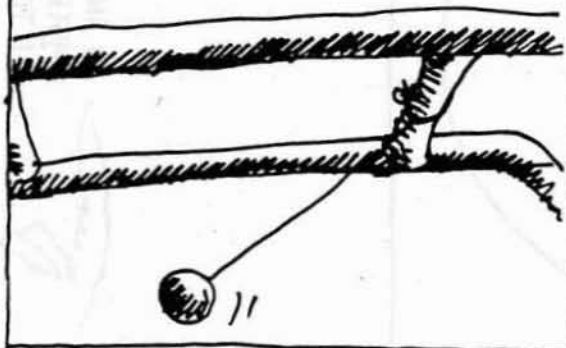


SOME FORCES ARE

FICTITIOUS



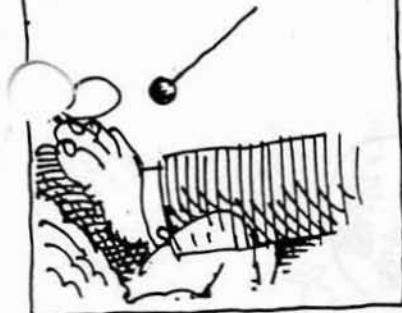
RECALL THE ACCELEROMETER BALL WE HUNG FROM RINGO'S ROLL BAR? IT HANGS BACKWARD WHEN HE ACCELERATES. BUT WHY?



THERE ARE ONLY TWO REAL FORCES ON THE BALL: GRAVITY, WHICH PULLS DOWNWARD WITH MAGNITUDE mg , AND THE TENSION T ON THE STRING. WHEN RINGO ACCELERATES, THE TOTAL OF THESE TWO MUST POINT FORWARD WITH MAGNITUDE ma , BY NEWTON'S SECOND LAW — SO THE STRING MUST HANG AT AN ANGLE.



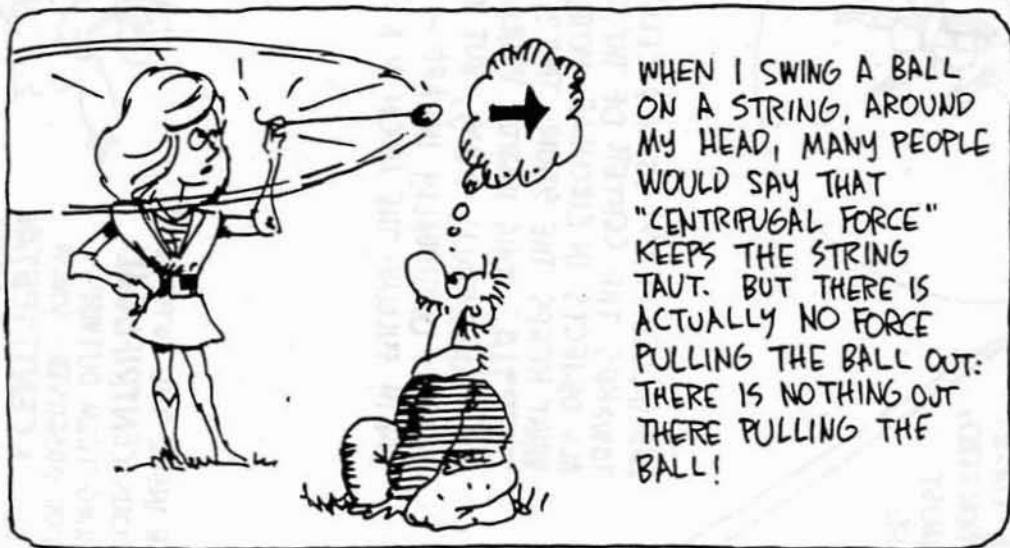
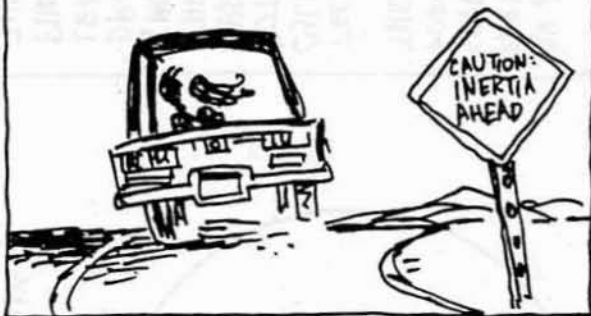
BUT RINGO, IN THE CAR, IMAGINES A STRANGE "ACCELERATION FORCE" PUSHING EVERYTHING BACKWARDS!



