

of a point discharging ether into space with a pulsating rate. The mathematical investigations may be found in the *Cambridge Transactions* and in the *American Journal of Mathematics*. They are not easy to read. C. A. and V. Bjerknæs do not pretend to have laid the foundations of the universe. They have treated a broad problem in hydrodynamics and treated it clearly, completely, systematically. To those who would read with any ease the developments of Hicks's and Pearson's theories the work of Bjerknæs is a practical necessity; to mathematician and physicist alike it is interesting; and had it appeared twenty years ago when first complete, it would doubtless have attracted much more attention and possessed a much greater influence than now.

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SHORTER NOTICES.

Vorlesungen über Geschichte der Trigonometrie. Von DR. A. VON BRAUNMÜHL. Zweiter Teil. Leipzig, B. G. Teubner, 1903. xi + 264 pp.

THE first part of von Braunmühl's History of Trigonometry was reviewed in the BULLETIN, volume 6 (1900), page 404. The second part is fully up to the standard of the first. The completed work will take its place as the fullest and most authoritative history of trigonometry that we have. Cantor's great work, *Vorlesungen über Geschichte der Mathematik*, comes down only to the year 1758, so that the present history of trigonometry covers nearly one hundred and fifty years of this science which have never been treated before with any degree of thoroughness.

The author begins the second part with the history of logarithms. In this connection he gives an account of John Speidell, the author of the first table of natural logarithms. Hitherto, German writers have overlooked Speidell. De Morgan's interesting account of him, given in the article "Tables" in the English Cyclopædia, does not seem to have been used by von Braunmühl. He examined the reprint of Speidell's work, the *New Logarithmes*, that is given in Maseres's *Scriptores Logarithmici*, volume 6, page 713. Maseres reprinted from the edition of 1628, yet von Braunmühl, unaware of this fact, refers in a footnote, page 26, to a remote source

as the authority for the existence of this edition. It is to be regretted that the Dictionary of National Biography overlooks Speidell. In gleaning information relating to mathematicians and astronomers, it appears that the editors of this great dictionary have not exhibited their usual industry. They have passed by not only Speidell, but also Thomas Streete and John Caswell, all men to whose books von Braunmühl makes repeated reference. It may be worth while, in this connection, to state that mention is made of John Speidell in Aubrey's *Brief Lives*,* as follows: "Mr. * * * Spiedell:— he taught mathematiques in London, and published a booke in quarto named Spiedel's Geometrical Extractions (London, 163–), which made young men have a love to geometrie."

Von Braunmühl repeatedly points out mistakes in our histories of mathematics. For instance, he calls attention to the error of ascribing to Napier all four of "Napier's analogies." Only two were given by him; the other two were added by Briggs.

The seventeenth century was the period when trigonometric series were first introduced and the nomenclature and notation of trigonometry were in process of rapid development. The author brings to light some interesting notations, suggested by Wallis, Wing, Oughtred, Herigone and others. De Moivre and Cotes recognized the periodicity of the trigonometric functions and discovered the theorems which bear their names. Goniometry, differential trigonometry, and improved methods of computing π were developed in the early part of the eighteenth century. But von Braunmühl brings out strongly the fact that the science was shaped anew by the genius of Leonhard Euler, who advanced analytic trigonometry, treated trigonometric functions as ratios, gave the first derivation of the sine and cosine series without using the calculus, derived as early as 1740 the expressions $\cos v = \frac{1}{2}(e^{v\sqrt{-1}} + e^{-v\sqrt{-1}})$, $\sin v = -\frac{1}{2}\sqrt{-1}(e^{v\sqrt{-1}} - e^{-v\sqrt{-1}})$ and such oddities as the expression $\frac{1}{2}(2^{v\sqrt{-1}} + 2^{-v\sqrt{-1}}) = \frac{1}{2}$, nearly. He invented several methods for the mensuration of the circle, some of them yielding rapid processes of computing π . He also systematized the treatment of spherical trigonometry.

Upon the history of trigonometry during the last century and a half, von Braunmühl has expended much effort. His aim has

* Ed. A. Clark, Oxford, 1898, Volume II, page 231.

been to include the higher developments, which reach into advanced branches of analysis, the theory of functions and of groups. This has led him to discuss the researches of Lambert, Carnot, Legendre, Möbius, Gauss, Cayley and other mathematicians, many of whom are still living.

Von Braunmühl has taken great pains to secure accuracy, and very few errors have been detected by us. On page 107 the author speaks of $i \equiv \sqrt{-1}$ as "das Gausssche i ." Probably he does not mean to convey the idea by this that Gauss was the first to use i ; this abbreviation was used before Gauss by Euler, as has been pointed out by Beman.* On page 107, line 9, there is an error in algebraic sign in Euler's expression for $\sin v$.

