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**Middle Eastern Contributions to Astronomy**  
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**Abstract**

Since the dawn of humanity, prior generations looked towards the blue of the sky and the black of the unknown that surpassed it. Humans have been observing, studying, and recording the cosmos for thousands of years. Today, space is dominated by states such as the U.S., China, and Russia. However, to truly understand the history of how humans looked upon the cosmos, one must go back thousands of years to the great Bronze Age civilizations of the Middle Eastern regions. It was in these civilizations where great advances in astronomy were first made. That is where it all began. Many advanced Bronze Age civilizations made advancements in astronomy that were far ahead of their time. The Sumerians frequently associated planets as well as the cosmos with deities. They put down the groundwork for modern mathematics such as the 360 degree circle and the 60 minute hour. Babylonian society continued this. During the reign of Nabonassar, detailed and accurate diaries and records were kept in relation the cosmos. Such records still exist today and are on display around the world. During the Seleucid Empire, astronomers used records to predict planetary movement and phenomena. Eventually, Babylonian astronomers developed mathematical models to directly predict such events. This basic ground work formed the foundation for future global astronomy. In the Middle Ages, the Middle East, under Islam, compiled large sums of knowledge in great libraries. Using knowledge of astronomy, many observatories were constructed. Star catalogues that helped to calculate the positions of the Sun, Earth, and the moon were created at such observatories. Middle Eastern astronomers during these times made detailed notes on constellations in addition to calculating the tilt of the Earth's axis and establishing a calendar that was very close to the Gregorian calendar in accuracy. Variants of tools such as the astrolabe were also created in the Middle East during this period. The Middle East continued to play a major role in astronomy in the Middle Ages. While the current superpowers in space and on Earth, the U.S., Russia, and China have made significant gains, the Middle East is ramping up their own space efforts. UAE astronauts recently made their first appearance on the ISS. The Middle East had and continues to play a profound role in aerospace and astronomy.

**Keywords: Middle East, astronomy, ancient, Middle Ages, advancements.**

**Acronyms/Abbreviations**

Arab Space Coordination Group (ASCG), International Space Station (ISS), United Arab Emirates (UAE)

**1. Introduction**

Space. The blackness dotted with galaxies, stars, and other celestial bodies. An object of wonder for millennia. The cosmos have created many questions and many answers. However, many more questions have not been answered and frankly not even asked. Astronomers and scientists have attempted to ask and answer those questions for centuries. One of the key regions for the discovery of the vast unknown called outer space was the Middle East. One cannot simply jump right into explaining those advancements in detail. Rather, the number of factors that came together to allow the Middle East to help to revolutionize astronomy must be acknowledged first.

*1.1 Instrumental Factors Causing Advancements*

The factors that allowed the Middle East to become the scientific powerhouse it was were both by chance as well as, manmade. Three main factors came into play in this instance. Geographical location, national leadership, and the basic human desire to know more. First, geographical location. The Middle East was situated in a prime location.

It had control of trade between Asia and Europe, notably the Silk Road. Middle Eastern societies were able to collect taxes on that trade etc., generating vast amounts of wealth. However, that position was also, important for intellectual advancement. The flow of information also went through the Middle East. As such, vast libraries and archives could be created. To preserve and expand upon knowledge these libraries were some of the greatest collections of knowledge of their time and as such, allowed the Middle East to create great astronomical advancements. However, one must also, look at the component of national leadership. Quality national leadership is vital for scientific advancements. Many great leaders of the various societies that dominated the region were responsible for building those great libraries and working to expand the knowledge of the region in general. Finally, the natural desire to know more. Since day 1, humans have been theorizing about why the sky is black a night, why the water is blue, and other basic questions. These theories evolved and became more advanced over time. Many theories and scientific discoveries and advances in the field of astronomy were in fact, made in the Middle

East. This is since great national leaders down to a lonely street vendor had the desire to know more. To expand both personal knowledge as well as, the knowledge of the group. At the end of the day, one must acknowledge that no matter how advanced the tools, or how instrumental prior information was, astronomers and scientists in the Middle East who were able to achieve great feats, were driven by a factor equally if not more instrumental. The simple desire to know more.

