Tides Essay, Research Paper

Lunar Tides

The moon, being much nearer to the earth than the sun, is the principal cause of tides. When the moon is directly over a given point on the surface of the earth, it exerts a powerful pull on the water, which therefore rises above its normal level. Water covering the portion of the earth farthest from the moon is also subject to this pull, so that another distinct dome of water is formed on the farther side of the earth providing the basis for a second wave. The lunar wave crest directly beneath the moon is called direct tide, and the crest on the side of the earth diametrically opposite is called opposite tide. At both crests, the condition known as high water prevails, while along the circumference of the earth perpendicular to the direct-opposite tidal axis, phases of low water occur.

Low and high waters alternate in a continuous cycle. The variations that naturally occur in the level between successive high water and low water are referred to as the range of tide. At most shores throughout the world, two high waters and two low waters occur every lunar day, the average length of a lunar day being 24 hr, 50 min, and 28 sec. One of these high waters is caused by the direct-tide crest and the other by the opposite-tide crest. Two successive high waters or low waters are generally of about the same height. At various places outside the Atlantic Ocean, however, these heights vary considerably; this phenomenon, which is known as diurnal inequality, is not completely understood at the present time.

Solar Tides

The sun likewise gives rise to two oppositely situated wave crests, but because the sun is far from the earth, its tide-raising force is only about 46 percent that of the moon. The sum of the forces exerted by the moon and sun result in a wave consisting of two crests, the positions of which depend on the relative positions of the sun and moon at the time. During the periods of new and full moon, when the sun, moon, and earth are directly in line, the solar and lunar waves coincide. This results in the condition known as spring tides, in which the high water is higher and the low water is lower than usual. When the moon is in first or in third quarter, however, it is at right angles to the sun relative to the earth, and the height of the waves is subject to the opposing forces of the sun and moon. This condition produces neap tides, in which the high water is lower, and the low water higher, then normal. Spring and neap tides occur about 60 hr after the corresponding phases of the moon, the intervening period of time being known as the age of the tide or age of the phase inequality. The interval of time between the crossing of a meridian by the moon at one point and the next high water at that point is called the lunitidal interval, or the high-water interval for that point. The low-water interval is the period between the time the moon crosses the meridian and the next low water. Average values for the high-water lunitidal intervals during periods of new and full moon are known as the establishment of the port. Values for the intervals during other periods of the month are often referred to as the corrected establishment.