogy of Ziaud Din Mohammed son of Qayim Mohammed son of Mulla 'Isa son of Sheikh Allah Dad as earlier established by Sayyid Sulayman Nadvi.<sup>47</sup> The discovery of two more astrolabes in the collection of Lahore and Karachi Museums, proves that Muhammad Muquim, the royal (Humayuni) astrolabe-maker of Shah Jahan's period also belonged to the famous family of astrolabe-maker from Lahore whose progenitor was Allah Dad. We will talk more about this family in the next part of this article.

The name of the progenitor of this family of royal astrolabe-makers, in all known cases, as in case of Lahore Museum too, is written as الهداد and hence has been read and transcribed variantly as al-Haddad, Illahdad and Allah Dad. In the first place there is no word as هداد with ( ه ). The word حداد with ( ح ) would mean 'blacksmith' and this too cannot be a personal name. Therefore, I accept here the reading of الهداد as Allah Dad as proposed by Maulana Sayyid Sulayman Nadavi long ago.

#### Astrolabe No. MM-1649 (Pl. VII-IX)

In the Collection of Lahore Museum, there is yet another astrolabe which bears accession No. MM-1649. It was acquired in 1986 at a big price. It was designed and fabricated in Lahore in the middle of the nineteenth century.<sup>48</sup> It is larger and much heavier than the Muquim Lahori's astrolabe in the same Museum, but is almost of the same size as that of National Museum astrolabe just discussed above. The brass chain ('ilaqa) down to safaih (spare discs), it is complete in all respects. Weighing a solid seven kilograms, it is 23.5 centimeters in diameters and gets a total of 63 cms when measured with armilla reflexa (*kursi*), armilla rotunda (*halqa*) and the total length of the brass chain. Its height upto the top of the *kursi* is 30.50 cms. The thickness of the main

disc with armilla reflexa and limbus (*hajra*) is 2 cms. It is a fine example of casting in brass. It has its alidade (Pl. VIII-b). A short inscription on the borsum (*zahr*) reads:

عمل استاد پیر بخش لاہوری

Trans: Work of the Master-craftsman (*Ustād*) Pir Baksh of Lahore.

On the front side there is a long Arabic inscription beginning with يا حافظ يا حفيظ and ending with يا علي يا علي . On the reverse is a quatrain in Persian beginning with ناد علی مظہر البجائب . On the ankabut is the famous formula inscription. A long inscription in Arabic in double lines, running all along the thickness of the astrolabe in the form of a circle, tells us, among other things, that this astrolabe was proposed by Maulvi Ghulam Muhammad Khan Allami and was designed by Lala Sahu Mall Lahori in the capital city of Lahore ( لاہور ) for the obedient young Mubarak Ali Khan in Samvat 1897/1257 A.H./1841 A.C. The astrolabe comprises the facies with a *kursi* welded on the top (Pl. VIII). The *kursi* suspends from a swivel with a ring for the support of a 30 cms long brass chain which ends in a squarish ring not shown in the photograph. In between *Umm* and *ankabut* (Pl. VIII-a) are seven *safaih* or extra discs carved on both sides (Pl. IX-b).

The front side (*wajh*) has a usual raised rim or limbus (*hajra*) graduated in usual manner of an astrolabe with major and minor graduation of 360°, each degree marked with an Arabic equivalence (Pl. VII-b). One of the *safaih* shown in Pl. IX-b has three concentric circles of usual denomination namely Tropic of Capricorn (outer-most), Tropic of Cancer (the inner-most) and the Equator (middle one). Near the central pin (*qutb*) can easily be read the words العرض ساعات . In the upper half, there is another centre for another group of concentric circles which represent lines of *al-muqantars* with line of horizon marking the outer-most circle. Four quadrants of 90° each. The lower quadrants are divided into 12 divisions by lines radiating from the central pin, each marking an angle of 15° and numbered 1 to 11. In the centre are the words العرض ساعات and the East and West sides of the Equator are marked with the words المغرب and المشرق .

The whole facies (Pl. VII-b) gives the names of the areas (*aqleem*), their latitudes and longitudes in a vertical column converging on *qutb*. The names of *aqleem* given on the facies mostly appertain to India and Pakistan, all rendered in beautiful and bold nasta'aliq script. Some more prominent cities in India read: Daulatabad, Ujjain, Nurpur, Baijapur, Qannauj, Somnath, Aurangabad, Awadh, Ahmadabad, Gawaliar, Burhanpur, Banares, Delhi, Mathura, Jaunpur, Amratsar, Ludhiana, Hardwar Ganga Ji, Najibabad, Farrukhabad, Jaganath, Lakhnau, Goa, Calcutta. Among cities typical of Pakistan are: Peshawar, Lahore, Sialkot, Pind Dadan Khan, Ramnagar, Kashmir, Multan, Mansar(?), etc. Among other cities of the Islamic world but lying outside the Subcontinent are: Madinatul Rasool, Makkah Muazamma, Basra, Balkh, Isfahan, Shiraz,

Herat, Bukhara, Samarkand, Sikandria (Alexandria), Badakhshan, Kabul, Kashgar, Qandhar, Kashmir. Among other Sarandeeep and even Tibet and London are quite prominent.

The back side (Pl. IX-a) shows the usual four divisions. The right hand upper quadrant is divided into squares with series of vertical and horizontal lines. The left hand upper quadrant on the other hand, shows a series of concentric circles with names of stars such as *Zohra*, *Aturad*, *Qamar* etc. and their coordinates. The lower left quadrant has similar concentric rings with two signs of zodiac inscribed in three group of four each. The lower right hand quadrant is empty except that one quarter of the square with graduated sides numbering 1 to 7 projects into it whereas the other one quarter is projected in the neighbouring quadrant with two sides each graduated from 1 to 12.

Now who was this *Ustad* Pir Bakhsh who fabricated this beautiful astrolabe? Had he any connection with the family of Shaikh Allah Dad or with any one among his known successors? We are not sure. In the 19th century there were a number of artists in Lahore with the family name 'Bakhsh'. They were master artisans in more than one craft. They were master wood-carver, blacksmith, architect, masons, naqqash (fresco-painter), painter, calligraphers etc! Probably *Ustad* Pir Bakhsh was a member of one of such artistic families of Lahore.<sup>49</sup> Descendants of several of them now claim themselves to be Chughtais. *Ustad* Pir Bakhsh's connection with the family of Allah Dad, which appears to be a family of scholars (Mulla or Shaikh), is more probable than with any other family of craftsmen. This astrolabe is important in one other respect. It tells us for the first time that by the 19th century, if not earlier, astrolabe designing and making was no more the exclusive privilege of the Muslims of this city. For the first time we have the name of a Hindu designer Lala Sahu Mall Lahori, resident of the capital city of Lahore. Unfortunately, nothing is known about this Lala Sahu Mall from any book or history of Lahore.

#### Astrolabe No. M-44-H (Pl. X-a & X-b)

Another planispheric astrolabe in the collection of Lahore Museum bears accession No. MM-44-H (Pl. X-a & X-b). It is simple to the extreme. It is a single disc astrolabe with an Index or *mastar* on the back and hence has no raised rim or *hajra*, and no depressed circular space called *Umm* or *mater*. Both the round facies and armilla reflexa (*kursi*) are made out of one single sheet of brass. A hole in the top of the triangular armilla reflexa receives a rivet for the remaining parts of the suspensory apparatus namely *'urwa*, *halqa* and *'ilaqa* which are all missing in our example. The *kursi* has a frill border but with the plain surface on both sides.

The instrument has been designed to act as a perennial calendar rather than an astrolabe proper. It comprises two discs – an inner movable one with a knob set within an outer fixed one (Pl. X-a). The days scribed are Persian beginning with *Shanba* (Saturday) and ending with *Juma* (Friday), but the month names are both English and

local (*desi*) such as *Chehtar* (چہتر), *Basak* (بساک), *Jehta* (جہتر), *Har* (ہار), *Saun* (سون), *Badro* (بادرو), *Asawal* (اساول), *Katak* (کاتاک), *Mahgar* (مہگر), *Poh* (پوہ), *Magha* (ماگھہ) and *Paghan* (پاکھن).

The Arabic months names are characteristically absent. The entire surface of the facies or *wajha* is divided into nine concentric circles – four on movable inner plate and five on the outer fixed plate. Barring the inner-most circle, the four inner circles are further divided into seven divisions each for a day of the week, with lines radiating from the centre. The months too, accordingly, have been grouped into seven boxes pairing February-March-November, September-December, April-July, January-October and remaining – May, August and June as single months in outer circle, and January-April-July, February-August, March-November, and remaining single months pairs in the inner circle. The 31 days of a month are marked in boxes between days and months names circles. The four outer circles are meant for computation of years and months on a calendar of 100 years. Like inner set of circles, the outer circles too are divided into seven groups. Each of the seven divisions of the circles in word of the outer-most circle is divided into sub-groups of five years each. In six out of seven divisions of the outer-most circle have been grouped twelve months of the year – two months in each group beginning from the top left-hand with the first month of the Christian Calendar namely January. It has also been indicated as to what is the corresponding days of a local month on first day of the Christian month. For example it has been shown that the first January will be on 20th of *Poh*, 1st February on 21st *Magh*, 1st March on 20th of *Phagan*, 1st April on 21st *Chaitr*, and so on and so forth. The 100 years are computed in three circles – 31 in the outer-most, 35 in the middle and 34 in the inner-most circle. Hundred is marked by double zero (00). At the right hand bottom of the *kursi* and in the seventh empty-division is scribed the following inscription:

عمل جوتشی دھرم چند

Trans: Work by Jotishi Dharam Chand.

No date and place name is given, but it is almost certain that the instrument was made during the last half of the 19th century when nasta'alique script has not yet developed enough as to differentiate between k (ک) and g (گ), t (ت) & tt (ٹ) and (ی) and (ے); and when the aspirates like Ph (پھ), Kh (کھ), Chh (چھ), tth (ٹھ) etc. have not taken proper shapes.

Similarly, following table shows how at the time of making this astrolabe, writing of the names of local (*desi*) months in local language have not yet been standardized as today. These are neither pure Hindi nor pure Punjabi:

Sanskrit	Hindi	Punjabi	On the Astrolabe	
			Front-side	Back-side
Chaitra	चैत्र	ਚੈਤਰ	چتر	نتر
Vaisakha	वैशाख	ਵੈਸਾਕھ	بساک	ساک
Jyaishta	ज्यैष्ठ	جیٹھ	جته	جه
Ashadha	आश्व	آش	ار	ہار
Sravana	श्रावण	ساون	ساون	ساون
Bhadrapada	भद्रपद	بھادروں	بادرو	بادرو
Asvina	असु	اسوں	اساوں	اسو
Karttika	कार्तिक	کرتے / کٹک	کارتک	کارتک
Margasirsha	मार्ग	مگر	مگر	مگر
Pausha	पौष	پوہ	پوہ	لوہ
Magha	मघ	مانگھ	مکبہ	مک
Phalgun	फाल्गु	پھلگن	پاکھن	سلن

Writing of certain month-names in characteristic Punjabi form, makes it almost certain that this astrolabe too was made in Punjab. If so, in Punjab no other city than Lahore can claim this credit. Thus I conclude that this astrolabe was manufactured in Lahore in the later half of the 19th century.

The dorsum or *zahr* of this astrolabe has several concentric circles - outer two graduated into four quadrants of 90° - with each box marking 6° (Pl. X-b). All numerals here as well as elsewhere, are in Arabic numerals (1, 2, 3, etc.) rather than in letters as in earlier cases. The next two circles are month circles with numeral divisions varying anti-clockwise from 1 to 15, 1 to 18, 1 to 10, and 1 to 12 followed from 1 to 15, 1 to 17 and 1 to 11 in the next circles and 1 to 60 in clockwise fashion in the third circle. Next four circles indicate the signs of zodiac and their latitudes in 12 groups of 30 degrees each - marked from 6 to 30°.

One Persian inscription on the back side names this instrument as Aina Falky - the Mirror of the Sky, the work of Dharam Chand. Obviously, dorsum or *zahr* is meant to locate the zodiac signs, as already given above with reference to local Punjabi month-

names with the help of an alidade. In the lower right hand quadrant, the following Persian inscription is placed in one of the concentric rings:

دریں آئینہ منکی

دھرم چند

"In this 'Mirror of the Sky' which has the circle of upper horizon and the circle of *Fauq* in the direction (?) of both the circles. Dharam Chand"

The names of the zodiacs are given on two of the inner-most concentric rings whereas the month-names - only local (*desi*), are given in two outer-most rings and are in groups of three or four months each such as *Katak & Phagan, Baisakh & Bhadron, Harr* (alone), *Jeth & Sawan, Chait & Aswaj, Magh & Maghar*.