There is evidently an error on page 44 in connection with Thomas Streete, the author of the *Astronomia Carolina*, 1661. In von Braunmühl's history the name of the astronomer occurs repeatedly and it is everywhere correctly spelled "Streete," except on page 44, where we read "Thomas Street (1626-1696)." Now, we are going to show that there were two distinct individuals, a Thomas Streete, the astronomer and a Thomas Street, the judge. The two were contemporaries, but the dates given by von Braunmühl apply to the judge, whose life is sketched quite fully in the Dictionary of National Biography. Wolf says in his *Geschichte der Astronomie*: "Streete designated himself on the title page [of his *Astronomia Carolina*] a 'Student in Astronomy and Mathematics'—was, therefore, in 1661, evidently still quite a young man. Otherwise nothing relating to him appears to have been handed down." Because of this paucity of biographical detail there is danger that an error in dates and in the identity of the man may not be easily detected and, therefore, may be repeated by other writers. We have been able to gather the following details relating to Thomas Streete, the astronomer.

1. Streete is the author of the *Astronomia Carolina*, 1661, and also of works bearing the following titles: *Examen Examinatum, or Wing's Examination of Astronomia Carolina examined* * * * with a castigation of the Envy and Ignorance of Vincent Wing, by Thomas Streete, Student in Astronomy and Mathematicks * * *, London, 1667; *The Genuine Use and Effects of the Gunne*, by Robert Anderson, with Tables of Projection by Thomas Streete, London, 1674; *A Compleat Eph-*

* BULLETIN, volume 4 (1898), page 274.

emerics for the Year of Christ 1684, by Thomas Streete, the author of *Astronomia Carolina* and Teacher of the Mathematics, London, 1684. At the end of his Ephemerics he says: "Touching my further progress in the work of my intended large astronomical tables, the obstacle is no other than my being as yet necessitated to labour upon other things for a present livelyhood * * *."

2. In the appendix to his *Astronomia Carolina* he states that he took observations of lunar eclipses with Mr. Moxon and Mr. R. Anderson in Cornehill. In the preface to the edition of the *Astronomia Carolina*, brought out by Halley in 1710, it is stated "that our author, before his death, had attempted to alter some things in his tables," but had left "very little of the work done."

3. Savérien in his *Dictionnaire universel de mathématique*, Paris, 1753, article "Quartier Anglois" says that after Hooke's invention of a quartier anglois (back-staff): "M. Stréet, auteur de l'*Astronomie Caroline*, inventa ensuite un autre Quartier Anglois, garni de deux plans au travers desquels il regardoit un object directement, & il trouvoit l'autre par la simple reflexion d'un morceau de miroir."*

4. In Aubrey's *Brief Lives* (a source of information generally overlooked by the historians of mathematics) there are a number of details about Thomas Streete. According to Aubrey, Streete was born in Ireland, at Castle Lyons, March 5, 1621. "He dyed in Chanon-row (vulgarly Channel-rowe) at Westminster, the 17th of August, 1689, and is buried in the church yard of the new chapell there towards the east window of the chancel, scilicet, within twenty or 30 foot of the wall. Hee made this following epitaph himself:—

'Here lies the earth of one that thought some good,
Although too few him rightly understood :
Above the starres his heightned mind did flye,
His hapier spirit into Eternity.'

His personality is described thus: "He was of a rough and cholérique humour. Discoursing with Prince Rupert, his highnesse affirmed something that was not according to art; sayd Mr. Street, 'whoever affirms that is no mathematician.' So they would point at him afterwards at court and say, 'There's the man that huff't prince Rupert.'"

* See also Savérien's *Histoire des Progrès de l'Esprit Humain dans les Sciences*, Paris, 1776, pp. 160, 161.

“He hath left with his widowe (who lives in Warwick lane at the signe of the * * *) an absolute piece of Trigonometrie, plain and spherical, in MS., more perfect than ever was yet donne, and more cleare and demonstrated.” Aubrey says that Streete published almanacs, “for about three yeares, dedicated to Elias Ashmole, esquire: but was not encouraged for his great paines.—He was one of Mr. Ashmole’s clarkes in the Excise office, which was his chiefest lively-hood.”

FLORIAN CAJORI.

Réflexions sur la Puissance Motrice du Feu et sur les Machines propres à Développer cette Puissance. Par SADI CARNOT. Réimpression facsimile conforme à l’édition originale de 1824. Paris, A. Hermann, 1903.

Eighty years ago Carnot published his short book which, taken with the work of Joule and Mayer a few years later, forms the basis of our present theories of heat. At that time M. Bachelier, the predecessor of Gauthier-Villars, probably found the work unpopular. Of late years the demand for the original has far exceeded the supply. It is with the purpose of meeting this demand as satisfactorily as possible and at a reasonable price that the work has been reprinted. To render the reproduction exact, even to the misspelling, the photographic method has been employed. This, with the fact that paper to imitate the old has been selected, makes the new edition practically as valuable as the original even from the standpoint of the bibliophile. Not long ago M. Hermann republished in a similar manner the *Théorie des Nombres* of Legendre, and more recently the *Mathematical Papers* of Green. Let us hope that as the great classics of scientific literature become rare, someone may always be found ready to reprint them. Such a procedure is often more desirable than translation or editing as in Ostwald’s or Appleton’s series of scientific classics. It puts at our disposal an exact reproduction of the original.

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