contents are nearly the same as those of the original work, the chief difference being that a large table of Gaussian logarithms is added. Vega differs from Hutton and Callet in giving so many useful non- logarithmic tables, and his collection is in many respects comple­mentary to theirs. Schulze, *Neue und erweiterte Sammlung log­arithmischer, trigonometrischer, und anderer Tafeln* (Berlin, 1778, 2 vols.), is a valuable collection, and contains seven-figure loga­rithms to 101,000, log sines and tangents to 2° at intervals of a second, and natural sines, tangents, and secants to 7 places, log sines and tangents and Napierian log sines and tangents to 8 places, all for every ten seconds to 4° and thence for every minute to 450, besides squares, cubes, square roots, and cube roots to 1000, binomial theorem coefficients, powers of *e,* and other small tables. Wolfram’s hyperbolic logarithms of numbers below 10,000 to 48 places first appeared in this work. Lambert, *Supplementa Tabu­larum Logarithmicarum et Trigonometricarum* (Lisbon, 1798), con­tains a number of useful and curious non-logarithmic tables ; it bears a general resemblance to the second volume of Vega, but contains numerous other small tables of a more strictly mathe­matical character. A very useful collection of non-logarithmic tables is printed in Barlow’s *New Mathematical Tables* (London, 1814). It gives squares, cubes, square roots, and cube roots (to 7 places), reciprocals to 9 or 10 places, and resolutions into their prime factors of all numbers from 1 to 10,000, the first ten powers of numbers to 100, fourth and fifth powers of numbers from 100 to 1000, prime numbers from 1 to 100,103, eight-place hyperbolic logarithms to 10,000, tables for the solution of the irreducible case in cubic equations, &c. In the stereotyped reprint of 1840 only the squares, cubes, square roots, cube roots, and reciprocals are retained. The first volume of Shortrede’s tables, in addition to the trigonometrical canon to every second, contains antilogarithms and Gaussian logarithms. Hassler, *Tabulae Logarithmicæ*

*et Trigono- metricæ* (New York, 1830, stereotyped), gives seven-figure logarithms to 100,000, log sines and tangents for every second to lo, and log sines, cosines, tangents, and cotangents from lo to 3° at intervals of 10" and thence to 45° at intervals of 30". Every effort has been made to reduce the size of the tables without loss of distinctness, the page being only about 3 by 5 inches. Copies of the work were published with the introduction and title-page in different lan­guages. Stanley, *Tables of Logarithms* (New Haven, U.S., 1860), gives seven-figure logarithms to 100,000, and log sines, cosines, tangents, cotangents, secants, and cosecants at intervals of ten seconds to 15° and thence at intervals of a minute to 45° to 7 places, besides natural sines and cosines, antilogarithms, and other tables. This collection owed its origin to the fact that Hassler’s tables were found to be inconvenient owing to the smallness of the type. Luvini, *Tables of Logarithms* (London, 1866, stereotyped, printed at Turin), gives seven-figure logarithms to 20,040, Briggian and hyperbolic logarithms of primes to 1200 to 20 places, log sines and tangents for each second to 9', at intervals of 10" to 2°, of 30" to 9°, of 1' to 45° to 7 places, besides square and cube roots up to 625. The book, which is intended for schools, engineers, &c., has a peculiar arrange­ment of the logarithms and proportional parts on the pages. Chambers’s *Mathematical Tables* (Edinburgh), containing loga­rithms of numbers to 100,000, and a canon to every minute of log sines, tangents, and secants and of natural sines to 7 places, besides proportional logarithms and other small tables, is cheap and suitable for schools, though not to be compared as regards matter or typo­graphy to the best tables described above. Of six-figure tables Bremiker’s *Logarithmorum VI. Decimalium Nova Tabula Bero- linensis* (Berlin, 1852) is probably one of the best. It gives logarithms of numbers to 100,000, with proportional parts, and log sines and tangents for every second to 5°, and beyond this point for every ten seconds, with proportional parts. Hantschl, *Logarithmisch-trigonometrisches Handbuch* (Vienna, 1827), gives five-figure logarithms to 10,000, log sines and tangents for every ten seconds to 6 places, natural sines, tangents, secants, and versed sines for every minute to 7 places, logarithms of primes to 15,391, hyperbolic logarithms of numbers to 11,273 to 8 places, least divisors of numbers to 18,277, binomial theorem coefficients, &c. Farley’s *Six-Figure Logarithms* (London, stereotyped, 1840) gives six-figure logarithms to 10,000 and log sines and tangents for every minute to 6 places. Of five-figure tables the most convenient is *Tables of Logarithms* (Useful Knowledge Society, London, from the stereotyped plates of 1839), which were prepared by De Morgan, though they have no name on the title-page. They contain five- figure logarithms to 10,000, log sines and tangents to every minute to 5 places, besides a few smaller tables. Lalande’s *Tables de Logarithmes* is a five-figure table with nearly the same contents as De Morgan’s, first published in 1805. It has since passed through many editions, and, after being extended from 5 to 7 places, passed through several more. Galbraith and Haughton, *Manual of Mathe­matical Tables* (London, 1860), give five-figure logarithms to 10,000 and log sines and tangents for every minute, also a small table of Gaussian logarithms. Houël, *Tables de Logarithmes à Cinq Déci­males* (Paris, 1871), is a very convenient collection of five-figure tables ; besides logarithms of numbers and circular functions, there

are Gaussian logarithms, least divisors of numbers to 10,841, anti­logarithms, &c. The work contains 118 pages of tables. The same author’s *Recueil de Formules et de Tables Numériques* (Paris, 1868) contains 19 tables, occupying 62 pages, most of them giving results to 4 places ; they relate to very varied subjects,—antilogarithms,