Who was this Jyothshi Dharam Chand? We are not sure. Nothing is known about him either from the Museum record or from any history book. But most probably he too belonged to the city of Lahore. Perennial calendars of this type were not un-common upto middle of the 20th century. I had one such calendar in my family at the inception of Pakistan in 1947. Despite some claim of Hindu influence on early Muslim astronomy,<sup>50</sup> Hindu contribution towards astrolabe-making is limited. Among 165 examples recorded by Gunther only eight are made by Hindus.<sup>51</sup> None bears the name of an astrolabist. The names of two Hindu astrolabists - Jyotishi Dharam Chand and Lala Sahu Mall Lahori known from the astrolabes of Lahore Museum are, therefore, a valuable addition to our knowledge. Hindu astronomical instruments were primitive and confined to four types:

- Clepsydra or water clock as referred to in the Jyotisha Vedanga,
- The Gnomon or the Sun-Dial as defined in Panchsidhantika,
- Armillary Sphere i.e. *Bhubha Gola*, fashioned as an Earth-Globe of wood, and
- Phalaka Yantra - in fact a part of a very simple astrolabe.<sup>52</sup>

The earliest proper astrolabe scribed in Devanagari script and datable to the end of the seventeenth century is in Delhi Museum.<sup>53</sup>

## III

## ASTROLABES AND ASTROLABE-MAKERS OF LAHORE

The above section has already shown how fine astrolabes were made in Lahore from the sixteenth to the close of the 19th centuries. In this section we will deal with all the known astrolabes made in Lahore and their makers, fabricators & designers - as known from the inscription carved on them. As we have already seen partially, and will see in somewhat more details hereafter, Lahore was once the most celebrated centres of astrolabe-making. J.D. North, writing some twenty years back, while referring to generations of family of astrolabe-makers in a single centre could find only the city of Lahore to suit his argument: "The family might all, for example", wrote North, "have worked at a centre such as Lahore, and thus perhaps have had connections with the Mogul Court".<sup>54</sup> Gunther's list of 26 Indian (excluding Hindu) astrolabes include 14 (54%) which were made at or by astrolabists belonging to Lahore and which list also discloses names of six members of a single family hailing from Lahore.<sup>55</sup> The real credit, however, for bringing to light a big number of astrolabes made by the last scion of this family goes to Allama Sayyid Sulayman Nadvi. Besides, he also brought to light the names of three other astrolabists - all belonging to the same family, all hailing from the city of Lahore and all claiming the sobriquet of "Asturlabi Humayuni Lahori".<sup>56</sup> They are: Sheikh Allah Dad, his son Mulla 'Isa, grandson Qayim Mohammed and the grand grandson Ziaud Din Mohammed. Soon after this, some valuable information was added by Nabia Abbott.<sup>57</sup> Maulana Mohammed Ilmud Din Salik, on the other hand, while writing as late as 1962<sup>58</sup> could not do justice with the subject and confided himself by giving a summary in Urdu of Sayyid Sulayman Nadvi's English article published in 1935. Having now discussed in part II above the existence of at least four astrolabes by one Mohammed Muqim, son of 'Isa, son of Allah Dad, we now confidently can add this name to the genealogy of Ziaud Din Mohammed *asturlabi Humayuni Lahori* as a brother of Qayim Mohammed.

What does the sobriquet "Asturlabi Humayuni Lahori" stands for? Gunther in 1932 translated it as 'Royal Astronomer' (p. 187). Sayyid Sulayman Nadvi, on the other hand, has suggested that the family adopted this sobriquet or *laqb* ( لقب ) because they manufactured their astrolabes after a model approved by the Emperor Humayun.<sup>59</sup> But it is strange that the only 'asturlab' which carries Allah Dad's name alone does not have this title. The inscription on the earliest extant-in-record astrolabe reported to be in the Library of Nawab Sir Salar Jang Bahadur, Hyderabad Deccan though refers to him as a master-craftsman (*Ustaz*) and an *asturlab-saz* of Lahore, does not give him the title of Humayuni. It reads as follows:

صنعة أستاذ الهداد اصطرلابي لاهوري سنة ٩٤٥ هـ

Trans: "Work of Master Allah-Dad, the astrolabe-maker of Lahore, dated 975 A.H./1567 A.C."

It is also evident from the date that it was made not during the reign of Humayun but the early years of Akbar's reign (1556-1605 A.C.). Nor there is any mention that either Allah Dad or his son 'Isa was employed in the royal service. The family started claiming for themselves the title "Humayuni" as a part of their sobriquet only when they became the royal astrolabists. The first one in the family to use this title was Qayim Muhammad in 1634. I think, therefore, that Gunther and Nabia Abbott are right to suggest that the word 'Humayuni' therefore should be regarded as to mean only 'royal'.<sup>61</sup>

Without denigrating Humayun's contribution towards astrology and astrolabe-making or undermining his claim to have developed a special type of this apparatus known after his name as *asturlab Humayuni*,<sup>62</sup> a regular workshop established at Lahore by Humayun himself or in his name is yet to be established. But that a workshop did exist here during his reign is now certain. A regular royal workshop for different works of arts and crafts was established in Lahore only under Akbar. At the same time there is every possibility that Shaikh Allah Dad had already established his workshop during the reign of Humayun as example of his work produced during the early reign of Akbar has already been quoted above. And once he started this work, Lahore and his family remained in the forefront of astrolabe-making for one and a half century and Lahore, in particular, for all times to come. It was during this time that Lahore became the biggest centre of astrolabe-making and it remained so till making of this instrument became obsolete at the close of 19th century. Individuals and families engaged in this profession became renowned. The stamp *asturlab Lahori* was a guarantee for its precision and aesthetic. At least the names of five linear descendants of a single family, and of two from some other families including one Hindu designer are known from the actual extant specimens.

Astrolabes made in Lahore during Mughal period are now scattered in several museums of the world in general and in India in particular. Gunther's 14 astrolabes made by the astrolabists of Lahore are reportedly in the Kestner Museum, Hamburg (S. No. 69), Ashmolean Museum, Oxford (S. Nos. 71, 72, 77), Jaipur Museum, Jaipur (S. Nos. 75, 80), British Museum, London (S. No. 78), State Library, Rampur (S. No. 77 A), Indian Museum, Calcutta (S. No. 81, 77), Delhi Museum, Delhi (S. No. 77), Hoffman Collection (S Nos. 86 & 87) and one from an unknown location. Two astrolabes by two members of Allah Dad family from the atelier of Lahore are reported to be in the Adler Planetarium & Astronomical Museums, Chicago, U.S.A.<sup>63</sup> One more from Lahore is in France(?)<sup>64</sup> and still another one in the Berlin Museum.<sup>65</sup> Maulana Muhammad Ilmud Din Salik, deriving his information mainly from 'Islamic Culture' issue of October, 1935, quoted several examples of astrolabes from the workshop of Lahore now found in various parts of India.<sup>66</sup> The Jaipur astrolabe of 1657 A.C., the Ashmolean Museum, Oxford astrolabe of 1658 A.C. & Jaipur Museum Arzachel astrolabe of 1680 - all recorded to have been made by Ziaud Din son of Qasim Muhammad son of Mulla 'Isa son of Shaikh Allah Dad (Gunther S. Nos. 75, 77, 80). This gives a complete genealogy of four generations of a single family of astrolabists from Lahore. The same genealogy, with the difference of one name i.e. Qayim instead of Qasim has been read on an astrolabe

reported to be in the Nadvatul Ulama Library, Lucknow. It is dated in 1059 A.H./1649 A.C. and belongs to Shah Jahan's reign. The inscription on it reads:

عمل ضياء الدين محمد بن قاسم محمد بن  
ملا عيسى بن شيخ الهداد اسطرلابي همايونى لاهوى ١٠٥٩ هـ

**Trans:** The work of Ziaud Din Muhammad, son of Qayim Muhammad son of Mulla 'Isa son of Shaikh Allah Dad, Royal Astrolabe-maker of Lahore, dated 1059 A.H.

Inscription on one spherical astrolabe, weight 1¼ pound, reported to be in the Library of Maulvi Yousaf of Phalwari Sharif, Distt. Patna since 1238 A.H./1822 A.C., records the same genealogy with the exception that it is dated a year earlier i.e. 1058 A.H./1648 A.C. and that Shaikh Allah Dad has been mentioned here as Mulla Allah Dad and that the word 'ibn' has been used instead of 'bin' both meaning son.<sup>67</sup> We will talk more about Ziaud Din Mohammed here below. Suffice here to say that between Ziaud Din and Allah Dad we know at least three more names belonging to the same family. We know about one Shaikh Allah Dad Langar Khani Lahori and the Mohalla Langar Khan in Lahore named after him. If it is so, Allah Dad appears to have been born in 924 A.H./1518 A.C. and must have been a young man of twenty-five or thirty during the reign of Humayun.<sup>68</sup> He was a contemporary of Maulana Maqsum Harwai - the mechanic who manufactured astronomical instruments, astrolabes & globes for Humayun<sup>69</sup> and Mulla Nurud Din Tarkhan Nuri Sufidini of Sindh.<sup>70</sup> Beside Allah Dad, we have extant specimens of three more persons belong to the same family. First one is Mulla 'Isa, son of Allah Dad. That he was a learned man and scholar is evident from his title *mulla*. At least two of his astrolabes have been referred to in various publications. The earlier one, dated 1013 .H./1604 A.C. is now in the Adler Planetarium and Astronomical Museum, Chicago.<sup>71</sup> The inscription on it reads:

صنعة اضعف العباد عيسى وؤد الهداد سنة ١٠١٣ هـ

**Trans:** "The work of the weakest of creatures, 'Isa, son of Allah Dad, year 1013 A.H."

His other known astrolabe was originally published by R.T. Gunther, (No. 68) and dated round about 1600 A.C., but N. Abbott modified the date between 1018-1034 A.H./1609-1624 A.C. in order to bring it closer to the times of his son Qayim Muhammad.<sup>72</sup> Thus Mulla 'Isa, the astrolabist of Lahore worked during the reigns Akbar & Jahangir, got a particular official assignment from and recognition by the emperor Jahangir sometime between 1604 and 1624 A.C. because his son Mulla Qayim Muhammad, who lived and worked during Jahangir's and Shah Jahan's reigns, was also in possession of this proud title in 1624 A.C. One of his astrolabes bearing a date 1034 A.H./1624 A.C., reported

to be in the possession of Qazi Abaid Ullah Bari of Calcutta, mentions this fact as follows:

عمل قاسم محمد بن عيسى بن الهداد  
اسطرلابي همايونى ١٠٣٤ هـ

**Trans:** "Work of Qayim Muhammad, son of 'Isa, son of Allah Dad, the Royal Astrolabe-maker, dated 1034 A.H."

In the other corner of the same apparatus it records to have been made in the 21st year of Jahangir.

In this inscription, it is not clear if Qayim Muhammad was a resident of Lahore. This doubt is dispelled in another inscription dated 1047 A.H./1637 A.C. found on a spherical globe made by Mulla Qayim Muhammad during the reign of Shah Jahan. It is in the Oriental Library, Bankipur and bears two inscriptions - one short and one long, both dated 1047 A.H. The shorter one reads:

صنعة اقل العباد قاسم محمد ابن عيسى ابن  
الهداد اسطرلابي لاهوى همايونى سنة ١٠٤٧ هـ

**Trans:** "The work of the humblest of servants, Qayim Muhammad son of 'Isa, son of Allah Dad, the Royal Astrolabe-maker of Lahore, year 1047 A.H."<sup>73</sup>

Was Qayim Muhammad Lahori the only son of Mulla 'Isa Lahori? Nadvi's account implies: yes. But two years later, Nabia Abbott made 'Isa look possibly to be the father of four sons - Qayim Muhammad (Calcutta astrolabe dated 1034 A.H./1024 A.C.), Qasim Muhammad (Ashmolean Museum, Oxford as in Gunther No. 77), Muhammad Muquim (British Museum, London, and Ashmolean Museum, Oxford, as in Gunther No. 78 & 72) and one Muhammad (Ashmolean Museum as in Gunther No. 71) without any proper name.<sup>74</sup> Gunther (S. No. 77, p. 210) even mentions a fifth name Kia Muhammad son of Mulla 'Isa son of Shaikh Allah Dad and himself father of Ziaud Din Muhammad as read by G.R. Kaye on a globe dated 1658 A.C. in Indian Museum, Calcutta. Nabia Abbott, however, was conscious about the weakness of her argument and finally doubted the existence of even two including one Muhammad Muquim. I think 'Qasim' is only a misreading of 'Qayim' and 'Muhammad' can stand either for 'Muhammad Muquim' or 'Qayim Muhammad' as is now confirmed from several specimens. Thus it turns out that Mulla 'Isa of Lahore had only two sons Muhammad Muquim and Qayim Muhammad - both were astrolabe-makers, both had royal assignments and hence deserved the title 'Humayuni' and both were residents of Lahore.<sup>75</sup> This will necessitate to eliminate the name Qasim Muhammad which Gunther read more than four times un-hesitantly [Gunther S. No. 75, 77 (bis) and 80] excluding his reading

of a name KIA MUHAMMAD son of Mulla 'Isa. We do not know which one of the two was elder brother. But as the reason d'etre for this article is the two astrolabes by 'Muhammad Muquim' now available in Pakistan, we give him precedence over the other. The contribution of this son of the soil of Lahore towards astrolabe making is being confirmed for the first time. Two of the astrolabes made by this renowned son of Mulla 'Isa of Lahore - one dated circa 1640 A.C. in Lahore Museum and the other dated in 1637 A.C. in the National Museum of Pakistan, Karachi, have already been discussed above. We also meet his name in the inscription on an astrolabe dated 1053 A.H./1643 A.C., listed by Gunther as his No. 72, Pl. XLVIII. It reads as follows:<sup>76</sup>

صنعة اضعف العباد محمد مقيم بن عيسى  
بن الهداد اصطرلابي همايون لاهوري سنة ١٠٥٣ هـ

**Trans:** "The work of the weakest of servants, Muhammad Muquim, son of 'Isa, son of Allah Dad, Royal Astrolabe-maker, resident of Lahore, the year 1053 A.H."

