

ASTRONOMICAL CUNEIFORM TEXTS

BABYLONIAN EPHEMERIDES
OF THE SELEUCID PERIOD FOR THE MOTION OF THE SUN,
THE MOON, AND THE PLANETS

I

Edited by
O. NEUGEBAUER

Published with the Assistance of the
INSTITUTE FOR ADVANCED STUDY
PRINCETON, NEW JERSEY



Springer Science+Business Media, LLC

O. Neugebauer
Institute for Advanced Study
Princeton, NJ 08540
U.S.A.

AMS Subject Classification: 01A17

Library of Congress Cataloging in Publication Data

Main entry under title:

Astronomical cuneiform texts.

Reprint. Originally published: London: Published for the Institute for Advanced Study, Princeton, N.J., by Lund Humphries, 1955.

“Published with the assistance of the Institute for Advanced Study, Princeton, New Jersey.”

Bibliography: v. 2, p.

Includes index.

Contents: v. 1. Introduction, the moon—v. 2. The planets, indices—v. 3. Plates.

1. Astronomy, Assyro-Babylonian. 2. Assyro-Babylonian language—Texts.

I. Neugebauer, O. (Otto), 1899— . II. Institute for Advanced Study (Princeton, N.J.)

QB19.A87 1983 528'.835

83-622

With 225 Illustrations.

© Springer Science+Business Media New York 1955

This book was originally published in 1955 by Lund Humphries, London, England, for the Institute for Advanced Study.

ISBN 978-1-4612-5509-3

ISBN 978-1-4612-5507-9 (eBook)

DOI 10.1007/978-1-4612-5507-9

DEDICATED TO THE MEMORY OF FATHERS

J. N. STRASSMAIER, S.J. (1846-1920)

J. EPPING, S.J. (1835-1894) F. X. KUGLER, S.J. (1862-1929)

PIONEERS IN THE INVESTIGATION OF

BABYLONIAN ASTRONOMY

VOLUME I

INTRODUCTION

THE MOON

PREFACE TO THE SPRINGER EDITION

When this collection of Babylonian astronomical texts was published in 1955 (a date omitted by mistake from the title page), it contained all texts of this type that I could lay my hands on. As was to be expected, the past 25 years provided more fragments, identified by A. Sachs and A. Aaboe in the British Museum and listed below. Also, some new joins could be made and some errors of mine corrected. Nevertheless, I think one still can consider the material of 1955 to be representative of what has been preserved of the mathematical astronomy of the Seleucid period.

In the meantime, far more progress has been made in our understanding of Babylonian astronomy, mainly by the publications of Aaboe, Hamilton, Maeyama, Sachs, van der Waerden, and others. As an example, I mention here only the elucidation of the

purpose of column Φ of the lunar ephemerides (by Aaboe) and the explanation of the method of computing the eclipse text ACT No. 60 (by Hamilton and Aaboe). Some of these advances I have tried to incorporate into my *History of Ancient Mathematical Astronomy* (1975), which should be used as a guide to the more recent literature.

My sincerest thanks go to Springer-Verlag for making this work again available to students of ancient astronomy. The Institute for Advanced Study, which together with Brown University has supported my work for more than four decades, has graciously given its permission for this reprint.

Princeton
November 1982

O. NEUGEBAUER

BIBLIOGRAPHY

Aaboe

A Seleucid Table of Daily Solar(?) Positions. *JCS** **18** (1964), 31-34.

On a Babylonian Scheme for Solar Motion of the System A Variety. *Centaurus* **11** (1966), 302f.

Some Lunar Auxiliary Tables and Related Texts from the Late Babylonian Period. *Danske Vid. Selsk., Mat.-fys. Med.* **36** (12) (1968).

A computed List of New Moons for 319 B.C. to 316 B.C. from Babylon: B.M. 40094. *Danske Vid. Selsk., Mat.-fys. Med.* **37** (3) (1969).

Remarks on the Theoretical Treatment of Eclipses in Antiquity. *JHA†* **3** (1972), 105-118.

Lunar and Solar Velocities and the Length of Lunation Intervals in Babylonian Astronomy. *Danske Vid. Selsk., Mat.-fys. Med.* **38** (6) (1971).

Scientific Astronomy in Antiquity. *Phil. Trans. R. Soc. London, A* **276** (1974), 21-42.