Gaussian logarithms, logarithms of (1+*x*)/(1-*x*), elliptic integrals, squares for use in the method of least squares, &c. Bremiker, *Tafel vier­stelliger Logarithmen* (Berlin, 1874), gives four-figure logarithms of numbers to 2009, log sines, cosines, tangents, and cotangents to 8° for every hundredth of a degree, and thence to 45° for every tenth of a degree, to 4 places. There are also Gaussian logarithms, squares from 0∙000 to 13,500, antilogarithms, &c. The book contains 60 pages. Willich, *Popular Tables* (London, 1853), is a useful book for an amateur ; it gives Briggian and hyperbolic logarithms to 1200 to 7 places, squares, &c., to 343, &c.

*Hyperbolic or Napierian Logarithms.—*The logarithms invented by Napier and explained by him in the *Descriptio* (1614) were not the same as those now called natural or hyperbolic (viz., to base c), and very frequently also Napierian, logarithms. Napierian logarithms, strictly so called, have entirely passed out of use and are of purely historic interest ; it is therefore sufficient to refer to Logarithms and Napier, where a full account is given. Apart from the inventor’s own publications, the only Napierian tables of importance are contained in Ursinus’s *Trigonometria* (Cologne, 1624-25) and Schulze’s *Sammlung* (Berlin, 1778), the former being the largest that has been constructed. Logarithms to the base *e,* where *e* denotes 2∙71828, were first published by Speidell, *New Logarithmes* (1619).

The most copious table of hyperbolic logarithms is Dase, *Tafel der natürlichen Logarithmen* (Vienna, 1850), which extends from 1 to 1000 at intervals of unity and from 1000 to 10,500 at intervals of ∙1 to 7 places, with differences and proportional parts, arranged as in an ordinary seven-figure table. By adding log 10 to the results the range is from 10,000 to 105,000 at intervals of unity. The table formed part of the *Annals of the Vienna Observatory* for 1851, but separate copies were printed. The most elaborate table of hyperbolic logarithms is due to Wolfram, who calculated to 48 places the logarithms of all numbers up to 2200, and of all primes (also of a great many composite numbers) between this limit and 10,009. Wolfram’s results first appeared in Schulze’s *Samm­lung* (1778). Six logarithms which Wolfram had been prevented from computing by a serious illness were supplied in the *Berliner Jahrbuch,* 1783, p. 191. The complete table was reproduced in Vega’s *Thesaurus* (1794), when several errors were corrected. Tables of hyperbolic logarithms are contained in the following collections:—Callet, all numbers to 100 and primes to 1097 to 48 places ; Borda and Delambre (1801), all numbers up to 1200 to 11 places ; Salomon (1827), all numbers to 1000 and primes to 10,333 to 10 places ; Vega, *Tabulae* (including Hülsse’s edition, 1840), and Köhler (1848), all numbers to 1000 and primes to 10,000 to 8 places ; Barlow (1814), all numbers to 10,000 ; Hutton and Willich (1853), all numbers to 1200 to 7 places ; Dupuis (1868), all numbers to 1000 to 7 places. Hutton also gives hyperbolic logarithms from 1 to 10 at intervals of ∙01 to 7 places. *Rees's Cyclopaedia* (1819), art. “Hyperbolic Logarithms,” contains a table of hyperbolic loga­rithms of all numbers up to 10,000 to 8 places.

*Tables to convert Briggian into Hyperbolic Logarithms, and vice versa.—*Such tables merely consist of the first hundred (sometimes only the first ten) multiples of the modulus ∙43429 44819... and its reciprocal 2∙30258 50929 ... to 5, 6, 8,10, or more places. They are generally to be found in collections of logarithmic tables, but rarely exceed a page in extent, and are very easy to construct. Schrön and Bruhns both give the first hundred multiples of the modulus and its reciprocal to 10 places, and Bremiker (in his edition of Vega and in his six-figure tables) and Dupuis to 7 places. Degen, *Tabularum Enneas* (Copenhagen, 1824), gives the first hundred multiples of the modulus to 30 places.

*Antilogarithms.—* In the ordinary tables of logarithms the natural numbers are integers, while the logarithms are incommen­surable. In an antilogarithmic canon the logarithms are exactquantities, such as ∙00001, ∙00002, &c., and the corresponding numbers are incommensurable. The largest and earliest work of this kind is Dodson’s *Antilogarithmic Canon* (London, 1742), which gives numbers to 11 places corresponding to logarithms from 0 to 1 at intervals of ∙00001, arranged like a seven-figure logarithmic table, with interscript differences and proportional parts at the bottom of the page. This work was the only antilogarithmic canon for more than a century, till in 1844 Shortrede published the first edition of his tables ; in 1849 he published the second edition, and in the same year Filipowski’s tables appeared. Both these works contain seven-figure antilogarithms : Shortrede gives numbers to logarithms from 0 to 1 at intervals of ∙00001, with differences and multiples at the top of the page, and Filipowski, *A Table of Anti­logarithms* (London, 1849), contains a table of the same extent, the proportional parts being given to hundredths.

*Addition and Subtraction, or Gaussian, Logarithms.—*The object