His name also appears on another astrolabe in Spitzer Collection of British Museum, London (S. No. 78 in the list of Gunther) dated 1070 A.H./1659-60 A.C., dia. 5½ inches.<sup>77</sup> Thus at least four of the specimens made by this scion of Allah Dad family of master-astrolabe-makers of Lahore are known. The credit for a fifth one by an un-named son of 'Isa, son of Allah Dad can also be shared by him at fifty-fifty basis.

As compared to Muhammad Muquim, the recorded extant specimens of his brother Qayim Muhammad are less numerous. He was maker both of astrolabes and 'globes' (see above). In the early period of his career he did not bother about claiming his residence at Lahore even when in 1034 A.H./1624 A.C. he was appointed as a Royal astrolabe-maker. But in 1047 A.H./1637 A.C. he proudly called himself *Lahori* - a resident of Lahore.<sup>78</sup> He worked during the reigns of Jahangir & Shah Jahan.

On two astrolabes the name Ziaud Din Muhammad, son of Qasim (Qayim) Muhammad, son of Mulla 'Isa and Ziaud Din Muhammad son of Mulla Qasim (Qayim) Muhammad, son of Hafiz 'Isa have been read. The inscription on the former, dated 1069 A.H./1658 A.C., read as follows: "The work of the humblest of the servants Diya al-Din Mohammad the son of Sheikh al-Haddad (sic) the Royal Astrolabe-maker, the son of Kasim Mohammad son of Mulla 'Isa of Lahore in the year 1069 A.H." <sup>79</sup> It is in Sir Lewis Collection, the Ashmolean Museum, Oxford. The other is a globe or sphere with an inscription which G.R. Kaye has read as follows: "Dia al-Din Muhammad ibn Mulla Qasim Muhammad ibn Hafiz 'Isa ibn Shaikh Allahdad, Humayuni, Sana 1087<sup>80</sup>." How it is possible that same Zia-ud Din Muhammad, on some other astrolabes, claims Qayim Muhammad to be his father. It is possible that both R.T. Gunther and G.R. Kaye have misread Qayim Muhammad as Qasim Muhammad. The same is true about one Muhammad, son of 'Isa of Lahore (Gunther No. 71).<sup>81</sup> But in any case these three astrolabes are from the atelier of Lahore and their makers ultimately belong to the family

of 'Isa, son of *Ustad* Allah Dad of Lahore. Since Qasim Muhammad, his father 'Isa & his father Allah Dad have been claimed 'Mulla' - an individual possessing religious knowledge and on two singular astrolabes 'Isa has been called 'Hafiz' (one who can recite the entire Holy Quran from memory) and his father Allah Dad as Shaikh (a scholar) respectively, it shows that this Lahore based family of astrolabists was basically a family of scholars turned into astrolabists. They made both planispheric (*asturlab sathi*) as well as globes (*asturlab kuri*). They were certainly the designers and probably the fabricators too of the astrolabes and globes bearing their names. It is a common place knowledge that the most beautiful astrolabes were always designed and fabricated by one person.

One of the last two scions of this Lahori family of astrolabists, who flourished during the reigns of Shah Jahan & Aurangzeb, was named Ziaud Din Muhammad. Coincidentally, he was the most prolific astrolabe-maker of Lahore. Several specimens of his fine workmanship are known in collections scattered all over the world. Unfortunately, none of his work appears to have survived in his own city i.e. Lahore. His signature on majority of his works, however, gives full genealogy of his family, his royal title i.e. *asturlabi humayuni* and the place of his residence i.e. Lahore. At least fifteen of his works - eleven planispheric astrolabes and four globes or astrolabio redondo are known from published works. The earliest of his extant work is a globe dated 1057 A.H./1647 A.C. whereas his last signed astrolabe dated 1087 A.H./1676 A.C. is in the Delhi Museum.<sup>82</sup> The earliest of the extant planispheric astrolabe signed by him is dated 1058 A.H./1648 A.C.

Ziaud Din Muhammad, son of Qayim Muhammad retained his proud title: "the Royal Astrolabe-maker" - "اسطرلابي همايوني" for long 30 years and always took pride in claiming himself to be the resident of Lahore. The only exception is the planispheric astrolabe in the Library of Rampur where the words "اسطرلابي همايوني لاهوري" are missing obviously due to the disfiguring of the inscription.

The inscription in all the astrolabes and globes are identical except one or two minor & insignificance differences and change of date in certain cases. Four of his astrolabes, reportedly one each now in Jaunpur, Rampur, Bankipur and one seen in London Exhibition held in 1931, bear the same date i.e. 1074 A.H./1663 A.C. In two cases - Hyderabad Deccan specimen dated 1064 A.H. and Rampur specimen, the word for son used is *ibn* whereas in all other examples he uses the word *bin* - both having the same meaning. In all inscriptions Ziaud Din Muhammad uses for himself the humble title 'اقل العباد' i.e. the humblest of creatures. For his works, he uses the word *عمل* i.e. "the work of" and for dates he uses *في سنة* i.e. in the year.... With these minor differences, the inscriptions on all the fifteen astrolabes and globes read as follows:

عمل اقل العباد ضياء الدين محمد بن قاسم محمد  
بن ملاء عيسى بن شيخ الهداد في سنة .....

**Trans:** "The work of the humblest creature Ziaud Din Muhammad, son of Qayim Muhammad, son of Mulla 'Isa, son of Shaikh Allah Dad, in the year..."

The fifteen extant astrolabes and globes of this great astrolabists of Lahore are as follows.<sup>83</sup>

#### A. Globes

1. Made in Lahore, dated 1058 A.H./1648 A.C. and reported to be in the collection of Maulvi Yusuf of Phulwari, Distt. Patna. It weighs 1½ pound. It is made of brass whereas the nails near each star are in silver.
2. Made in Lahore in 1064 A.H./1653 A.C., now in Tibbia College, Aligarh.
3. Made in Lahore, dated 1071 A.H./1660 A.C. Reportedly (in 1935) it was in Berlin Museum, Germany.
4. Made in 1087 A.H./1676 A.C. made by Ziaud Din Muhammad ibn Mulla Qasim Muhammad ibn Hafiz 'Isa ibn Shaikh Allah Dad, Humayuni, Sana 1087.<sup>84</sup> It is in Delhi Museum.

#### B. Planispheric Astrolabes

5. Made in Lahore, dated 1057 A.H./1647 A.C., in the Adler Planetarium and Astronomical Museum, Chicago, U.S.A.
6. Made in Lahore, dated 1059 A.H./1649 A.C., and reported to be in the Library of Nadwa tul 'Ulema, Lucknow.
7. Made in Lahore, dated 1064 A.H./1653 A.C., now in the Library of Nawab Sardar Yar Jahg, Hyderabad, Deccan. It originally belonged to Maulana Habibur Rahman Khan Sherwani, Resident of Habib Ganj, Distt: Aligarh.
8. So-called Jaipur B Astrolabe, dia. 13", made in 1657 A.C. (Gunther S. No. 75, p. 206-212).
9. Made in A.H. 1069/1658 A.C., dia. 7", purchased in 1911 in Algeria. Now, part of Lewis Evans Collection in the Ashmolean Museum, Oxford (No. 77 in Gunther's Astrolabes of the World, p. 208, where he wrongly calls Ziaud Din Mohammad as son of Shaikh al-Haddad/Allah Dad).
10. Once belonged to Maulana Abu Bakr of Jaunpur made in Lahore and bears the date 1074 A.H./1663 A.C.

11. In the collection of Library of Rampur and inscribed with date 1074 A.H./1663 A.C. The title "Asturlabi Humayuni Lahori" missing due to disfigurement of the inscription. (Gunther S. No. 78 A, p. 228 and Journ. United Province Hist. Society, October 1928).
12. Exhibited in Persian Art Exhibition, London, 1931. Made in Lahore and bears the date 1074 A.H./1663 A.C. (Printed Catalogue p. 193).
13. Made in Lahore, astrolabe bears the date 1074 A.H./1663 A.C., reported to be in the Library of Bankipur.
14. Made by Ziaud Din, son of Mulla Qayim Muhammad, son of Hafiz 'Isa, dated 1087 A.H./1676 A.C.<sup>84</sup>
15. So-called Ziaud Din's Arzachel astrolabe (dia. 24") in Jaipur Museum, made in 1091 A.H./1680 A.C. made at Delhi for Nawab Iftikhar Khan of Jaunpur.

Gunther, but none else, has briefly described one astrolabe of 6½" diam. acquired in 1882 by the Indian Museum, Calcutta. Sufficient details are not available except that it was made by one Jamalud Din of Lahore in 1092 A.H./1681 A.C. and that its *Kursi* is somewhat coarser than that executed by Muhammad ibn 'Isa, who appears to have been the senior maker at Lahore. There are 20 symmetrical perforations through the *Kursi* (Gunther, S. No. 81, p. 213). The similarity of names, closeness of dates of their works and Lahore being the ancestral house of the two, make Ziaud Din & Jamalud Din look like real brothers during the middle of Aurangzeb's reign. No specimen of any other descendant of Allah Dad's family of Lahore or any descendants of Ziaud Din Muhammad of Lahore has so far come to light. Apparently, the family tradition of *asturlab-sazi* ended with Ziaud Din Muhammad and Jamalud Din but not the art of *asturlab-sazi* in Lahore itself. There are at least two astrolabes in the Hoffman Collection - one of small size (dia. 3½ inches) and other of medium size (dia. 5½ inches) - the latter inscribed on the back (no details are available). No date has been assigned to either of the two, but R.T. Gunther, on stylistical ground, has assigned both of them to the atelier of Lahore (Gunther S. Nos. 86 & 87, p. 216). Here in the city of Lahore, this scientific, artistic and smithy tradition, however, continued till late in the 19th century when we hear two other families - one Muslim and other Hindu, busy in designing and fabricating astrolabes. One beautiful example dated 1841 and fabricated in Lahore is now in Lahore Museum. It was designed by a Hindu - Lala Sahu Mall and was fabricated by one master-craftsman - *Ustad Pir Bakhsh*. Both were residents of Lahore. On philological and grammatical grounds I have shown above, that the single disc astrolabe called *Aina Falky* i.e. The Mirror of Sky, designed and fabricated by a Hindu named Jyotishi Dharam Chand, was the last astrolabe in extant made in the workshop of Lahore. By the beginning of the 20th century, the astrolabe went completely out of use in the society and hence its designers and mechanics all gradually shifted to new professions.

## CONCLUSION

As already discussed, Lahore had prolonged traditions of *asturlab-sazi*. But, Lahore's place and contribution in this science is yet to be ascertained in a proper perspective. We have described above only three of them made in Lahore - all reached museums accidentally and not through a conscientious attempts of museum people. Two *Asturlabe Kuri* have not been described here. Many more made in Lahore are known in many museums and libraries the world over. Many more Lahore astrolabes are waiting to be discovered. This is yet another facet of Lahore's history which is awaiting unveiling.

## ACKNOWLEDGEMENTS

For translation of several Persian inscriptions on astrolabes and globes I have heavily depended upon an article of Maulana Sayyid Sulayman Nadvi published in Islamic Culture, October, 1935, except that I have preferred to translate the word 'Humayuni' as 'royal'. For a few other inscriptions, I have benefitted from the advice of Prof. Muhammad Aslam. Photographs at Pl. II, IV, V, XI & XII are my own whereas those at Pl. III, VII, VIII, IX & X have been supplied by the courtesy of Director, Lahore Museum and Pl. VI by the courtesy of Director, National Museum of Pakistan through two of my former students M/s Muhammad Hassan and Muhammad Jamil Chaudhry. For my fresh study of two astrolabes and two globes of Lahore Museum, I was greatly facilitated by Mrs. Nusrat Ali, Keeper and Mr. Muhammad Saleem, Modeller, both of Lahore Museum. M/s Muhammad Naem, Draftsman, Muhammad Din, Surveyor, Imtiaz Ahmad, Photographer and Zahoor Ahmad, P.A., all from my own Directorate, have assisted me in the selection and final preparation of Pl. I and all the three drawings and typing of the script. I am thankful to all of them. Mr. Muhammad Asghar, my former colleague in Lahore Museum and now Deputy Director, American Centre Library, Lahore, made it possible for me to consult the original copy of the Astrolabes of the World by R.T. Gunther specially air-mailed by the Document Supply Centre of the British Library, London, through the British Council Library, Lahore. I am deeply indebted to all those involved in this transaction, especially Mr. Asghar. I am also grateful to Mr. M.A. Halim, Project Director, Islamabad Museum, Islamabad, for permitting me to examine the Muquim Lahori's astrolabe in his custody.