Aaboe and Norman T. Hamilton

Contributions to the Study of Babylonian Lunar Theory. *Danske Vid. Selsk., Mat.-fys. Med.* **40** (6) (1979).

Aaboe and Janice A. Henderson

The Babylonian Theory of Lunar Latitude and Eclipses According to System A. *Archives Internationales d'Histoire des Sciences* **25** (1975), 181-222.

Aaboe and Peter J. Huber

A Text concerning Subdivision of the Synodic Motion of Venus from Babylon: BM 37151. *Connecticut Acad. Arts and Sciences, Memoir* **19** (1977), 1-4.

Aaboe and A. Sachs

Some Dateless Computed Lists of Longitudes of Characteristic Planetary Phenomena from the Late Babylonian Period. *JCS* **20** (1966), 1-33.

Two Lunar Texts of the Achaemenid Period from Babylon. *Centaurus* **14** (1969), 1-22.

O. Neugebauer and A. Sachs

Some Atypical Astronomical Cuneiform Texts. I. *JCS* **21** (1967), 183-218; II. *JCS* **22** (1969), 92-113.

* *JCS*: Journal of Cuneiform Studies. † *JHA*: Journal for the History of Astronomy.

PREFACE

This edition of *Astronomical Cuneiform Texts* is intended to furnish the basis for a chapter on Babylonian Mathematical Astronomy in a larger History of Ancient Astronomy. In the present work, however, no attempt has been made to arrive at general historical conclusions, though the introductions to volumes I and II provide the reader with the necessary background of Babylonian lunar and planetary theory.

The publication of this work has been made possible by the generosity of the Institute for Advanced Study in Princeton, New Jersey. The underlying research was begun at the Mathematical Institute of the University of Copenhagen and continued at Brown University and during repeated stays in Princeton. It is only through the support and understanding which I met in these institutions that I have been able to carry out a program of so large a scale. It is with a feeling of sincere gratitude and indebtedness that I conclude these volumes.

It was my aim to reach completeness so far as the special texts under consideration are concerned. Accordingly, I have republished about fifty texts which were previously published by Kugler (1900, 1907), Thureau-Dangin (1922), and Schnabel (1924, 1927). About thirty of these texts have been substantially enlarged by joining new fragments to the already published parts or by adding unpublished columns or sections. The material presented here in its entirety amounts to about 300 tablets and fragments; one may estimate that the present edition contains about four or five times as much material as was known previously. About 170 texts concern the moon; the rest have to do with the five planets, Jupiter being better represented than all the other planets combined. About one-third of all texts come from Uruk; two-thirds, in all probability, from Babylon.

In 1881 the key to the understanding of Babylonian mathematical astronomy was found by Father Epping, S.J., in British Museum tablets which had been identified as astronomical by Father Strassmaier, S.J. Around this time Strassmaier was copying many thousands of texts – tablet by tablet, fragment by fragment – which had been sent to the British Museum in the tens of

thousands. Whenever he ran across an astronomical text of a worthwhile size he recopied it for study by Epping and, after Epping's death, by Father Kugler, S.J. It was not until the 1920's that more astronomical texts from Paris and Berlin became available. When I began to work on the present edition in 1935, it was again Strassmaier's material that formed the basis. Strassmaier's notebooks, by that time, were in the custody of the Pontificio Istituto Biblico in Rome; from these notebooks, astronomical texts were extracted by Father Schaumberger, C.Ss.R., for the continuation of Kugler's work. Father Schaumberger not only sent me the copies of relevant texts, but also drew my attention to unpublished astronomical texts from Uruk which were in Chicago at the Oriental Institute. Finally, with the kind help of the late H. Ehelolf, I obtained access to the texts in Berlin.