### *1.2 Ancient Middle Eastern Contributions to Astronomy*

To begin chronologically; advances made by ancient middle-eastern civilizations such as Sumeria. Some key Sumerian inventions/advancements in the field of astronomy include the wheel, writing, maps, mathematics, time and clocks, and astronomy and astrology. Each one of these vital inventions or concepts formed the cornerstone of modern astronomy. The two inventions considered to be ground-breaking were the wheel and writing. Writing was created sometime around 3600 BC to 3500 BC. Writing was primarily created for long-distance trading,. However, writing was also used to record information for generations to follow. As such, knowledge, instead of having to be learned, again and again, was retained and could be expanded upon. The writing system is known as cuneiform spread from Sumeria a vast number of other civilizations in Mesopotamia as well as, Anatolia. In addition, these societies developed organized forms of mathematics. Math was most likely was created and developed as a way of keeping track of financial transactions from trading, which would come back around to benefit studies in astronomy as previously explained. However, mathematics was also, likely used in the architecture and engineering work behind the great Mesopotamian cities. The Mesopotamian system was based on sixty. This caused the 60 second minute and the 60 minute hour to be created. Utilizing such skills, concepts of time were created and sundials were built to keep track of time, with 12 hours for light and another 12 hours for darkness. While initial efforts were based on a lunar calendar and somewhat inaccurate, by around 1700 BC, the definition and calculation of time were significantly clearer and more precise.

### *1.3 Middle Eastern Contributions to Astronomy from the Middle Ages*

Moving on to the Middle Ages. The Middle Ages were truly a golden age for developments and advancements in the field of astronomy. The core of work during this time period in the Middle East was based off of prior knowledge from regions such as Iran, Greece, and India. However, Middle Eastern astronomers updates that information work to create more precise and accurate research. Such work focused on the movement of heavenly bodies, etc. Work was conducted to make more precise models of the universe, as well as, to calculate the movements of the planets within the universe. Some of the major centres of research during the time included Baghdad, Cairo, Rayy, and Isfahan. Astronomers worked diligently to translate research in

languages such as Greek and Sanskrit into Arabic. These ancient documents informed astronomers during the Medieval period about methods to calculate the position of planets and stars. In addition, this information also, assisted Medieval astronomers in creating tables on these heavenly bodies. Arab Bedouin traditions were recorded for the first time during this period and were instrumental in these advancements. Not only did these advancements have scientific impacts, but religious ones as well. It helped to determine the correct time for prayer, Ramadan, etc. As a result, new scientific instruments, as well as, whole new calendars were developed. Based on Greek information as well as information from countless other civilizations, Medieval Middle-Eastern astronomers were able to revolutionize the field of astronomy with new tools, new theories, and most important, new knowledge.

### *1.5 Middle Eastern Astronomy in the Modern Period*

As unfortunate as they may be, it is essential to acknowledge the events and factors, particularly throughout the last 200 years, that caused a demise in major Middle Eastern scientific advancements. These factors include external conflict, civil war, corruption, and other negative events. However, the future couldn't be farther from that. The future of the Middle East in astronomy and aerospace is blossoming and filled with the potential of greatness.

Despite past events, the Middle East has jumped back into space and has been making great strides. The United Arab Emirates (UAE) has created the UAE Space Agency in addition to joining the Arab Space Coordination Group (ASCG) which is composed of many Middle Eastern nations that are working towards advancements in astronomy and aerospace. In addition, the UAE put astronauts on the International Space Station (ISS) relatively recently. It is quite obvious that despite an unfortunate recent past, the Middle East is diligently working to become a major power in space. The Middle East has played an instrumental role in the development of modern astronomy. Based on it's current track, it appears the Middle East will continue to play an important role in astronomy and aerospace.

## **2. Factors Enabling Advancements in Astronomy**

In relation to the vast amount of advancements made by the Middle East in the field of astronomy, a number of variables and factors were involved. However, three variables were likely the most instrumental in causing these advancements to occur. The variables are artificial, natural, and a combination of both. These three variables are trade (of both materials and thought/information), leadership at all levels of government, and the inherent human desire for knowledge.

### *2.1 Trade in Relation to Advancements in Astronomy by the Middle East.*

Trade has been and still is, an essential component to a society. Going back a few thousand years, the east, in particular, China, is producing silk among other valued

commodities. The Western Roman Empire, was these commodities. Those commodities will travel from merchant to merchant. One merchant will go to what is known as a trading hub and will trade the goods for something else. That trader that now has the goods will repeat the process at another trading hub and so on. However, the majority of these trade routes went through the Middle East. This was due to the fact that Western maritime technology was primitive compared to the maritime technology of today. It took a great deal of skill to venture away from the coastline in the Mediterranean and survive. Going into the open Atlantic was considered to be a death wish. As such, trade went through the Middle East for the most part. This allowed the governments governing the Middle East to collect taxes from these merchants and ultimately, to tax the goods themselves. However, there was also, the trade of information. Whether it was a traveling philosopher or astronomer or simply a pair of traders having a meal together, information was exchanged and frankly, culture was exchanged. Due to this, a large amount of goods, wealth and information was flowing through the Middle East at any given time during this period. [1]



