Fig. 1: The Ptolemaic system.

Shown schematically is the geocentric orbit of the sun and part of the deferent and epicycle for Jupiter. An observed fact, without any deeper explanation in the Ptolemaic scheme, is that the radius vector in the deferent of a superior planet (Mars, Jupiter, Saturn) must always lie parallel with the Earth-Sun direction. When the planet is closest to the earth in its epicycle ("at perigee"), the sun must necessarily be directly opposite on the other side of the earth. We can call this the "perigee problem," but until Copernicus, practically no one even considered it something crying for an explanation.

Fig. 2: The transition to a Tychonic system.

Suppose we scale up the size of the epicycle until it matches the size of the sun's orbit. All that we observe from earth are the angles, and they remain exactly the same in these similar triangles. If you don't understand why, be sure to ask for help!

Now complete the parallelogram with the dashed line SP. Notice that it doesn't matter whether you consider that the planet's position is found via the Ptolemaic deferent and epicycle (E to D to P) or by letting it move in a circle around the sun (E to S to P). All that is observed is the direction of line EP.

Fig. 3: The heliocentric transformation.

Compare Figure 2 with Figure 3 to see what has happened. Amazing! The rudiments of the Copernican system have appeared before our eyes!

Notice that if the Earth-Sun distance is 1.0, the distance to Jupiter is firmly fixed (5.4 units) by this procedure, so Copernicus' heliocentric step locks the distances of the planets relative one to another.
How does this arrangement give a natural explanation to the "perigee problem"?

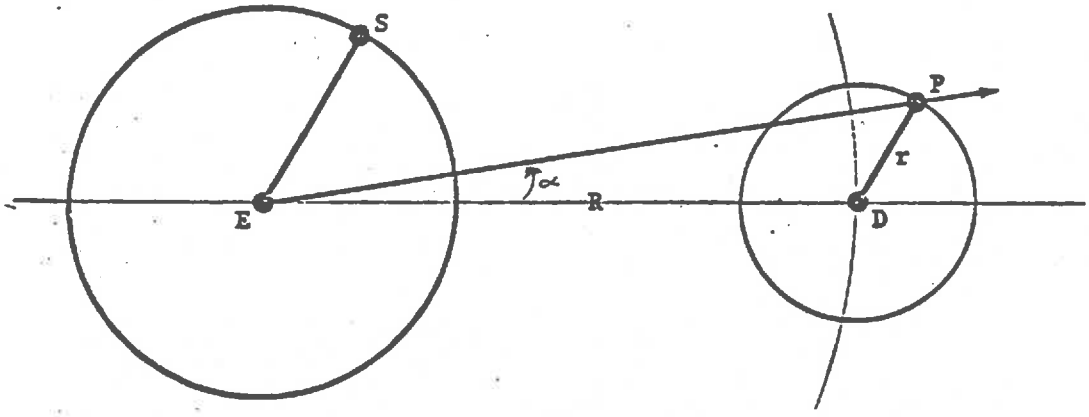

Fig. 1

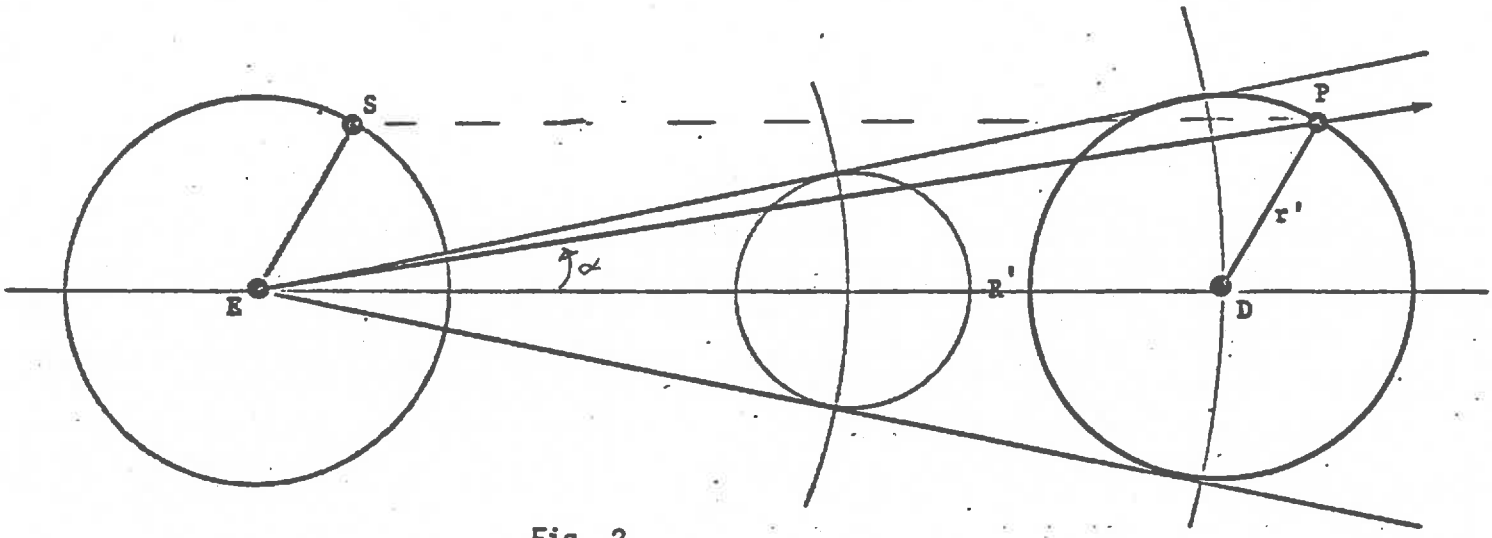

Fig. 2

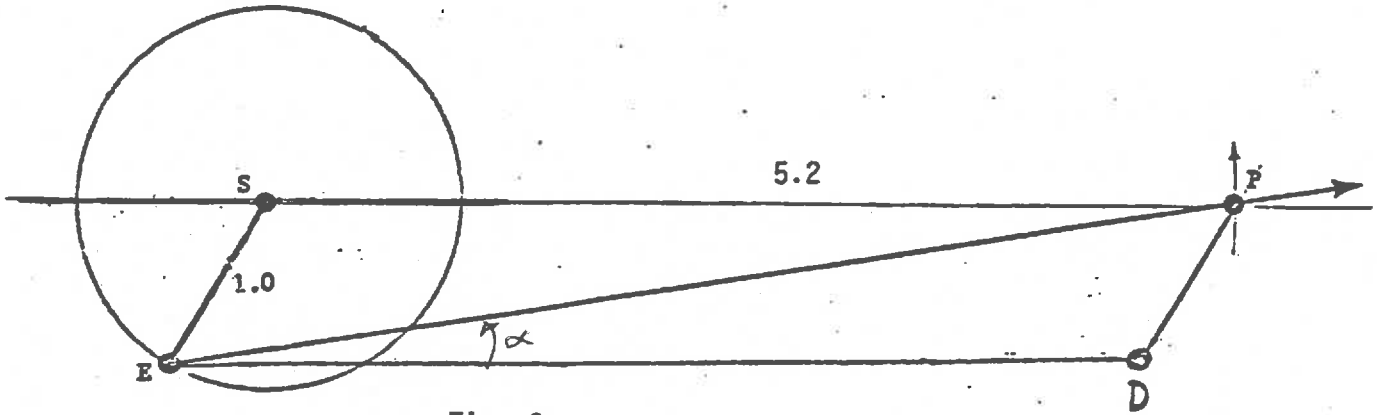

Fig. 3