THE CONTRIBUTIONS OF THE ARAB AND ISLAMIC CIVILIZATIONS TO ASTRONOMY

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This Book, together with the associated CDs, represents a cornerstone in the creation of a digital encyclopedia of Arabic and Islamic manuscripts in the fields of Science and Mathematics. We believe that it is imperative to resort to appropriate use of these modern technologies to make such Arabic and Islamic Sciences accessible and available to all, at minimum possible cost, we hope that this effort will eventually reveal the treasures of ancestral legacies and enrich the World Library for the benefit of the researchers, the scholars and the analysts.
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(2)
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# TABLE OF CONTENTS

**FOREWORD**

**READERS GUIDE**

**THE SYSTEM OF TRANSLITERATION**

**ASTRONOMY AND ITS APPLICATIONS IN THE ARAB CULTURE**

**THE ILLUSTRATED ASTRONOMY MANUSCRIPTS**

**Astronomical Instruments**

- Al-Azżāl’s Treatise on Sundials
- Al-Mizzi’s Treatise on the Astrolabe
- The Compendium of Principles and Alms on Operations with the Zarqulj Plate
- Gem of the Seekers on Operations with the Astrolabe
- The Seekers Excursion in the Science of the Astrolabe
- A Treatise on Operations with the Astrolabe, Almucantars and the Sine Quadrant
- A Treatise on the Equatorial Circle

**Almanacs and Times**

- Fresh and Sweet Source on Ephemerides of the Plants and Visibility of the Crescent
- The Glitter in Solving the Seven (Planets)
- Guide from Fallacy in Knowing the Timekeeping and Determining Qiblah and Related Matter without Instruments
- Guiding The Eyeful and the Heart-Full in Knowing the Parts of Day and Night
- Healing of Diseases by Drawing Hour (line) on Walls and Sundials

**The Sun, The Moon, The Zodiac and Planets**

- Images of Fixed Stars
- The Dispersed Gems on Operations with the Protractor Quadrant
- Instructions on the Elements of the Art of Astrology
- An Introduction to the Science of Predication of Stars
- An Introduction to Working with the Covered Quadrant
- Removing the Doubt on Operations with the Sine Quadrant
- Sufficient Satisfaction on Operations with Truncated Northern Quadrant
- A Treatise on Arithmetical Rules and Geometrical Works in Using the Sine Quadrant
- A Treatise on Operations with the Quadrant on which Almucantars are Imaged
- A Treatise on Operations with the Shakazia Quadrant
- A Treatise on Operations with the Sine Quadrant
CONTENTS

IDE

OF TRANSLITERATION

AND ITS APPLICATIONS IN THE ARAB CULTURE

ASTROD ASTRONOMY MANUSCRIPTS

<table>
<thead>
<tr>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azzāzī's Treatise on Sundials</td>
</tr>
<tr>
<td>Mizzi's Treatise on the Astrolabe</td>
</tr>
<tr>
<td>Compendium of Principles and Aims on Operations with the Zarqali Plate</td>
</tr>
<tr>
<td>m of the Seekers on Operations with the Astrolabe</td>
</tr>
<tr>
<td>Seekers Excursion in the Science of the Astrolabe</td>
</tr>
<tr>
<td>Treatise on Operations with the Astrolabe, Almucantars and the Sine Quadrant</td>
</tr>
<tr>
<td>Treatise on the Equatorial Circle</td>
</tr>
<tr>
<td>d Times</td>
</tr>
<tr>
<td>Sh and Sweet Source on Ephemerides of the Plants and Visibility of the Crescent</td>
</tr>
<tr>
<td>Glitter in Solving the Seven (Planets)</td>
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</tr>
<tr>
<td>bout Instruments</td>
</tr>
<tr>
<td>ing The Eyspal and the Heart-Fall to Knowing the Parts of Day and Night</td>
</tr>
<tr>
<td>aling of Diseases by Drawing Hour (line) on Walls and Sundials</td>
</tr>
</tbody>
</table>

Moon, The Zodiac and Planets

ges of Fixed Stars |
| Dispersed Gems on Operations with the Protractor Quadrant |
| ections on the Elements of the Art of Astrology |
| ntruction to the Science of Predication of Stars |
| ntruction to Working with the Covered Quadrant |
|oving the Doubt on Operations with the Sine Quadrant |
| fluent Satisfaction on Operations with Truncated Northern Quadrant |
| Treatise on Arithmetical Rules and Geometrical Works in Using the Sine Quadrant |
| Treatise on Operations with the Quadrant on which Almucantars are Imaged |
| Treatise on Operations with the Shakazin Quadrant |
| Treatise on Operations with the Sine Quadrant |

Working with the Sines

- al-Fāṭīhiyyah (treatise of Fath al-Dīn) on Operations with the Sine Quadrant
- Explanation of the Hidden in Operations with the Sine Quadrant
- The Students Way and the Stroll of Minds in Knowing the Times by Calculation

Astronomical Tables

- Astronomical Tables
- A Collection of Ephemerides Segments
- The Fine Truth in Calculating the Degrees and Minutes
- Guidebook for the Pupil to Equations of Planets

Spherical Shape of the Earth

- Compendium of Simple Astronomy

APPENDIXES

(A) Glossary of Astronomical Terms
(B) The Jummal Calculations (Assigning Numerical Values to Letters of the Alphabet)
(C) Defining the Astrolabe, its Parts and Uses
(D) Sky Constellations and Mansions of the Sun and the Moon

BIBLIOGRAPHICAL LIST OF MANUSCRIPTS COLLECTION AT AL-AZHAR LIBRARY

REFERENCES

CONTRIBUTORS
FOREWORD

In the context of CULTNAT's interest in Cultural Continuity, especially in the field of Science, and in the light of the importance of Electronic Documentation of Manuscripts in highlighting the effective role undertaken by the Arabs and Muslims in maintaining such Cultural Continuity; and in view of the fact that preserving World Heritage always was – and still is – one of UNESCO's principal interests and concerns, CULTNAT (the Center for Documentation of Cultural and Natural Heritage of Egypt) has entered into a Cultural Partnership Contract with UNESCO for the preparation of a collection of publications aiming at acquainting the World with Arab and Islamic contribution to the advancement of Science.

The Partnership proceeded under the umbrella of the "World Memory" program for cultural promotion and dissemination, aiming at the preservation of the World's wealth of Books and Documents, was prompted by the present progress in Information and Communications Systems. In this context, the Regional Office of UNESCO in Cairo has implemented a regional program for the documentation and publication of Arabic and Islamic Manuscripts in the fields of Science and Mathematics.

Now, it gives both the Regional Office of UNESCO in Cairo and CULTNAT great pleasure to introduce this publication; which is one of the fruits of their established collaboration. This Book, together with the associated CDs, represent the corner stone in the creation of a digital encyclopedia of Arabic and Islamic manuscripts in the fields of Science and Mathematics. We believe that it is imperative to resort to the appropriate use of these modern technologies to make such Arabic and Islamic Sciences accessible and available to all, at minimum possible cost; in order to narrow the so-called "Digital Gap" or "Digital Fissure", currently existing between the developed and developing countries.

Finally, we hope that this modest effort will eventually reveal the treasures of ancestral legacies and enrich the World Library for the benefit of the researchers, the scholars and the analysts.

The Regional Office of UNESCO in Cairo

CULTNAT
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The project proceeded under the umbrella of the “World Memory” program for cultural promotion and protection, and preservation of the World’s wealth of Books and Documents, was prompted by the need for an Enhanced Information and Communications System. In this context, the Regional Office of UNESCO in Cairo ran a regional program for the documentation and publication of Arabic and Islamic Sciences, fields of Science and Mathematics.

The Regional Office of UNESCO in Cairo and CULTNAT are happy to introduce this reference in the creation of a digital encyclopedia of Arabic and Islamic Sciences, an Information and Communications System. We believe that it is imperative to resort to the appropriate use of these杰 works to make such Arabic and Islamic Sciences accessible and available to all, at minimum cost to narrow the so-called “Digital Gap” or “Digital Divide”, currently existing between the developed and developing countries.

This modest effort will eventually reveal the treasures of ancestral legacies and enrich the world of the researchers, the scholars and the analysts.

ice of UNESCO in Cairo

READERS GUIDE

The total of 436 Astronomy Manuscripts, including theses, are kept at Al-Azhar Al-Sharif Library and attributed to 136 authors, interpreters and collectors. Most manuscripts are in Arabic except for two that were written in Turkish, and a third in Persian.

This Book begins with a scientific introduction dealing with Astronomy and its applications in the Arab and Islamic Culture. Then comes the main body of the Book with the photographic presentation of a special selection of 31 manuscripts selected from the Astronomy Collection kept at Al-Azhar Al-Sharif Library. Next, we will find a Glossary of Astronomical terms with brief definitions. A number of annexes have also been included for better understanding of the subject matter. The Book was finally concluded with a Bibliographical Listing of the complete Astronomy and Timekeeping Collection kept at Al-Azhar Al-Sharif Library.

The selected manuscripts are organized in a specific predetermined order according to subject matter. Within each subject group, manuscripts were arranged in alphabetical order. When an author was accorded more than one entry in a specific group, the works were arranged accordingly as related to the organization of the subject matter in the alphabetical order within that group.

The Subject Groups of the Book include the following:

- Astronomical Instruments
- Almanacs and Tables
- The Sun, The Moon, The Zodiac and Planets
- Working with the Sines
- Astronomical Tables
- Spherical Shape of the Earth

The following particulars were given for each work:

- Title of the Manuscript
- Bibliographical data (including title, the name of the author, the transcriber, transcription date as well as the order of the thesis in relation to other documents in the same group and the documentation, and identification numbers of the Manuscript in the Library Collection)
- Biographical notes on the Author, and his most important related works
- A summary of the Manuscript’s contents
- Some selected pictures of the Original Manuscript followed by a commentary on its contents
THE SYSTEM OF TRANSLITERATION

In this issue of the "Contributions of Arabic and Islamic Civilization to Sciences" series, we chose to abide by the international standards of transliteration rules approved by the Library of Congress (LC) and the American Library Association (ALA).

First: The Letters of Alphabet:
The table below gives the Arabic Letters and its equivalent phonetic values in these rules.

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<thead>
<tr>
<th>Arabic</th>
<th>Transliteration</th>
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<tr>
<td>ب</td>
<td>Badr al-Dīn</td>
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<tr>
<td>ت</td>
<td>Tuhfah</td>
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<tr>
<td>ث</td>
<td>Thamarāt</td>
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<tr>
<td>ج</td>
<td>Jāyb</td>
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<td>ح</td>
<td>ḫamal</td>
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<td>خ</td>
<td>Khuwārizmi</td>
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<tr>
<td>د</td>
<td>Muhammad</td>
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<tr>
<td>ذ</td>
<td>al-dhahab</td>
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<td>al-zīj</td>
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<tr>
<td>س</td>
<td>al-Saqa</td>
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<tr>
<td>ش</td>
<td>al-Shāfi‘ī</td>
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<tr>
<td>ص</td>
<td>al-Ṣawālhi</td>
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<td>ض</td>
<td>al-fayḍ</td>
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<td>ط</td>
<td>Ṭaybughā</td>
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<td>ـ</td>
<td>al-zuhr</td>
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<td>al-Qimmi</td>
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<td>muṣhab</td>
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<td>Haybāh</td>
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<td>al-wuqt</td>
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<td>ي</td>
<td>Yūnus</td>
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<tr>
<td>ـ</td>
<td>Huyyah</td>
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</table>

Second: The use of (٠) Alif and (ـ) hamzah:
The use of (٠) Alif depends on: being at the beginning of the word or in the middle or the end. If the Alif was in the beginning, then it is written as it is “A” at-Ātrāk, and if it is written in the middle or at the end it is written as “٠”; al-Muʿaqīt and shīfī.

Third: Vowels and Diphthongs:
Short: ٠ = (fathah): rayb; ـ = (kasrah): zāhil; ـ = (dammah): Ṭaybughā

Long: ـ = al-Māšīnī; ـ = al-Māšīnī; ـ = al-Ṣuṭṭī

Diphthong: ay - ـ; aw - ـ
An Overview by Ahmad Fouad Basha
Professor of Physics, Faculty of Science, Cairo University

Introduction

The Arabs used to give “Astronomy” many names like “the Science of Universe Form”, “the Science of Stellar Rules” and “Astrology”. This has been due to its association, as stated by the al-Šafā Brothers, with the study of the structure of Epicycles, the number of planets, and the division of Constellations dimensions and motion in this Art. First of all, they began by absorbing what the Ancients – including the Egyptians, the Greeks, the Persians and the Indians – had accomplished. The first book in Astronomy to be translated into Arabic from the Greek Language was “The Key of the Stars” attributed to “Hermes the Sage” during the Un Nayyad Rule. That was followed by translating two other books, namely: Ptolemy’s “Al-Magistr” and the “Sidibind”, during the days of the Abbasid Caliph: al-Manṣūr. Muslim writings next proceeded by following the same styles of those works, then moved forward and eventually adopted different and innovative styles. This creative phase of scientific development reached its zenith very early in the third Hegira Century (9th A.D), and continued right through the 9th Hegira Century (15th A.D).

A number of Ephemerides (Arabic Zījs i.e. astronomical handbooks with lists and tables) were compiled and classified over that period, among which were: al-Battānī’s “The Šāhī Zīj”, which was the first work to contain accurate information and accurate observations that greatly helped future scientists up to the beginning of the renaissance in Europe. There was also al-khwarizmī’s “Sidibind Zīj” for which there is a Latin translation of the copy revised by al-Majritī in Cordoba (Qartabah, Spain) c. 1000 A.D. Many other works of al-Būzjānī, al-Hamādānī, al-Kindī, al-Bīrūnī, Ibn Yūnus, al-Šufī and others had also appeared.

The progress in Astronomy throughout the Muslim Renaissance was marked by the spread of observatories all over the Muslim World. As early as 829 A.D, the Abbasids built an observatory in Damascus and some scholars considered it the first in the Muslim Era. Also, the sons of Māsāh Ibn Shākir built an observatory in Baghdad, and the Fatimides built the “Ḫākimī Observatory” on the top of al-Muṣṭāṭīm mountain, which was renowned for the precision of its instruments, and the distinction of its workers. There were also other observatories in Syria, Asbahan, Maragha in Azerbaijan, Samanqand, Egypt, Andalusia and other countries and locations.

In addition to observatories, Muslim Scientists managed to invent and develop numerous instruments and tools for observation works. For example, the sundial and clepsydra were used for keeping of the time during the hours of the Day and the Night, and the astrolabe was universally used in its many different forms: the spherical, the plane and the linear, depending on whether it was representing the “Celestial Sphere”, or its projection on a plane surface, or the projection of the latter on a straight line.
There were also other observation instruments and tools such as the zenith and altitude, the quadrants (such as the astrolabe quadrant, the circle quadrant, the zarqūlāh quadrant, the complete quadrant, the northern quadrant, etc.), the house of the needle (the compass) and the pendulum, which was discovered by Ibn Yūnas al-Miṣrī who used it in his observatory for the measurement of time intervals taken in marking the stars and also in making the knocking clocks pendulum about six centuries before Galileo.

al-Bīrūnī mentioned that he had written 1000 important dissertations on all types of the astrolabe, and that in one of which he had put forward a simple theory for measuring the circumference of the earth; with a degree of precision that remarkably matches the latest established figure. The subjects to which Muslim and Arab Scientists had added important contributions in the various branches of Astronomy can be classified into two major fields, namely: Theoretical Astronomy and Applied Astronomy, which will be briefly dealt with herein.

I. Theoretical Astronomy

This is the branch of Astronomy concerned with the form of the Universe as conceived by the scientists, as well as the apparent motion of the heavenly bodies within a framework of a Model that can helpfully explain such motion. The Ancients used to give the stars which appear to be stationary the name of the “Fixed Planets” in order to distinguish them from the seven planets wandering around the earth. These according to the system introduced by Ptolemy, are: the Sun, the Moon, Mercury, Venus, Mars, Jupiter and Saturn. In Ptolemy’s Model, this means that the Earth was considered as the “Center of the Universe” and that the planetary motion is uniformly circular. The last five planets were called “the Wandering Planets” because they are hesitantly “lost” in the heavens, from time to time, among the different stars. They also move linearly in a certain direction, then they soon change and move in the opposite direction; which is known as “Regression”. The ancients did not know then what we know now about the Earth’s and other Planets’ motion in orbits around the Sun; a concept that is originally attributed to Copernicus (in the 16th century), placing the Sun at the center of the Planetary System. Nor did the Ancients know that the planets are dark bodies that get their light from the Sun.

The theoretical basis for these studies is Spherical Trigonometry being the main mathematical tool to solve problems in Spherical Astronomy. In fact, Ptolemy’s theory was, completely applicable to the majority of arithmetical purposes, certainly with respect to the fixed stars and with specific modifications, also to the Sun and the Moon and the Planets. In an attempt to explain the irregular motion of the Planets, Ptolemy constructed geometrical models for hypothetical motion on what are called “the Epicyclic Motion”, “the Eccentric Motion”, “the Deferent” and the “Equant”. Yet, some of these modifications were exposed to objections from Muslim Scientists; on either Philosophical or Practical (observational) bases or on both. On their part, Muslim Scientists had in fact contributed important additions; proposing modifications on Ptolemy’s System. For example, al-Hasan Ibn al-Haytham listed (c. A.D 1040) in his book “Doubts about Ptolemy” sixteen objections to Ptolemy’s Theory.
Astronomy

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In the 13th century (A.D), Naṣīr al-Dīn al-Ṭūsī (c. A.D 1274) introduced more comprehensive reforms through what is called “al-Ṭūsī’s Couple” to explain the evident contradictions between Ptolemy’s theoretical formations and the results of practical observations. Other astronomers from the Marāghi school had also proposed important additions. Among the most prominent members of that group are Muḥammad al-Dīn al-ʿArāfī al-Diminishqi (c. A.D 1266) and Ibn al-Shāhīr (c. A.D 1375). All those achievements had paved the way to Copernicus’ theory which places the Sun at the Center of the Planetary System. The results of research studies comparing the texts of Copernicus’ Works and those of the Marāghi Astronomers assert that similarities were so remarkably close (with the exception of the central position of the Sun) to the extent that some to state (without much exaggeration) that Copernicus was the most famous – if not the last – of the Marāghi followers. That prompted them also to pose the question not whether Copernicus had learnt the Marāghi Theory, but rather, where and how he actually learnt it?

II. Applied Astronomy

The Muslim Renaissance Scientists had developed their observation tools and instruments and recorded their remarks in many outstanding works that still retain their epistemological and methodological value, as sources of knowledge and experience to this day. For example, ‘Abd al-Rahmān al-Ṣūfī belongs to the school of researching astronomers that came into existence in the second half of the 10th century (A.D) in the Persian city of Shiraz under the rule of Buwayhids. His best known work, is the book on “The 48 Constellations of Planets” in which he revised all the stars mentioned in Ptolemy’s book of “Al-Majest” with great precision. Such precision had led him to earn the praise of “Shellerp”, in which he asserted that: “al-Ṣūfī had given us a description of the heavens that are adorned with the stars, in a far better way than was ever given; a description that had no equal for the next nine centuries (i.e. to this very day).

In the 11th century (A.D), the book of “The Great Ḥikūmī Ephemeris” was classified by Ibn Yūnus. Such classification had benefited “Laplace” in defining the inclination of the Zodiac and the differences between Jupiter and Saturn. The famous American astronomer, “Simon Newcomb”, had also used Ibn Yūnus’s remarks on the Solar and Lunar Eclipse in his research work on lunar motion.

The Muslim Renaissance Scientists had also known about the fact that the Moon changes its pattern of motion from one year to the other and al-Buzajāni was able to correct the moon’s position through the “Speed Formula”, which he himself had discovered. In his book of “al-Mas’ūdī Canon” al-Bīrūnī discussed important subjects including seven methods for defining the Cardinal Directions, splitting the angle into three divisions without ruler or dividers, establishing the time of day or night, establishing the seasons through meteorological observations and measuring the exact length of the year with infinite precision. Moreover, al-Bīrūnī’s genius is remarkably demonstrated by his writing on the shift of the Solar Apogee which is the greatest distance between the Earth and the Sun. The secret of al-Bīrūnī’s genius lies in the fact that the point of the Solar Apogee only shifts by a single degree every 300 years, and he was able to establish this figure on the basis of only four observations, by making use of “Differential Calculus”.
al-Hasan ibn al-Haytham attracted the attention to the study of the marks appearing on the face of the moon. Ibn Rushd, on the other hand, was the first to observe the Sun Spots (freckles) when he learnt by astronomical calculations the crossing time of the Planet Mercury past the Sun. He observed this and saw it as a black spot on the disc of the Sun at the predetermined (calculated) time. Also, al-Battani had his observations of the Solar and Lunar Eclipses upon which the modern scientists were able, in 1947, to determine the increase in the accelerated motion of the moon over a period of one century.

The science of timekeeping and time reckoning (al-niqāt) is, on the other hand, considered an essential part in the practice of astronomy under the Muslim State; since Muslims are obliged to fulfill religious duties which involve the study of the cosmos and learn about time systems and time organization. For example, they have to establish the exact times for the daily prayers, the beginnings of the lunar months, the dates for religious feasts and defining the direction of al-qiblah (towards Mecca) for the specific locations throughout the World; i.e. wherever a Muslim worshipper goes. The system of the “time keeper”, as a professional astronomer, came to appear with the advent of the 13th century (A.D); and he was, in the first place, responsible for the organization of the prayer times. The astronomer Shihab al-Din al-Sufi al-Maqqoli (or al-Maqsi) had classified time tables: starting with sunrise as a function of its altitude and longitude for the latitude of Cairo. The tables were expanded and developed in the 14th century (A.D) into a vast collection of 200 handwritten sheets, containing over 30,000 entries. In Syria, the same century saw the completion of the most important work in the science of astronomical times as al-Mizzi returned to Syria after concluding his studies in Egypt. There, he established a collection of tables for the hour angles as well as tables for the Prayer times similar to those available for the City of Cairo.

Ibn al-Shaţir had also established tables for the Prayer times for a location at the 34 degrees latitude. Ibn Yânus, on the other hand, described a precise way to define the direction for qiblah which “Carl Shoy” had found striking. Also, it gives a modern definition for the Sine and Cosine equation in Spherical Trigonometry. Moreover, Shams al-Din al-Khalilî is credited with the most important contribution to the science of astronomical times when he revised the calculations of al-Mizzi Tables for the two new parameters (the local altitude and the inclination of the epicycle) which Ibn al-Shaţir had deduced. His Time Tables, with respect to the Sun and Prayer Times for Damascus, remained in use there up to the 19th century (A.D).

One of the principal uses of the clepsydra (water clock) was to help in announcing the prayers time at the night or when the sky is covered with heavy clouds (obscured). In fact, the prayers time was fixed on the body of the clepsydra as the rate of water flow was adjusted daily in accordance with the length of the Day and the Night. The outer parts of such type of clocks, which date back to the 14th century (A.D), are still exhibited in one of the upper chambers in the Qarawiyyin Mosque of the Moroccan City of Fes where prayers time was announced by hoisting a flag on the top of the minaret during the hours of the day; and by lighting a flame during the hours of the night, to benefit those living outside the city bounds.

The qiblah (towards the direction of Mecca) for a certain location is, on the other hand, a trigonometric function of the local latitude and that of Mecca, as well as the difference in longitudes between the location and Mecca.
Faytham attracted the attention to the study of the marks appearing on the face of the moon. On the other hand, was the first to observe the Sun Spots (freckles) when he learnt by astronomical observations the crossing time of the Planet Mercury past the Sun. He observed this and saw it as a black spot on the Sun at the predetermined (calculated) time. Also, al-Battani had his observations of the Solar and lunar eclipses when the modern scientists were able, in 1947, to determine the increase in the accelerated motion of the Earth over a period of one century.

Time-keeping and time reckoning (al-mlqāt) is, on the other hand, considered an essential part in the Muslim State; since Muslims are obliged to fulfill religious duties which are linked to the cosmos and learn about time systems and time organization. For example, they have to fix times for the daily prayers, the beginnings of the lunar months, the dates for religious feasts in the direction of al-qiblah (towards Mecca) for the specific locations throughout the World; i.e. the worshipper goes. The system of the “time keeper”, as a professional astronomer, came to be in the 13th century (A.D.); and he was, in the first place, responsible for the organization of the seven parameters. The astronomer Shāhāb al-Dīn al-Ṣufī al-Maqdīsī (or al-Maqqṣī) had classified time tables as a function of its altitude and longitude for the latitude of Cairo. The tables were expanded the 14th century (A.D.) into a vast collection of 200 handwritten sheets, containing over 30,000 sheets. The same century saw the completion of the most important work in the science of astronomical tables returned to Syria after concluding his studies in Egypt. There, he established a collection of about angles as well as tables for the Prayer times similar to those available for the City of Cairo.

Also, established tables for the Prayer times for a location at the 34 degrees latitude. Ibn Yūnus, 1 described a precise way to define the direction for qiblah which “Cari Shay” had found striking. In modern terms, the Sun and Cosine equation in Spherical Trigonometry. Moreover, Shams is credited with the most important contribution to the science of astronomical tables when he lattices of al-Mizzi Tables for the two new parameters (the local latitude and the inclination of the earth) al-Shāṭir had deduced. His Time Tables, with respect to the Sun and Prayer Times for the fixed location there up to the 19th century (A.D.).

In conclusion, we find that astronomers of Muslim Renaissance had added very important contributions to the development of both Theoretical and Applied Astronomy; by adopting an experimental system relying on observations and calculations, in understanding and interpreting astronomical phenomena and explaining planetary motion. The theories they reached and the ephemerides they compiled had the greatest effect on enriching the results collected by “Tycho Brahe”, and used by “Kepler” in formulating his famous laws on planetary motion. Subsequent to all those developments, Newton was able to deduce his Gravitation Law; and the eventual development from Classical Mechanics to Relativistic Mechanics and Celestial Mechanics and the immense progress in Space Research, which is the pride of our present age. George Sarton, our leading contemporary Science Historian, duly testifies that it was the Arab Research advancements in Astronomy that had doubtlessly paved the way to the great renaissance flourished by Kepler and Copernicus. This testimony is much in harmony with the fact that Science is a Common Human Heritage, and that the history of scientific discoveries is very similar to the history of human civilizations; proceeding in ever-moving phases and cycles, each with its impact and importance in the development of the human intellect.

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For Further Reading:

- Donald R. Hill; Islamic Science and Engineering, Edinburgh University Press 1993, Translated by Al-Muhammad Bāshī, Sīlāt al-‘ilam al-ma‘rifah (305), Kuwait – 2004
The Illustrated Astronomy Manuscripts
Selected from the Holdings of Al-Azhar Library
Khaṭīb al-‘Azzażī: (Died in the last quarter of the 13th Century, H)
He is Khaṭīb ibn Ibrāhīm al-‘Azzażī al-Ḥusnī al-Miṣrī al-Sharqāwī al-Shaḥī al-Falākī.