## APPENDIX

## ORIGINAL TERMS USED IN THIS ARTICLE

Al-azada/Al-aḍada	العزادة	Sighter called Alidade. A sort of radius or regula placed on the backside of an astrolabe.
Ankabut/Jali	عنكبوت/جالی	A star map of the heaven also called spider, rete, aranea, and <i>jali</i> . It is a detachable disc made in a variety of decorative forms and placed on the <i>Umm</i> .
Asa-i-Tusi	عصا طوسی	Same as <i>Asturlab Khatti</i> . A Linear Astrolabe known after the name of its inventor Tusi.
Assimut	اِسْمُت	Same as Azimuth in English.
Asturlab	اسطرلاب/اصطرلاب	Astrolabe in English and in Greek.
Asturlab Khatti	اسطرلاب خطی	See Asa-i-Tusi.
Asturlab Kuri	اسطرلاب کروی	Spherical astrolabe or Globe, called <i>astrolabio redondo</i> in Latin.
Asturlab Musattah	اسطرلاب مسطحه	Planispheric astrolabe consisting of a suspensory apparatus, a disc and a spider. Same as <i>Musattah asturlab</i> .
Asturlab Ukri	اسطرلاب اُکری	See <i>Asturlab Kuri</i> .
Bast-ul Kura	بست الکوره	See <i>Asturlab Musattah</i> .
Bozanti Taqweem	بوزنطی تقویم	Julian Calendar. Also called Qibti or Coptic Calendar.
Chhalla	چھلا	See fals.
Dai'rat al 'Itidal	دائرة الاعتدال	See Madar ra's al-Hamal.
Dai'rat al buruj	دائرة البروج	Ecliptical longitudes.
Dai'rat al macantara	دائرة مقنطره	Equator. English: al-macantars.

Dwairul arz	دوائر العرض	Circle of a latitudes.
Dwair-al-samut	دوائر السموت	Vertical circles.
Dwair-al-tul	دوائر الطول	Circles of longitude.
Fals	فلس	A small ring or washer placed below the <i>faras</i> .
Fana	فانه	See <i>faras</i> .
Faras	فارس	A horse-shaped wedge kept above the ring. Also called <i>equus</i> , <i>fana</i> , <i>caballus</i> , <i>cuneus</i> & <i>ghorra</i> (horse).
Ghorra	گھوڑا	See <i>Faras</i> .
Habs	حبس	See ' <i>Urwa</i> '.
Hajra/Hadjra	حجرة	Means 'ring' or 'curve'. Latin <i>morgo</i> or <i>limbus</i> . Outer raised rim of <i>wajh</i> .
Halqa	حلقه	Armillar rotunda or 'ring' - a part of suspensory apparatus of a planispheric astrolabe.
'Ilaqa	علاقه	Cord or chain - a part of suspensory apparatus.
Jali	جالى	See <i>ankabut</i> .
Khat Nisful Lail	خط نصف الليل	Latin: <i>linea mediae noctis</i> i.e. lower half or northern half of the meridian.
Khat Nisfun Nahar	خط نصف النهار	Latin: <i>linea meridionalis</i> i.e. upper or southern half of the meridian.
Khat wastus Sama	خط وسط السماء	Meridian. Latin: <i>linea medii coeti</i> . Vertical line running from the top of the astrolabe to its bottom.
Kiffa	كف	See <i>hajra/hadjra</i> .
Kursi	كرسى	Means 'Throne'. Triangular portion of the suspensory apparatus of a planispheric astrolabe.
Madar ra's al-Hamal	مدار رأس الحمل	The Middle Circle among the three concentric circles representing Equator or Dairatal 'Itidal.

Madar ra's al-Jady	مدار رأس الجدى	The outer-rim of the <i>safiha</i> or tympanum representing the Southern Tropic i.e. the Circle of the Head of Capricorn.
Madar ra's as-Sartan	مدار رأس السرطان	The inner-most circle among the three concentric circles on the <i>safiha</i> . It is the Circle of the Head of Cancer.
Mahan	مهن	A hole bored through the centre of <i>wajha</i> , <i>ankabut</i> , all detachable discs and alidade.
Mantaqa-tul-Buruj	منطقة البروج	Circle of the Zodiac.
Mastar	مسطر	Index or Ostensory usually found on the front of a European astrolabe.
Mihwar	محور	See <i>qutb</i> .
Mubattah asturlab	مبطّحه اسطرلاب	See <i>Musattah Asturlab</i> .
Mudir	مدير	A knob to rotate <i>ankabut</i> . Also called <i>muharrak</i> .
Muharrak	محرک	See <i>mudir</i> .
Mumsik	ممسک	A projecting bit of metal either on the <i>Umm</i> or on the <i>hajra</i> which fits into an exactly corresponding depression or hole on the edge of each disc and prevent it from rotating.
Musattah asturlab	مسطحه اسطرلاب	Planispheric or flat astrolabe of the type discussed in this article.
Namainda	نمائنده	<i>Ass Shataba</i> .
Nok	نوک	See <i>Shataba</i> .
Qibti Taqweem	قبطى تقويم	See <i>Bozanti Taqweem</i> .
Qutb	قطب	Latin: <i>claus</i> or <i>axis</i> i.e. a broad-head pin passing through the central hole ( <i>mahan</i> ).
Qutb Shamali	قطب شمالى	North Pole of heavens positioned on an astrolabe as the common centre of three concentric circles on a <i>safiha</i> .

Safīha (Pl. Safaiha)	صفيحة (صفائح)	Latin: Tympanum or tabula regionum. A brass disc with plain surface showing list of latitudes or the stereographic projection of the heavens.
Shabakah	شبكة	Means 'net'. Same as ankabut.
Shataba	شطبہ	Pointer. More than one pointer on ankabut with names of Stars, they represent. Same as <i>shazziya</i> , <i>nok</i> , <i>namainda</i> .
Samtul Ra's	سمت الراوس	Zenith.
Sa'at-ul-'Itidal	ساعت الاعتدال	Horae aquales.
Sa'at-ul-zamania	ساعت الزمانيه	Horae inacquales.
Shazziya	شظية	See Shataba.
Tamm	تَمَم	An astrolabe is called complete or tamm if ninety (90) circles are shown on it from degree to degree. It is bipartial ( <i>nisfi</i> ), if 45 circles are shown, tripartial ( <i>thulthi</i> ), if thirty (30) circles are shown, so on and so forth.
Ufq al-Ustawa	افق الاستوى	The diameter from east to west on <i>asafīha</i> . The right half on this line is called <i>Khat-al-mashraqi</i> , and left half <i>Khat-al-maghrabi</i> .
Umm	أم	Means womb. In Latin: mater (mother). Stands for flat depressed portion within <i>hajra</i> on the front side or <i>wajh</i> . Also called <i>habs</i> .
'Urwa	عُرْوَة	Latin: armilla reflexa. Swivel. Rotatable ring. Part of the suspensory apparatus above <i>kursi</i> .
Tawq	طوق	Same as <i>hajra</i> .
Wajha/Wadjha	وجهه	Facies. Front-side of the planispherical astrolabe.
Watad	وتد	Same as axis, claus, <i>mehwar</i> and <i>qutb</i> .
Waza-al-Kura	وضع الكرة	The true Arabic name for an astrolabe, though seldom used. Latin: Walzacora, Walzachora, Walzagora etc.
Zahr	ظهر	Backside of planispherical astrolabe.

## REFERENCES

1. Asturlab (اصطراب or اسطرلاب) in Arabic, Persian & Urdu and or (وضع الكروي) in Greek is called 'Wad'at al-Kura' (وضع الكروي) i.e. 'Position of the Globe'. For oriental terms used to describe various parts of an astrolabe see Appendix at the end of this paper.
2. It is claimed that Claudius Ptolemy (بطليموس) (100-160 A.C.) wrote a treatise on the spreading out of the surface of the sphere or "The original Greek & Arabic versions by Maslama ibn Ahmad al-Majriti (d. circa 397 A.H./1007 A.C.) have been lost. Fortunately, a Latin translation made in 1143 A.C. by H. Dalmatta titled Planisphaerium, exists. Ptolemaic astrolabes, however, formed a separate class of instruments, and have nothing in common, except in name, with the astrolabe we have today before us. (See: Willy Hartner, "The Principle and Use of the Astrolabe", A Survey of Persian Art. Edited by Arthur Upham Pope, Vol. VI. Reprinted Manafazadah Group Tehran, London & Tokyo. n.d. pp. 2531-32, f.n. (henceforth A Survey of Persian Art) and *ibid.*, 'Asturlab', The Encyclopaedia of Islam, Ed. by H.A.R. Gibb et al. New Edition, Leiden, London: 1960, Vol. I (A-b), p. 722.
3. Hipparchus (إبرخس) of Nicaea (circa 160-120 B.C.), made his observations at Rhodes. But, all his scientific works have perished and it is to Ptolemy that we owe our information about the extent and importance of his researches. (G.N. Banerjee, Hellenism in Ancient India, Delhi: 1961, p. 142). He was the first to apply himself to the consideration of the problem of stereographic projection. A silver planisphere based on principles for an outline by Hipparchus is reported to have existed as late as circa 415 A.C. and described by Synesius of Cyrene, though disregarded by Ptolemy (A Survey of Persian Art, p. 2532). Some even claim that astrolabe was invented by Apollonius of Perg in circa 240 B.C. But, it is not a serious claim.
4. Dr. Ali A. Al-Daffa and Dr. John J. Stroyls, "The Art of the Astrolabe", The Proceedings of the Hijra Celebration Symposium on Islamic Art, Calligraphy, Architecture & Archaeology, March 1-6, 1981, Peshawar, p. 231.
5. Owen Gingerich, "Islamic Astronomy", *Scientific American*, April 1986, p. 78.
6. *Ibid.*, p. 74.
7. In 1902, a ship wreck was excavated off the seashore of Antikythera (Greece). Among its finds was a bronze instrument, badly damaged though, with an astronomical inscription in Greek. This is an astrolabe in a wider Greek sense. Although this instrument gives elliptical & equatorial coordinates of the sun, the moon and four planets, the principle of the Antikythera instrument is entirely different from that of a planispheric astrolabe. Consensus of opinion favour a date of it in the third century A.C. (See *A Survey of Persian Art*, pp. 2531-2532). For better details see Gunther Vol. I, pp. 55-58 (The Astrolabe of Antikythera, C.A.D. 250).
8. D.J. des. Price, "An International Checklist of Astrolabes", Pt. I in Arch. Intern. d'Hist. de Sciences, 1955, Pl. I.
9. 'Abd al-A'imma was a prolific Iranian astrolabist of the 19th century. He designed and fabricated instruments of remarkable beauty, with mathematically correct details. (See Owen Gingerich, D. King and G. Saliba, "The 'Abd al-A'imma Astrolabe Forgeries", *Journal of History of Astronomy*, Vol. 3, 1972, pp. 188-198).
10. Ali A. al-Daffa et al., p. 231.
11. Asturlab Kuri or U'kri is a celestial globe with a 'spider' and a ring. It is used for measuring stellar distances and determining times. It is as old as the flat or planispheric astrolabe. The author of al Fihrist regards Ptolemy to be its inventor but no one else shares this view.  
The spherical globe is disadvantageous for handling and still does not give results better than its flat counterpart.

