lying orbits. Because the ninth sphere is the sphere of the diurnal rotation, it naturally bears the celestial equator. The principal features of both the eighth and ninth spheres are illustrated in figure 6.14.

The celestial equator $A'$ is intersected at $A$ by the fixed ecliptic $A_1$. This is not the real, observable ecliptic, but merely a fictitious reference circle inscribed in the ninth sphere. We call it “fixed” because it is fixed with respect to the celestial equator, with which it always makes the angle $\varepsilon = 23^\circ 56'$. According to Thabit. The pole of the celestial equator is $P$, and the fixed solstitial colure (not the real, observable solstitial colure) intersects the fixed ecliptic and the equator at right angles. Furthermore, centered on $A$ is a small circle whose radius, according to Thabit, is $4^\circ 16'43''$. There is another small circle (not shown) on the opposite side of the sphere, centered on the point opposite $A$. All these are features of the ninth sphere, absolutely fixed with respect to one another.

Moving around the small circle at a uniform rate is point $C$, which in medieval Latin astronomy is called the moving caput Arietis, the “head [or beginning] of Aries.” Thus, angle $\beta$ increases uniformly with time. According to Thabit, $\beta$ goes through $360^\circ$ in about 4,162 Arabic years (about 4,077 Julian years). Diagonally opposite $C$ is a point called the moving caput Librae, which similarly moves in a small circle. These two points are always opposite one another, so that when caput Arietis is north of the equator, caput Librae is south of the equator.

The true, actual ecliptic is labeled “movable” in the diagram because it moves with respect to the equator. This movable ecliptic passes through the moving caput Arietis $C$ and through the unseen caput Librae on the other side of the sphere. The mechanism resembles the drive system for an old-fashioned steam locomotive. The actual, observable spring equinocial point $\mathcal{Y}$ is the intersection of the movable ecliptic with the equator.

Point $D$, the moving caput Cancri, or beginning of Cancer, is $90^\circ$ from $C$ along the movable ecliptic. Point $D$ of the movable ecliptic always stays on the fixed ecliptic. Its motion is therefore a simple to-and-fro vibration along the fixed ecliptic. $D$ is not the true, observable solstitial point. It, too, is merely a fictitious reference point. The true solstitial point, at which the movable ecliptic is at its greatest distance from the equator, is obviously $90^\circ$ from $\mathcal{Y}$ along the movable ecliptic and is labeled $\Xi$ in the figure.

Finally, it is important to remember that the stars (and also the apogees of the planets) are embedded in the sphere of the movable ecliptic. Thus, the stars gyrate around with motion of $C$ and the movable ecliptic. Consequently, the latitudes of the stars (their angular distances above or below the plane of the movable ecliptic) remain invariable. The eighth sphere in the title of Thabit’s work is the sphere of the movable ecliptic, to which the stars are attached. It is the wobbling of this sphere with respect to the ninth sphere, or sphere of the equator, that causes the stars to advance and recede with respect to the equinoxes. This to-and-fro motion is called accession and recession. Moreover, the same mechanism causes the obliquity of the ecliptic to change.

**Accesion and Recession** To see how the motion of accession and recession arises, let us use figure 6.15. This figure shows a close-up of the region about point $A$ at four different epochs according to Thabit’s system. The four views are separated by equal intervals of time, each interval corresponding to $45^\circ$ of motion in $\beta$. Point $C$ and a star $S$ both lie in the eighth sphere. Thus, the distance of $S$ from $C$ does not change. This particular star happens to lie exactly on the movable ecliptic (and thus has latitude zero forever). The longitude of $S$ is the angular distance from $\mathcal{Y}$ to $S$, which now varies in a nonsteady way; we obtain a variable rate of precession. Note that $\mathcal{Y}$'s increased