His works include:
• A Treatise on Lines of the Circle’s Parts
• A Treatise on the Rules Of Astronomy
• The Bright Planet on Working with the Arched Quadrant
• The Seekers Way to Knowing the Times by Calculation

al-‘Azzażī’s Treatise on Sundials – Khaṭīb ibn Ibrāhīm al-‘Azzażī 71517/497

It is one of the late works in Astronomy aiming at presenting a comprehensible treatise on the circle’s parts. The Treatise includes an introduction, two Chapters and a conclusion. The first chapter deals with establishing the zenith for the circle’s parts using the al-mucantars. The Manuscript also contains a practical way to make one of the observation and measuring instruments, the Compass. The author tells that he had performed a practical observation experiment in the year 1282A.H. The Manuscript further contains a group of tables and the circle to be drawn around one of the instruments in order to define the right direction for al-Miḥrāb (niches in mosques indicating the direction pointing towards Mecca).

The Manuscript was transcribed by ‘Alī Mayyās al-Shaḥī al-Bayūnī al-Afghānī in the year 1302H.
al-'Azzāzī’s Treatise on Sundials
(risālat al-‘Azzāzī fī al-mażāwil)

‘Azzāzī: (Died in the last quarter of the 13th Century, H)

Inclu-:
- on Lines of the Circle’s Parts
- on the Rules Of Astronomy
- Planet on Working with the Arched Quadrant
- rs Way to Knowing the Times by Calculation

8 Treatise on Sundials – Kahīl ibn Ibrāhīm al-‘Azzāzī 71517/497

The late works in Astronomy aiming at presenting a comprehensible treatise on the circle’s parts.
- includes an introduction, two Chapters and a conclusion. The first chapter deals with establishing
- the circle’s parts using the al-macantar. The manuscript also contains a practical way to make
- observation and measuring instruments, the Compass. The author tells that he had performed a
- servation experiment in the year 1282A.H. The manuscript further contains a group of tables and
- be drawn around one of the instruments in order to define the right direction for al-Mihrab (niches
- indicating the direction pointing towards Mecca).

The manuscript was transcribed by ‘Ali Mayas al-Shafi’i al-Bayumi al-Ahmadi in the year 1302H.

al-‘Azzāzī’s Treatise on Sundials, (risālat al-‘Azzāzī fī al-mażāwil)

- The Table for the Arc of al-‘Asr (afternoon prayer time) for the latitude of 30 degrees north “lám” and another for the
  latitude of 31 degrees north “lám aleph”. (See appendix b) for al-Jummal Calculations).
- An instrument named al-baṣiṣṭa (the simple or the flat plane) for defining the right direction for the mihrab (niches in
  mosques indicating the direction pointing towards Mecca) for the different locations. In using the instrument, it is first
  lined up with the four cardinal directions with the needle (the pointer) matching with them. The mihrab for the location
  would be indicated through positioning with respect to the needle’s inclination.

- A Treatise on Sundials by Khālid b. Ibrāhīm al-‘Azzāzī, 71517/497
Muhammad al-Mizzi: (690 – 750 H/ 1291 – 1349 AD)
He is Shams al-Din Abi’Abd Allâh Muhammad ibn Alâmad ibn ‘Abd al-Ra’dîn al-Mizzi al-Miqârî. al-Mizzi studied the Qur’ân and the Arabic Language and excelled in Astronomy and Mathematics, and was renowned for making curious types of astrolabes. It is purported that his astrolabes were sold in his time for 10 Dinârs, or more, a piece. The quadrant was sold for two Dinârs a piece. He came to Egypt to study under the al-Akâfîn in Cairo, but he lived for most of his life in Damascus where he worked as a Miqârî (time keeper) at the Umayyad Mosque. His scientific interests were limited to the making of astronomical instruments, observing the motion of the Sun in relation to the Earth and the study of both the Apogee and Perigeec in the distances of the different planets from the Earth.

His works include:
- The Gem of the Minds on operations with the Astrolabe
- A Treatise on the Folded Quadrant
- A Treatise on the Lined Quadrant
- A Treatise on the Winged Quadrant
- Tables of Perigeec for the Latitude of Damascus
- A Treatise on the Quarter Circle Placed on The Arc
- Removing the Doubt on Operations with the Sine Quadrant

al-Mizzi’s Treatise on the Astrolabe – Muhammad al-Mizzi

It is one of the Manuscripts dealing with the science of astronomical instruments that the author had mastered, and in which he had excelled. This is evident, particularly, in the sundial carrying his signature, and is the pride of the British Museum. The astrolabe is the subject of this manuscript in which he gives detailed description of the instrument and its features and the way it is used for measuring the altitude and the way to determine the two tangents, the inclination, the distance, the latitudes for locations, the arcs of the day and the night, the circle for the day and the night, the apogee, prayer times, the rise of constellations on the epicycle, the zenith for each altitude as well as that for the qiblah (direction towards Mecca), the rise-and-set times for the planets, and some surveying practices such as heights of columns (poles) and mountains, and the depths of wells and widths of rivers.
al-Mizzī’s Treatise on the Astrolabe
(Risālat al-Mizzī fī al-ṣūrīlāb)

Ad al-Mizzī: (690 – 750 H/1291 – 1349 AD)

At-Dīn Abī ‘Abd Allāh Muḥammad ibn Ḥabhīl ibn ‘Abd al-Rahīm al-Mizzī al-Miqā‘īl. al-Mizzī Qur‘ān and the Arabic Language and excelled in Astronomy and Mathematics, and was renowned for his astronomical work. It is purported that his astrolabes were sold in his time for 10 Dinārs each. The quadrant was sold for two Dinārs a piece. He came to Egypt to study under the al-‘ario; but he lived for most of his life in Damascus where he worked as a Miqā‘īl (time keeper) at al-Mosque. His scientific interests were limited to the making of astronomical instruments, the motion of the Sun in relation to the Earth and the study of both the Apogee and Perigee in the different planets from the Earth.

Incllude:

The Minds on operations with the Astrolabe
On the Folded Quadrant
On the Lined Quadrant
On the Winged Quadrant
For the Latitude of Damascus
On the Quarter Circle Placed on the Arc
The Doubt on Operations with the Sine Quadrant

Treatise on the Astrolabe – Muḥammad al-Mizzī 65513/476


al-Mizzī’s Treatise on the Astrolabe, (Risālat al-Mizzī fī al-ṣūrīlāb)
Description of the features on the astrolabe where the altitude arc is defined as the arc drawn on the back of the astrolabe and which is divided into 90 equal divisions starting from the East-West line. The astrolabe chamber is also defined as the ring surrounding the plates, and which is divided into 360 (Sheen Se’en; 300 + 60 by jummal calculations) divisions, i.e., representing the divisions of the epicycle. The plates are also explained where each contains three complete circles with the same center as that of the plate and represent the orbits (tropics) of Capricorn, Aries and Libra, and Cancer.
The Compendium of Principles and Aims on Operations with the Zarqalía Plate (jāmi‘ al-mabādi’ wa-al-ghāyāt fī al-‘amal bi-al-ṣafīḥah al-zarqāliyyah)

Abū al-Ḥasan al-Marrākushī (660H/1261AD)

He is Abū al-Ḥasan ibn ‘Umar al-Marrākushī, a Moroccan scientist who acquired fame in the fields of Astronomy, Mathematics and Geography. He also made sundials and produced a map of al-Maghrib al-‘Arabī (Morocco), where he corrected Ptolemy’s mistakes. He was also the first to use the longitude lines to indicate equal hours on the map.

His works include:
• A treatise of concise exposition of operations for determining the visibility of the new moon
• The Compendium of Principles and Aims in the science of Time Keeping

The Compendium of Principles and Aims on Operations with the Zarqalía Plate - Abū al-Ḥasan al-Marrākushī 28/7657

A manuscript, of the Academic Specialized type, in 130 chapters. It constitutes one of the pioneering works on the science of observation instruments and tools. The work had a great impact on the astronomical community both in Egypt and Syria, and was also considered as the most important reference on the theory of the sundial during the late stage in the astronomy of Muslim Renaissance. The Manuscript is abundantly adorned with drawings and illustrations, and it concentrates on the description of manufacturing techniques; which means that it was not expanding only on the theoretical aspects. The treatise deals also with both the vertical and horizontal sundials, in addition to including the first use of the lines indicating the equal hours which the Greeks did not employ. Moreover, it applied the conical sectors in the description of constellations.
The Compendium of Principles and Aims on Operations with the Zarqalia Plate
(jami' al-mabādi‘ wa-al-ghāyat fī al-'aml bi-al-shaf‘ūh al-zarqāliyyah)

On this first page of the Manuscript, al-Murkishi demonstrated the importance of this instrument called “The Zarqalia Plate”, as he asserted that it is one of the most noble and majestic instruments being suitable for all horizons and performs many tasks that other instruments cannot perform. Moreover, he added that it is very light to carry and very simple in its parts, though its use is marred by some mystery, but he promised to clarify all in an exploratory way through a later book. In the 129th Chapter, the author presented several practical ways to test the soundness of the instruments and the degree of precision it offers. He also presented another way to confirm the proper order in its interior, and another to test the altitude parts and the Tangent keys.
Gem of the Seekers on Operations with the Astrolabe
(Tuḥfat al-ṭullāb fī al-ʿamal bi-al-aṣṭūralāb)

Abū al-Qāsim ibn al-Ṣaffār: (Died in the first half of the 5th Century, H)

He is Abū al-Qāsim, ʿAlmaḍ ibn ʿAbd Allāh ibn ʿUmar ibn al-Ṣaffār al-Andalusī a Mathematician, Engineer, Astronomer and Physician. Studied in Córdoba and was taught by Abū al-Qāsim Maslamah Ibn ʿAlmaḍ al-Maṭrīḥ. He emigrated to, and settled in, the town of Denia in Andalusia; up to the time of his death in Denia, he studied all the basic sciences of the age: especially those of Mathematics and Astronomy and proved his great genius in Engineering, to the extent that he earned the title of “Engineer”. He was engaged in teaching those sciences and carried out scientific experiments in the field of astronomical observation of stellar motion and the motion of other celestial bodies. All Arabic References indicate that he died in the year 426 H/A.D 1035. Though al-Maqqrī, who died in the year 433, made mention of his name; as an indication that al-Ṣaffār was – at least – living up to that date. Ibn ʿṢāʾid al-Andalusī also treated that in his book "ṭabaqāt al-umam; the Classes of Nations." 

His works include:
• The concise zig according to the model of Sindhind
• The Book Of Working With the Astrolabe

Gem of the Seekers on Operations with the Astrolabe - Abū al-Qāsim Ibn al-Ṣaffār 12/4386

This is a hand-written copy of the book using Naskh script and applying a commentary system. It is contained within a collection; from sheet 330 to sheet 358. Plutot de Tivoli translated this Book into Latin around the year A.D 1134, and the Book was also translated into Hebrew during the last third of the thirteenth century, A.D. This is a clear proof of the Book’s scientific value at that period.

This manuscript is characterized by its scientific contents, elegance of style and clarity of thought and expression; being the outcome of the Author’s own practical experience in making a good number of astrolabes and other observation instruments. The Manuscript, therefore, represents a true translation of what the Author enjoyed in terms of experience in Astrolabe-making and its competent use.
Gem of the Seekers on Operations with the Astrolabe
(Tuhfat al-ṭullāb fi al-ʿamal bi-al-ṭṣurūlāb)

Ṣaffār: (Died in the first half of the 5th Century, H)
and ibn ʿAbd Allāh ibn ʿUmar ibn al-Ṣaffār al-Andalusī a Mathematician, Engineer, an. Studied in Córdoba and was taught by Abū al-Qāsim Maslama ʿAbd al-Allāh ibn Ṭūr, and settled in, the town of Denia in Andalusia; up to the time of his death in Denia, cienas of the age: especially those of Mathematics and Astronomy and proved his ng, to the extent that he earned the title of "Engineer". He was engaged in teaching 1 out scientific experiments in the field of astronomical observation of stellar motion celestial bodies. All Arabic References indicate that he died in the year 426 H/A.D 831, who died in the year 433, made mention of his name; as an indication that al-ing up to that date. Ibn Ṣаʿīd al-Andalusī also treated that in his book "ṭṣabaqāt altions."

ng to the model of Sindhind

With the Astrolabe

Operations with the Astrolabe - Abū al-Qāsim Ibn al-Ṣaffār 12/4386

The book using Naskh script and applying a commentary system. It is contained sheet 330 to sheet 358. Plato de Tivoli translated this Book into Latin around the look was also translated into Hebrew during the last third of the thirteenth century, of the Book's scientific value at that period.

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Gem of the Seekers on Operations with the Astrolabe (Tuhfat al-ṭullāb fi al-ʿamal bi-al-ṭṣurūlāb)
Abū al-Qāsim ibn al-Ṣaffār begins here explaining the different parts of the Astrolabe; speaking about the ring, or hanger, from which it can be suspended. Next, he speaks about the loop, the seat (brace or bracket) which is the protruding part of the astrolabe that comes on the top of the principal part of the astrolabe, and is normally decorated and — sometimes — bears the name of its maker. Next, he proceeds with the principal part (body) of the Astrolabe or "Mater", Mother, which is the major plate incorporating all plates, i.e. the circular plate with a ring encompassing all other plates and the Chamber (which is the space inside the "Mater" of the Astrolabe). It is divided into 360 divisions (angular degrees) which are the degrees of the epicycle and the plates within the Chamber (the longitudes and latitudes of some cities were, sometimes, inscribed on the Chamber). Then he explained the drawings inside the Chamber showing that there are three circles on each plate which are the small circle for the head of the Tropic of Cancer, the medium circle for the head of the Tropic of Aries and Libra, and the large circle for the head of the Tropic of Capricorn. There was also his mention of the curved plates, which are the circles inscribed in the upper half of the plates and it is clear that he was describing here the face of the astrolabe.
The Seekers Excursion in the Science of the Astrolabe
(nuzhat al-ṭullāb fi ‘ilm al-astūrūlāb)

Umayyah ibn Abī al-Ṣalt: (460-529H/1067-1134AD)
He is Umayyah ibn ‘Abd al-‘Azīz ibn Abī al-Ṣalt al-Andalusī al-Dānī Abī al-Ṣalīh who was a Scientist, a Writer and a Sage. Umayyah was born in Denia of Eastern Andalusia and lived in Seville for twenty years, and in Africa for another twenty years as well as staying in Cairo. He was singular, in his time, in the Mathematics of Andalusia besides mastering the art of music, and his playing of the lute. When he reached the age of 50 he left Andalusia for Egypt (510H/1116AD) and stayed in Alexandria for a period and returned back to Andalusia, where he spent the rest of his life. He died in al-Mahdiyah, in the year 510H/1134AD.

His most important works include:
• A Treatise on operations with the Astrolabe
• A Treatise on Music
• A Treatise on Egypt
• A Book of Geometry
• The Literary Garden
• Correcting the Logic of the Mind

The Seekers Excursion in the Science of the Astrolabe – Umayyah ibn Abī al-Ṣalt 469/62519

One of the important books in the history of astronomy of the Muslim era, which is found in other libraries under the title of “A Treatise on working with the Astrolabe” and deals with the fundamentals of this instrument, and its use. The manuscript is in 33 sheets distributed among chapters related to the basics of the astrolabe. The part explaining its components such as the holder, the loop, the bearing and the alidade in detail is written in red ink in order to be distinguished from the rest of the text. Next, it moves into the different uses of this observational instrument; including the establishment of the Sun’s position on the zodiac as well as the orbits of the different planets, the Sun’s Apogee and Perigee, and the latitude of a certain place by virtue of the Sun’s or a planet’s altitude with respect to that place.

The Seekers Excursion in the Science of the Astrolabe
(nuzhat al-ṭullāb fī ʿilm al-astūrulāb)

al-Ṣalt: (460-529H/1067-1134AD)
Abd al-ʿAzīz ibn Abī al-Ṣalt al-Andalusī al-Dānī Abū al-Ṣalt who was a Scientist, a
mayaḥ was born in Denia of Eastern Andalusia and lived in Seville for twenty years,
other twenty years as well as staying in Cairo. He was singular, in his time, in the
alusi besides mastering the art of music, and his playing of the lute. When he reached
Andalusia for Egypt (510H/1116AD) and stayed in Alexandria for a period and returned
here he spent the rest of his life. He died in al-Mahdiyyah, in the year 510H/1134AD.

Works include:
- Stations with the Astrolabe
- ... of the Mind
- ... in the Science of the Astrolabe – Umayyah ibn Abī al-Ṣalt 469/62519

This book is found in other libraries and deals with the fundamentals of this instrument,
which is divided into 33 sheets distributed among chapters related to the basics of the astrolabe.
its components such as the holder, the loop, the bearing and the alidade in detail is written
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sets, the Sun’s Apogee and Perigee, and the latitude of a certain place by virtue of the
altitude with respect to that place.

3H, by ʿAbī ʿAlī ibn ʿAbī ʿAmrī al-Ṣaḥīlī al-ʿAmīfī

The Seekers Excursion in the Science of the Astrolabe. From chapter 57 dealing with the difference in longitude between two places, i.e. their mid-day time difference. He indicates that this requires two persons at the two places simultaneously observing (and timing) the same phenomenon, e.g. the onset of (or end of) a lunar eclipse.
A Treatise on Operations with the Astrolabe, Almucantars and the Sine Quadrant

(risalah fi al-‘amal bi-al-üşṭūrulāb wa-rūb‘ al-muṣafatāt wa-al-rūb‘ al-muṣayyab)

Ibn al-Shā‘irī (704 – 777H/1304 – 1375AD)
He is Abū al-Ḥasan ‘Ālī al-Dīn ‘Afī ibn Ḥabrām ibn Muḥammad al-Anṣārī (Known as) Ibn al-Shā‘irī.
Ibn al-Shā‘irī was born in Damascus and spent most of his life working there as a timekeeper and prayer caller at the Umayyad Mosque. He achieved great fame among the scholars of his time as a genius astronomer. His great fortune allowed him to visit many countries including Egypt where he had a long stay and studied Astronomy and Mathematics both in Cairo and Alexandria. He excelled in Geometry and Arithmetic and was soon to proceed to Astronomy, where he achieved great distinction; which became evident in his many innovations. There was an instrument for indicating and checking prayer times, which he called “al-baṣīṣ” meaning the simple and placed in the Umayyad Mosque, that was one of his inventions. He also corrected the sundials that remained in use for centuries in Egypt and Syria; and served as a time-correction reference throughout the Arab World. His works included several ephemerides, containing astronomical theories and new knowledge. His most important achievement was, perhaps, his refusal of Ptolemy’s Theory that declared the Earth as the center of the Universe, and that the heavenly bodies rotate around the Earth. That theory was a matter of established fact at the time of Ibn al-Shā‘irī, and some sources claim that he was the first to contradict it; and they go as far as to credit him with the first declaration that it is the Earth and the wandering planets that regularly rotate around the Sun, and that the Moon orbits the Earth. Such claim, however, remains the subject of scholarly dispute; being strongly refuted by others.

His works include:
• The Ultimate Goals in Astronomical Works
• The Ultimate Question in Correcting the Origins
• Explanation of the Hidden in Working With the Sine Quadrant

A Treatise on Operations with the Astrolabe, Almucantars and the Sine Quadrant - Ibn al-Shā‘irī 95634/564

The treatise explains the astrolabe and its use in determining the altitudes for the Sun and the Planets, as well as measuring the arcs for the Sun during day times and for the Planets in the night times, also knowing the times passed and that remaining of the day or the night, Sun and planet rise time, the cardinal directions and the azimuth angle for the qiblah. All of that being given within a scope attesting to the depth of the author’s experience in the astrolabe and its components, as he offered explanations of the special terms associated with this indispensable instrument to any contemporary student of astronomy.

The Manuscript was transcribed by Muḥammad ibn Muḥammad ibn ‘Afī in the year 1272 H.
on Operations with the Astrolabe, Almucantars and the Sine Quadrant
al-`amal bi-al-`uṣṭūrulāb wa-rub` al-muqanṭarāt wa-al-rub` al-muḥayyāb)

4 – 777H/1304 – 1375AD)

`Alī ibn al-Dīn `Alī ibn Ibrahīm ibn Muḥammad al-Anṣārī (Known as) Ibn al-Shaṭīr, in Damascus and spent most of his life working there as a timekeeper and prayer caller. He achieved great fame among the scholars of his time as a genius astronomer. His knowledge enabled him to visit many countries including Egypt where he had a long stay and studied mathematics both in Cairo and Alexandria. He excelled in Geometry and Arithmetic and was an astronomer, where he achieved great distinction; which became evident in his many astronomical works, containing astronomical theories and most important achievement was, perhaps, his refusal of Ptolemy's Theory that declared the Earth is the center of the Universe, and that the heavenly bodies rotate around the Earth. That theory was held fact at the time of Ibn al-Shaṭīr, and some sources claim that he was the first to deny it as far as to credit him with the first declaration that it is the Earth and the wondering bodies that orbit around it, and the Moon orbits the Earth. Such claim, however, remains a disputed point being strongly refuted by others.

A Treatise on Operations with the Astrolabe, Almucantars and the Sine Quadrant
(risālah fi al-`amal bi-al-`uṣṭūrulāb wa-rub` al-muqanṭarāt wa-al-rub` al-muḥayyāb)

This page contains the introduction to the Manuscript where the author declared that he chose to summarize the “Treatise on operations with the Astrolabe, almucantars and the Sine Quadrant” in such a way so that it contains the most essential guidelines necessary for the greatest benefits, while at the same time offering ease of use. He made the summary in three chapters: the first on working with the astrolabe, the second on working with the al-almucantars and the third on working with the Sine quadrant.
He is Abū al-Faḍl Il ‘Iz al-Dīn ‘Abd al-‘Azīz ibn Muḥammad al-Waffā’ī, a renowned Egyptian Astronomer who lived in the ninth century of Hegira. He worked as a timekeeper at the Mu‘ayyad Mosque, near to Zuwa’ilah gate, and other mosques in the land of Egypt. al-Waffā’ī authored more than twenty treatises and forty manuscripts. His research interests concentrated on specific subjects; such as reckoning time through longitudes and latitudes … etc.

His works include:
• Concise exposition of the dispersed Gems on operations with the almucantar quadrant
• Essence of Gems on operations with the Moon
• Use in reckoning oblique (sundial)
• A Treatise on operations with the Triangle


al-Waffā’ī, the Egyptian Astronomer, invented this instrument, the Equatorial circle, in the 15th century (AD). It is one of the instruments referred to by Astronomers as “astronomically indispensable, or an instrument with multiple uses”. It consists of a semicircular housing fixed, at the two diagonal ends, to a horizontal base and can be adjusted to a position parallel to the celestial equator, at any latitude. The instrument also consists of a special optical radial direction instrument fixed to the housing to measure the hourly angle for any celestial (heavenly) body with angular inclination below the inclination of the ecliptic. The base carries lines pointing to the qiblah (direction of Mecca) for the different places. The treatise also dealt with many commentaries; such as the Commentary of Abī al-Faṭḥ al-Ṣūfī al-Miṣrī on “al-muwaṣṣal fī Dāʾīrat al-Muʿaddal” in which he explicitly credited ‘Abd al-‘Azīz al-Waffā’ī with its invention.
A Treatise on the Equatorial Circle
(risālah fī dāʾirat al-muʿaddal)

-Waffāʾī (811-879H/1408-1474AD):
11th century of Hegira. He worked as a timekeeper at the Muʿayyad Mosque, near to other mosques in the land of Egypt. al-Waffāʾī authored more than twenty treatises and his research interests concentrated on specific subjects; such as reckoning time through 'udes ... etc.

1 of the dispersed Gems on operations with the almucantar quadrant
in operations with the Moon

oblique (sundials)

ations with the Triangle

Equatorial Circle – 'Abd al-ʿAzīz al-Waffāʾī 533/88225

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A Treatise on the Equatorial Circle, (risālah fī dāʾirat al-muʿaddal)

From the introduction to a Treatise on the equatorial, "al-Muʿaddal" Circle, it is clear that its inventor is the astronomer ‘Abd al-ʿAzīz al-Waffāʾī, who stated that: "some of my friends had asked me to prepare a treatise on the instrument that I named the Muʿaddal Circle. I arranged this treatise in an Introduction, 15 chapters and an epilogue". He described his instrument as a solid, or hollow, wooden semicircle with a needle housing in the middle. The four cardinal directions and qiblah of the different locations are marked on the circle whose diagonal is marked with a sixtieth ruler, and the footnotes of the manuscript indicate its educational tendency.
Fresh and Sweet Source on Ephemerides of the Plans and Visibility of the Crescent
(al-manhal al-`adhb al-zulāl fī ḥal al-taqwīm wa-ru`yat al-hīlāl)

Abū Ahmad ibn al-Majdī (767 – 850 H / 1365 – 1446 AD)
He is Abū Ahmad ibn Rajab ibn Ṭaybūghā' al-Majdī al-Qāhibī al-Shaftī, known as Ibn al-Majdī after his grandfather. Ibn al-Majdī was born, and brought up, in Cairo and learnt the Qur'an and studied with the help of a number of well known scholars like al-Nawā'ī, al-Dumī'ī and al-Balqī. His contributions to Astronomy had great importance and were of great scientific value as he managed to recognize the state of a certain planet at a certain time as well as the tangent projected on the surface parallel to the horizon at any specific moment and the altitude of the Sun when shining on an inaccessible location. He also wrote a number of important research works on establishing the depths of wells and the breadth of rivers and the distances between two mountains and the one nearer to the traveler on the road. Ibn al-Majdī authored about fifty books and dissertations most of which still remain as manuscripts.

Among his works:
• Guiding the confused to knowing how to draw (lines) of surplus of turn
• Essence of what was said in determining the time and visibility of the crescent
• Revealing the truths on arithmetic of degrees and minutes
• A Treatise on operations with the quadrant on which almucantars are imaged
• Facilitation and approximation on solutions (of problems) and compilation (of labels)

Fresh and Sweet Source on Ephemerides of the Plans and Visibility of the Crescent, also known as: (The Sweet Pure Spring in Timing the New Moon) - Abū Ahmad ibn al-Majdī 10/4383

It is one of the small and brief thesises written for the purpose of recognizing the beginnings of the lunar Arabic months by way of calculation, and observing the New Moons (Crescents). The work reflects its author’s comprehensive and precise knowledge of all the terms and symbols in the Astronomy of the day. It appears that the manuscript was written early in the ninth century of Hegira as it is indicated from its context that it was dealing with the New Moon for the month of Ramadan in the year 812 H. Ibn al-Majdī is speaking here about extracting medians (means) from the tables for any planet, and working out the solar and planetary Almanacs at any time.
Source on Ephemerides of the Plans and Visibility of the Crescent (‘adhāb al-zulāfī fī ḥal al-taqwīm wa-ru’yat al-hīlāl)

aḍāf (767 – 850 H / 1365 – 1446 AD)

ab ibn Ṭaybūbuah al-Majdī al-Qāhirī al-Shafi‘ī, known as, Ibn al-Majdī after his grandfather. He was born in Cairo and learnt the Qur’an and studied with the help of a number of important scholars, including al-Nawawī, al-Dumīrī and al-Balqīnī. His contributions to Astronomy had great significance, and he managed to recognize the state of a certain planet at any given time, and to predict the time and the visibility of the crescent. His work was based on arithmetic of degrees and minutes, with the quadrant on which al-μμuqantar are imaged. His work was compiled on the basis of problems and solutions.

