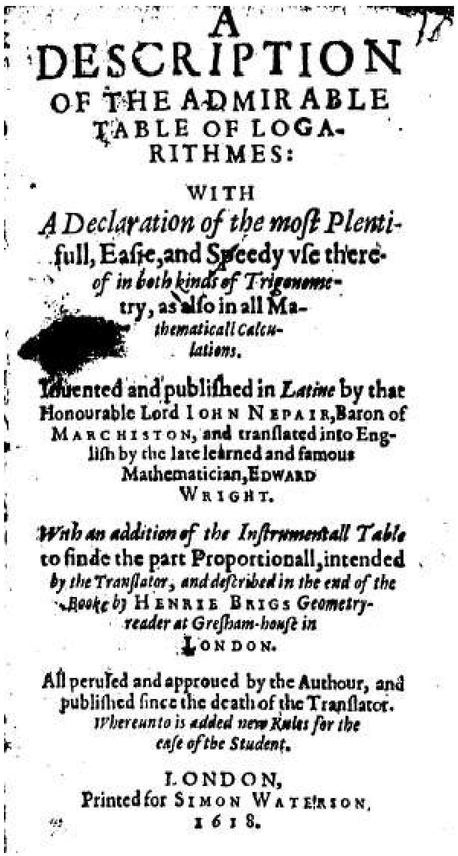
William Oughtred und die Logarithmen

IM 2006 in Greifswald

29. September 2006

Klaus Kühn aus Alling


A DESCRIPTION OF THE ADMIRABLE TABLE OF LOGARITHMES:

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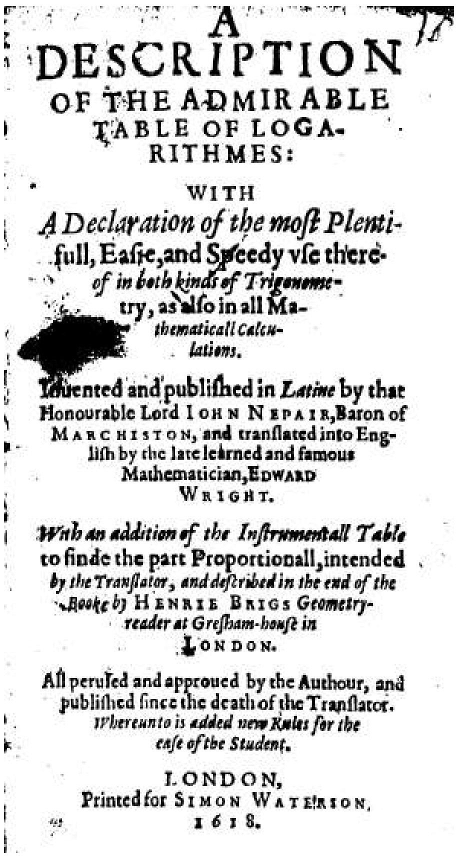
William Oughtred und die Logarithmen - Abstrakt

Drei Namen sind mit der Geschichte der Logarithmen eng verbunden: John Napier (1550 - 1617), Jobst Bürgi (1552 - 1632) und Henry Briggs (1560 - 1630). Während die Entwicklung der Logarithmen durch Napier auf einer mathematisch-kinematischen Methode beruhte (1), ist Bürgi den Weg der "Antilogarithmenberechnung" gegangen (5). Das Verdienst von Henry Briggs liegt darin, die Basis 10 einzuführen, die zu einer Vereinfachung der Berechnungen führte (6). Die Idee dazu entstand nach seinen Besuchen bei Napier (1615 und 1616) und bezog sich auf die numerischen Werte. Napier hatte zunächst nur trigonometrische Werte logarithmiert.

In den nächsten Jahren nach der Veröffentlichung der "Mirifici Logarithmorum Canonis Descriptio" - der ersten Logarithmentafel - im Jahre 1614 entstanden in schneller Folge weitere Ausgaben des Werkes in englischer und französischer? Sprache. Interessant dabei war, dass sich die einzelnen Ausgaben unterschieden. Zwar waren die Tafeln meist gleich geblieben, aber es tauchten auch Zusatzinformationen auf - sogenannte APPENDIXE. Die Autoren dieser Appendixe waren nicht immer zweifelsfrei zu identifizieren und so machten sich Mathematikhistoriker daran, mehr über die Autorenschaften herauszufinden.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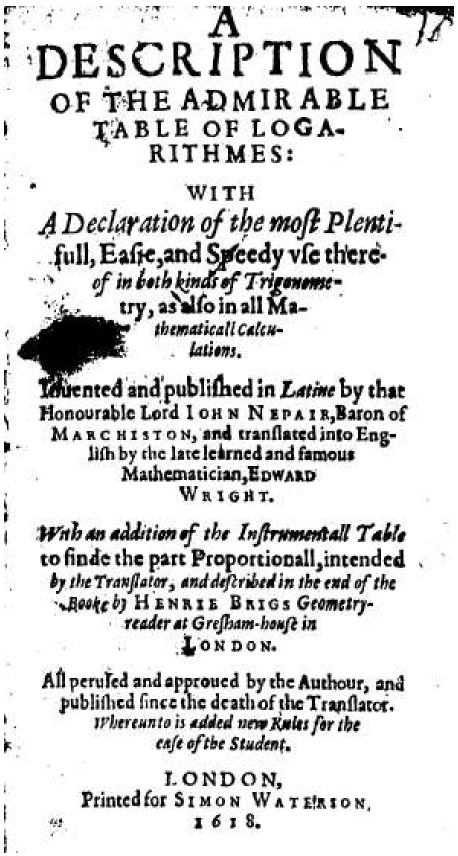
William Oughtred und die Logarithmen – Abstrakt (2)