The work on this material was practically completed in 1945. At that time, contact with Istanbul was re-established. Dr. F. R. Kraus kindly sent me, from his excellent catalog of about 60,000 texts, a list of more than a hundred astronomical fragments from Uruk, and, subsequently, a microfilm of the texts themselves. Many of these fragments could be joined with one another or with tablets in Paris, Berlin and Chicago. The result was that the Uruk texts became about as uniform a group as the Babylon texts in the British Museum. This entailed almost a complete rewriting of my manuscript, a task which took about three years. In the meantime, it had become clear that Strassmaier's notebooks contained additional material which I had not yet seen. In 1949, on the recommendation of Father A. Deimel, S.J., all of Strassmaier's relevant notebooks were placed at my disposal through the courtesy of the Pontificio Istituto Biblico. Dr. A. Sachs went through some thousands of such copies and identified those which belong to my class of texts. The yield was about 100 new fragments, which, when reduced in number by joins, became 83 more or less complete texts. The photographing of the originals in the British Museum and the working out of the details required more than two years, again resulting in a re-writing of about half of the manuscript.

Strassmaier's notebooks cover only texts with the inventory numbers between BM 32,000 and BM 36,000. He did, however, make notes about similar texts, numbered between BM 45,000 and 47,000, which had been quoted to him by Pinches. Thus it was clear that the astronomical archive had a much greater extent than the part explored by Strassmaier. This conclusion was confirmed in 1952. A travel grant by the Rockefeller Foundation enabled Dr. Sachs to work during the summer at the British Museum. There he was given access to about 1800 sheets of copies of astronomical texts, made by Pinches in the years preceding 1900. Many of these masterly copies duplicated texts which we knew through Strassmaier. But there were also many that were new and that substantially increased our knowledge. For the present edition, about 60 new fragments had to be incorporated, about half of which joined previously known texts.

This process of successive approximation has left its traces on the present edition. Quite a few texts were slowly pieced together from many fragments scattered not only over the different collections of the same museum, but sometimes over two or three museums on different continents. Each new join required the re-computing of hundreds of numbers or changes in the numbering of lines, columns, sections, and texts. There are many texts which went through this process five or six times. In spite of all attempts to keep track of these continuous changes which went on, year after year, it is only too evident that many mistakes must have been made which I have been unable to eliminate. A serious student of these texts must not only be indulgent toward small inconveniences, *e.g.*, in the counting of texts and plates, or with inconsistencies in transcription or translation, but he also must be aware of the necessity of continually checking all possible ramifications of whatever statement he may doubt.

Furthermore, the reader should have no illusions with respect to the completeness of the material. We know the Uruk archive only insofar as it has reached Istanbul and the collections of Berlin, Paris, and the United States. The Babylon archive is now available as far as it was explored by Strassmaier and Pinches, or, on the basis of the original inventory numbers, the material that came to the British Museum between 1876 and 1882. But we have no estimate, *e.g.*, about the contents of the collections of the Iraq Museum and others, while the British Museum promises to produce still more texts as the recently begun process of systematic cataloging proceeds. Indeed it was this prospect

which induced me to publish this edition now, at a moment when we have reached the end of Strassmaier's and Pinches' material. Since the present edition has already occupied the main part of my time for research for a period of twenty years, it is clear that the possibility of doubling the source material would jeopardize the publication even of the limited section which is accessible now.

A great debt of gratitude I owe to Mr. D. A. Jonah, Librarian of the Brown University Library, for many years of patience and helpfulness in all my bibliographical requests. And the final task of putting my manuscript into print has been performed by Lund Humphries in London with great skill and with understanding for my exacting requirements.

I wish to express my thanks to the curators and keepers of the following collections for their cooperation and helpfulness; Berlin, Staatliche Museen; Chicago, The Oriental Institute of the University of Chicago; London, British Museum; New Haven, Yale Babylonian Collection of Yale University and Morgan Library Collection; New York, Columbia University Library and The Metropolitan Museum of Art; Paris, Musée du Louvre; Philadelphia, The University Museum of the University of Pennsylvania. British Museum tablets are published by courtesy of the Trustees of the British Museum.

How much I owe to my friend and colleague, Dr. A. Sachs, for his help in all phases of the preparation of this work cannot be explained in a few sentences. For ten years he has read and reread the manuscript in all its stages. There is scarcely a page where his suggestions did not contribute to the clarity of formulation and correctness of detail. During the summer of 1952 and again since September 1953 there was scarcely a day when I did not ask him for collations of texts in the British Museum, for help with photographs and copies or readings. Without him I would never have been able to complete this work.