A book on Ephemerides of the Plans and Visibility of the Crescent, also known as: ‘The Wealth of the Clever and the Way to Solving the Almanac’. Therefore, he speaks here about an accessible and comprehensible method, through harmless approximation, if the crescent were beyond the limits of vision and denial. This is the case in which he says that he explained in detail elsewhere. He further lists a number of his previous works, which he presents the reader. For example, these include: “The Orphan Gem in Simplifying the Almanac Craft”, “The Signals on the way to Work With Transformations”, and “Simplification and Approximation in Expounding the Methods of Solving and Assembling”. 

I and brief theses written for the purpose of recognizing the beginnings of the lunar cycle, and observing the New Moons (Crescents). The work reflects its author’s precise knowledge of all the terms and symbols in the Astronomy of the day. It appears to have been written early in the ninth century of Hegira as it is indicated from its context that it was written for the month of Ramadan in the year 812 H. Ibn al-Majdī is speaking here about his tables for any planet, and working out the solar and planetary cycles.

Fresh and Sweet Source on Ephemerides of the Plans and Visibility of the Crescent (al-mañahal ‘adhāb al-zulāfī fī ḥal al-taqwīm wa-ru’yat al-hīlāl)

The author dealt here with observing the New Moon, and states that he reached a method to establish that involving written calculations whose soundness had been proven. Yet, they are too difficult for those who are not competent in matters of Arithmetic calculations. Further, he stated that he expounded his method in a thesis which he titled: “The Wealth of the Clever and the Way to Solving the Almanac”. Therefore, he speaks here about an accessible and comprehensible method, through harmless approximation, if the crescent were beyond the limits of vision and denial. This is the case in which he says that he explained in detail elsewhere. He further lists a number of his previous works, which he presents the reader. For example, these include: “The Orphan Gem in Simplifying the Almanac Craft”, “The Signals on the way to Work With Transformations”, and “Simplification and Approximation in Expounding the Methods of Solving and Assembling”.

Source on Ephemerides of the Plans and Visibility of the Crescent / Shihāb al-Dīn Abī Ṭālib Abī Ṭālibah ibn al-Majdī • 10 Folios • First Thesis • 18 x 13 cm
Ahmad al-Kum Rishi: (786 – 836H/1384-1432AD)

He is Shihab al-Din Ahmad ibn Ghulam Allah ibn Ahmad al-Hasib al-Kum Rishi, having belonged to “Kum Rish” which was one of the Cairo suburbs – but is no longer in existence. He worked as timekeeper at “al-Mu’ayyad Mosque” near Bab (the gate of) Zuwailah. Ibn Hajar described him as having worked in the art of stars and knew a great deal of the rules and was able to solve the ephemeris and to write the Almanacs; and was among the famous in that art. He was over 50 years of age when he died in the year 836H.

Among his works:
• Sufficient for science on the composition of the calendar
• Delight of the observer on a more accurate definition of principles of Ibn al-Shajir
• Delight of the observer on abridgment of zig Ibn al-Shajir

The Glitter in Solving the Seven (Planets) -Kum Rishi 493/71513

In this thesis, al-Rishi dealt with the Ephemeris of Ibn al-Shajir; the renowned astronomer as he abridged the work and adjusted and corrected the errors he spotted. He initially gave this thesis the title of: “The Stroll of Thought in Abridging Ibn al-Shajir’s Ephemeris”, and in another version: “The Stroll of Thought in Correcting Ibn al-Shajir’s Originals”. Then he abridged that and gave it the title of “The Glitter in solving the Seven/ The Glitter in Solving the Seven Planets”.

This work was the subject of many interpretations; like the interpretation of Sheikh Muhammad al-Khujari. The Manuscript contained tables for the extraction of the various dates and their related months, and deriving those dates from one another (i.e. cross-referencing); as well as the fasting and feasting seasons, tables for the sun and the moon and the five planets, tables for the solar and lunar eclipses and spotting the new moons, tables explaining the coordinates of the fixed planets (stars) and their latitudes and longitudes, and tables of the latitudes and longitudes for locations. It also contains tables to extract the years of the different dates (Arabic, Coptic, Byzantine and Persian) and their corresponding months and deriving those dates from one another and tables for the Muslim, Coptic and Jewish feasts and fasting seasons.

The Manuscript was transcribed by ‘Ali Sayyid al-Shafii al-Bayumi al-Ahmadi in the year 1302H

• The Glitter in Solving the Seven (Planets) / Shihab al-Din Ahmad ibn Ghulam Allah ibn Ahmad al-Hasib al-Kum Rishi  83 folios  23.5 x 32 cm
The Glitter in Solving the Seven (Planets) (al-lum'ah fl ḥal (al-kawākib) al-sab'ah)

Ishī (786 – 836H/1384-1432AD)

Ummad ibn Ghuţam Allāh ibn Aţmād al-Ḫāṣib al-Kūmi Rishī, having belonged to "Kūm of the Cairo suburbs – but is no longer in existence. He worked as timekeeper at "al-ṣārīr Bāb (the gate of) Zawāfa. Ibn Ḥajar described him as having worked in the art of the deal of the rules and was able to solve the ephemerals and to write the Almanacs; and is in that art. He was over 50 years of age when he died in the year 836H.

on the composition of the calendar on a more accurate definition of principles of Ibn al-Shāţir on abridgment of zig Ibn al-Shāţir
g the Seven (Planets) -Kūm Rishī 493/71513

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ject of many interpretations; like the interpretation of Sheikh Muḥammad al-Khuḍari and tables for the extraction of the various dates and their related months, and deriving another (i.e. cross-referencing); as well as the fasting and feasting seasons, tables for and the five planets, and the new moons, coordinates of the fixed planets (stars) and their latitudes and longitudes, and tables of the times for locations. It also contains tables to extract the years of the different dates and their corresponding months and deriving those dates from the Muslim, Coptic and Jewish feasts and fasting seasons.

ranscribed by A’lī Māyyās al-Shāfi’i al-Bayūnī al-Ĥāmādi in the year 1302H

The Glitter in solving the Seven (Planets) (al-lum’ah fl ḥal (al-kawākib) al-sab’ah)

It presents a Comparison of the names of the seven moving or revolving planets in the Arabic, Persian, Greek, Hebrew, Indian and Turkish languages. The text also explains the difference between the moving planets (The Planets) and the fixed planets (The Stars). The Photograph illustrates a page from one of the explanatory (interpretation) books of "The Glitter" book written by Muḥammad al-khuḍari al-Dumāyī under the title of "al-Khuḍari’s exposition of commentary on the Glitter", which is also in al-Aţžar Library’s Collection – under number 34492/336.
Guide from Fullacy in Knowing the Timekeeping and Determining Qiblah and Related Matters without Instruments
(al-hidayah min al-dalalah fi-ma’refat al-waqf wa-al-qiblah wa-ma yata‘alaq bi-himmā min ghayrAllah)

Shihāb al-Dīn al-Qalyūbī: (died: 1069 H/ 1658 AD)

He is Shihāb al-Dīn Abū al-‘Abbās ʿAlī ibn ʿAlī ibn Sulaymān al-Qalyūbī, who died at the end of the month of Shawwal in the year of 1069 H, and whose competence combined the fields of Shari‘ah Law and Philosophy and was also a Medical expert genius. Shihāb al-Dīn was particularly known for excessive teaching as he used to over-repeat to his students the exposition of lessons and problems.

His works include:
- A Treatise on knowledge of the names of cities, their longitudes and declinations
- A Treatise on Time Keeping

Guide from Fullacy in Knowing the Timekeeping and Determining Qiblah and Related Matters without Instruments (also known under: An Introduction in the Science of Time and Qiblah) – Shihāb al-Dīn (ʿAlīnāb) al-Qalyūbī 6/1942

This Manuscript deals with the subject of establishing times, such as prayer times; and provides data on the Hegira and Coptic Calendars and extracting the leap and simple years as well as giving useful terminologically linguistic information. For example, the work presents both the Linguistic and Theological terms for the meaning of Time, Month and Year. Excerpts from the Manuscript would explain its objective as it is stated in its introduction: “I made of it what makes it easy for the minds to deal with it and for the learner to absorb and assimilate it without depending on a specific instrument and without limitations as to locations”. The author concludes this treatise with a practical remark asserting that he inspected most “Miḥrāb” in the burial shrines of Egypt and found that they were shifted from the proper direction. Therefore, they cannot be approved and are not suitable for the validating prayers. Modern research works have proven the validity of his statement with some miḥrābs. The manuscript is organized in an Introduction, twelve chapters and an Epilogue.

Transcribed by: Abū al-Su‘ūd al-Rifā‘ī al-Ṣaḥīḥ
ullacy in Knowing the Timekeeping and Determining Qiblah and Related Matters without Instruments
1-الدأيالله في معرفة الوقت والقبلة والحقوق
2-الدأيالله في معرفة الوقت والقبلة والحقوق

d-الدأيالله في معرفة الوقت والقبلة والحقوق

edge of the names of cities, their longitudes and declinations

Keeping

Knowing the Timekeeping and Determining Qiblah and Related Matters without Instruments

The author speaks here about the research work he had carried out on the mihrāb (Qiblah niches in the direction of Mecca) in the burial shrines of Egypt and the majority of the Country’s regions which he found to be shifted from the azimuth of the (proper) qiblah. In conclusion, the Colophon pointed out that “the scribe had completed the task of transcribing the Manuscript on the 10th of the sacred month of Muharram, in the year of 1078; after the flight (from Mecca to Medina) of the Prophet, “The Best of Peace and Blessings upon Him”.

This photograph records a detailed explanation of the way to find the direction of Qiblah from Egypt the Guarded (Miṣr al-mahjrūsah), using the house of the needle (Compas).
Guiding the Eyeful and the Heart-Full to Knowing the Parts of Day and Night (hidayat uli al-baṣā’ir wa-al-abṣār ilā ma’refat ajzā’ al-layl wa-al-nahār)

Aḥmad al-Suṣā‘ī: (died: 1197 H / 1782 AD)
He is Shams al-Dīn, Aḥmad ibn Aḥmad ibn Mūhammad al-Suṣā‘ī al-Shāfī‘i al-Azhari, who came from a village called al-Suṣā‘iyah near Al-Mahalla town in Egypt, and who worked in teaching during the life of his father and after his death; authoring many works in many linguistics, Shari‘ah (Islamic Law), jurisprudence (doctrine), Astronomy and Arithmetic.

His works include:
• The Select of Gems in Lines and Circles
• A Treatise on the Mansions of the Moon

Guiding the Eyeful and the Heart-Full to Knowing the Parts of Day and Night – Aḥmad al-Suṣā‘ī
438/53670

This manuscript stands as a witness to the concern of Muslims with the humanitarian aspects of conveying knowledge and their determination to communicate it to those who lost their sight (the heart-full); as clear from the title and contents. Writing of the manuscript, as it happened, came about when one of (the Astronomer) Sheikh ‘Ayyād’s students was blind and he asked his tutor to write an easy to learn recitation poem and to teach him about the science of timekeeping. The Sheikh responded by composing what is known as “Manẓūmat Sheikh ‘Ayyād or the Poem of Shaykh ‘Ayyād”. The manuscript “Guiding the Eyeful and the Heart-Full to Knowing the Parts of Day and Night” is an explanation of that “Poem”, and it deals with astronomy subjects; like leap (intercalary) years and ordinary (simple or slight) years, the seasons, the constellations, volume of the Sun, phases of the Moon, lengths of the days and nights and the direction of qiblah (Mecca).
the Eyeful and the Heart-Full to Knowing the Parts of Day and Night
ufū al-bašā’ir wa-al-ābšāī ila ma’rūfat ajzā’ al-layl wa-al-nahār

(died: 1197 H / 1782 AD)
, Ahmad ibn Ahmad ibn Muhammad al-Suji’i al-Shafi’i al-Azhari, who came from a
‘iyah near Al-Mahalla town in Egypt, and who worked in teaching during the life of his
lacht; authoring many works in many linguistics, Shari’ah (Islamic Law), jurisprudence
y and Arithmetic.

s in Lines and Circles
Dansons of the Moon

and the Heart-Full to Knowing the Parts of Day and Night – Ahmad al-Suji’i

Guiding the Eyeful and the Heart-Full to Knowing the Parts of Day and Night
(hidayat ufū al-bašā’ir wa-al-ābšāī ila ma’rūfat ajzā’ al-layl wa-al-nahār)

The author defines the “Time” and the “Month” both linguistically and scientifically. He also defines the science of “Time
or timekeeping” as the science through which the lengths of days and nights and their states are determined. The uses and
benefits of that science are declared as knowing about prayer times and adhering to the qiblah. There is here a quotation
citing the great scholar Shihāb al-Dīn al-Qāyūbī, who died in the year 1069 H.
Jamāl al-Dīn al-Ṣūfī, (died: 719 H/ 1319 AD)

He is Jamāl al-Dīn Abū al-'Abbās Ahmad ibn 'Umar ibn Ismā‘īl ibn Muḥammad ibn Abī Bakr al-Ṣūfī. It appears that the particulars given in the manuscript about its author were added at a later date, and do not agree with the names for the same author as given in other manuscripts. According to David King; the name is sometime given as Shihāb al-Dīn al-Maqdisī al-Ṣūfī, or Shihāb al-Dīn al-Maqdisī. The author is, on the other hand, not 'Abd al-Rahmān al-Ṣūfī the author of “Images of the Fixed Planets” nor is he Shams al-Dīn al-Ṣūfī the author of “Reaching the Goals in Working With the Moon”.

Healing of Diseases by Drawing Hour (Line) on Walls and Sundials- Jamāl al-Dīn al-Ṣūfī, 18/5528

The manuscript is in 15 Chapters and contains tables and geometrical drawings in which the author explained in it the types of errors arising from the use of faulty geometrical tools like the ruler and compasses. The Manuscript deals with the inclination and altitude for the mid-day time. Also, he referred to many terms like the limit of the Eastern scope, the tangents, the Azimuth for al-qiblah, the deviation, and working out of the hours and the deviations.
Healing of Diseases by Drawing Hour (Line) on Walls and Sundials (ṣifāʾ al-aṣqām fī waqāt al-sāʾat ‘ala al-ḥiṭān wa-al-rukhām)

Ṣūfī, (died: 719 H/ 1319 AD)
Abū ʿAbbās Ahmad ibn ʿUmar ibn Ismāʿīl ibn Muḥammad ibn Abī Bakr al-Ṣūfī. Particulars given in the manuscript about its author were added at a later date, and do not refer to the same author as given in other manuscripts. According to David King; the name is Shihāb al-Dīn al-Maqdisī al-Ṣūfī, or Shihāb al-Dīn al-Maqdisī. The author is, on the other hand, al-Rahmān al-Ṣūfī the author of "Images of the Fixed Planets" nor is he Shams al-Dīn f"Reaching the Goals in Working With the Moon".

15 Chapters and contains tables and geometrical drawings in which the author explained errors arising from the use of faulty geometrical tools like the ruler and compasses. The author explained the inclination and altitude for the mid-day time. Also, he referred to many terms like the scope, the tangents, the azimuth for al-qiblah, the deviation, and working out of the shadows.

Healing of Diseases by Drawing Hour (Line) on Walls and Sundials (Ṣifāʾ al-aṣqām fī waqāt al-sāʾat ‘ala al-ḥiṭān wa-al-rukhām)

A table for the arch of al-ʿAṣr (afternoon prayer time) on the Northern aspects of the shifted walls with respect to the zodiac signs of Cancer, Aries and Capricorn also with respect to distance and tangent. The amount of shift, the distances and tangents are written in alphabetic letters according to their numerical values (Jumma System).

A discourse on knowing the inclination, the tangent, the altitude, the Zenith, the extent of the Eastern scope and adjusting the day-time; its arch, parts of its hours and the number of its Equal hours. There is also reference to the use of arithmetic to help the students, and to the tables calculated by Ahmad ibn Muḥammad ibn Kathīr al-Faragḥānī.
'Abd al-Rahmān al-Ṣūfī (291 – 376H/903 – 986AD)

He is Abī al-Ḥusayn 'Abd al-Rahmān ibn 'Umar ibn Muḥammad ibn Sahl al-Ṣūfī al-Rāżī who is considered one of the most renowned astronomers of the Muslim World. Al-Ṣūfī was born in Persia and moved to Baghdad where he received the appreciation of the authorities and was closely connected to the Sultan 'Aḍūd al-Dawlah al-Buwāhī. He was distinguished with his great intelligence and accurate observation, and was against some of Ptolemy’s astronomical ideas. Therefore, his writings in Astronomy remained a basic reference to Arab and European astronomers for a long time. His religious nature had an influence on his astronomical interests due to what Astronomy holds, of clear proofs, asserting the Creator’s Majesty. His books include: Images of the fixed planets, the Rhymes to the fixed planets, and the origin of the rays and the book of remembrance. According to Ibn al-‘Ibī’s version, al-Ṣūfī had died in the year 376H.

Among his Works:
- A Thesis on Working with the Astrolabe
- A Rhyme on the Fixed Planets

Images of Fixed Stars- 'Abd al-Rahmān al-Ṣūfī

When al-Ṣūfī produced his book “Images of the Fixed Planets”, it became a reference and a source for most of the subsequent studies in Astronomy as it was translated into the Spanish language under the title of “Libros del Saber de Astronomía”. This title literally means “The Book of Astronomical Knowledge” which proves the encyclopedic and reference nature of the original. The Spanish translation had a great influence on the modern European languages in their listing of star names and terms as the book contained drawings of some 1022 stars and planets in human and animal forms, together with their Arabic names. The book also indicated that the number of hidden ones is beyond count. The book of “Images of the Fixed Planets” is distinguished by its varied illustrations including images, drawings and tables explaining the forms and the characteristics. Sarton finds this book as one of the three most important Astronomy books of the Muslim Culture; in addition to the ephemeris of Ibn Yūnis and the ephemeris of Uloghi Bey. The copy of the book in Al-Azhar Collection is one of the oldest and rarest, and it comprises the introduction to the book without the drawings and other illustrations.
البَنَتُ (291 – 376H/903 – 986AD)

١ al-Sufi: (291 – 376H/903 – 986AD)

١ Abū al-Raḥmān ibn ‘Umar ibn Muḥammad ibn Sahl al-Ṣufi al-Rāzī who is considered one of the greatest astronomers of the Muslim World. Al-Ṣufi was born in Persia and moved to Baghdad when he was young. He was a great teacher, and he closely connected to the Persian ‘Abd al-Dawla. Distinguished with his great intelligence and accurate observation, and was against some of the astronomical ideas. Therefore, his writings in Astronomy remained a basic reference to Arab and Persian astronomers for a long time. He was a great teacher, and his influence on his astronomical interests is not only limited to Astronomy but also to other fields of knowledge.

٢ The Rhymes to the fixed planets, and the origin of the rays and the book of remembrance. Iṣṭi‘ibn’s version, al-Ṣufi had died in the year 376H.

٢ Fixed Planets

The book “Images of the Fixed Planets” was his reference to the fixed stars. The book was translated into the Spanish language under the title of “Libros de las Estrellas.” This title literally means “The Book of Astronomical Knowledge” which proves the importance of the book. The Spanish translation had a great influence on the astronomers in their listing of star names and terms as the book contained drawings of some of the stars in the sky, together with their Arabic names. The book also indicated the positions of some of the stars in the sky.

٢ al-Sufi’s book “Images of the Fixed Planets” is distinguished by its accuracy, clarity, and the introduction to the book. It comprises the introduction to the book without the drawings and other illustrations.

٢ ‘Abd al-Raḥmān al-Ṣufi 558/95628

In the second page of the introduction to ‘Abd al-Raḥmān al-Ṣufi’s book on the Fixed Planets, he stated that he saw many people dealing with the knowledge about the Fixed Planets and that they are following two schools. The people in one of these schools would follow the ways of astrologers depending on what the books have on the latitudes and longitudes of those planets. Subsequently, they draw them without distinguishing between what is right and what is wrong. He further states that some scientists of his time tried to add to the planets observed by Ptolemy by as much as the number of the planet movements over the years that had passed from his time to theirs.
The Dispersed Gems on Operations with the Protractor Quadrant
al-dur al-manthūr fī al-‘amal bi-rub’ al-dustūr (al-‘u’lu’ al-manthūr fī al-‘amal bi-rub’
al-dustūr)

Jamāl al-Dīn al-Mārdīnī: (died in 809H/1400AD)
He is Jamāl al-Dīn ‘Abd Allāh ibn Yūṣūf al-Mārdīnī, who was one of the most renowned astronomers of the
9th century of Hegira. Ibn Hajar said that al-Mārdīnī became the top time-keeping scientist of his time, and
he was knowledgeable in the science of Universe Form i.e. Astronomy with strong and firm faith. He held
positions and had authored many works and excelled in Arithmetic. He was the grandfather of Badr al-Dīn
al-Mārdīnī on his mother’s side. The astronomer, Ibn al-Majdī, is considered one of his most renowned pupils.

His works include:
• A Treatise on Working With the Shakkāzī Quadrant
• The sexagesimal treatise
• The Dispersed Gems in Working With the Quadrant Canon (which some researchers attribute to his grandson
Badr al-Dīn al-Mārdīnī)
• The Fathiyya in the Sine Works

The Dispersed Gems on Operations with the Protector Quadrant, also known as The Dispersed Pearls in
Working with the Quadrant Canon - Jamāl al-Dīn al-Mārdīnī 30/7660

This Manuscript is one of those dealing with the science of astronomical observation. It treats the subject of
the quadrant canon and its use in measuring the altitude and the tangent and the inclination and the distances
of planets; as well as establishing the latitudes of countries and the arches of the day and the night and the
times for the afternoon prayer and the twilight and dawn; and recognizing the Qiblah direction, the Cardinal
directions, and the rise of constellations for a certain country and astronomical rises and planetary rises and
the state of planets at a certain time.

The copy is dated 1129H.
The Dispersed Gems on Operations with the Protector Quadrant
al-dir al-manthūr fī al-‘aman bi-rub‘ al-dustūr (al-lu‘lu‘ al-manthūr fī al-‘aman bi-rub‘ al-dustūr)

The author defined the circle as a plane surface surrounded by a single line inside of which there is a point where all lines drawn from it to the surrounding line are equal in length. This point is called the center of the circle, and the line passing the center dividing the circle into two halves is called the diameter. From this, it is evident that students of astronomy in the Middle Ages had to have working knowledge of both Geometry and Arithmetic to which the author referred; and clearly asserted, in the introduction to his book.
Instructions on the Elements of the Art of Astrology
(al-taḥrif li-awā’il ṣinā’at al-tanjīm)

Abū al-Rayḥān al-Bīrūnī: (362 – 440 H / 972 – 1048 AD)
He is Abū al-Rayḥān Muhammad ibn Ahmad al-Bīrūnī, one of the most exceptional and well-known encyclopedic scientists as a philosopher, a historian, a travel writer, linguist, poet, mathematician, physicist, and pharmacist. His legacy includes more than 180 books, which he authored on different branches and fields of knowledge and science. His great fame is attributed to his prolific output and his intellectual genius in addition to his clear religious and spiritual devotion; for he constantly adorned his books and writings with verses from the Holy Qur’an. The famous contemporary astronomer and science historian George Sarton described al-Bīrūnī (who is known in the West as al-Bīrūnī) as one of the greatest brains known in history, for he is one of the greatest scientists in the world and is an example of the exceptional scientific genius with his sharp mind, acute intelligence, keen curiosity and determined pursuit of the truth and scientific research through systematic observation and experimentation.

His surviving works include:
- The Remaining Traces From Past Centuries
- Collection of information on knowledge of jewels
- Comprehending the Possible Aspects in Making the Astrolabe
- A Treatise on knowing the Azimuth of Qiblah
- The Masudic canon (regulations) on astronomy and astrology

Instructions on the Elements of the Art of Astrology - Abū al-Rayḥān al-Bīrūnī 523/88223

It is one of the pioneering books in Astronomy that did not receive the rightfully deserved attention, though it is considered the best known book appearing throughout the eleventh century of Hegira. The book is a scientific encyclopedia dealing with astronomy, arithmetic, geometry, algebra and numbers as well as the shape of the universe and the canons of the stars. It also discusses the theory about the rotation of the Earth around its own axis. The author indicates that a person does not qualify as an astrologist / astronomer without first acquiring competence in those branches of knowledge. He presented the work as a set of questions and answers accompanied with illustrations of drawings and figures. The author delved, as well, into the question of the connection between the event of a person’s date of birth and the appearance or emergence of certain stars. He also presented a table of the planets and their significance to, or influence on, crafts. In view of this book’s importance, Ramsay Wright set a photographic edition of it provided with translations on the opposite pages on the basis of a Persian Version translated in 530 pages from the original Arabic.
Instructions on the Elements of the Art of Astrology (al-taḥīf li-awā’il ʿiṣnaʿat al-tanfīm)

I-Bīrūnī: (362 – 440 H / 972 – 1048 AD)
Muhammad ibn Aḥmad al-Bīrūnī, one of the most exceptional and well known encyclopedic spherist, a historian, a travel writer, linguist, poet, mathematician, physicist and pharmacist. More than 180 books, which he authored on the different branches and fields of knowledge at fame is attributed to his prolific output and his intellectual genius in addition to his spiritual devotion for he constantly adorned his books and writings with verses from the most contemporary astronomer and science historian George Sarton described al-Bīrūnī (West as al-Bīrūnī) as one of the greatest brains known in history, for he is one of the 1 the World and is an example of the exceptional scientific genius with his sharp mind, en curiosity and determined pursuit of the truth and scientific research through systematic ritualization.

This includes:
- The collection of information on knowledge of jewels
- Possible Aspects in Making the Astrolabe
- The Azimuth of Qiblah
- The Musulnic canon (regulations) on astronomy and astrology

Elements of the Art of Astrology - Abū al-Rayḥān al-Bīrūnī

This book is a diaries dealing with astronomy, arithmetic, geometry, algebra and numbers as well as the 2 and the canons of the stars. It also discusses the theory about the rotation of the Earth. The author indicates that a person does not qualify as an astrolabe / astronomer without reference in those branches of knowledge. He presented the work as a set of questions and answers with illustrations of drawings and figures. The author delved, as well, into the question of the event of a person's date of birth and the appearance or emergence of certain stars on a table of the planets and their significance to, or influence on, crafts. In view of this, the author wrote a photographic edition of it provided with illustrations on the opposite side. A Persian Version translated in 530 pages from the original Arabic.

Instructions on the Elements of the Art of Astrology, (al-taḥīf li-awā’il ʿiṣnaʿat al-tanfīm)

It is one of the earliest attempts to draw a map of the World showing the City of Alexandria on the Syrian Sea (the Mediterranean), the Suez City on the sea of Aden (the Red Sea), the Indian Ocean (the Eastern Ocean), the Atlantic Ocean (the Ocean or Oceanous), the Persian Sea (the Arab Gulf). Some areas were identified by the races (ethnic groups) inhabiting them, for example; the Berber (the North African desert), the Negro islands (the Southern isles of the Indian ocean), the Sicilian Russia, the Warank sea (Baltic sea) and al-Ziyyij islands (Java). The author also asked a question about the Equator and its characteristics then began to answer it as seen in the photograph.
An Introduction to the Science of Predication of Stars


Abū Naṣr al-Qīmî (Died in the second half of the 4th Century, H)

He is Abū Naṣr al-Ḥasan ibn ‘Alī al-Qīmî, upon whom Ibn Ṭawús said that the honorable shaykh Naṣr ibn al-Ḥasan al-Qīmî was renowned in astronomy and the precision of his views on matters of that science.