Eine wichtige Arbeit aus diesem Bereich ist eine von J.W.L. Glaisher (1848 - 1928), der sich in der 1914 erschienenen Veröffentlichung (2)*"The earliest use of the radix method for calculating logarithms, with historical notices relating to the contributions of Oughtred and others to mathematical notation"* mit einem 16-seitigen Appendix auseinandersetzt, der 1618 (in diesem Jahr hatten sich Henry Briggs und William Oughtred auch persönlich getroffen) nur in der 2. Auflage der von Edward Wright ins Englische übersetzten "Mirifici - A description of the admirable table of logarithmes…" erschien. In diesem Appendix geht es um eine Methode, Logarithmen zu berechnen und zwar um die sogenannte Wurzelmethode - "Radix Method", mit der die Logarithmen der Zahlen zu berechnen sind. Ursprünglich wurde dieser Appendix Henry Briggs zugeordnet, der in diesem Band einen anderen Beitrag leistet - "Instrumental Table". Allerdings hat Glaisher einige Anhaltspunkte von A. de Morgan aufgegriffen, sie erweitert und gefestigt und kam zu dem Ergebnis, dass dieser Appendix von William Oughtred (1574 - 1660) verfasst wurde. Glaisher (s. Seiten 147 und 160 seines Artikels) macht diese Zuordnung an folgenden Faktoren zur "mathematical notation" fest:

1. Abkürzungen für Sine und tangent mit s bzw. t sowie s* und t* für cosine und cotangent (Abkürzungen, die Briggs nie gebraucht hatte)
2. Anwendung des X als Multiplikationszeichen
3. Die Anwendung des Begriffes "Cathetus" für die Senkrechte CA
4. Nutzung von CA als Lot von C auf die Gegenseite, dadurch Bezeichnung des Dreiecks mit BCD
5. Gebrauch des Wortes "ingredient"
6. Einsatz von Strichen und Kreisen, um Seiten und Winkel zu bezeichnen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William Oughtred und die Logarithmen – Abstrakt (3)

Die Radixmethode wurde in späteren Jahrhunderten weiter verfeinert und ist mit Namen wie Robert Flower (1771), George Atwood (1786), Zecchini Leonelli (1802), Thomas Manning (1806), Thomas Weddle (1845) sowie Peter Gray und Thomas Ellis verbunden. Auf diese relativ einfache Methode ist in jüngerer Zeit bereits mehrfach in Artikeln im JOS und bei der IM 2004 hingewiesen worden.

Dieser Artikel soll einen Beitrag dazu leisten, die vielfältigen Interessen (3) von William Oughtred aufzuzeigen und hier besonders auf seine Beziehungen zu den Logarithmen einzugehen. Logarithmen sind der Ursprung für alle Rechenschieber.

Literatur

J. Fischer: Napier and the Computation of Logarithms, JOS, 7(1), 11 - 16 (1998); 7(2) S. 50 (1998)

J.W.L. Glaisher: The Quarterly Journal of Pure and Applied Mathematics, 46, 125-197 (1914/15)

K. Kühn: William Oughtred - Inventor of the Slide Rule, SR Gazette, 4, 75 - 84 (2003)

R. Otnes: How Briggs Computed Logarithms, JOS, 4(2), 26-27 (1995)

R. Otnes: The Logarithms of Joss Bürgi, JOS, 7(2), 50-51 (1998)

T. Sonar: Die Berechnung der Logarithmentafeln durch Napier und Briggs, IM 2004

Additional Reading:

1. The History of Mathematical Tables; Ed. M. Campbell-Kelly et al., Oxford University Press 2003

2. A History of Numerical Analysis from the 16th through the 19th Century, H.H. Goldstine; Springer Verlag New York 1977

Der freundlichen Unterstützung von Karl Kleine, der mir eine Kopie des Original-Appendix besorgte, sei herzlich gedankt. Ohne diese Kopie hätte ich diese Arbeit nicht schreiben können, da in Glaishers Arbeit die zitierten Appendix-Passagen in einen anderen Zusammenhang als im Original gebracht sind, was deren Verständlichkeit erschwerte.