Fig. 1. Dinar c. 698-99 A.D. Image Courtesy of Metropolitan Museum of Art

As stated previously the Middle East was a major hub for the trade of both information and goods. This allowed the Middle East to acquire a great deal of wealth, as well as, thought and skills that gave the region an head start over other societies during the time. This allowed the Middle East to construct tools and building such as observatories and great libraries that aided in the process of these advancements. Overall, the exchange of thought, culture, and knowledge in general was also, instrumental to the advancements in the field of astronomy by the Middle East.

## 2.2. Leadership in Relation to Advancements in Astronomy by the Middle East

Regardless of resources available to society, without quality leadership, nothing of any significance will happen. However, the Middle East had a number of truly great and magnificent leaders/societies that contributed to these advances in astronomy in major ways.

The major groundwork for modern astronomy was put down during pre-Medieval peoples such as the Sumerians and the Babylonians. The Sumerians, the oldest known Mesopotamian society developed a form of writing known as Cuneiform. In addition, the Sumerians performed basic research and were able to record knowledge that would form the cornerstones of modern astronomy. In addition, the Sumerians developed a system of astrology that was centered around a number of planetary gods. Both of these traits would play a very significant role in Babylonian society. The Babylonians, utilizing the knowledge left to them by the Sumerians, were able to create a new system of astronomy that focused on a select few constellations and stars. In addition, a sexagesimal numbering system was developed by the Babylonians. These advancements were essential to furthering astronomy. [2]

During the period where the majority of the Middle East and the Islamic world was controlled by the Ottoman empire, a number of advances in astronomy occurred, both material and philosophical. To begin, a push began to separate astronomy from religion and/or astrology. This allowed for concepts such a stationary Earth to be questioned and ultimately replaced with concepts such as, a moving Earth. In addition, the Ottoman empire was one of the first societies to use decimal points instead of the sexagesimal system. This aided in a number of star catalogues created during the period. The Ottoman Empire was essential in furthering Middle Eastern astronomy during the period. [3]

## 2.3 The Basic Human Desire for Knowledge

Since day 1, humans have been curious. That is why children want to know more about what makes cars move and what makes buildings stand. However, that is also why adults research and explore in space and on Earth about the many mysteries this planet and this universe holds. Curiosity is “a basic element of our cognition”. Curiosity, when coupled with the right variables, as well as, a quality system of learning can lead to a great level of knowledge and success. When used properly, curiosity has a plethora of positive effects both short and long-term. As a result of this as well as the basic human function known as “curiosity” the Middle East was able to make a vast amount of vital advancements in the field of astronomy. [4]

## 3. Middle Eastern Contributions to Astronomy from the Ancient World

Middle Eastern Advancements in the ancient world in the field of astronomy were essential. Such advancements were essential to further knowledge of astronomy, which would ultimately lead up to the system of and knowledge of astronomy that is present in modern society. Basic yet essential advancements such as an organized system for astronomy, star catalogues, and basic principles of math. As such, this period of advancements in astronomy was arguably one of the most important for astronomy.

### 3.1 The Development of a System of Writing

Writing was created sometime around 3600 BC to 3500 BC. Writing was primarily created for long-distance trading, and other standard functions of society at the time. However, writing was also used to record information for generations to follow. As such, knowledge, instead of having to be learned, again and again, was retained and could be expanded upon. The writing system is known as cuneiform spread from Sumeria a vast number of other civilizations in Mesopotamia as well as, Anatolia. [2] The development of an organized system of writing was and still is essential for record keeping, organized mathematics, and other such basic functions of astronomy, and now aerospace. The development of writing due to it's basic functions as previously explained, is an essential component to modern astronomy and aerospace.

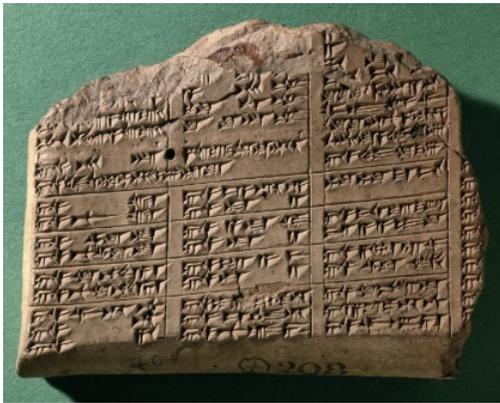


Fig. 2. Neo-Assyrian lexical list of names on a clay tablet.  
Image Courtesy of Trustees of the British Museum

