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CHAPTER I

FROM THE BACKYARD TO THE BIG BANG

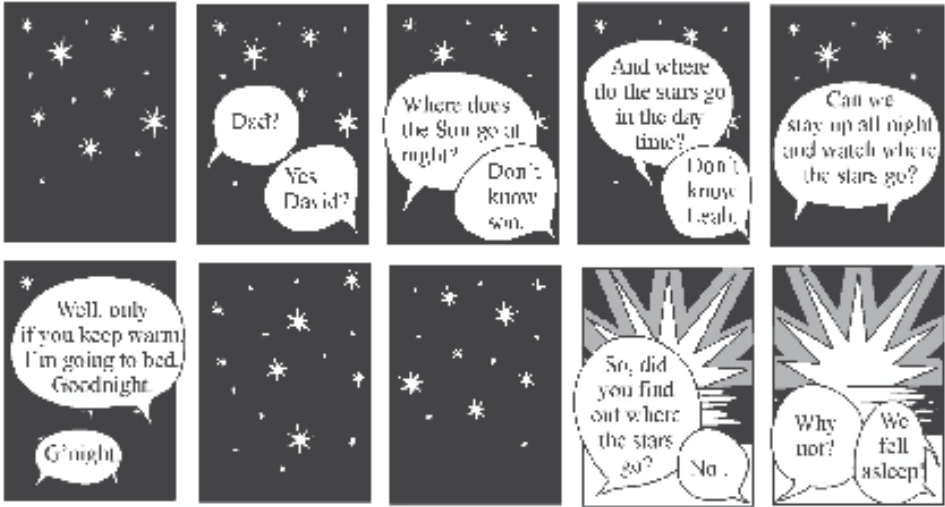
— A BRIEF HISTORY OF
COSMOLOGY

BACKYARD COSMOLOGY

Early cosmology was easy. All you had to do was to look at the night sky. Well, you had to look at it for a long time, and you had to look at it night after night all year round. But before television there was nothing much else to do at night anyway, and before streetlights and cities it was also much easier to see the night sky and its blaze of glorious starlight.

We can be sure that someone did manage to stay up all night and notice that the stars went the same way as the sun and the moon. They all disappeared over the western horizon, following one another like a flock of sheep. Because they all followed the same path night after night it would soon become obvious that the heavenly bodies were traveling in circles around the earth.

The earliest cosmologies therefore represented the earth as the center of the universe, with the sun, moon, and stars turning in circles around it. Despite our sophisticated modern knowledge, this model still works perfectly well in everyday life. Scientific bodies such as meteorological offices, maritime service organizations, and the world's time-keeping authorities all refer to “sunrise” and “sunset” times and “moonrise” and “moonset” times, and they predict tides and moon phases and other phenomena associated with the heavens from the point of view of a stationary earth and a moving sky.



TIMEKEEPING AND NAVIGATION

From the earliest times, the celestial bodies have served as timekeepers. Many ancient cultures erected large stone structures, some of which survive today, that enabled them to obtain fixed reference points for the calculation of the progress of the seasons. One such place is Stonehenge in England.

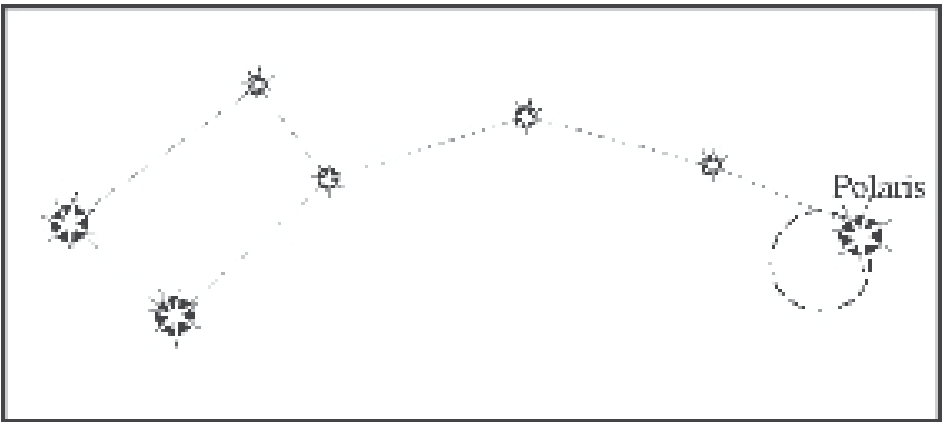
Because the sun played such an important role in timekeeping, some ancient cultures, notably among native Americans, used a “compass” with four cardinal points marked by the position of the sun at sunrise on winter solstice



Stonehenge — At midsummer dawn, the sun rises directly over the “heel” stone in the background of the picture.

(the shortest day of the year), sunset on winter solstice, sunrise on summer solstice (the longest day of the year) and sunset on summer solstice.