hauinge ye Azi: of ye ☉s altit: & ye decl: to finde the houre of the day

as ye cosine of the decl:
is to the sine of ye azimuth
soe the cosine of the alti:
to the sine of ye houre

hauinge the houre of ye day the ☉s altitude and the declination to find the azimuth

as ye cosine of ye altitude
is to the sine of the houre
soe cosine of the declination
to the sine of ye azimuth

hauinge the distance of the ☉ from the next equinoctiall point to find the right ascention

As the radius
to cosine of greatest decl:
soe the tan: of ye distance
to the tan: of right ascention

hauinge the ~~[illegible]~~ declin of ☉ to finde his right ascention

as the tan of great decl
to tan declination given
soe the radius
to the sine of the right ascention

An Appendix to the *Logarithmes, shewing* the practise of the Calculation *of Triangles, and also a new and ready way for the exact finding out of such lines and Logarithmes as are not precisely to be found in the Canons.*

What great ease is offered vnto vs in this art of Logarithmie, for the resolution of all Triangles both plaine and Sphæricall (without my speech) experience it selfe wil quickly shew to such as haue at any time beene tyred with the labourious worke of the formerly vsed tables of Triangles, I meane of *Sines, Tangents* and *Secants*. Yet into the full obtayning of the facility and readinesse that the excellent inuention of this Author may affoord vs, two things seemed vnto mee conueniently might bee added hereunto: The one is a direction for the practise of the seuerall rules of the Calculation of Triangles: The other is a perfect and readie way of finding out such Sines and Logarithmes

A 3 which

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GULIELMUS OUGHTRED ANGLUS, ex Academia Cantabrigiensi, Ætat. 73. 1646.

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gles : The other is a perfect and readie way of finding out ſuch Sines and Logarithmes

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which are not to be found exactly in the Tables. This latter the Author in the fourth Chapter of his firſt Booke, leaueth wondrouſly perplexed: and the Tranſlator, that

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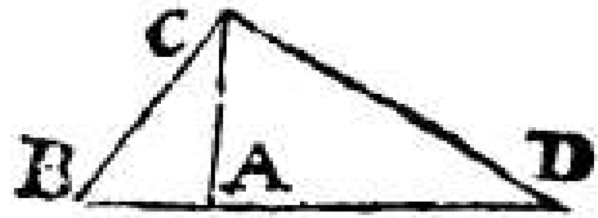
right angled trian-gles, ABC. & ADC as you may ſee in the figure.



Hauing thus deſcribed your triangle, note the parts thereof giuen with a right line, & the part ſought with a circle. As in the figure we are by the angle B. and the two ſides B D and C D to finde out the angle D intercepted betweene them.

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In euery seuerall calculation, I set downe onely the practise plainly to the eye, as it is to be wrought: wherein if you obserue the order & the notes, you shal not lightly erre. The notes are these. For the Logarithme of an arch or an angle, I set before it (s) for the antilogarithme or complement thereof (s*) and for the Differential (t) The Logarithme

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and for the Differential (*t*) The Logarithme of a straight line, hath no note beside his own letters. The note of Addition is (+) of substracting (—) ...

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letters. The note of Addition is (+) of sub-stracting (—) of multiplying (x) This note ([ ) sheweth that the number set therein is reserued to diuide some other number: the note of equality is (=) As for example:

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note of equality is (═) As for example: sB + BC ═ CA. that is, the Logarithme of the angle B. at the Base of a plain right-angled triangle, increased by the addition of the Logarithme of BC. the hypotenusa thereof, is equall to the Logarithme of CA the cathetus. And from hence plaine

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Now followeth the way of finding out ſuch ſines and logarithmes, as are not in the canon preciſely to be had: the ground of which worke is, becauſe the differences of the ſines and logarithmes in this canon, are equall ſo farre vntill the ſine decreaſe about 980000. and the logarithme increaſe about 202000. Wherefore if wee ſhall by any art bring the logarithme, being it ſelfe great, that it may be leſſe then 202000. or the ſine being it ſelf little, that it may bee greater then 980000. we may haue the difference to bee added, or ſubſtracted, moſt readily without any proportion. For the performance whereof, I haue inuented and framed this Table following: which conſiſteth of two parts; the former being of abſolute ſines, the latter of tenth and hundreth parts.

