Darwin, George Howard | Encyclopedia.com

(*b*. Down House, Kent, England, 9 July 1845; *d*. Cambridge, England, 7 December 1912)

mathematics, astronomy.

Darwin was the fifth child of Charles Robert Darwin and Emma Wedgwood. His greatgrandfather was Erasmus Darwin: his middle name commemorates Erasmus Darwin's first wife, Mary Howard. The Darwin family was comfortably settled in Kent, where George Howard Darwin began his education at the private school of the Reverend Charles Pritchard (who was afterward Savillian professor of astronomy at Oxford). Darwin went on to attend Trinity College, Cambridge, from which he graduated second wrangler and Smith's prizeman in 1868. Darwin did not immediately embrace a scientific career, but rather studied law for six years and was admitted to the bar in 1874, although he never practiced that profession.

Darwin was elected fellow of Trinity College in October 1868, but did not return there for good until October 1873. There, in 1875, he began the series of mathematical papers that were eventually to form the four large volumes of his *Scientific Papers*. In 1879 he was elected fellow of the Royal Society and in 1883 he was elected Plumian professor of astronomy and experimental philosophy at Cambridge, to succeed James Challis.

Darwin held the Plumian professorship for the rest of his life. The chair bore no necessary connection with the observatory, and practical astronomy formed no part of his duties. His lectures on theoretical astronomy were poorly attended, but among his students were Ernest W. Brown and Sir James Jeans. During this tenure, Darwin received several honors and distinctions, including, in 1905, a knighthood (knight commander of the Bath) through the offices of his college friend Arthur Balfour. In 1912 he served as president of the International Congress of Mathematicians at Cambridge. This was his last public function; he died of cancer shortly thereafter, and was buried in Trumpington Cemetery, near Cambridge. He was survived by his widow, the former Maud Du Puy of Philadelphia, whom he had married in 1884, and four children, of whom the eldest, Charles Galton Darwin, was also a scientist.

Darwin's paper "On the Influence of Geological Changes on the Earth's Axis of Rotation," published in 1876, marked the beginning of his investigations of essentially geophysical problems. This work was directly inspired by Lord Kelvin, whose great interest in the young Darwin may be said to have been the chief influence in his decision to make science his career. Another group of papers, dated from 1879 to 1880, are concerned with the tides in viscous spheroids, and still show the influence of both Kelvin and Laplace, although their scope is more general. In his paper of this series, "On the Precession of a Viscous Spheroid and on the Remote History of the Earth" (1879), Darwin proposed the "resonance theory" of the originated from the fission of a parent earth as the result of an instability produced by resonant solar tides. His monumental paper "On the Secular Changes in the Elements of the Orbit of a Satellite Revolving About a Tidally Distorted Planet" was published in 1880.

Following his accession to the Plumian chair Darwin delved even more deeply into the problems of the origin and evolution of the solar system, making numerous investigations of the figures of equilibrium of rotating masses of fluid and, later, making extensive studies of periodic orbits in the restricted problem of three bodies, carried out with special reference to cases obtaining for the particular values of the mass ratio of the two finite bodies of 1:10 and 1:1048 (the latter approximating the mass ratio of Jupiter to that of the sun).

Darwin's most significant contribution to the history of science lies in his pioneering work in the application of detailed dynamical analysis to cosmological and geological problems. That many of his conclusions are now out of date should in no way diminish the historical interest of his experiments, nor the important service that he rendered cosmogony by the example he gave of putting various hypotheses to the test of actual calculations. Darwin's method remains a milestone in the development of cosmogony, and subsequent investigators have favored it over the merely qualitative arguments prevalent until that time.

That Darwin's scientific work is homogeneous is apparent from glancing at the titles of the more than eighty papers collected in the four volumes of his *Scientific Works*. After publishing some short notes on a variety of subjects, he devoted himself steadfastly to the problems of mathematical cosmogony, departing from them only to undertake problems of pressing practical concern (as, for example, in his work on oceanic tides). The greatest part of his work is devoted to the explanation of the various aspects of the history of the double stars, the planetary system, and satellite systems. His papers on viscous spheroids (including those on tidal friction), on rotating homogeneous masses of fluids, and even those on periodic orbits are means to this end.

Darwin's work is further marked by the virtually complete absence of investigations undertaken out of sheer mathematical interest, rather than in the elucidation of some specific problem in physics. Indeed, he was an applied mathematician of the school of Kelvin or Stokes and was content to study physical phenomena by the mathematical methods most convenient to the purpose, regardless of their novelty or elegance. Should the problem fail to yield to analysis, Darwin resorted to computation, never hesitating to embark upon onerous and painstaking numerical work (such as marks his investigations of the stability of pear-shaped figures of equilibrium or of periodic orbit in the restricted problem of three bodies). Indeed, it would seem that he actually preferred quantitative rather than qualitative results, although he seldom carried his calculations beyond pragmatic limits. That this approach was sometimes too blunt is illustrated by Darwin's 1902 investigation of the stability of a rotating pear-shaped figure, which he found to be stable; shortly after publication of Darwin's results, Aleksandr Liapunov announced his proof of the instability of the pear-shaped figure, and several years later Darwin's pupil Jeans showed that Liapunov was indeed correct.

In his speech to the Fifth International Congress of Mathematicians at Cambridge in 1912, Darwin summed up his method, speaking of his work on the problem of three bodies and comparing his technique to that of Poincaré, to whom he had often paid tribute:

My own work… cannot be said to involve any such skill at all, unless you describe as skill the procedure of a housebreaker who blows in a safe door with dynamite instead of picking the lock. It is thus by brutal force that this tantalising problem has been compelled to give up a few of its secrets; and, great as has been the labour involved, I think it has been worth while…. To put at their lowest the claims of this clumsy method, which may almost excite the derision of the pure mathematician, it has served to throw light on the celebrated generalisations of Hill and Poincaré.

I appeal, then, for mercy to the applied mathematician, and would ask you to consider in a kindly spirit the difficulties under which he labours. If our methods are often wanting in elegance and do but little to satisfy that aesthetic sense of which I spoke before, yet they constitute honest attempts to unravel the secrets of the universe in which we live.

BIBLIOGRAPHY

I. Original Works. Darwin's books are *The Tides and Kindred Phenomena in the Solar System* (London, 1898), based on a series of popular lectures delivered in Boston in 1897, and *Scientific Papers* (London, 1907–1916). Among his most important articles are "On the Influence of Geological Changes on the Earth's Axis of Rotation," in *Philosophical Transactions of the Royal Society***167A** (1876). 271–312; "On the Precession of a Viscous Spheroid and on the Remote History of the Earth." *ibid*., **170A** (1879), 447–538; "On the Secular Changes in the Elements of the Orbit of a Satellite Revolving About a Tidally Distorted Planet." *ibid*., **171A** (1880). 713–891; and "On a Pear-Shaped Figure of Equilibrium," *ibid*., **200A** (1902), 251–314, Darwin's presidential address presenting the medal to Poincaré is in *Monthly Notices of the Royal Astronomical Society*, **60** (1900), 406–415.

II. Secondary Literature. A memoir of Darwin's life by his brother, Sir Francis Darwin, is affixed to vol. V of his *Scientific Papers* (London, 1916).

Obituaries include those by F. J. M. Stratton in *Monthly Notices of the Royal Astronomical Society*, **73** (1913), 204–210; and S. S. Hough, in *Proceedings of the Royal Society*, **89A** (1914), i-xiii.

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