The stars also provided a means of navigating, particularly at night and at sea. In Genesis 1:14, when God was creating the stars, He said, “Let them be for signs and for seasons and for days and years.” We will consider their role as timekeepers shortly, but one obvious meaning of “signs” is that they point toward something. This can have a prophetic directional sense for the future, as we shall look at later, but it can also have a geographic directional sense for the present. In the northern hemisphere, for example, the famous “Pole Star” shows the way to the north pole, and in the southern hemisphere the famous “Southern Cross” shows the way to the south celestial pole (which falls approximately where the long axis meets the bisector of the two pointers).



The constellation Ursa Minor. The north celestial pole lies within the dashed circle. The bright star Polaris, or Pole Star, shows night travelers where it is.

THE SHAPE OF THINGS

There is a common myth that ancient peoples thought the earth was flat. Some may have thought so, but most others certainly did not. Seafarers plied the Mediterranean from very early times and they would all have known that ships disappear over the horizon and yet do not fall off the edge. Even the shortest journey, such as from the coast of Lebanon to the island of Cyprus for example, a distance of about 95 miles (150 km), would have been sufficient to yield this insight. Aristotle (384–322 B.C.) reasoned as follows: “Earth’s shape must necessarily be spherical. For every portion of earth has weight until it reaches the center, and the jostling of parts . . . would bring about . . . convergence . . . [and] if an equal amount is added on every side the extremity of

the mass will be everywhere equidistant from its center, i.e., the figure will be spherical.” He also noted that the changing star positions with latitude pointed to a spherical earth. In his view, the diameter was “of no great size” and he quoted an un-named mathematician’s estimate of 400,000 stades (about 64,000 km).¹ Others figured out that a lunar eclipse is caused by the shadow of the earth falling across the face of the moon, and they noticed that the earth’s shadow was always exactly circular in shape, regardless of the orientation of the earth at the time of the eclipse. If the earth had been round and flat, it would have cast circular shadows only when an eclipse occurred near midnight. For eclipses that occurred near sunrise or sunset, the sun’s rays would strike a flat earth obliquely, and would produce an elliptical shadow, not a circular one. The only shape that always casts a circular shadow is a sphere.

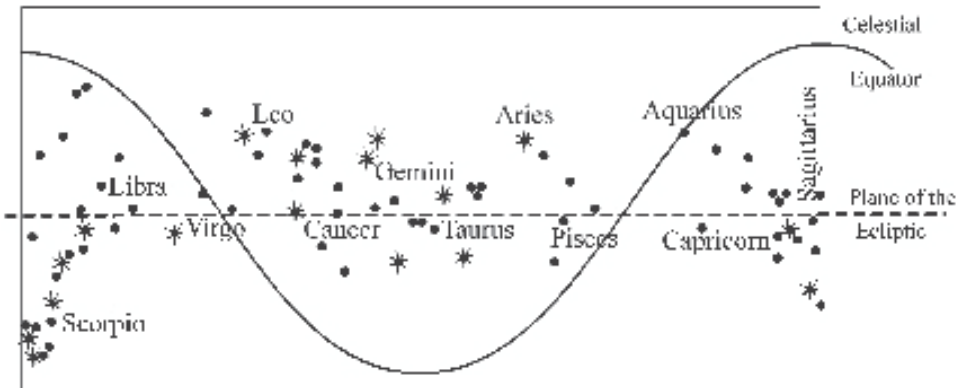
Eratosthenes (276–196 B.C.), the director of the great library at Alexandria, in Egypt, measured the circumference of the earth with somewhat greater accuracy.² One day he read that in the southern Egyptian town of Syene, near the first cataract of the Nile River, at noon on June 21, vertical sticks cast no shadow on the ground, temple columns cast no shadows, and a reflection of the sun could be seen in the water at the bottom of a deep well. The sun was apparently directly overhead. He was thereby inspired to test whether the same thing happened at Alexandria. However, on June 21 his sticks at Alexandria did cast a shadow. The difference, he thought, might have something to do with the curvature of the earth. So he calculated the angle that would account for the difference in shadow lengths and then hired a man to pace out the distance between Alexandria and Syene. The distance was about 800km and the angle was about seven degrees. Seven degrees is about 1/50 of the circumference of a circle, so $50 \times 800 = 40,000$ kilometers. Our best estimate of the earth’s circumference today is 40,074 kilometers. Not bad!

WANDERERS AND HOUSES

Another observation that was made early on is that some stars are fixed and some stars move. Some move detectably from one night to the next, while others move on longer time scales of weeks, months, or years. These moving stars were called “wanderers” by the Greeks, and their word for wanderer is now our word “planet.”