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1	000000	100	4605168	10000	9210337
2	693146	200	5298314	20000	9803483
3	1096612	300	5703780	30000	10308949
4	1386294	400	5991462	40000	10596631
5	1609437	500	6214605	50000	10819774
6	1791758	600	6396925	60000	11002095
7	1945909	700	6551077	70000	11156246
8	2079441	800	6684609	80000	11289778
9	2197223	900	6802391	90000	11407560
10	2302584	1000	6907753	100000	11512921
20	2995730	2000	7600899	200000	12206067
30	3401196	3000	8006365	300000	12611533
40	3688878	4000	8294047	400000	12899215
50	3911021	5000	8517190	500000	13122358
60	4094342	6000	8699511	600000	13304679
70	4248493	7000	8853662	700000	13458830
80	4382025	8000	8987194	800000	13592362
90	4499807	9000	9104976	900000	13710144

Correction:
3 = 1098612

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The supplement of the Table for tenth and hundreth parts.

Sin.	Logarith.	Sin.	Logarith.	Sine.	Logarithme
11	95311	17	530628	104	39222
12	182321	18	587786	126	48790
13	262364	19	641853	106	58269
14	336473	101	9951	107	67659
15	405465	102	19803	108	76962
16	470004	103	29560	109	86177

Correction:
126 = 105

Berchnungsbeispiel aus dem Appendix

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direct you. Lastly, to this logarithme found out by the canon, adde the logarithms of the Table collaterall to the sine & parts wherewith you multiplyed, and the summe of all shall be the logarithme of the sine or number proposed: as for example, I would haue the logarithme of 257.

257 x 3000
771000 x 12 too little.
1542
925200 x 108: yet too little.
99921600 [?]

999216 the logarithme of this by the canon at the first view, appeareth to be 748. vnto this adde the logarithmes of the table colaterall to 3000. & 12, & 108. & so

784
8006365
182321
76962
8266432

shall

(14)

shal you haue 8266432 for the true logarithme of 257.

sed. As for example. I would haue the sine or numerall valour of this logarith. 8266430.

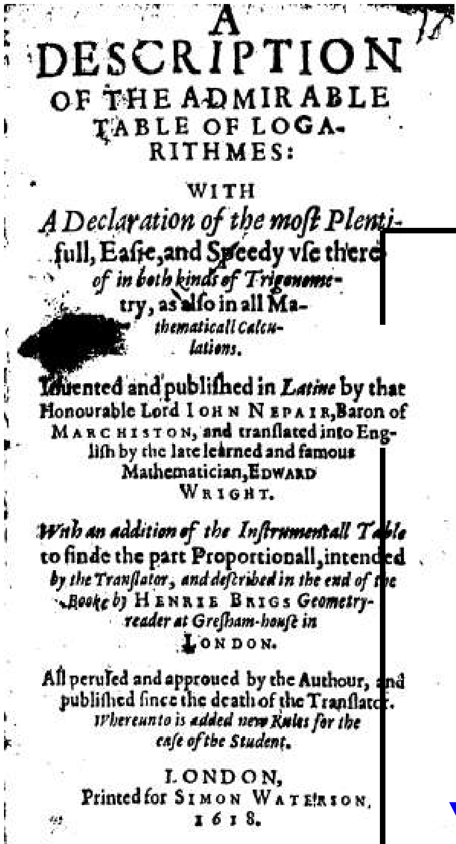
8266432
8006365 [3000.
260067
182321 [12
77746
76962 [108

784. the sine whereof by the canon, offereth it selfe to be 999216. which must bee diuided as is shewed in the rule.

108)
12) 99921600 (925200 (771|000.
3|000) (257

So then the sine or numerall valour of the logarithme, 999216. giuen is 257.

Brechnungsbeispiel aus Glaisher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LONDON,
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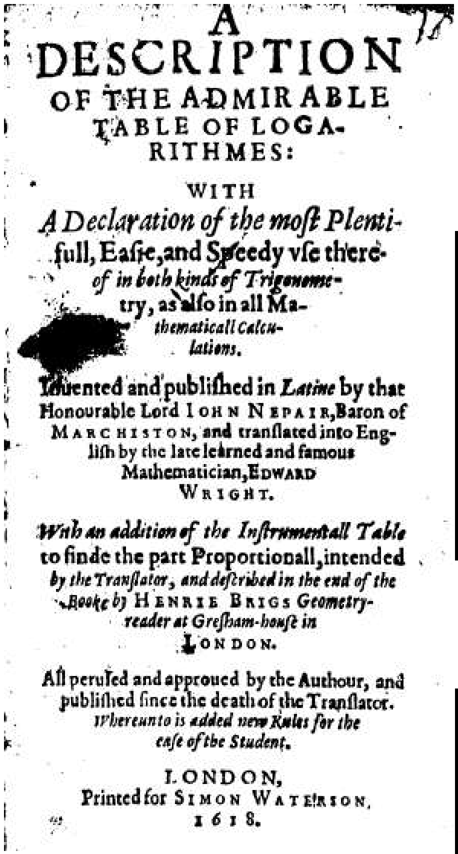
1618.

