

PETER J. HUBER - SALVO DE MEIS

**BABYLONIAN ECLIPSE OBSERVATIONS
FROM 750 BC TO 1 BC**



IsIAO - Mimesis 2004



MIMESIS

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This long awaited book covers a large gap in Assyriology, with the collection of complete texts, translation and analysis of Babylonian Eclipse Observations recorded in a particularly important epoch of

BABYLONIAN ECLIPSE OBSERVATIONS FROM 750 BC TO 1 BC

The book will also be interesting for students of ancient history and for chapters of astronomy history or science.

The terminology of the astronomical observations is explained in a chapter of over 100 pages both for understanding special terms and to have these ready for consultation, including technical terms, lists of kings or "Lunar Signs".

The most modern astronomical theories have been used for dating, and a deep statistical analysis has been an important tool to cover many aspects of the reliability of the observation records.

The Data Analysis covers not only the eclipses themselves, but the related phenomena, such as rising and setting of Sun and Moon, among others planetary occultations, culminations of stars. Besides observed eclipses, also clearly predicted eclipses are considered.

A thorough study of the LT, the difference between Dynamical and Universal Time, considers old and recent theories and by statistical analysis proposes a more reliable formula for corrections to the Study of the Length-of-Day, an important subject now for geophysics.

For every eclipse considered the Babylonian and Julian Dates are given, besides the times of all planets, moonrise, culminate and moonset, rising and setting times of Sun and Moon.

Very useful eclipse lists are supplemented such as Catalog of Lunar and Solar eclipses from 750 BC to the year 2000.

Maps of Solar and Lunar eclipses are provided to help locate visibility zones, a useful guide to searching alternative documents in nearby areas.

This book is being published in the framework of an IAU-AO Project concerning the History of Sciences and Pseudosciences in Antiquity and in the Orient, and is an example of interdisciplinary between schools of science-specialization. The support of MEF (Rex 4019) is deeply acknowledged. In the Projects of National Interest entitled "Interuniversity collaboration researches in the field between East and West from Antiquity to Middle Ages,"

Peter J. Huber

IsIAO



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BABYLONIAN ECLIPSE OBSERVATIONS
FROM 520 BC TO 1800 AD

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Cover picture: Fragment of a big compilation of lunar eclipse observations, arranged in 18-year groups (LBAT 1415 + 1416 + 1417 = BM 35115+).

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Foreword

This long awaited book covers a large gap in Assyriology, with the collection of complete texts, translation and analysis of Babylonian Eclipse Observations occurred in a particularly important epoch of Mesopotamian history, namely from 750 BC to 1 BC.

For the first time are available the latest documents, and accurately determined dating are provided, with comprehensive lists of Solar and Lunar eclipses.

The book will also be important in fields outside pure Assyriology, for example to scholars of astronomy, history of science, philologists.

The terminology of the texts is clearly explained, in order to put the reader at ease both for understanding special terms and to have these ready for consultation, including technical terms, lists of kings or "Lunar Sixes".

The most modern astronomical theories have been used for dating, and a deep statistical analysis has been an important tool to cover many aspects of the reliability of the observation records.

The Data Analysis covers not only the eclipse themselves, but the related phenomena, such as rising and setting of Sun and Moon, timings relative to eclipses, planetary events, culminations of stars.

Besides observed eclipses, also clearly predicted eclipses are considered

A thorough study of the ΔT , the difference between Dynamical and Universal Time, considers old and recent theories and by statistical analysis proposes a new, reliable formula for it and guides to the study of the Length-of-Day, an important subject, not only for geophysicists.

For every eclipse considered the Babylonian and Julian Dates are given, besides the times of all phases, magnitude, entrance and exit angles, rising and setting times of Sun and Moon.

Very useful eclipse lists are supplemented such as Canons of Lunar and Solar eclipses from -800 to the year 0.

Maps of Solar and Lunar eclipses are provided to help locate visibility zones, a useful help to guide in searching alternative documents in nearby areas.

This book is being published in the framework of an Is.I.A.O. Project concerning the History of Sciences and Pseudosciences in Antiquity and in the Orient, and is an example of interdisciplinarity between scholars of various specialization. The support of MIUR (ex 40%) is deeply appreciated, for the Projects of National Interest entitled "Interculturality, cultural, historical-religious Interaction between East and West from Antiquity to Middle Ages".

I would like to thank Is.I.A.O. for supporting this type of research and Peter J. Huber and Salvo De Meis for their studies devoted to this important field of knowledge.

Antonio Panaino

Peter J. Huber and Salvo De Meis

**Babylonian Eclipse Observations
from 750 BC to 1 BC**

Preface

The principal purpose of this book is to make the Neo- and Late-Babylonian eclipse observations available to astronomers, geophysicists, historians of science and other non-Assyriologists. It has had an indecently long gestation period. Its origins go back to the late 1950s, when one of us (PJH) as a graduate student helped van der Waerden write his *Anfänge der Astronomie*. At that time I extracted the eclipse records accessible through the *Late Babylonian Astronomical and Related Texts*, recently published by Abraham Sachs (LBAT, 1955), figured out the terminology of those texts and produced transliterations and translations. In 1973, when I was immobilized by a broken leg and needed some amusement, I obtained photographs of several unpublished eclipse texts from the British Museum, and then revised, polished and more than doubled the size of my former draft to a manuscript of 123 pages. Its publication was postponed, mostly because of other duties, but also because rushing into print did not make sense, since at that time a full publication of the astronomical diaries by Sachs seemed to be imminent. The latter task was brought to a good end only in 1996 by Hermann Hunger. However, in the interim I had made my manuscripts freely available to Abe Sachs, F. R. Stephenson and others, who did make extensive and mostly good use of it. A secondary reason for the delay was that I disapproved of some of the eclectic uses that had been made of, and the rash conclusions that had been drawn from my frequently cited, but not very accessible manuscript. Most of the resulting misunderstandings seemed to have been caused by an insufficient appreciation of the error structure of the material. I felt the situation could only be remedied if I attached my own statistical analysis of the data to a published version of my manuscript. For a long time I lacked both the leisure and the tools necessary for doing such an analysis effectively. These tools became available slowly: in 1983 I obtained a first set of decent eclipse programs from F. R. Stephenson, soon thereafter my own general purpose data analysis package became flexible and powerful enough for the task at hand, and in the late 1990s I finally began to understand the intricacies of the Earth's irregular rotation.

It is not easy to work directly with the Babylonian source texts – broken eclipse records are hidden in them like needles in a haystack – and one needs a reference extract not only for easier access, but also for fixing the readings, datings and interpretations upon which one is basing the analysis. This still holds now, when most of the texts are accessible in authoritative transliterations and translations. Eclipse records still are hard to locate – actually, like a human face in a crowd, the tell-tale graphic patterns contained in them may jump into one's eye more readily from the cuneiform text than from a transliteration or translation. It goes without saying that an extract cannot give the full context, and therefore does not replace access to the original sources: photos, hand-copies and text editions such as those by Sachs and Hunger. In 1998 my future co-author asked for a copy of my 1973 manuscript and afterwards urged me to prepare it for publication. This interchange developed into a happy and intensive collaboration. The old transliterations and translations have been checked and revised according to our present understanding of the texts, and new eclipses from the diaries have been added, so that the book now contains all currently accessible Neo- and Late-Babylonian eclipse observations; the numbers grew from 178 lunar and 32 solar eclipses and eclipse possibilities contained in the 1973 manuscript to 269 and 90, respectively. The astronomical calculations are new, based on more modern theories. Moreover, we have added a thorough analysis of the timing data. We believe that such an analysis, quantitatively disentangling random and systematic errors, is a crucial – but hitherto sorely neglected – prerequisite to the study of almost any aspect of Babylonian observational astronomy. All more important calculations were cross-checked by both of us. While the efforts were joint, ultimate responsibility for errors belongs to PJH for the transliterations, the translations and the data analysis, to SDM for the eclipse diagrams. We are grateful to many colleagues for their help and their suggestions; we should mention in particular J. Britton, C. Michel-Nozières, L. Morrison and J. Steele. Very special thanks are due to Hermann Hunger for making

transliterations of texts available to us prior to publication, and for many electronic interchanges on various technical details, and to Jean Meeus for discussions and for providing us with versions, sometimes customized ones, of his programs.

PJH
SDM

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1. Introduction

1.1 The Sources

The transliterations and translations given in this volume cover the eclipse observations accessible through LBAT and Sachs-Hunger (see Bibliography); some unpublished texts were read from photographs, or were made accessible to us in transliteration by Hermann Hunger. Hunger's edition of the eclipse texts (2001) appeared when the manuscript was in its final stages and could be utilized for final checks. Most or all texts come from an archive in Babylon and are preserved in late (Seleucid) copies. It is convenient to quote them according to their LBAT catalogue numbers. (Starred numbers denote unpublished texts, doubly starred numbers denote texts published outside of LBAT; many of those are now available through Sachs-Hunger (1988-1996) and Hunger (2001).) They can be grouped as follows.

- (A) A most interesting, tightly organized big compilation, originally covering 24 Saros cycles, that is $24 \times 38 = 912$ lunar eclipse possibilities or $24 \times 18 = 432$ years. Extending over several tablets, it must have started not earlier than -748 Sept. 21 and not later than -739 March 20, and it must have ended between -316 Dec. 13 and -307 July 9. (LBAT *1414, 1415+1416+1417, *1419).
- (B) Various shorter collections of consecutive lunar eclipses, often also in 18-year groups. Ranging from -746(?) to -159 (LBAT 1413, *1420, 1421, 1426, 1427, *1432, 1436, 1443).
- (C) Individual eclipses reported on single tablets. Ranging from -189 to -65 (LBAT 1437 to *1450).
- (D) Eclipses reported in Astronomical Diaries; probably the source material for all other text categories. (LBAT 181 to 523). The Sachs-Hunger edition of the diaries (1988-1996) has added more eclipses.
- (E) Eclipses reported in Goal Year texts. Ranging from -250 to -40. (LBAT **1216 to 1304).

Roughly speaking, most of the earlier reports (before -250) are available in the form of compilations, while most of the later ones are individual reports, or are contained in Diaries or Goal Year texts. See Sachs (1948) for a description of these text categories, and Hunger (1999) for a discussion of their relationships.

The big compilation **A** is interesting not only because of its contents, but also because of its organization. Unfortunately, only a very small fraction is preserved (about 5%). The eclipse descriptions are arranged in a kind of spreadsheet with 38 rows and 24 columns. Each of the 912 cells contains one eclipse description. If one reads downward, one reaches the chronologically next eclipse possibility, 6 (sometimes 5) months later, if one reads across, one reaches the next eclipse in the Saros cycle, 18 years later. Physically, a typical cell is approximately 20mm wide and on average 34mm high. Because of its size, the spreadsheet must have been subdivided into several tablets (at least 4, perhaps 7, see the tentative reconstruction at the end of this section). Each of these tablets must have contained at least 5 contiguous rows and stretched over all 24 columns. The fragment LBAT *1414 preserves the lower left hand corner of one such tablet. It shows that there were 24 columns: its obverse contains parts of columns 1 to 5, and the reverse parts of columns 20 to 24. Columns 1-12 are on the obverse and 13-24 on the reverse of such a tablet; one passes from the obverse to the reverse by turning the tablet around the right hand edge (an arrangement very common for astronomical tables, but unusual otherwise). The bottom row of LBAT *1414 begins with the (unobservable) eclipse of -730 April 9 in column 1 and ends with the eclipse of -316 Dec. 13 in column 24. The fragments LBAT 1415+1416+1417 form part of a single tablet; they physically join and contain parts of the first 5 rows of that tablet, hence we can expect that the tablets contained 5 or more rows each. That the fragments belong to the same compilation is evidenced by the fact that for all of them the passage from obverse to reverse occurs between the same two Saros cycles, namely between columns 12 and

13 of the spreadsheet. Limits for the beginning of the compilation can be derived from the following considerations. If the fragment LBAT *1414 is part of the last tablet of the compilation, the latter would have ended on -316 Dec. 13, and hence would have started with the (unobservable) eclipse of -748 Sep. 21. If, on the other hand, LBAT 1417, which appears to preserve the top edge of a tablet, happens to form part of the first tablet of the compilation, the latter would have begun on -739 March 20 and ranged to -307 July 9.

The apparent catch-line after the eclipse of -316 Dec. 13, referring to the eclipse possibility of -315 June 8, paradoxically can be used to argue that the bottom row of LBAT *1414 was the bottom row of the compilation, and thus, that the compilation must have ended right there. The argument goes as follows. Catch-lines are supposed to point to the beginning of the next tablet, that is, from the last entry on the reverse of a tablet to the first entry on the obverse of the next tablet. Thus, in the case of an “internal” continuation of the compilation (with a split of the spreadsheet between rows n and $n+1$, where n is less than 38), the catch-line should point from row n of the last column 24 to row $n+1$ of the *first* column 1, for example from -320 Mar. 7 to -735 Dec. 25 (cf. the modern Saros Canon below). But if we are already in the bottom row 38 of the last column 24, it should point to row 1 of the *next* column 25, that is, to the beginning of a (potential or actual) continuation of the compilation. In our case, the catch-line does the latter.

The relation of our compilation to the so-called Saros Cycle texts is not clear. These are arranged in a similar fashion, but contain only the dates (year and month) of eclipse possibilities (see Aaboe *et al.*, 1991). Though, I should point out that when I was searching for eclipses in the diaries, I found it indispensable to calculate a modern version of precisely such a Saros Cycle text to assist me in the hunt.

The following pages contain such a modern “Saros canon” illustrating the structure of the big eclipse compilation, assuming that it began in -748 and ended in -316, and was spread over 4 tablets (with 9+9+10+10 rows). A distribution over 7 tablets (with 6+6+6+5+5+5+5 rows) is of course equally possible. Incidentally, I was unable to find a plausible reconstruction, i.e. distribution onto tablets, for which the compilation begins right with Nabonassar’s reign. But, at least, the first *visible* eclipse in my reconstruction, -746FEB06, falls in Nabonassar’s accession year, and also appears to be the first eclipse of LBAT 1413. Cells where at least some part of the tablet surface has been preserved are shaded. Each cell gives the date in the Julian calendar and the Goldstine (1973) syzygy number. The + and - signs indicate whether the beginning and end of the eclipse, respectively, were above (+) or below (-) the horizon; if those positions are left blank, there was no eclipse at all. For convenience, I have continued the canon to the year 117AD.

Hunger (2001) recently published a fragment of a similar compilation of solar eclipse possibilities (Text No. 11 = BM 71537). Note that there is a onto-to-one correspondence between lunar and solar eclipse possibilities (their dates differ by half a month), and in terms of our spreadsheet, the fragment covers the rectangle formed by columns 21-24 and rows 26-33, with diagonally opposite corners at -375FEB28 and -318JUL26. The physical layout of the tablet is different from that of the lunar eclipse compilation: one passes from the obverse to the reverse between rows 28 and 29, by turning the tablet around the bottom edge. Nevertheless, it is probable that the two compilations are closely related, and they even may be coextensive, covering the same 912 cells. Note in particular that both compilations seem to end with the same column 24, and that the solar fragment passes from obverse to reverse between two rows where the lunar compilation splits tablets. The text appeared too late to be fully incorporated into the present volume, but the only clearly observed eclipse (-338SEP04) among the preserved possibilities was added to our transliterations and translations.

Obverse

1	2	3	4	5	6	7	8	9	10	11	12
-748SEP21 3125 --	-730OCT02 3348 +-	-712OCT12 3571 ++	-694OCT24 3794 --	-676NOV03 4017 +-	-658NOV15 4240 +-	-640NOV25 4463 --	-622DEC06 4686 +-	-604DEC17 4909 +-	-586DEC28 5132 --	-567JAN07 5355 +-	-549JAN19 5578 +-
-747FEB17 3130	-729FEB28 3353	-711MAR10 3576	-693MAR21 3799	-675APR30 4023	-657MAY12 4246	-639MAY22 4469	-621JUN02 4692	-603JUN12 4915	-585JUN24 5138 --	-567JUL04 5361 --	-549JUL15 5584 +-
-747AUG12 3136	-729AUG23 3359	-711SEP03 3582	-693SEP14 3805	-675SEP24 4028	-657OCT06 4251	-639OCT16 4474	-621OCT27 4697	-603NOV07 4920	-585NOV18 5143	-567DEC28 5367	-548JAN08 5590
-746FEB06 3142 +-	-728FEB17 3365 --	-710FEB27 3588 +-	-692MAR09 3811 ++	-674MAR21 4034 --	-656MAR31 4257 --	-638APR11 4480 +-	-620APR22 4703 +-	-602MAY03 4926 --	-584MAY13 5149	-566MAY24 5372	-548JUN04 5595
-746AUG02 3148 +-	-728AUG12 3371 --	-710AUG23 3594 +-	-692SEP03 3817 +-	-674SEP14 4040 --	-656SEP24 4263 +-	-638OCT06 4486 +-	-620OCT16 4709 --	-602OCT27 4932 +-	-584NOV07 5155 --	-566NOV18 5378 +-	-548NOV28 5601 +-
-745JAN26 3154 +-	-727FEB05 3377 --	-709FEB16 3600 +-	-691FEB27 3823 +-	-673MAR10 4046 --	-655MAR20 4269 +-	-637MAR31 4492 +-	-619APR11 4715 --	-601APR22 4938 --	-583MAY02 5161 +-	-565MAY14 5384 +-	-547MAY24 5607 --
-745JUL22 3160 +-	-727AUG01 3383 +-	-709AUG13 3606 --	-691AUG23 3829 +-	-673SEP03 4052 +-	-655SEP14 4275 --	-637SEP25 4498 +-	-619OCT05 4721 +-	-601OCT17 4944 --	-583OCT27 5167 --	-565NOV07 5390 +-	-547NOV18 5613 --
-744JAN15 3166 --	-726JAN25 3389 +-	-708FEB06 3612 +-	-690FEB16 3835 --	-672FEB27 4058 +-	-654MAR10 4281 +-	-636MAR20 4504 --	-618MAR31 4727 --	-600APR10 4950 +-	-582APR22 5173 --	-564MAY02 5396 --	-546MAY13 5619 +-
-744JUL10 3172	-726JUL22 3395	-708AUG01 3618 --	-690AUG12 3841 +-	-672AUG23 4064 --	-654SEP03 4287 --	-636SEP13 4510 +-	-618SEP25 4733 --	-600OCT05 4956 --	-582OCT16 5179 +-	-564OCT27 5402 --	-546NOV07 5625 --
-744DEC05 3177	-726DEC16 3400	-708DEC27 3623	-689JAN07 3846	-671JAN17 4069	-653JAN29 4292	-635FEB08 4515	-617FEB19 4738	-599MAR31 4962	-581APR11 5185	-563APR22 5408	-545MAY03 5631
-743MAY31 3183 --	-725JUN11 3406	-707JUN21 3629	-689JUL03 3852	-671JUL13 4075	-653JUL24 4298	-635AUG04 4521	-617SEP14 4745	-599SEP24 4968	-581OCT05 5191	-563OCT16 5414	-545OCT27 5637
-743NOV25 3189 +-	-725DEC06 3412 --	-707DEC16 3635 +-	-689DEC28 3858 +-	-670JAN07 4081 +-	-652JAN18 4304 +-	-634JAN29 4527 +-	-616FEB09 4750 +-	-598FEB19 4973 +-	-580MAR02 5196 --	-562MAR13 5419 +-	-544MAR23 5642 +-
-742MAY20 3195 +-	-724MAY30 3418 +-	-706JUN11 3641 --	-688JUN21 3864 --	-670JUL02 4087 +-	-652JUL13 4310 +-	-634JUL24 4533 --	-616AUG03 4756 +-	-598AUG14 4979 +-	-580AUG25 5202 --	-562SEP05 5425 +-	-544SEP15 5648 +-
-742NOV14 3201 +-	-724NOV24 3424 +-	-706DEC06 3647 --	-688DEC16 3870 +-	-670DEC27 4093 +-	-651JAN07 4316 --	-633JAN18 4539 +-	-615JAN28 4762 +-	-597FEB09 4985 --	-579FEB19 5208 --	-561MAR02 5431 +-	-543MAR13 5654 --
-741MAY10 3207 +-	-723MAY20 3430 --	-705MAY31 3653 +-	-687JUN10 3876 +-	-669JUN22 4099 --	-651JUL02 4322 --	-633JUL13 4545 +-	-615JUL24 4768 --	-597AUG04 4991 --	-579AUG14 5214 +-	-561AUG26 5437 --	-543SEP05 5660 --
-741NOV03 3213 +-	-723NOV14 3436 +-	-705NOV25 3659 --	-687DEC05 3882 +-	-669DEC17 4105 +-	-651DEC27 4328 --	-632JAN07 4551 +-	-614JAN18 4774 +-	-596JAN29 4997 --	-578FEB08 5220 +-	-560FEB19 5443 +-	-542MAR02 5666 --
-740MAR30 3218	-722MAY10 3442	-704MAY20 3665	-686MAY31 3888	-668JUN10 4111 +-	-650JUN22 4334 --	-632JUL02 4557 --	-614JUL13 4780 +-	-596JUL24 5003 --	-578AUG04 5226 --	-560AUG14 5449 +-	-542AUG26 5672 --
-740SEP22 3224	-722OCT04 3447	-704OCT14 3670	-686OCT25 3893	-668NOV05 4116	-650NOV16 4339	-632NOV26 4562	-614DEC08 4785	-596DEC18 5008	-578DEC29 5231	-559JAN09 5454	-541FEB19 5678
-739MAR20 3230 +-	-721MAR31 3453 --	-703APR10 3676 +-	-685APR22 3899 +-	-667MAY02 4122 --	-649MAY13 4345 --	-631MAY23 4568 +-	-613JUN04 4791	-595JUN14 5014	-577JUN25 5237	-559JUL06 5460	-541AUG15 5684
-739SEP12 3236 +-	-721SEP23 3459 --	-703OCT03 3682 +-	-685OCT15 3905 +-	-667OCT25 4128 --	-649NOV05 4351 +-	-631NOV16 4574 --	-613NOV27 4797 +-	-595DEC07 5020 +-	-577DEC19 5243 --	-559DEC29 5466 +-	-540JAN10 5689 +-
-738MAR09 3242 --	-720MAR19 3465 +-	-702MAR31 3688 +-	-684APR10 3911 --	-666APR21 4134 +-	-648MAY01 4357 +-	-630MAY13 4580 --	-612MAY23 4803 --	-594JUN03 5026 +-	-576JUN14 5249 +-	-558JUN25 5472 --	-540JUL05 5695 --
-738SEP01 3248 +-	-720SEP12 3471 +-	-702SEP23 3694 --	-684OCT03 3917 +-	-666OCT15 4140 +-	-648OCT25 4363 --	-630NOV05 4586 +-	-612NOV16 4809 +-	-594NOV27 5032 +-	-576DEC07 5255 +-	-558DEC19 5478 --	-540DEC29 5701 +-
-737FEB26 3254 --	-719MAR08 3477 +-	-701MAR20 3700 +-	-683MAR30 3923 --	-665APR10 4146 +-	-647APR21 4369 +-	-629MAY02 4592 --	-611MAY12 4815 --	-593MAY23 5038 +-	-575JUN03 5261 +-	-557JUN14 5484 --	-539JUN24 5707 --
-737AUG22 3260 --	-719SEP01 3483 +-	-701SEP13 3706 +-	-683SEP23 3929 --	-665OCT04 4152 +-	-647OCT15 4375 +-	-629OCT26 4598 --	-611NOV05 4821 +-	-593NOV17 5044 --	-575NOV27 5267 +-	-557DEC08 5490 +-	-539DEC19 5713 --
-736JAN16 3265	-718JAN27 3488	-700FEB07 3711	-682FEB17 3934	-664FEB29 4157	-646APR10 4381	-628APR20 4604	-610MAY01 4827	-592MAY11 5050	-574MAY23 5273	-556JUN02 5496 --	-538JUN13 5719 +-
-736JUL12 3271	-718JUL23 3494	-700AUG03 3717	-682AUG14 3940	-664AUG24 4163	-646SEP05 4386	-628OCT15 4610	-610OCT26 4833	-592NOV05 5056	-574NOV17 5279	-556NOV27 5502	-538DEC08 5725
-735JAN05 3277 --	-717JAN16 3500 +-	-699JAN26 3723 +-	-681FEB07 3946 --	-663FEB17 4169 +-	-645FEB28 4392 +-	-627MAR11 4615 --	-609MAR22 4838 +-	-591APR01 5061 +-	-573APR13 5284 --	-555APR23 5507 --	-537MAY04 5730 +-
-735JUL01 3283 +-	-717JUL13 3506 +-	-699JUL23 3729 --	-681AUG03 3952 +-	-663AUG13 4175 +-	-645AUG25 4398 --	-627SEP04 4621 +-	-609SEP15 4844 +-	-591SEP26 5067 --	-573OCT07 5290 --	-555OCT17 5513 +-	-537OCT29 5736 --
-735DEC25 3289 +-	-716JAN06 3512 +-	-698JAN16 3735 +-	-680JAN27 3958 +-	-662FEB07 4181 --	-644FEB18 4404 +-	-626FEB28 4627 +-	-608MAR11 4850 --	-590JUN14 5073 +-	-577JUN25 5296 +-	-559JUL06 5519 --	-541AUG15 5742 +-
-734JUN20 3295 +-	-716JUL01 3518 --	-698JUL12 3741 --	-680JUL22 3964 +-	-662AUG02 4187 +-	-644AUG13 4410 --	-626AUG24 4633 +-	-608SEP03 4856 +-	-590SEP15 5079 --	-572SEP25 5525 +-	-554OCT06 5748 +-	-536OCT17 5748 +-
-734DEC15 3301 --	-716DEC25 3524 +-	-697JAN06 3747 +-	-697JAN16 3970 +-	-661JAN27 4193 +-	-643FEB07 4416 --	-625FEB18 4639 +-	-607FEB28 4862 +-	-589MAR12 5085 --	-571MAR22 5308 +-	-553APR02 5531 +-	-535APR13 5754 --
-733JUN09 3307	-715JUN20 3530	-697JUL01 3753 --	-697JUL11 3976 +-	-661JUL23 4199 --	-642FEB28 4422 --	-625AUG13 4645 +-	-607AUG24 4868 +-	-589SEP04 5091 --	-571SEP14 5314 +-	-553SEP26 5537 +-	-535OCT06 5760 --
-733NOV05 3312	-715NOV15 3535	-697NOV27 3758	-697DEC07 3981	-661DEC18 4204	-643DEC29 4427	-624JUN09 4650	-606JAN19 4873	-588JAN31 5096	-570FEB10 5319	-552MAR22 5543	-534APR02 5766 --
-732APR30 3318 +-	-714MAY11 3541 --	-696MAY21 3764 +-	-678JUN01 3987 +-	-660JUN12 4210 --	-642JUN23 4433	-624JUL03 4656	-606JUL15 4879	-588JUL25 5102	-570SEP04 5326	-552SEP14 5549	-534SEP25 5772
-732OCT24 3324 --	-714NOV04 3547 +-	-696NOV15 3770 +-	-678NOV26 3993 --	-660DEC06 4216 +-	-642DEC28 4439 +-	-624DEC28 4662 --	-605JAN08 4885 +-	-587JAN19 5108 +-	-571SEP14 5331 --	-553SEP26 5554 +-	-535OCT06 5788 +-
-731APR19 3330 +-	-713MAY01 3553 +-	-695MAY11 3776 --	-677MAY22 3999 +-	-659JUN01 4222 +-	-641JUN13 4445 --	-623JUN23 4668 +-	-605JUL04 4891 +-	-587JUL15 5114 --	-569JUL26 5337 --	-551AUG05 5560 +-	-533AUG17 5783 --
-731OCT13 3336 --	-713OCT24 3559 +-	-695NOV04 3782 +-	-677NOV15 4005 --	-659NOV25 4228 +-	-641DEC07 4451 +-	-623DEC17 4674 --	-605DEC28 4897 +-	-586JAN08 5120 +-	-568JAN19 5343 --	-550JAN29 5566 +-	-532FEB10 5789 +-
-730APR09 3342 --	-712APR19 3565 +-	-694MAY01 3788 +-	-676MAY11 4011 --	-658MAY22 4234 +-	-640JUN01 4457 +-	-622JUN13 4680 --	-604JUN23 4903 --	-586JUL15 5126 +-	-568JUL15 5349 +-	-550JUL26 5572 --	-532AUG05 5795 +-

Fragments of Compilation A: LBAT 1415-1417 (top), *1419 (middle), *1414 (bottom).