And finally I should like to express my respect to the shades of the scribes of Enūma-Anu-Enlil, descendants of Ekur-zākir or of Sin-leqē-unninnī, and of all the other scribes who computed and wrote the texts which are published here. By their untiring efforts they built the foundations for the understanding of the laws of nature which our generation is applying so successfully to the destruction of civilization. Yet they also provided hours of peace for those who attempted to decode their lines of thought two thousand years later.

O. N.

TABLE OF CONTENTS

PART I. INTRODUCTION

§ 1. The Texts. Description and Notation	1	§ 5. The Mathematical Methods for the Com- putation of Ephemerides	28
A Description of the Texts	1	A General Concepts	28
B The Present Edition	1	B Step Functions	29
§ 2. Provenance and Dates	4	C Linear Zigzag Functions	30
A The Provenance of the Texts	4	§ 6. Time Reckoning and Dating	32
B The Dates of the Texts	6	A Eras	32
C The Seleucid Kings	7	B The Continuous Calendar	33
D Conclusions	7	C Dating	35
§ 3. The Colophons	11	§ 7. Astronomical Ideograms	38
A General Remarks	11	A Months and Zodiacal Symbols	38
B The Scribal Families	13	B General Astronomical Ideograms	38
C Text of the Colophons	16	§ 8. Metrological Units	39
D Index of Personal Names and Place Names	24	A Angular Distances	39
E Concordance	26	B Tithis	40
§ 4. Errors in the Texts	27		

PART II. EPHEMERIDES OF THE MOON

INTRODUCTION		VII 18-Year Cycle	54
§ 1. The Lunar Theory in General	41	VIII Column E*	54
§ 2. System A	44	IX Approximate Column E	55
A Column T	44	F Column Ψ	55
B Column Φ	44	I Definition of Ψ	55
I Monthly Variation	44	II Column Ψ'	55
II Daily Variation Φ^*	45	III Significance of Ψ	57
C Column B	45	G Column F and related Columns	58
I General Structure	45	I Column F	58
II Rules for Checking	46	1. Unabbreviated Parameters	58
III Diophant	46	2. Unabbreviated Parameters. Variant	58
IV Daily Motion B*	47	3. Abbreviated Parameters	58
D Column C	47	II Column F*	58
E Column E	47	H Column G	59
I ΔE	47	I Definition of \hat{G}	59
II Column E outside the Nodal Zone	48	II Definition of G	60
III Column E inside the Nodal Zone	49	III Computation of G from F	61
IV Dating by Diophant	50	IV Diophant for G	61
V Continuation of E over N Years	52	V Checking Rules for \hat{G}	61
VI Rules for Checking	54		

