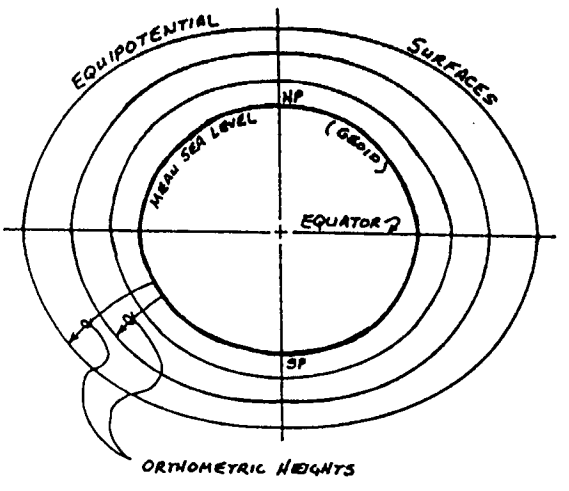
PHYSICAL GEODESY

Physical geodesy is the branch of science which relates the internal constitution of the earth to its external gravity field. Gravity is a vector quantity and (at a simplified level) is the vector sum of gravitational attraction and centrifugal force due to the earth's rotation. Gravitational attraction is the mutual force, described by Newton, which exists between each and all particles of the universe.

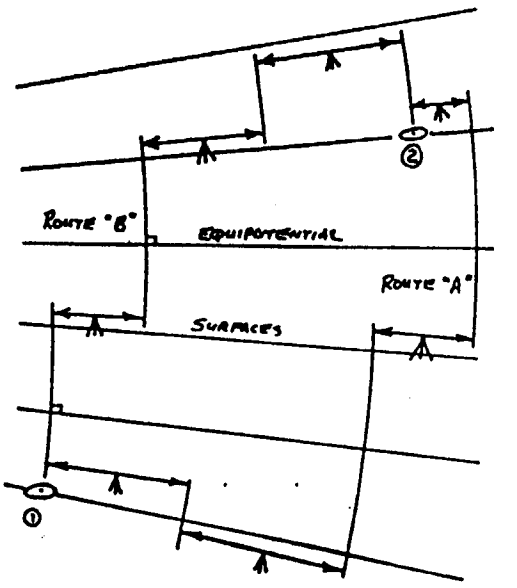
$F = k M_1 M_2 / D^2$ where k = universal gravitational constant, M_1 & M_2 are masses of particles, and D = distance between particles.

The magnitude of the attraction decreases by the square of the distance between them and the direction is co-linear. Particles with large separation react minimally, but taken as a large collection (a large body such as the earth or sun can be treated as a point mass located at its center), they combine to keep the planets in orbit about the sun and the moon & satellites in orbit about the earth. Conventional practice on earth is to express gravitational attraction as the force per unit mass related to the mass of the earth concentrated at its center.

The small vector quantity for centrifugal force can not be ignored in physical geodesy but the total gravity vector is considered because that is the force acting on a plumb bob and a level surface is perpendicular to that vertical line. As noted earlier, the consequence of the vector force addition is a flattened earth as postulated by Newton. Another consequence is that level, *equipotential*, surfaces are not parallel (on a global scale) and the distance between two level surfaces is not constant as shown below.



a.) EQUIPOTENTIAL SURFACES



b.) ROUTE DEPENDENT LEVELING