Reverse

13	14	15	16	17	18	19	20	21	22	23	24
-531JAN29 5801 --	-513FEB09 6024 ++	-495FEB20 6247 +-	-477MAR03 6470 --	-459MAR13 6693 + +	-441MAR25 6916 +-	-423APR04 7139 --	-405APR15 7362 + +	-387APR26 7585 +-	-369MAY07 7808 --	-351MAY17 8031 - +	-333MAY29 8254 +-
-531JUL26 5807 ++	-513AUG06 6030 --	-495AUG16 6253 +-	-477AUG27 6476 ++	-459SEP07 6699 --	-441SEP18 6922 --	-423SEP28 7145 ++	-405OCT10 7368 +-	-387OCT20 7591 --	-369OCT31 7814 ++	-351NOV11 8037 - +	-333NOV22 8260 --
-530JAN19 5813	-512JAN30 6036	-494FEB09 6259	-476FEB21 6482	-458MAR03 6705	-440MAR13 6928	-422MAR25 7151	-404APR04 7374	-386APR15 7597 +-	-368APR26 7820 +-	-350MAY07 8043 - +	-332MAY17 8266 +-
-530JUN15 5818	-512JUN25 6041	-494AUG05 6265	-476AUG15 6488	-458AUG27 6711	-440SEP06 6934	-422SEP17 7157	-404SEP28 7380	-386OCT09 7603	-368OCT19 7826	-350OCT31 8049	-332NOV10 8272
-530DEC10 5824 --	-512DEC20 6047 + +	-493JAN01 6270 + +	-475JAN11 6493 --	-457JAN22 6716 +-	-439FEB02 6939 + +	-421FEB13 7162 --	-403FEB23 7385 +-	-385MAR07 7608 +-	-367MAR17 7831 --	-349MAR28 8054 + +	-331APR08 8277
-529JUN04 5830 - +	-511JUN14 6053 + +	-493JUN26 6276 --	-475JUL06 6499 --	-457JUL17 6722 +-	-439JUL28 6945 --	-421AUG08 7168 --	-403AUG18 7391 +-	-385AUG30 7614 + +	-367SEP09 7837	-349SEP20 8060	-331OCT01 8283
-529NOV29 5836 ++	-511DEC10 6059 + +	-493DEC21 6282 --	-475DEC31 6505 +-	-456JAN12 6728 +-	-438JAN22 6951 --	-420FEB02 7174 +-	-402FEB13 7397 +-	-384FEB24 7620 --	-366MAR06 7843 - +	-348MAR16 8066 + +	-330MAR28 8289 --
-528MAY24 5842 --	-510JUN04 6065 --	-492JUN14 6288 + +	-474JUN26 6511 +-	-456JUL06 6734 --	-438JUL17 6957 +-	-420JUL28 7180 +-	-402AUG08 7403 --	-384AUG18 7626 --	-366AUG30 7849 +-	-348SEP09 8072 --	-330SEP20 8295 +-
-528NOV17 5848 ++	-510NOV29 6071 --	-492DEC09 6294 --	-474DEC20 6517 +-	-456DEC31 6740 +-	-437JAN11 6963 --	-419JAN21 7186 +-	-401FEB02 7409 +-	-383FEB12 7632 --	-365FEB23 7855 +-	-347MAR06 8078 ++	-329MAR17 8301 --
-527MAY13 5854 ++	-509MAY25 6077 --	-491JUN04 6300 --	-473JUN15 6523 +-	-455JUN26 6746 --	-437JUL07 6969 --	-419JUL17 7192 +-	-401JUL29 7415 +-	-383AUG08 7638 --	-365AUG19 7861 +-	-347AUG30 8084 +-	-329SEP10 8307 --
-527NOV06 5860	-509NOV18 6083	-491NOV28 6306	-473DEC09 6529	-455DEC20 6752	-437DEC31 6975	-418JAN10 7198	-400JAN22 7421	-382FEB01 7644	-364FEB12 7867	-346FEB23 8090	-328MAR05 8313
-526APR04 5865 --	-508APR14 6088 --	-490APR25 6311 +-	-472MAY06 6534	-454MAY17 6757	-436MAY27 6980	-418JUN07 7203	-400JUL17 7427	-382JUL29 7650	-364AUG08 7873	-346AUG19 8096	-328AUG29 8319
-526SEP27 5871 --	-508OCT07 6094 - +	-490OCT19 6317 +-	-472OCT29 6540 --	-454NOV09 6763 +-	-436NOV20 6986 +-	-418DEC01 7209 --	-400DEC11 7432 +-	-382DEC23 7655 +-	-363JAN02 7878 - +	-345JAN13 8101 + +	-327JAN24 8324 --
-525MAR24 5877 --	-507APR03 6100 + +	-489APR15 6323 - -	-471APR25 6546 --	-453MAY06 6769 - +	-435MAY16 6992 +-	-417MAY28 7215 --	-399JUN07 7438 --	-381JUN18 7661 +-	-363JUN29 7884 - +	-345JUL10 8107 --	-327JUL20 8330 --
-525SEP16 5883 ++	-507SEP27 6106 --	-489OCT08 6329 +-	-471OCT18 6552 +-	-453OCT30 6775 --	-435NOV09 6998 +-	-417NOV21 7221 +-	-399DEC01 7444 --	-381DEC12 7667 +-	-363DEC23 7890 +-	-344JAN03 8113 - +	-326JAN13 8336 +-
-524MAR12 5889 - +	-506MAR23 6112 + +	-488APR03 6335 +-	-470APR14 6558 - -	-452APR24 6781 - +	-434MAY05 7004 +-	-416MAY16 7227 --	-398MAY27 7450 - -	-380JUN06 7673 +-	-362JUN18 7896 - +	-344JUN28 8119 - -	-326JUL09 8342 - +
-524SEP05 5895 --	-506SEP16 6118 + +	-488SEP27 6341 - -	-470OCT08 6564 - +	-452OCT18 6787 +-	-434OCT30 7010 --	-416NOV09 7233 +-	-398NOV21 7456 - +	-380DEC01 7679 - -	-362DEC12 7902 +-	-344DEC23 8125 - +	-325JAN03 8348 - +
-523MAR01 5901	-505MAR12 6124	-487MAR23 6347	-469APR03 6570	-451APR13 6793	-433APR25 7016	-415MAY05 7239 --	-397MAY16 7462 - +	-379MAY26 7685 +-	-361JUN07 7908 --	-343JUN17 8131 --	-325JUN28 8354 +-
-523AUG26 5907	-505SEP06 6130	-487SEP16 6353	-469SEP28 6576	-451OCT08 6799	-433OCT19 7022	-415OCT30 7245	-397NOV10 7468	-379NOV20 7691	-361DEC02 7914	-343DEC12 8137	-325DEC23 8360
-522JAN20 5912 --	-504JAN31 6135 + +	-486FEB11 6358 +-	-468FEB22 6581 - -	-450MAR04 6804 +-	-432MAR15 7027 +-	-414MAR26 7250 --	-396APR05 7473 +-	-378APR17 7696	-360APR27 7919	-342MAY08 8142	-324MAY19 8365
-522JUL16 5918 ++	-504JUL27 6141 + -	-486AUG07 6364 - -	-468AUG17 6587 +-	-450AUG29 6810 +-	-432SEP08 7033	-414SEP19 7256	-396SEP29 7479	-378OCT11 7702	-360OCT21 7925	-342NOV01 8148	-324NOV12 8371
-521JAN10 5924 ++	-503JAN20 6147 - -	-485JAN31 6370 +-	-467FEB11 6593 +-	-449FEB22 6816 --	-431MAR04 7039 +-	-413MAR16 7262 +-	-395MAR26 7485 - -	-377APR06 7708 +-	-359APR17 7931 +-	-341APR28 8154 - -	-323MAY08 8377 +-
-521JUL05 5930 ++	-503JUL16 6153 - -	-485JUL27 6376 - -	-467AUG06 6599 - +	-449AUG18 6822 - +	-431AUG28 7045 - -	-413SEP08 7268 - +	-395SEP18 7491 +-	-377SEP30 7714 - -	-359OCT10 7937 - +	-341OCT21 8160 + +	-323NOV01 8383 - -
-521DEC30 5936 ++	-502JAN10 6159 + +	-484JAN21 6382 - -	-466JAN31 6605 +-	-448FEB12 6828 - +	-430FEB22 7051 - -	-412MAR04 7274 +-	-394MAR16 7497 - -	-376MAR26 7720 - -	-358APR06 7943 +-	-340APR17 8166 - +	-322APR28 8389 - -
-520JUN24 5942 + -	-502JUL05 6165 --	-484JUL15 6388 - +	-466JUL26 6611 +-	-448AUG06 6834 - -	-430AUG17 7057 - -	-412AUG27 7280 +-	-394SEP08 7503 --	-376SEP18 7726 --	-358SEP29 7949 +-	-340OCT10 8172 - -	-322OCT21 8395 - +
-520DEC19 5948	-502DEC30 6171	-483JAN09 6394	-465JAN21 6617	-447JAN31 6840	-429FEB11 7063	-411FEB22 7286	-393MAR05 7509	-375MAR15 7732	-357MAR27 7955	-339APR06 8178	-321APR17 8401
-519MAY15 5953 --	-501MAY26 6176	-483JUN05 6399	-465JUN17 6622	-447JUL26 6846	-429AUG07 7069	-411AUG17 7292	-393AUG28 7515	-375SEP08 7738	-357SEP19 7961 --	-339SEP29 8184 + +	-321OCT11 8407 + -
-519NOV08 5959 --	-501NOV19 6182 + +	-483NOV30 6405 --	-465DEC11 6628 - +	-447DEC21 6851 +-	-428JAN02 7074 +-	-410JAN12 7297 --	-392JAN23 7520 +-	-374FEB03 7743 +-	-356FEB14 7966	-338FEB24 8189	-320MAR07 8412
-518MAY04 5965 ++	-500MAY15 6188 --	-482MAY26 6411 --	-464JUN05 6634 +-	-446JUN17 6857 --	-428JUN27 7080 --	-410JUL08 7303 +-	-392JUL19 7526 +-	-374JUL30 7749 --	-356AUG09 7972 +-	-338AUG21 8195 + -	-320AUG31 8418 --
-518OCT28 5971 - +	-500NOV07 6194 + +	-482NOV19 6417 +-	-464NOV29 6640 - +	-446DEC10 6863 +-	-428DEC21 7086 +-	-409JAN01 7309 - +	-391JAN11 7532 +-	-373JAN23 7755 --	-355FEB02 7978 - +	-337FEB13 8201 + +	-319FEB24 8424 --
-517APR24 5977 --	-499MAY04 6200 + +	-481MAY16 6423 --	-463MAY26 6646 --	-445JUN06 6869 +-	-427JUN17 7092 +-	-409JUN28 7315 --	-391JUL08 7538 - +	-373JUL19 7761 +-	-355JUL30 7984 --	-337AUG10 8207 --	-319AUG20 8430 +-
-517OCT17 5983 ++	-499OCT28 6206 + -	-481NOV08 6429 - -	-463NOV18 6652 +-	-445NOV30 6875 - +	-427DEC10 7098 - +	-409DEC21 7321 +-	-390JAN01 7544 --	-372JAN12 7767 - +	-354JAN22 7990 +-	-336FEB03 8213 - -	-318FEB13 8436 - +
-516APR12 5989	-498APR24 6212	-480MAY04 6435	-462MAY15 6658	-444MAY26 6881 - +	-426JUN06 7104 --	-408JUN16 7327 - +	-390JUN27 7550 + +	-372JUL08 7773 --	-354JUL19 7996 --	-336JUL29 8219 + +	-318AUG10 8442 +-
-516OCT06 5995	-498OCT17 6218	-480OCT28 6441	-462NOV08 6664	-444NOV18 6887	-426NOV30 7110	-408DEC10 7333	-390DEC21 7556	-371JAN01 7779	-353JAN12 8002	-335JAN22 8225	-317FEB03 8448
-515MAR03 6000 --	-497MAR14 6223 + +	-479MAR24 6446 +-	-461APR05 6669	-443APR15 6892	-425APR26 7115	-407MAY07 7338	-389MAY18 7561	-374JUL08 7784	-353JUL08 8008	-335JUL18 8231	-317JUL30 8454
-515AUG27 6006 --	-497SEP07 6229 + +	-479SEP18 6452 - -	-461SEP29 6675 - +	-443OCT09 6898 +-	-425OCT21 7121 --	-407OCT31 7344 +-	-389NOV12 7567 +-	-371NOV22 7790 --	-353DEC03 8013 + +	-335DEC14 8236 + +	-317DEC25 8459 --
-514FEB20 6012 --	-496MAR02 6235 + +	-478MAR14 6458 +-	-460MAR24 6681 --	-442APR04 6904 - +	-424APR14 7127 +-	-406APR26 7350 --	-388MAY06 7573 --	-370MAY17 7796 +-	-352MAY28 8019 --	-334JUN08 8242 - -	-316JUN18 8465 +-
-514AUG17 6018 + -	-496AUG27 6241 --	-478SEP07 6464 - +	-460SEP18 6687 +-	-442SEP29 6910 --	-424OCT09 7133 +-	-406OCT21 7356 +-	-388OCT31 7579 --	-370NOV11 7802 +-	-352NOV22 8025 + -	-334DEC03 8248 --	-316DEC13 8471 +-

Fragments of Compilation A: LBAT 1415-1417 (top), *1419 (middle), *1414 (bottom).

	25	26	27	28	29	30	31	32	33	34	35	36
-315JUN08	-297JUN19	-279JUN29	-261JUL11	-243JUL21	-225AUG01	-207AUG12	-189AUG23	-171SEP02	-153SEP14	-135SEP24	-117OCT05	
8477 --	8700 +	8923 ++	9146 --	9369 -+	9592 ++	9815 --	10038 -+	10261 ++	10484 --	10707 +	10930 +	
-315DEC02	-297DEC14	-279DEC24	-260JAN04	-242JAN15	-224JAN26	-206FEB05	-188FEB17	-170FEB27	-152MAR09	-134MAR21	-116MAR31	
8483 ++	8706 +	8929 --	9152 ++	9375 --	9598 --	9821 ++	10044 +-	10267 --	10490 ++	10713 ++	10936 --	
-314MAY29	-296JUN08	-278JUN19	-260JUN30	-242JUL11	-224JUL21	-206AUG01	-188AUG12	-170AUG23	-152SEP02	-134SEP14	-116SEP24	
8489 +	8712 --	8935 +-	9158 +-	9381 --	9604 +-	9827 +-	10050 --	10273 +	10496 ++	10719 --	10942 +	
-314NOV21	-296DEC02	-278DEC13	-260DEC23	-241JAN04	-223JAN14	-205JAN25	-187FEB05	-169FEB16	-151FEB26	-133MAR10	-115MAR20	
8495	8718	8941	9164	9387	9610	9833	10056 +-	10279 --	10502 ++	10725 +	10948 --	
-313APR19	-295APR29	-277MAY10	-259JUN19	-241JUN30	-223JUL11	-205JUL22	-187AUG01	-169AUG13	-151AUG23	-133SEP03	-115SEP14	
8500	8723	8946	9170	9393	9616	9839	10062	10285 --	10508 --	10731 +	10954 +	
-313OCT12	-295OCT22	-277NOV03	-259NOV13	-241NOV24	-223DEC05	-205DEC16	-187DEC27	-168JAN07	-150JAN17	-132JAN29	-114FEB08	
8506	8729	8952	9175	9398	9621	9844	10067	10290	10513	10736	10959	
-312APR07	-294APR18	-276APR29	-258MAY10	-240MAY20	-222MAY31	-204JUN11	-186JUN22	-168JUL02	-150JUL14	-132JUL24	-114AUG04	
8512 +	8735 +	8958 +	9181 --	9404 +-	9627 +-	9850 --	10073 --	10296	10519	10742	10965	
-312OCT01	-294OCT12	-276OCT22	-258NOV03	-240NOV13	-222NOV24	-204DEC05	-186DEC16	-168DEC27	-149JAN07	-131JAN17	-113JAN29	
8518 +	8741 --	8964 +	9187 --	9410 +-	9633 +-	9856 --	10079 ++	10302 +	10525 --	10748 ++	10971 +	
-311MAR27	-293APR07	-275APR18	-257APR29	-239MAY09	-221MAY20	-203MAY31	-185JUN11	-167JUN21	-149JUL03	-131JUL13	-113JUL24	
8524 +	8747 ++	8970 +-	9193 --	9416 +-	9639 ++	9862 --	10085 --	10308 ++	10531 +	10754 --	10977 +	
-311SEP20	-293OCT02	-275OCT12	-257OCT23	-239NOV03	-221NOV14	-203NOV24	-185DEC06	-167DEC16	-149DEC28	-130JAN07	-112JAN18	
8530 ++	8753 +-	8976 --	9199 ++	9422 --	9645 +-	9868 ++	10091 --	10314 ++	10537 +-	10760 --	10983 +	
-310MAR16	-292MAR26	-274APR07	-256APR17	-238APR28	-220MAY09	-202MAY20	-184MAY30	-166JUN11	-148JUN21	-130JUL02	-112JUL12	
8536	8759 +	8982 --	9205 --	9428 +-	9651 --	9874 --	10097 ++	10320 +	10543 --	10766 +	10989 +	
-310SEP10	-292SEP20	-274OCT01	-256OCT12	-238OCT23	-220NOV03	-202NOV14	-184NOV24	-166DEC06	-148DEC16	-130DEC27	-111JAN07	
8542	8765	8988	9211 --	9434 +-	9657 +-	9880 --	10103 +	10326 +	10549 --	10772 +	10995 +	
-309FEB04	-291FEB14	-273FEB26	-255MAR08	-237MAR19	-219MAR30	-201APR10	-183APR20	-165MAY31	-147JUN10	-129JUN22	-111JUL02	
8547 +	8770 +	8993 --	9216	9439	9662	9885	10108	10332	10555	10778	11001 --	
-309JUL31	-291AUG11	-273AUG22	-255SEP01	-237SEP13	-219SEP23	-201OCT04	-183OCT14	-165OCT26	-147NOV05	-129NOV16	-111NOV27	
8553	8776	8999	9222	9445	9668	9891	10114	10337	10560	10783	11006	
-308JAN25	-290FEB04	-272FEB16	-254FEB26	-236MAR08	-218MAR20	-200MAR30	-182APR10	-164APR20	-146MAY02	-128MAY12	-110MAY23	
8559 --	8782 +	8905 ++	9228 --	9451 +-	9674 ++	9897 --	10120 +	10343 +	10566 --	10789 +	11012 +	
-308JUL19	-290JUL31	-272AUG10	-254AUG21	-236SEP01	-218SEP12	-200SEP22	-182OCT04	-164OCT14	-146OCT25	-128NOV05	-110NOV16	
8565 +	8788 +	8911 --	9234 ++	9457 +-	9680 --	9903 ++	10126 +	10349 --	10572 ++	10795 +	11018 --	
-307JAN13	-289JAN25	-271FEB04	-253FEB15	-235FEB26	-217MAR09	-199MAR19	-181MAR31	-163APR10	-145APR21	-127MAY02	-109MAY13	
8571 +	8794 --	9017 +	9240 +	9463 --	9686 +-	9909 ++	10132 --	10355 +	10578 +	10801 --	11024 --	
-307JUL09	-289JUL20	-271JUL30	-253AUG11	-235AUG21	-217SEP01	-199SEP12	-181SEP23	-163OCT03	-145OCT15	-127OCT25	-109NOV05	
8577 +	8800 --	9023 +	9246 +-	9469 --	9692 +	9915 ++	10138 --	10361 ++	10584 ++	10807 --	11030 +	
-306JAN03	-288JAN14	-270JAN25	-252FEB05	-234FEB15	-216FEB26	-198MAR09	-180MAR19	-162MAR30	-144APR10	-126APR21	-108MAY01	
8583	8806	9029	9252	9475	9698	9921	10144 --	10367 ++	10590 --	10813 --	11036 +	
-306JUN28	-288JUL08	-270JUL20	-252JUL30	-234AUG10	-216AUG21	-198SEP01	-180SEP11	-162SEP23	-144OCT03	-126OCT15	-108OCT25	
8589	8812	9035	9258 --	9481 +-	9704 --	9927 --	10150 ++	10373 --	10596 +	10819 +	11042 --	
-306NOV23	-288DEC03	-270DEC15	-252DEC25	-233JAN05	-215JAN16	-197JAN27	-179FEB06	-161FEB18	-143FEB28	-125MAR11	-107MAR22	
8594	8817	9040	9263	9486	9709	9932	10155	10378	10601	10824	11047	
-305MAY20	-287MAY30	-269JUN10	-251JUN21	-233JUL02	-215JUL12	-197JUL23	-179AUG03	-161AUG14	-143AUG24	-125SEP05	-107SEP15	
8600 +	8823 --	9046 +	9269 ++	9492 --	9715 --	9938	10161	10384	10607	10830	11053	
-305NOV12	-287NOV22	-269DEC04	-251DEC14	-233DEC26	-214JAN05	-196JAN16	-178JAN27	-160FEB07	-142FEB17	-124FEB29	-106MAR11	
8606 +	8829 +	9052 --	9275 ++	9498 +-	9721 --	9944 ++	10167 +	10390 --	10613 ++	10836 +	11059 --	
-304MAY08	-286MAY19	-268MAY30	-250JUN10	-232JUN20	-214JUL02	-196JUL12	-178JUL23	-160AGU03	-142AUG14	-124AUG24	-106SEP04	
8612 +	8835 +	9058 --	9281 --	9504 ++	9727 +-	9950 --	10173 +	10396 +	10619 --	10842 +	11065 +	
-304OCT31	-286NOV12	-268NOV22	-250DEC04	-232DEC14	-214DEC25	-195JAN05	-177JAN16	-159JAN26	-141FEB07	-123FEB17	-105FEB28	
8618 +	8841 --	9064 +	9287 ++	9510 --	9733 +-	9956 +-	10179 --	10402 +	10625 +	10848 --	11071 +	
-303APR28	-285MAY09	-267MAY19	-249MAY30	-231JUN10	-213JUN21	-195JUL01	-177JUL12	-159JUL23	-141AUG03	-123AUG13	-105AUG25	
8624 +	8847 --	9070 --	9293 +	9516 +	9739 --	9962 +	10185 +	10408 --	10631 --	10854 +	11077 +	
-303OCT21	-285NOV01	-267NOV12	-249NOV23	-231DEC03	-213DEC15	-195DEC25	-176JAN06	-158JAN16	-140JAN27	-122FEB07	-104FEB18	
8630 --	8853 +	9076 --	9299 +	9522 ++	9745 --	9968 ++	10191 ++	10414 --	10637 ++	10860 +	11083 --	
-302MARCH18	-284MARCH28	-266APR08	-248APR19	-230MAY30	-212JUN09	-194JUN20	-176JUN30	-158JUL12	-140JUL22	-122AUG02	-104AUG13	
8635	8858	9081	9304	9528	9751	9974	10197	10420	10643 --	10866 ++	11089 +	
-302SEP11	-284SEP22	-266OCT03	-248OCT13	-230OCT25	-212NOV04	-194NOV15	-176NOV26	-158DEC07	-140DEC17	-122DEC29	-103JAN08	
8641	8864	9087	9310	9533	9756	9979	10202	10425	10648	10871	11094	
-301MAR07	-283MAR17	-265MAR29	-247APR08	-229APR19	-211APR30	-193MAY11	-175MAY21	-157JUN01	-139JUN12	-121JUN23	-103JUL03	
8647 +	8870 +	9093 --	9316 --	9539 +-	9762 +-	9985 --	10208 +	10431 +	10654 --	10877	11100	
-301SEP01	-283SEP11	-265SEP22	-247OCT03	-229OCT14	-211OCT24	-193NOV05	-175NOV15	-157NOV26	-139DEC07	-121DEC18	-103DEC28	
8653 --	8876 --	9099 ++	9322 +-	9545 --	9768 +-	9991 +-	10214 +	10437 +	10660 +	10883 +	11106 +	
-300FEB25	-282MAR07	-264MAR17	-246MAR29	-228APR08	-210APR19	-192APR29	-174MAY11	-156MAY21	-138JUN01	-120JUN12	-102JUN23	
8659 +	8882 --	9105 +	9328 +-	9551 --	9774 --	9997 ++	10220 --	10443 --	10666 ++	10889 --	11112 --	
-300AUG20	-282AUG31	-264SEP10	-246SEP22	-228OCT02	-210OCT13	-192OCT24	-174NOV04	-156NOV14	-138NOV26	-120DEC06	-102DEC17	
8665 --	8888 +	9111 +	9334 --	9557 +	9780 ++	10003 --	10226 +	10449 +	10672 +	10895 +	11118 +	
-299FEB13	-281FEB25	-263MAR07	-245MAR18	-227MAR29	-209APR09	-191APR19	-173APR30	-155MAY11	-137MAY22	-119JUN01	-101JUN13	
8671	8894 +	9117 --	9340 ++	9563 +-	9786 --	10009 +-	10232 +-	10455 --	10678 +	10901 +	11124 --	
-299AUG09	-281AUG20	-263AUG30	-245SEP11	-227SEP21	-209OCT02	-191OCT13	-173OCT24	-155NOV03	-137NOV15	-119NOV25	-101DEC06	
8677	8900	9123	9346 --	9569 --	9792 +-	10015 --	10238 --	10461 +	10684 --	10907 +	11130 +	
-298JAN04	-280JAN16	-262JAN26	-244FEB06	-226FEB17	-208FEB28	-190MAR10	-172MAR21	-154APR01	-136APR11	-118MAY22	-100JUN01	
8682 +	8905 +	9128 --	9351 ++	9574	9797	10020	10243	10466	10689	10913	11136	
-298JUN30	-280JUL10	-262JUL21	-244JUL31	-226AUG12	-208AUG22	-190SEP02	-172SEP13	-154SEP24	-136OCT04	-118OCT16	-100OCT26	
8688 +	8911 --	9134 +-	9357	9580	9803	10026	10249	10472	10695	10918	11141	
-298DEC25	-279JAN04	-261JAN15	-243JAN26	-225FEB06	-207FEB16	-189FEB28	-171MAR10	-153MAR21	-135APR01	-117APR12	-99APR22	
8694 +	8917 --	9140 ++	9363 +-	9586 --	9809 ++	10032 +-	10255 --	10478 +	10701 ++	10924 --	11147 --	

