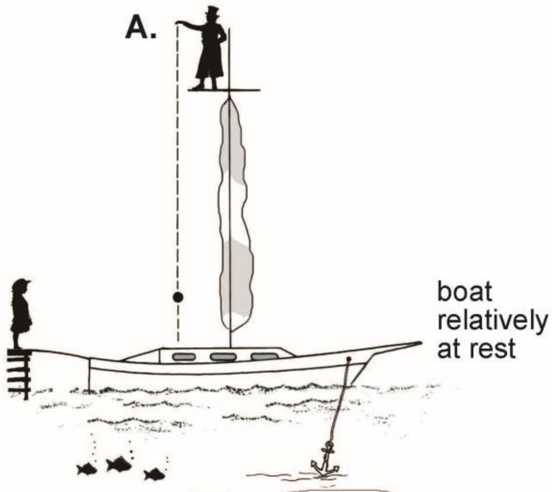
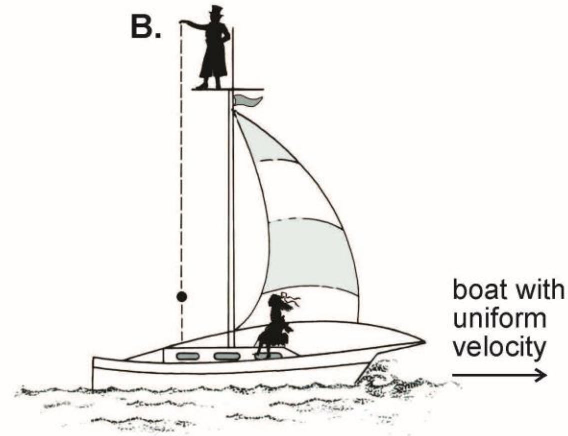
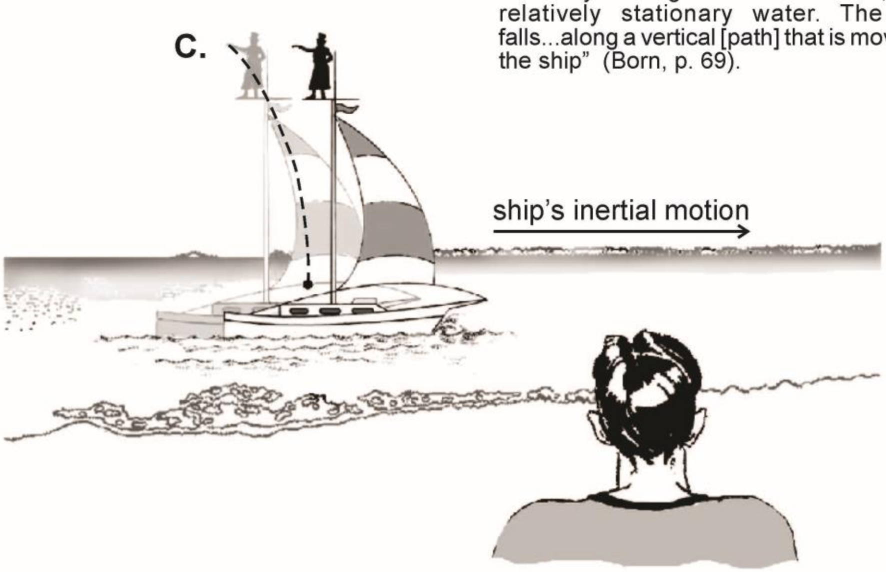
Figure 5.1 Galileo's Examples of Inertia and Common Inertial Motion in Support of the Copernican Theory



When the boat is relatively at rest in port, the man drops a stone from the mast. The stone appears to both of the relatively stationary observers (the man and the girl) to fall straight down, and it lands near the foot of the mast.



After the boat leaves port and begins to sail at a uniform speed straight ahead, the man drops another stone from the top of the mast. The stone again lands near the foot of the moving mast, and to the observers on board (who share the same common lateral inertial motion as the ship and the stone) it appears like it fell straight down. Why? Because the body of reference for the observers on board is the uniformly moving boat and its mast, not the relatively stationary water. The "stone falls...along a vertical [path] that is moving with the ship" (Born, p. 69).