BUT THERE IS NOTHING DOING THE PUSHING. THE "FORCE" IS FICTITIOUS, AN EFFECT OF INERTIA RESISTING THE CAR'S ACCELERATION.

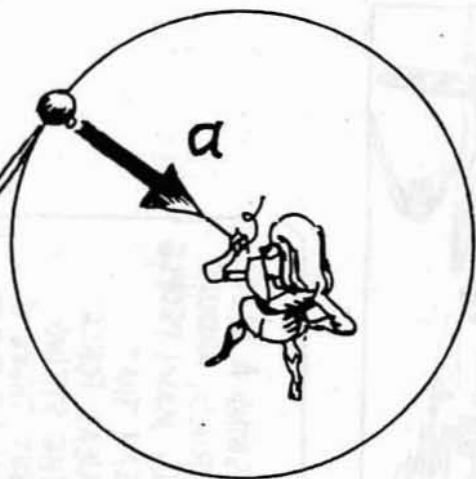


ALL THE SIDEWAYS AND BACK-AND-FORTH FORCES YOU FEEL WHILE DRIVING ARE FICTITIOUS, THE RESULT OF YOUR INERTIA RESISTING ACCELERATION.



WHEN I SWING A BALL ON A STRING, AROUND MY HEAD, MANY PEOPLE WOULD SAY THAT "CENTRIFUGAL FORCE" KEEPS THE STRING TAUT. BUT THERE IS ACTUALLY NO FORCE PULLING THE BALL OUT: THERE IS NOTHING OUT THERE PULLING THE BALL!

"CENTRIFUGAL FORCE" IS FICTITIOUS! THE ONLY FORCE PULLING ON THE BALL IS THAT OF THE STRING, PULLING TOWARD THE CENTER OF THE CIRCLE - A **CENTRIPETAL** FORCE. THIS FORCE IS NON-ZERO, SO THE BALL MUST BE ACCELERATING.



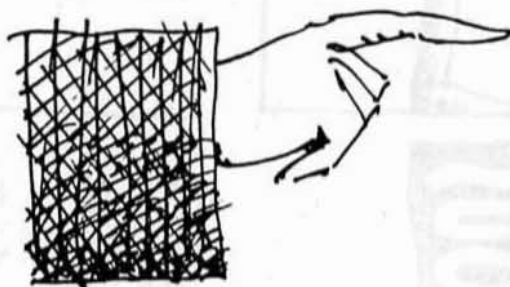
AND INDEED IT IS! IT IS ACCELERATING TOWARDS THE CENTER OF THE CIRCLE, AS ALL OBJECTS IN CIRCULAR MOTION DO. WHAT KEEPS THE STRING TAUT? THE BALL'S **INERTIA**. THIS INERTIA WOULD MAKE IT FLY TANGENTIALLY AWAY, BUT THE STRING PULLS IT CONTINUALLY INWARD - JUST LIKE THE EARTH PULLING THE MOON IN A CIRCULAR ORBIT.

THE PEOPLE INSIDE THE ROTOR FEEL THE FICTITIOUS **CENTRIFUGAL** FORCE PUSHING THEM OUTWARD. BUT OUTSIDE OBSERVERS KNOW THERE IS ONLY A **CENTRIPETAL** FORCE FROM THE WALL, PUSHING THE RIDERS INWARD INTO CIRCULAR MOTION.



AN AMUSEMENT PARK OFFERS SEVERAL FICTITIOUS FORCES. LOOK AT THE **ROTOR**:

PEOPLE ENTER A CYLINDER, WHICH ROTATES, PRESSING THEM AGAINST THE WALL - THEN THE FLOOR DROPS AWAY, LEAVING THEM PINNED TO THE WALL!



IN AN ACCELERATING SYSTEM (ROTATING HERE) FICTITIOUS FORCES APPEAR. A NON-ACCELERATING OBSERVER CAN DESCRIBE THE MOTION WITH REAL FORCES AND NEWTON'S LAWS.