Synthetic continuation of Compilation A.

	37	38	39	40	41	42	43	44	45	46	47	48
-99OCT16	-81OCT27	-63NOV07	-45NOV18	-27NOV28	-9DEC10	9DEC20	27DEC31	46JAN11	64JAN22	82FEB02	100FEB13	
11153 --	11376 ++	11599 +-	11822 --	12045 ++	12268 +-	12491 -+	12714 +-	12937 --	13160 ++	13383 +-	13606 --	
-98APR11	-80APR21	-62MAY03	-44MAY13	-26MAY24	-8JUN03	10JUN15	28JUN25	46JUL06	64JUL17	82JUL28	100AUG07	
11159 -+	11382 ++	11605 +-	11828 --	12051 -+	12274 ++	12497 --	12720 --	12943 +-	13166 +-	13389 --	13612 --	
-98OCT05	-80OCT16	-62OCT27	-44NOV07	-26NOV18	-8NOV28	10DEC10	28DEC20	46DEC31	65JAN11	83JAN22	101FEB01	
11165 ++	11388 --	11611 ++	11834 +-	12057 --	12280 +-	12503 +-	12726 -+	12949 +-	13172 +-	13395 +-	13618 +-	
-97MAR31	-79APR11	-61APR22	-43MAY02	-25MAY13	-7MAY24	11JUN04	29JUN14	47JUN26	65JUL06	83JUL17	101JUL28	
11171 ++	11394 +-	11617 --	11840 +-	12063 +-	12286 --	12509 --	12732 +-	12955 +-	13178 --	13401 +-	13624 +-	
-97SEP25	-79OCT05	-61OCT17	-43OCT27	-25NOV07	-7NOV18	11NOV29	29DEC09	47DEC21	65DEC31	84JAN11	102JAN22	
11177 --	11400 ++	11623 +-	11846 --	12069 +-	12292 +-	12515 --	12738 +-	12961 +-	13184 --	13407 +-	13630 +-	
-96FEB19	-78MAR02	-60MAR12	-42APR22	-24MAY02	-6MAY13	12MAY24	30JUN04	48JUN14	66JUN26	84JUL06	102JUL17	
11182	11405	11628	11852	12075	12298	12521 --	12744 --	12967 +-	13190 +-	13413 --	13636 +-	
-96AUG14	-78AUG26	-60SEP05	-42OCT16	-24OCT26	-6NOV07	12NOV17	30NOV28	48DEC09	66DEC20	84DEC30	103JAN11	
11188	11411	11634	11858	12081	12304	12527	12750	12973	13196	13419	13642	
-95FEB08	-77FEB19	-59MAR02	-41MAR13	-23MAR23	-5APR04	13APR14	31APR25	49MAY06	67MAY17	85MAY27	103JUN08	
11194 --	11417 ++	11640 --	11863 --	12086 +-	12309 --	12532 --	12755 +-	12978 --	13201 --	13424	13647	
-95AUG03	-77AUG15	-59AUG25	-41SEP05	-23SEP16	-5SEP27	13OCT07	31OCT19	49OCT29	67NOV09	85NOV20	103DEC01	
11200 ++	11423 --	11646 --	11869 +-	12092 +-	12315 --	12538 +-	12761 +-	12984 --	13207 +-	13430 +-	13653 --	
-94JAN29	-76FEB09	-58FEB19	-40MAR02	-22MAR13	-4MAR23	14APR04	32APR14	50APR25	68MAY05	86MAY17	104MAY27	
11206 +-	11429 --	11652 ++	11875 +-	12098 --	12321 +-	12544 +-	12767 --	12990 +-	13213 +-	13436 --	13659 --	
-94JUL24	-76AUG03	-58AUG14	-40AUG25	-22SEP05	-4SEP15	14SEP27	32OCT07	50OCT18	68OCT29	86NOV09	104NOV19	
11212 --	11435 --	11658 +-	11881 +-	12104 --	12327 +-	12550 +-	12773 --	12996 +-	13219 --	13442 +-	13665 +-	
-93JAN18	-75JAN28	-57FEB09	-39FEB19	-21MAR02	-3MAR13	15MAR24	33APR03	51APR14	69APR25	87MAY06	105MAY16	
11218 --	11441 ++	11664 +	11887 --	12110 +	12333 +	12556 --	12779 +	13002 +-	13225 --	13448 --	13671 --	
-93JUL13	-75JUL24	-57AUG04	-39AUG14	-21AUG26	-3SEP05	15SEP16	33SEP27	51OCT08	69OCT18	87OCT30	105NOV09	
11224 ++	11447 --	11670 --	11893 +-	12116 +-	12339 --	12562 +-	12785 +-	13008 --	13231 +-	13454 --	13677 --	
-93DEC08	-75DEC18	-57DEC30	-38JAN09	-20JAN20	-2JAN31	16FEB11	34MAR23	52APR02	70APR14	88APR24	106MAY05	
11229	11452	11675	11898	12121	12344	12567	12791	13014	13237	13460	13683	
-92JUN03	-74JUN14	-56JUN24	-38JUL06	-20JUL16	-2JUL27	16SEP05	34SEP16	52SEP27	70OCT08	88OCT18	106OCT30	
11235 --	11458 --	11681	11904	12127	12350	12574	12797	13020	13243	13466	13689	
-92NOV26	-74DEC08	-56DEC18	-38DEC29	-19JAN09	-1JAN20	17JAN30	35FEB11	53FEB21	71MAR04	89MAR15	107MAR26	
11241 ++	11464 ++	11687 --	11910 +-	12133 +-	12356 --	12579 +-	12802 +-	13025 --	13248 +-	13471 +-	13694 --	
-91MAY23	-73JUN04	-55JUN14	-37JUN25	-19JUL05	-1JUL17	17JUL27	35AUG07	53AUG18	71AUG29	89SEP08	107SEP20	
11247 ++	11470 +-	11693 --	11916 --	12139 +-	12362 --	12585 --	12808 +-	13031 +-	13254 --	13477 +-	13700 +-	
-91NOV16	-73NOV27	-55DEC07	-37DEC19	-19DEC29	0JAN09	18JAN20	36JAN31	54FEB11	72FEB22	90MAR04	108MAR15	
11253 --	11476 --	11699 ++	11922 +-	12145 +-	12368 +-	12591 --	12814 +-	13037 +-	13260 --	13483 +-	13706 +-	
-90MAY13	-72MAY23	-54JUN03	-36JUN13	-18JUN25	0JUL05	18JUL16	36JUL26	54AUG07	72AUG17	90AUG28	108SEP08	
11259 ++	11482 --	11705 --	11928 +-	12151 +-	12374 --	12597 +-	12820 +-	13043 --	13266 --	13489 +-	13712 +-	
-90NOV05	-72NOV16	-54NOV27	-36DEC07	-18DEC19	0DEC29	19JAN09	37JAN20	55JAN31	73FEB11	91FEB22	109MAR04	
11265 ++	11488 +-	11711 --	11934 +-	12157 --	12380 +-	12603 +-	12826 --	13049 +-	13272 +-	13495 --	13718 +-	
-89MAY02	-71MAY12	-53MAY23	-35JUN02	-17JUN14	1JUN24	19JUL05	37JUL15	55JUL27	73AUG06	91AUG17	109AUG28	
11271	11494	11717	11940	12163	12386 --	12609 +-	12832 +-	13055 --	13278 --	13501 +-	13724 --	
-89SEP26	-71OCT07	-53OCT18	-35OCT28	-17NOV09	1NOV19	19DEC01	37DEC11	56JAN21	74JAN31	92FEB12	110FEB22	
11276	11499	11722	11945	12168	12391	12614	12837	13061	13284	13507	13730	
-88MAR21	-70APR01	-52APR12	-34APR23	-16MAY03	2MAY15	20MAY25	38JUN05	56JUN16	74JUN27	92AUG06	110AUG17	
11282 -+	11505 ++	11728 --	11951 --	12174 +-	12397 --	12620	12843	13066	13289	13513	13736	
-88SEP15	-70SEP26	-52OCT06	-34OCT18	-16OCT28	2NOV08	20NOV19	38NOV30	56DEC10	74DEC22	93JAN01	111JAN12	
11288 --	11511 +-	11734 +	11957 --	12180 +-	12403 +-	12626 --	12849 +-	13072 +-	13295 --	13518 +-	13741 +-	
-87MAR11	-69MAR22	-51APR01	-33APR13	-15APR23	3MAY04	21MAY15	39MAY26	57JUN05	75JUN17	93JUN27	111JUL08	
11294 +-	11517 --	11740 +	11963 +-	12186 --	12409 +-	12632 +-	12855 --	13078 +-	13301 +-	13524 --	13747 --	
-87SEP04	-69SEP15	-51SEP25	-33OCT07	-15OCT17	30CT28	21NOV08	39NOV19	57NOV29	75DEC11	93DEC21	112JAN01	
11300 --	11523 +-	11746 +	11969 --	12192 +-	12415 +-	12638 --	12861 +-	13084 +-	13307 --	13530 +-	13753 +-	
-86FEB28	-68MAR11	-50MAR22	-32APR01	-14APR13	4APR23	22MAY04	40MAY15	58MAY26	76JUN05	94JUN17	112JUN27	
11306 ++	11529 --	11752 --	11975 +-	12198 --	12421 --	12644 +-	12867 +-	13090 --	13313 +-	13536 +-	13759 --	
-86AUG24	-68SEP03	-50SEP14	-32SEP25	-14OCT06	4OCT16	22OCT28	40NOV07	58NOV18	76NOV29	94DEC10	112DEC21	
11312 --	11535 -+	11758 +	11981 --	12204 --	12427 +-	12650 --	12873 --	13096 +-	13319 --	13542 +-	13765 +-	
-85JAN20	-67JAN30	-49FEB10	-31FEB21	-13MAR04	5APR13	23APR24	41MAY04	59MAY16	77MAY26	95JUN06	113JUN16	
11317	11540	11763	11986	12209	12433	12656	12879	13102	13325	13548 --	13771 +-	
-85JUL15	-67JUL25	-49AUG05	-31AUG16	-13SEP25	5OCT06	23OCT17	41OCT27	59NOV08	77NOV18	95NOV30	113DEC10	
11323	11546	11769	11992	12216	12439	12662	12885	13108	13331	13554	13777	
-84JAN09	-66JAN19	-48JAN30	-30FEB10	-12FEB21	6MAR03	24MAR14	42MAR25	60APR04	78APR16	96APR26	114MAY07	
11329 --	11552 +-	11775 +	11998 --	12221 --	12444 +-	12667 +-	12890 --	13113 +-	13336 +-	13559	13782	
-84JUL03	-66JUL15	-48JUL25	-30AUG05	-12AUG16	6AUG27	24SEP06	42SEP18	60SEP28	78OCT09	96OCT20	114OCT31	
11335 +-	11558 -+	11781 --	12004 +-	12227 +-	12450 --	12673 +-	12896 +-	13119 --	13342 +-	13565 --	13788 --	
-84DEC28	-65JAN08	-47JAN18	-29JAN30	-11FEB09	7FEB20	25MAR03	43MAR14	61MAR24	79APR05	97APR15	115APR26	
11341 +-	11564 -+	11787 +	12010 +-	12233 --	12456 +-	12679 +-	12902 --	13125 +-	13348 +-	13571 --	13794 --	
-83JUN23	-65JUL04	-47JUL15	-29JUL26	-11AUG05	7AUG17	25AUG27	43SEP07	61SEP18	79SEP29	97OCT09	115OCT21	
11347 --	11570 +-	11793 --	12016 --	12239 +-	12462 +-	12685 --	12908 +-	13131 +-	13354 --	13577 +-	13800 +-	
-83DEC17	-65DEC28	-46JAN07	-28JAN19	-10JAN29	8FEB09	26FEB20	44MAR02	62MAR13	80MAR24	98APR04	116APR14	
11353 --	11576 -+	11799 +-	12022 --	12245 +-	12468 +-	12691 --	12914 --	13137 +-	13360 --	13583 --	13806 +-	
-82JUN13	-64JUN23	-46JUL04	-28JUL15	-10JUL26	8AUG05	26AUG16	44AUG27	62SEP07	80SEP17	98SEP29	116OCT09	
11359	11582	11805 +	12028 +-	12251 --	12474 +-	12697 +-	12920 --	13143 --	13366 +-	13589 --	13812 --	
-82NOV07	-64NOV17	-46NOV28	-28DEC09	-10DEC20	8DEC30	27JAN11	45JAN21	63MAR03	81MAR13	99MAR25	117APR04	
11364	11587	11810	12033	12256	12479	12702	12925	13149	13372	13595	13818	
-81MAY03	-63MAY14	-45MAY25	-27JUN04	-9JUN15	9JUN26	27JUL07	45JUL17	63AUG27	81SEP06	99SEP18	117SEP28	
11370 ++	11593 +-	11816	12039	12262	12485	12708	12931	13155	13378	13601	13824	

Synthetic continuation of Compilation A.

1.2 Coverage

All eclipses occurring in *observational* texts are included here, not only observed eclipses, but also those which are clearly predicted. Eclipse predictions in *predictional* texts (Almanacs and Normal Star Almanacs) are not covered. With one exception — the solar eclipse of -668MAY27, discussed in Section 2.8 — the Assyrian observations (Nineveh, 7th century B.C.) were excluded; for these see SAA 8 (Hunger 1992), SAA 10 (Parpola 1993), and De Meis and Hunger (1998).

Most eclipses are explicitly dated in the texts themselves (by king – year – month – day). Sometimes, for example in Goal-Year texts, such an explicit date will not appear in the transliterations and translations because it is given in the text a few lines earlier in connection with another event. Reports contained in a compilation such as A are uniquely dated by their position on the grid — though, unfortunately, some eclipse observations may have been entered in the wrong cell in antiquity (a possible example is -712 April 19). In the case of the diaries, we have adopted the dates given in Sachs and Hunger. Otherwise, the basis of inferred dates is given in the notes.

1.3 Observations and predictions

It is not always easy to distinguish between calculated and observed data. As already Kugler had recognized, *an-mi sin* (*šamáš*) ordinarily denotes a predicted eclipse, whereas the opposite order *sin* (*šamáš*) *an-mi* denotes an observed eclipse.

However, there are many exceptions to this rule. A case in point is the famous lunar eclipse of -522 July 16-17, where the alleged observation reported in Strm. Kamb. 400 in all likelihood is a prediction for -522, made by quoting an actual observation of 54 years earlier. The solar eclipse of -248 May 4 appears to be an exception to the rule in the other direction.

Note that the big compilation A *always* reports the time when the eclipse begins, even when the begin is invisible in Babylon. Thus, if an eclipse is reported only summarily, the time of its beginning may very well be a later, calculated addition. But if the report is rather complete and contains also other times, the times presumably are measured.

If “eclipse possibility” is taken to mean a syzygy at which the sun is within half a month’s progress from a lunar node, then 38 possibilities occur in 223 months (or 18 years). The spacings between these possibilities are mostly 6 months (33 times) and sometimes 5 months (5 times). At least one, very often both, of the two eclipse possibilities bordering a 5-month interval will not materialize as an eclipse. See Aaboe *et al.* (1991). We do not know according to what rules, if there were any, the Babylonians would insert non-eclipses to complete the pattern. Apparently, they did not necessarily choose the one closest to the node (cf. in particular the eclipse possibilities of -422 Aug./Sep., -382 June/July and -278 Nov./Dec., which may suggest that they have preferred the interval sequence 5+6 to 6+5 months).

Our texts contain both positive and negative predictions, i.e. predictions of occurrence and of non-occurrence of an eclipse. If an eclipse is described as “passing by” (*šá dib*, “which passes”, *dib* = *etēqu* “to pass”), then there apparently was no need to watch for an eclipse — at least, I am not aware of any references to observations made in the case of passing eclipses, apart from a single damaged passage explicitly stating that none was made: “[lunar eclipse] after sunset; I did not watch” (diary, -382 June 29). Often a reason for passing is given. These reasons are of three kinds: (i) a wrong time of the day for a lunar or solar eclipse; (ii) a laconic statement “5 *itu dib*”, or “5 *dib*”, “5 (months), passes”, presumably referring to the 5-month intervals mentioned in the preceding paragraph, and (iii) curious phrases “BAR *dib*” or “BE *dib*”. In Babylonian mathematical astronomy, the sign BAR is a technical

term with the seemingly contradictory meanings “node” and “eclipse excluded”, and BE also means “eclipse excluded” (see the glossary of ACT, Neugebauer (1955)). Moreover, BAR is also the standard sign for the fraction $\frac{1}{2}$; either way, it might refer to some unspecified observations made half a month earlier, when the moon was near the opposite node. One is particularly reminded of some curious statements in the lunar eclipse omens of Enūma Anu Enlil, Tablet 20: “Observe his last visibility on the 28th of Month V, and you will predict an eclipse for the 14th day of Month VI. The day of last visibility will show you the eclipse.” (Rochberg-Halton (1988), p.201 and elsewhere).

Positive predictions are not explicitly characterized as such, but the solar eclipse texts frequently say “when I watched, I did not see” (*ki pap nu igi*), and one diary has the remarkable statement: “Night of the 15th, lunar eclipse of 1 finger; when I watched I did not see it” (-302 Sep. 11).

1.4 Reliability of the data

Unfortunately, there is very little redundancy for a most crucial part of the data, namely the time when the eclipse begins. Moreover, already a slight damage to the surface of a tablet can obliterate the distinction between 40 and 50, or between 4, 5, 6, 7 and 8. For the texts under consideration, the following sources of errors seem to be the most important ones:

- copying errors (ancient or modern); in particular misreadings of damaged or tightly written signs;
- misinterpretations; in particular: reading the result of modern calculations into an imperfectly preserved or understood text;
- false identification of an eclipse report (the eclipse of -712 April 19 seems to be an ancient example); there is always the possibility that a prediction (= earlier observation?) has been substituted for a missing observation.

I have checked my former readings against Hunger's, where available in Sachs-Hunger, Vol. I-III, and Hunger, Vol. V, but some errors may have slipped through. In any case, important conclusions should never be based on a single textual witness. If possible, crucial interpretations should be re-checked against Hunger's transliterations and translations for the context (in particular, for the reliability of the date) and against the hand copies and photos for the reliability of the readings.

1.5 Development of observational practice

Very summary reports occur at all times. From the more complete records, the following development of observational practice seems to be discernible, with occasional additions and subtraction of features, respectively. On the right hand side, the dates of earliest well preserved examples of such are given. The + and – signs indicate addition or dropping of a particular feature.

“Oldest reports”:

- (a) little more than night watch, and
the side of the disk which was eclipsed. -746(?)

“Old reports:”

- (b) + time of begin (relative to sunset/sunrise);
+ approximate entrance angle;
+ magnitude; } -701 March
-685 April
- (c) + total duration;
+ approximate exit angle;
+ position relative to a fixed star; -631 May

“Fully developed reports”:

- (d) + all time intervals;
+ occasional positions of visible planets -572 April
-554 Oct.
- (e) – the positions of planets are no longer given
(only presence and absence) -407 Oct.
- (f) + time intervals between sunset/sunrise and moonset/moonrise -366 Aug.
- (g) + time of begin relative to the culmination of a *ziqpu* star -225 Aug.

But note that the seemingly latest addition, time relative to the culmination of a *ziqpu* star, already occurs in Assyrian reports from the 7th century (SAA 10, #134 and #149).

1.6 Note on the transliteration

Non-Assyriologists tend to be confused by the ever changing transliteration of cuneiform texts, and some explanatory notes are in order. The principal source of the confusion is that the opinions of the Sumerologists about the pronunciation even of common words differ and change every few years. By the time the Late Babylonian astronomical texts were written, Sumerian and Akkadian had been dead languages for some 1500 and 500 years, respectively. Moreover, these texts are written in a peculiar shorthand notation, using a combination of (pseudo-)Sumerian ideograms and phonetically written Akkadian words. The latter sometimes are abbreviated to their first syllable. Sumerian and Akkadian lexica offer little help, the meaning of the texts must be deciphered from the astronomical context.