1. Dennis R. Danielson, *The Book of the Cosmos* (Cambridge, MA: Helix Books, 2000), p. 41–42.
2. Carl Sagan, *Cosmos* (London: Macdonald & Co., 1980), p. 14–15. The apparent accuracy of this estimate is rather fortuitous, given the uncertainties in the measurement methods that he used.

The early timekeepers also noticed that the sun, moon and stars all followed roughly the same path through the sky; what we call today the “plane of the ecliptic.” Furthermore, they noticed that the annual cycle of the seasons corresponded with a complementary cycle of fixed stars. Identifiable groups of fixed stars (“constellations” — such as Orion or the Pleiades) would move slightly each night and complete one whole circuit of the heavens in concert with the progress of the sun through the seasons. So they divided the background stars into 12 “houses,” which we now call the “signs of the zodiac,” and they plotted the movements of the sun, moon, and planets through these “houses” as a way of describing the progress of the seasons. Later time-keepers moved on to the use of calendars instead of star charts but those who practice astrology still use this method of timekeeping today.



The 12 houses of the Zodiac. The “Plane of the Ecliptic” is the path taken by the sun, moon, and planets. The “Celestial Equator” varies because the earth is tilted at an angle of 23 degrees to the ecliptic.

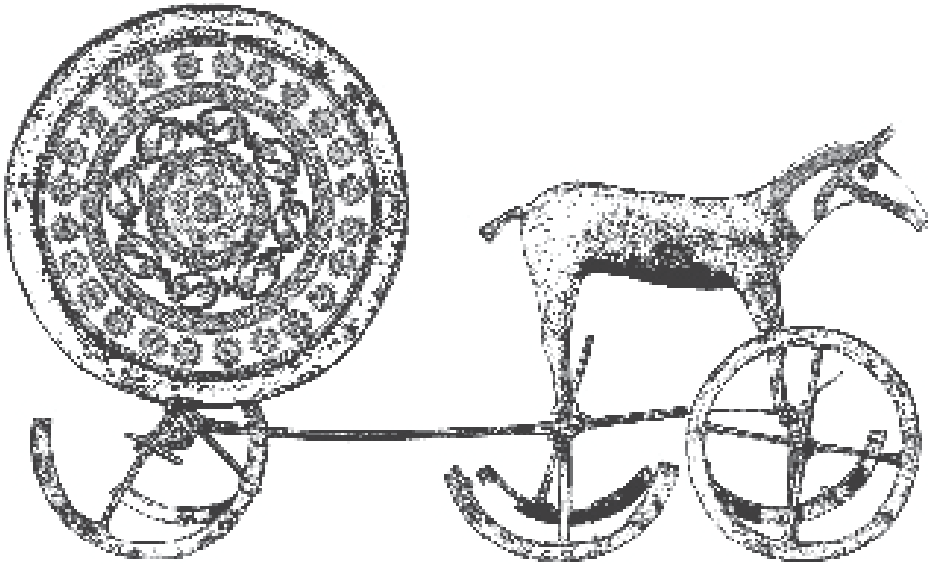
SPIRIT UNIVERSE

It is only in modern times that many people have chosen to see the universe as a purely physical entity. All ancient cultures viewed the universe as embracing a spiritual dimension as well as a physical one. The denizens of the spirit world included the spirits of dead ancestors, nature spirits, and creator spirits or gods. Many cultures believed in a supreme Creator or Great Spirit.

The biblical world view includes a spirit realm that is beyond time and space, the dwelling place of the Creator God who is a spirit being (John 4:24). The physical world is described as having been spoken into existence by the Creator (Gen. 1) and as being held in existence by that same creative word (Heb. 1:3; Col. 1:17). The physical is thus a product of the spiritual,

and depends upon it for its continuing existence. In the spirit universe there are also innumerable angels, personal spirit beings created to be servants of humanity in God's great work of redemption (Heb. 1:14). Some of these spirit beings (Satan and his followers) rebelled against God and were cast out of heaven down to the earth (Rev. 12:7–11), where they are called demons and are the enemies of mankind.

In some cultures it was thought that the sun, moon, stars, and planets all moved through the sky by the action of spirit beings. Ancient people from northern Europe, for example, represented the sun as being carried through the sky by a spirit horse.



Gilded bronze sun being drawn by a spirit horse and carriage in a Bronze Age sculpture from Denmark, with reconstructed detail.

Bible authors sometimes personified the heavenly bodies. For example:

... the sun ... comes forth like a bridegroom leaving his chamber, and like a strong man runs its course with joy (Ps. 19:4–5).

They were warned against attributing any divinity to the heavenly bodies that might induce them to worship, such as their pagan neighbors did (Deut. 4:19). Sometimes certain persons were identified with stars — Jesus is called “bright morning star” (Rev. 22:16) and Satan is called “Day Star, son of Dawn” (Isa. 14:12) — but this is simply a metaphorical use of language.