rior. He found that the precessional and nutational movements could not possibly be as they are, if the planet consisted of a central core of molten rock surrounded with a crust of twenty or thirty miles in thickness; that the least possible thickness of crust consistent with the existing movements was from 800 to 1000 miles; and that the whole might even be solid to the centre, with the exception of comparatively small vesicular spaces filled with melted rock.[51]

M. Delaunay[52] threw doubt on Hopkins' views, and suggested that, if the interior were a mass of sufficient viscosity, it might behave as if it were a solid, and thus the phenomena of precession and nutation might not be affected. Lord Kelvin (Sir W. Thomson), who had already arrived at the conclusion that the interior of the globe must be solid, and acquiesced generally in Hopkins' conclusions, remarked that the hypothesis of a viscous and quasi-rigid interior "breaks down when tested by a simple calculation of the amount of tangential force required to give to any globular portion of the interior mass the precessional and nutational motions which, with other physical astronomers, M. Delaunay attributes to the earth as a whole."[53] He held the earth's crust down to depths of hundreds of kilometres to be capable of resisting such a tangential stress (amounting to nearly $\frac{1}{10}$th of a gramme weight per square centimetre) as would with great rapidity draw out of shape any plastic substance which could properly be termed a viscous fluid, and

---

[51] Phil. Trans. 1839, p. 381; 1840, p. 193; 1842, p. 43; Brit. Assoc. 1847.

[52] In a paper on the hypothesis of the interior fluidity of the globe, Comptes rendus, July 13, 1868. Geol. Mag. v. p. 507. See also H. Hennessy, Comptes rendus, March 6, 1871, Geol. Mag. viii. p. 216. Nature, xv. p. 78. O. Fisher, "Physics of the Earth's Crust," 2d Edition, 1889.

[53] Nature, February 1, 1872.