However, for the man on the shore who has a different visual perspective and a different body of reference (vis. the shore and water which are at rest relative to the moving boat) and who does <u>not</u> share the same common inertial motion with the boat, the man on the mast, and the stone...the trajectory of the falling stone appears to be curving forward relative to the boat. Why? Because the man on the shore has a different perspective, and his reference body is the relatively stationary shore and water, not the uniformly moving boat and mast.

Question: Which observation is correct? Answer: The perception of each observer is <u>relative</u> to his position, his perspective, his reference body.

Galileo's ship

From Wikipedia, the free encyclopedia

Galileo's ship is a physics experiment proposed by Galileo Galilei, the famous 16th and 17th century physicist, astronomer, and philosopher. The experiment was created to disprove popular arguments against the idea of a rotating Earth.

Background

Galileo's 1632 book *Dialogue Concerning the Two Chief World Systems* considered (the Second Day) all the common arguments then current against the idea that the Earth moves. One of these is that if the Earth were spinning on its axis, then we would all be moving to the East at hundreds of miles an hour so a ball dropped straight down from a tower would land West of the tower which would have moved some distance East in the interim. Similarly, the argument went, a cannon ball fired to the East would land closer to the cannon than one fired to the West because the cannon moving East would partly catch up with the ball. To counter such arguments the book observes that a person on a uniformly moving ship has no sense of movement and so a cannon ball dropped from the top of the mast would fall directly to the foot. To prove the point Galileo's fictional advocate Salviati proposed the experiment described below to show the classical principle of relativity according to which there is no internal observation (i.e. without, as it were, looking out the window) by which one can distinguish between a system moving uniformly from one at rest. Hence, any two systems moving without acceleration are equivalent, and unaccelerated motion is relative. The principle was stated only for mechanical motion. Later its application to the behavior of light led Albert Einstein to formulate the special theory of relativity.

The proposal

Salviati's experiment goes as follows:

> Shut yourself up with some friend in the main cabin below decks on some large ship, and have with you there some flies, butterflies, and other small flying animals. Have a large bowl of water with some fish in it; hang up a bottle that empties drop by drop into a wide vessel beneath it. With the ship standing still, observe carefully how the little animals fly with equal speed to all sides of the cabin. The fish swim indifferently in all directions; the drops fall into the vessel beneath; and, in throwing something to your friend, you need throw it no more strongly in one direction than another, the distances being equal; jumping with your feet together, you pass equal spaces in every direction. When you have observed all these things carefully (though doubtless when the ship is standing still everything must happen in this way), have the ship proceed with any speed you like, so long as the motion is uniform and not fluctuating this way and that. You will discover not the least change in all the effects named, nor could you tell from any of them whether the ship was moving or standing still. In jumping, you will pass on the floor the same spaces as before, nor will you make larger jumps toward the stern than toward the prow even though the ship is moving quite rapidly, despite the fact that during the time that you are in the air the floor under you will be going in a direction opposite to your jump. In throwing something to your companion, you will need no more force to get it to him whether he is in the direction of the bow or the stern, with yourself situated opposite. The droplets will fall as before into the vessel beneath without dropping toward the stern, although while the drops are in the air the ship runs many spans. The fish in their water will swim toward the front of their bowl with no more effort than toward the back, and will go with equal ease to bait placed anywhere around the edges of the bowl. Finally the butterflies and flies will continue their flights indifferently toward every side, nor will it ever happen that they are concentrated toward the stern, as if tired out from keeping up with the course of the ship, from which they will have been separated during long intervals by keeping themselves in the air. And if smoke is made by burning some incense, it will be seen going up in the form of a little cloud, remaining still and moving no more toward one side than the other. The cause of all these correspondences of effects is the fact that the ship's motion is common to all the things contained in it, and to the air also. That is why I said you should be below decks; for if this took place above in the open air, which would not follow the course of the ship, more or less noticeable differences would be seen in some of the effects noted.