Gesucht Ln		SIN	Ln aus Tabelle		Hilfsgröße X (:1.000.000)	e^x
257	X	3000	8006368		8,006	3000,0013
771000	X	**1,2**	182322		0,182	1,2
925200	X	**1,08**	76961		0,077	1,08
999216	138147263					
784	+		8265650	=	**8266434**	
1.000.000						

Radix Methode: Auflösung einer Zahl (x oder :) in Faktoren der Form $1+-r/10^n$

Berechnungsbeispiel aus Glaisher



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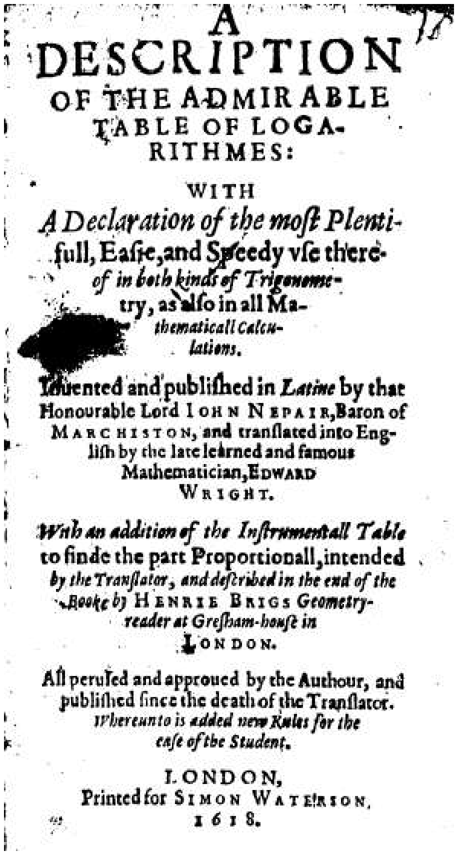
1618.

Gesucht "sin"		Ln aus Tabelle			Ln	
257			8266434		**8266434**	
	:	3000	8006368			
771000			260067			
	:	1,2	182322			
925200			77745			
	:	1,08	76961			
			784			
999216			999216			
			1000000		13,81551056	1000000

William Oughtred als Mathematiker - Spuren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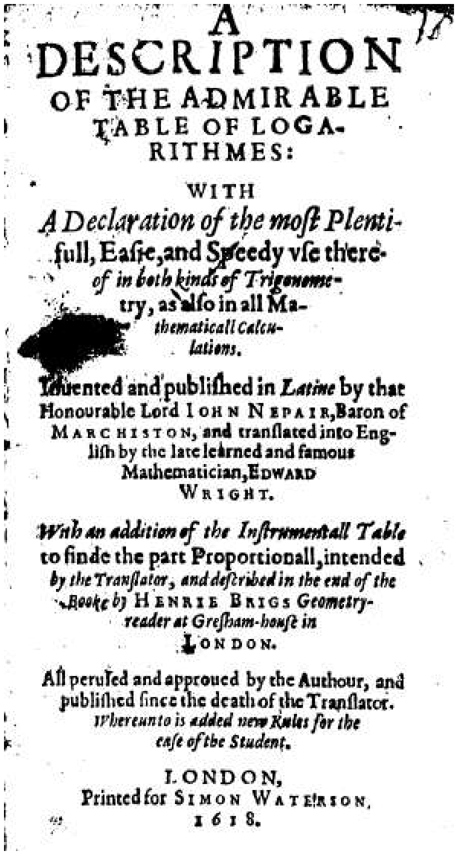
- "Love" and use "of symbols" – Autorenschaft
- "Disinclination to publish his mathematical manuscript (at least under his own name)"
- "Always earnest to encourage the study of mathematics" ….!!!!!!!

Zitate von Glaisher

Wer hat das geschrieben ?
Was steht darin ?



