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GAUSS.

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GAUSS, CARL FRIEDRICH (1777—1855), an eminent German mathematician, was born of humble parents at Brunswick, April 23, 1777, and was indebted for a liberal education to the notice which his talents procured him from the reigning duke. His name became widely known by the publication, in his twenty-fifth year (1801), of the *Disquisitiones Arithmeticae*. In 1807 he was appointed director of the Göttingen observatory, an office which he retained to his death: it is said that he never slept away from under the roof of his observatory, except on one occasion, when he accepted an invitation from Humboldt to attend a meeting of natural philosophers at Berlin. In 1809 he published at Hamburg his *Theoria Motus Corporum Cælestium*, a work which gave a powerful impulse to the true methods of astronomical observation; and his astronomical workings, observations, calculations of orbits of planets and comets, &c., are very numerous and valuable. He continued his labours in the theory of numbers and other analytical subjects, and communicated a long series of memoirs to the Royal Society of Sciences at Göttingen. His first memoir on the theory of magnetism, *Intensitas vis magneticæ terrestris ad mensuram absolutam revocata*, was published in 1833, and he shortly afterwards proceeded, in conjunction with Professor Wilhelm Weber, to invent new apparatus for observing the earth's magnetism and its changes; the instruments devised by them were the declination instrument and the bifilar magnetometer. With Weber's assistance he erected in 1833 at Göttingen a magnetic observatory free from iron (as Humboldt and Arago had previously done on a smaller scale), where he made magnetic observations, and from this same observatory he sent telegraphic signals to the neighbouring town, thus showing the practicability of an electromagnetic telegraph. He further instituted an association (Magnetische Verein), composed at first almost entirely of Germans, whose continuous observations on fixed term-days extended from Holland to Sicily. The volumes of their publication, *Resultate aus den Beobachtungen des magnetischen Vereins*, extend from 1836 to 1839; and in those for 1838 and 1839 are contained the two important memoirs by Gauss, *Allgemeine Theorie des Erdmagnetismus*, and the *Allgemeine Lehrsätze*—on the theory of forces attracting according to the inverse square of the distance. The instruments and methods thus due to him are substantially those employed in the magnetic

observatories throughout the world. He co-operated in the Danish and Hanoverian measurements of an arc and trigonometrical operations (1821—48), and wrote (1843, 1846) the two memoirs *Ueber Gegenstände der höhern Geodäsie*. Connected with observations in general we have (1812—26) the memoir *Theoria combinationis observationum erroribus minimis obnoxia*, with a second part and a supplement. Another memoir of applied mathematics is the *Dioptrische Untersuchungen*, 1840. Gauss was well versed in general literature and the chief languages of modern Europe, and was a member of nearly all the leading scientific societies in Europe. He died at Göttingen early in the spring of 1855. The centenary of his birth was celebrated (1877) at his native place, Brunswick.

Gauss's collected works have been recently published by the Royal Society of Göttingen, in 7 vols. 4to, Gött., 1863—71, edited by E. J. Schering,—(1) the *Disquisitiones Arithmeticae*, (2) *Theory of Numbers*, (3) *Analysis*, (4) *Geometry and Method of Least Squares*, (5) *Mathematical Physics*, (6) *Astronomy*, and (7) the *Theoria Motus Corporum Caelestium*. They include, besides his various works and memoirs, notices by him of many of these, and of works of other authors in the *Göttingische gelehrte Anzeigen*, and a considerable amount of previously unpublished matter, *Nachlass*. Of the memoirs in pure mathematics, comprised for the most part in vols. II., III., and IV. (but to these must be added those on *Attractions* in vol. v.), it may be safely said there is not one which has not signally contributed to the progress of the branch of mathematics to which it belongs, or which would not require to be carefully analysed in a history of the subject. Running through these volumes in order, we have in the second the memoir, *Summatio quarundam serierum singularium*, the memoirs on the theory of biquadratic residues, in which the notion of complex numbers of the form $a + bi$ was first introduced into the theory of numbers; and included in the *Nachlass* are some valuable tables. That for the conversion of a fraction into decimals (giving the complete period for all the prime numbers up to 997) is a specimen of the extraordinary love which Gauss had for long arithmetical calculations; and the amount of work gone through in the construction of the table of the number of the classes of binary quadratic forms must also have been tremendous. In vol. III. we have memoirs relating to the proof of the theorem that every numerical equation has a real or imaginary root, the memoirs on the *Hypergeometric Series*, that on *Interpolation*, and the memoir *Determinatio Attractionis*—in which a planetary mass is considered as distributed over its orbit according to the time in which each portion of the orbit is described, and the question (having an implied reference to the theory of secular perturbations) is to find the attraction of such a ring. In the solution the value of an elliptic function is found by means of the *arithmetico-geometrical mean*. The *Nachlass* contains further researches on this subject, and also researches (unfortunately very fragmentary) on the lemniscate-function, &c., showing that Gauss was, even before 1800, in possession of many of the discoveries which have made the names of Abel and Jacobi illustrious. In vol. IV. we have the memoir *Allgemeine Auflösung...*, on the graphical representation of one surface upon another, and the *Disquisitiones generales circa superficies curvas*. And in vol. v. we have a memoir *On the Attraction of Homogeneous Ellipsoids*, and the already mentioned memoir *Allgemeine Lehrsätze...*, on the theory of forces attracting according to the inverse square of the distance.