An Introduction to the Science of Predication of Stars – Abū Naṣr al-Qīmî 536/88228

This manuscript contains five articles organized in 64 chapters. The first article is set in 12 chapters dealing with the form and number of epicycles and the planets and their sizes. According to his studies of the time, the article gives the sizes of heavenly bodies, like the Sun and Jupiter in terms of the Earth’s size. It also gives their distances from the Earth which differ from the values we reached now. Chapter five (in the same article) deals with the nature of the Earth and its global Spherical form.
duction to the Science of Predication of Stars

al ila ‘ilm aḥkām al-nujūm (al-bārī‘ al-madkhal ila ‘ilm aḥkām al-nujūm)

mī (Died in the second half of the 4th Century, H)

asan ibn ‘Aṣif al-Qimmīl on whom Ibn Ṭawūs said that the honorable shaykh Naṣr ibn Ṭawūs renowned in astronomy and the precision of his views on matters of that science.

the Science of Predication of Stars – Abū Naṣr al-Qimmīl

536/88228

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An Introduction to the Science of Predication of Stars,
al-madkhāl ila ‘ilm aḥkām al-nuṣūm (al-bāṭī) al-madkhāl ila ‘ilm aḥkām al-nuṣūm

b. The sketch is showing the circle of the horizon and the cardinal directions as well as the Ecliptic, the day rate, muʿaddal circle, description of the Earth and knowing regions and countries and their distances from the equator.
of Predication of Stars, al-'amal (al-bārā'ī) al-madkhal ila 'ilm al-ajhām al-nujūm)


The sketch that clarifies the phenomena of solar eclipse and lunar eclipse.
An Introduction to Working with the Covered Quadrant
(muqaddimah fi al-‘amal bi-al-rub’ al-musattar)

Sibṭ al-Mārdīnī: (826 – 907H/ 1422 – 1501AD)

He is Abū ‘Abd Allāh Badr al-Dīn Muḥammad ibn al-Ghazāl al-Dimishqī - alias (also known as/a.k.a.) Sibṭ al-Mārdīnī, astronomer and mathematician. Originally, his family came from Damascus, but he was born in Cairo; where he also died. He worked as a Miqāṭī (time keeper) at Al-Azhar Mosque.

His works include:
• Gift to friends on arithmetic operations
• Opening mysteries in inheritance
• Sufficient for satisfaction on operations with truncated northern quadrant
• An introduction on operations with the hidden quadrant
• Subtleties of truths on arithmetic of degrees and minutes
• The fine truth in calculating the degrees and minutes

An Introduction to Working with the Covered Quadrant – Sibṭ al-Mārdīnī  343/34499

The Manuscript contains a description of the Covered Quadrant as well as finding out the inclination and a country’s latitude knowing the orbit and the circle and the remainder of the circle, knowing the latitude from the circle, and knowing the zenith. This is in addition to finding out the tangent from the altitude, and the time for the afternoon prayer and the remainder of its circle and the remainder to sunset, knowing the astronomical rises and the beginning of rises and sets, and the altitude of the pole for the zodiac.

Transcribed by Ibrāhīm Muḥammad ibn Abīnād al-Muzīn in the year 1138 H.
An Introduction to Working with the Covered Quadrant
(muqaddimah fi al-`amal bi-al-rub’ al-musattar)

nī : (826 – 907H/ 1422 – 1501AD)
Allāh Badr al-Dīn Muḥammad ibn al-Ghazāl al-Dimashqī - alias (also known as/a.k.a.) Ṣibṭ
nomer and mathematician. Originally, his family came from Damascus, but he was born in
also died. He worked as a Miqāṭī (time keeper) at Al-Azhar Mosque.

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1 to Working with the Covered Quadrant – Ṣibṭ al-Mārifīl 343/34499

contains a description of the Covered Quadrant as well as finding out the inclination and a
knowing the orbit and the circle and the remainder of the circle, knowing the latitude from
owing the zenith. This is in addition to finding out the tangent from the altitude, and the
moon prayer and the remainder of its circle and the remainder to sunset, knowing the
and the beginning of rises and sets, and the altitude of the pole for the zodiac.

brāhīm Muḥammad ibn Ḥamad al-Muzin in the year 1138 H.

An Introduction to Working with the Covered Quadrant, (muqaddimah fi al-`amal bi-al-rub’ al-musattar)
The Introduction indicates that the Manuscript consists of an Introduction and twenty chapters. The Introduction also speaks
of the drawings found on this instrument, and the author states that the hole with the thread is called the “Pole”, and it is
the center of the Quadrant. It is moreover noted that the transcriber had written the terms and the titles of chapters such
as the hole, the arch, or the arched in red ink; in order to distinguish them from the rest of the text.
Muḥammad al-Mizzi: (690 – 750 H/ 1291 – 1349 AD)
He is Shams al-Dīn Abū ʿAbd Allāh Muḥammad ibn ʿAbd al-Raḥmān al-Miẓzī al-Miqāṭī. al-Mizzī studied the Qur’ān and the Arabic Language and excelled in Astronomy and Mathematics, and was renowned for making curious types of astrolabes. It is purported that his astrolabes were sold in his time for 10 Dinārs, or more, a piece. The quadrant was sold for two Dinārs a piece. He came to Egypt to study under the al-Akafānī in Cairo, but he lived for most of his life in Damascus where he worked as a Miẓāṭī (time keeper) at the Umayyad Mosque. His scientific interests were limited to the making of astronomical instruments, observing the motion of the Sun in relation to the Earth and the study of both the Apogee and Perigee in the distances of the different planets from the Earth.

His works include:
- The Gem of the Minds on operations with the Astrolabe.
- A Treatise on the Folded Quadrant
- A Treatise on the Lined Quadrant
- A Treatise on the Winged Quadrant
- Tables of Perigee for the Latitude of Damascus
- A Treatise on the Quarter Circle Placed on The Arcs
- Removing the Doubt on Operations with the Sine Quadrant

Removing the Doubt on Operations with the Sine Quadrant – Muḥammad al-Mizzi 30/7660

The Book contains a discourse on working out the altitude, deducing the tangent from the altitude, and finding out the tangent’s diameter and inclination. It also encompasses parts on establishing the Sun’s inclination and the planet’s distance, deducing the inclination and distance from the span or amplitude of the sunrise and the country’s latitude, deducing the Sun’s magnitude from the inclination, deducing the country’s latitude from the non-hidden part of the sky, establishing the possibility of the Sun or the planet reaching the zenith at an assumed latitude, deducing the span or amplitude of the sunrise and planet rise from the inclination of the Sun, establishing the part that passed and the part that remains of the day and the night in a foreign country and finding Mecca’s azimuth.

Transcription dated to the year 1128 H
Removing the Doubt on Operations with the Sine Quadrant
(kashf al-rayb fi al-'amal bi-rub' al-jayb)

I-Mizzî: (690 – 750 H/ 1291 – 1349 AD)
In Abû 'Abd Allâh Muḥammad ibn Ahmad ibn 'Abd al-Rahîm al-Mizzî al-Miqâtî, al-Mizzî in and the Arabic Language and excelled in Astronomy and Mathematics, and was renowned as types of astrolabes. It is purported that his astrolabes were sold in his time for 10 Dinârs.

The quadrant was sold for two Dinârs a piece. He came to Egypt to study under the al-; but he lived for most of his life in Damascus where he worked as a Miqâtî (time keeper) at osque. His scientific interests were limited to the making of astronomical instruments, tion of the Sun in relation to the Earth and the study of both the Apogee and Perigee in the different planets from the Earth.

- Minds on operations with the Astrolabe.
- Folded Quadrant
- Lined Quadrant
- Winged Quadrant
- for the Latitude of Damascus
- Quarter Circle Placed on The Area

Doubt on Operations with the Sine Quadrant

A discourse on working out the altitude, deducing the tangent from the altitude, and finding diameter and inclination. It also encompasses parts on establishing the Sun’s inclination and the deducing the inclination and distance from the span or amplitude of the sunrise and the country’s the Sun’s magnitude from the inclination, deducing the country’s latitude from the non-hidden establishing the possibility of the Sun or the planet reaching the zenith at an assumed latitude, or amplitude of the sunrise and planet rise from the inclination of the Sun, establishing the part that remains of the day and the night in a foreign country and finding Mecca’s azimuth.

dated to the year 1128 H

Shams al-Din Abû 'Abd Allâh Muḥammad in 'Abd al-Rahîm al-Mizzî al-Miqâtî • 20 folios • 16.3 x 21.5 cm

Al-Mizzî raises here an important issue as he finds it not desirable for any one to write a treatise on the Sine, then refers to another work on some likely matters of multiplications and divisions since all astronomical works have to use multiplications and divisions and extracting the square roots. Therefore, he devoted a chapter in his treatise on multiplications and divisions and extracting the square roots from the sine. He was compelled into that by the people’s disinterest in the sine works since they did not find the one who would clear for them a problem or open up a mystery.
Sufficient Satisfaction on Operations with Truncated Northern Quadrant
(kifāyat al-qūnūt fī al-‘amal bi-al-rub‘ al-shamālī al-maqūūt)

Sībṭ al-Mārdīnī (826 – 907H/1422 – 1501AD)
He is Abū ‘Abd Allāh Badr al-Dīn Muhammad ibn al-Ghazāl al-Dimishqī - alias (also known as/a.k.a.) Sībṭ al-Mārdīnī, astronomer and mathematician. Originally, his family came from Damascus, but he was born in Cairo, where he also died. He worked as a Miṣqāf (time keeper) at Al-Azhar Mosque.

His works include:
• Gift to friends on arithmetic operations
• Opening mysteries in inheritance
• Sufficient for satisfaction on operations with truncated northern quadrant
• An introduction on operations with the hidden quadrant
• Subtleties of truths on arithmetic of degrees and minutes
• The fine truth in calculating the degrees and minutes

Sufficient for Satisfaction on Operations with Truncated Northern Quadrant – Sībṭ al-Mārdīnī
342/34498

This treatise is considered a summary of another one written by Mārdīnī Sībṭ wrote under the title of: “Revealing the Lodged Secret” credited by some scholars credit to Ibn al-Majīf and contains an introduction and 15 chapters. The Introduction included the essentials of the instrument concerning the hole or center where the thread passes or the pole of the quadrant exists. The Altitude or Height arcs are divided into 90 parts where the numbers are inscribed in the letters of the Jummal Calculations (numerical values given to the letters of the Alphabet). The study is full of technical terms that are used in the astronomical instruments of the age like “Shāqīlī or plumb line”, “Qurb‘ or Pole” and “Shīyāyatun‘ or two splinters”. The chapters, from one to fifteen, on the other hand, contain the techniques and methods of use for the different astronomical purposes like knowing the distance of the Sun above the horizon, knowing the inclination or the distance of the Sun from the equinox, knowing the midday time (noon) and knowing the latitudes of countries (or distances from the equator). In the the final chapter, the author deals with the method of finding out the area and the remainder of the night through the known planets. It was recorded that the treatise was inscribed in the year 1123H.

Transcription date: 1123 H.
Sufficient Satisfaction on Operations with Truncated Northern Quadrant
(kifayat al-qumā' fī al-ʿamāl bi-al-rubʿ al-shamālī al-maṣfūʿ)

The author explains in the twelfth chapter a practical method to find out the qiblah Azimuth and the Cardinal Directions using the Intersected Quadrant. His educational inclinations are evident in his phrases as he says: “Place the thread on the noon line meridian and shift the Meri away from the orbit of Aries in the northern direction as much as the latitude of Mecca (which is “Kāf Alīf” = 21° north/Jummal calculations), then we mark it with the Meri, then we move the thread by as much as the difference in longitude between Mecca and your place”. Next, the author continues explaining the steps for reaching the direction of Mecca. (See the Jummal calculations index)
A Treatise on Arithmetical Rules and Geometrical Works in Using the Sine Quadrant

risālah mushtamīlah ‘alā qa'ā’id ḥisābiyyah wa-a’māl handasīyyah fi al-‘amal bi-rub‘ al-juyūb

Sibt al-Mardini : (826 – 907H/1422 – 1501 AD)

He is Abū ‘Abd Allāh Badr al-Dīn Muḥammad ibn al-Ghazāl al-Dimishqī - alias (also known as/a.k.a.) Sibt al-Mardini, astronomer and mathematician. Originally, his family came from Damascus, but he was born in Cairo, where he also died. He worked as a Miqāṭi (time keeper) at Al-Azhar Mosque.

His works include:
• Gift to friends on arithmetic operations
• Opening mysteries in inheritance
• Sufficient for satisfaction on operations with truncated northern quadrant
• An introduction on operations with the hidden quadrant
• Subtleties of truths on arithmetic of degrees and minutes
• The fine truth in calculating the degrees and minutes

A Treatise on Arithmetical Rules and Geometrical Works in Using the Sine Quadrant – Sibt al-Mardini

This Manuscript is distinguished by connecting the Astronomical and Mathematical aspects with respect to the use of the Sine Quadrant; which the author considers as one of the best and most useful astronomical instruments for its wide and comprehensive applications. The Manuscript is also noted for its illustrative practical nature. When the text speaks of the way to find out the height of an arc in a circle passing through the same horizon, it explains the manner in which the Quadrant must be held and what must be done in order to achieve that. Here, the explanation is also accompanied by graphic illustrations. The Manuscript deals with the uses of the Sine Quadrant in finding out the Azimuth, the Inclination and the Zodiac. It also deals with the methods of establishing the latitude, the lengths of the Day and the Night, the planetary distances, the time for the afternoon prayer, the lengths of the twilight and the dawn, the times for sunrise and sunset, the direction of qiblah, astronomical rises, the angles of rises and falls the widths of rivers and the depths of wells.

Transcribed by Muḥammad ibn ʿAlam ʿId
A Treatise on Arithmetical Rules and Geometrical Works in Using the Sine Quadrant

This is an illustration of the way to distinguish between the Azimuth and the Altitude for a planet. From the drawing, it is seen that the Azimuth is an arc on the horizon circle between the meridian circle and vertical circle passing through the planet.

The author explains on this page the map for establishing the Azimuth of Qiblah for a certain country location; which is the arc on the horizon circle, confined between the day meridian for the country and the circle passing through the two poles of the country and Mecca. He also explains the method by which the longitude for a country is determined.
A Treatise on Operations with the Quadrant on which Almucantars are Imaged (risālah fī al-‘amāl bi-al-rub’ al-malūm bi-al-muqamārāt)

Aḥmad ibn al-Majdī: (767-850H/1365-1446AD)
He is Aḥmad ibn Ṭaybūghā al-Majdī al-Qāhirī al-Shāfiʿī, known as ibn al-Majdī after his grandfather. Ibn al-Majdī was born and brought up in Cairo. He learnt the Qur’ān and studied under a number of famous scholars such as al-Nawawī, al-Dimirī and al-Bulqīnī. His contributions to Astronomy were of great scientific value.

He wrote: "The Sweet Spring in Solving the Almanac and Spotting the New Moon".

A Treatise on Operations with the Quadrant on which Almucantars are Imaged - Aḥmad ibn al-Majdī 29/7658

The work contains an introduction on measuring the altitude and establishing the position of the Sun, the inclination, the apogee, the latitude, the day and night arches, the circle, the zenith and azimuth, and measuring the extended and inverted tangent, the afternoon altitude, the circle excess, time left to sunset, the share of dawn, Dusk, the Qiblah azimuth, finding directions, and local and astronomical rises.

Transcribed by Aḥmad ibn Mūhammad ibn ‘Aḍī ibn ‘Abd al-Kāfī in 1272H

* A Treatise on operations with the Quadrant on which Almucantars are Imaged / Shihāb al-Dīn Abī al-‘Abbās Aḥmad ibn Ṭaybūghā al-Qāhirī al-Shāfiʿī * 4 folios * third treatise * 16 x 21.5 cm
A Treatise on Operations with the Quadrant on which Almucantars are Imaged (risalah fi al-'amal bi-al-rub' al-marsum bi-al-muqaṣṣarāt)

The eighth chapter in the treatise explains the way to find the qiblah and to set the Mihrab using the arched quadrants. These are successive arches, some of which emanate from the Tropic of Capricorn and some begin at the meridian (meridian line) and end at the Tropic of Cancer. It is noted that the remarks and footnotes, on the manuscript, are too many the thing which explains its educating nature.
A Treatise on Operations with the Shakazia Quadrant

This plate or Shakkâzï astrolabe is attributed to its well known inventor, the Andalusî scholar ‘Ali ibn Khalaf. The idea behind it is briefly that light emerges from the point of vernal equinox and falls on a plane passing through the two points of the winter and summer solstices; perpendicular to the Equator. The result is a plate giving a vertical cross-section of the universe whose two ends represent the two Poles; unlike the normal astrolabes, which are based on the assumption that light emerges from the South Pole and falls on the Equator. The oldest reference on this is the Murâkhišî’s [Jâmi‘-al-ambadi’] speaking of leveling the Zuruqîyyah and Shakkâzïyyah plates, which differ only slightly from one another.

There is also a treatise, by Ibn al-banna’ al-Murâkhišî that is kept at the general treasury at Rabat, which was devoted to the Shakkâzïyyah. Two other treatises on the Shakkâzïyyah quadrant by al-Zurqîlî, are also known to exist. The presented manuscript is one of the brief treatises written on the way to use this instrument for different purposes; such as establishing the East and West, the meridian line, the circle, the altitude, the zenith, the Cardinal Directions, the astronomical rises and the qiblah azimuth. Some scholars attribute this treatise to the grand Jamâl al-Dîn al-Mârînî; on the basis of comparison with the Zâhirîyyah manuscripts in Damascus (Numbers: 4/1237 and 4/1458). It is also said that the inventor of this instrument is ‘Âlî al-Dîn Tâybughâ al-Duwadîr al-Bukhârî.

Transcribed by ‘Abd al-Wahîb Ahmâd ibn al-Barskît al-‘Umdatî al-Ahmadî in the year 1104H.
A Treatise on Operations with the Shakazia Quadrant

(risālah fi al-‘aman bi-rub’ al-shakkāziyāh)

own.

 akkāzī astrolabe is attributed to its well known inventor; the Andalusī scholar ‘Alī ibn Khalaf.

It is briefly that light emerges from the point of vernal equinox and falls on a plane passing points of the winter and summer solstices; perpendicular to the Equator. The result is a plate l cross-section of the universe whose two ends represent the two Poles; unlike the normal h are based on the assumption that light emerges from the South Pole and falls on the Equator.

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>Operations with the Shakazia Quadrant - author unknown

reatise, by Ibn al-bānī‘ī al-Murākibī that is kept at the general treasury at Rabat, which was šahkāziyyah. Two other treatises on the Shakkāziyyah quadrant by al-Zūrqi, are also known asented manuscript is one of the brief treatises written on the way to use this instrument for ex; such as establishing the East and West, the meridian line, the circle, the altitude, the zenith, rections, the astronomical rises and the qiblah azimuth. Some scholars attribute this treatise sī al-Dīn al-Māridī; on the basis of comparison with the Žāhirīyah manuscripts in Damascus 37 and 4/1458). It is also said that the inventor of this instrument is ‘Alī al-Dīn Ṭaybughā jāklamāshī.

‘Abd al-Wāḥīd Ṭahmābī ibn al-Barakāt al-Ṭunbatay al-Ahmadi in the year 1104H.
Sībīṣ al-Šārīfi: (826 – 907H/ 1422 – 1501AD)
He is Abū ‘Abd Allāh Badr al-Dīn Muḥammad ibn al-Ghazāl al-Dīnī - alias (also known as/a.k.a.) Sībīṣ al-Šārīfi, astronomer and mathematician. Originally, his family came from Damascus, but he was born in Cairo; where he also died. He worked as a Miṣṣīrī (time keeper) at Al-Azhar Mosque.

His works include:
• Gifts to friends on arithmetic operations
• Opening mysteries in inheritance
• Sufficient for satisfaction on operations with truncated northern quadrant
• An introduction on operations with the hidden quadrant
• Subtleties of truths on arithmetic of degrees and minutes
• The fine truth in calculating the degrees and minutes

A Treatise on Operations with the Absented Quadrant

A specifying treatise organized in an introduction and 20 chapters, classified within the scope of the science of Instruments for astronomical observations. The treatise explains in detail the way to use the Sine Quadrant in the different astronomical works as well as the drawings of the Quadrant itself. For example, it shows the altitude arch around the quadrant. In the first chapter, the treatise explains a practical method to obtain the altitude, and the way to hold the Quadrant. In the other chapters, it explains the methods of obtaining the sine of the arc, the latitudes of countries, the remainder of the circle, the tangent from the altitude and the altitude from the tangent as well as the other traditional usual subjects of Muslim Astronomy; as those of Qiblah and the Cardinal directions.
A Treatise on Operations with the Absented Quadrant (risālah fī al-ʿamal bi-al-rubʿ al-mujayyab)

(826 – 907H/1422 – 1501 AD)
Allāh Badr al-Dīn Muḥammad ibn al-Ghāzāl al-Dimishqī - alias (also known as/a.k.a.) Sībṭ onomer and mathematician. Originally, his family came from Damascus, but he was born in also died. He worked as a Mīqārī (time keeper) at Al-Azhar Mosque.

The text discusses arithmetic operations, inheritance, satisfaction on operations with truncated northern quadrant, on operations with the hidden quadrant, and the use of trigonometric functions to calculate the degrees and minutes.

Operations with the Absented Quadrant - Sībṭ al-Mārdhī

The treatise organized in an introduction and 20 chapters, classified within the scope of the science or astronomical observations. The treatise explains in detail the way to use the Sine Quadrant astronomical works as well as the drawings of the Quadrant itself. For example, it shows the und the quadrant. In the first chapter, the treatise explains a practical method to obtain the e way to hold the Quadrant. In the other chapters, it explains the methods of obtaining the the latitudes of countries, the remainder of the circle, the tangent from the altitude and the e tangent as well as the other traditional usual subjects of Muslim Astronomy; as those of Cardinal directions.

Here, in this 19th chapter, the author speaks about defining the astronomical and local (domestic) rises, and the onsets of twilights and times. He defines the domestic rises and onsets as the time passed from the rise of the head of Aries to the Sunrise, and that is why they are called daybreaks. The way to find them is by opening the sixty’s thread (the altitude arch around the quadrant), then marking the cosine and moving the thread to the point of the emergence of Aries on the sine of the degree difference to the nearest inversion out of which the thread had moved from the beginning of the arch.
al-Fāṭḥiyah (treatise of Fath al-Dīn) on Operations with the Sine Quadrant
(al-fathiyah fi al-a’māl al-Jaybiyah)

Jamāl al-Dīn al-Mārdīnī: (died 809H/1400AD)
He is Jamal al-Dīn ‘Abd Allāh ibn Khafīl ibn Yūsuf al-Mārdīnī, one of the most renowned astronomers of the ninth century of hegira. Ibn Ḥajar said about him that, in his time, he came on the top of the Miṣqat (Timekeeping) Science and that he was also knowledgeable in the science of Universe form (Astronomy), together with religious competence; and that he had positions and combinations and was outstanding in arithmetic. He was the author of the “Dispersed Gems in Working With the Canon Quadrant”.

al-Fāṭḥiyah (treatise of Fath al-Dīn) on Operations with the Sine Quadrant - Jamāl al-Dīn al-Mārdīnī 28/7657

This manuscript is in 10 folios containing an introduction and 20 Chapters, and an Epilogue. It is classified in Astronomy under the works dealing with observation instruments as it specifically deals with the observation instrument called the “Sine Quadrant” which is the quarter of a circle’s circumference used in working out the altitudes of planets. The author explained the trigonometric ratios, and the way to find out the Sines and the Tangents to define the altitudes of the Sun and the planets, the Sun’s inclination, the latitude from the location, the epicycle, the azimuth for the location, the qiblah direction, the Four Cardinal Directions, the distances of planets, the circle between the midday or afternoon prayer times and the time span of the twilight.

Sīhī al-Mārdīnī had a treatise titled “Correcting the Sine Treatise named al-Fāṭḥiyah”, Damascus, al-Zāhiriyah 6888.

Transcribed by Ḥasan ibn ʿAbd al-Qādir al-Mawṣīfī in the year 1237H
al-Mardini (died 809H/1400 AD)

īn 'Abd Allah ibn Khālid ibn Yūsuf al-Mardini, one of the most renowned astronomers of the 'hégira. Ibn Hajar said about him that, in his time, he came on the top of the Miṣqât (Timekeeping) at he was also knowledgeable in the science of Universe form (Astronomy), together with stience; and that he had positions and combinations and was outstanding in arithmetic. He was ie “Dispersed Gems in Working With the Canon Quadrant”.

āse of Fath al-Dīn) on Operations with the Sine Quadrant - Jamāl al-Dīn al-Mardini 28/765

is in 10 folios containing an introduction and 20 Chapters, and an Epilogue. It is classified under the works dealing with observation instruments as it specifically deals with the observation of the “Sine Quadrant” which is the quarter of a circle’s circumference used in working out planets. The author explained the trigonometric ratios, and the way to find out the Sines and the data of the Sun and the planets, the Sun’s inclination, the latitude from the Sun, the azimuth for the location, the qiblah direction, the Four Cardinal Directions, the nets, the circle between the midday or afternoon prayer times and the time span of the twilight.

had a treatise titled “Correcting the Sine Treatise named al-Fāthiyah”. Damascus, al-Zahiriyyah

Hasan ibn 'Abd al-Qādir al-Mawṣli in the year 1237H

(Sharq) (treatise of Fath al-Dīn) on Operations with the Sine Quadrant / Jamāl al-Dīn 'Abd Allah ibn Yūsuf al-Mardini 10 folios the first treatise 15 x 21.5

The first page of the Manuscript is divided into an introduction and 20 chapters and an Epilogue by the author. As for the introduction, it was devoted to the drawings of the instrument. The First Chapter had dealt with the way to take the altitude and magnitude of the Sun, and placing the thread at the observed value for the magnitude of the Sun.
Explanation of the Hidden on Operations with the Absented Quadrant

(iddāh al-maghib fi al-lamal bi-al-mughayyab)

Ibn al-Shāṭīr (704 – 777H/1304 – 1375AD)
He is Abū ʿAbd Allāh Muḥammad ibn ʿAbd Allāh ibn Ṭūsī (known as) Ibn al-Shāṭīr.
Ibn al-Shāṭīr was born in Damascus and spent most of his life working there as a timekeeper and prayer caller at the Umayyad Mosque. He achieved great fame among the scholars of his time as a genius astronomer. His great fortune allowed him to visit many countries including Egypt where he had a long stay and studied Astronomy and Mathematics both in Cairo and Alexandria. He excelled in Geometry and Arithmetic and was soon to proceed to Astronomy, where he achieved great distinction; which became evident in his many innovations. There was an instrument for indicating and checking prayer times, which he called “al-baqī – meaning the simple” and placed in the Umayyad Mosque, that was one of his inventions. He also corrected the sundials that remained in use for centuries in Egypt and Syria; and served as a time-correction reference throughout the Arab World. His works included several ephemerides, containing astronomical theories and new knowledge. His most important achievement was, perhaps, his refusal of Ptolemy’s Theory that declared the Earth as the center of the Universe, and that the heavenly bodies rotate around the Earth. That theory was a matter of established fact at the time of Ibn al-Shāṭīr, and some sources claim that he was the first to contradict it; and they go as far as to credit him with the first declaration that it is the Earth and the wondering planets that regularly rotate around the Sun, and that the Moon orbits the Earth. Such claim, however, remains the subject of scholarly dispute; being strongly refuted by others.