12. Asturlab *Sathi* or planispheric astrolabe is a portable instrument in the form of circular disc with diameter varying from 10 to 20 cms. (4" to 8"). The simplest type consists of the following fixed, semi fixed or detachable parts (see Fig. 1, 2 and 3, and Pl. I):-
- The main circular disc with raised border (*hajra* = حجرة or limbus) around a circular depressed space called *Umm* ( اُم ) or mater (mother).
  - The suspensory apparatus welded to the top of the main disc.
  - Ankabut* ( عنكبوت ) or spider secured within *hajra* with a central pin (*qutb* = قُطْب).
  - Al-adada* ( المضادة ) or Alidade secured on the back of the astrolabe with a *qutb*.
  - Detachable thin discs (*safiha* = صفيحة; pl. *safaih* = صفايح) - usually seven to ten in number, each carved on both sides.
- Suspensory apparatus further comprises a triangular piece (*al-kursi* = الكرسي), fixed to the top of it is 'al-Urwa' ( العروة ) or armilla suspensoria which further hangs from 'al-halqa' ( الحلقه ) or ring or armilla rotunda which itself receives 'al-ilaqa' ( العلاقه ), i.e. cord or chain.
13. *A Survey of Persian Art*, p. 2530.
14. J.D. North, "The Astrolabe", *Scientific American*, Vol. 230, No. 1, January, 1974, p. 97. (Henceforth referred to as J.D. North).
15. Syed M. Ashfaque, "Muslim Contribution to Astronomy", *Museums Journal of Pakistan*, Karachi, Vol. XIX, March, 1967, pp. 28-30.
16. Majority of the astrolabe-makers took pride in claiming themselves to be 'al-asturlabi'. Some, however, preferred to retain their ancestral trade-titles namely 'al-ibari' ( الابري ) i.e. needle-maker, or 'al-najjar' ( النجار ) i.e. carpenter. (See اردو دائرہ معارف اسلامیہ لاہور، جلد دوم: 1966، ص 626).
17. Owen Gingerich, however, regards its attribution to Masha-ullah as a mistake. He regards it a later period 'pastiche' for a variety of sources including Geoffrey Chaucer's translation in 1390. See O. Gingerich, "Islamic Astronomy", *Scientific American*, April 1986, p. 78.
18. W. Hartner, *A Survey of Persian Art*, p. 2531-33. Tusi of this list is a different person from Tusi who invented *Asa-i-Tusi* astrolabe. Muhammad bin Musa al-Khawarazmi authored two books on astrolabes entitled:
- (i) کتاب العمل بالاصطرلاب  
(ii) کتاب الامر بالاصطرلاب
- But no copy of these two is traceable today. See Prof. Ghulam Rabbani Aziz, *Tarikh Khawarazmi Shahi*, Lahore: 1977, PP. 247-48.
19. See f.n. 7 above.
20. O. Gingerich, "Islamic Astronomy", *Scientific American*, April, 1986, pp. 74-83, (cover picture).
21. W. Hartner as in f.n. 18 above. Also see W.H. Morley (Description of a Planispheric Astrolabe constructed for Shah Sultan Hussain Safawi, London: 1856, p. 4, as reprinted in R.T. Gunther, *The Astrolabes of the World*, Oxford: 1932, Reprint London: 1976, Vol. I, pp. 1-50) who claimed long ago that the earliest extant astrolabe dates in circa 293 A.H./905 A.C. made by Ahmad ibn Khalaf for the caliph Ja'far (906-87 A.C.), but others regard it as a 12th or 13th century copy of an original.
22. J.D. North, op. cit., p. 104.
23. W. Hartner, *A Survey of Persian Art*, pp. 2533-34 & ibid., 'Asturlab' in *The Encyclopaedia of Islam*, op. cit., p. 723 & *Urdu Daira-i-Ma'araf-i-Islamia*, Lahore: 1966, Vol. II, p. 626.
24. *Urdu Daira-i-Ma'araf-i-Islamia*, loc. cit.

25. "It is now generally conceded by the European scholars that the scientific Hindu astronomy, as contained in *Parasara Tantra*, *Jyotisha-sastra* and *Jyotisha-vedanga* etc., has been originally based on that of the Alexandrian Greeks..." G.N. Banerjee, *Hellenism in Ancient India*, Delhi: 1961, pp. 140-145 & 195. Also see G.R. Kaye, *Hindu Astronomy*, MASI, No. 18, Calcutta: 1924, Rep. Swati Publication, Delhi, 1991, en passim.
26. Robert T. Gunther, *Astrolabes of the World*, loc. cit.
27. *A Survey of Persian Art*, pp. 2530-2554.
28. Ibid., p. 2535, f.n. 1.
29. For an interesting account of Humayun's interest in astronomy, astronomical affairs and astrolabes leading to his invention of a special type of astrolabe named after him as *Asturlab Humayuni*. See Maulana Sayyid Sulayman Nadvi, "Muslims and Astronomy", *Al-Nadwa*, Lucknow, March 1909, p. 24 and ibid., "Some Indian Astrolabe-makers", *Islamic Culture*, Vol. IX, 1935, pp. 622-626.
30. Saifur Rahman Dar, *Lahore Museum Treasures*, T.D.C. Punjab, Lahore: 1988, p. 37 & ibid., *Illustrated Guide to the Lahore Museum*, Fourth Edition, Lahore, 1994, p. 22.
31. Saifur Rahman Dar, "A Rare Astrolabe" in daily "The Nation", Lahore, January 2, 1987.
32. Ali A. Al-Daffa et al., op. cit., p. 231. For oriental terms used for different parts of an astrolabe and their western equivalent see Appendix at the end of this paper.
33. Ibid., p. 233.
34. J.D. North, p. 100.
35. Each Arabic zodiac name is followed hereafter in bracket by its equivalent in English and Persian as these appear on the zodiac coins of Jahangir. (See Saifur Rahman Dar, "Jahangir's Zodiac Coins", Daily "The Nation", Lahore, November 7, 1986, and ibid., "The Unique Zodiac Coins", *Bonjour*, Karachi, No. 14, 1993, pp. 20-23.
36. For this see: Ali A. Al-Daffa et al., op. cit., p. 232, fig. 3.
37. Ibid.
38. Willy Hartner, *A Survey of Persian Art*, p. 2547.
39. Only once before a poor photograph of the front-side of this astrolabe was published, without any accompanying text or caption, on the back-title of the *Museums Journal of Pakistan*, March, 1967.
40. The photograph and some information about this astrolabe was initially provided to me by my former student Mr. Jamil Ahmad Chaudhry, Museum Assistant, National Museum of Pakistan, Karachi. However, on September 26, 1994, I had the occasion of examining this astrolabe in the collection of Islamabad Museum, where it has been recently shifted from Karachi.
- 40-a. The three dates in three different eras are very interesting, though not unusual. Beside the Hijra date, which is the most common on all the Islamic astrolabes, we also casually get the Iranian dates in Yazdajir diyah era, and Iskandar Rumiya (Seleucid) era introduced in the third century B.C. Beside the Islamabad Museum astrolabe, the Ashmolean Museum astrolabe of Muqim Lahori also bears beside the Hijra date, the Rumi date of the year 1955 (Gunther, No. 72, p. 197). Wilson's Astrolabe (Gunther S. No. 67) of much earlier date bears Hijra date (669 A.H./1270 A.C.), Yazdajir diyah date of the year 640 and the Iskandar Rumiya date of the year 1582. The local date in Malikshahi era in the year 193 is also given. In purely Hindu astrolabes and 19th century astrolabes of India, dates are also given in Vikram Era as well as the Christian or Gregorian calendar.
41. Nabia Abbott, "Indian Astrolabe Makers", *Islamic Culture*, Vol. XI, January 1937, p. 144 (Henceforth N. Abbott).

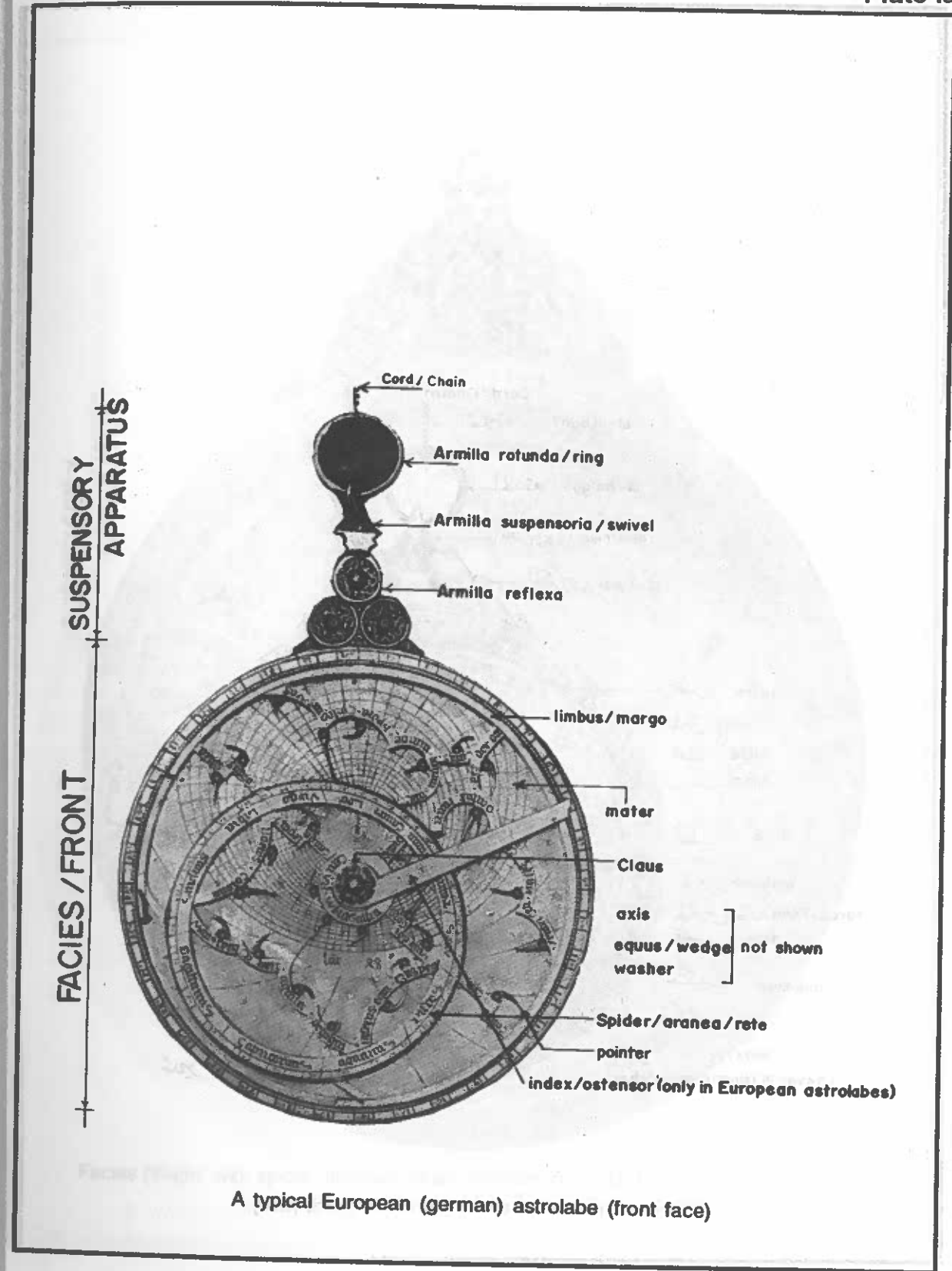
42. Beside this astrolabe, National Museum of Pakistan, Karachi also possesses four other planispheric astrolabes and two Globes or *asturlab kari*. But this is not the place to discuss them here.
43. G.R. Kaye, Delhi Museum Astronomical Instruments, *Memoirs of the Archaeological Survey of India*, No. 12, Calcutta, 1921, Reprint: Swati Publications, Delhi: 1991, Binding No. 4), p. 1.
44. Sayyid Sulayman Nadvi, "Some Indian Astrolabe Makers", *Islamic Culture*, Vol. XI, October 1935, pp. 121-131 (Henceforth Nadvi).
45. N. Abbott, pp. 144-45. Her translation of the Arabic text as to mean 'two sons of 'Isa' is doubtful. It means only 'son of 'Isa'.
46. Muhammad Ilmud Din Salik, (لاہور کے علمائے کرام و دینی مدرسے), *Naqoosh*, Lahore Number, 1962, pp. 448-449.
47. Sayyid Sulayman Nadvi, op. cit., p. 630.
48. Saifur Rahman Dar, *Illustrated Guide to Lahore Museum*, Fourth Edition, Lahore: 1994, p. 22. Also see Bata Pakistan Limited Table Calendar for the year 1988, months November and December.
49. Mrs. Mussarat Hasan, in her Ph.D. Thesis entitled: Punjab Paintings during the 18th & 19th Centuries, for the Punjab University, Lahore (Under process) has recorded a number of such families of Lahore. I have discussed this subject briefly in my article entitled: "Imam Bakhsh Musawwir Lahori: Discovery of a 19th Century Artist of Lahore", in *Journal of Research Society of Pakistan*, Lahore, Vol. XXX, No. 3, July 1993, pp. 1-16.
50. Owen Gingerich, "Islamic Astronomy", op. cit., p. 74 & G.R. Kaye, *Hindu Astronomy*, op. cit., p. 49 f.n. & p. 102.
51. W. Hartner, *A Survey of Persian Art*, XI, op. cit., p. 2534 and Gunther I, S. Nos. 92-97, pp. 221-228.
52. G.R. Kaye, *Hindu Astronomy*, MASI, No. 18, Calcutta: 1924, pp. 67-70.
53. G.R. Kaye, Delhi Museum Astronomical Instruments, MASI, No. 12, Calcutta: 1921, Rep. Delhi: 1991, pp. 1, 9-12.
54. J.D. North, p. 105.
55. R.T. Gunther, *Astrolabes of the World*, loc. cit.
56. Nadvi, pp. 121-131. Also see his earlier article "Muslims and Astronomy" published in March 1909 issues of *Al-Nadwa*, Lucknow, p. 24.
57. N. Abbott, pp. 144-146.
58. Muhammad Ilmud Din Salik, op. cit., pp. 448-449.
59. Nadvi, p. 626.
60. Ibid., p. 627.
61. N. Abbott, p. 145.
62. "In the evening... he went up the roof of the library to enjoy the cool of the afternoon and received the homage of the people who had assembled at the Chief Mosque (nearby)... This being done he sent for the mathematicians to observe the rising of Venus, for at that exact hour he wished to hold a grand assembly in which to promote officers." Ishwari Prasad, *The Life and Times of Humayun*, Oriental Longman, Bombay: 1955, Rep. 1956, pp. 356-357 and p. 364. For a fuller and richer account of Humayun's interest in asturlab-sazi, see Nadvi, pp. 621-626.
63. N. Abbott, p. 144. Both are made by the members of Allah Dad family of Lahore.

