75 OUT OF THIS WORLD FACTS ABOUT ASTRONOMY

The study of astronomy in the uslim world included scholars om many countries and cultures.

Keeping a close watch on the y helped Muslims find the rection of Mecca.

The Quran encourages the ploration of the universe.

Muslim civilization was the first use observatories and large struments to study the heavens.

WORKING IN TEAMS ET ASTRONOMERS TUDY PLANETS AND TARS IN MORE DETAIL HAN EVER BEFORE.

The Toledan Tables are astro-omical charts that predict the ovements of the moon, sun, and anets and take their name from ledo, a city in Muslim Spain.

The tables were written in the h century by Al-Zarqali, known Europe as Arzachel.

For 300 years Muslim-ruled ledo was the world's center for tronomy and science.

Caliph Al-Ma'mum set up a overnment-funded observatory Baghdad so astronomers could rk together in one place.

Scientists at Al-Ma'mum's servatory discovered that the lar apogee, the point at which e sun is farthest from the rth, changes over time.

hmad al-Mizzi's uadrant; fore-round: armillary here

11 We now know the solar apogee changes because the whole solar system moves within our galaxy.

12 The Maragha Observatory, built in northern Persia (now Iran) in 1263, had a library with more than 40,000 books.

13 The astronomer Jamal al-Din introduced instruments from the observatory to China in 1267.

14 The foundations of the Maragha Observatory still stand in Iran.

15 The 15th-century astronomer-mathematician Ulugh Beg created an observatory in Samarkand (now in Uzbekistan) while he was Sultan.

16 Ulugh Beg calculated the length of a year at 365 days, 6 hours, 10 minutes, and 8 seconds—just 62 seconds longer than the figure used today!

17 In the 9th century 'Abbas ibn Firnas built a glass planetarium in his house that showed images of stars and planets.

18 HIS PLANETARIUM EVEN FEATURED ARTIFICIAL THUNDER AND LIGHTNING.

19 Many astronomical instruments created in the early Muslim world greatly influenced the development of modern astronomy.

20 These new kinds of astrolabes, sextants, and quadrants measured the height of stars more accurately than ever before.

21 SEXTANTS WERE THE GPS OF THE MEDIEVAL WORLD.

22 Astrolabes, sextants, and quadrants helped make possible the European age of exploration.

23 An amazing observatory built by Taqi al-Din in Istanbul, Turkey, had an impressive array of extremely large instruments.

24 Large instruments made more accurate measurements possible.

25 THE OBSERVATORY IN DAMASCUS, SYRIA, HAD A 20-FOOT (6-M) QUADRANT AND A 56-FOOT (17-M) SEXTANT.

26 Today some of the largest optical telescopes are in the Canary Islands.

27 The need to know prayer times and the direction of Mecca led to substantial improvements in the astrolabe, an ancient instrument.

28 An astrolabe shows how the 3-D sky would look if it were flat.

29 People used astrolabes to tell time day or night, navigate on land, and calculate sunrise and sunset.

30 Astrolabes are sometimes called the pocket watches of the medieval world.

31 Observations made with astrolabes helped lead to the birth of modern astronomy.

32 The astrolabe is considered the most important astronomical observational device before the invention of the telescope.

33 It could take up to six months to build an astrolabe because the makers had to do extensive calculations, engrave all the parts, and then assemble them all by hand.

34 THE OLDEST KNOWN ASTROLABE MADE IN THE MUSLIM WORLD IS FROM 10TH-CENTURY BAGHDAD.

35 Using a huge astrolabe, astronomer Ibn Yunus recorded more than 10,000 observations of the sun's position during a 30-year period.

36 The astrolabe was based on the ancient Greek model of the universe described by Ptolemy that showed the Earth at the center.

37 In 1387 Geoffrey Chaucer, author of *The Canterbury Tales*, gave his young son an astrolabe made to work for Oxford, England.

38 The universal astrolabe, developed in Toledo, Spain, in the 11th century by Al-Zarqali, changed star mapping forever.

39 The universal astrolabe could be used at any location.

40 Jabir ibn Aflah, who lived in the 1100s, designed the first portable celestial globe to measure coordinates of planets and stars.