His works include:
• The Ultimate Goals in Astronomical Works
• The Ultimate Question in Correcting the Origins
• Explanation of the Hidden in Working With the Sine Quadrant

Explanation of the Hidden on Operations with the Absented Quadrant - Ibn al-Shāṭīr 463/59863

The work is considered one of the earliest treatises on the Sine Quadrant and its uses with clarifying all its obscurities. The work contained ways to work out the cosine of every arc, and to work out the sine from the arc as well as knowing the altitude, the extended and contracted tangent and the diameter or diagonal of the tangent. It also explains the way to deduce the altitude or height from the tangent knowing the inclination and the distances of the planets from the median of the daytime as well as knowing the latitudes of countries, and the Apogee of the Sun or the planet for the circle of the daytime’s median. Moreover, the work contained special chapters for knowing the widths of rivers and the depths of wells, and many methods for defining the Azimuth of Mecca.

Transcribed by Yūnus ibn al-Ḥāfiz ʿAlī in the year 1157 H.
Explaination of the Hidden on Operations with the Absented Quadrant
(idāh al-maghīb fī al-ʿaml bi-al-mughāyyab)

(704 – 777H/1304 – 1375AD)

ʿAbd al-Rahmān al-Ṭūsī (777H – 869H/1375AD – 1460AD)

Born in Damascus and spent most of his life working here as a timekeeper and prayer caller at osque. He achieved great fame among the scholars of his time as a genius astronomer. His great
to visit many countries including Egypt where he had a long stay and studied Astronomy and
t in Cairo and Alexandria. He excelled in Geometry and Arithmetic and was soon to proceed to
re he achieved great distinction; which became evident in his many innovations. There was an
idealizing and checking prayer times, which he called “al-balḥ” – meaning the simple” and placed
Mosque, that was one of his inventions. He also corrected the sundials that remained in use for
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is refusal of Prolemy’s Theory that declared the Earth as the center of the Universe, and that the
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des:
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ths of rivers and the depths of wells, and many methods for defining the Azimuth of Mecca.

Yūnus ibn al-Ḥājī ‘Ali in the year 1157 H.

Explanation of the Hidden on Operations with the Absented Quadrant
(idāh al-maghīb fī al-ʿaml bi-al-ruḥ fī al-mujāyyab)

In chapter 88, the work speaks about knowing the Apogee of the Sun or the planet. In chapter 89, it speaks about the Sun
or the planet reaching its zenith at certain assumed latitude and whether this occurs once or twice.
The Students Way and the Stroll of Minds in Knowing the Times by Calculation
(wasillat al-ṭullāb wa-nuzhat al-albāb iš ma’rifat al-awqat bi-al-ḥsāb)

Sibṭ al-Mārdini: (826 – 907H/ 1422 – 1501AD)
He is Abu ’Abd Allāh Badr al-Dīn Muḥammad ibn al-Ghazzāl al-Dimishqī - alias (a.k.a.) Sibṭ al-Mārdini, astronomer and mathematician; originally (his family) from Damascus, but was born in Cairo – where he also died. He worked as a Miṣāţi (time keeper) at Al-Azhar Mosque.

His works include:
• Gift to friends on arithmetic operations
• Opening mysteries in inheritance
• Sufficient for satisfaction on operations with truncated northern quadrant
• An introduction on operations with the hidden quadrant
• Subtleties of truths on arithmetic of degrees and minutes

The Students Way and the Stroll of Minds in Knowing the Times by Calculation -
Sibṭ al-Mārdini 287657

According to the author, the work is an introduction to knowing how to extract the Sine values by calculation. The manuscript is in an Introduction, twenty five chapters and an Epilogue. It has explanations pointing out that it was prepared as an educational treatise in astronomy. The Epilogue indicates that the Manuscript was transcribed in the year 1183H.
The Students Way and the Stroll of Minds in Knowing the Times by Calculation
(wasiṣṭ al-ṭullāb wa-nuẓḥat al-albīb ila maʿrifat al-ʿawqāt bi-al-ḥṣāb)
Ibn Yusuf al-Misri: (341 – 399H/ 952 – 1008AD)

He is Abū al-Ḥasan 'Ali ibn 'Abd al-Raḥmān ibn Ahmad ibn Yūnus al-Ṣadaff al-Misri, a well known Egyptian Astronomer, Mathematician and literary figure. Ibn Yūnus was born in Egypt to a traditionally scientific and learned family. His great grandfather, Yūnus al-Ṣadaff was one of the eminent Shāfī'ī scholars and his father 'Abd al-Raḥmān ibn Yūnus was also one of the major historians and Hādhāth preachers. He introduced laws and formulas of great value in the discovery of the logarithms and was also the inventor of the pendulum centuries before Galileo. Ibn Yūnus had, to his credit, great achievements; such as his observation of the Solar eclipses in the years 368 and 390H, which were the first eclipses to be recorded with extreme precision and in an absolutely scientific manner by recording the altitude of the Sun before and after the eclipse. Arab and Muslim scholars and scientists used to refer to Ibn Yūnus as the Second Ptolomy, and both Galileo and Bacon were familiar with his works. Ibn Yusuf managed to solve many problems in spherical astronomy; applying perpendicular projections. Next, he undertook the establishment of Ibn Yūnus' Observatory, which was part of "Dar Al-hikma". He further excelled in observing the planets and the stars, determined the orbital year and the seasons and arrived at the value of the Earth's Radius and Circumference.

His works include:
- The Hakimī Ephemeris
- The Small Ephemeris
- Tables of the Sun, the Moon and the Book of Tangents

Ibn Yūnus began working on that ephemeris around the year 380H/990AD, in the Observatory founded by the Fatimid Caliph al-Ḥakim bi-Amr Allāh, on the top of the Muṣṭafāt Mountain; to whom he attributed this work that came to be known as al-Ḥakimī Ephemeris, and was in four volumes. The Ephemeris was described by Ibn Khallikān as: “It is a large ephemeris which I have seen in four volumes, and I have never seen a longer one among the many ephemerides I know, and it is in the form of numerous astronomical tables and contained the renewal of locations for 277 towns”. The tables were preceded by explaining the way to use them, and they contain corrections of many of the previous observations. There is a rare copy of this Hakimī Ephemeris prepared by Ibn Yūnus, which was translated into French by "Caussin" in the year 1804. The Manuscript that “Causin” had used for his translation is kept at the library of “Leiden” University in Holland. No body knows how it reached there, but there is no doubt that it was one of the dispatched copies some 700 years ago. Some copies of it were kept at al-Azhar Library, and the “Leiden” copy might have been one of the Azhar copies that were dispersed or destroyed. “Causin” suggests that the “Leiden” copy contains half of the original observations made by Ibn Yūnus himself. It appears that this ephemeris had originally comprised a lengthy Introduction and 81 chapters, the subject of which was referred to in the Introduction. The “Leiden” Manuscript ends with the 22nd chapter. The value of this Manuscript lies in the evidence that it presents about the attempts of the scientists in the reign of the ‘Abbassid Caliph, al-Ma‘ānī, to measure or determine the circumference of the Earth.
Astronomical Tables
(Jadawil falakiyyah)

sri: (341 – 399H/ 952 – 1008AD)
‘Ali Ibn ‘Abd al-’Rahmân Ibn Aḥmad Ibn Yûnûs al-Sadafi al-Misri, a well known Egyptian
mathematician and literary figure. Ibn Yûnûs was born in Egypt to a traditionally scientific and
great-grandfather, Yûnûs al-Sadafi was one of the eminent Shâfi’i scholars and his father
a Yûnûs was also one of the major historians and Hijadîth preachers. He introduced laws
at value in the discovery of the logarithms and was also the inventor of the pendulum;
like Ibn Yûnûs had, to his credit, great achievements; such as his observation of the Solar
in 368 and 398H, which were the first eclipses to be recorded with extreme precision and
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scientists used to refer to Ibn Yûnûs as the Second Ptolemy, and both Galileo and Bacon
his works. Ibn Yûnûs managed to solve many problems in spherical astronomy; applying
ions. Next, he undertook the establishment of Ibn Yûnûs’s Observatory, which was part
He further excelled in observing the planets and the stars, determined the orbital year and
ed at the value of the Earth’s Radius and Circumference.

meris • The Small Ephemeris • Tables of the Sun, the Moon and the Book of Tangents
es - Ibn Yûnûs al-Misri 9/4382

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e Earth.

Tables / Abû al-’Hasan ‘Ali ibn ‘Abd al-’Rahmân ibn Aḥmad ibn Yûnûs al-Sadafi
folios • the second treatise • 13.5 x 18 cm

Astronomical Tables, (Jadawil falakiyyah)
The table is showing the movement of the Lion’s Heart; as observed by Ibn Yûnûs for the 30th
latitude in relation to the collected and extended Arabic Months. Below the table, there is the method of knowing the Solar Almanac by adding the
mean for the required date, and the apogee, where it goes through a number of subtractions and algebraic steps until the
assumed date is reached from the table.
A Collection of Ephemerides Segments (jumlat qīta' min al-āzyāj)

Author Unknown

This manuscript does not provide the author's name, though it contains some tables attributed to known astronomers like Ibn Hibīūr or Abī 'All ibn Hīnībī al-Qanāʾī, who died in the year 330H. TheCalligraphy style in the manuscript is identical with the commonly used styles of inscribing manuscripts during the sixth and seventh Hegira centuries. The Manuscript contains tables on the movement of the center of Sun, for the Meridian (midday) of Cordova (Andalusia). It also contains tables of the Arabic, Roman and Persian years as well as tables of the Moon's movement in the Arabic years; and the movement of Saturn, Jupiter, Mars, Venus and Mercury for the Arabic Calendar. Moreover, there are tables for the inclination of the Sun and the Moon's Latitude, tables for the Sun and the Moon and the Planets, and tables for the days and the hours.

A Collection of Ephemerides Segments - author unknown 585/ 95655

Transcribed by Idrīs ibn Mūhammad ibn 'Īsā al-Anṣārī in the year 924H
A Collection of Ephemerides Segments
(jumlat qita' min al-azyāj)

...does not provide the author’s name, though it contains some tables attributed to known Ibn Hibintā or Abī ‘Alī ibn Hibintā al-Qurānī), who died in the year 330H. The Calligraphy ascript is identical with the commonly used styles of inscribing manuscripts during the sixthe century. The Manuscript contains tables on the movement of the center of Sun, for the ry of Cordova (Andalusia). It also contains tables of the Arabic, Roman and Persian years of the Moon’s movement in the Arabic years; and the movement of Saturn, Jupiter, Mars, ury for the Arabic Calendar. Moreover; there are tables for the inclination of the Sun and the ; tables for the Sun and the Moon and the Planets, and tables for the days and the hours.

Ephemerides Segments - author unknown 585/95655

drūs ibn Muhammad ibn ‘Īsā al-Anṣārī in the year 924H

A Collection of Ephemerides Segments, (jumlat qita' min al-azyāj)

This page shows a table for the Moon’s movement in Arabic years for Cordova’s Meridian (midday) both on the collected and the extended. It also contains tables of the skies for Solar and Lunar eclipses in several constellations. The inscription at the end of the Manuscript (Colophon) shows that this ephemeris was completed on the morning of Sunday the 10th of Junād al-Uli in the 608H/933 Coptic/1520 Roman (of Alexander the son of Philip) giving also the name of the transcriber who came from Alexandria.
The Fine Truth in Calculating the Degrees and Minutes
(raq'a 'iq al-ḥṣaq'a 'iq fī ḥṣāb al-daraj wa-al-daqa'iq)

Sibṭ al-Maḍīnī: (826 – 907H/ 1422 – 1501 AD)
He is Abū ʿAbd Allāh Badr al-Dīn Muhammad ibn al-Ghazāl al-Dimishqī - alias (a.k.a.) Sībṭ al-Maḍīnī, astronomer and mathematician originally (his family) from Damascus, but was born in Cairo, where he also died. He worked as a Miṣāṭī (time keeper) at al-Azhar Mosque.

His works include:
• A Treatise on Operations with the Sine Quadrant
• A Treatise of Arithmetical Rules, and Geometrical Works in Using the Sine Quadrant
• Satisfying the Fair in Working With the Intersected Northern Quadrant
• An Introduction to Working with the Covered Quadrant
• The Students Way and the Stroll of Minds in Knowing the Times by Calculation

The Fine Truth in Calculating the Degrees and Minutes - Sībṭ al-Maḍīnī 499/71519

A treatise on what may be called the calculation methods in Astronomy; as it speaks of the Jummal letters (with numerical values) in the preparation of ephemerides, and the way to place them individually and collectively and placing these letters in their order. These are among the essentials and basics for the students of astronomy in order to be able to read the tables in an ephemeris. The treatise consists of an Introduction, 10 chapters and an Epilogue. The first chapter speaks about the mathematical operation of addition which the author defines as combining a number and numbers with one another. Chapter two deals with subtraction, then the sixty's tables or the sixty's ratios, and knowing the ratio of a multiplicity product and the division. In the final chapter, the author speaks of the route to knowing the balance which is a number to test the validity of the calculation work including addition, subtraction, multiplication and division.
The Fine Truth in Calculating the Degrees and Minutes
(raqa‘i‘q al-ḥaqqa‘i‘q fi ḥsāb al-daraj wa-al-daqa‘i‘q)

(826 – 907H/ 1422 – 1501AD)

Abū ʿAbd Allāh Badr-al-Dīn Muhammad Ibn al-Ghazar al-Dimashqī - alias (a.k.a.) Sibṭ al-Māridīnī, mathematician originally (his family) from Damascus, but was born in Cairo, where he also s a Miqāṭ (time keeper) at al-Azhar Mosque.

: Iterations with the Sine Quadrant
: Theoretical Rules, and Geometrical Works in Using the Sine Quadrant
: in Working With the Intersected Northern Quadrant
: to Working with the Covered Quadrant
: and the Stroll of Minds in Knowing the Times by Calculation

Calculating the Degrees and Minutes - Sibṭ al-Māridīnī 499/71519

may be called the calculation methods in Astronomy; as it speaks of the Jummal letters (a.k.a.) in the preparation of ephemerides, and the way to place them individually and acting these letters in their order. These are among the essentials and basics for the students der to be able to read the tables in an ephemeris. The treatise consists of an Introduction, 1 Epilogue. The first chapter speaks about the mathematical operation of addition which as combining a number and numbers with one another. Chapter two deals with subtraction, slas or the sixty’s ratios, and knowing the ratio of a multiplication product and the division. 

The author speaks of the route to knowing the balance which is a number to test the ulation work including addition, subtraction, multiplication and division.

The Fine Truth in Calculating the Degrees and Minutes, (raqa‘i‘q al-ḥaqqa‘i‘q fi ḥsāb al-daraj wa-al-daqa‘i‘q)

This photograph represents the Introduction where the author indicates that he had organized the treatise in an Introduction, 10 chapters and an Epilogue. The Introduction speaks of the Jummal Letters, and that there are three orders for the initial letters; the units, the tens and the hundreds. In each of these, there are 9 decades. This page brings together 9 words namely: Iqṣab, Bakr, Ḥash, Dunt, Hitn, Wasalh, Dha‘ad, Khafaḍ and Ta‘ṣṣ. (See the Jummal Calculations Index)
Ibn al-Banna' al-Marrakushi (654 – 721H/1256-1321 AD)

He was Abū al-‘Abbās ʿAlī ibn Muḥammad ibn Uthmān al-Azād who was born in the city of Marrakush. His grand father belonged to the Yimini Azād Tribe. He was a Mathematician, an Architectural Engineer and a Physician who was well known in the seventh century of hégira (thirteenth AD). He wrote about 82 books, 70 of which were in Astronomy, Astrology, Numbers, Arithmetic, Geometry and Algebra. His works remained as a main source in Arithmetic for a long time; for what it contained of innovative mathematical ideas. Therefore, scholars treated his works with comments and explanations. Among those influenced by his works the great scholars al-Qalṣādī and Ibn Khaldun.

His works include:
• Book of simplification on ephemerides of plants
• Book on determining (the azimuth of) the Qiblah
• The book on rule of transit of the sun and moon through lunar stations and determining time at night and day

Guidebook for the Pupil to Equations of Planets- Ibn al-Banna’ al-Marrakushi 16/5520

A Treatise consisting of an Introduction and 24 chapters in which the author stated that he prepared that ephemeris according to the style applied by Abī al-‘Abbās Āḥmad ibn ‘Alī ibn Ishāq al-Tunīsī. This indicates the existence of several schools of Astronomy in the Muslim World during that period. The manuscript contains a great amount of calculations and tables, from which the dates and beginnings of Arabic months can be known and it appears from existing manuscripts that this work remained an Astronomy source in the Muslim World for a long time. The Spanish Escorial (*) library keeps a copy of this work, which dates back to the 10th century of Hégira, thus, it justified its title “The Seeker’s Way”, by remaining a principal source of Astronomy for many decades.

(*) Refer to the copy of the library in Spain, which dates back to the 10th century of hégira in; the index of the photocopies manuscripts, pp 249 and 250.
Guidebook for the Pupil to Equations of Planets (minhāj al-ṭālib li-ta’dīl al-kawākib)

Marrākushī (654 – 721H/1256-1321AD)

Ibn al-Marrākushī was born in the city of Marrākush, longed to the Yimini Azad Tribe. He was a Mathematician, an Architectural Engineer and is well known in the seventh century of Hegira (thirteenth AD). He wrote about 82 books, Astronomy, Astrology, Numbers, Arithmetic, Geometry and Algebra. His works remained Arithmetical for a long time; for what it contained of innovative mathematical ideas, treated his works with comments and explanations. Among those influenced by his works I-Qalsâdî and Ibn Khaḍîm.

Pupil to Equations of Planets-Ibn al-Banna’ al-Marrākushī 16/5520

In an Introduction and 24 chapters in which the author stated that he prepared that g to the style applied by Abī al-‘Abbās Al-mârâkushî, ‘Abd al-Mârâkushî, this indicates that the schools of Astronomy in the Muslim World during that period. The manuscript contains calculations and tables, from which the dates and beginnings of Arabic months can be known existing manuscripts that this work remained an Astronomy source in the Muslim World Spanish Escorial (*) library keeps a copy of this work, which dates back to the 10th century and it is known as “The Seeker’s Way”, by remaining a principal source of Astronomy for Spain in the century, which dates back to the 10th century of Hegira in; the index of manuscripts, pp 249 and 250.

The second chapter of the Manuscript is explaining the method of extracting the Roman dates from the Arabic dates, and the Arabic dates from the Roman dates by calculation, and from tables.
al-jaghmīnī: (died in the year 745H/1345AD)

He is Maḥmūd ibn Muḥammad ibn ʿUmar al-Jaghmīnī (or Jaghmīnī), a renowned Arabic Astronomer and Physician who was born at Jaghmīn in Khuwārizm (date is not precisely known). Most likely, he died in one of the Hegira years of 721, 735 or 745.

His works include:
* A Treatise in Arithmetic
* The Canon in Medicine
* The Strength and Weakness of Planets
* Exposition of Arithmetic and Matters of Bequests

Compendium of Simple Astronomy – al-Jaghmīnī al-khuwārizmī 558/95628

This is an educational book that contains many important research topics in the fields of Astronomy and Geography; such as the Spherical shape of the Earth, its movement and the movement of the planets around the Earth. Therefore, many scholars undertook the exposition of this book considering it as one of the important sources in the fields of Astronomy and Geography and was subsequently spread, and widely available throughout the Muslim World; due to its accuracy and comprehensive coverage of subjects. The book was described by “Nillino” as one of the most important works in the history of Arab astronomy and its study was made compulsory for the qualification of the learners in the fields of Astronomy and Geography, which means that it was a basic educational book in the history of Muslim Science. Among the scholars who undertook its exposition were Sheikh ʿAbd al-Rāhmān al-Suwīdī, Fadh al-Dīn al-ʿUbdī, Qāḍī Zādah al-Rūmī, al-Shārīf al-Jirjānī, Muḥammad ibn Zādah al-Ṭayyib and Kamal al-Dīn al-Turkumānī (14th century AD).

The book was also translated into the German Language in the year 1893.
Compendium of Simple Astronomy (al-mulakhaṣ fi al-hay'ah al-busītah)

died in the year 745H/1344AD

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so translated into the German Language in the year 1893.

| Compendium of Simple Astronomy, (al-mulakhaṣ fi al-hay'ah al-busītah) |
| It is an Illustration of the Sun and the Sun’s position with respect to the Universe as explained above. |
Glossary of Astronomical Terms
Altitude
The Angular distance of a heavenly body from the horizon’s circle tangential with the vertical circle passing by that body.

Aphelion
The farthest point on the orbit of a planet or of another heavenly body, from the Sun; in the body’s true orbit around the Sun.

Apogee Lunar
The farthest point of the moon from the Earth; in the Moon’s true orbit around the Earth.

Apparent Magnitude
The degree of brightness of a star in its position with respect to an observer on the Earth.

Armillary Sphere
An astronomical instrument in the form of a skeleton sphere made up of hoops (rings) turning on several axes to show the motion of the heavenly bodies. It represents the Celestial Equator the (planetary) orbits and the Eclipses.

Astrolabe
An astronomical instrument that gives a three-dimensional projection of the heavens on a plane surface. It was also used in measuring the altitudes of heavenly bodies. The word comes from the Greek origin “Astrolabos” derived from the two roots of “Astro” and “Lambano”, literally meaning “The mirror of the planets/stars”. That is the reason why the science of the stars was called “Astronomy”. The principal parts of the Astrolabe are: the Plate, the mother (Um), the Spider (net) and the alidade.

Astrology
Astrology is a set of accepted beliefs that determine the psychological characteristics and metaphysical (spiritual) effects and influences of the Sun, the Moon, the planets and constellations on the Earth and everything on it; and inside of it. It is commonly believed now that Astrology is concerned with everything related to Man’s life past, present and future though it is also concerned with everything else on Earth; including the formation and composition of minerals. Nevertheless, astrologists employ a fair deal of correct astronomical information; such as the positions of the wandering stars, expressed in degrees and minutes of arc, for the desired times. This clearly means that the astrologer (astrologist) should have knowledge of the zodiac and the twelve zodiacal constellations; as well as the planetary orbits and their positions with respect to these constellations.
The early Muslim Astrologers (Astrologists) were called the “al-Ahkāmi”; in reference to the Science of “ahkām al-nujūm”, or “star rules”. A distinction is, therefore, made between al-Ahkāmi and the Astronomer. While the latter employs astronomical data to establish the scientific facts about the heavenly bodies in relation to calendars, directions, seasons and other parameters; the former relates astronomical data to the personal characteristics of individuals, as basis for predicting their future.

**Azimuth**

The angular direction of a body in the heavens or skies measured from the North (0°) and across the East, South and West respectively.

**Celestial Equator**

The projection on the Celestial Sphere of the Earth’s Equatorial Line.

**Celestial Horizon**

The circle marking the intersection of the Earth and the heavens.

**Celestial Latitude**

The angular distance of a heavenly body from the nearest point on the Ecliptic (or the virtual orbit of the Sun).

**Celestial Longitude**

The angular distance of a heavenly body on the Ecliptic at the point of the vernal equinox, and it is measured in degrees East along the Ecliptic.

**Celestial Meridian Line**

The Great Circle, on the Celestial Sphere, that passes through the point of the Zenith and the point of the North and divides the Celestial Sphere into two halves, East and West.

**Celestial Poles**

The two, Northern and Southern, points on the Celestial Sphere (Globe).

**Celestial Sphere**

An imaginary sphere with the observer at its center, its radius is infinity, its poles are the two ends of the Earth’s Axis of Rotation, its Equator is the extension of the plane of the Earth’s Equator and its Axes are: the inclination and the straight ascent (horizontal), the altitude and azimuth (vertical) and the celestial longitude and latitude (Ecliptic).

**Conical Lunar Eclipse**

The condition in which the Moon enters the conical shadow, or penumbra (partial shadow) of the Earth.

**Conjunction**

The presence of two heavenly bodies on one line with, and nearest to, the Sun. Hence, the two bodies will share the same celestial longitude.
Constitution (Signs of the Zodiac)

Groups of Stars lying on the Ecliptic, 12 in number (the orbit of the Earth around the Sun, or the apparent orbit of the Sun around the Earth) which are part of 88 stellar groups spreading in the heavens.

Culmination

The highest altitude of a heavenly body above the horizon between its rise, and its crossing of the Meridian line and its setting.

Declination

The angular distance of the (heavenly) body North or South of the Celestial Equatorial Circle i.e. similar to the latitude of a location on Earth.

Directness

The intrinsic motion of the planet in its usual direction in the heavens, among the stars from the West to the East. This is different from the apparent motion of the planet from the East to the West resulting from the daily rotation of the Earth around its own axis.

Ecliptic

An imaginary circular region in the Celestial Sphere or sky dome. Astronomers divide the Ecliptic into four equal portions, each containing three divisions bearing the names of certain signs of the zodiac where the ascending northerly portion contains the Aries, Taurus and Gemini signs of the zodiac. The descending northerly portion, on the other hand, contains the Cancer, Leo and Libra (or zodiac - or corn ear) signs of the zodiac. The descending southerly portion contains the Libra, Scorpio, and Sagittarius signs of the zodiac. The ascending northerly quarter contains the Capricorn (us), Aquarius and Pisces signs of the zodiac. The four portions (quarters) of the Ecliptic represent the Spring, Summer, Autumn and Winter Seasons respectively. The Sun appears to be crossing each of these signs of the zodiac once a year. There are special tables giving the particulars for each point on the Ecliptic in its four quarters.

Ephemeris

The Arabic term (Zij) for Ephemeris had been transliterated from the Bahawi (Ancient Persian) Language meaning the warp in which the weft (or the wool) of a fabric is woven (woven). The Persian used the word to refer to the astronomical tables which give the time and location for heavenly bodies and astronomical phenomena events throughout the year.

Epicycle

A small circle whose center revolves around a larger circle.

Epicycles

The daily track or path of the heavenly body in the heavens as a result of the Earth's rotation around its axis.
Signs of the Zodiac

A hypothetical point in the Ptolemy System corresponding to the Earth with respect to the center of the Principal Circle.

Equatorial Circle

An imaginary circle that divides the Globe into two halves.