64. J. Sottas, "Description d'un astrolabe arabe construit a Lahore", *Academic de Marine (Paris), Communications et memoires* 9, 1930, pp. 153-185.
65. Mohammed Ilmud Din Salik, op. cit., p. 449.
66. Ibid., pp. 448-49.
67. On another astrolabe, 12 cms in diameter, now in Adler Museum, Chicago, "*Isa wald Allah Dad*" instead of "*Isa bin Allah Dad*", is written - both meaning the same. See N. Abbott, p. 144.
68. For computation of his age see Sayyid Sulayman Nadvi, p. 630. Nabia Abbott, on the other hand, opined that Allah Dad Langar Khani got his topographical name Langar Khani Lahori from the *mohalla* in Lahore where he lived during Humayun and Akbar's reign and not the vice versa as believed to be by Nadvi. See N. Abbott, p. 145. Moreover, the identity of Allah Dad, the astrolabist with Allah Dad Langar Khani Lahori is not confirmed.
69. Nadvi, p. 626.
70. Mulla Nurud Din Tarkhan Nuri (d. 994 A.H./1585 A.C.), a *jagirdar* of Sufidun in Sindh and companion of Humayun, was fond of astronomy, arithmetic and the astrolabe. See for details *Ma'ahir-al-Umara*, Calcutta, Vol. I, p. 478 and Nadvi, op. cit., p. 623. For more details about Mulla Nurud Din Nuri, see Thomas William Beal, *An Oriental Biographical Dictionary*. Reprinted by Sind Sagar Academy, Lahore, n.d., p. 306. William Morley (Description of a Planispheric Astrolabe, loc. cit.) records (at p. 39) the name of another astrolabe from Sindh - this time Thatta. The name of the astrolabist is Muhammad Saleh Alamgir.
71. N. Abbott, p. 144.
72. Ibid., p. 145.
73. For this and the longer inscription also dated 1047 A.H., see Nadvi, p. 627 and Salik, op. cit., pp. 448-449. The text of this inscription as given both by Nadvi & Salik (loc. cit.), though somewhat incomplete reads as follows:
- تمت این کره مشتمل بیک
- این فن تا با این تاریخ سنه ۱۰۴۷ھ
- This indicates that the model of this globe was based on the observatory of Ullugh Baig at Samarqand with three degrees added to each star.
74. N. Abbott, p. 144.
75. The inscription on an Adler Museum, Chicago:
- صنعة تمت بايدي اضعف العباد ابن عيسى  
ابن ملة الهداد سنة ۱۰۱۸ھ في مدينة دار الخلافة لهاور.
- Trans: "Its making was completed by the hands of the weakest of servants, the son of 'Isa, son of Mulla Allah Dad, in the year 1018 A.H./1609 A.C. in the capital city of Lahawar."

has been wrongly translated by N. Abbott, (op. cit., p. 144) as to convey the sense as it was by 'two' un-named sons of 'Isa. It was certainly made by either of the two sons of 'Isa but at a stage of his carrier when the names of his father and grandfather were more important than either of the two sons. Earlier, Gunther (S. No. 69, p. 187) has committed the same mistake.

- 76. N. Abbott, p. 144.
- 77. Ibid.
- 78. Nadvi, p. 627.
- 79. N. Abbott, p. 144.
- 80. Ibid.
- 81. G.R. Kaye, Delhi Museum Astronomical Instruments, *Memoirs of the Archaeological Survey of India*, No. 12, Calcutta: 1921, Swati Publications, Reprint Delhi: 1991, p. 1.
- 82. Anyone interested in reading complete inscriptions on these astrolabes and globes should refer to the following works:
  - i) R.T. Gunther, *The Astrolabes of the World*, op. cit., pp. 187-220.
  - ii) Nadvi, pp. 121-131.
  - iii) Nabia Abbott, "Indian Astrolabe Makers", *Islamic Culture*, Vol. XI, 1937, p. 144 ff, and
  - iv) Muhammad Ilmud Din Salik, loc. cit.

I do not think it is necessary to reproduce all these inscriptions individually here.
- 83. G.R. Kaye, op. cit., p. 1, 16 & Fig. 9.
- 84. Nabia Abbott, p. 145. No more details are available.

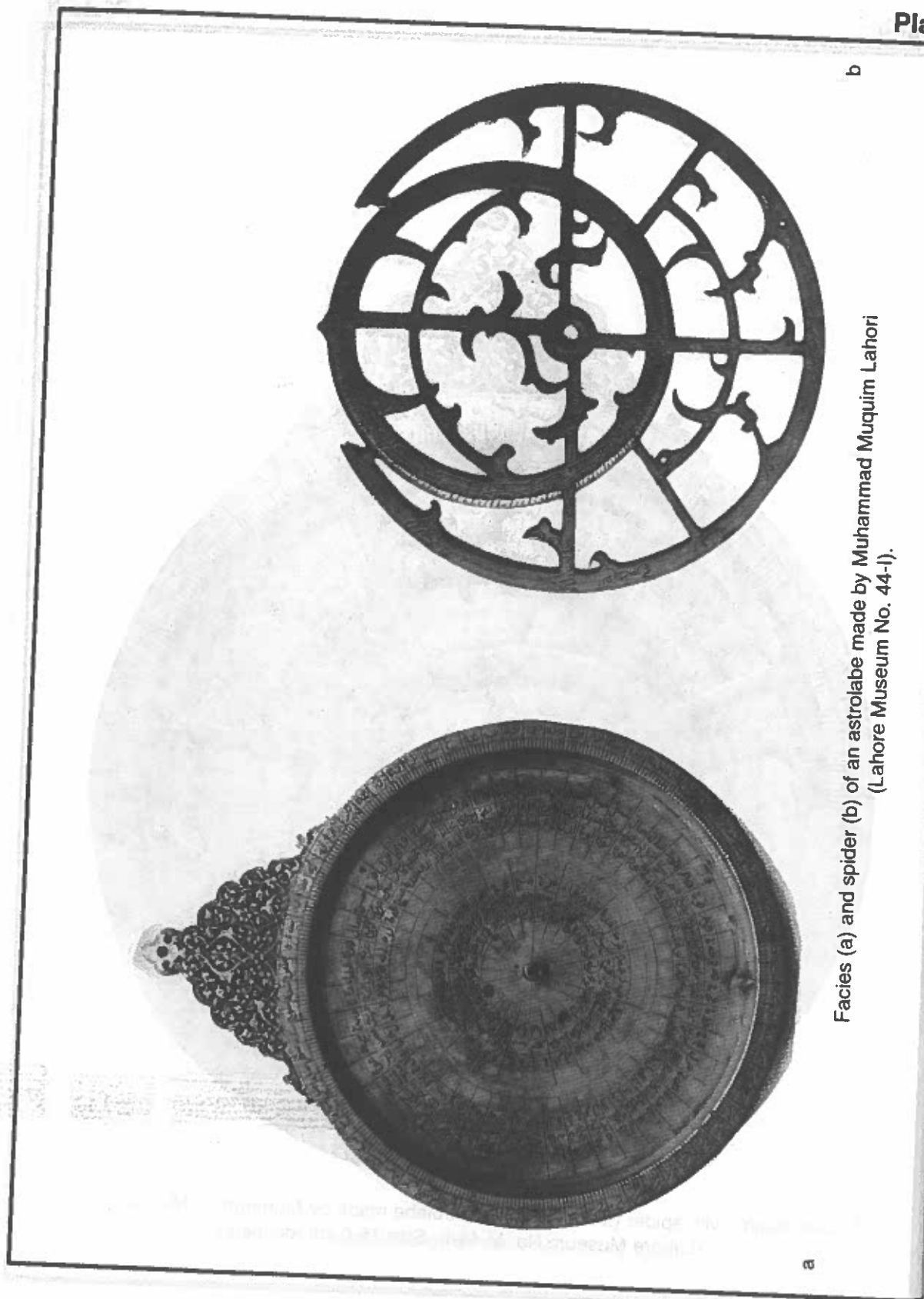




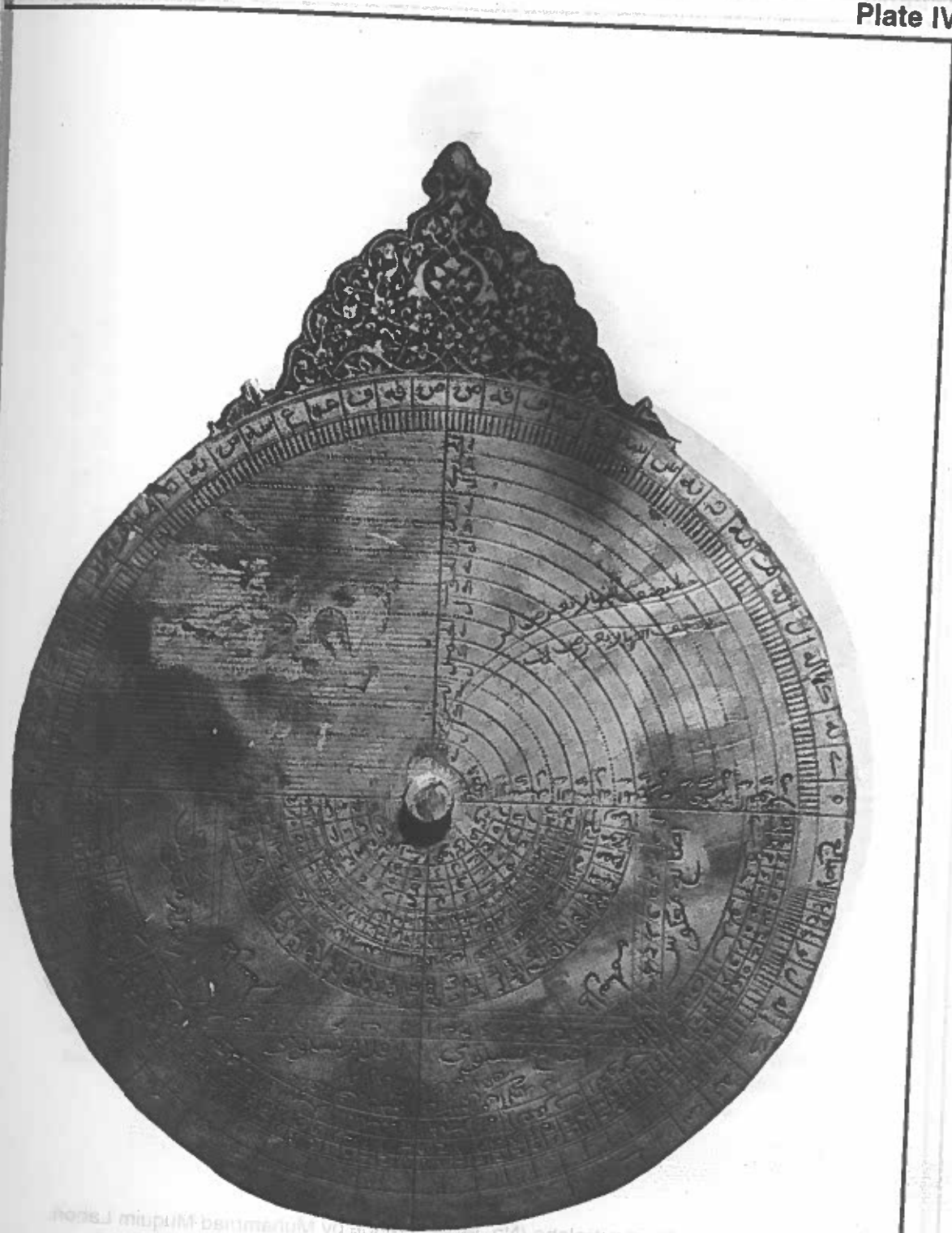
A typical Oriental (Islamic) astrolabe (front face)