At least in principle, the transliteration tries to render the texts sign-by-sign in latin script in such a way that the cuneiform original is unambiguously reconstructible, while at the same time staying close to the putative Sumerian and Akkadian pronunciations. Phonetically written Akkadian is rendered in lower case italics, Sumerian in lower case roman letters. Upper case roman letters are used to identify a sign without interpreting it (and then, the most frequent syllabic value is used). There is a subtle, but largely irrelevant, distinction between hyphens and dots. The latter are used for non-phonetical sign combinations such as “A.IGI” — that is: WATER+EYE — meaning “weeping, lamentation”, and pronounced “er” in Sumerian, “*bikītu*” in Akkadian. The combination “A.IGI” will be transliterated “ir”; note that the cuneiform syllabary has difficulties distinguishing between the vowels e and i, and that accents and subscripts in transliterations are used to distinguish between (approximately) homophonous signs and have no phonetic meaning. In our texts, “ir” denotes the time of maximal phase of an eclipse. The situation gets more complicated in the case of “AN.MI” (SKY+BLACK), the standard ideogram for “eclipse”. Currently, one believes that this combination was pronounced

something like “anku” and one therefore tends to transliterate it as “an-ku₁₀”. AN by itself in our texts is used for “sky” and for “Mars”, and, rather curiously, for “rain”. In regular cuneiform, and also in the oldest diaries, “rain” is denoted by the sign combination A.AN (WATER+SKY), pronounced “sèg” in Sumerian, “zunnû” in Akkadian. It is difficult to understand why A.AN should have been shortened to AN, unless the Late Babylonian scribes actually read it aloud as “a-an”, which is neither Sumerian nor Akkadian! Under these circumstances, the principles of transliteration stated above work even worse than usual; the actual pronunciation of shorthand notation may be both moot and irrelevant. To give a familiar modern illustration: what is the proper way to read the (pseudo-)Latin ideogram “i.e.”? As “id est”, “eye-ee”, or “that is”?

To complicate matters even further, signs may have different pronunciations depending on Sumerian grammatical context, a context which is absent in our texts. For example, the sign DU (originally the picture of a foot) can be used for the verb “to go”. Unfortunately, just like its modern English counterpart, this verb uses different roots for different verbal aspects. Thus, NI.DU can be transliterated as “i-gen” or as “i-du”, depending on whether it expresses a finished or an unfinished action (comparable to “he went”, or “he goes”, respectively). Should we now transliterate the ungrammatical sign combination “SI DU”, which in our texts stands short for “north(wind) blew”, into pseudo-Sumerian pseudo-phonetical “si gin” or “si du”? We shall follow Sachs and Hunger and use the former. In addition, the same sign DU also can mean “to stand”, and then it is pronounced and transliterated “gub”.

The Sachs-Hunger edition of the diaries uses a two-way split: lower case italics for Akkadian phonetical writings, upper case roman for everything else. In this book, while otherwise staying close to their conventions, we have decided in favor of a three-way split: lower case italics for Akkadian, lower case roman for Sumerian, and upper case roman when we are quoting signs without interpreting them. Also, in order to avoid high-order subscripts, we shall follow the practice of Parpola in SAA and prefer the old-fashioned, probably unphonetical “an-mi” to a possibly phonetical “AN.KU₁₀”.

1.7 Terminology of the texts

A fully developed eclipse report contains the following data in the following order (texts LBAT 1437 to *1450 and Diaries):

(1) Date: Year, Month, Day

Note that the Babylonian day begins with sunset and the month with the first visibility of the new moon. The year begins near the vernal equinox, from a few weeks before to a few weeks after. From about 500 BC on, a 19-year intercalary cycle was in effect. See Parker and Dubberstein (1956), and Huber *et al.* (1982), p. 9.

The following page gives a list of the Babylonian kings and the beginnings of their reigns.

Kings of Babylon: names and their 5-letter abbreviations used in the computer listings:

Abbreviation	Name	Year
NBNSR	Nabonassar	-747
NBNDZ	Nabu-nadin-zer	-733
NBSUK	Nabu-šum-ukin	-731
UKNZR	Ukin-zer	-731
PULU	Pulu (=Tiglathpileser III)	-728
ULULA	Ululai (=Salmanassar V)	-726
MKAID	Marduk-apal-iddina	-721
SARG2	Sargon II	-709
SANH1	Sennacherib	-704
	Marduk-zakir-šum II	-702
	Marduk-apal-iddina II	-702
BELIB	Bel-ibni	-702
ASNSM	Aššur-nadin-šum	-699
NLUSZ	Nergal-ušezip	-693
MUSMK	Mušezip-Marduk	-692
SANH2	Sennacherib	-688
ASRHD	Asarhaddon	-680
SSSUK	Šamaš-šum-ukin	-667
KANDL	Kandalanu	-647
NBPLS	Nabopolassar	-625
NBKDR	Nebuchadnezzar II	-604
AMLMK	Amel-Marduk	-561
NLSUS	Nergal-šar-usur	-559
	Labaši-Marduk	-555
NBNID	Nabunaid	-555
CYRUS	Cyrus	-538
CAMBS	Cambyses	-529
DARI1	Dareios I	-521
XERXS	Xerxes	-485
ARTX1	Artaxerxes I	-464
DARI2	Dareios II	-423
ARTX2	Artaxerxes II	-404
ARTX3	Artaxerxes III	-358
ARSES	Arses	-337
DARI3	Dareios III	-335
ALEXG	Alexander III the Great	-330
PILIP	Philip	-323
	Antigonus	-317
ALEX4	Alexander IV	-316
S.E.	Seleucid Era	-311

The year numbers correspond to the Julian year in which year 0 of the respective king begins. Thus, to find the Julian year in whose spring year n of a king began, add n to the number in the table. Note that the Assyrian king Sennacherib exercised the rule over Babylon twice. — Before Alexander the Great, year 0 coincides with the accession year of the king. From Alexander onward, accession years were no longer used (i.e. the part of the regnal year remaining after the death of the previous ruler is reckoned as “year 1” of his successor). From there to the early Seleucid Era, overlapping year counts are competing with each other; Alexander’s years usually are counted from his Macedonian accession (with year 1 = -335, rather than -329).

Month names (itu = *arhu* “month”)

I	bar	=	Nisannu	VII	du ₆	=	Tašrītu
II	gu ₄	=	Ayaru	VIII	apin	=	Arahsamna
III	sig	=	Simānu	IX	gan	=	Kislīmu
IV	šu	=	Dūzu	X	ab	=	Tebētu
V	izi	=	Abu	XI	zíz	=	Šabātu
VI	kin	=	Ulūlu	XII	še	=	Addaru

Intercalary months

VI ₂	kin dir,	kin-2-kám,	kin-a
XII ₂	še dir,	dir še	

The texts usually save space by not repeating those parts of the date that already have occurred a few lines earlier on the same tablet. For example, the first lines of LBAT 1417 systematically mention the kings' names, and not merely year numbers, suggesting that these were indeed the top lines of the tablet.

In Arsacid times, confusing double dates are used, for example -79APR11:

mu-1-me-1+ŠU-8-kám šá ši-i mu-2-me-32-kám ^lar-šá-kám lugal lugal-meš šá it-tar-ri-du ^lú-ruda-a lugal itu bar ge₆ 13

Year 168, that is year 232, Arsaces, king of kings, which is in the time(?) of king Orodes, month I, night 13.

Here, *me* means 100, 1+ŠU is a ligature standing short for 1 šu-ši and denoting 60. Paradoxically, the *first* year number 168 refers to the Arsacid era, the *second* year number 232 to the Seleucid era.

(2) Time between moonrise and sunset (ME)

Example: 6,30 me muš “6°;30 ME measured”.

The unit of time is 1 uš or time degree ($1^\circ = 4$ minutes). After ME, a meteorological remark can be inserted: *dir* “clouded(?)”, *a-kám* “mist (or dust?)”. *muš* may be an abbreviation for *muššuh* “measured”; the opposite is *nu pap* = *ul attasar* “(I have) not observed”. From the context it appears that *muš* does not merely mean “measured”, but implies something like “measured (despite adverse conditions)”. The names of the six relevant time intervals (“Lunar Sixes”) are:

na	:	sunset to moonset	after new moon
šú	:	moonset to sunrise	
me	:	moonrise to sunset	
na	:	sunrise to moonset	near full moon
ge ₆	:	sunset to moonrise	
kur	:	moonrise to sunrise	before new moon

(3) Time of the begin of the eclipse relative to the culmination of a *ziqpu* star

Example: 5 uš ár (ina igi) mál tak-šat ziq-pi
“5° after (before) *takšat* culminated”

See Section 2.7 for a list with the identification of the *ziqpu* stars. Whether uš here is meant as a measure of time or of angle is difficult to say (we take it to be the former).

(4) Entrance angle of the shadow

Example: sin an-mi id kur u si ki-i tab-ú
“lunar eclipse, beginning on the north east side”.

In one text (LBAT *1420) the cardinal directions are denoted by numerals:

ulù	=	1	“south”	(180°)
si	=	2	“north”	(0°)
kur	=	3	“east”	(90°)
mar	=	4	“west”	(270°)

There is no discernible difference between kur *u* si (“east and north”) and si *u* kur, both meaning “northeast”. Sometimes one finds the fuller expression *ina bi si u kur*, “in between north and east”, where we take *bi* to be an abbreviation for *birīt*. Whether the sign ID should be transliterated as Sumerian á or as Akkadian *id* (*idu* = “side”) is moot. It can be omitted, and the directions can be denoted more fully by si šar (šár) “northern direction” (from šāru “wind); *ki-i*, *ki* means “when”, and tab-ú, tab = šurrû “to begin”. Earlier investigations had indicated that the angles are measured in the equatorial system, but are not very accurate. A re-examination on the basis of the expanded material would be appropriate.

(5) Time to the maximal phase

(6) Magnitude of maximal phase

Example: ina 20 ge₆ 6 si gar-an
“in 20° night it made 6 fingers” (-79 April 11).

For solar eclipses, ge₆ “night” is of course replaced by me “day”. Eclipse magnitudes are expressed either in fingers (12 fingers correspond to totality) or in fractions of the lunar disk (halves, thirds and quarters). With a single exception (-135 April 1), 5 and 7 fingers do not occur. Pre-Seleucid texts avoid fingers altogether, except for the smallest and largest partial eclipses. Some other sample expressions for lunar eclipse magnitudes:

2 si šú-im	“2 fingers covered” (-133 Mar. 10)
4-ú hab šú	“a quarter of the disk covered” (-407 Oct. 31)
al-la 4-ú hab-rat	“over a quarter of the disk” (-325 Jan. 3)
al-la šal-šú hab-rat	“over a third of the disk” (-97 Mar. 31)
2-ta šu _{II} hab-rat	“two thirds of the disk” (-66 Jan. 19)
3 re-bít	“3 quarters” (-600 April 10)
2 si ana til tag ₄	“2 fingers lacked to totality” (-423 Sep. 28)

1 si <i>ana</i> til-tim tag ₄	“1 finger lacked to totality (-119 June 1)
<i>i ana</i> til tag ₄	“a little lacked to totality” (-409 Dec. 21)
<i>gab(-bi)(-šú) šú(-im)</i>	“in its totality covered” (<i>passim</i>)

(*i* is abbreviation for *isi*, *isa* “a little”, *til* = *gamru* “complete”, *til-tim* = *gamertim* (gen.) “completeness”, *tag₄* = *rēhu* “to remain”, *šú-im* = *arim* or *katim*, both “covered”)

(7) Duration of maximal phase

Example: 6 ge₆ ír *ana* zalág-*ru* ki-i tab-ú
“6° night lamentation until when becoming-bright did begin” (-119 June 1).

In this context, *ír* (A.IGI) = *bikītu* “lamentation, weeping” apparently describes what the people did and is a curious way of referring to the maximal phase (also for partial eclipses, cf. -79 April 11); *zalág* = *namāru* “to become bright”, “to clear”.

(8) Time from the end of maximal phase to the end of the eclipse

(9) Direction, in which the shadow crosses the disk

Example: *ina* 18 ge₆ ta si *u* kur *ana* ulù *u* mar *zalág-ir*
“in 18° night from north-east to south-west it became bright” (-153 Mar. 21).

(*ta* = *ištū*, *ultū* “from”; *zalág-ir* = *innamir* “it became bright”)

(10) Total duration of the eclipse

Example: 44 gar ír *u* *zalág-ru* “44° total duration” (lunar, -153 Mar. 21).
23 gar *u* *zalág-ru* “23° total duration” (solar, -253 Jan. 31).

The meaning of the whole phrase is determined by the fact that the number is the sum of items (5), (7) and (8); literally: ”making (or onset), weeping and becoming bright (or clearing)”. In the case of non-total solar eclipses, there is no time for weeping.

A few text add remarks such as:

ina gar ír né-hi *ina* *zalág ha-mut*
“during onset (and) maximal phase it was slow, during clearing, it was fast” (-316 Dec. 13).

This may refer to the perceived speed of the movement of the shadow, since the observed duration of the “slow” phase typically is longer than that of the “fast” phase.

(11) Meteorological remarks

Examples:

an-mi-šú túg an-e gar-in “	(during) its eclipse, the sky was overcast(?)” (literally: <i>nalbaš šamē šakin</i> “heavenly garment was in place”, -238APR28).
ina an-mi-šú si gin	“in its eclipse, north wind blew (literally: north went)” (<i>ibid.</i>).
ina an-mi-šú si šá pa mar gar gin	“during its eclipse, north(wind) which was set to the west side blew” (so Sachs and Hunger). (pa = <i>kappi</i> “wing”, see -153MAR21 and -65DEC28.)
ina an-mi-šú mar šá ana si sal-pu (NI.BU) gin	“during its eclipse west(wind) blew which was turning(?) toward north” (-253JAN31).
an-mi-šú sa ₅ (DIR)	“its eclipse was red (or clouded? reading dir), (-554OCT06).
ina an-mi-šú gír gír gù ^d im	“during its eclipse, lightning flashed, roaring of Adad (= thunder)” (-370NOV11). (Instead of ^d im, also ^d u, also the weather-god Adad).

See Sachs and Hunger, Vol. I, p.27ff., for a discussion of the weather terms. One wonders about the importance accorded to the winds and their directions. Were celestial winds once thought to blow the shadow across the lunar disk?

(12) Presence and absence of planets

Example: *ina an-mi-šú mál-babbar genna u an gub-u' ina zalág-ru genna šú íb-tag₄^dudu-idim-meš nu gub-u'*
“During its eclipse, Jupiter, Saturn and Mars stood there. When becoming bright, Saturn set. The other planets did not stand there.” (-79 Apr. 11)

Normal order of listing: Jupiter (mál babbar, in early texts ^dsag-me-gar), Venus (*dele-bat*), Mercury (gu₄-ud), Saturn (genna), Mars (an, in early texts ^dsalbatānu), Sirius (mál kak-si-sá, mál kak-ban).

(13) Position relative to a fixed star

Example: 2/3 kùš ár rín šá ulù 6 si ana ulù sig ád
“2/3 cubits behind the southern scale (α Librae), 6 fingers toward south beneath, eclipsed” (-79 Apr. 11).

1 kùš = 24 si = 2½°;
ár “behind”, *ina igi* “in front of”,
sig = šaplis “beneath”, e (= eliš) “above”.
ád (=GIR) seems to be an abbreviation of *adriš* (“dark”, adverb derived from *adāru* “to become dark”), cf. -352 Nov. 22.

For the precise interpretation of relative positions, see Grasshoff (1999). “In front” and “behind” mean a smaller and a larger longitude, “beneath” and “above” a smaller and a larger latitude, respectively. A list of the relevant fixed stars can be found in Sachs and Hunger, Vol. I, p.17f.

Sometimes (although rarely), also *uš* is used as a measure of angle ($1 \text{ uš} = 1^\circ$), cf. -684 Oct. 3 (?), -536 Oct. 17, -441 Mar. 25, -409 Dec. 21.

(14) Time of the begin of the eclipse, relative to sunset/sunrise

Example: *ina 1,6 ge₆ gin* “ 66° after sunset”

The four cases are:

- (a) *ina x (uš) ge₆ gin* “ x° after sunset” (lit.: “ x° night gone”)
- (b) *ina x (uš) (ge₆) ana zalág* “ x° before sunrise” (lit.: “ x° night (remaining) to becoming bright”) variant: *ana kur šamáš tag₄* “remaining to sunrise”
- (c) *ina x (uš) me nim-a* “ x° after sunrise” (lit.: “ x° day risen”)
- (d) *ina x (uš) (me) ana šú šamáš* “ x° before sunset” (lit.: “ x° day to sunset”).

Some texts express time in double hours and fractions thereof (danna = KAS.BU = *bēru*, sometimes abbreviated to kas; 1 danna = 30 *uš* = 120 minutes of time).

Some texts give only the watch of the night:

(en-nun) usan	=	(<i>māṣartu</i>) <i>barārītu</i>	“evening watch”
murub ₄	=	<i>qablītu</i>	“middle watch”
u ₄ -zal	=	<i>namārītu</i>	“morning watch”

The words *ina* and *in* seem to be freely interchangeable, but there might be subtle semantic differences (perhaps: *ina* = “at”, *in* = “around” x° after sunset).

(15) Time between sunrise and moonset (NA)

Analogous to ME, see under (2).

The order of the items (11), (12) and (13) is not strictly fixed, and some texts insert item (14) (begin of the eclipse) before item (3). Only few texts reports all items.

If the moon (or sun) rises or sets while eclipsed, this is noted, often together with the magnitude of the eclipse at that moment:

sin ki-i e-a 2 si id ulù [...] “when the moon rose, 2 fingers on the south side [were eclipsed]” (-65 Dec. 28).

<i>sin ki e-a 2-ta šu_{II} hab-rat id si u kur a-rim</i>	“when the moon rose, two thirds of the disk on the north east side were covered” (<i>arāmu</i> “to cover”) (-66 Jan. 19).
<i>sin ta dir ki e-a 2 si id [mar] ana zalág tag₄</i>	“when the moon rose from a cloud, 2 fingers on the [west] side lacked to brightness” (-189 Aug. 23).
<i>ád a</i>	“it rose eclipsed” (-712 Apr. 19).

Here, *e-a* renders some form of *asû* “to rise”, with ideogram substitution: phonetically written *e* (=E) for è (=UD.DU). In the last example, *a* is another abbreviation for some form of *asû*, and *ád* probably is an abbreviation for *adriš* = “eclipsed, dark” (adv.).

<i>ina 16 ge₆ gab-bi šú-im ád šú</i>	“after 16° night, totally covered, it set eclipsed” (<i>šú</i> = <i>rabû</i> “to set”) (-188 Feb. 17).
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When atmospheric conditions impeded or prevented observation of some phase of the eclipse, this was noted:

<i>gar u ír dir nu pap</i>	“onset and maximal phase cloudy, not observed” (-211 April 30).
<i>a-kám ki pap</i>	“mist (or dust) when observed” (-135 Sep. 24).

However, the details are not always clear.

An eclipse which does not take place is denoted by *šá dib* “which passed” (*dib* = *etēqu* “to pass”). In particular, this concern lunar eclipses expected to occur during daylight; solar eclipses at night; eclipse possibilities spaced within 5 months of another. In such cases, it seems that the Babylonian astronomer as a rule did not bother to watch. See Section 1.3 above for a more detailed discussion of predicted eclipses.

Solar eclipse possibilities falling in daylight often are reported as
ki pap nu igi “when watched, not seen”

Such remarks seem to be meant in a personal way (“when I watched, I did not see it”) but the first person is not expressed in the writing.

For passing eclipses, the time is reported variously: sometimes not at all; sometimes summarily: *ki* (= *itti*) *kur šamáš* “with sunrise”; sometimes very precisely.

2. Data Analysis

The Babylonian eclipse observations invite and permit a detailed statistical analysis, both of the accuracy of Babylonian observations and of our assumptions about the slowing down of the Earth's rotation. Subsets of the present data have been analyzed repeatedly by various authors; the most recent analyses of the Babylonian eclipse timings are those by Stephenson and Fatoohi (1993) and by Steele (2000). Unfortunately, none of the previous analyses had paid proper attention to systematic deviations between ancient naked-eye observations and modern calculations geared towards telescopic observations. Some of these systematic deviations, or biases, are of the same order as the effects under investigation. We cannot reliably estimate crucial parameters, such as the clock-time error, before we have attained a reasonably accurate knowledge of the error structure of the observations, both with regard to systematic and random errors. But vice versa, in order to determine this error structure, we should already know fairly accurate approximations to those parameters. Several iterations will be needed, alternating between the determination of complementary aspects, until consistency is reached. In this chapter I shall try to tell the tangled tale of such determination in a simplified, straightened-out fashion.

Aided by hindsight, we can summarize the trickier quantitative aspects of the data analysis and of the error structure of the data as follows. Modern astronomical calculations are crucially dependent on the clock-time correction $\Delta T = ET - UT$. This is the difference between the uniform time scale ET of celestial mechanics and the civil time scale UT based on the rotation of the earth. Unfortunately, the rotation of the earth slows down in an irregular fashion and ΔT is only inaccurately known. It grows from about 3 hours in the year 50 BC to about 6 hours in 750 BC. For the first millennium BC, Babylonian eclipse timings have turned out to be the best means for determining ΔT . These timings are admittedly crude. Short time intervals were measured with a standard error of about 12 minutes (random errors in the spotting of the beginning and end of eclipse phases). Large intervals have random errors of about 15 percent of the length of the interval (random variability inherent in the measuring devices, conjectured to be water clocks). By averaging over many such timings it is possible to determine ΔT with a standard error well below 3 minutes for the central epoch of the period of the observations (i.e. around 325 BC). Unfortunately, this is complicated by the presence of systematic nuisance effects. First, the Babylonian measurements are affected by elusive systematic errors of 2 to 5 percent. In addition, there are systematic discrepancies between the ancient naked-eye observations of the eclipse phases and modern calculations geared towards telescopic observations. For example, observed Babylonian lunar eclipses appear to last about 12 minutes longer than calculated, while solar eclipses are shorter by about the same amount. Unfortunately, most Babylonian eclipse timings are relative to the same phase, namely time intervals from sunset or sunrise to the onset of the eclipse, so systematic effects will enter most time differences in the same way. Since they are larger than the hoped-for accuracy of the estimate, we must be extremely careful, lest they vitiate the latter.

2.1 Astronomical theories and programs

We now have a bewilderingly rich body of rather different modern astronomical programs and tables at our disposal, partly based on analytical expansions, partly on brute force numerical integration. The best known and most easily accessible among them are the programs by Bretagnon and Simon for the planets and by Chapront and Chapront for the Moon, and the tables by Meeus and Mucke for lunar and solar eclipses. They are available through Willmann-Bell, P.O. Box 35025, Richmond, VA 23235, USA. For the historical period in question, the celestial mechanics of all of them is more accurate than the ancient visual observations. But there are problems with regard to the irregular slowing down of the rotation of the Earth and the lunar orbital acceleration. Moreover, modern astronomy and astronomical computer programs are not well adapted to naked-eye observations. This concerns in particular the beginning of eclipses, and factors affecting the times of sunrise and sunset. Different choices among currently fashionable variants of these empirical parameters can change the calculated time of the beginning of an eclipse by twenty minutes or more.

The following direct comparison of the results of two programs of independent origin is instructive. In our present work, all astronomical computations were performed with members of two independent program families, based on different theories. One family (SMN, short for Stephenson, Morrison and Newcomb) consists of Fortran programs written before 1983 by Stephenson and Morrison, with various, mostly minor later modifications by me (PJH); it is based on Newcomb's theories. The other (MCC, short for Meeus, Chapront and Chapront) consists of Basic programs written by Meeus in 1998/99, and is based on more recent theories by Chapront and Chapront. The main reason for undertaking a detailed comparison was to pinpoint the reasons for some disturbingly large differences in the outputs. In particular, I was afraid of the possibility of human errors. For example, the tables by Kudlek and Mickler (1971) had been vitiated by a gross programming error, and Tuckerman's tables (1962) had inherited a clerical error in the mean longitude of Mars from P. V. Neugebauer's *Astronomische Chronologie* (1929), (we would say now: a mix-up between ET and UT, see Stephenson and Houlden (1981)). To our gratification, it turned out that the differences between the results of our two program families were almost entirely due to their different treatment of the empirical terms: predominantly to differences in their assumptions about ΔT , secondarily to their treatment of the Earth's shadow, and thirdly to different assumptions about atmospheric refraction and the height of the observer.

For the purposes of program comparison, I made some temporary modifications to the source code of the programs. First, I equalized the treatment of ΔT in the two programs. Furthermore, I eliminated Stephenson's extra 7% increase of the earth's shadow, and I simplified his calculation of risings and settings of Sun and Moon. Following Meeus, I used 34' horizontal refraction, without seasonal corrections, and assumed zero height of the observer (against Stephenson's 15 or 20 meters). Some secondary differences in the code remain, for example in the lunar orbital acceleration (SMN: $-26''/\text{cy}^2$, MCC: $-25.88''/\text{cy}^2$). SMN uses the traditional 2% increase of the earth's shadow (cf. Section 2.3), while MCC uses a more sophisticated formula by Danjon. MCC uses the conventional geographical coordinates of Babylon (44.5°E , 32.5°N), while SMN has supposedly better values (44.42°E , 32.55°N). My version of SMN expresses event times in true local time, while MCC uses Universal Time; I transformed the latter into the former by taking local time midnight to be the midpoint between sunset and sunrise.

The actual comparison was based on 700 lunar eclipses between the years -750 and 0, calculated as visible in Babylon by both SMN and MCC. To avoid misunderstandings, I must stress that this part of the analysis is a mere comparison between programs, observations are not involved. The results were as follows. With SMN, the four contacts on average are shifted relative to MCC by -27, -20, +52 and +59 seconds, respectively. In other words, with SMN the midpoints of the eclipses are 16 seconds later, and totality lasts 72 seconds longer than with MCC. A systematic shift of 16 seconds is irrelevant (the shifts caused by mere round off in the coefficients of the formulas adopted for ΔT are of the same size). The difference in the duration of totality probably has to do with Danjon's formula. Otherwise,

the timing differences between the programs appear to behave randomly and to be irrelevant. For the times of individual contacts, the standard deviation of the differences between SMN and MCC is 36 seconds, which equals the tabulation precision (the computer outputs had been rounded to multiples of 0.01 hours). SMN tends to calculate slightly larger magnitudes than MCC (differences between 0 and 0.02; on average 0.007). Entrance and exit angles differ at most by $\pm 2^\circ$, apart from two outliers. These outliers, with entrance angles differing up to 5° , and time differences of up to 7 minutes, occur with two exceptional eclipses (-244FEB06 and -318AUG10) whose magnitudes calculate as 0.00 and 1.00 with MCC, but as 0.01 and 1.01 with SMN, respectively.