Fixed, moving, and Wandering / Wondering Planets

The Ancients used to give the name of "Fixed Planets" to the relatively stationary stars in the heavens as seen by the eyes in order to distinguish them from the seven moving planets around the Earth. The latter meant the Sun, the Moon, Mercury, Venus, Mars, Jupiter and Saturn. The last five among these were given the name of the "Wandering/Wondering Planets"; as they keep wandering meandering in the heavens between the stars, from time to time. Their movement would, at a time, be in a certain direction called the "straight movement". However, they soon change movement returning back to the opposite direction, and this change is called the "Return, or Recession or Regression". The Ancients did not know then what is known now, about the movement of the Earth and the Planets around the Sun and that the planets are dark bodies that get their light from the Sun.

Full Moon

The state of the Moon and Earth Opposition so that the Moon, the Sun and the Earth respectively lie on the one straight line.

Gnomon

A pointer or indicator on the Sundial with the function of projecting the Sun shadow on the Dial. It also points to the Celestial North Pole.

Helical Rising

The rise (emergence) of a star or a planet, simultaneously with the Sunrise though the term is normally used to indicate the first appearance of the heavenly body in the dawn sky.

Horizon

The boundary separating the heavens sky from the land or the sea or the circle that coincides with the horizon and divides the Celestial Sphere or Globe into two halves or the Great Circle on the Celestial Sphere that is, anywhere, always at a right angle (i.e. of 90°) with the zenith of the observer.

Hour Angle

The angle, at a certain moment, made by the Meridian Line of the observed body and the Meridian Line of the observer.
Inclination

The distance of the heavenly body from the Equatorial Circle.

Islamic Calendar

The major calendar of the Moslem nation is called the Hejri Calendar which is a lunar calendar. The year consists of 12 months (354 days). Each even month has 29 days (sa‘far, rabi‘ al-akhir, jumud al-akhir, Sha‘bân, Shawâl, dhî al-hijah), while the odd month has 30 days (muharram, rabi‘ al-awwal, jumud al-awwal, Sha‘bân, rajab, ramadân, dhî al-qî‘dah). The Islamic Hejri calendar has been first used on Monday July 15th in 622 AD.

Lunar Conjunction

The presence, on the same line of the Moon, the Sun and the Earth.

Lunar Eclipse

The passage of the Moon across the shadow of the Earth. The eclipse could be total, or only partial.

Lunar Latitude

The distance of the moon from the Ecliptic.

Lunar Mansions

The lunar mansions are twenty eight in number, and were given that name by the Ancients who believed that the moon spends a night in each; over the Arabic month. They are, however, positions in which the Moon appears over the lunar month; each of which is distinguished by a specific stellar background.

Magnitudes

A definition of the relative luminosity of a star as it appears to an observer on the Earth, and it does not express its real or true luminosity since the distant stars appear faint (dim) despite their strong actual luminosity. The magnitude is in three types: the apparent magnitude which is observed by the human healthy naked eyes, as it appears in its actual position on the celestial sphere; the absolute magnitude, which is the apparent magnitude the star would have if it were at an assumed distance of 10 parsec from the Sun; and the Bolometric magnitude, which is the total radiation received from an object and recorded by optical instruments in the different wavelengths.

Mansions of the Moon

The variations in the bright luminous side of the Moon facing the earth. These are: the Waning, the Crescent, the First Quarter, the Full Moon and the Second Quarter.

Meridian

An imaginary Great Circle that passes the two points of the North and the South crossing the Head Zenith.
Meteorology

Meteorology is the branch of science devoted to the observation and study of the general atmospheric parameters; with particular attention to weather changes and forecasts. People in the past made close connection between weather conditions and astronomy; attributing the onset of winds, rains, heat waves and cold spells to the emergence of certain stars or constellations. This despite the fact that such connection does not necessarily exist. Some ancient cultures had, moreover, gone as far as to attribute the weather spells directly to those stars as creator gods; a concept emphatically rejected in Islam.

The origin of connecting the weather to astronomy, however, goes back to observation of the annual seasons resulting from changes in the position of the Earth with respect to the Sun; a fact that the ancients did not realize, since they had no knowledge of the Earth’s movement. Nevertheless, the peoples had benefited from this connection. The Babylonians, for example, were able to set tables guiding farmers to the best and opportune times for plowing or sowing or harvesting; as well as specifying the rainy seasons. The Ancient Egyptians, on the other hand, connected astronomy to the Nile’s flood season and set from that the flood times; guiding farmers to related appropriate actions. Muslim Scientists, from the Abbasii period onward, managed to transform that available ancient knowledge into an experimental science employing measuring and observational instruments; to set ephemerides and calendars, and produce related works.

Opposition

The presence of the planet on one straight line with the Sun in between.

Opposition State

The position of a planet when it is exactly opposite to the Sun in the sky with respect to the Earth as the three would be nearly on one straight line.

Perigee Lunar

The nearest point of a planet or a star to the Earth.

Perihelion

The position on the orbit of a planet or of any other heavenly body; when the Planet or the Body is at its nearest point to the Sun; in the body’s true orbit around the Sun.

Planetary Connection

The presence of a planet on a straight line with another planet without the Sun coming in between.

Principal Longitude

The Meridian Line on the Surface of the Earth that passes through Greenwich represented by the longitude (0°).

Quadrant

An astronomical instrument used to measure the apparent positions of the heavenly bodies.
Quadrature
An astronomical instrument used to measure the apparent positions of the heavenly bodies, and it has the shape of a quarter circle.

Regression (Recession)
A reverse in the planet’s own movement among the stars in the heavens from East to West. The planet does not change its motion, but the phenomenon happens when the Earth changes its motion in its orbit as it gets near the Perigee or the Apogee with respect to the planet. As the speed of the Earth in its orbit is different from the planet’s speed in its orbit, the latter appears as if it were receding (regressing or moving backward) in its movement among the stars instead of moving forward. This movement is not marked by observation sighting, but rather through drawing the tracing of the planet’s coordinates in relation to the stars over the period of six months.

Sind-hind
A corrupted term from the Indian word “Siddhanta” meaning “Knowledge”, but it was later given to any book dealing with astronomy (the science of star rules). There are five collections in Mathematics and Astronomy that carry this name of Sind-hind.

Solar Ascent
The rise of the Sun during the Daytime from Sunrise to the Meridian Circle.

Solar Declension
The Sun’s descent from the Meridian Circle, to Sunset through its track.

Solar Eclipse
The veiling of the Sun by the Moon; as it lies directly between the Earth and the Sun. The Solar Eclipse could be total, or only annular (ring-shaped): or partial.

Solstices
The Summer Solstice falls on the 22nd of June when the Sun is in the Northern half of the Celestial Sphere; perpendicular to the tropic of Cancer and the Daytime is longest. The Winter Solstice falls on the 22nd of December when the Sun is in the Northern half of the Celestial Sphere perpendicular to the tropic of Capricorn and the Daytime is shortest.

Spherical Triangle
A triangle drawn on the surface of a sphere; so that its sides are arcs of great circles, and the length of the side is expressed by the value of the corresponding angle at the center of the sphere. The angles in a spherical triangle, are central, and total 180°

Syzygy
The astronomical condition of alignment of the earth, moon, and sun at new and full moon, the time of maximum spring tidal forcing. At these times the range of tide is greater than average.
Veiling

A phenomenon resulting from the movements of the planets or the Moon in the heavens where the stars hide (disappear) for a period of time depending on the speed of the moon or the planet relative to the Earth.

Vernal and Autumnal Equinoxes (The Equinoxes)

The Vernal Equinox falls around the 21st of March of every year, at the beginning of the Spring season. It marks the moment at which the Sun crosses the meeting point of the Ecliptic with the Celestial equator; from the South to the North.

The Autumnal Equinox falls around the 22nd of September of every year, at the beginning of the Autumn season. It marks the moment at which the Sun crosses the meeting point of the Ecliptic with Celestial equator; from the North to the South. At the Equinoxes, the length of the Day equalizes with the length of the Night, and the Ecliptic crosses the Celestial Equator twice in the year.

Waning of the Moon

A state of connection between the Moon and the Earth so that the Moon, the Earth and the Sun are respectively on a straight line.

Zenith

The highest point above the observer’s head.

Zenith Distance

An angular distance from the zenith point to the star on a great circle containing the Zenith, the Star and the Nadir.

Zodiac

A term used in the science of Form (Falak/Astronomy) which refers to the groups of stars that Earth goes past, in its motion around the Sun though it appears that it is the Sun that goes past them in its apparent motion around the Earth. This means that the Zodiaca are similar to stations signs in which the Sun stays in its motion over the year. In every month of the year, the Earth (seemingly the Sun) enters one of these Zodiaca, so that the Sun’s apparent motion around the Earth is divided into 12 signs of the Zodiac, and this is known in Astronomy as “The Zodiac”. Each of these three groups signs constitute a Season of the year.

The Ancients used to draw in their minds imaginary lines connecting between each group of stars (constellation) which will appear to them in the image of an animal or a legendary hero from their ancient mythology, or anything else that comes into their minds. That was how they came to give those constellation names, such as: Aries, Pisces, Taurus, Leo, ...etc. The Arabs used to distinguish or identify each star with its location in the image, so that they say, for example, Scorpio’s heart, Aries’s head, Pisces’s belly and so on. The Zodiac belt for the apparent movement of the planets and the Sun is distinguished with the Moon around the Earth, on the two sides of an epicycle (circle) to about 9°.
Appendix (B)
The Jummal Calculations
(Assigning Numerical Values
to Letters of the Alphabet)
The Phoenician Alphabet used to consist of 22 letters abridged in the following group of six words: Abjad, Hawwaz, Ḥuṣṭi, Kalamun, Saʿṣaṣ, Qarshat. The Alphabet was called “Abjad letters”, after the first word in the group to which the remaining six Arabic letters were added. These form the two words: “Thakadh” and “Daẓagh”; bringing the letters of the Arabic Alphabet to a total of 28, arranged into what is known as the “Arabic Abjad letters”. These were grouped into the above eight words in order to be easily memorized; though they do not have Arabic meanings.

The Arabs have used to record dates through the use of phrases or sentences; before they knew the Indian numerals, and the Ghoberian (or Arabic) Numerals – as they were referred to in the West. This type of recording dates, through the use of phrases or sentences, was known as the “Jummal Calculation”. It is likely that the name came from the Arabic verb of "Ajmal" meaning Adding up numbers; with reference to al-Jumlah (sentence).

There are, however, other ways of pronouncing the word as “Jumal”, but it commands little acceptance. Each letter in the above (expanded) group of eight words was given a corresponding number. Hence, the first nine letters correspond to the units, i.e. the numbers 1 to 9, the next nine letters correspond to the tens, i.e. the numbers 10 to 90 then the next to the hundreds, i.e. the numbers 100 to 900; and finally the remaining letter (Ghin) is assigned the figure 1000. Numbers exceeding 1000 were formed by combing the corresponding letters together.

The following tables give details of the numbers corresponding to those letters; upon which the “Jummal Calculations” were based:

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<td>Ḍād</td>
<td>Zāʾ</td>
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</tbody>
</table>
Alphabet used to consist of 22 letters abridged in the following group of six words: حرف النحو، ساذا، دعوم، صاحب، بلقش، أبوذ. The Alphabet was called “Abjad letters”, after the up to which the remaining six Arabic letters were added. These form the two words: آثاغ”; bringing the letters of the Arabic Alphabet to a total of 28, arranged into “Arabic Abjad letters”. These were grouped into the above eight words in order red, though they do not have Arabic meanings.

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<td>جم</td>
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</table>

As an example of what the transcribers of manuscripts wrote on the basis of “Al Jummal Calculations”; “Transcription was completed in dhalw”, meaning the year 736H. Another one says: Written in Ghaqnah, meaning the year 1152H.

Also as examples:
The Number 324 = Shajī
The Number 360 = Shīn
The Number 1,001 = Ghāb
The Number 1,002 = Ghāb
The Number 2,000 = Bigh
The Number 10,000 = Gigh

Subsequently, the days of the month in numbers and letters are presented as follows:

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For further details, refer to:
- ‘Imām Muḥammad al-Shanqī; Methods of Dating Manuscripts Transcriptions, Issue number 4, Dār al-kutub Wa al-wathā’iq al-maṣriyyah, 2004
- Qadri Hāfiz Tūqān; The Arabic Scientific Heritage in Mathematics and Astronomy, Dar al-Shurūq (No Date)
- Donald R. Hill; Islamic Science and Engineering, Edinburgh University Press 1993, Translated by Ahmad Fu‘ād Bāšā, Silsīlat ālam al-ma‘rifah (305), Kuwait – 2004
Defining the Astrolabe, its Parts and Uses
The astrolabe was the astronomical instrument par excellence of the middle ages. It, in its simplest form, consists of a metal or a wooden disc that is suspended from a ring (hanger, or holder). It has a pointer in the center which can be turned in the direction of the observed object. The disc is divided into degrees in order to determine the altitude angle of the Sun or the star, at a certain moment. It is often that a picture of the Sun is drawn on the front of the instrument. To determine the time, the Sun’s altitude is measured first and subsequently the position of the Sun for the certain day in the area of the zodiacs could be determined. Then the pointer is moved or turned until the position of the Sun coincides with another circle on the disc corresponding with the latitude. The line, extending from the point of coincidence to the centre at its other end, would give the time on a certain scale on the rim of the instrument. The scale would mostly follow the letters of the “Jummal Calculations” system. The most important parts of the Astrolabe are listed as follows:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring</td>
<td>Called the Hanger from which the astrolabe is suspended, in order to take the readings of altitude and observation.</td>
</tr>
<tr>
<td>Loop</td>
<td>The part connected with the Ring and the Seat.</td>
</tr>
<tr>
<td>Seat</td>
<td>The part between the loop and Astrolabe Um (body).</td>
</tr>
<tr>
<td>Astrolabe Umm (Body, or Mater)</td>
<td>The major circular plate with a hoop (rim) within which the other plates are combined.</td>
</tr>
<tr>
<td>Climate (Plates)</td>
<td>Round discs varying in number, in each astrolabe, from three to more than ten. They have holes in the center and are dented at the side in order to be fixed to a special jet within the chamber, and to prevent them from rotating. In each plate there are three circles around the centre of the plate.</td>
</tr>
<tr>
<td>Rete</td>
<td>The fretted network net with holes and dents for observing some planets and stars, a lever to move it and two circles. The major circle from the center is the tropic of Capricorn. The minor circle has the tropic of Cancer at its center and bears the 12 signs of the zodiac and an arc whose tropic is the head of Aries and Libra, and it is the tropic of the two equinoaxes. The rete is essentially a star map, or reproduction of the heavens and it is free to rotate.</td>
</tr>
<tr>
<td>Alidade or Ruler</td>
<td>The movable straight rule on the back of the astrolabe. It has two cuts, with holes to take altitude of the Sun during the day and the altitudes of the planets at night. It is also used in the measurement of land heights. It is free to rotate like the rete.</td>
</tr>
<tr>
<td>Pin (Axis)</td>
<td>The pole holding the plates and the cobweb from holes in their centers.</td>
</tr>
</tbody>
</table>
astronomical instrument par excellence of the middle ages. It, in its simplest form, consists of a that is suspended from a ring (hanger, or holder). It has a pointer in the center which can be turned observed object. The disc is divided into degrees in order to determine the altitude angle of the sun moment. It is often that a picture of the Sun is drawn on the front of the instrument. To e Sun’s altitude is measured first and subsequently the position of the Sun for the certain day in could be determined. Then the pointer is moved or turned until the position of the Sun coincides the disc corresponding with the latitude. The line, extending from the point of coincidence to the would give the time on a certain scale on the rim of the instrument. The scale would mostly follow Calculations’ system. The most important parts of the Astrolabe are listed as follows:

<table>
<thead>
<tr>
<th><strong>Horse</strong></th>
<th>The part inside the pole it holds.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Astrolabe back</strong></td>
<td>The part divided into 360° and quadrants, and it is inscribed with the names of the signs of the zodiac and incised with the drawing illustrations for the use of the astrolabe. It is mostly used in Astrology.</td>
</tr>
<tr>
<td><strong>Brace / Bracket</strong></td>
<td>The part above the astrolabe mater normally triangular in shape and decorated. It is also known as the seat and often bears the name of the maker.</td>
</tr>
</tbody>
</table>

The astrolabe is assembled by placing the plate on the body (mater) inside the annulus, then placing the rete over the plate, then the alidade over the rete. The other alidade, if one is provided, is placed in position on the back. A pin is then passed through all the parts, and secured behind the rear alidade by a cotter.

The Arabs used the astrolabe in their Astronomical, Geographic, Topographic and Navigational observations and calculations. They surpassed, in its making, the nations that came before them including those of Babel and Greece. For the Arabs, the astrolabe had developed into a special science with research fields related to the ways of its use, mastering the art of providing the plates with the astrolabe lines and the knowledge of placing it for the latitudes of the specific areas.

While the Greeks employed the astrolabe for only two uses or a little more, the Arabs had numerous uses for it, including:

1- Finding the (sign of the) zodiac in which the Sun passes and the number of degrees that it covered of it.
2- Measuring the altitude of the Sun and the planets.
3- Knowing the commanded prayer times.
4- Knowing the times for the end of Dusk and break of Dawn.
5- Knowing the times of the day and the night.
6- Knowing one (specific) hour of the night, and its fractions.
7- Finding the unknown planets placed in the astrolabe’s rete through those known ones amongst them.
8- Knowing the Sun’s zenith in the day, and the zenith of the planets in the night.
9- Knowing al-qiblah direction in the night and the day.
10- Knowing the latitudes and longitudes.
11- Knowing the shadow (tangent) from the Sun’s altitude, and the Sun’s altitude from the shadow (tangent).
12- Knowing the height and height difference between two sites.
13- Knowing the positions of the Moon and the planets with respect to the zodiacs (constellations).
14- Knowing the positions on the horizon of the Sunrises and Sunsets.
15- Using the small flat astrolabe in place of the pocket watch.

| **Called the Hanger from which the astrolabe is suspended, in order to take the readings of altitude and observation.** |
| **The part connected with the Ring and the Seat.** |
| **The part between the loop and Astrolabe Um (body).** |
| **The major circular plate with a hoop (rim) within which the other plates are combined.** |
| **Round discs varying in number, in each astrolabe, from three to more than ten. They have holes in the center and are dent at the side in order to be fixed to a special jut within the chamber, and to prevent them from rotating. In each plate there are three circles around the centre of the plate.** |
| **The fretted network net with holes and dents for observing some planets and stars, a lever to move it and two circles. The major circle from the center is the tropic of Capricorn. The minor circle has the tropic of Cancer at its center and bears the 12 signs of the Zodiac and an arc whose tropic is the head of Aries and Libra, and it is the tropic of the two equinoxes. The rete is essentially a star map, or reproduction of the heavens and it is free to rotate.** |
| **The movable straight rule on the back of the astrolabe. It has two cuts, with holes to take altitude of the Sun during the day and the altitudes of the planets at night. It is also used in the measurement of land heights. It is free to rotate like the rete.** |
| **The pole holding the plates and the cobweb from holes in their centers.** |
Sky Constellations and Mansions of the Sun and the Moon
From ancient times man had keenly observed the apparent movement of the Sun in the celestial sphere, and appearance of the heavens as a result of such motion where the star scene and star groupings change before the eyes of the beholder on Earth, while keeping their shapes over the ages. The ancients used to draw in their imagination hypothetical or imaginary lines connecting the stars in each group or constellation, so that each constellation would appear to them in the shape of an animal or a legendary hero of an ancient myth, or anything that comes to their minds. Therefore, they gave these constellations names such as: Aries, Pisces, Taurus, Leo, Libra, and so on. They even imagined stories involving these constellations, e.g. the Giant (al-Jabbar/ Hercules) which is a fierce hunter who has a Taurus (bull) before him and a Hare (rabbit) under his feet. He also has a big (Major) Dog and a small (Minor) Dog. The tale about him tells that he was killed by Scorpio in the Gemini Constellation. All the names here refer to constellations.

In the science of Universe form (Astronomy), constellations are groups of stars that the Earth passes during its rotation around the Sun, though it would appear to the observer that it is the Sun that moves past them in its apparent rotation around the Earth. The constellations are, therefore, like houses or Mansions where the Sun, resides or stays in its apparent rotation over the year. In every month of the year, the Earth -or seemingly the Sun, enters one of these mansions zodiacs. The apparent orbit of the Sun around the Earth, known in Astronomy as the Zodiac, is divided into twelve zodiacs (stations of the zodiac). Every three of these stations of the zodiac would form a Season of the year.

The signs of the zodiac for the Spring Season (March 21 – June 21) are those of Aries, Taurus and Gemini; those for the Summer Season (June 22 – September 22) are the Crab (Cancer), the Lion and Virgo; those for the Autumn Season (September 23 – December 22) are Libra, Scorpio and Sagittarius; and those for the winter Season (December 22 – March 21) are those of Capricorn, Aquarius and Pisces.

When someone, for example, is described as a “Taurus”, then this means that he/she was born between April 21 and May 21. Persons described as “Aquarius”, on the other hand, would have been among those born between January 21 and February 20. When the Sun is in front of a constellation, it would not be possible to observe its member stars during the day but its corresponding constellation would be seen at night, instead. This means that when the Sun is in Aries, then its light will prevent the observation of its constellation and other day constellations around it, but the corresponding constellation of Libra would be observed at night, as well as the other constellations around it. Also, when the Sun is in Scorpio, the Taurus constellation would be observed at night.

To assist the memorization of constellation (zodiacal) names, they were arranged in Rhyme that may be translated as follows:

Taurus Carried the Nut of the Crab (Cancer) And the Leo tended the Virgo of Libra
Scorpio shot a Capricorn with its Sagittarius And Aquarius bailed out the lake of Pisces
As man had keenly observed the apparent movement of the Sun in the celestial sphere, heavens as a result of such motion where the star scene and star groupings change before us on Earth, while keeping their shapes over the ages. The ancients used to draw in their local or imaginary lines connecting the stars in each group or constellation, so that each appear to them in the shape of an animal or a legendary hero of an ancient myth, or to their minds. Therefore, they gave these constellations names such as: Aries, Pisces, and so on. They even imagined stories involving these constellations, e.g. the giant (al–ich is a fierce hunter who has a Taurus (bull) before him and a Hare (rabbit) under his leg (Major) Dog and a small (Minor) Dog. The tale about him tells that he was killed by a Constellation. All the names here refer to constellations.

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Not all constellation shapes resemble those of the shapes of names representing them, but only some of them. Resemblance can, for example, be observed in the shape of the Taurus constellation where the principal member stars are arranged in a triangle, somewhat resembling the skull of the bull. The Arabs used to distinguish each member star by its location on the body (of the constellation animal shape). Referring to the heart of Scorpio, the leg of Cygnus, the head of Aries and the belly of Pisces would be examples.

As to the Mansions of the Moon, they are related to its various positions with respect to the Earth and the Sun, resulting in its phases (faces) so that the beginnings of the lunar (Hegira) months can be identified. From the perspective of Astronomy, the Moon passes by constellations called the “Mansions of the Moon”, during its cycle around the Earth and the cycle of the Earth around the Sun. The Moon completes its cycle or turn around the Earth in 29 days, 12 hours, 44 minutes and 2.8 seconds, which add up to a total constituting of the associating (Conjunction length of the zodiac, and approximately the length of the Arabic Hegira month.
The constellations along that orbit are divided into 28 houses (Mansions) hosting the Moon during its persistent cycles around the Earth as it covers 13° every day, to be seen among a different group of stars (Mansion) to those of the previous day.

In comparing these Moon Mansions to the zodiacs, the zodiac contains about two mansions and a third. The Arabs give 14 Moon Mansions the name of the Northern (Syrian) Mansions as they exist in the Celestial North. The other 14 Moon Mansions are described as Southern (Yemeni) Mansions as they exist in the Celestial South. The first of the Northern Mansions is "al-shärṭān" and their last is the "unarmed fisherman; al-sammāk. On the other hand the first of the Southern mansions is "al-ghafr", and their last is the "al-Rašīd" or "Belly of Pisces". The names of the 28 Lunar Mansions, however, are: al-shārṭān, al-buṭīn, al-tharayyā, al-daburān, al-haqāh, al-hanā'ah, al-dharā' (the Arm), al-nathrāh, al-tārīf (end), al-jābāh (forehead or front), al-zibrāh, al-shahrāh, al-'iwa', al-sammāk (fisherman), al-ghafr, al-zabānī, al-ilāf (laurel or diadem), al-qālī (heart), al-shawlāh, al-na'ā'īm, al-baldah (township), Sa'd al-dhābiḥ, Sa'd al-Bal', Sa'd al-Su'ūd, Sa'd al-khābiyā, First Branch, Second Branch and al-rasha' (Belly of Pisces).

Each one of the Moon’s Mansions has a date of rising and a date of setting (falling or descending); for it is known that the Sun shows in the early morning (the period between dawn break and sunrise), in one of these mansions and hides it; as well as the preceding one, due to the intensity of its light. As a result, the mansions preceding these two would show in the early morning. Such a scene is called “the Rising or ascending” which is referred to by the Arabs in the phrase: “on the ascent of that thing, such matter will occur”. The falling (setting or descending) mansion in the West, early morning as the “ascending” shows up is called “the watcher”. The Watcher of each ascending mansion is its 15th mansion in the zodiac. For example, the descending watcher for the ascending “Asharun” mansion is “Alghafir” mansion.

The Sun remains in the one mansion for 13 days before it leaves to the next and every mansion that the Sun enters, will rise (ascend) in the early morning after 26 days. For example, if the Sun entered al-tharayyā (mansion number 3) in early morning it will hide (screen or obscure) al-tharayyā and the preceding al-buṭīn (mansion number 2). The ascending mansion in the early morning will then be al-shārṭān (mansion number 1) whose descending watch star would be al-ghafr (its mansion number 15). The Sun will remain in al-tharayyā for 13 days, then moves to al-daburān (mansion number 4) and screens (hides or obscures or blocks) it together with “al-tharayyā since it blocks the present mansion, and the one preceding. The Sun will remain in “al-daburān” for 13 days, before it moves to Alhaqa’a (mansion number 5) then al-tharayyā will emerge after 26 days, to become the ascending mansion in the early morning, while al-ilāf (laurel or diadem) mansion, the watcher for al-tharayyā, descends.