J	Column J	61	II	Column L	79
K	Column C'	62	H	Column M	80
L	Column K	63	J	The Columns from N to P	81
M	Columns M and P	63	I	Column N	81
	I The Hours of the Syzygies	64	II	Column O	82
	II The Dates of the Syzygies	64	III	Column Q	82
	III The Computation of Column P	65	IV	Column R	83
	IV Visibility Conditions	66	V	Column P. Visibility Conditions	83
	V Summary	67	K	Eclipses	85
N	Eclipses	68			
	I Introduction	68	CHAPTER I. SYSTEM A		
	II The Columns T to C	69	§ 1.	Ephemerides	86
	III The Columns E and Ψ	69	No. 1.	Full moons. S.E. 124 and 125	86
	IV The Columns from F onwards	69	No. 2.	New moons. S.E. 124 to 126	86
§ 3.	System B	69	No. 3.	New and full moons. S.E. 141	87
	Introduction	69	No. 3aa.	New moons. At least S.E. 141	87
	A Column T	70	No. 3a.	New and full moons. S.E. 142	87
	B The Columns A and B	70	No. 3b.	New and full moons. S.E. 142	88
	I Column A	70	No. 4.	New moons. At least S.E. 145 to 149	88
	1. Unabbreviated Parameters	70	No. 4a.	New moons. At least S.E. 146 to 149	88
	2. Abbreviated Parameters	71	No. 5.	New moons. S.E. 146 to 148	89
	II Column B	71	No. 5a.	New moons. At least S.E. 146	90
	III Column B*	72	No. 6.	Full moons. At least S.E. 149	91
C	The Columns C, D, and related Columns	72	No. 6aa.	New moons. At least S.E. 150 to 155	91
	I Column C	72	No. 6ab.	New moons. At least S.E. 154	91
	II Column D'	73	No. 6a.	New and full moons. S.E. 155	91
	III Column D	73	No. 6b.	New moons. At least S.E. 172	92
D	Column Ψ' and related Columns	73	No. 7.	New and full moons. S.E. 176	92
	I Column Ψ''	73	No. 7a.	New moons. S.E. 180 and 181	95
	1. Parameters expressed in degrees	73	No. 8.	New moons. At least S.E. 182 and 183	95
	2. Parameters expressed in eclipse magnitudes	74	No. 8a.	Full moons. At least S.E. 183	95
	II Column $\Delta\Psi'$	74	No. 8b.	New moons. At least S.E. 183, 184	95
	1. Unabbreviated Parameters	74	No. 9.	New moons and full moons. S.E. 185	95
	2. Abbreviated Parameters	75	No. 10.	New and full moons. S.E. 186	96
	III Column Ψ'	75	No. 11.	New moons. S.E. 188 and 189	96
E	The Columns F, G, and related Columns	76	No. 11a.	New moons. At least S.E. 189	97
	I Column F	76	No. 12.	New moons. S.E. 190 and 191	97
	1. Unabbreviated Parameters	76	No. 13.	New and full moons. S.E. 194 and 195	97
	2. Abbreviated Parameters	76	No. 13a.	New moons. At least S.E. 201 and 202	98
	II Column F'	76	No. 14.	New and full moons. S.E. 202	98
	III Column F*	76	No. 15.	New and full moons. S.E. 209 and 210	98
	IV Column ΣF^*	77	No. 16.	New and full moons. S.E. 219	99
	V Column G	78	No. 16a.	New moons. At least S.E. 229	99
F	The Columns H and J	78	No. 16b.	Full moons. At least S.E. 248, 249	99
	I Column H	78			
	II Column J	78			
	1. Unabbreviated Parameters	78			
	2. Abbreviated Parameters	79			
	3. Diophant for J	79			
G	The Columns K and L	79			
	I Column K	79			

No. 17. Full moons. At least S.E. 253 . . . 100
 No. 18. New and full moons. S.E. 263 . . . 100
 No. 18a. Full moons. At least S.E. 266 to 269 or S.E. 41 to 44 . . . 101
 No. 19. New moons for at least two years . . . 102
 No. 20. New moons and full moons for at least one year . . . 103
 No. 21. New moons and full moons for at least one year . . . 103
 No. 22. New moons and full moons for at least one year . . . 103
 No. 23. New moons for at least one year . . . 104
 No. 24. Full moons for at least one year . . . 104
 No. 25. New moons for at least one year . . . 105
 No. 26. New moons for two years . . . 106
 § 2. Eclipses. 106
 No. 60. Lunar eclipses. S.E. 137 to 160 . . . 106
 No. 50. Solar eclipses. At least S.E. 141 to 147. 109
 No. 61. Eclipses(?). At least S.E. 177 to 199(?) 109
 No. 61a. Solar eclipses. At least S.E. 191 to 194 112
 No. 51. Solar eclipses. At least S.E. 199 to 206 112
 No. 51a. Lunar eclipses(?). S.E. 206 to 220 113
 No. 52. Solar eclipses. At least S.E. 244 to 248 114
 No. 53. Solar and lunar(?) eclipses. At least S.E. 298 to 253(?) 115
 No. 54. Eclipses(?) for at least seven years 116
 No. 55. Eclipses or excerpts for several years 116
 § 3. Auxiliary Texts 117
 A Latitudes 117
 No. 70. Full moons. At least S.E. 49 to 60 117
 B Excerpts 117
 No. 75. New moons. At least S.E. 181 to 185 117
 No. 76. New moons. S.E. 204 to 221 118
 § 4. Daily Motion 118
 No. 80. Moon. S.E. 178 I 118
 No. 81. Moon. S.E. 178 VII 118
 § 5. Ephemerides of Undetermined System from Babylon 120
 No. 90. Fragment. Columns B, E, C 120
 No. 91. Fragment. Columns E, T 120
 No. 92. Full moons for at least two years 121
 No. 92a. Longitudes and latitudes of the moon in four separate years 122
 No. 93. Latitudes(?) and eclipses magnitudes for at least seven years 122