Conclusions. Differences in celestial mechanics between SMN and MCC are too small to become recognizable through the Babylonian material. The subsequent data analysis was performed with the SMN programs since they were easier and quicker for me to modify and re-run than the interpreted Basic programs MCC.

2.2 Rising and setting of Sun and Moon

Conventionally, risings and settings of the Sun are calculated assuming a horizontal atmospheric refraction of $34'$, plus $16'$ for the semi-diameter of the Sun (to correct for the upper rim). In other words, the Sun is assumed to rise or set when its zenith distance is $90^\circ 50'$. This corresponds to an observer located at ground level, making standard assumptions about atmospheric pressure and temperature. The Moon is treated similarly, with an added correction for the lunar parallax. See *Explanatory Supplement*, p. 398-403.

An investigation of the Babylonian measurements of Lunar Sixes (time differences between rising and setting of Sun and Moon) had shown that Sun and Moon on average rise 1.9 minutes earlier and set 1.9 minutes later than calculated by this method, see Huber (2000a). This can be corrected by increasing the refraction value by $22'$ from $34'$ to $56'$, within an estimated uncertainty of about $\pm 1'$. The simplest explanation is that the observations were made about 108 meters above ground. Apart from that, our standard assumptions about the atmospheric conditions may be inappropriate for the climate of Babylon. By the way, few people seem to be aware how variable the horizontal refraction is. Modern observations on the Pacific Coast show a root-mean-square random variability of $10'$ (Schaefer and Liller (1990)). From the Babylonian Lunar Sixes I had independently estimated almost the same RMS variability of $12'$ (the latter value also may contain some contributions from the topography of the horizon). In view of these fluctuations, calculation cannot possibly fix the moment of an individual rising or setting more accurately than within a standard error of about 1.3 minutes.

We shall assume that the eclipses were observed from the same location as the Lunar Sixes, and that therefore the times of sunset and sunrise should be calculated with a zenith distance $91^\circ 12'$ ($= 90^\circ + 34' + 16' + 22'$), nominally corresponding to an observer 108 meters above ground. The Babylonian eclipse timings are not accurate enough to permit a reliable independent determination, the estimation error being of the same order as the effect to be estimated. Actually, they seem to favor a lower value of the zenith distance, near or even below the standard value $90^\circ 50'$. While it is possible that the lunar eclipse observers did not bother to climb a tower, a more likely explanation is that residual systematic errors in the measurement of the time intervals between sunset or sunrise and the beginning of the lunar eclipses are to blame (see Section 2.5). Fortunately, since some of the timings are relative to sunset and some relative to sunrise, the biasing effects of these particular systematic timing errors cancel out, at least in part, when one is estimating ΔT .

2.3 Eclipse phases: the shadow of the Earth

Observation has shown that the atmosphere of the earth has the effect of increasing the apparent radius of the earth's shadow by about one fiftieth. Conventionally, in modern ephemerides lunar eclipse times therefore are calculated by increasing the earth's shadow by 2%. Instead of the conventional 2%, Meeus in his programs prefers to use a more sophisticated, but nearly equivalent formula due to Danjon.

The terrestrial atmosphere also causes the boundary of the shadow to lack a sharp, clearly defined edge. A human naked-eye observer will place the four contacts at slightly different values of the shadow radius. In order to improve the agreement with medieval observations, many authors, including Morrison and Stephenson in their programs of early 1980 vintage, had proposed to increase the size of the Earth's shadow by an additional 7% (beyond the conventional 2%) when calculating the first and last contacts. On average, this advances the beginning and retards the end of an eclipse by 6-7 minutes. Note that a change of 6-7 minutes is too small to be noticed in isolated naked-eye observations, it will only show up in averages. The current fashion among most authors, including Stephenson, seems to be to return to the conventional modern value of 2% in order to avoid confusion.

The Babylonian notions of the four eclipse contacts evidently were somewhat different from ours. To clarify the discussion in the present section, I shall denote the calculated modern versions by C1 to C4, the observed Babylonian ones by B1 to B4. The most obvious difference is that B2 and B3, beginning and end of maximal phase, were observed and timed also for partial eclipses. We must conclude that these were not "contacts" in our sense, but seemingly they were defined by the property that the degree of obscuration increased from B1 to B2, stayed constant from B2 to B3, and decreased from B3 to B4. It is not yet clear to us how to properly define and calculate modern counterparts of B2 and B3 for partial eclipses. In any case, it appears that for the Babylonians the partial phases began earlier and ended later than for us. We shall now discuss the separate pieces of evidence. It will be necessary to anticipate some statistical information that will become properly available only in Section 2.5.

Penumbral eclipses. We are not aware of any penumbral eclipses that had been observed and reported by the Babylonians *as such*. However, there are several deep penumbral eclipses that seem to have been reported just like ordinary weak partial eclipses, namely those of **-414SEP19**, **-396SEP29**, **-378APR17**, and **-187AUG01**, with negative magnitudes of -0.09, -0.14, -0.02 and -0.01, respectively. Negative magnitudes here represent the fraction of the lunar diameter by which the moon stays away from the border of the central shadow. Unfortunately, all but the third of the records are poorly preserved, and it is possible that one or the other among them might be a misfiled report of a genuine eclipse. If we increase the size of the Earth's shadow such that these eclipses calculate as regular partial eclipses, then they require increases of at least 7%, 11%, 2%, and 1%, respectively. On the other hand, there is a deep penumbral eclipse (**-302SEP11**, magnitude -0.05), where the Babylonian astronomer expected a weak eclipse of 1 finger, but failed to see it ("when I watched I did not see it"). In that case, the eclipse should just have become visible as an ordinary partial eclipse if the shadow is increased by 4% or more. Since it is possible that in the damaged report of the eclipse of -396SEP29 a similar remark implying that the observer had not seen the eclipse has broken off, I am inclined to disregard that eclipse report. In any case we should be aware that the shadow radius at which the observer notices the beginning of an eclipse seems to have a surprisingly large variability. The accuracy of spotting eclipse contacts was of the order of several minutes (in Section 2.5 we shall estimate about 7 minutes), and on average, one minute of time corresponds to one percentage point in the shadow radius.

Phases of total eclipses. There are eight total lunar eclipses where all four contacts are above the horizon and all three time intervals (onset = B2-B1, totality = B3-B2 and clearing = B4-B3) were measured and are preserved in the texts. Among them, one record (-316DEC13) seems to contain a gross error (a difference of about 15° = 1 hour between observation and calculation for the duration of totality), leaving us with 7 complete sets of observations. The three types of intervals have almost

equal mean lengths of about $20^\circ = 80$ minutes. Therefore, they should be affected by similar systematic and random errors.

Date	observed			calculated		
	onset	totality	clearing	onset	totality	clearing
-554OCT06	17	28	20	16.50	24.60	16.50
-500NOV07	15	25	25	16.65	23.55	16.65
-377APR06	15	21	19	15.75	19.20	15.75
-370NOV11	22	20	21	16.95	21.15	16.95
-316DEC13	19	5*	16	17.10	20.85	17.25
-225AUG01	17	10	15	16.80	16.05	16.80
-214DEC25	21	16	19	15.75	20.70	15.75
-123AUG13	19	24	19	16.80	24.30	16.80
mean value	18.0	20.6	19.7	16.46	21.36	16.46

Table 1. Total lunar eclipses, all phases observed. Duration of phases in time degrees. The calculated values assume the standard 2% increase of the shadow. The mean values were calculated excluding the eclipse of -316DEC13.

The mean differences (observed – calculated) in the duration of the phases and their estimated standard errors, all measured in time degrees ($1^\circ = 4$ minutes), are:

$$\begin{array}{ll} \text{Onset:} & 1.5^\circ (\pm 1.0) \\ \text{Totality:} & -0.8^\circ (\pm 1.3) \\ \text{Clearing:} & 3.3^\circ (\pm 1.1) \end{array}$$

The partial phases are lengthened relative to calculation, the total phase shortened. Note that the calculated values of these differences are independent of any assumption about ΔT . The differential lengthening of the partial relative to the total phases, $(1.5+3.3)/2 + 0.8 = 3.2^\circ = 13$ minutes, has an estimated standard error of 6 minutes, and thus is significantly different from 0. Given that the phases are of comparable length, this particular difference cannot be explained away as being caused by systematic errors of time measurement. Note that this argument is based only on the relative lengths of the phases, and thus is independent of the value of ΔT . Unfortunately, the number of completely observed total eclipses is too small for an accurate quantitative determination of the effects.

Comprehensive least squares fit. Almost all Babylonian eclipse timings are measurements of time intervals between sunset and the beginning of the eclipse, or between the beginning of the eclipse and sunrise. This makes it difficult to separate the effects caused by (i) a different definition of the beginning of the eclipse, (ii) systematic errors in the Babylonian measurement of longer time intervals, (iii) errors in ΔT , and (iv) problems with the horizontal refraction affecting sunset and sunrise. The best hope for disentangling them lies in a comprehensive least squares fit. There are some 154 useable measurements of time intervals: 81 timings relative to rising or setting of sun or moon, and 73 relating to duration of phases. I experimented with least squares fits of all possibly relevant parameters to these observations. These parameters comprised time shifts of the contacts, zenith distance of the sun at sunset/sunrise, and errors in ΔT . As already mentioned, it turned out that the observational accuracy is not good enough to fit the zenith distance in a meaningful fashion, so I adopted the value $91^\circ 12'$ derived from the Lunar Sixes. If we assume symmetry around the center of the eclipse, the least squares fit yields statistically significant shifts of the contacts relative to their modern versions: B1 and B4 are shifted outward by 6 minutes, B2 and B3 inward by 4 minutes. This lengthens the partial phases by about 10 minutes, and shortens the total phase by about 8 minutes. The mean shifts of the contacts have an estimated standard error of 1.7 minutes. On average, a 1% change in the shadow radius changes the timing by about 1 minute, and we obtain an even better agreement if instead of the timings, we change the shadow radii by +6%, -4%, -4% and +6% for the four contacts respectively. These changes are to be applied *after* increasing the shadow by the traditional 2%. Note that the shifts are too small to show up in individual eclipse observations (phases are spotted with a standard error of approximately 7 minutes, see Section 2.5). — Initially, I also had experimented with asymmetric shadow changes, since without accurately predicted eclipse times, B1 is harder to spot than B4. But

the difference, if there is any, is well below statistical significance, and because of the high correlation of the timing of the first contact with ΔT , attempts to fit B1 and B4 separately and independently tend to destabilize the least squares fit.

The eclipse -119JUN01. A Babylonian eclipse report confirms that the shadow radii for B2 and B3 ought to be decreased. According to calculation, the eclipse of -119JUN01 was total, with a magnitude of 1.012 (MCC), or 1.019 (SMN), but according to the Babylonian report, 1 finger was remaining to totality. Decreasing the shadow radius for totality by 2% just suffices to make the eclipse partial.

The eclipse -189FEB28. According to the Babylonian report, the eclipse of -189FEB28 was total. According to calculation with the standard shadow radius, it was total with a magnitude of 1.042 (MCC), or 1.051 (SMN). Decreasing the shadow radius for totality by 4% just suffices to make the eclipse partial; with 3.5% decrease it is still total. Together, these two eclipse observations suggest that for totality the shadow radius should be decreased between 2% and 3.5%.

Summary of the conclusions. It is difficult to separate errors in time measurements from errors in spotting the phases, and both may depend on the time of the night. It appears that the Babylonians spotted their versions B1 to B4 of the contacts with a root-mean-square random error of about 7 minutes. Apart from these random fluctuations, there are systematic shifts of the same order, sufficiently large that the mean shadow radii appropriate for calculating Babylonian lunar eclipse contacts are significantly different from our modern conventions. The least squares fits indicate an increase of the shadow radius of 6% for B1 and B4, and a decrease of 4% for B2 and B3, with estimated standard errors of about 1.7%. For the first and last contacts, medieval naked-eye observations have suggested an even higher value 7%. Also one Babylonian report, -414SEP19, argues for at least 7%, while another, -302SEP11, seems to argue for a value of 4% or lower. For B2 and B3, the eclipses of -189FEB28 and -119JUN01 suggest a decrease between 2% and 3.5%, insignificantly below the 4% value from the least squares fit. For our subsequent calculations, by way of a conservative compromise, we have decided to accept the 6% increase for B1 and B4 from the least squares fit, but to use a slightly reduced decrease of 3% for B2 and B3. These changes are to be applied on top of the conventional 2% increase. On average, they shift the times of the four contacts by approximately -6, +3, -3 and +6 minutes against conventional calculations, shortening the total and lengthening the partial phases.

2.4 Secular terms

Because of tidal friction, the rotation of the Earth is slowing down, such that the length of day (LOD) increases about 2 milliseconds per century. This causes a discrepancy between Ephemeris Time ET (the uniform time scale on which the dynamical theories of the solar system are based) and Universal Time UT (the time scale based on the rotation of the earth, roughly equivalent to Greenwich Mean Time). The differences between ET and its more modern replacement Dynamical Time DT are minute and irrelevant for our purposes. Through preservation of angular momentum in the Earth-Moon system, tidal friction also affects the motion of the Moon, causing a lunar orbital acceleration. Until very recently, those effects could not be determined very accurately, and moreover, equally recently, one has realized that the rotation of the earth has a surprisingly large stochastic component, with fluctuations on a decadal to millennial range (Stephenson and Morrison 1995, Huber 2000b).

If one disregards stochastic fluctuations and assumes a constant tidal deceleration of the rotation of the Earth, then the clock-time correction $\Delta T = ET - UT$ can be modeled by a parabola with a vertex close to the epoch AD1800. The approximate position of the vertex is fixed through the conventional definition of the length of day, going back to Newcomb. In 1982, Morrison and Stephenson therefore proposed to model the clocktime correction by

$$(ST82) \quad \Delta T = 32.5 t^2 \text{ sec},$$

where t is the time since AD1800, measured in centuries. The coefficient 32.5 (with a standard error of about 0.3) had been estimated from Babylonian observations with a mean epoch around 390BC, contained in the 1973 manuscript version of the present book. — Note that if ΔT is increased, the calculated (local) time of a lunar eclipse is made earlier by the same amount.

Medieval Arabic observations, whose timings exhibited an average offset of 8 minutes from ST82, provided the first hard evidence for millennial fluctuations in ΔT . In order to accommodate those, Stephenson and Morrison in 1984 proposed an alternative model based on a spline interpolation. For the segment between 390BC (the knot at the center of the Babylonian observations) and AD948 (the knot at the center of the Arabic observations) they proposed to use:

$$(ST84) \quad \Delta T = 1360 + 320 t + 44.3 t^2 \text{ sec},$$

with t in centuries since AD1800, while for the segment between AD948 and AD1600, they used $\Delta T = 25.5 t^2 \text{ sec}$. I should stress that ST84 had been intended for interpolation, not for extrapolation beyond 390BC, and that the coefficient of the quadratic term, with its large jumps at the knots of the spline interpolation, lacks a direct physical interpretation as a measure of the slowing down of the Earth's rotation. Both ST82 and ST84 use a lunar orbital acceleration of $-26''/\text{cy}^2$, and through their construction, they are forced to cross over near 390BC.

Since 1984, confusingly many other expressions for ΔT have been proposed, and later determinations are not necessarily better. They shall be discussed in Section 2.9, but for our present purposes the above two are the most relevant.

For the years before AD948, the newest versions of the programs by the Chapronts and by Meeus use a lunar orbital acceleration of $-25.88''/\text{cy}^2$, and

$$(ME98) \quad \Delta T = 2177 + 497 t + 44.1 t^2 \text{ sec},$$

with t in centuries since AD2000. This model is intended to be identical to ST84, apart from minimal adjustments correcting for the slightly different value of the lunar orbital acceleration. Note that ST84, when re-expressed for the epoch AD2000, amounts to

$$(ST84') \quad \Delta T = 2177 + 497.2 t + 44.3 t^2 \text{ sec},$$

with t in centuries since AD2000. It is unfortunate that the widely distributed and publicly available 1991 version of the Chapronts' theory and programs uses a much too low value of $-23.8946''/\text{cy}^2$ for the lunar orbital acceleration; lunar laser ranging since 1992 consistently has yielded values between -25.8 and -26.0.

The true ΔT is rather wiggly (see Section 2.9 for further remarks on this), and the time segment between -750 and -50 neither is long enough, nor are the Babylonian eclipse observations accurate enough to estimate the curvature (i.e. the quadratic term in ΔT) applicable to that segment. Stephenson and Fatoohi (1993) and Steele and Stephenson (1998) therefore decided to let the unknown curvature to be 0 and to fit a straight line. It seems to us that it makes more sense to borrow the curvature term from either ST82 or ST84 and to use the comprehensive least squares fit mentioned in the preceding subsection to estimate linear correction terms to either of these formulas. This gives the following improved least-squares fitted formulas.

$$(ST82f) \quad \Delta T = -1925 - 81 t + 32.5 t^2 \text{ sec},$$

and

$$(ST84f) \quad \Delta T = 3370 + 421 t + 44.3 t^2 \text{ sec}.$$

(with t measuring time in centuries since AD1800).

Unless stated otherwise, our calculations are based on the final fit ST82f. Some are also using a formula from an intermediate, preliminary fit:

$$(ST82i) \quad \Delta T = -1740 - 77 t + 32.5 t^2 \text{ sec}.$$

ST82i gives insignificantly higher values than ST82f, and the calculated contacts are correspondingly earlier (1.9 minutes for the year 0, 1.4 minutes for the year -800).

The polynomial coefficients for a modern epoch are non-intuitive. The five models (ST82, ST84 \approx ME98, ST82f, ST84f) are more conveniently compared and discussed in terms of the value and slope of ΔT at the central epoch -325 (this year is the weighted average date of the observations used in the

fit), in particular if the slope is expressed in terms of the length of day. Note that the offset of the LOD from 86400 seconds is $\Delta T'/36525$ sec, where the prime denotes the derivative with respect to t . The fitted models ST82f and ST84f are practically equivalent, as they ought to be, see Tables 2 and 3.

Model	ΔT (minutes) epoch -325	LOD (ms) epoch -325	Shadow changes
ST82	244.6	-37.8	C1, C4: +7%
ST84	242.7	-42.8	
ME98	241.0	-42.5	
ST82f (SE)	241.2 (2.2)	-40.0 (1.8)	C1, C4: +6% C2, C3: -3%
ST84f (SE)	240.5 (2.2)	-40.0 (1.8)	C1, C4: +6% C2, C3: -3%

Table 2. Comparison of the five models for ΔT at the central epoch -325. The LOD-values give the offset of the length of day from 86400 seconds. The parenthesized SE values are estimated standard errors.

At the central epoch -325 the two estimates of the LOD in ST82f and ST84f theoretically ought to be equal, apart from secondary weighting and round-off effects. At the same epoch the difference (of about 0.7 minutes) between the estimates of ΔT depends only on the difference between the coefficients of the quadratic term and on the temporal spread of the observations, not on the values of the observations themselves. It is interesting to note that the LOD value estimated from the present material in a direct fashion lies between and agrees within statistical accuracy with the indirect values implied by the parabolas ST82 or ST84 in an accidental fashion.

YEAR	ST82	ST84	ST82f	ST84f	SE
0	175.5	165.9	167.7	169.1	4.2
-50	185.4	176.7	178.3	179.1	3.8
-100	195.5	187.9	189.1	189.4	3.3
-150	206.0	199.4	200.2	200.1	2.9
-200	216.7	211.3	211.6	211.2	2.6
-250	227.6	223.6	223.2	222.6	2.3
-300	238.9	236.3	235.1	234.4	2.2
-350	250.4	249.3	247.3	246.6	2.2
-400	262.2	262.7	259.8	259.2	2.3
-450	274.2	276.4	272.5	272.1	2.6
-500	286.5	290.6	285.5	285.4	2.9
-550	299.1	305.1	298.8	299.0	3.3
-600	312.0	319.9	312.3	313.0	3.8
-650	325.1	335.2	326.1	327.4	4.2
-700	338.5	350.8	340.2	342.2	4.7
-750	352.2	366.8	354.6	357.3	5.2
-800	366.2	383.1	369.2	372.8	5.8

Table 3. Evaluation of different formulas for ΔT ; values expressed in minutes. The last column contains estimated standard errors of the fitted values in ST82f and ST84f.

The four main formulas are evaluated in Table 3. The discrepancies between ST82 and ST84 reach annoyingly large values of 10-15 minutes near the end-points of the time segment of interest. Admittedly, this still is of the order of accuracy of individual Babylonian timings (but compare the discussion of the Assyrian eclipse of -668MAY27 near the end of Section 2.8). Interestingly, after -400 the fitted curve ST82f agrees closely with the interpolatory ST84, which had been designed by Stephenson and Morrison to fit between AD948 and 390BC; it agrees even a shade better than ST84f. But before -400, ST82f agrees closely with the more stable ST82. For the past users of ST82 or ST84

it will be gratifying to note than in the end regions, where ST82 and ST84 disagree most, the fitted curves lie between.

The original model ST82 had been based on a subset of the present observational material, with fewer late eclipses (therefore, its central epoch was around -390). If we re-estimate the coefficient of the quadratic term in the same way the original ST82 had been determined, but now using the improved value $\Delta T=241.2$ minutes at the central epoch -325, we obtain a smaller value 32.0. With the epoch -500 (which is still well inside the spread of observations: about a quarter of them fall before, three quarters after -500) we obtain 32.4. Given that these values are affected by a standard error of about 0.3, the discrepancies are not significant.

The majority of all eclipse timings are relative to the first contact, and therefore any estimates of ΔT based on them are influenced by systematic differences between ancient naked-eye observations of the first contact and modern calculations. According to our present investigations, the naked-eye beginnings of Babylonian lunar eclipses are advanced by about 6 minutes (and those of solar eclipses are delayed by about 6 minutes, see below) against conventional modern calculations. In 1982, Morrison and Stephenson providentially had used a 7% increase of the shadow radius in their programs (i.e. 7% for C1 and C4, 0% for C2 and C3, on top of the conventional 2%), advancing the time of the first contact by 6-7 minutes on average. Thus, the above formulas for ΔT all are geared toward increased shadow diameters, and combining them with eclipse calculations using the standard 2% convention for the first contact is inconsistent and should be avoided.

The available corpus of Late Babylonian observations permits some independent checks on this determination of ΔT , based on time differences between settings and risings of Sun and Moon, on culminations of fixed stars, and on solar eclipses. The most intriguing among them is the first one, based on the so-called Lunar Sixes, cf. Huber (2000a). Gratifyingly, it agrees reasonably well with the ΔT values determined here. This is important because the determination of ΔT from Lunar Sixes, although it has a higher random error, is much less sensitive to systematic errors than that from eclipse data. In particular, it is independent of any assumptions about the shadow radii. For the central epoch -200 of the Lunar Sixes, ΔT can be determined from them as 219.5 minutes, with a standard error of about 5.7 minutes. The ΔT -values for -200 calculated by the above formulas (determined on the basis of timed lunar eclipses), or by the spline fit SM95 of Stephenson and Morrison (1995), all lie a few minutes below the value found from the Lunar Sixes. On the other hand they lie slightly above the values found from culminations and from timed solar eclipses (see Sections 2.7 and 2.8 below). Neither Lunar Sixes, nor solar eclipses, nor culminations permit a reliable determination of the slope, i.e. of the LOD. The ΔT value from culminations is problematic in view of possible mis-identifications of *ziqpu*-stars, and the value from solar eclipses possibly is affected by the inaccurately known delay in the spotting of the beginning of the eclipse by a naked-eye observer.

	ΔT (minutes) epoch -200	SE
Lunar Sixes	219.5	5.7
Lunar eclipses ST82	216.7	—
SM95	213.3	—
ME98	212.7	—
ST84	211.3	—
ST82f	211.6	2.6
ST84f	211.2	2.6
Culminations	211.3	5.4
Solar eclipses	209.8	5.5

Table 4. Four determinations of ΔT from independent data.

In any case, the extreme values in Table 4 have the largest standard errors, and the discrepancies are not statistically significant. But the ΔT -value estimated from the Lunar Sixes demonstrably is too high

by at least 2 minutes: the total solar eclipse of -135APR15 calculates as partial if we shift ST82 upward by more than 0.5 minutes (see Section 2.8).

2.5 The statistics of the lunar eclipse timings

After elimination of a few gross errors (they are identified in Section 2.11), some 154 useable measurements of time intervals remain. Among them are 49 timings relative to sunset, 3 to moonset, 27 to sunrise, 2 to moonrise, and 73 relating to phases (20 onset, 20 totality, 13 clearing, 20 total duration). Incidentally, the ancient observers were somewhat negligent and confounded the times of sunrise and moonset, when the Moon set eclipsed (eclipses of -406OCT21, -352NOV22, -79APR11). See Figures 1 and 2 for plots of the residuals (observed minus calculated values) against chronological time and against calculated values. Calculations were based on ST82f, with shadow changes as in Table 2.