The Moon resides or stays every night, in a different mansion from the beginning of the month to its 28th day. It may hide for a night or two according to the length of the Arabic month. This will happen when the moon is in the waning phase where nothing is seen of it as The Creator assigned it to many mansions until it returns back, bent like “the old bunch holding palm dates” so that the years may be counted and the numbers are ultimately computed.
Moon Mansion | Its Ascent | Its Descent | Remarks
--- | --- | --- | ---
1. al-shārți | April 16 | October 18 | a.k.a horns of Aries or the butting ones
2. al-buṭān | April 30 | October 31 | a.k.a. belly of Aries
3. al-thāruyā | May 13 | November 13 | a.k.a. al-sababīn
4. al-dabārān | May 26 | November 26 | a.k.a. al-kīlī or Libra
5. al-haqqā | June 9 | December 9 | a.k.a. the Heart
6. al-han'ah | June 22 | December 22 | a.k.a. al-shawālah
7. al-dhīrī | July 4 | January 4 | a.k.a. al-nā'īm
8. al-nāthrah | July 17 | January 17 | a.k.a. al-baladh
9. al-ṭarf | July 31 | January 31 | a.k.a. Sa’d al-dhībah
10. al-jabbāh | August 14 | February 12 | a.k.a. Sa’d Balā'
11. al-zabrāh | August 28 | February 25 | a.k.a. Sa’d al-sa’ūd
12. al-ṣarāfah | September 9 | March 9 | a.k.a. Sa’d al-khabiyā
13. al-‘uwā | September 22 | March 22 | a.k.a. early bucket
14. al-sammāk | October 5 | April 4 | a.k.a. delayed bucket
15. al-gafr | October 18 | April 16 | a.k.a. Belly of Pisces
16. al-sababīn | October 31 | April 16 | a.k.a. al-shārți or Scorpio tail
17. al-kīlī | November 13 | May 13 | a.k.a. al-buṭān or Scorpio head
18. al-qalīb | November 26 | May 26 | a.k.a. al-kīlī or Athanāyā
19. al-shawālah | December 9 | June 9 | or the heart of Scorpio
20. al-nī’ām | December 22 | June 22 | a.k.a. al-dabārān
21. al-baladh | January 4 | July 4 | a.k.a. al-haqqā
22. Sa’d al-dhībah | January 17 | July 17 | a.k.a. al-shawālah
23. Sa’d Balā’ | January 31 | July 31 | a.k.a. al-nāthrah
24. Sa’d al-sa’ūd | February 12 | August 14 | a.k.a. al-ṭarf
25. Sa’d al-khabiyā | February 25 | August 28 | a.k.a. al-jabbāh
26. First Branch | March 9 | September 9 | a.k.a. al-zabrāh
27. Second Branch | March 22 | September 22 | a.k.a. al-ṣarāfah
28. Belly of Pisces | April 4 | October 5 | a.k.a. al-‘uwā

References:

N = Night of
a.k.a. = also known as

The above table illustrates the dates for Moon Mansion ascent, and descent throughout the year. The table shows that the Yemeni Mansions are the Watchers for the Syrian Mansions; which means that when a Syrian Mansion appears or rises, the Yemeni Mansion sets or disappears.
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<th>Serial No</th>
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<th>Special No</th>
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<td>Ibn Ghazali’s Exposition of Subh Al-Mamduni’s Work</td>
<td>‘Ali al-Bakhtari</td>
<td>667h</td>
</tr>
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<td>95628</td>
<td>558</td>
<td>The Book of Omar Aslifi in Astronomy</td>
<td>‘Umar al-Sufi, Abu al-Hasan</td>
<td>-</td>
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<td>224</td>
<td>Exposition of the Mullai Abduswahab’s Israfa Thesis</td>
<td>‘Uthman Ziauddin, Aḥmad Tālib</td>
<td>1127h</td>
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<td>The Seekers’ Trip in the Science of the Astralobe</td>
<td>Abū al-Ṣattāl, Muṣyayyih ibn ‘Abd al-Azīz al-Andalūsī al-Dārī</td>
<td>529h</td>
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<td>8163</td>
<td>46</td>
<td>The Book of Abi Ma’štah Alfakhi</td>
<td>Abū Ma’ṣṭah al-Falaḵī</td>
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<td>Uncovering the Mask in Drawing of the Qurans</td>
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<td>A Selection of Alsdah’s Teachings on Shifts</td>
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<td>The Brightest Planet in Working the Quarter Arch</td>
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<td>Khalīl Azzażī’s Thesis on Placing the Hours</td>
<td>Abī al-Ẓāfīr, Khaṭḥūl ibn Ibrahim al-Azīzī al-Ḥusayn</td>
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<td>A Thesis on the Absent Sun</td>
<td>Abī al-Ẓāfīr, Khaṭḥūl ibn Ibrahim al-Azīzī al-Ḥusayn</td>
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<td>40630</td>
<td>366</td>
<td>The Springs of Magic in Lunar Phases</td>
<td>Abī al-Ẓāfīr, Khaṭḥūl ibn Ibrahim al-Azīzī al-Ḥusayn</td>
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<td>2116</td>
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<td>Abū al-Raḥmān ibn Muhammad ibn Muhammad ibn ʿĀmir al-Akhdarī</td>
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<td>4386</td>
<td>12</td>
<td>Fixed Orbits in Knowing Distances and Directions</td>
<td>Abū al-Raḥmān ibn Muhammad ibn Muhammad ibn ʿĀmir al-Akhdarī</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>88225</td>
<td>533</td>
<td>A Thesis of Eye’s Delight and Roaming of Vision</td>
<td>Abū al-ʿAzharī, ʿAlī ibn Muhammad</td>
<td>877h</td>
</tr>
<tr>
<td>Serial No.</td>
<td>General No.</td>
<td>Special No.</td>
<td>Manuscript Title</td>
<td>Author</td>
<td>Date of Death</td>
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<td>-----------</td>
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<td>----------------------------------------------------------------------------------</td>
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<tr>
<td>18</td>
<td>34502</td>
<td>346</td>
<td>The Familiar Sweet Well in the Crescent and Lunar Eclipse</td>
<td>al-Azhafr, Ahmad</td>
<td>-</td>
</tr>
</tbody>
</table>
| 19        | 42769      | 390         | Gem of those Seeking to Learn the Ancients’ Dates                                | al-Burdif, 'Abd al-Rahman ibn Shams al-Hill al-Burdi
|           |            |             | tufid al-salat bi-ma'rifat tawarihi al-mutaqaddim                                  |                      | -             | 1106h              |
| 20        | 41625      | 361         | Gem of Wish Finding the Times of Asr and Zuhur                                    | al-Baqi, Muhammed ibn 'Umar ibn Qais ibn Ismail 'r
|           |            |             | tufid al-marjia fi ma'rifat swiq al-razi wa al-zur bi-ashlaim                         |                      | 1111h          | 1143h              |
| 21        | 6168       | 19          | Burdini’s Thesis for Working with Sined Quarter                                    | al-Burdivi, Ahmad ibn 'Abd Allah | -             | -                  |
| 22        | 88223      | 531         | Comprehending Astronomy                                                             | al-Burdivi, Muhammed ibn Ahmad | 440h          | -                  |
| 23        | 1027       | 1           | The Useful to the Needy in Explaining the Lamp                                   | al-Burdivi, Sahnun ibn 'Uthman ibn Sulayman ibn Aujun ibn Aujun | 11h          | -                  |
| 24        | 95616      | 546         | The Useful to the Needy in Explaining the Lamp                                    | al-Burdivi, Sahnun ibn 'Uthman ibn Sulayman ibn Aujun ibn Aujun | 11h          | 1378h              |
| 25        | 95617      | 547         | The Useful to the Needy in Explaining the Lamp                                    | al-Burdivi, Sahnun ibn 'Uthman ibn Sulayman ibn Aujun ibn Aujun | 11h          | 1016h              |
| 26        | 42756      | 377         | The Collective Thesis in Constellations and Phases                               | al-Burdivi, 'Abd ibn Melal al-Hasani | -             | -                  |
| 27        | 4362       | 12          | The Calendar Required for Time Fixing                                             | al-Daalid, 'Allu ibn Muhammad ibn Abi al-Qais ibn Ibrahim | 1078h         | 1372h              |
| 28        | 34500      | 344         | The Calendar Required for Time Fixing                                            | al-Daalid, ‘Ali ibn Muhammad ibn Abi al-Qais ibn Ibrahim | 1079h         | -                  |
| 29        | 71526      | 506         | The Knower’s Way to Quarters and Sama'                                         | al-Daalid, ‘Ali ibn Muhammad ibn Abi al-Qais ibn Ibrahim | 1079h         | -                  |
| 30        | 71515      | 495         | The Knower’s Way to Quarters and Sama’                                           | al-Daalid, ‘Ali ibn Muhammad ibn Abi al-Qais ibn Ibrahim | 1079h         | -                  |
| 31        | 95646      | 574         | Treasured Minutes with the Scales and Divisions                                  | al-Damanih, ‘Abd Allah ibn ‘Abd al-Rahman ibn Aujun | 1025h         | -                  |
| 32        | 34480      | 324         | Gem of the Soul in Dates and the Sun’s State                                      | al-Damanih, ‘Abd Allah ibn ‘Abd al-Rahman ibn ‘Abd al-
|           |            |             | jawharat al-nafs fi ma'rifat al-taufik al-musta’mal wa hal darajat al-shams            | Daarishil al-Shafi' | 1025h         | -                  |
| 33        | 34483      | 327         | Gem of the Soul in Dates and the Sun’s State                                      | al-Damanih, ‘Abd Allah ibn ‘Abd al-Rahman ibn ‘Abd al-
<p>|           |            |             | jawharat al-nafs fi ma'rifat al-taufik al-musta’mal wa hal darajat al-shams            | Daarishil al-Shafi' | 1025h         | -                  |
| 34        | 39985      | 357         | Offering Advice on Working with the Sauer                                        | al-Damanih, ‘Abd al-Latif | -             | -                  |
| 35        | 2493       | 122         | The Rising Stars in Needed Crafts for Time Working                                | al-Damanih, Muhammed ibn Abi al-Khuny al-Hassani | 10h           | 1106h              |</p>
<table>
<thead>
<tr>
<th>Serial No.</th>
<th>General No.</th>
<th>Special No.</th>
<th>Manuscript Title</th>
<th>Author</th>
<th>Date of Death</th>
<th>Transcription Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>7664</td>
<td>261</td>
<td>The Rising Stars in Needled crafts for Time Working</td>
<td>al-Dinâbâqî, Muhammad ibn Abî al-Khayr al-Ḥasanî</td>
<td>10k</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>7673</td>
<td>32</td>
<td>Omar Affarakuﬁ’s System</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1018h</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>67343</td>
<td>478</td>
<td>Omar Affarakuﬁ’s System Using Quarter Arches</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1018h</td>
<td></td>
</tr>
<tr>
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<td>67343</td>
<td>478</td>
<td>Omar Affarakuﬁ’s System Using Quarter Arches</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1018h</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>8441</td>
<td>280</td>
<td>The System of Intervening Months</td>
<td>al-Dumârî al-Mısırî, ‘Abî al-‘Azîz ibn Abû ‘Ammar ibn Sa’d</td>
<td>964h</td>
<td>1131h</td>
</tr>
<tr>
<td>44</td>
<td>8218</td>
<td>521</td>
<td>Radwan Effendi’s Records</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1123h</td>
<td>1195h</td>
</tr>
<tr>
<td>46</td>
<td>8216</td>
<td>63</td>
<td>The Canon in the Science of Time</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1123h</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>4381</td>
<td>8</td>
<td>The Styles of Stars in Solving the Gems</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1123h</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>82764</td>
<td>385</td>
<td>The Styles of Stars in Solving the Gems</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1123h</td>
<td></td>
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<tr>
<td>50</td>
<td>7602</td>
<td>27</td>
<td>The Great Flow in Learning the Calendar Cannon</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1123h</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>95528</td>
<td>558</td>
<td>Compendium of Simple Astronomy</td>
<td>al-Dumârî al-Mısırî, ‘Umar ibn Muhammad ibn Abî Bakr al-Farâbî</td>
<td>1123h</td>
<td></td>
</tr>
<tr>
<td>Serial No.</td>
<td>General No.</td>
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<td>Manuscript Title</td>
<td>Author</td>
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<td>4540</td>
<td>13</td>
<td>Mathematics of AbuHamid Alghazali</td>
<td>al-Ghazali, Abu Hamid Muhammad Ibn Muhammad Al-Ghazali</td>
<td>500th</td>
<td>-</td>
</tr>
<tr>
<td>55</td>
<td>82225</td>
<td>533</td>
<td>The Absent Sine</td>
<td>al-Ghazali, Muhammad Ibn Muhammad</td>
<td>754th</td>
<td>-</td>
</tr>
<tr>
<td>56</td>
<td>95636</td>
<td>566</td>
<td>Gem of Love to Reveal all Desired in Quarter Sines</td>
<td>al-Hasani, ‘Ali Ibn Fami</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>57</td>
<td>42763</td>
<td>384</td>
<td>A Thesis on Fixing of New Arabic Months and Years</td>
<td>al-Hasani, Almad</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>58</td>
<td>53665</td>
<td>423</td>
<td>The Bright Lights and Time Reckoning</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>1240th</td>
<td>111th</td>
</tr>
<tr>
<td>59</td>
<td>83347</td>
<td>1722</td>
<td>The Bright Lights and Time Reckoning</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>60</td>
<td>42112</td>
<td>859</td>
<td>A Book of Astronomy and Time Fixing</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>61</td>
<td>34779</td>
<td>752</td>
<td>Ascending Ladder in Phases and Constellations</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>1225th</td>
<td>-</td>
</tr>
<tr>
<td>62</td>
<td>71531</td>
<td>511</td>
<td>The Moving Planets; Times and Distances</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>63</td>
<td>53668</td>
<td>426</td>
<td>The Flower Garden in the Works of Day and Night</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>64</td>
<td>42759</td>
<td>380</td>
<td>The Truths about Sheets and Sheets about the Truths</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>65</td>
<td>88225</td>
<td>536</td>
<td>Introduction to the Science of Prediction of Stars</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>66</td>
<td>95645</td>
<td>573</td>
<td>Pole of the Lights from the Flower Garden</td>
<td>al-Briadi, Muhammad Ibn Sadiq</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>67</td>
<td>95642</td>
<td>572</td>
<td>Gazali Footnote on Alphonse Astronomy</td>
<td>al-Afandi, Muhammad Ibn Abu al-Hasan</td>
<td>1124th</td>
<td>-</td>
</tr>
<tr>
<td>68</td>
<td>8180</td>
<td>60</td>
<td>Radwan Effendi’s Time Fixing Summary</td>
<td>al-Jahmishi, Muhammad Ibn Muhammad</td>
<td>1124th</td>
<td>-</td>
</tr>
<tr>
<td>69</td>
<td>88225</td>
<td>533</td>
<td>Alghamidi’s Exposition of a Book in Astronomy</td>
<td>al-Jahmishi, Muhammad Ibn Muhammad</td>
<td>1124th</td>
<td>-</td>
</tr>
<tr>
<td>70</td>
<td>88225</td>
<td>533</td>
<td>A Short Thesis on the Absent Sine</td>
<td>al-Jahmishi, Muhammad Ibn Muhammad</td>
<td>1124th</td>
<td>-</td>
</tr>
<tr>
<td>71</td>
<td>88225</td>
<td>533</td>
<td>Compendium on Working with Quarters on Circles</td>
<td>al-Jahmishi, Muhammad Ibn Muhammad</td>
<td>1124th</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
- The table contains entries for various manuscripts and authors, with details about the manuscripts and the authors' dates of death.
- The manuscripts cover a range of topics including mathematics, astronomy, and astrology, with titles such as "Mathematics of AbuHamid Alghazali," "The Absent Sine," and "A Thesis on Fixing of New Arabic Months and Years."
- The authors are listed with their dates of death, which range from 500th to 1240th.
- The transcription dates are indicated, with some entries marked as "-" indicating no specific date given.