CHAPTER II. SYSTEM B

Introduction 124
 Arrangement of the Texts 124
 § 1. Ephemerides 126
 A Ephemerides from Uruk 126
 No. 100. New moons. S.E. 106 to 108 126
 No. 101. New moons. S.E. 118 and 119 129
 No. 102. New moons, last visibility, and full moons. S.E. 121 132
 No. 103. New moons. S.E. 123 136
 No. 104. New moons and full moons. S.E. 124 136
 No. 105. Full moons. S.E. 135 to 137 138
 No. 106. New moons. At least S.E. 136 and 137 139
 No. 107. Full moons for at least one year 139
 No. 108. New moons for several years 140
 No. 109. New moons for at least one year 140
 No. 110. Full moons for at least one year 140
 B Ephemerides from Babylon 140
 No. 119. New moons. At least S.E. 176(?) 140
 No. 120. New moons and full moons. S.E. 179 141
 No. 121. New moons and full moons. S.E. 181 143
 No. 121a. New moons. At least S.E. 185 to 188 144
 No. 122. New moons. S.E. 208 to 210 144
 No. 122a. New moons. At least S.E. 221 146
 No. 123. New moons and full moons. S.E. 235 146
 No. 123aa. New moons and full moons. S.E. 236 150
 No. 123a. New moons and full moons for two years 150
 No. 124. Full moons for at least one year 152
 No. 125. Fragment of ephemeris for at least one year 153
 No. 125a. Full moons for at least one year 154
 No. 125b. Fragment of ephemeris for at least three years 154
 No. 125c. Fragment of ephemeris for at least one year 154
 No. 125d. Fragment of ephemeris for at least two years 155

No. 125f. Eclipse magnitudes for at least two years. Ephemeris(?)	155	No. 174. S.E. 124 to 131	175
No. 126. Full moons for four years	155	No. 175. Fragment	176
No. 126a. Full moons for at least one year	157	F Visibility	176
No. 127. Fragment of ephemeris for at least one year	157	No. 180. New moons. S.E. 120 to at least 125	177
No. 128. Last visibility for at least two years	158	No. 181. New moons. Several years	177
No. 129. Full moons for at least two years	159	No. 182. New moons. Several years	177
§ 2. Eclipses.	160	§ 4. Daily Motion	178
A Solar Eclipses	160	A Solar Motion	178
No. 130. Solar eclipses for at least ten years, incl. S.E. 126 to 130	160	No. 185. S.E. 124	178
B Lunar Eclipses	161	No. 186. Several months	178
No. 135. Lunar eclipses for S.E. 113 to 130	161	No. 187. Fragment	179
No. 136. Lunar eclipses for at least seven years, incl. S.E. 121 to 124	163	B Lunar Motion	179
§ 3. Auxiliary Tables	164	No. 190. For 248 days	179
A Longitudes	164	No. 191. S.E. 117	180
No. 140. S.E. 115 to at least 130	164	No. 192. S.E. 118	180
No. 141. At least S.E. 121 to 124	165	No. 193. S.E. 119	181
No. 142. S.E. 123 to 142	166	No. 194. S.E. 130	181
No. 143. At least S.E. 146	166	No. 194a. S.E. 243	182
No. 144. S.E. 148 to 161	166	No. 194b. Several months	183
No. 145. At least S.E. 126 to 139	167	No. 195. Fragment	183
No. 146. Several years	167	No. 196. Several months	183
B Eclipse Magnitudes	167	Appendix. Solstices and Equinoxes	184
No. 149. At least S.E. 54 to 67	167	No. 198. S.E. 116 to 131	184
No. 150. At least S.E. 115 to 138	168	No. 199. A least S.E. 143 to 157	185
No. 151. At least two years	168		
No. 152. Fragment	168	CHAPTER III. PROCEDURE TEXTS	
C Lunar Velocity	169	Introduction	186
No. 155. S.E. 104 to 124	169	§ 1. Procedure Texts from Babylon	186
No. 156. At least S.E. 122 to 131	169	No. 200.	186
D Columns H and J	169	Introduction	186
No. 160. S.E. 123 to at least 154	170	Section 1	187
No. 161. S.E. 124 to 156	170	Section 2. Column C_1	187
No. 162. At least S.E. 133 to 151	170	Section 3. Column B_2	188
No. 163. At least S.E. 117	170	Section 4. Column Ψ'	188
No. 164. At least S.E. 127 to 132	170	Section 5. Columns Φ and F	189
No. 165. At least S.E. 137 to 156	171	Section 6. Column E	190
No. 166. Several years	171	Section 7. Solar velocity	193
No. 167. Fragment	171	Section 8. Variation of daily solar velocity	194
E Syzygies	172	Section 9. Monthly solar velocity; eclipse magnitudes	194
No. 170. S.E. 104 to 112	172	Excursus: The term ḥab-rat	197
No. 171. S.E. 115 to 124	173	Section 10. Determination of the extremal velocities in general	198
No. 172. At least S.E. 117	175	Section 11. The seasons of the year	199
No. 173. S.E. 123 to 130	175	Section 12. Column J	200
		Section 13. Columns K and M	201
		Section 14. Columns Φ and G	202
		Section 15. Column P_1 , day numbers in column M	204
		Section 16. Column P_3	208