Before about the year -561, i.e. the end of Nebuchadnezzar's reign, almost all eclipse timings, except the very shortest ones, seem to have been rounded to the nearest multiple of 5°. Afterwards, other integer values are used freely, with only a slight preference for multiples of 5. However, this improvement of recording precision apparently was not accompanied by an improvement of measurement accuracy, and during the entire period under investigation, rounding to the nearest multiple of 5 would have been entirely adequate. Also otherwise, the changes in observational accuracy have remained surprisingly minimal, considering that the observations spread over more than seven centuries. The only noticeable change is that the earlier lunar eclipse time measurements seem to exhibit a mild positive bias, and the later ones a decidedly negative bias (see the end of Section 2.11).

A comparison between the observed values and the values calculated from ST82f shows that short time intervals were measured with a standard error of about 2.8°, while large intervals suffer from a relative standard error of about 14%. Presumably, the former is predominantly caused by errors in spotting the contacts. Note that short intervals occur near sunset and sunrise, when the sky is relatively bright and the beginning of the eclipse is hard to spot. On the other hand, the errors in large intervals predominantly will be caused by errors in the time measurements. Overall, the standard deviations σ of individual observations can be modeled reasonably well by the interpolatory formula

$$\sigma^2 = 2.8^2 + (0.14 t_{\text{calc}})^2,$$

all quantities being expressed in time degrees. Thus, the break-even point between the two error components occurs at an interval length of 20°. In our least squares fits we have used the inverse variances σ^{-2} for weighting the observations, and we have somewhat arbitrarily excluded aberrant data with deviations exceeding 2.9σ as gross errors.

I checked the weights by sorting the observations according to their calculated absolute values, and then computing grouped averages. This was done both overall and separately for measurements relative to sunset (SS), to sunrise (SR) and for eclipse phases, see end of Section 2.11. It appears that the estimated overall standard deviations σ agree well with the measurements from sunset, while the random errors of intervals measured to sunrise are approximately 20% larger, and the errors of the phases are about 15% smaller than those predicted by the above formula for σ^2 .

In particular, the random error of a short (“zero-length”) interval thus would be 2.8°, and that of a short phase would be about 85% of 2.8°, or 10 minutes. Most of this would have to be due to errors in the spotting of the beginning and end of the phase. At first, this seems counter-intuitive, for the following reason. The spotting of sunset is highly accurate. The interval from, say, sunset to the beginning of an eclipse involves the spotting of only one phase and therefore should be determined more accurately than an interval of the same length from the beginning of the eclipse to the beginning of totality, which involves two phases. The probable reason for this paradox is that short intervals to the beginning of an eclipse occur near sunset and sunrise, where phases are harder to spot than in the

dark of the night. Anyway, if we assume that the determinations of beginning and end of phases are statistically independent, this translates into an average random spotting error of about $10/\sqrt{2} = 7$ minutes, somewhat higher near sunrise/sunset, somewhat lower in the dark of the night. It goes without saying that these numbers must be taken with a grain of salt. They should be compared also to the timing errors of approximately 5 minutes found by Stephenson and Said (1991) for the Arabic observations of eclipse contacts.

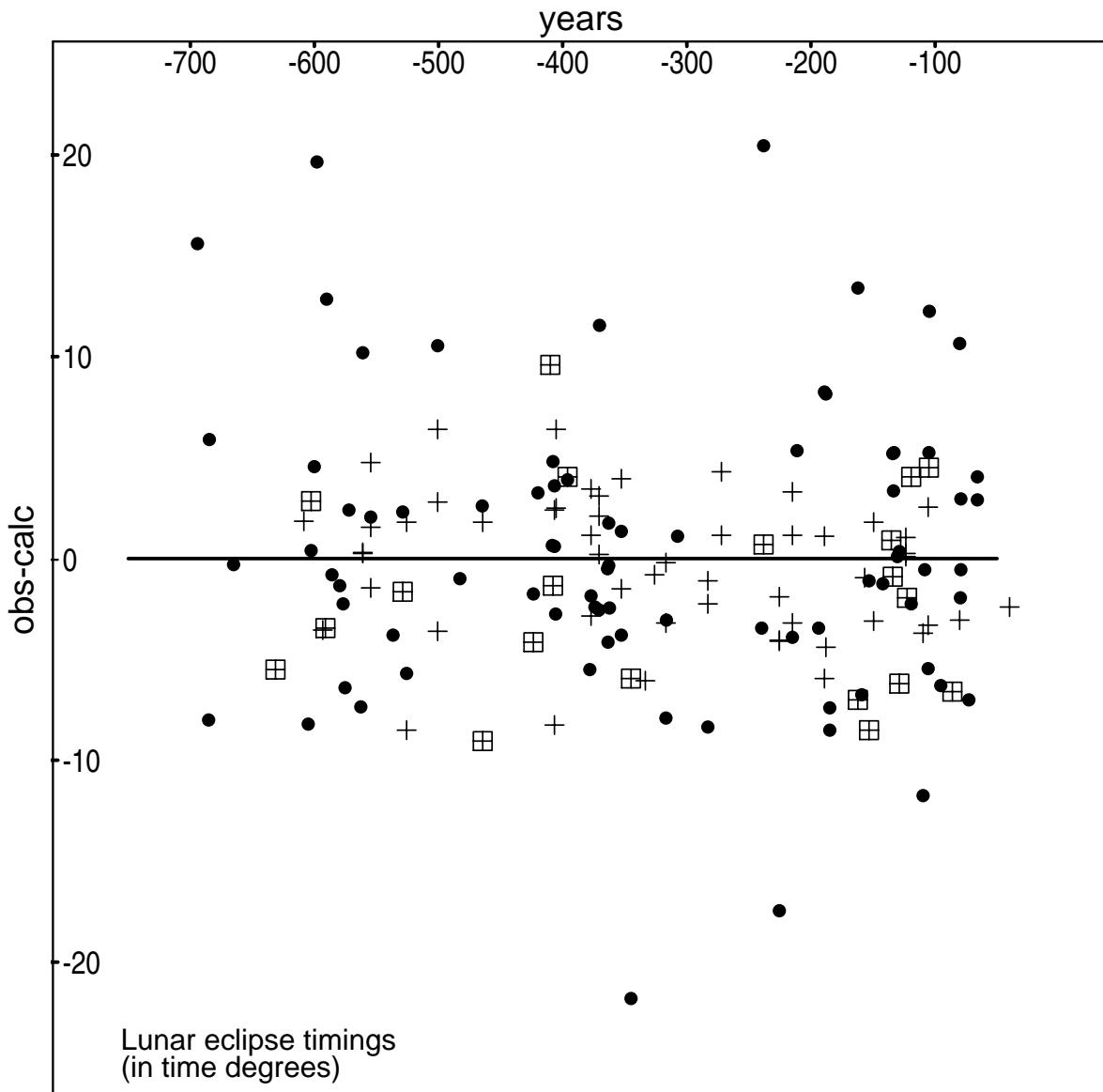


Figure 1. Lunar eclipse timings. Plot of residuals against chronological time. Dots (•) correspond to timings relative to sunset or sunrise, plus signs (+) correspond to durations of eclipse phases, or to total durations, when they are surrounded by a square. All measurements are in time degrees.

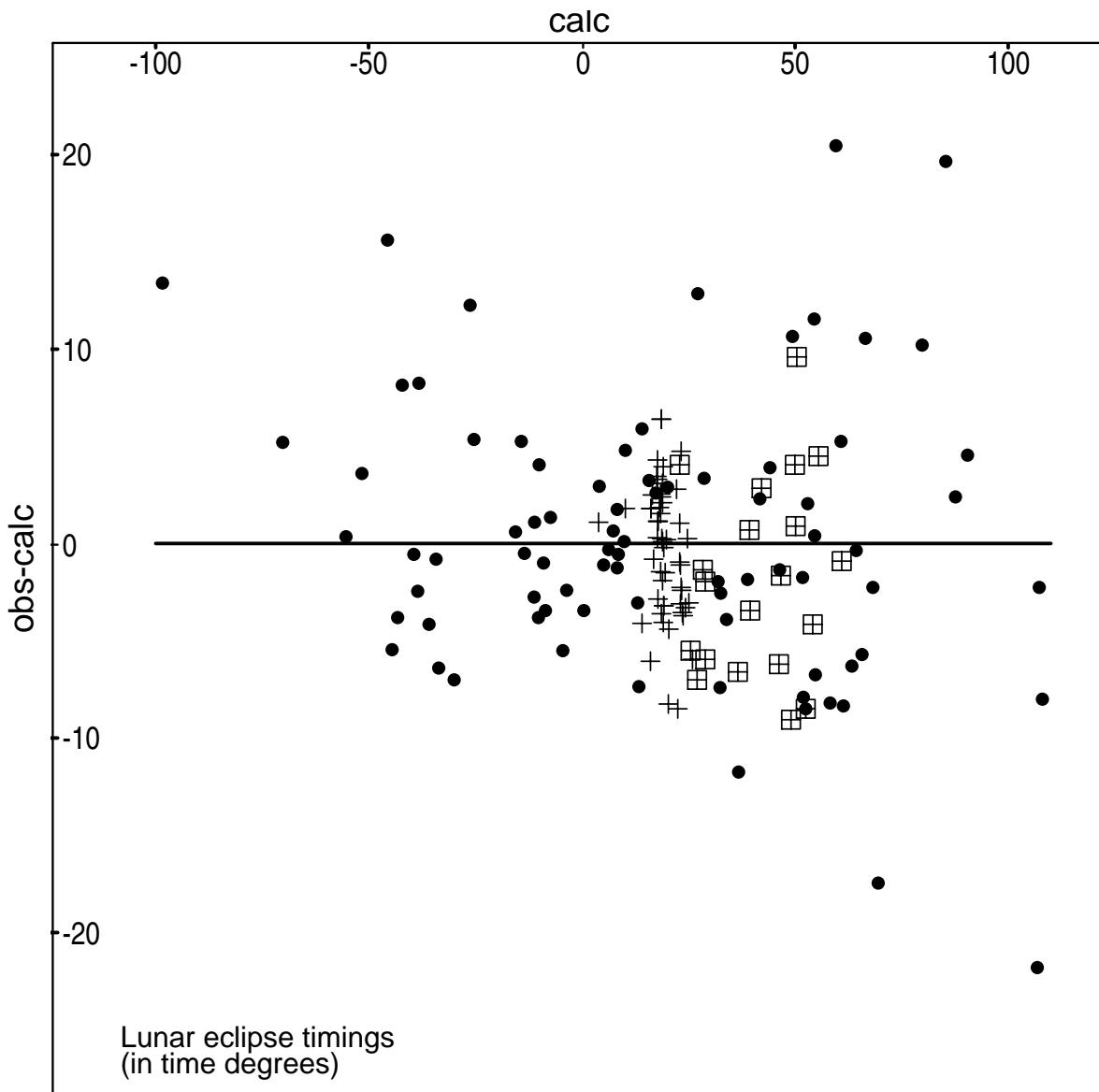


Figure 2. Lunar eclipse timings. Plot of residuals against calculated values. Dots (\bullet) correspond to timings relative to sunset (positive half-axis) or sunrise (negative half-axis), plus signs ($+$) correspond to durations of eclipse phases, or to total durations, when they are surrounded by a square. All measurements are in time degrees.

The systematic errors or biases are statistically insignificant; they are masked by random errors. The mean interval lengths to sunset are 46.2° (calculated) and 46.1° (observed), corresponding to a percentual bias of -0.2% , with an estimated standard error of 2.5% . The mean interval lengths to sunrise are 31.1° (calculated) and 29.9° (observed), corresponding to a percentual bias of -3.8% , with an estimated standard error of 3.9% . That is, the estimated percentual biases are smaller than their own estimated estimation errors. Though, in absolute terms those imperfectly known biases may still be large enough to matter. Note that for the mean interval lengths of 30° to 50° , the estimated standard errors of the biases amount to about $1.2^\circ = 5$ minutes in absolute terms, which is more than twice the horizontal refraction effect of 1.9 minutes observed in the Lunar Sixes data. See Section 2.11 for details.

Rather surprisingly, the errors of lunar eclipse timings thus present a picture very much different from that of the Lunar Sixes observations (Huber 2000a). The time intervals of the Lunar Sixes are smaller, extending to $30^\circ = 2$ hours at most, and the random errors are much smaller. The standard deviation σ of the Lunar Sixes observations can be rendered approximately by

$$\sigma^2 = 0.6^2 + (0.08 t_{\text{calc}})^2.$$

Among the Lunar Sixes, the smallest intervals ($<6^\circ$) are measured without noticeable systematic errors throughout. Larger intervals, however, can be afflicted by very sizeable, statistically significant systematic errors, whose relative size increases with the size of the intervals. Moreover, there are differences with regard to the type of interval. Near Full Moon, for intervals ranging in size from 6° to 16° , the biases are negligible in the evenings, but in the mornings they amount to between -7% and -12%. Near New Moon, the biases are about two times larger in the morning than in the evening, and for the largest intervals of 30° they may reach -6° , or -20%. We do not know the reasons for the different behavior. But we are tempted to speculate that the longer night intervals of the eclipses perhaps were measured by watching the rotation of the celestial sphere, while the shorter time intervals of the Lunar Sixes, occurring near dusk and dawn, perhaps were measured by physical devices such as water clocks.

2.6 Timings relative to planet events

According to a report of the eclipse of -370NOV11, Jupiter rose $2^\circ = 8$ minutes before the end of totality. Our analysis of the eclipse timings did not make use of this particular piece of information. Since the event happened in the dark of the night, we can expect this short time interval to be measured more accurately than short intervals occurring near sunset or sunrise. That is, we can expect a random spotting error for the end of totality somewhat below 7 minutes, plus an independent error of about 1.3 minutes for the rising of Jupiter, caused by fluctuations in horizontal refraction. Calculation gives an interval of 13 minutes = 3.2° , that is a discrepancy of 5 minutes between observation and calculation, which is about what we expected. (Notes on calculation: For the eclipse, I used ST82f with SMN (cf. Section 2.1) and a 3% decrease of the shadow radius, which yields 18.96 UT = 22.12 LT for the end of totality. For Jupiter I used Bretagnon & Simon, also with ST82f, and a zenith distance of $90^\circ 56'$, which yields that Jupiter rises at 18.75 UT. Incidentally, in this case our improvements to ΔT and to the shadow radius very nearly cancel out: MCC (cf. Section 2.1) with ME98 puts the end of totality at 18:56 = 18.93 UT. If we use the conventional zenith distance $90^\circ 34'$ for the rising of the planet, we obtain that Jupiter rises at 18.78.)

2.7 Timings relative to culminations

Occasionally, the beginning of a lunar eclipse is also timed relative to the culmination of certain fixed stars, the so-called *ziqpu*-stars. While Schaumberger (1952) had claimed exceptional accuracy for those timings, there are still problems with the unambiguous identification of the *ziqpu*-stars. Just like Schaumberger, we still have to rely on the eclipse observations for checking those identifications. For the purposes of a statistical analysis of the eclipse timings, we therefore better should ignore the *ziqpu*-data — or at least, keep the results separate. For convenience, we present the results of a preliminary analysis of the data, based on Schaumberger's identifications.

Number	Names from Schaumberger p. 228, 226 (= AO 6478, with variants from VAT 16436)	Names from Hunger-Pingree p. 85	Identification, from Schaumberger p.229	-700 α	-700 δ	Coordinates adopted here α δ
I	šudun, <i>ni-i-ri den-líl</i>	Yoke	α Bootis	182.81°	34.79°	182.81° 34.79°
II	šudun anše <i>arkiti</i> , <i>na-dul-lum</i>	Rear Harness	ξ Bootis (+0,π or ζ)	191.50°	32.38°	191.50° 32.38°
III	<i>Kippati</i>	Circle	α Coronae	205.12°	38.35°	205.12° 38.35°
IV	šá maš-a-ti	Star from the Doublets	β Herculis	218.97°	30.46°	218.97° 30.46°
V	šá taš-ka-a-ti, tak-šá-a-tú	Star from the Triplets	α Herculis	228.40°	18.35°	228.40° 18.35°
VI	dele, e-du	Single Star	μ Herculis	240.81°	32.48°	240.81° 32.48°
VII	gašan tin	Lady of Life	α Lyrae	256.62°	39.16°	256.62° 39.16°
VIII	ku-ma-ri šá u₄-ka-du₈-a	Shoulder of Panther	β Cygni	265.4°	32°	265.40° 32.00°
IX	ni-bi-i šá gaba-šú	Bright Star of his Breast	α Cygni	287.53°	38.03°	287.53° 38.03°
X	kin-ṣu	Knee	15 Lacertae (group)	318-320°	30°	319.00° 30.00°
XI	a-si-di	Heel	σ Andromedae?	333°	23°	333.00° 23.00°
XII	4 šá mul lu-lim	4 Stars of the Stag	π, ο, ξ, ν Cassiopeiae	338°	34°	338.00° 34.00°
XIII	um-mu-lu-ti	Dusky Stars	h Persei (group)	355.63°	42.75°	355.63° 42.75°
XIV	ni-bi-i šá šu-gi, sa₄ šá mūl šu-gi	Bright Star of Old Man	α Persei	9.42°	36.97°	9.42° 36.97°
XV	na-aš-ra-pi	naṣrapu	b, c Persei (group)	18.90°	36-38°	18.90° 37.00°
XVI	gàm, gàm ḫenlil(BE)	Crook	α Aurigae	33.31°	37.95°	33.31° 37.95°
XVII	rittí gàm, rittí gàm ḫdam-ki-nun-na	Hand of Crook	β Aurigae	43.07°	38.94°	43.07° 38.94°
XVIII	maš-tab-ba, maš-maš ḫnabû u ḫnergal	Twins	α Geminorum	69.86°	32.41°	69.86° 32.41°
IXX	maš-tab-ba arkī	Rear Twin	β Geminorum	74.16°	29.48°	74.16° 29.48°
XX	al-lul	Crab	Praesepse (group)	87-91°	23-34°	89.00° 23.50°
XXI	2 mul ^{meš} šá sag-du mul'ur-gu-la	2 Stars from Head of Lion	ε, μ Leonis	105.49° 106.84°	32.57° 35.17°	106.17° 33.87°
XXII	4 šá gaba-šú	4 Stars from his Breast	α, γ, η, ζ Leonis	114.42° 115.25° 112.90° 113.77°	22.21° 30.51° 26.83° 33.79°	114.42° 22.21°
XXIII	2 šá giš-kun-šú	2 Stars from his Thigh	δ, θ Leonis	129.97° 131.07°	33.43° 28.38°	130.52° 30.40°
XXIV	dele šá kun-šú	Single Star from his Tail	β Leonis	141.04°	28.59°	141.04° 28.59°
XXV	a-edin (= erū)	Frond	γ Comae Ber.	150.82°	42.87°	150.82° 42.87°
XXVI	šudun anše, na-ad-dul-lum ár-ku-ú	Harness	υ, η Bootis	174.06° 175.79°	30.44° 33.29°	174.92° 31.86°

Table 6. The *Ziqpu*-Stars, as identified by Schaumberger (1952). In the Names column, the upper line gives the name from AO 6478, the lower line from VAT 16436, when there are relevant differences. All coordinates are for the year -700.

Table 6 presents the identifications of the *ziqpu*-stars, as given by Schaumberger (1952), plus their English names used by Hunger and Pingree (1999). One notices a possible confusion in the names of stars II and XXVI. A comparison between the texts AO 6478 and VAT 16436 suggests that one should equate the “Rear Donkey Yoke” (*śudun anše arkitu*) with “*naddullum*”, but the “Donkey Yoke” with the “Rear *naddullum*” (*naddullum arkû*)! — now which is the “Harness” and which the “Rear Harness” of Hunger and Pingree?

Table 7 presents the results of calculations (using ST82i). Note that according to them the “Donkey Yoke” (-80.0421) and the “Rear *naddullum*” (-162.0330) appear to correspond to star XXVI, and the “Rear Donkey Yoke” (-134.0321) to star II, exactly as AO 6478 and VAT 16436 had suggested. Among the 24 eclipses timed relative to a culmination, the context is broken off in 4 cases, so that we cannot be sure whether the texts there had recorded a non-zero time difference (x° before/after the culmination). There are many very small differences (six below 1°) in the α +Shift–ST column, but also some rather large ones (three above 10°). It is difficult to tell whether the latter are due to careless observations, wrong identifications or other gross errors. Ignoring for the moment any difficulties caused by unreliable identifications, we note that individual *ziqpu*-timings fluctuate with a standard deviation σ of about $6^\circ = 24$ minutes around a mean offset of about 0.5° . The more robust median offset, which should be less affected by wrong identifications of *ziqpu*-stars, is almost the same, namely 0.35° . These offsets suggest that the ΔT -values deriving from ST82i should be reduced by 1.5 to 2 minutes, i.e. practically to the values of ST82f. But note that the estimate of the offset has a standard error of about 5.4 minutes, and ST82f itself has a standard error of about 2.7 minutes, so the discrepancies in any case are well below statistical significance.

JULDAT	UT	ST	Star	Shift	α	α +Shift	α +Shift-ST	Culmination as recorded in the text
-225.0801	20.66	300.2	9	0.0	291.6	291.6	-8.6	<i>sa₄ šá gaba-šú ziq-pi</i>
-214.1225	16.36	19.8	14	0.0	16.1	16.1	-3.7	<i>sa₄ šá múl šu-gi a-[n]a ziq-pi [gub-uz]</i>
-193.1105	2.77	126.0	22	0.0	121.8	121.8	-4.2	4 šá gaba-šú ziq-pi
-189.0228	1.04	213.6	4	0.0	224.3	224.3	10.8	<i>ki šá? maš-[šá?]-tú? a?-na? ziq?-pi?</i>
-187.0801	19.30	280.5	8	0.0	270.1	270.1	-10.4	<i>ku-mar šá múl u₄-ka-du₄-[a ziq-pi]</i>
-177.0712	20.14	273.0			207.2	270.2	-2.8	(alternative date)
-184.1124	16.21	347.7	12	0.0	343.9	343.9	-3.8	4 šá múl <i>lu-lím z[iq-pi]</i>
-182.1004	23.11	40.7	17	*****	51.4	*****	*****	[...] ... múl <i>rit gám ziq-pi</i>
-162.0330	20.32	173.6	26	3.0	181.7	184.7	11.1	3 uš ár múl <i>na-ad-dul ár ziq-pi</i>
-159.0126	18.17	79.4	18	*****	78.6	*****	*****	[...] ... múl maš-maš ziq-pi
-149.0703	23.41	313.6	10	-4.0	324.9	320.9	7.3	4 uš <i>ina igi</i> múl <i>kin-ṣa ziq-pi</i>
-142.0217	15.38	59.0	17	5.0	52.1	57.1	-1.9	5 uš ár <i>rit gám ziq-pi</i>
-135.0401	22.59	210.2	3	0.0	211.1	211.1	0.9	<i>kip-pat ziq-pi</i>
-134.0321	22.44	196.8	2	0.0	198.1	198.1	1.3	múl <i>śudun anše [ár-ku]-ú ziq-pi</i>
-133.0310	2.42	244.6	7	*****	261.3	*****	*****	[... šjá? gaš[an] tin ziq-pi]
-128.1105	23.66	81.4	18	*****	79.1	*****	*****	[...] ár maš-maš ziq-pi
-122.0802	17.72	258.0	6	5.0	246.3	251.3	-6.7	5 uš ár múl <i>dele ziq-pi</i>
-119.0601	20.53	239.4	5	5.0	234.9	239.9	0.5	5 uš ár múl <i>tak-ṣat ziq-pi</i>
-104.0813	0.50	10.5	14	-7.0	17.6	10.6	0.2	7° before <i>nibū šá šu-gi</i> culminated
-95.0803	20.21	296.9	9	5.0	292.7	297.7	0.8	5 uš ár <i>sa₄ šá gaba-šú ziq-pi</i>
-93.0713	18.70	253.0	7	0.0	261.6	261.6	8.6	múl <i>gašan tin [...] ziq-pi</i>
-90.1105	16.62	335.3	11	0.0	340.1	340.1	4.8	múl <i>a-sí-du ziq-pi</i>
-86.0228	20.05	140.5	23	0.0	139.6	139.6	-0.9	múl 2 šá <i>giš-kun-šú ziq-pi</i>
-80.0421	18.83	174.0	26	-5.0	182.8	177.8	3.8	5 uš <i>ina igi</i> <i>śudun [anše ziq-pi]</i>
-79.0411	23.99	241.5	6	-5.0	246.7	241.7	0.2	5 uš <i>ina igi</i> <i>dele ziq-pi</i>

Table 7. Eclipses timed by culminations. The columns give the Julian date and UT of the calculated first contact, the corresponding sidereal time (ST) or hour angle of the vernal equinox, the number of the *ziqpu*-star (here in Arabic instead of Roman numerals), the Shift in degrees for an eclipse beginning before or after the culmination (taken from the eclipse text in the last column, stars indicating that the number is not available), the rectascension α of the *ziqpu*-star for the epoch in question (calculated by correcting the coordinates of Table 6 for precession), α +Shift, and α +Shift-ST (the latter difference ideally ought to be 0), and finally, the culmination record excerpted from the text.