41 Since ancient times astronomers have used 3-D models of the heavens called armillary spheres.

42 These spheres have rings set at different angles to show the paths of planets and stars.

43 By the 10th century the Muslim world was producing two kinds of complex armillary spheres: demonstrational and observational.

44 DEMONSTRATIONAL ARMILLARY SPHERES PUT THE EARTH AT THE CENTER WITH THE SUN, TROPICS, EQUATOR, AND POLAR CIRCLES MOVING AROUND IT.

45 Observational armillary spheres had sighting devices on the rings but did not have the Earth at the center.

46 Using armillary spheres, astronomers produced flat charts of the heavens, which were then used to make astrolabes.

47 *THE ALMAGEST*, BY 2ND-CENTURY B.C.E. GREEK SCHOLAR PTOLEMY, HAD AN IMPORTANT INFLUENCE ON ASTRONOMERS OF THE MUSLIM WORLD.

48 Ninth-century astronomer Al-Farghani, inspired by Ptolemy's work, wrote several important books on astronomy.

49 The medieval Italian poet Dante probably gained his astronomical knowledge by studying the writings of Al-Farghani in Latin.

50 One of Al-Farghani's most important inventions was the Nilometer. Created in 861, it measured the water level of the Nile at Cairo and predicted when the river would flood each year.

51 Scientist Al-Battani combined elements of the celestial globe and the armillary sphere to create a new instrument called *al-baydha*, meaning "the egg."

52 The creation of the egg allowed astronomers to assign stars exact coordinates.

53 Al-Battani is also credited with timing new moons, calculating the length of solar years, and predicting eclipses.

54 Star maps created in the Muslim world were used in Europe and the Far East for centuries.

55 Today the names of more than 165 stars reflect their Arabic origins.

56 THE ASTRONOMER 'ABD AL-RAHMAN AL-SUFI WAS THE FIRST TO MENTION A STAR SYSTEM BEYOND OUR MILKY WAY GALAXY.

57 In 964 Al-Sufi named his find "little cloud." Today we call it the Andromeda galaxy.

58 The Andromeda galaxy is about 2.6 million light-years from Earth.

59 Our Milky Way galaxy contains between 200 and 400 billion stars.

60 The Milky Way is about 1,000 light-years thick, 100,000 light-years wide, and 300,000 light-years around.

61 The terms "zenith" and "azimuth" are of Arabic origin.

62 The astronomer Qutb al-Din al-Shirazi and his student Kamal al-Din al-Farisi explained that rainbows are caused by the refraction of the sun's rays in raindrops.

63 According to Copernicus, Ibn Rushd, a philosopher and astronomer, may have observed sunspots.

64 The 17th-century astronomer Galileo Galilei built on Latin translations of works written by astronomers of the Muslim world.

65 Six hundred years before Galileo, Muslim astronomer Al-Biruni explored the idea that the Earth rotated on its own axis.

66 Al-Biruni is sometimes referred to as the Leonardo da Vinci of his day.

67 Astronomer-scientist Thabit ibn Qurra lived in Baghdad, where he revised many Arabic versions ancient Greek and Syriac science texts before his death in 901.

68 IT WAS EASIER FOR EARLY CIVILIZATIONS TO OBSERVE PLANETS AND STARS WITH THE NAKED EYE BECAUSE THERE WERE NO BRIGHT CITY LIGHTS.

69 Human eyes can take up to a hour to adjust to the night sky. This "night vision" makes it easi to see things that are farther away and less bright in the sky.

70 There are five planets that can be easily seen with the nake eye: Mercury, Venus, Jupiter, Mars, and Saturn.

71 Unlike some earlier thinkers the scholars of Muslim civilizatio did not believe that the stars ar planets were living beings.

72 The Quran talks about orbits and other astronomical phenomena.

73 The groundbreaking observa tions and discoveries made by astronomers during Muslim civilization had a huge impact o astronomy in the Western worl

74 Among those influenced by these medieval astronomers wa Nicolaus Copernicus, a Renaissance scholar from Polan who is often considered the founder of modern astronomy.

75 Copernicus relied heavily o work done by Al-Battani, Ibn a Shatir, Nasir al-Din al-Tusi, an other astronomers of the Muslim world.