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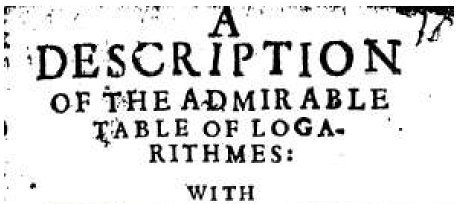
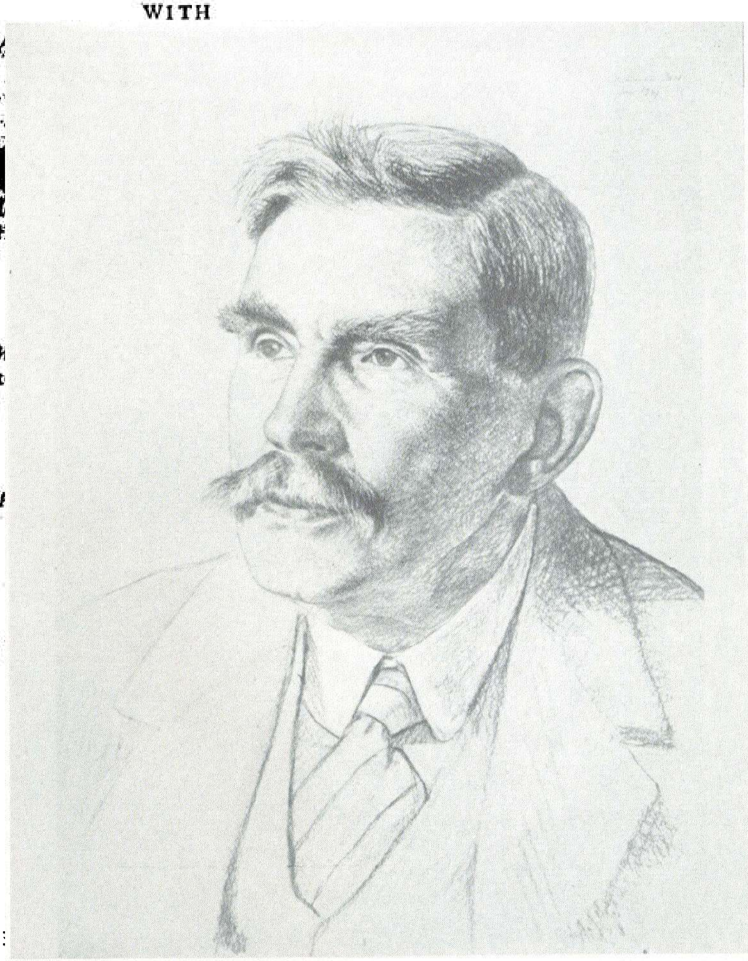
Annotationen im Band von 1618

James Whitebread Lee Glaisher



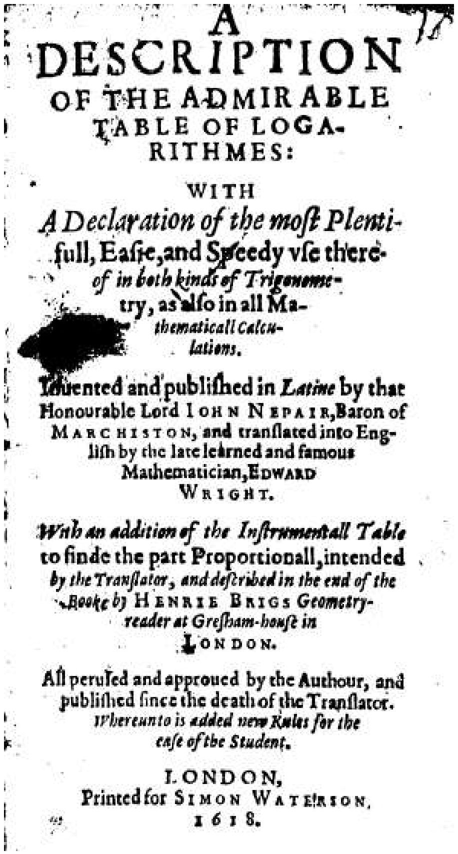


J. W. L. GLAISHER 1927

JAMES WHITBREAD LEE GLAISHER (1848–1928)

B. Lewisham, Kent, England. F.R.S. (1875); refused the invitation to become Astronomer Royal (1881); president London Math. So., Cambridge Phil. So., R.A.S. (twice), and Section A of B.A.A.S.; fellow, lecturer and tutor Trinity Coll., Cambridge; DeMorgan medallist (1908); Sylvester medallist (1913); editor *Mess. Math.*, 1871–1929 (last), *Quart. J. Math.*, 1878–1928. Eldest son of James Glaisher *supra*.