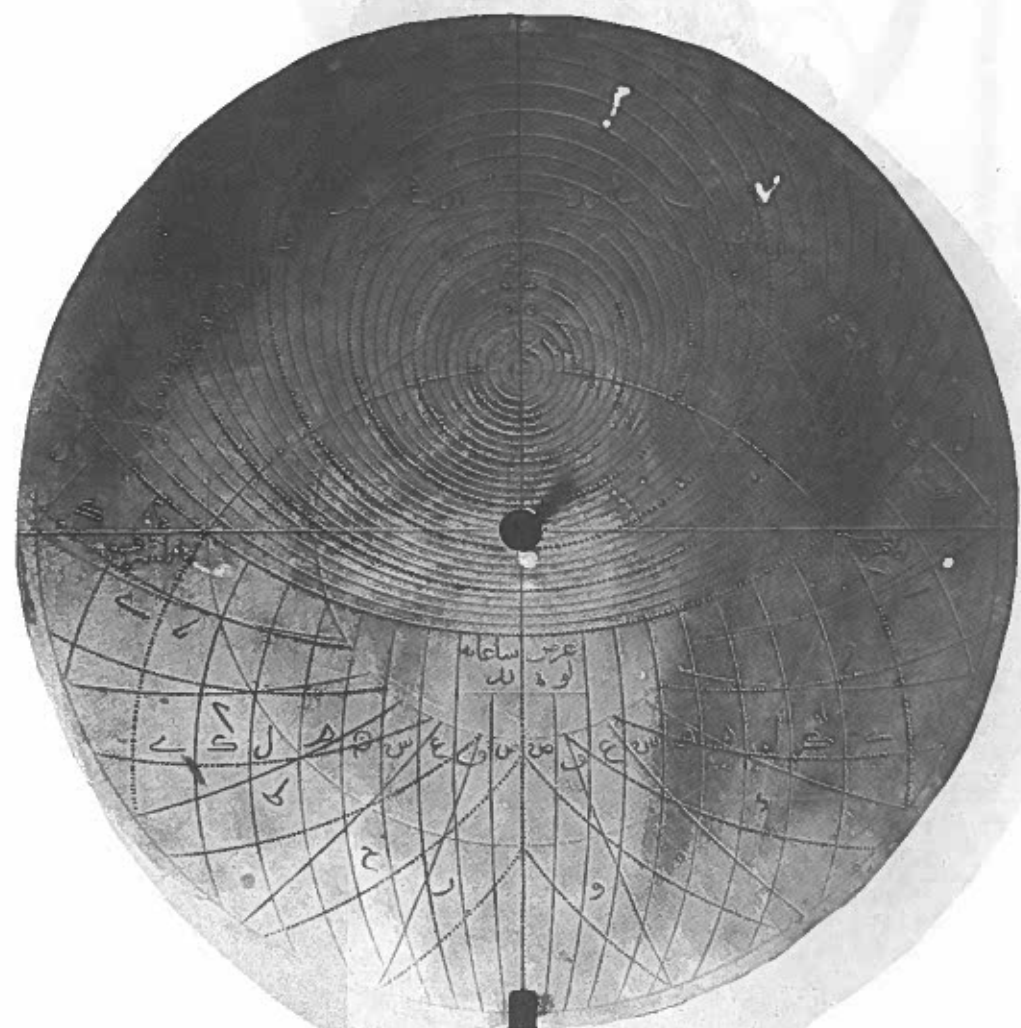
Facies (Wajh) with spider (ankabut) of an astrolabe made by Muhammad Muquim Lahori (Lahore Museum No. M-44-I). Size 16.0 cm. diameter.



Facies (a) and spider (b) of an astrolabe made by Muhammad Muquim Lahori  
(Lahore Museum No. 44-1).



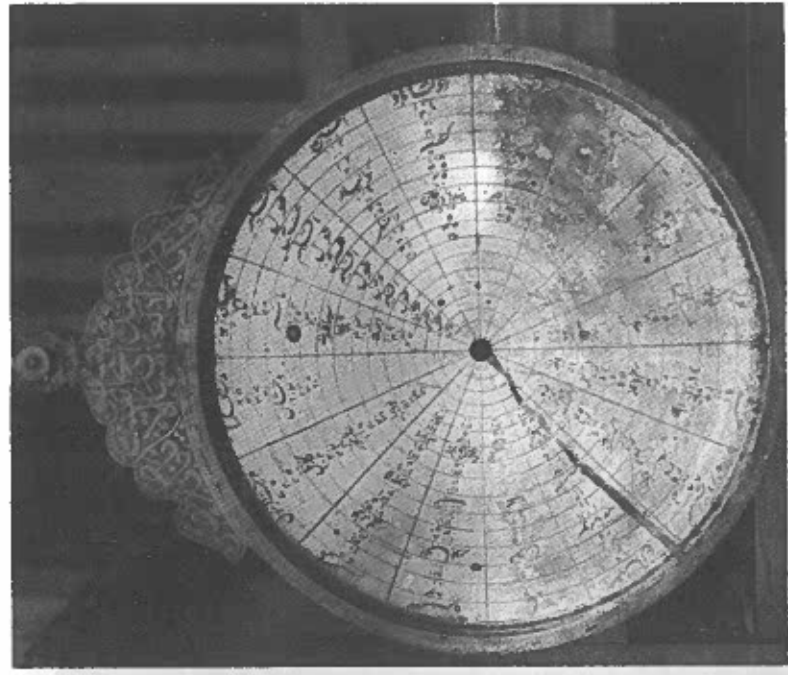
Backside (zahr) of an astrolabe with inscription which means  
"Made by Muhammad Muquim, son of Isa, son of Allah Dad Asturlabi Humayuni Lahori"  
(Lahore Museum No. M-44-1).



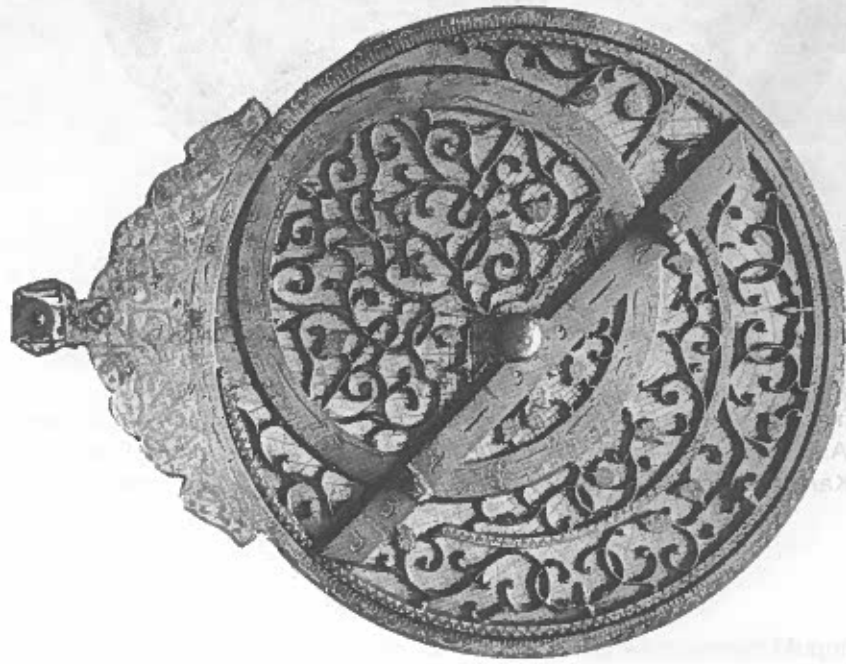
One of the (safaih) of astrolabe (No. M-44-I) made by Muhammad Muquim Lahori.



Facies (wajh) with spider (ankabut) of the astrolabe made by Muhammad Muquim, son of Isa, son of Allah Dad, Asturlabi Humayuni Lahori In 1047 A.H./1640 A.D. now in the Collection of National Museum of Pakistan, Karachi (Accession No. NM. 1959. 407). Size 25.6 x 37.5 cms



b



a

Brass astrolabe (Lahore Museum No. M-1649) designed by Lala Sahu Mal Lahori and made in 1841 by Ustad Pir Bakhsh Lahori. Size 30.50 x 23.50 cm. excluding chain.

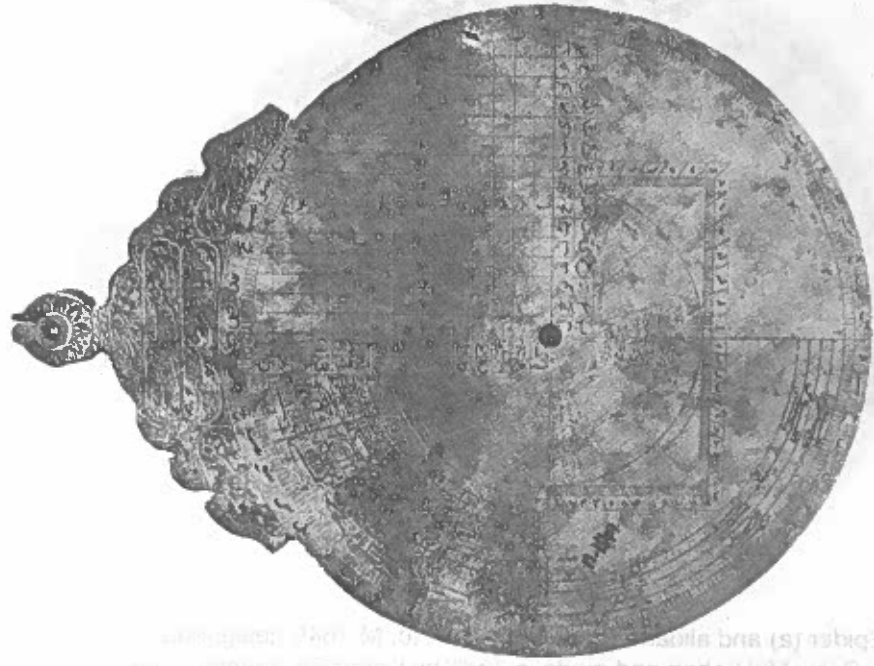


a. Ankabut.

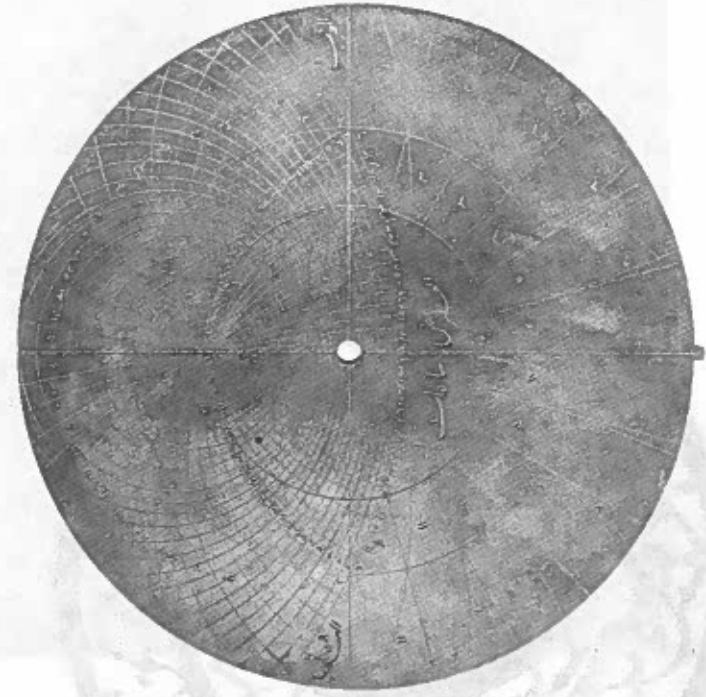


b. Alidade

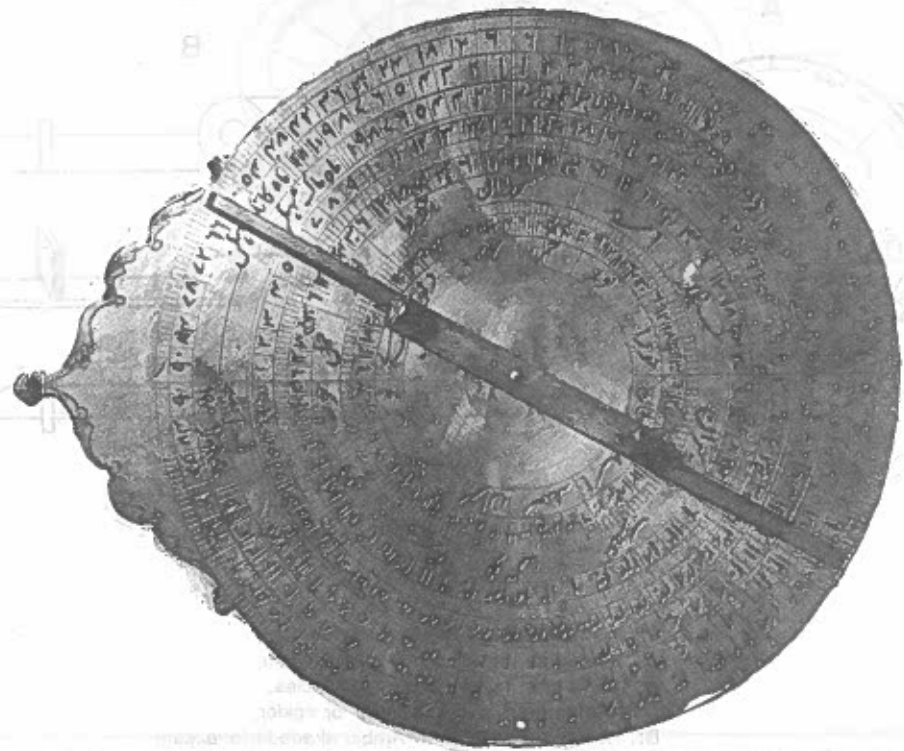
Spider (a) and alidade (b) of astrolabe No. M-1649 designed by Lala Sahu Mal Lahori and made in 1841 by Ustad Pir Bakhsh Lahori.



