This is a philosophical chapter that allows us to find our bearings in the spectrum of empiric versus *a priori* knowledge. I could gloss over objections which state that accepting the existence of orbits, and particularly circular orbits, might be equivalent to accepting an unproven premise. I could skip this chapter and hold circular orbits up as an example of orbital possibilities and not many protests would be raised. But I feel it is better to confront the issue at the risk of appearing to dwell on a mundane or even a minor point.

I will show in this chapter to what degree we can say, before beginning our proofs, that orbits can exist and to what degree the statement that they do exist qualifies to be *a priori*.

In Chapter 5 we saw that a planet in motion around a central body sweeps equal areas in equal times if attractive force is toward the central body. It follows logically that a circular orbit is a physical possibility. In order to abide by the geometrical rules the planet would simply need to travel at constant speed all along in the orbit. Only in that case could the planet sweep equal areas in equal times.

In Chapter 6 the physical meaning of equal areas in equal times was explored. The inverse relationship between radius and tangential velocity was derived. The circular orbit is the case where the radius does not change. Obviously, in the examination of a circular orbit we are not able to relate a change in tangential velocity to a change in radius since radius is invariant. In other words the inverse relationship between radius and tangential velocity is hidden, or dormant, for circular orbits. Nonetheless, circular orbits seem like a viable possibility.

Can a circular orbit be truly an *a priori* reality? It clearly is. We must surely accept that orbits can exist as a given condition for our proofs. Otherwise we are stating that there is a possibility that orbits might never exist. If that were the case, nothing would ever revolve around a central body. Without any significant analysis, perhaps this could be true. But *a priori* thought tells us otherwise. We can justify the existence of an orbit in general terms by allowing a planet to fall towards its central body due to attractive force to a degree that negates the planet's speed and direction toward eventual escape. What is left to accept as a premise is that attractive force can exist. That is the premise upon which

all the rest is built. After that, all the rest is *a priori*. In a sense I am saying that this book sums up to be answering the question-" If attractive force is possible, can orbits exist and if so, what will be their behavior?" That is quite a different question from that posed to Newton - "Given that the planets travel in elliptical orbits, what is the quantitative nature of the force on the planet?" Allowing the premise that orbits are elliptical deems Newton's proof to be empirical since the premise is Kepler's astronomical observation that planetary orbits are ellipses.

Let's suppose that an objection is raised to allowing attractive force to exist since that is an empirical kind of knowledge. One could argue that we only know that attractive force can exist because of our experience. But that kind of argument only leads to absurdity. For example, one could equally say that we can not know in *a priori* fashion that things can move - it is only by experience that we know this can happen. But we are not in that end of the empirical versus *a priori* knowledge spectrum. In other words, we are not looking to make a philosophical claim that our methods are the most ultimately *a priori* methods possible. Rather, we are looking to fit in with Kepler and Newton's examination of planetary behavior -

though in a more *a priori* fashion than previously accomplished.

It is thus fair to say, with the foregoing assumption that attractive force is allowed to exist, that orbits can exist. The geometrical behavior of sweeping equal areas in equal times qualifies to regulate orbits. Circular orbits certainly adhere to this requirement.

In summary, - where are we in the *a priori* versus empirical knowledge spectrum? We are not allowing the empirical observations about the motions of planets as described by Kepler. We are allowing attractive force to exist. That seems to me to be an acceptable *a priori* concept. But if it seems objectionable to some, - one can accept it as a hypothesis and interpret this book to state that it will prove in *a priori* fashion that - *if* attractive force exists, the orbits will be shown to be ellipses and the force will be shown to decrease with the square of the distance. That is still, I propose, a novel challenge.

Having cleared the air, we can move on to Chapter 11 where it will be shown in *a priori* fashion that orbits are ellipses.