Quelle: R.C. Archibald; Mathematical Table Makers; Scripta Mathematica 1948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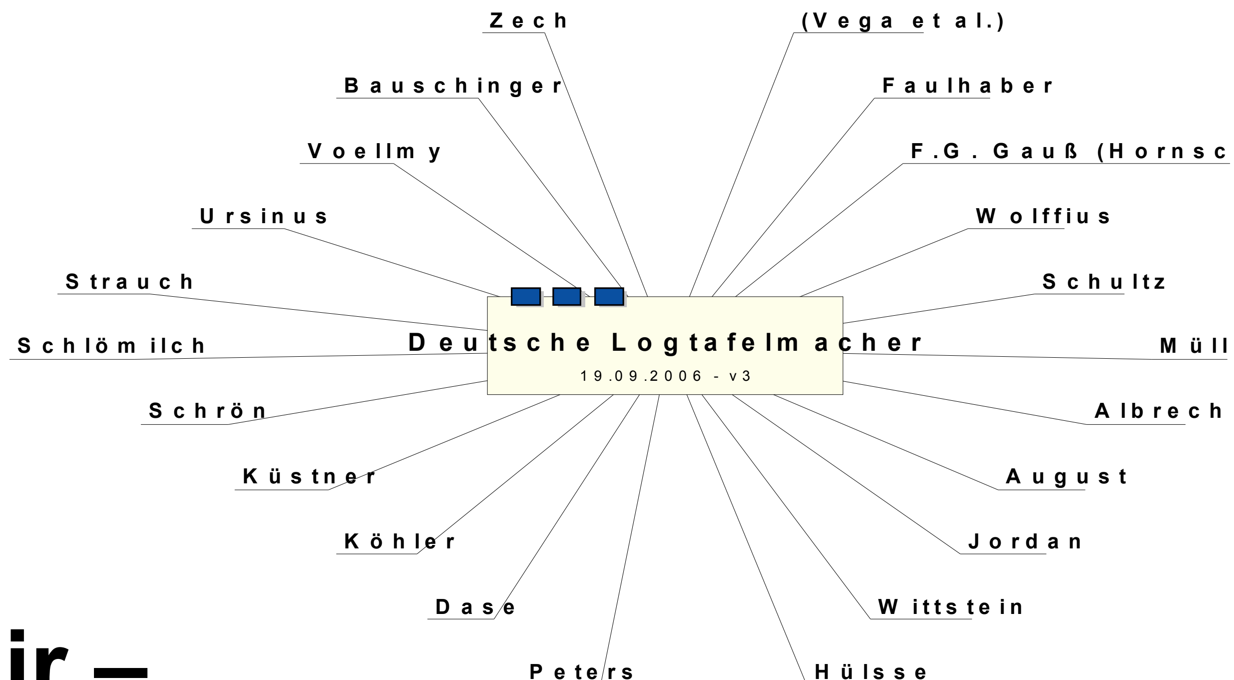
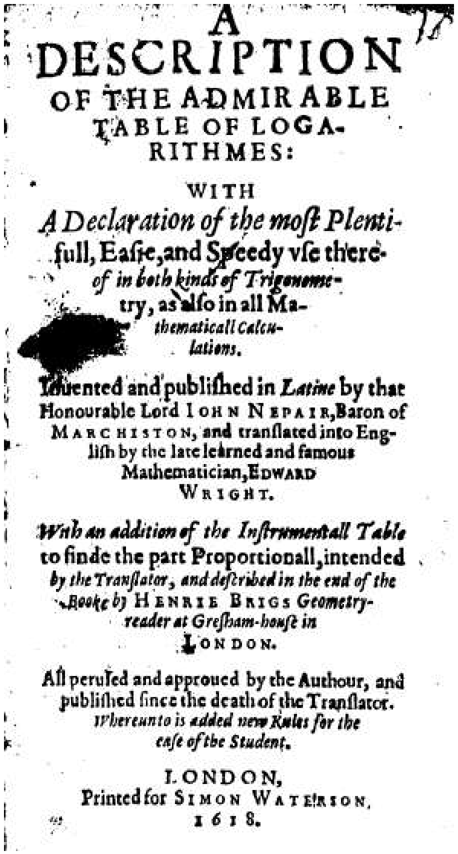
Wer macht mit ? Ich suche Biographien deutscher Tafelmacher – freie Auswahl.



Bitte bei mir – info@rechenschieber.org - melden - DANKE !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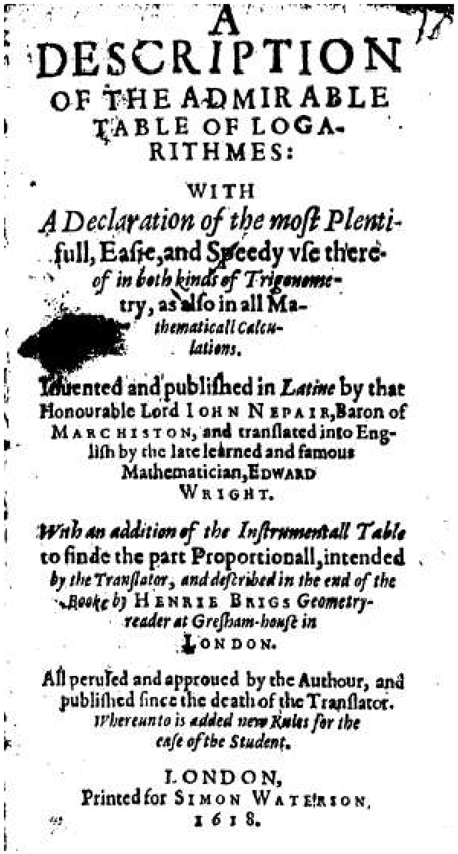
William Oughtred and Logarithms - Abstract

Three names are closely connected with the history of logarithms: John Napier (1550 - 1617), Jobst Bürgi (1552 - 1632) und Henry Briggs (1560 - 1630). While Napier constructed logarithms based on a mathematical-kinematical method (1), did Bürgi use the route by calculating "antilogarithms" (5). Henry Briggs introduced the base of 10, which resulted in a simplificaction of calculating logarithms (4). This idea included numerical values, whereas Napier´s logarithms were used for trigonometrical data only.