### 3.2 The Development of a System of Mathematics

Math most likely was created and developed as a way of keeping track of financial transactions from trading. However, mathematics was also, likely used in the architecture and engineering work behind the great Mesopotamian cities. The Mesopotamian system was based on sixty. This caused the 60 second minute and the 60 minute hour to be created. [2] The development of an organized system of mathematics is crucial to aerospace and astronomy today. The ability to keep time plays a vital role in coordination between stage separations, launches, etc. In addition, the development of math in general allows trajectories, times, and other basic components of aerospace and astronomy to be calculated therefore, an essential component of aerospace and astronomy today.

### 3.3 The Development of an Organized and Calculated System of Time

Utilizing such skills as discussed in section 3.1 concepts of time were created and sundials were built to keep track of time, with 12 hours for light and another 12 hours for darkness. While initial efforts were based on a lunar calendar and somewhat inaccurate, by around 1700 BC, the definition and calculation of time were significantly clearer and more precise. [2] The ability to keep time plays a vital role in

coordination between stage separations, launches, etc. Time plays an obvious and significant role in modern astronomy and aerospace mainly due to it's ability to facilitate coordination and precise calculations, and other essential components of aerospace and astronomy today.

## 4. Middle Eastern Contributions to Astronomy from the Middle Ages

The Middle East, in particular, the Islamic world utilized the advancements made in previous eras to great effect. The Middle East took many ideas from Iran (known by a number of different names during the period), Greece, and India. These ideas and the advancements made utilizing them would be essential to the modern understanding of astronomy. During this period, principles were challenged and systems of mathematics and timekeeping were refined in terms of accuracy and precision. Middle Eastern astronomers during this period worked to translate ancient work in Sanskrit and Greek into Arabic. [5] The information unlocked by this would be vital to creating catalogues, equations, etc. to track a number of celestial bodies and record that information. The tracking of such bodies was a major component of Middle Eastern astronomy during this time. It caused a number of additional advancements, most notably, the advancement of knowledge. This also, had significant cultural effects as this allowed for those following Islam to know when holidays such as Ramadan begin, as well as, determining the correct time for prayer, etc. The Medieval Period would also, be an essential component of modern astronomy as it is known today. [2]



Fig. 3. Kitab suwar al-kawakib al-thabita (Book of the Images of the Fixed Stars) of al-Sufi.  
Image courtesy of Metropolitan Museum of Art

## 5. Middle Eastern Astronomy in the Modern Period

As tragic as they may be, one must acknowledge the events and factors, particularly throughout the last 200 years, that caused a demise in major Middle Eastern scientific advancements. These factors include external conflict, civil

war, and notably, the downfall of the once mighty Ottoman Empire. [6] However, those events do not overshadow the overall history of the region. Occasionally, some look to a few unfortunate events and allow those events to determine the past and the future. However, the future couldn't be farther from that. The future of the Middle East in astronomy and aerospace is in full bloom and filled with potential.

### 5.1 Current Advancements

Despite past events, the Middle East has jumped back into space and has been making great strides. The United Arab Emirates (UAE) has created the UAE Space Agency in addition to joining the Arab Space Coordination Group (ASCG) which is composed of many Middle Eastern nations that are working towards advancements in astronomy and aerospace. [7] In addition, the UAE put astronauts on the International Space Station (ISS) relatively recently. [8] One may also, look towards the current UAE effort for a Mars program. This is designed to encourage young people to become involved in space to forge a great path as well as, for scientific benefit. [9] It is quite obvious that despite an unfortunate recent past, the Middle East is diligently working to become a major power in space. The Middle East has played an instrumental role in the development of modern astronomy. Based on its current track, it appears the Middle East will continue to play an important role in astronomy and aerospace.



Hazzaa al-Mansoori during training in Russia in August. Courtesy of Maxim Shipenkov

## 6. Conclusions

The advancements made by the Middle East in astronomy were and still are critical. From creating the basic building blocks of mathematics and astronomy to creating advanced star catalogues and timekeeping methods based on the basic building blocks, the Middle East played a vital role in the development of astronomy. Astronomy has a major impact on the culture and the characteristics of a society. Astronomy creates cultural, economic, and

technological benefits which is why it is essential. [10] The Middle East represents a crucial component of astronomy and aerospace and is currently experiencing a revitalization in aerospace and astronomy. The Middle East was, is, and will likely be in the future a major component of aerospace and astronomy, benefitting the world as a whole.

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