2.8 Solar eclipses

The smaller number and the structure of the available solar eclipse data make a reliable analysis difficult. There are 32 useable time differences (7 to sunrise, 7 to sunset, a majority of them relative to the first contact, plus 17 lengths of phases, namely 8 from the first contact to mid-eclipse, 6 from there to the last contact, and 4 from the first to the last contact).

The main problem is that the data exhibit large systematic errors. Surprisingly, a first, crude analysis suggested systematic errors of about -12% for the lengths of the phases (that is, the observed values on average are about 12% smaller than the calculated ones), but much lesser systematic errors of only about -6% for the time differences to sunset or sunrise, even though the latter intervals are much larger. See the computer output in Section 2.12 for details. We do not know how the Babylonians observed solar eclipses, perhaps by watching the reflection of the sun in water, or perhaps by quick glances through a pinhole, but it is plausible that the observed beginning of a solar eclipse occurred several minutes later than the actual first contact, and similarly, that the observed end occurred earlier than the last contact. If we assume symmetry around the center of the eclipses, we obtain the best fit by assuming that all timings are affected by a systematic measurement error of about -5%, and that for the Babylonian naked-eye observations onset and end of a solar eclipse on average are delayed, respectively advanced, by about 6 minutes (this amounts to 7% of the average phase length, and in combination with the 5% overall bias it adds up to the -12% systematic error noticed before). These fitted percentages are not very accurate. They are affected by standard errors of about 4 percentage points, thus the 5% overall systematic error may be in doubt, but the combined effect on the eclipse phases is statistically significant. A simultaneous least squares fit of all relevant parameters yields the estimate $\Delta T=209.8$ minutes at the central epoch -200 of the solar eclipses, with an estimated standard error of 5.5 minutes. This value must be taken with a grain of salt: if there were a deviation from symmetry, for example if the delay of the first contact exceeds the advance of the last contact (which is quite plausible), we would have to increase our estimate of ΔT by a like amount.

The sample size is too small for a reliable modeling of the error structure. Crudely, the random errors of solar eclipse timings are comparable to those of the lunar eclipse timings, that is, errors of about 3° for small intervals and about 15% for large intervals. Also here, just as in the case of the lunar eclipses, the intervals to sunrise seem to have larger random errors than those to sunset, and again the random errors of the phases appear to be about 15% smaller than what our formula for σ would indicate, compare the tabulation near the end of Section 2.12.

A non-statistical analysis based on a discussion of particular solar eclipses is instructive too. The smallest solar eclipses that were actually seen have magnitudes 0.17 and 0.18 (-321SEP26 and -194JUN06). Four eclipses with smaller magnitudes 0.07, 0.08, 0.10 and 0.16 apparently were not seen (-62MAY18, -186DEC31, -133AUG19 and -123FEB03); in the first and fourth case, the report explicitly notes that the eclipse was watched but not seen. This might suggest that solar eclipses need to reach a magnitude of about 0.17 (or 2 digits) to be noticed. But the above-mentioned shift of about 6 minutes of the observed begin and end of the eclipses suggests a smaller value: on average, the begin of the eclipse seems to occur at a magnitude of about 0.06, when the lunar disk intrudes about 12% of the solar radius, see Figure 4. On the basis of what we know about Babylonian observational practice, the most likely explanation is that we must distinguish between the actually observed and the recorded first contacts, and that the latter involve some educated guesswork and backward extrapolation.

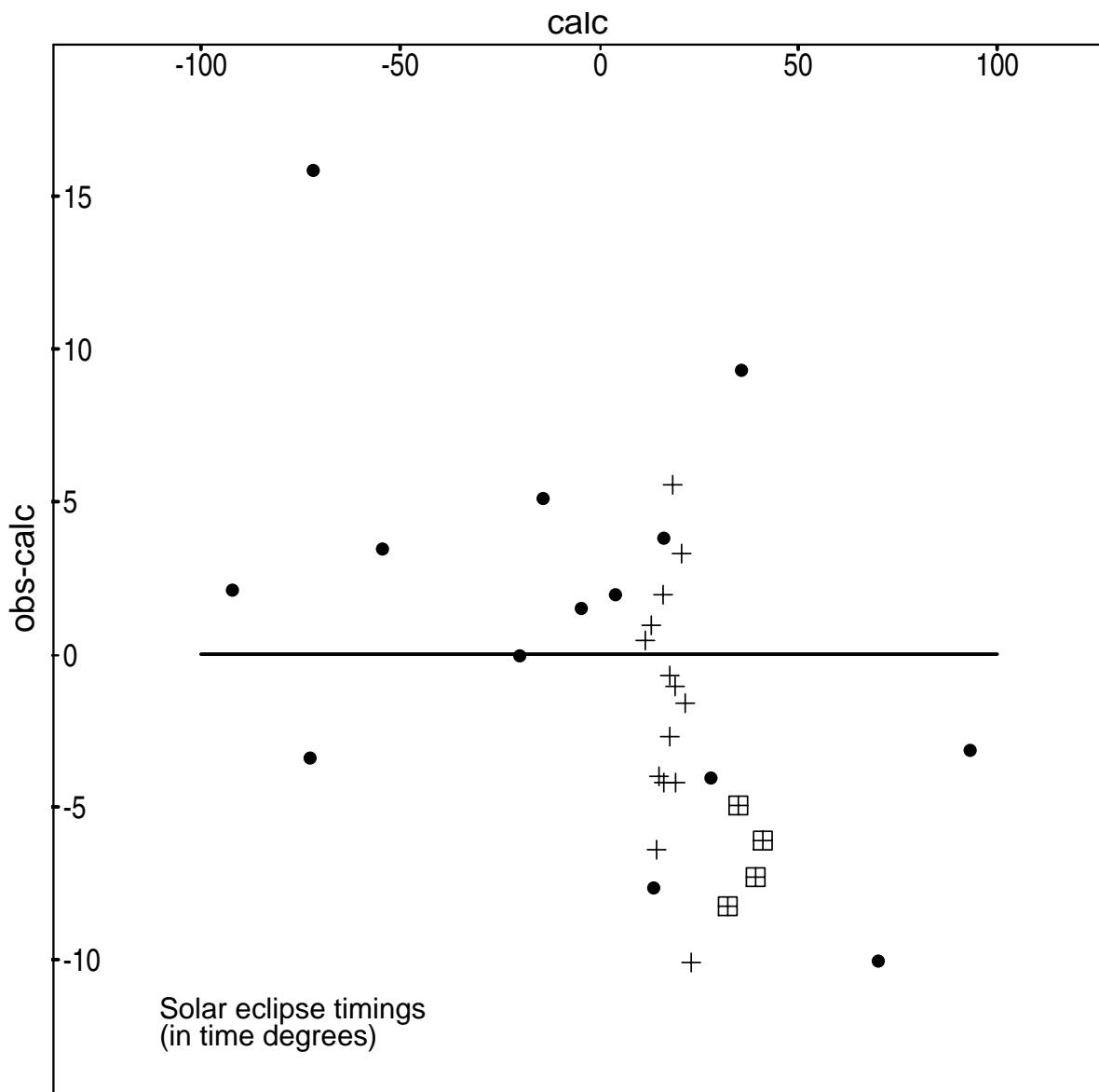


Figure 3. Solar eclipse timings. Plot of residuals against calculated values. Dots (•) correspond to timings relative to sunrise (positive half-axis) or sunset (negative half-axis), plus signs (+) correspond to durations of eclipse phases, or to total durations, when they are surrounded by a square. All measurements are in time degrees. The observed phases predominantly are shorter than calculated.

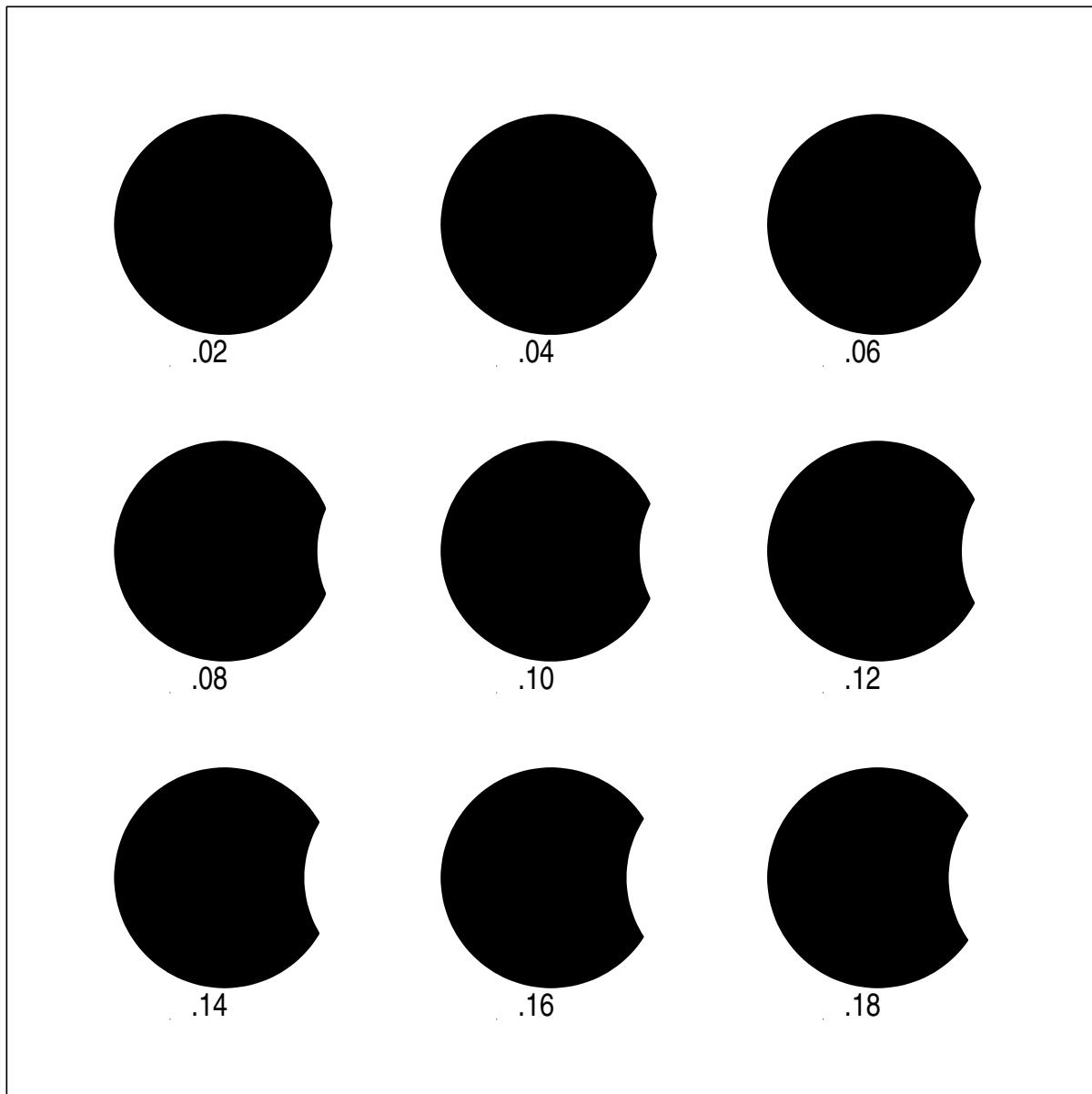


Figure 4. Appearance of the solar disk for weak eclipses, magnitudes from 0.02 to 0.18.

There is one very interesting and relevant total eclipse (-135APR15), giving hard bounds on ΔT (namely $187.7 \leq \Delta T \leq 203.2$ minutes for -135, against 202.7 minutes for ST82, 195.8 for ST84, and 196.8 for ST82f). Another one (-321SEP26) was observed to begin just 3° before sunset (calculated interval: 4.5° , using ST82f and $91^\circ 12'$ zenith distance for sunset), that is, $1.5^\circ = 6$ minutes later than calculated. In still another remarkable case (-124SEP07) the astronomer says: “When I watched, I did not see it; at 1° before sunset”. There was indeed an eclipse beginning immediately before sunset, with a calculated interval of 1.35° ; a shift of 6 minutes would delay it to seconds past sunset. This may refer to an unbelievably accurate prediction, or perhaps more likely, to an observation by a luckier colleague. In any case, the timings of the last two eclipses agree remarkably well with our estimate that the observation of the first contact is delayed against modern calculation by approximately 6 minutes.

An eclipse reported in SAA 10,148, and thus observed either in Nineveh (43.13E, 36.40N) or perhaps rather in Assur (43.23E, 35.48N, Akkullanu apparently resided in Assur) is similarly interesting: “Akkullanu himself has written: ‘The sun at its rising made an eclipse of two fingers’.” This must be the eclipse of -668MAY27, being the only one between -700 and -626 where the sun rises eclipsed; compare also LAS 2, p.89. Using ST82f and $90^\circ 24'$ zenith distance for sunrise (lower rim of the sun),

we obtain the following eclipse circumstances for Nineveh T1: 4.07 LT; Tm: 1.64 UT = 4.66 LT, Altm -3.4° , Magn 0.207; T4: 5.27 LT, Alt4 3.3° ; SR 4.91 LT. For Assur: T1: 4.04 LT; Tm: 1.62 UT = 4.64 LT, Altm -4.0° , Magn 0.222; T4: 5.28 LT, Alt4 3.0° ; SR 4.94 LT. For both places, the magnitude at sunrise is 0.17, fitting perfectly. If ΔT is increased (decreased) by 7 minutes, the magnitude at sunrise is decreased to 0.12 (1.5 digits) or increased to 0.21 (2.5 digits), respectively. An increase of 15 minutes renders the visibility of the eclipse questionable (magnitude at sunrise below 0.06), while with a decrease of 20 minutes the sun rises at mid-eclipse, at a magnitude of 0.25, or 3 digits.

Summary. The best fit for the timed solar eclipses is obtained by lengthening all observed times by 5% (to compensate for suspected systematic errors in the time measurements), and moreover delaying, respectively advancing, the first and last contacts by 6 minutes against modern calculation. These shifts of the contacts correspond to assuming that the visual onset and end of the eclipses occur at a magnitude of about 0.06.

2.9 The bigger picture

Over the past 20 years confusingly many expressions for ΔT to be used for purposes of historical astronomy have been proposed, causing John Britton to complain that they were multiplying like rabbits. On purpose, our analysis steered clear of all of them; our own fit was determined on the basis of the Babylonian timed lunar eclipses, all other evidence being used only for checking or corroboration. The following comments and figures should help to explain the situation.

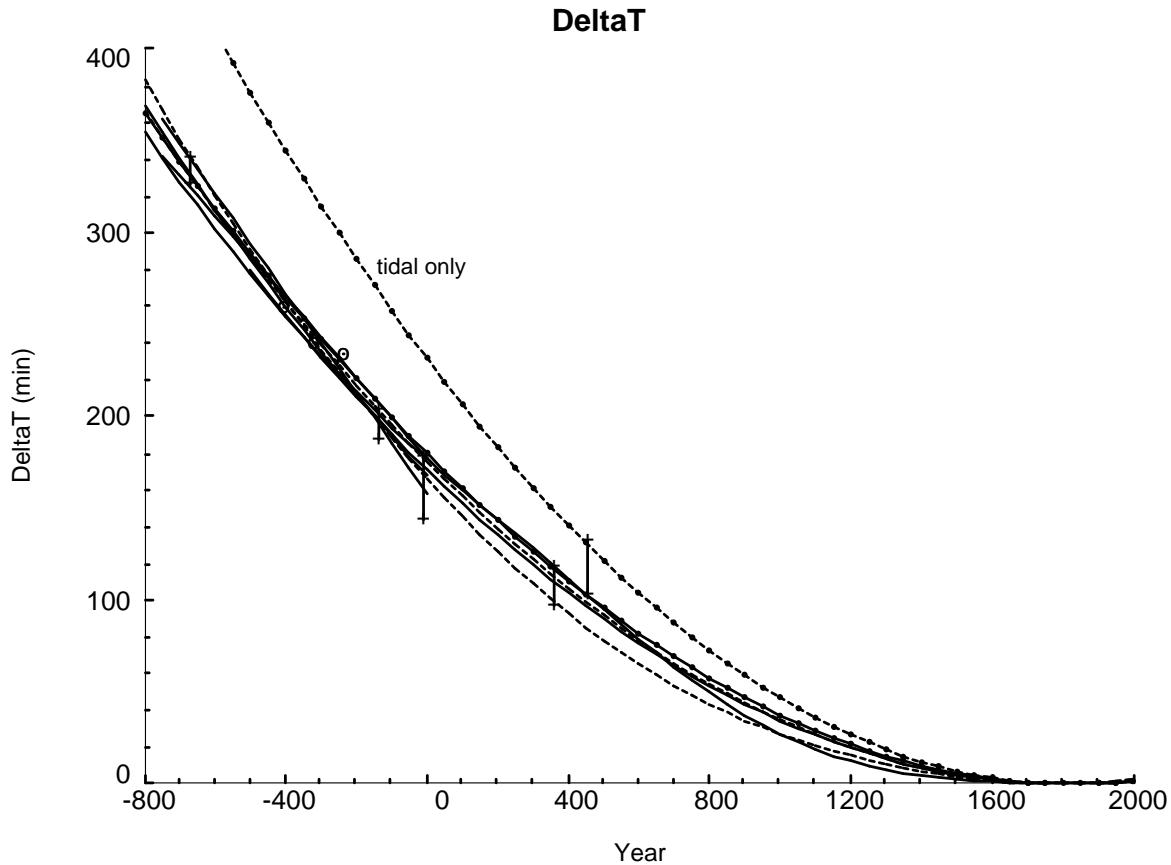


Figure 5. Various expressions for ΔT . Dot-dashed: purely tidal. Dot-solid: tidal plus post-glacial rebound. Solid and dashed: various empirical expressions. The tidal and post-glacial rebound models are based solely on modern observations, with parameter values determined from lunar laser ranging and from artificial satellite measurements.

A purely tidal model, which assumes that the LOD increases by 2.3 ± 0.1 ms/cy, as determined from lunar laser ranging, clearly does not fit the observations. The empirical formulas proposed in the past 20 years all lie in a narrow strip substantially below (see Figure 5). Stephenson and Morrison (1995) have argued that this divergence can be explained by the presence of a non-tidal component due to post-glacial rebound. According to them (p. 198), rebound adds

$$d(t) = a \tau (\exp(-t/\tau) - 1)$$

to the purely tidal value ($2.3 t$ ms) of the LOD. Here, time t is measured in centuries since AD1820 (thus t is negative for the periods of interest), the acceleration rate $a = 0.44 \pm 0.05$ ms/cy is determined from satellite measurements of the present-day rate of change of the Earth's zonal harmonic J_2 , and $\tau = 40$ cy is the relaxation time. The latter figure is based on a personal communication of Yoder to Morrison: "Models which fit ice sheet disintegration and observed dJ_2/dt (from near-Earth satellites) predict that the relaxation time is of the order 4000 to 5000 years." If we integrate these formulas, we obtain that ΔT has a tidal component of

$$\Delta T_{\text{tid}} = 2.3 t^2 36525/2 \text{ ms},$$

and a rebound component of

$$\Delta T_{\text{reb}} = -a \tau (\tau (\exp(-t/\tau) - 1) + t) 36525 \text{ ms},$$

where 36525 is the number of days in a century. Figure 6 shows the differences of the various formulas for ΔT to the tidal+rebound model.

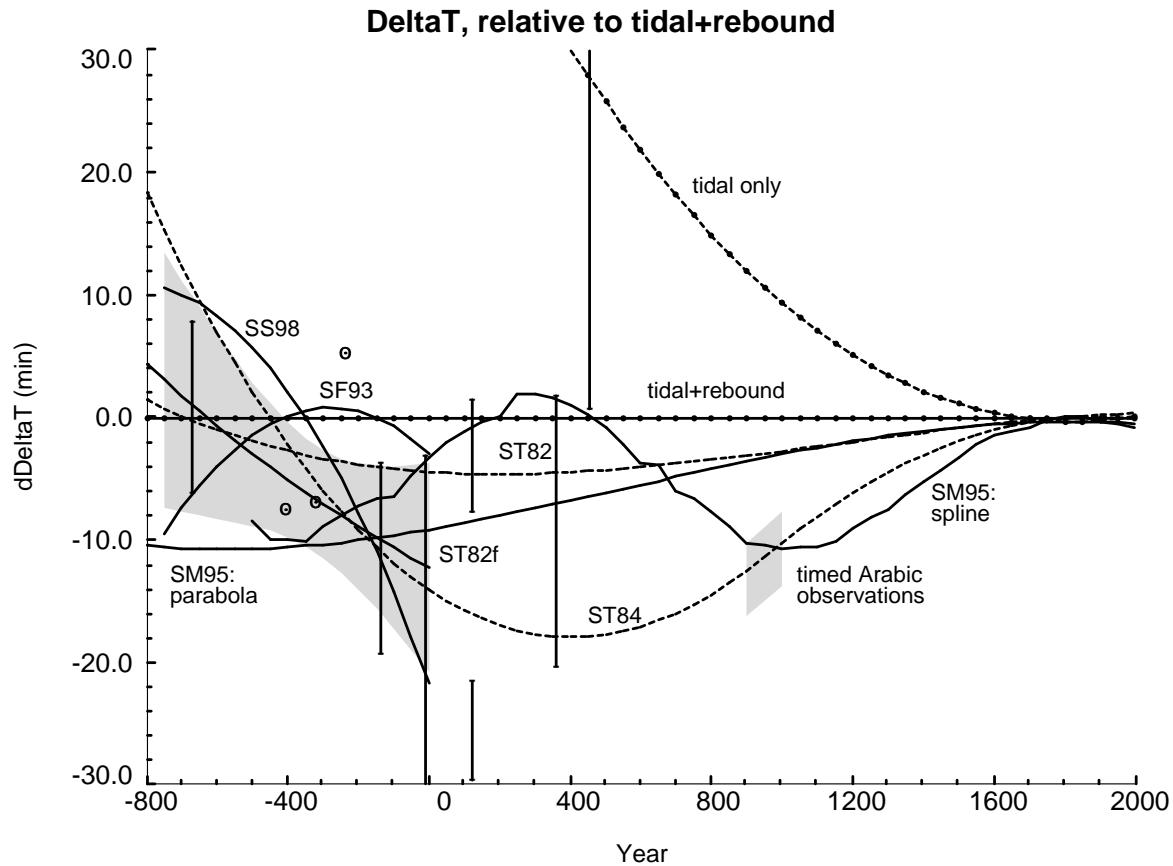


Figure 6. Various expressions for ΔT . Plotted are the differences $d\Delta T$ to the values obtained from combining the purely tidal values with post-glacial rebound. Dot-dashed: purely tidal. Dot-solid: tidal plus post-glacial rebound. Dashed: ST82 and ST84. Solid curves: the spline curve taken from the table of SM95, p. 198; the parabola taken from SM95, p. 188 ($\Delta T = -20 + 31 t^2$ sec, with t in centuries since AD1820); the different straight line fits SF93 and SS98 to the Babylonian data, proposed by Stephenson and Fatoohi (1993) and by Steele and Stephenson. The shaded areas represent 2σ limits, the left one to our estimate based on the Babylonian timed lunar eclipses (central line: ST82f), the right one to the estimate of Stephenson and Said (1989), based on timings of solar and lunar eclipses made by Muslim astronomers. Three selected timed observations are indicated by circles, six intervals by vertical bars (see the following discussion).

One should be aware that spline functions are designed to stay close to the data, where available, and to fill the gaps between them as smoothly as possible. They reconstruct empirical functions sensibly, but not always faithfully, and using them for extrapolation is treacherous. The treatment given by Stephenson and Morrison (1995) is not entirely transparent, but wisely, they had refrained from extending their ΔT -table (p. 198) beyond -500. It appears that the most influential data are concentrated in four distinct groups: modern (after AD1600), Arabic (around AD1000), Chinese (around AD400), and Babylonian (around 300BC). The spline-fitted curve must satisfy the centers of these four groups.

In Figure 6 three timed observations (all with very short intervals) were inserted mainly to alert to the fact that Babylonian timings of short intervals have standard deviations of about 12 minutes, and that they carry weight not individually, but only through their numbers. The first two timed observations (-408JUN16 and -321SEP26) agree with calculation better than average, while the seemingly large deviation of the third, the lunar eclipse of -239NOV03, is only a shade worse than average. It was observed to begin 3° before sunrise, but with ST82f and 6% enlargement of the shadow it calculates to begin 0.45° after. This is just a shade larger than the estimated spotting error of the start of a lunar eclipse. But the vertical scale of the figure makes it evident that we may run into problems with systematic errors: remember that we had estimated from the Babylonian material that observed first contacts are shifted by about 6 minutes against conventional modern calculations, in different directions for lunar and solar eclipses. For example, it also remains an open question whether the 3 minutes difference Stephenson and Said (1989) had found between their determinations of ΔT values from Arabic timed solar and lunar eclipse observations is random or systematic. Note also that the high values of the spline curve near AD400 seem to depend crucially on a single, not otherwise corroborated eclipse record (the total solar eclipse of AD454).