**Additional Information:**
- The list includes entries for "al-Dimashqi, Muhammad Ibn Abu al-Khayr al-Jassasil" and "al-Dimashqi, Muhammad Ibn Abu al-Khayr al-Jassasil" with dates of death and no specific transcription dates provided.
- The "Time Fixing" entry includes "al-Dimashqi, Muhammad Ibn Abu al-Khayr al-Jassasil" with a transcription date of "1024th."
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<th>Serial No.</th>
<th>General No.</th>
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<th>Manuscript Title</th>
<th>Author</th>
<th>Date of Death</th>
<th>Transcription Date</th>
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<tr>
<td>72</td>
<td>34476</td>
<td>320</td>
<td>Calendar of Moving Planets in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī</td>
<td></td>
<td>955h</td>
</tr>
<tr>
<td>73</td>
<td>67045</td>
<td>480</td>
<td>Planets Marking the New Year of 1139h</td>
<td>al-khawānī, Ramanūn ibn Sāliḥ ibn ‘Umar ibn Ijāzī</td>
<td>1158h</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>42758</td>
<td>379</td>
<td>Al-Khulaj’s Exposition of the Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>45606</td>
<td>397</td>
<td>Al-Khulaj’s Exposition of the Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td>1249h</td>
</tr>
<tr>
<td>76</td>
<td>14478</td>
<td>292</td>
<td>Al-Khulaj’s Exposition of the Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>42753</td>
<td>374</td>
<td>Al-Khulaj’s Exposition of the Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>45605</td>
<td>396</td>
<td>Al-Khulaj’s Exposition of Al-Khulaj’s Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>34491</td>
<td>335</td>
<td>Al-Khulaj’s Exposition of Al-Khulaj’s Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td>1249h</td>
</tr>
<tr>
<td>80</td>
<td>71520</td>
<td>500</td>
<td>Al-Khulaj’s Exposition of Al-Khulaj’s Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td>1308h</td>
</tr>
<tr>
<td>81</td>
<td>27591</td>
<td>554</td>
<td>Al-Khulaj’s Exposition of Al-Khulaj’s Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khaṭṭābī, Muḥammad al-Khaṭṭābī al-Dimyāṭī al-Shāfī</td>
<td>1208h</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>8161</td>
<td>1385</td>
<td>Exposition of the Seven Signs in the Kawkab al-Nayyira</td>
<td>al-Khulaj’s Exposition</td>
<td></td>
<td></td>
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<tr>
<td>83</td>
<td>88249</td>
<td>537</td>
<td>Working Difference in Proximity Year</td>
<td>al-Kuṭaimī, Muḥammad al-Kuṭaimī al-Shāfī</td>
<td>1025h</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>34499</td>
<td>343</td>
<td>Working Difference in Proximity Year</td>
<td>al-Kuṭaimī, Muḥammad al-Kuṭaimī al-Shāfī</td>
<td>1025h</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>59409</td>
<td>461</td>
<td>End-Thought in the Works of Days and Nights</td>
<td>al-Lādiḥāqī, Muḥammad ibn Muḥammad</td>
<td>1218h</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>28988</td>
<td>317</td>
<td>End-Thought in the Works of Days and Nights</td>
<td>al-Lādiḥāqī, Muḥammad ibn Muḥammad</td>
<td>1040h</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>28988</td>
<td>317</td>
<td>The Soul Desire to Solve the Sun</td>
<td>al-Lādiḥāqī, Muḥammad ibn Muḥammad</td>
<td>1077h</td>
<td></td>
</tr>
<tr>
<td>Serial No.</td>
<td>General No.</td>
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<td>Date of Death</td>
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<td>----------------</td>
<td>--------</td>
<td>---------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>88</td>
<td>88225</td>
<td>533</td>
<td>A Thesis on the Sined Quarter Arcches</td>
<td>al-Māridnī, Jamāl al-Dīn Abī al-Allāh</td>
<td>843h</td>
<td>-</td>
</tr>
<tr>
<td>89</td>
<td>23153</td>
<td>510</td>
<td>Exposition of the Sun (Lamp) in Astronomy</td>
<td>al-Maghzībī, Abī al-Relāmin ibn Muhammad ibn Jamīr al-Akdharī</td>
<td>983h</td>
<td>-</td>
</tr>
<tr>
<td>90</td>
<td>34479</td>
<td>323</td>
<td>Journal of Astronomical Numbers for Tan Fixing</td>
<td>al-Mafīrī, Abī Abī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>91</td>
<td>4540</td>
<td>13</td>
<td>The Uranus System in Solar and Lunar Phases</td>
<td>al-Manāwī, Abī Abī</td>
<td>1048h</td>
<td>1079h</td>
</tr>
<tr>
<td>92</td>
<td>112887</td>
<td>624</td>
<td>Some Good Benefits Taken from Elegant Books</td>
<td>al-Maqrīzī, Abī al-īsm Muhammad zayn al-Fawārī</td>
<td>1290h</td>
<td>-</td>
</tr>
<tr>
<td>93</td>
<td>34500</td>
<td>344</td>
<td>Guiding the Beginner and Remider of the Ultimate</td>
<td>al-Maqrīzī, Abī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>94</td>
<td>8178</td>
<td>272</td>
<td>Collection of Principles and End Goals</td>
<td>al-Murākhiṣānī, Abī Abī Abī</td>
<td>7h</td>
<td>-</td>
</tr>
<tr>
<td>95</td>
<td>7657</td>
<td>28</td>
<td>The Congregation of Principles and Xena as Operations</td>
<td>al-Murākhiṣānī, Abī</td>
<td>7h</td>
<td>-</td>
</tr>
<tr>
<td>96</td>
<td>4383</td>
<td>10</td>
<td>Meeting of the Two Seas in Using the Sinin Calendar</td>
<td>al-Mansī, Yūsuf ibn Muhammad</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>97</td>
<td>95632</td>
<td>562</td>
<td>Ahla Hinda's Exhibition of the Madi Flower Garden</td>
<td>Abī Sirāzjādī, Abī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>98</td>
<td>95632</td>
<td>562</td>
<td>A Thesis on Time Fixing</td>
<td>Abī Sirāzjādī, Abī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>99</td>
<td>7605</td>
<td>31</td>
<td>Papers on Working with the Quarter Arcches</td>
<td>al-Miṣrī, Abī Abī Abī</td>
<td>109h</td>
<td>989h</td>
</tr>
<tr>
<td>100</td>
<td>71510</td>
<td>490</td>
<td>Gem of Wishes Explaining the Beginners Way</td>
<td>Abī</td>
<td>1273h</td>
<td>1295h</td>
</tr>
<tr>
<td>101</td>
<td>47275</td>
<td>378</td>
<td>Gem of Wishes Explaining the Beginners Way</td>
<td>Abī, Abī</td>
<td>1273h</td>
<td>-</td>
</tr>
<tr>
<td>102</td>
<td>6168</td>
<td>19</td>
<td>Al-Muṣṭaṣ's Thesis on the Astrolobe</td>
<td>Abī, Abī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>103</td>
<td>65513</td>
<td>476</td>
<td>Al-Muṣṭaṣ's Thesis on the Astrolobe</td>
<td>Abī, Abī</td>
<td>730h</td>
<td>1052h</td>
</tr>
<tr>
<td>104</td>
<td>7668</td>
<td>30</td>
<td>Explanation of the Hidden in Operations with the Sine Quadrant</td>
<td>Abī, Abī</td>
<td>730h</td>
<td>1128h</td>
</tr>
<tr>
<td>105</td>
<td>6168</td>
<td>19</td>
<td>The Flowering Gardens in the Working of the Quarter Arcches</td>
<td>Abī, Abī</td>
<td>730h</td>
<td>1046h</td>
</tr>
<tr>
<td>106</td>
<td>8174</td>
<td>56</td>
<td>Satisfying the Brief and Spomoting the Zealous</td>
<td>Abī, Abī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Serial No</td>
<td>General No</td>
<td>Special No</td>
<td>Manuscript Title</td>
<td>Author</td>
<td>Date of Death</td>
<td>Transcription Date</td>
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<tr>
<td>107</td>
<td>8179</td>
<td>59</td>
<td>The Wealth of the Clever in Solving the Calendar ghayrat al-falām wa al-ṭarīq li-ḥall al-qaqālīm</td>
<td>al-Mujāhid, Aḥmad ibn ‘Abd al-Fattāḥ ibn Yūsuf ibn ‘Umar al-Mahdī</td>
<td>1181h</td>
<td>-</td>
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<tr>
<td>109</td>
<td>42752</td>
<td>373</td>
<td>Table Naming the Twelve Houses on New Records jadwal tamniyat al-bayāt al-sīrāh ‘an ‘arād al-ṣaḥīf al-jāfīd</td>
<td>al-Munṣūfī, ‘Abd al-Qādir ibn Muḥammad</td>
<td>997h</td>
<td>-</td>
</tr>
<tr>
<td>110</td>
<td>92489</td>
<td>1817</td>
<td>A Thesis on Astronomy and Time Fixing risāla‘ al-falāk wa al-miqāṣ</td>
<td>al-Munṣūfī, Abī ‘Abd al-Allāh</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>112</td>
<td>5472</td>
<td>223</td>
<td>Key of the Needy to Planets and Constellations ma‘rifat al-qibāl al-muḥāfiq fī ma‘rifat manzil al-ṣams wa-al-ṣa‘īf</td>
<td>al-Munṣūfī, Abī ‘Abd Allāh ibn ‘Allī ibn ‘Uthmān ibn Dawūd ibn Abī Mi‘īsī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>113</td>
<td>12976</td>
<td>368</td>
<td>The Bright Planets in Fixing the New Months al-kawākib al-arabiyyah fīna thabat bih aswāf al-shahīr al-arabiyyah</td>
<td>al-Nūḥ al-Falākī, Muḥammad ibn ‘Abd al-Raḥmān</td>
<td>1285h</td>
<td>1320h</td>
</tr>
<tr>
<td>114</td>
<td>42765</td>
<td>386</td>
<td>Revealing the Veil on the Guide to Scholars khasf al-ḥiyāt ‘an mursīd al-ṣuflīh</td>
<td>al-Nūḥ al-Falākī, Muḥammad ibn ‘Abd al-Raḥmān</td>
<td>1285h</td>
<td>1280h</td>
</tr>
<tr>
<td>115</td>
<td>28898</td>
<td>317</td>
<td>End-Thought in the Works of Days and Nights naḏrāt al-afkār fī al-māl al-ḥayl wa al-mabīr</td>
<td>al-Nūḥ al-Falākī, Muḥammad ibn ‘Abd al-Raḥmān</td>
<td>1285h</td>
<td>-</td>
</tr>
<tr>
<td>118</td>
<td>42754</td>
<td>375</td>
<td>Ibn Younus’s Exposition of Ibn Alhabba’k System sharḥ Muḥammad ibn Yūsuf ‘alā muṣarrat ibn al-Habīb al-muṣarrat bi-ghayrat al-ṣuflīh ‘ilm al-ṣuflīh</td>
<td>al-Nūḥ al-Falākī, Muḥammad ibn ‘Abd al-Raḥmān</td>
<td>1185h</td>
<td>-</td>
</tr>
<tr>
<td>119</td>
<td>34580</td>
<td>344</td>
<td>The Gem of Judges tawfiq al-ṣuflīh</td>
<td>al-Nūḥ, Muḥammad ibn Yūsuf</td>
<td>904h</td>
<td>-</td>
</tr>
<tr>
<td>120</td>
<td>34499</td>
<td>343</td>
<td>A Thesis on Lunar Eclipse risāla‘ ‘amal al-khawāf al-qamār</td>
<td>al-Nāṣir, Miḥrāb ibn Miḥrāb al-Muhandīs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>121</td>
<td>42105</td>
<td>371</td>
<td>Arabic - Translated 1243 H mu‘arrab in 1243 H</td>
<td>al-Qābānī, Khādir ibn ‘Abd al-Qādir</td>
<td>1069h</td>
<td>1078h</td>
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<tr>
<td>122</td>
<td>7410</td>
<td>23</td>
<td>Guide from Fallacy in Knowing the Timekeeping and Determining Qiblah and Related Matter with Instruments / al-kitāb bi-nu‘mat al-qiblātā fī mu‘rifat al-ṣawāt wā al-qiblāh wa-ma yawz al-ḥijām min ghuyr al-ḥāṣi</td>
<td>al-Qābānī, Si‘d ‘Almah</td>
<td>1069h</td>
<td>-</td>
</tr>
<tr>
<td>123</td>
<td>1942</td>
<td>6</td>
<td>Guide from Fallacy in Knowing the Timekeeping and Determining Qiblah and Related Matter with Instruments / al-kitāb bi-nu‘mat al-qiblātā fī mu‘rifat al-ṣawāt wā al-qiblāh wa-ma yawz al-ḥijām min ghuyr al-ḥāṣi</td>
<td>al-Qābānī, Aḥmad ibn Aḥmad ibn Sallān</td>
<td>1069h</td>
<td>1078h</td>
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<tr>
<td>Serial No.</td>
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<td>124</td>
<td>34006</td>
<td>350</td>
<td>Guide from Fallacy in Knowing the Timekoping and Determining Qiblah and Related Matter without Instruments - al-hijayah min al-qiblah fi ma‘rifat al-mawqif wa al-qiblah wa ma yata‘ala qabliha min ghayr al-ikhah</td>
<td>al-Qayyūbī, Ahmad ibn Ahmad ibn Sakāmah</td>
<td>1069h</td>
<td>1129h</td>
</tr>
<tr>
<td>125</td>
<td>41629</td>
<td>365</td>
<td>Guide from Fallacy in Knowing the Timekoping and Determining Qiblah and Related Matter without Instruments - al-hijayah min al-qiblah fi ma‘rifat al-mawqif wa al-qiblah wa ma yata‘ala qabliha min ghayr al-ikhah</td>
<td>al-Qayyūbī, Ahmad ibn Ahmad ibn Sakāmah</td>
<td>1069h</td>
<td>-</td>
</tr>
<tr>
<td>126</td>
<td>95651</td>
<td>581</td>
<td>The Council’s Thesis Adopting Sunna System risalat al-bayyāh ‘alā ‘arrajat abl al-sunnah</td>
<td>al-Qarānī, Ibrāhīm</td>
<td>1064h</td>
<td>-</td>
</tr>
<tr>
<td>127</td>
<td>8171</td>
<td>274</td>
<td>The Qasays’s Thesis in Astronomy risalat al-Qasays fi al-falak</td>
<td>al-Qaṣṣāfī, ‘Abd al-Haflin ibn Muhammad al-Hasanī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>128</td>
<td>8441</td>
<td>280</td>
<td>The Pointer of Rises ḍarab al-mañfīl</td>
<td>al-Qaṣṣāfī, ‘Abd al-Haflin ibn Muhammad al-Hasanī</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>130</td>
<td>4381</td>
<td>8</td>
<td>Al-Qasims’s Exposition of Ibn Abū-Zīgī’s Thesis sharḥ Yūsūf al-Raṣāfī ‘alā risalat al-mu‘ājad fi al-amāl bi-rub‘ al-muṣaqārat</td>
<td>al-Raṣāfī, Yūsūf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>1023h</td>
<td>-</td>
</tr>
<tr>
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<td>6188</td>
<td>19</td>
<td>The End Question Clearing the Ten Time Fising Chapters ghayr al-ṣāli fi sharḥ al-sharafus fī sharḥ al-tawṣīq</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>1026h</td>
<td>-</td>
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<tr>
<td>132</td>
<td>23147</td>
<td>504</td>
<td>The End Question Clearing the Ten Time Fising Chapters ghayr al-ṣāli fi sharḥ al-sharafus fī sharḥ al-tawṣīq</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>1026h</td>
<td>1113h</td>
</tr>
<tr>
<td>133</td>
<td>4386</td>
<td>32</td>
<td>The Share in Solving the Seven Planets Al-lam‘ah fi al-sab‘ah (al-lam‘ah fi al-sab‘ah)</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>935h</td>
<td>-</td>
</tr>
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<td>134</td>
<td>7421</td>
<td>24</td>
<td>The Share in Solving the Seven Planets Al-lam‘ah fi al-sab‘ah (al-lam‘ah fi al-sab‘ah)</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>936h</td>
<td>-</td>
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<tr>
<td>135</td>
<td>27526</td>
<td>314</td>
<td>The Share in Solving the Seven Planets Al-lam‘ah fi al-sab‘ah (al-lam‘ah fi al-sab‘ah)</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>936h</td>
<td>-</td>
</tr>
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<td>136</td>
<td>71513</td>
<td>493</td>
<td>The Share in Solving the Seven Planets Al-lam‘ah fi al-sab‘ah (al-lam‘ah fi al-sab‘ah)</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>936h</td>
<td>1302h</td>
</tr>
<tr>
<td>137</td>
<td>41630</td>
<td>366</td>
<td>The Seekers’ Tool in Day and Night Time Calculations waṣṣalat al-calā‘ih li-l-ayn wa al-nahār bi-ṭarāq al-halāb</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>995</td>
<td>-</td>
</tr>
<tr>
<td>138</td>
<td>53671</td>
<td>429</td>
<td>The Seekers’ Tool in Day and Night Time Calculations waṣṣalat al-calā‘ih li-l-ayn wa al-nahār bi-ṭarāq al-halāb</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>995</td>
<td>1197h</td>
</tr>
<tr>
<td>139</td>
<td>45616</td>
<td>16</td>
<td>Qādī Zadā’s Exposition of Al-ṣaḥḥāmah’s Summary sharḥ qādī zādā fī ’l-al-muhālikhāt li-jumahihim li-fim al-man‘ah</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>1232h</td>
<td>1245h</td>
</tr>
<tr>
<td>140</td>
<td>8177</td>
<td>274</td>
<td>A Thesis on Astronomy risalat al-falak</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>1170h</td>
<td>-</td>
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<tr>
<td>141</td>
<td>8177</td>
<td>58</td>
<td>The Rise of Lustre and the Hiding of what was Evil in the-charity wa kifūn mī fī mār‘ibyya</td>
<td>al-Raṣāfī, Yūsuf ibn Yūsuf ibn ’Abd al-Qaṣīm ibn Ahmad al-Aḥbarī</td>
<td>995</td>
<td>1197h</td>
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<tr>
<td>Serial No.</td>
<td>General No.</td>
<td>Special No.</td>
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<td>142</td>
<td>95033</td>
<td>563</td>
<td>Students' Delight in the Science of the Astrolabe</td>
<td>al-Radînî, Muhammad ibn Muhammad ibn Bâyqânî ibn Al-Hasan ibn Al-Hasan</td>
<td>1940b</td>
<td>-</td>
</tr>
<tr>
<td>143</td>
<td>112888</td>
<td>625</td>
<td>Mind's Delight in the Science of the Astrolabe</td>
<td>al-Saâfîrî, Abû al-Qâsim al-Saâfîrî al-Hasanî</td>
<td>1940b</td>
<td>-</td>
</tr>
<tr>
<td>144</td>
<td>4386</td>
<td>12</td>
<td>Students' Gem in Working with the Astrolabe</td>
<td>al-Sâbânî, Muhammad ibn 'Abd Allâh ibn Fadl al-Fâhshâl al-Saâfîrî</td>
<td>336b</td>
<td>-</td>
</tr>
<tr>
<td>145</td>
<td>71597</td>
<td>487</td>
<td>Benefits Gained in Sines and Arcs</td>
<td>al-Sâbânî, Muhammad ibn 'Abd Allâh ibn Fadl al-Fâhshâl al-Saâfîrî</td>
<td>1210b</td>
<td>-</td>
</tr>
<tr>
<td>146</td>
<td>28898</td>
<td>317</td>
<td>Reaching the Goal in Working with the Moon</td>
<td>al-Sâfîrî, Abû al-Fadl al-Saâfîrî</td>
<td>376</td>
<td>-</td>
</tr>
<tr>
<td>147</td>
<td>48997</td>
<td>411</td>
<td>Images of Fixed Stars</td>
<td>al-Sâfîrî, Abû al-Rahmân ibn 'Umar ibn Muhammad ibn Sâlih al-Saâfîrî</td>
<td>376</td>
<td>-</td>
</tr>
<tr>
<td>148</td>
<td>8159</td>
<td>1384</td>
<td>Revealing Absent Astrolabe Wonders</td>
<td>al-Sâfîrî, Abû al-Rahmân ibn 'Umar ibn Muhammad ibn Sâlih al-Saâfîrî</td>
<td>376</td>
<td>-</td>
</tr>
<tr>
<td>149</td>
<td>4382</td>
<td>9</td>
<td>Zenith Tables</td>
<td>al-Sâfîrî, Abû al-Rahmân ibn 'Umar ibn Muhammad ibn Sâlih al-Saâfîrî</td>
<td>376</td>
<td>-</td>
</tr>
<tr>
<td>150</td>
<td>4382</td>
<td>9</td>
<td>Tables of Circle Remains</td>
<td>al-Sâfîrî, Abû al-Rahmân ibn 'Umar ibn Muhammad ibn Sâlih al-Saâfîrî</td>
<td>376</td>
<td>-</td>
</tr>
<tr>
<td>151</td>
<td>4386</td>
<td>12</td>
<td>Teaching Style in Working with the Moon</td>
<td>al-Sâfîrî, Râma'dân ibn Sâlih ibn 'Umar ibn 'Umar ibn al-Hussânî</td>
<td>1156a</td>
<td>1093b</td>
</tr>
<tr>
<td>152</td>
<td>4386</td>
<td>12</td>
<td>Teaching Style in Working with the Moon</td>
<td>al-Sâfîrî, 'Abd al-Rahmân</td>
<td>1156a</td>
<td>1093b</td>
</tr>
<tr>
<td>153</td>
<td>5523</td>
<td>17</td>
<td>Teaching Style in Working with the Moon</td>
<td>al-Sâfîrî, 'Abd al-Rahmân</td>
<td>1156a</td>
<td>1093b</td>
</tr>
<tr>
<td>154</td>
<td>42112</td>
<td>859</td>
<td>Speaker's Delight in the Rules of Mounting Events</td>
<td>al-Shâbârîshâlî, Muhammad ibn 'Ali ibn Muhammad ibn 'Ali al-Shâbârîshâlî</td>
<td>1021b</td>
<td>-</td>
</tr>
<tr>
<td>155</td>
<td>21313</td>
<td>510</td>
<td>Shining Planets in Placing Planets and Horizontal Shifts</td>
<td>al-Shâbârîshâlî, Muhammad ibn 'Ali al-Shâbârîshâlî</td>
<td>1071b</td>
<td>-</td>
</tr>
<tr>
<td>156</td>
<td>34452</td>
<td>326</td>
<td>The Magnificent Paths in Working with al-Quarâr Anubis in all Directions</td>
<td>al-Shârîfî al-Yamânî, Muhammad ibn Muhammad ibn Sâlih ibn Muhammad al-Râfî</td>
<td>1055b</td>
<td>-</td>
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<td>157</td>
<td>41627</td>
<td>363</td>
<td>The Silk Sense in Time Keeping by Geometry</td>
<td>al-Shâbârîshâlî, Muhammad ibn 'Ali ibn Muhammad ibn 'Ali al-Shâbârîshâlî</td>
<td>1021b</td>
<td>-</td>
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<td>158</td>
<td>28996</td>
<td>315</td>
<td>Guiding the Open Eyed to Parts of the Day and Night</td>
<td>al-Sâlihî al-Asâfîrî, 'Abd al-Asâfîrî al-Asâfîrî</td>
<td>1197b</td>
<td>-</td>
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<td>159</td>
<td>53670</td>
<td>428</td>
<td>Guiding the Open Eyed to Parts of the Day and Night</td>
<td>al-Sâlihî al-Asâfîrî, 'Abd al-Asâfîrî al-Asâfîrî</td>
<td>1197b</td>
<td>-</td>
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<td>The Hidden Gem and Desired Kept Secret</td>
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- er: al-Saaji, Ibraham ibn Ahmad ibn Muhammad al-Saaji' al-Badrawi
- Al-fakih al-Qadhi al-Qadhi
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<td>Thesis on Questions Related to Qehba</td>
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<td>Tijûrî's Thesis on Working with Quarter Arches</td>
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<td>Tajaddud's Thesis on the Four Seasons and Prayers Times</td>
<td>al-Tajjālī, Abd al-Rahmān ibn Muḥammad ibn Ahmad</td>
<td>999h</td>
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<td>Alsenoussi's Exposition of Ibn Alihbbak's System</td>
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<td>Thesis of Bīrām the Third on the Roundness of Earth</td>
<td>al-Tūmālī, Muḥammad ibn al-Thālibī ibn Muḥammad ibn Muḥammad ibn Husayn b. al-Wāfī</td>
<td>1259h</td>
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<td>A Thesis on Working with the Triangle</td>
<td>al-Wāfī, 'Ir al-Dīn</td>
<td>-</td>
<td>-</td>
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<td>88225</td>
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<td>The Equatorial Arches</td>
<td>al-Wāfī al-Fāsālī, 'Abd al-'Azīz ibn Muḥammad</td>
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<td>The System of Arches with Hours on the Vertical Pole</td>
<td>al-Wāfī al-Fāsālī, 'Abd al-'Azīz ibn Muḥammad</td>
<td>879h</td>
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<td>Circle of the Adjusted</td>
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<td>879h</td>
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<td>The Bright Stars in Working with the Quarter Arches</td>
<td>al-Wāfī, 'Abd al-'Azīz ibn Muḥammad</td>
<td>879h</td>
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<td>Wallet's Thesis on Timing of Haj Applying Alms to the Arches</td>
<td>al-Wāfī, 'Abd al-'Azīz ibn Muḥammad</td>
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<td>Comprehensive Treasury (Turkish)</td>
<td>al-Zarwālī, 'Abd al-Malik ibn Muḥammad ibn 'Uṯmān</td>
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<td>-</td>
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<td>A Useful System in Solar Shifting</td>
<td>al-Zarwālī, Muḥammad ibn Muḥammad</td>
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<td>The Compendium on Reduced Quarter Arch’s Timing</td>
<td>Fāyād Allāh, Shahr Zādāh</td>
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<td>The Beginning of Nama (Turkish)</td>
<td>Ḥafṣūn al-Ḥasan</td>
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<td>Ibn Amuqāz’s Thesis in the Astrolabe</td>
<td>Ibn ’Amīd, Abī al-Ḥasan, Abī al-Rāqī</td>
<td>-</td>
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<td>Esposition of Ibn Abī’l-jal’s System</td>
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<td>Fresh &amp; Sweet Source on Phenomena of the Planets and Visibility of the Crescent</td>
<td>Ibn al-Majīlī, Abīnāb ibn Rābah al-Mūdhghā</td>
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<td>The Compendium on in Fixing Time and New Moon</td>
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<td>Two Chapters on Work with the Quarter Arches to Know the Time and Qibla</td>
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<td>The Magdāli Thesis in the Working of the Quarter Arches</td>
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<td>850h</td>
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<td>A Treatise on Operations with the Quadrant and the Alhament of the Quadrant</td>
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<td>-</td>
<td>850h</td>
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<td>The Flowering Garden in the Working of the Covered Quarter</td>
<td>Ibn al-Majīlī, Abīnāb ibn Rābah al-Mūdhghā</td>
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<td>Guidebook for the Pupil to Equations of Planets and the Distances and Intervals</td>
<td>Ibn al-Banīl al-Māri Khālīḥ, Abīnāb ibn Muḥammad ibn ’Uthmān al-Adwāf</td>
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<td>93649</td>
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<td>The Science in Calculations of Distances</td>
<td>Ibn al-Hāfīz al-Māri Khālīḥ, Abīnāb ibn Muḥammad ibn ’Uthmān al-Adwāf</td>
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<td>14485</td>
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<td>Full Moons Rise in Converting the Months and Years</td>
<td>Ibn al-Ḥaṭṣamī, Abīnāb ibn Muḥammad ibn ’Umar ibn Muḥārak ibn ’Abd Allāh al-Ḥasan</td>
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120
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<th>Date of Death</th>
<th>Transcription Date</th>
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<td>231</td>
<td>88225</td>
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<td>The Gem of Friends in Fixing Almehrab</td>
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<td>59408</td>
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<td>The Magician’s Thesis in the Working of the Quarter Arches risalah</td>
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<td>850th</td>
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<td>95028</td>
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<td>Door Locks in Collective Astrolobe Science</td>
<td>Ibn al-Ra'isan Muhammad ibn Ibrahim ibn 'Ali al-Masri al-Sufi</td>
<td>715th</td>
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<td>Ripe Fruits of the Universal Tool</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
<td>777th</td>
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<td>Explanation of the Hidden on Operations with the Absent Quadrant</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
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<td>1157th</td>
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<td>Thesis of Ibn El-Shater in Fundamentals of the Astrolobe risalah</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
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<td>67042</td>
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<td>A Thesis on the Fourth Work of the Triangle risalah fi al-'amal bi-al-ruh’ al-mathal al-Din</td>
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<td>The Common Good in Working the Complete Quarter for Time Fixing al-ma'in al-'ilm bi-al-ruh’ al-Din</td>
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<td>A Thesis on Working with the Winged Quarter risalah</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
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<td>34505</td>
<td>339</td>
<td>Summary of Ibn al-Siraj</td>
<td>Ibn al-Shatir</td>
<td>1105th</td>
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<td>243</td>
<td>11088</td>
<td>340</td>
<td>Arranged Pearls in the Wire of Apt Quarter Circle</td>
<td>Ibn al-Shatir</td>
<td>1075th</td>
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<tr>
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<td>556</td>
<td>Ibn Qura'man’s Thesis in Placing the Lines risalah</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
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<td>95029</td>
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<td>Astronomical Tables</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
<td>777th</td>
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<td>246</td>
<td>5328</td>
<td>18</td>
<td>Healing of Disease by Drawing Bone (InLine) on Walls and Sundials shufi al-ajmín fi waqf al-'áli</td>
<td>Ibn al-Shatir, 'Ali ibn Ibrahim ibn Muhammad al-Ansari</td>
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<td>8167</td>
<td>50</td>
<td>Kushyar’s Thesis in the Working of Sundials risalah</td>
<td>Kushyar, Abu al-Jussan</td>
<td>590th</td>
<td>-</td>
</tr>
<tr>
<td>248</td>
<td>8170</td>
<td>53</td>
<td>Kushyar’s Thesis in the Working of Sundials risalah</td>
<td>Kushyar, Abu al-Jussan</td>
<td>590th</td>
<td>-</td>
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<tr>
<td>249</td>
<td>7658</td>
<td>29</td>
<td>The Mirror of Wonders in Using the Common Sines mir'ah al-'ayyin fi al-'amal bi-al-yalib</td>
<td>Mahamid ibn A'lim ibn Muhammad al-Huji</td>
<td>1118th</td>
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<td>General No.</td>
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<td>250</td>
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<td>533</td>
<td>Mu'lla Jam'i's Thesis in Philosophy</td>
<td>Mu'lla b. 'Abd al-Qadir</td>
<td>-</td>
<td>-</td>
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<td>251</td>
<td>88225</td>
<td>533</td>
<td>Mulla Jahlaby's Proposition of the Short Ephemeris al-sharh mulkijahabi 'ala mithihr sur al-dajj</td>
<td>Mu'lla Jahlabi, Muhammad ibn 'all al-Annabi</td>
<td>-</td>
<td>-</td>
</tr>
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<td>252</td>
<td>71532</td>
<td>513</td>
<td>Collection of Astronomical Rulings al-majmu'at mash'al falsakyyah</td>
<td>Qusim, Ahmad Hilmii</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>253</td>
<td>39984</td>
<td>356</td>
<td>A Thesis on Working with the Quarter Arches risalih fi 'ala-an'al bi-rabi' al-muqanfisat</td>
<td>Shihab al-Din, Ahmad ibn Muhammad</td>
<td>-</td>
<td>1175h</td>
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<td>254</td>
<td>67044</td>
<td>499</td>
<td>Revealing the Secrets in Bisected Quarter yath al-stru al-mawdud fi 'ala-an'al bi-rabi' al-maqiy</td>
<td>Sibt al-Muradi, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
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<td>14486</td>
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<td>Revealing the Secrets in Bisected Quarter yath al-stru al-mawdud fi 'ala-an'al bi-rabi' al-maqiy</td>
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<td>The Fine Trinads in Marking the Scales and Minutes raqiq al-haqiq fi 'hisb al-durar wa al-daiqu</td>
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<td>The Golden Style to Work with the Sined Quarter al-stru al-madhathb fi 'ala-an'al bi-rabi' al-maqiy</td>
<td>Sibt al-Muradi, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
<td>1301h</td>
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<td>556</td>
<td>The Shining Methods to Work with Sixtieth Ratios al-tawq al-saniyah fi 'ala-anal bi-l-nishab al-sultaniyyah</td>
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<td>912h</td>
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<td>al-Fadiyah (Treatise of Fad') al-Dira</td>
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<td>342</td>
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<td>A Thesis on the Sines Questions risalah fi al-ma'sil al-jaybyiyah</td>
<td>Sibt al-Mardini, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
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<td>291</td>
<td>39984</td>
<td>356</td>
<td>Sufficient Satisfaction on Operations with Truncated Northern Quadrant kifayat al-qanu' fi al-'amal bi-al-rub' al-shami'li al-ma'siqi</td>
<td>Sibt al-Mardini, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
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<td>226</td>
<td>Sufficient Satisfaction on Operations with Truncated Northern Quadrant kifayat al-qanu' fi al-'amal bi-al-rub' al-shami'li al-ma'siqi</td>
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<td>Sufficient Satisfaction on Operations with Truncated Northern Quadrant kifayat al-qanu' fi al-'amal bi-al-rub' al-shami'li al-ma'siqi</td>
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<td>Sufficient Satisfaction on Operations with Truncated Northern Quadrant kifayat al-qanu' fi al-'amal bi-al-rub' al-shami'li al-ma'siqi</td>
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<td>1817</td>
<td>Sufficient for Satisfaction on Operations with Truncated Northern Quadrant kifayat al-qanu' fi al-'amal bi-al-rub' al-shami'li al-ma'siqi</td>
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<td>912h</td>
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<td>296</td>
<td>34837</td>
<td>331</td>
<td>Collecting the Gems in Fixing Lines and Circles luqat al-daw'ir fi tahdīf al-khurāj wa al-daw'ir</td>
<td>Sibt al-Mardini, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
<td>1233h</td>
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<td>Collecting the Gems in Fixing Lines and Circles luqat al-daw'ir fi tahdīf al-khurāj wa al-daw'ir</td>
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<td>912h</td>
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<td>1225h</td>
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<td>301</td>
<td>34949</td>
<td>343</td>
<td>Introduction to Almamyr Sibii in Working with the Hidden Quarter muṣūd in al-'amal bi-al-rub' al-mansūr</td>
<td>Sibt al-Mardini, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
<td>1133h</td>
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<td>302</td>
<td>4386</td>
<td>12</td>
<td>Guiding the Inquirer on Living the Complete Quarter hidayat al-nūr fi al-'amal bi-al-rub' al-kāmil</td>
<td>Sibt al-Mardini, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
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<td>39985</td>
<td>357</td>
<td>The Seeks' Tool in Time Reckoning by Calculations waṣilat al-tulāb ilā maṣ'īf al-ṣawqī bi-al-ṭābīb</td>
<td>Sibt al-Mardini, Muhammad ibn Muhammad ibn Ahmad al-Ghazali al-Dimashqi</td>
<td>912h</td>
<td>1212h</td>
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<td>The Seeks' Tool and Comfort of Mind in Time Reckoning by Calculations waṣilat al-tulāb wa muḥāfat al-ṭābīb ilā maṣ'īf al-ṣawqī bi-al-ṭābīb</td>
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<td>The Dispensed Pearls in Applying the Quarter Rule</td>
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<td>-</td>
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<td>The Dispensed Pearls in Applying the Quarter Rule</td>
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<td>308</td>
<td>8184</td>
<td>62</td>
<td>The Times Revealers</td>
<td>Sihi al-Mandili, Muhammad ibn Muhammad ibn Ahmad al-Ghazal al-Dinashiqi</td>
<td>912h</td>
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<tr>
<td>309</td>
<td>41631</td>
<td>367</td>
<td>Experimental Results in Basic Astronomy</td>
<td>Sihi al-Mandili, Muhammad ibn Muhammad ibn Ahmad al-Ghazal al-Dinashiqi</td>
<td>912h</td>
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<td>7658</td>
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<td>Mird's Delight in the Science of the Astrolobe</td>
<td>Sihi al-Mandili, Muhammad ibn Muhammad ibn Ahmad al-Ghazal al-Dinashiqi</td>
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<td>The Short Ephemeris for the Planets, the Moon and the Sun al-zij al-makhtasar fī ‘ll al-kawākib wa-al-shams wa-al-qamar</td>
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<td>Thesis on Seasons risālat al-fusul</td>
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<td>434</td>
<td>5277</td>
<td>205</td>
<td>Time Records al-tavājūt ‘l-‘agrāb sa‘ūd fī al-nilūjā</td>
<td>Anonymous</td>
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CONTRIBUTORS
Scientific Supervision and Introduction:

**Professor Ahmad Fuad Basha**
Professor of Physics, Faculty of Science, Cairo University

**UNESCO (Cairo Office)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tbody>
<tr>
<td>Dr. Tarek Shawki</td>
<td>Regional Informatics Advisor</td>
</tr>
<tr>
<td>Dr. Zeinab Al-Morsedi</td>
<td>Informatics Program Assistant</td>
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<td>Dr. Reem Bahgat</td>
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</tr>
<tr>
<td>Dr. Faisal A. Esmael</td>
<td>Consultant</td>
</tr>
<tr>
<td>Sayed Darwish</td>
<td>Project Executive Manager</td>
</tr>
<tr>
<td>Mohamed Araf</td>
<td>Islamic Scholar</td>
</tr>
<tr>
<td>Mazin Emauddin</td>
<td>Photographer</td>
</tr>
<tr>
<td>Mohamed Fadel</td>
<td>Image Processing Specialist</td>
</tr>
<tr>
<td>Osama Abdullah</td>
<td>Project Administrative Assistant</td>
</tr>
<tr>
<td>Medhat Abdulmonenla</td>
<td>Data Processing and Revision Assistant</td>
</tr>
<tr>
<td>Mona Al-Shenawi</td>
<td>Transliterator</td>
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Head of Central Administration
Head of Manuscripts Committee
Project Coordinator

Address:
Khalideen Garden, Darussa 1826
Cairo, Egypt
Tel: (202) 588 1152
Fax: (202) 588 1153

THE SCIENTIFIC COMMITTEE

Professor Abdulaziz Bakri
Dr. Mohamed Nader Sayed
Dr. Fuad Yousef Kamal

Astronomy Department & Meteorology,
Faculty of Science (Boys), Al-Azhar University

Address:
Al Mokharyam Al Daom St.
Nasr City, Cairo, Egypt
Tel: (202) 262 9557
BRARY

Assoubki
si
Hassanin

Head of Central Administration
Head of Manuscripts Committee
Project Coordinator

Address:
Khalideen Garden, Dornsas 1826
Cairo, Egypt
Tel: (202) 588 1152
Fax: (202) 588 1153

IC COMMITTEE

E. Bakri
E. Sayed

Astronomy Department & Meteorology,
Faculty of Science (Boys), Al-Azhar University

Address:
Al Mokhaway Al Daem St.
Nasr City, Cairo, Egypt
Tel: (202) 202 9557