No. 200a	210	No. 203. Column Φ	244
Introduction	210	No. 204	245
Section 1. Column Φ	210	Section 1. Columns E and Ψ	245
Section 2. Column B_1	211	Section 2. Columns Ψ and E	246
Section 3. Column C_1	211	Section 3. Columns E and Ψ	247
No. 200aa	211	Section 4. Columns Ψ and E	247
Sections 1 to 5. Column Φ	211	Section 5. Columns Φ and F	248
Section 6. Column B_1	213	Section 6. Column Φ	249
Section 7. Column P_1	213	Section 7. Longitudes(?)	249
No. 200b	213	Section 8. Latitudes	250
Section 1. Column Φ	213	No. 204a. Columns Φ , G, and F	251
Section 2. Column C_1	214	No. 205. Columns Φ and G	252
Section 3. ΔC_1	214	No. 206. Columns Φ and G	253
Section 4. ΔE	215	No. 207. Columns Φ and G	254
No. 200c. ΔE	216	No. 207a. Columns Φ and G	255
No. 200d	217	No. 207b. Columns Φ and G	256
Section 1. Solar velocity; eclipse magnitudes	217	No. 207c. Columns Φ and G	257
Section 2. ΔE ; main differences	218	No. 207ca. Columns Φ and G	258
Section 3. ΔE ; intermediate differences	218	No. 207cb. Columns Φ and G	261
No. 200e. ΔF	219	No. 207cc. Columns Φ and G	262
No. 200f. Eclipses; ΔE	219	No. 207cd. Columns Φ and G	263
No. 200g. Eclipses	220	No. 207d. Columns Φ and A	263
No. 200h. Eclipses; ephemeris for S.E. 60 and 61	221	No. 207e. Columns Φ and A	268
No. 200i	222	No. 207f. Columns Φ and $A(?)$	269
Section 1. Column E	222	No. 208. Columns F and G	269
Section 2. Column F	225	No. 210	271
Section 3. Column $P_{2,3}$	225	Section 1. System A, Column B	271
Section 4	226	Section 2	271
No. 201	226	Section 3. System B, Sidereal and Synodic Periods.	271
Introduction	226	Section 4.	273
Sections 1 to 4. First and last visibility	227	Section 5. System B, Column A	273
Sections 5 and 6. Coefficients for ecliptic and latitude.	239	Section 6. Eclipse cycle	273
No. 201a	240	Sections 7 and 8	273
Section 1. First visibility	240	No. 211	274
Section 2. Coefficients for ecliptic and latitude	241	Section 1. Eclipse cycle	274
Section 3	241	Section 2. System B, Column $\Delta\Psi(?)$	274
No. 201aa. First and last visibility	241	Section 3. System B, Columns F and G	274
No. 202	242	Sections 4 and 5	275
Transcription	242	Section 6. Eclipse Magnitude	275
Section 1. Coefficients	243	Section 7. System B, Column $\Delta\Psi(?)$	275
Section 2. Coefficients	244	Section 8. Eclipse cycle	276
Section 3. Day numbers of syzygies	244	§ 2. Procedure Texts from Colophons	276
Section 4. Change of epoch, System B(?)	244	Introduction	276
		No. 220. Eclipses	276
		No. 221. Daily Motion of the Moon	277