The publication of "Mirifici Logarithmorum Canonis Descriptio" - the first logarithmical tables - in 1614 lead to a sequence of much more tables in english and french? . All those editions were different, mainly through their APPENDIX´s, whereas the logarithmic tables remained the same. Some of the authors of those appendixes were not to be identified easily. This task was taken over later by mathematical historians.

A publication by J.W.L. Glaisher (1848 - 1928) from 1914*"The earliest use of the radix method for calculating logarithms, with historical notices relating to the contributions of Oughtred and others to mathematical notation"* covers a 16-page appendix, which appeared 1618 in the 2nd edition of "Mirifici - A description of the admirable table of logarithmes…" translated from Latin by Edward Wright. This appendix covers a method to calculate logarithms by the - "Radix Method" (6). Initially this appendix was dedicated to Henry Briggs. But Glaisher took some hints from A. de Morgan and after further investigations he concluded, that this appendix was written by William Oughtred (1574 - 1660).



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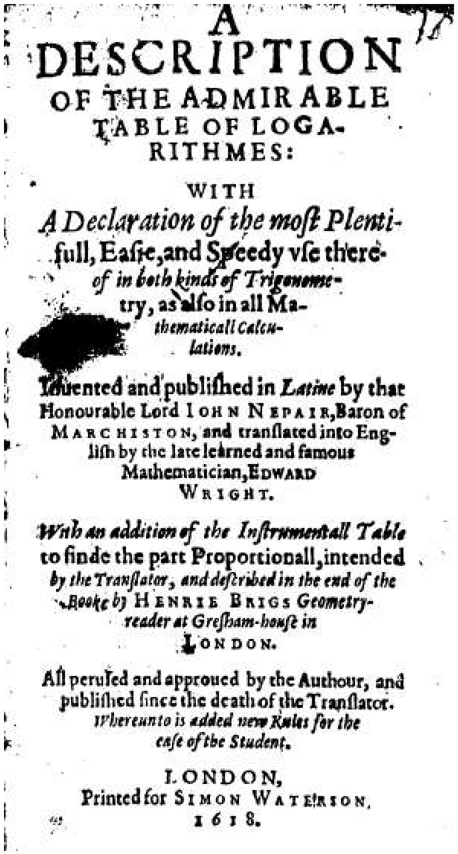
William Oughtred and Logarithms – Abstract (2)

Glaisher (see pages 147 and 160 of his article) based his opinion on these factors of "mathematical notation" :

1. abbreviations for sine and tangent are s resp. t as well as s* and t* for cosine and cotangent (abbreviations, which Briggs never has used)
2. use of X as the sign of multiplication
3. the use of the word "cathetus" for perpendicular
4. he uses CA for the perpendicular let fall from C on the opposite side, and therefore denotes an oblique-angled triangle by BCD
5. the use of the word "ingredient"
6. the use of circles and strokes to denote the data and quæsita in a triangle

This paper is intended to demonstrate the broad mathematical interest of William Oughtred (3), especially his relations to logarithms, which are the basis for all slide rules.

William Oughtred and Logarithms – Abstract (3)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Literature

J. Fischer: Napier and the Computation of Logarithms, JOS, 7(1), 11 - 16 (1998); 7(2) S. 50 (1998)

J.W.L. Glaisher: The Quarterly Journal of Pure and Applied Mathematics, 46, 125-197 (1914/15)

K. Kühn: William Oughtred - Inventor of the Slide Rule, SR Gazette, 4, 75 - 84 (2003)

R. Otnes: How Briggs Computed Logarithms, JOS, 4(2), 26-27 (1995)

R. Otnes: The Logarithms of Joss Bürgi, JOS, 7(2), 50-51 (1998)

T. Sonar: Die Berechnung der Logarithmentafeln durch Napier und Briggs, IM 2004

Additional Reading:

1. The History of Mathematical Tables; Ed. M. Campbell-Kelly et al., Oxford University Press 2003
2. A History of Numerical Analysis from the 16th through the 19th Century, H.H. Goldstine; Springer Verlag New York 1977

Acknowledgement: Support from Karl Kleine, who provided me with a copy of the original-appendix, made this article possible for me and is gratefully acknowledged.