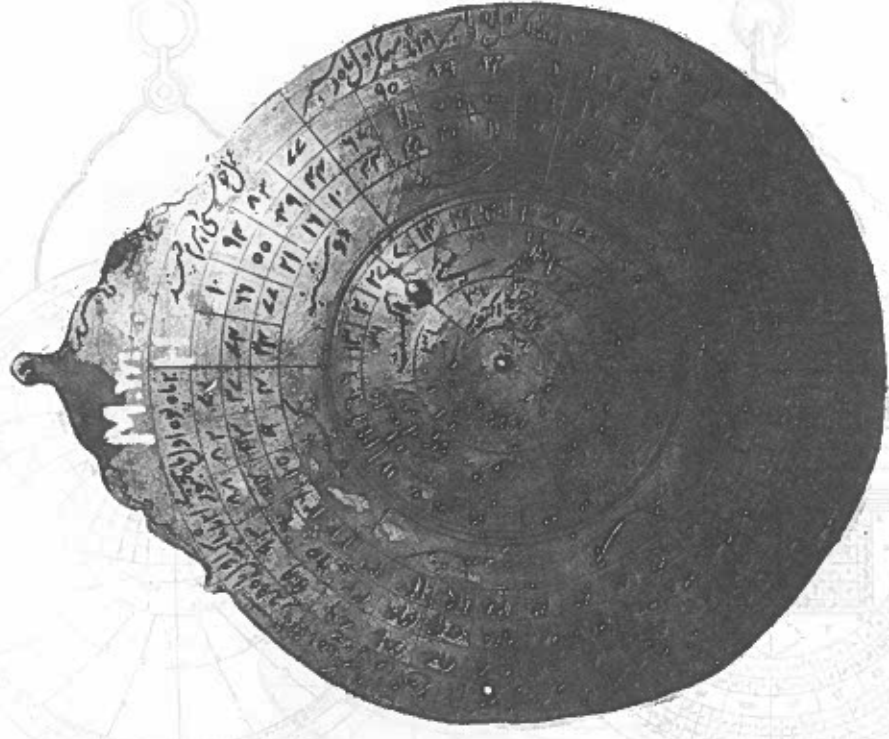
a. Backside (zahr) of astrolabe No. (M-1649) in Lahore Museum.



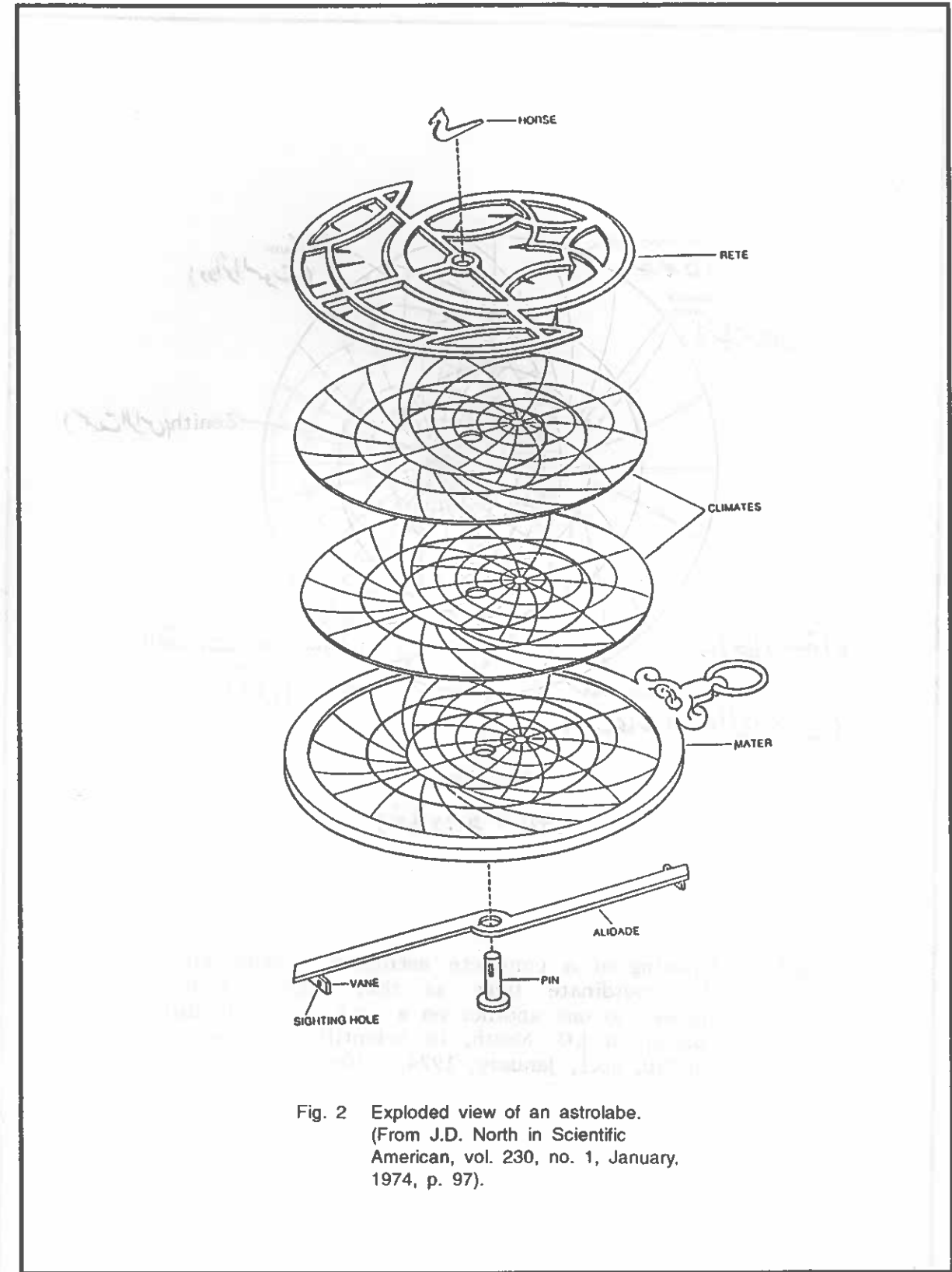
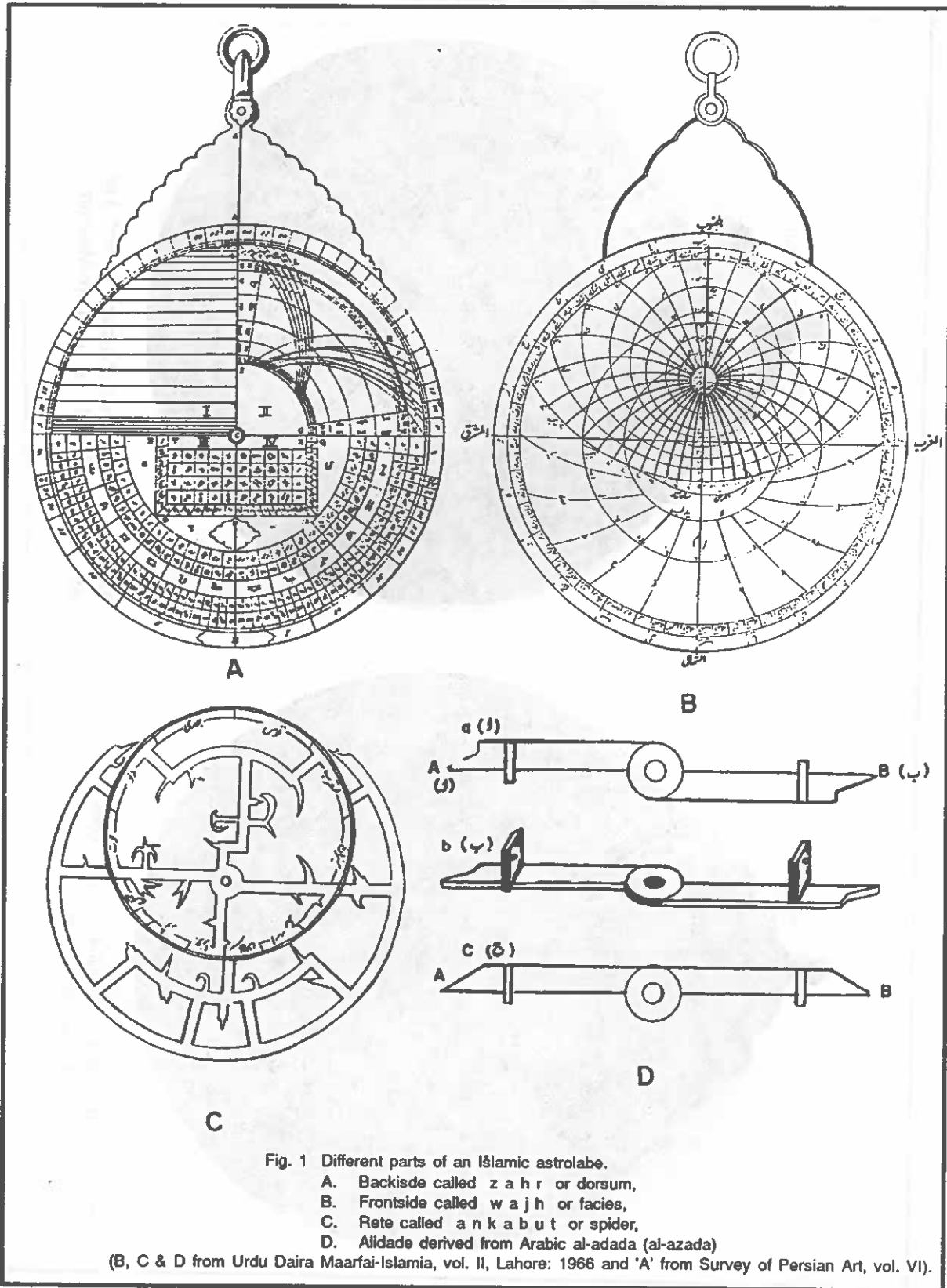
b. One of the (safaih) of astrolabe (No. M-1649) in Lahore Museum.



Frontside of astrolabe (No. MM-44-H) in Lahore Museum designed by Jyotishi Dharam Chand.



Backside or dorsum with Mastar (مستار) of astrolabe (No. MM-44-H) in Lahore Museum.



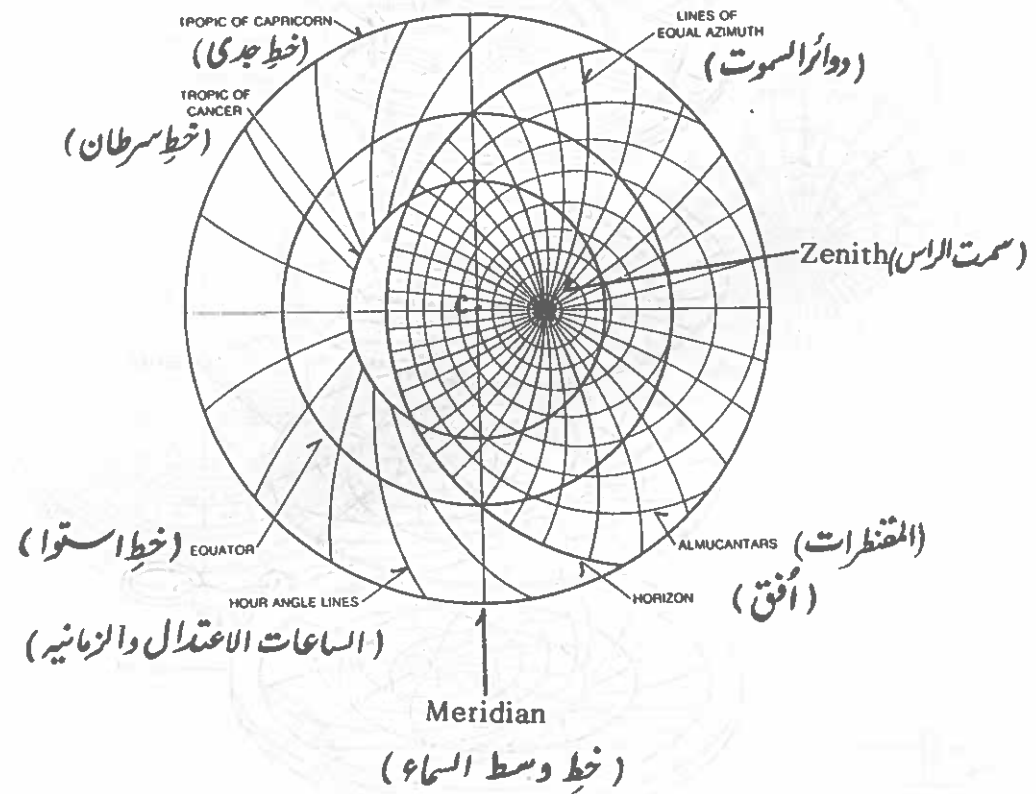


Fig.3 Drawing of a complete astrolabe showing all the coordinate lines as they appear with respect to one another on a *safiha* (climate) (Based on J.D. North, in *Scientific Christian*, vol.230, no.1, January, 1974, p.104).