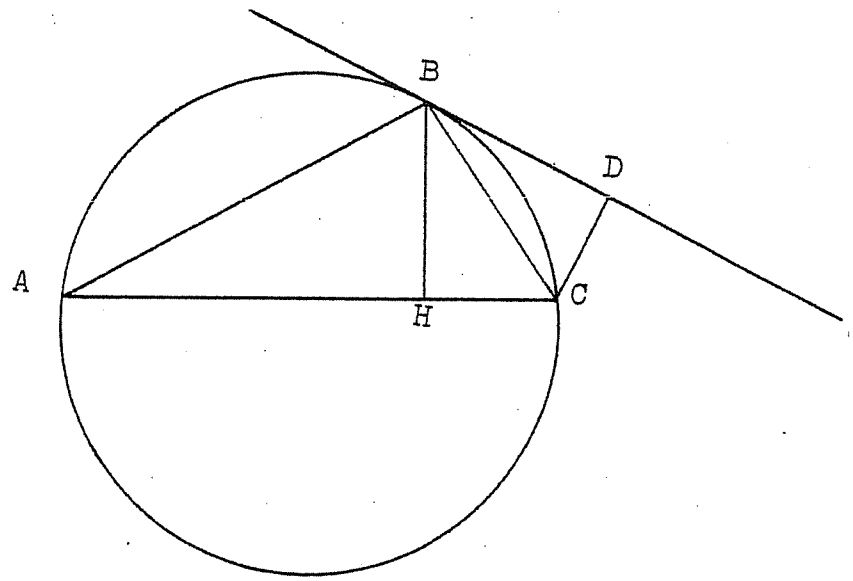It is sufficient to show that $\angle BAH = \angle DHC$. First note that $\angle BAH = \angle DBC$ because the two angle subtend the same arc on the circle. Next consider the circle $\mathcal{C}$ with diameter DH. Because $\angle BDC$ and BHC are right angles, this circle passes though the points B, H, C, D. Thus $\angle DBC = \angle DHC$ because both subtend the same arc on circle $\mathcal{C}$. Thus it follows that $\angle BAH = \angle DHC$, so AB is parallel to DH.