Selected observations are indicated in Figure 6:

- 668MAY27 (Assur, 43.23°E , 35.48°N): solar eclipse at sunrise, observed magnitude 2 digits. The end points of the vertical bar correspond to magnitudes of 1.5 and 2.5 digits respectively; they indicate the precision of the recording, not necessarily the accuracy of the observation. At the upper end, an increase of ΔT by a further 8 minutes renders the visibility of the eclipse questionable; at the lower end, a decrease by about 13 minutes makes the sun rise around mid-eclipse, with a magnitude of 0.25, that is of 3 digits.
- 408JUN16 (Babylon, 44.42°E , 32.55°N): lunar eclipse ending 8° after sunset.
- 321SEP26 (Babylon): solar eclipse, beginning 3° before sunset.
- 239NOV03 (Babylon): lunar eclipse, beginning 3° before sunrise. According to calculation using (ST82f) the eclipse began 0.45° after sunrise, but despite this, the discrepancy very well may be a random deviation.
- 135APRIL15 (Babylon): total solar eclipse. The end points of the vertical bar delimit the range of totality.
- 9JUN30 (Babylon): total solar eclipse. The end points of the vertical bar delimit the range of totality.
- 120JAN18 (Lo-yang, 112.47°E , 34.75°N): solar eclipse, described as very nearly total. The vertical bars delimit partiality, with magnitude ranges between 0.98 and 1.00, with the excluded total range left open.
- 360AUG28 (Jiankang = Nanjing, 118.78°E , 32.03°N): annular solar eclipse, observed as a “hook”, i.e. as a large partial, non-annular eclipse. The vertical bar extends from magnitude 0.88 (reasonably large partial) at the lower end, to magnitude 0.93 (just annular) at the upper end.
- 454AUG10 (Jiankang = Nanjing): total solar eclipse. The end points of the vertical bar delimit the range of totality. Totality in this case is very sensitive to the location of the observer (this was pointed out to us by J. Britton): if the location is moved north by 14 km to 32.15°N , the bottom end of the totality bar is lowered by 5 minutes to the ST82-curve.

The next two figures use simulations to illustrate the effects of the random fluctuations in the rotation of the earth. According to Huber (2000b), the LOD behaves much like a Brownian motion with drift, with independent increments having a variance of $0.058 \text{ ms}^2/\text{yr}$. Figure 7 is an enlargement of Figure 6, showing how such ΔT -curves might look like. The integration constants in the simulated curves were adjusted in such a way that a linear fit in the manner of Section 2.4 gives the same results as the Babylonian observations, namely the ST82f-curve, which is drawn in the middle of the shaded area. Interestingly, an analysis of the simulation results indicates that the estimated standard errors of ΔT and of the LOD (cf. Section 2.4, Table 2) are due about equally to observational errors and to the intrinsic wiggle of the rotation of the earth. In other words: even if many more of the Babylonian observations had survived, we would not obtain a substantially better accuracy in the determination of ΔT and LOD for the Neo- and Late-Babylonian period. Moreover, for the purposes of historical astronomy, such an improvement would largely be irrelevant, given that the errors of individual Babylonian timings scatter well beyond the shaded area in Figure 7.

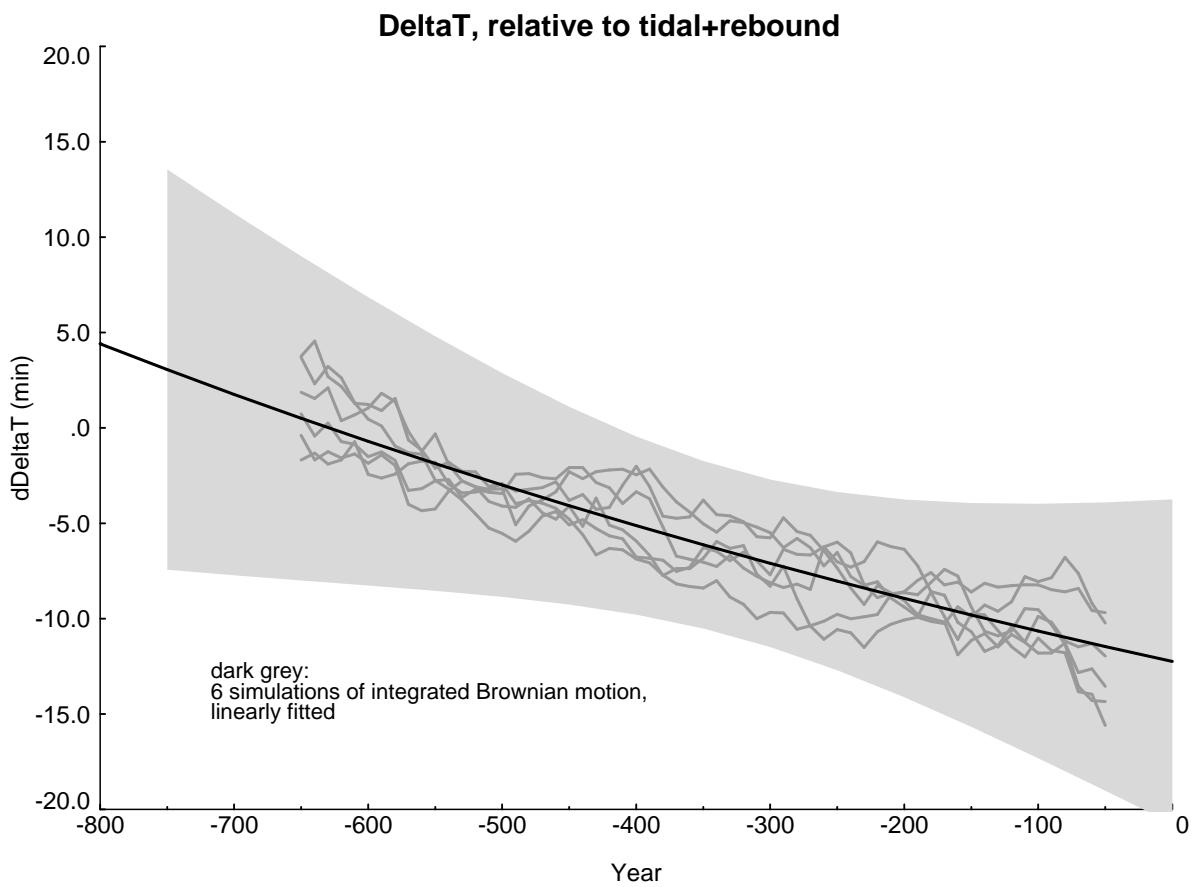


Figure 7. Enlargement of part of Figure 6, but with 6 simulations of ΔT , adjusted such that a linear fit in the manner of Section 2.4 results in ST82f.

Figure 8 again shows the same data as Figure 6, but 20 simulations of ΔT of a different kind were added. These simulations arbitrarily were anchored at the years -250 and +950, fixing the values of ΔT there at -8 and -11 minutes respectively. The LOD values at the end points correspond to the straight line interpolating between -250 and +950. The LOD was simulated as a conditional Brownian motion, with independent increments with variance $0.058 \text{ ms}^2/\text{yr}$. Under these assumptions, approximately 1 simulation in 100 exceeds the value +2 minutes at the year +450. Note that the simulations tend to fill the space between ST84 and the SM95 spline, and that one of our simulations (which are the first 20 produced by the random number generator), almost makes it to the bottom end of the totality bar for the AD454 eclipse. Thus, totality of the AD454 eclipse is just barely compatible

with the Brownian motion model. However, the simulations also intimate that if the eclipse of +120 is to be non-total, and if the ΔT -curve is to reach a high value near +400, it ought to flatten and begin to curl up very soon after -250. The timed lunar eclipses do not offer firm evidence of such a flattening of the ΔT -curve. There are too few observations for a reliable determination of ΔT after -100, and the anticipated effect (of perhaps 3 minutes around the year -100) is near the limits of observability. Though, the results listed near the end of Section 2.11 seem to support such an assumption.

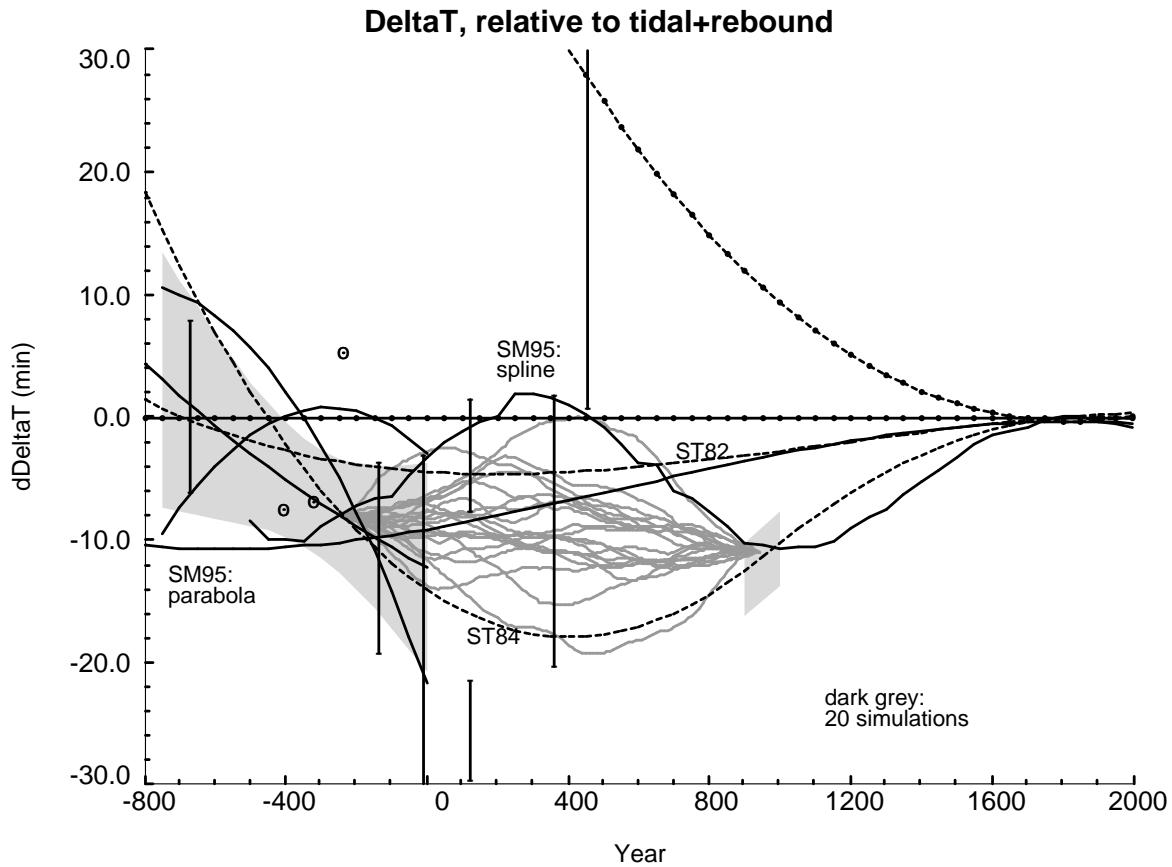


Figure 8. Same data as Figure 6, but with 20 simulations of ΔT , anchored at the years -250 and +950.

Figures 9 and 10 graph some results for the LOD values, illustrating the volatility of the spline estimates. At the weighted center of the Babylonian observations (near -325) the estimates for the LOD and for ΔT are independent, and the estimated standard error of the LOD-value is 1.8 ms. The vertical bar in Figure 9 indicates 2σ limits, thus the difference to ST82 is not significant, but that to the SM95 spline is. This might be taken as an indication that the value of ΔT near AD400 ought to be lowered a few minutes against the SM95 spline curve, in order to make both the ΔT - and the LOD-curves somewhat flatter. Under these circumstances, I would be reluctant to use the SM95 spline for the Babylonian period, it seems to be overly dependent on the single eclipse of +454AUG10.

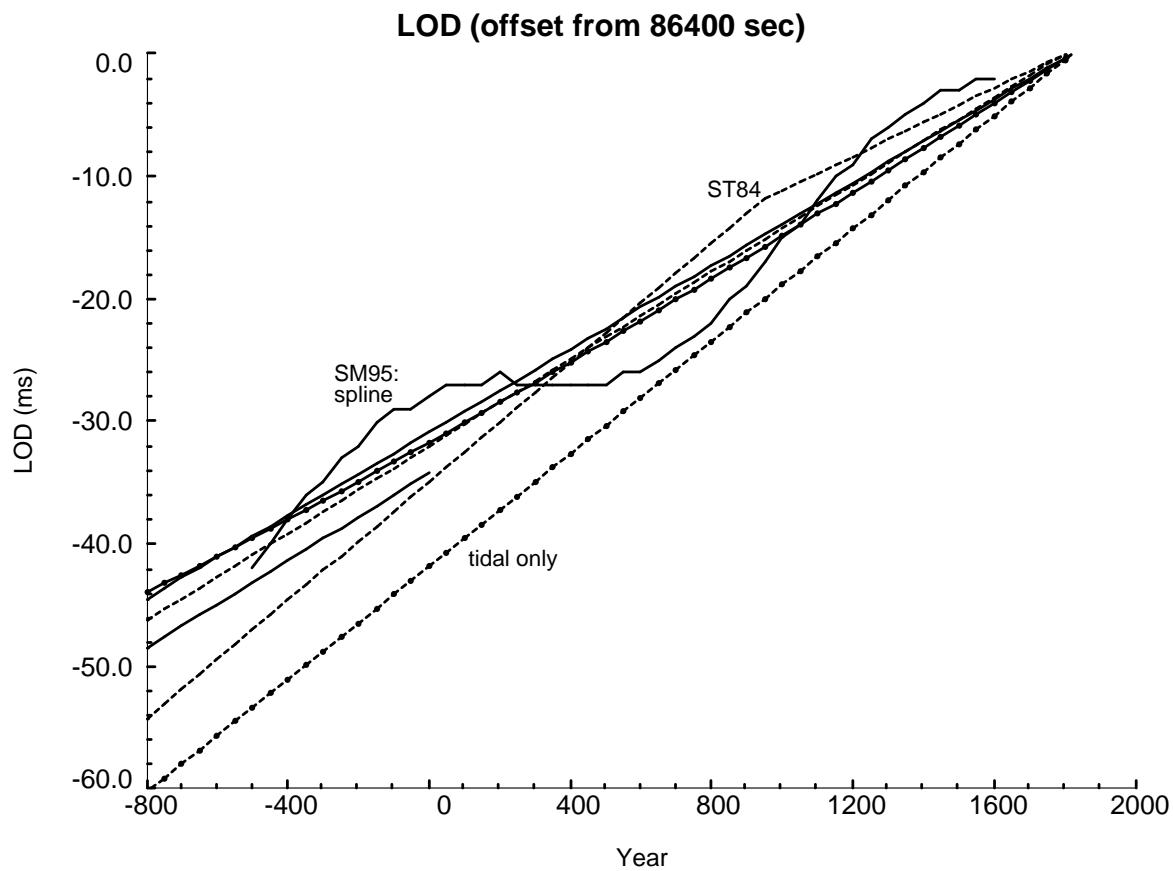


Figure 9. Length-of-Day, analogous to Figure 5.

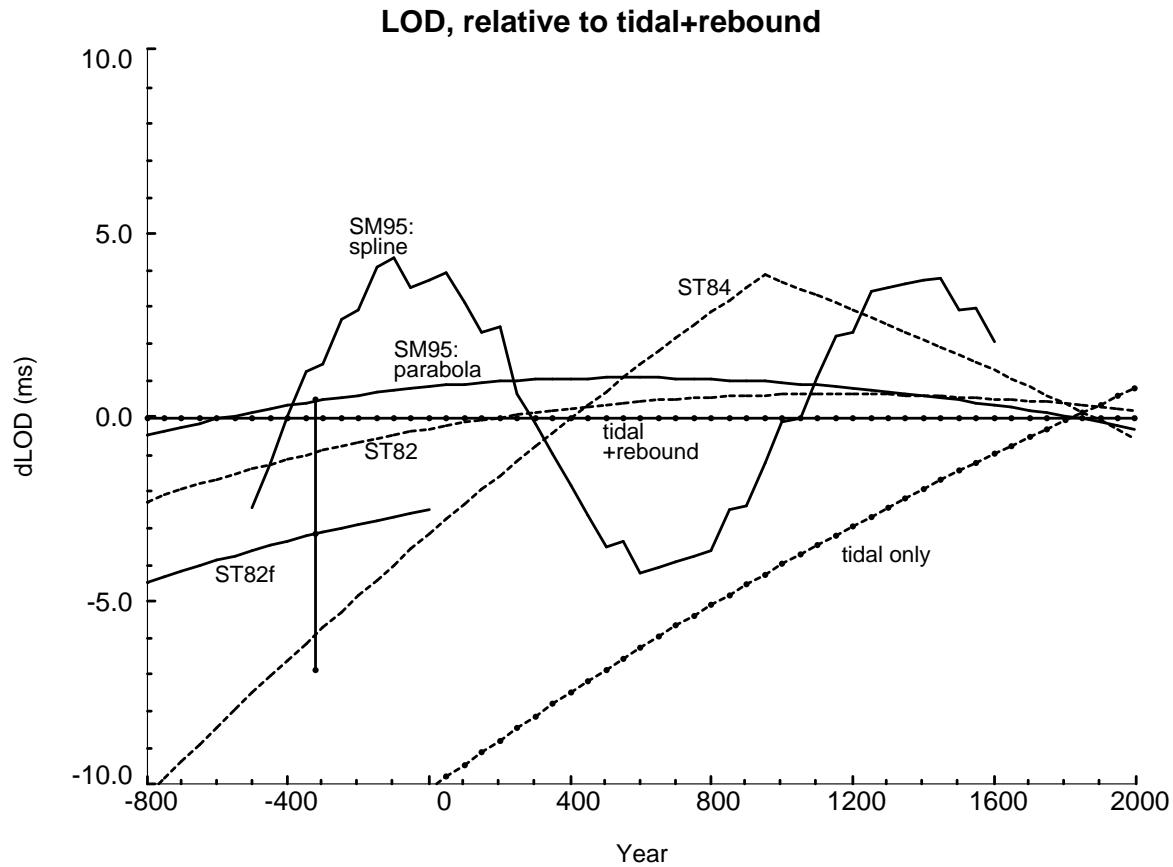


Figure 10. Length-of-Day relative to tidal+rebound, analogous to Figure 6.

2.10 Conclusions and recommendations

We must distinguish between the intended applications. For *calculating eclipses in the Neo- and Late Babylonian period* (from -750 to 0), the formulas ST82f and ST84f are for most practical purposes equivalent, and either can be recommended. ST82 and ST84 agree somewhat less well, although not in a statistically significant fashion; ST84 fits poorly in the first half, ST82 poorly in the second half of the period in question.

The choice of a formula for *extrapolation beyond the Neo-Babylonian period* is trickier and needs some discussion. We note that the LOD behaves like a Brownian motion process with drift (Huber 2000b). It follows that the extrapolation of ΔT should be anchored at the earliest well-determined values of ΔT and the LOD. Whether one should put that moment at the central epoch -325 of the presently available observations or earlier, say at -500, is debatable; I lean toward the latter alternative. Then one should use the best available estimate of the drift in the LOD (i.e. of the curvature term in ΔT) for extrapolation. If we assume linear drift (i.e. constant curvature), this suggests to use ST82f, or something very similar.

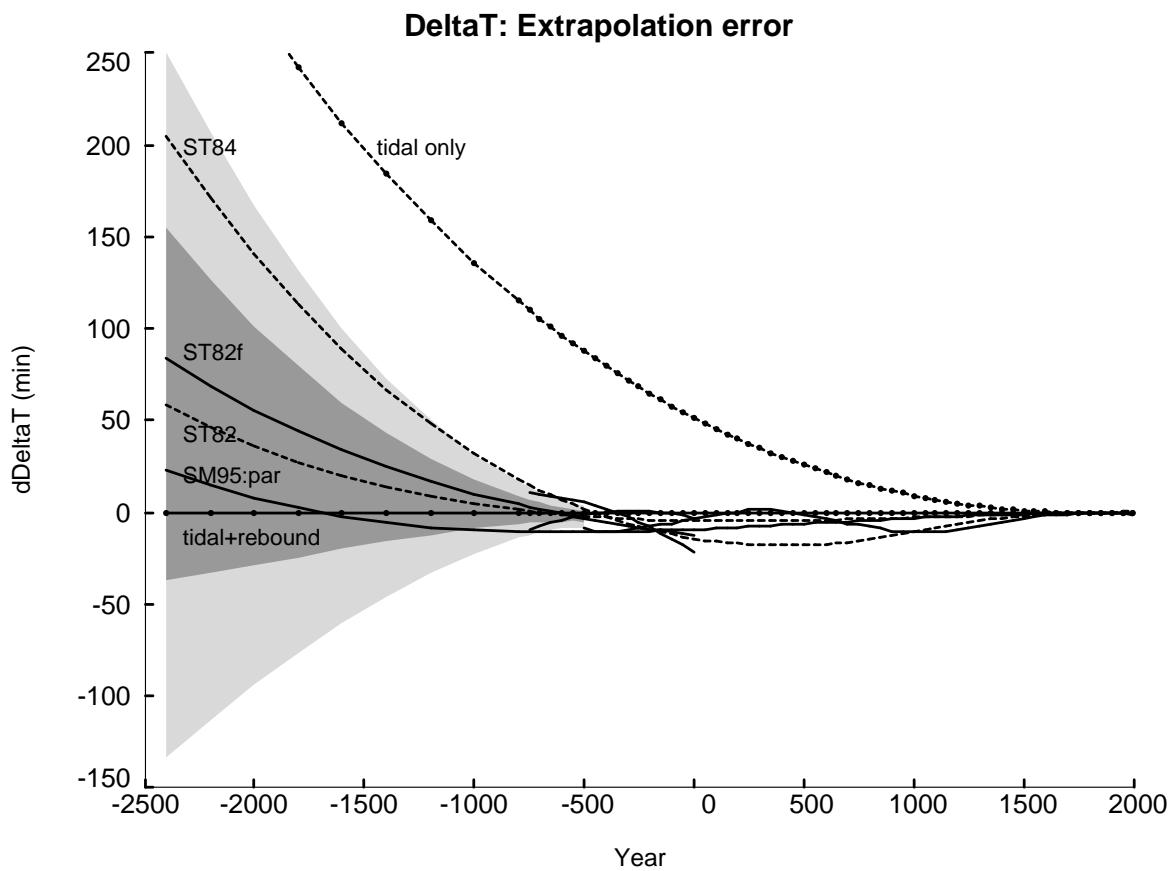


Figure 11. Extrapolation of ΔT . Plotted are the differences to the values obtained from combining the purely tidal values with post-glacial rebound, as in Figure 6. The gray areas, somewhat arbitrarily centered at ST82, represent 1σ and 2σ limits for the extrapolation error for extrapolating beyond -500. They are derived from the Brownian motion model of Huber (2000b).

The theoretically cleanest approach might be that offered by the post-glacial rebound model based on a decomposition into three components: tidal + rebound + fluctuations, as described at the beginning of the preceding section. If we accept this model, then the curvature decreases toward the past, and we obtain somewhat lower values of ΔT . Though, there may be also other effects influencing the LOD process, for example changes in sea levels. In any case, until the parameters of the post-glacial rebound model are known more accurately, we probably better stay with a simpler quadratic + fluctuations model, with parameters empirically determined from the historical data. It can be seen from Figure 11 that the extrapolation error predicted by the Brownian motion model is quite large. The old and simple ST82 remains an excellent compromise, with both ST82f and the post-glacial rebound model based on the currently available parameters staying well within 1σ limits.

2.11 Supplement: Fitting of Lunar eclipses

The following pages of computer output are documenting the final stage of the comprehensive least squares fitting process for the timed lunar eclipses. In particular, they show which time measurements entered into it. Redundancy was avoided (i.e. sums were disregarded, if all summands were available). The main purpose of this final stage was to check whether the estimated modifications in the timings of the contacts had been adequately translated into shadow radii. The header lists the parameters used (they correspond to ST82f): geographical longitude and latitude of Babylon, changes of shadow radii in percent, cut-off point for magnitudes, horizontal refraction ($56'$), and the coefficients used in the formula for ΔT . There are four lines of output for each eclipse. The first two are extracted from a table of eclipses calculated with the parameters of the header. The third line is the input to the program: the date, and one or more observed time differences (in time degrees), taken from the Babylonian records. Question marks, indicating questionable readings, were ignored, after we realized that the probable reading errors were dominated by the timing errors. Inequalities were disregarded in the fitting process. The fourth line lists the corresponding calculated values (in times degrees). The list is followed by details of the results of the least squares fit. Grossly discrepant values (i.e. where the difference of observation minus calculation exceeded 2.9 times its estimated standard error σ) were excluded from the fit.

```
***** LUNAR ECLIPSES *****
Longitude= 44.4200, Latitude= 32.5500
Shadows 6.0 -3.0 -3.0 6.0 %, magn> -.12, hr 56.
Alternate Delta T, with coeffs 1800 -1925.00 -81.00 32.50
-----
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
NBNSR 1U VI -746AUG02 .64 1.94 .00 .00 5.28* Magn 1.03 46 277 18.65 19.02 4.99 5.17
-746.0802 c4-ms>0 1.6500
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
NBNSR 1U XI -745JAN26 1.68 2.33 3.59 5.00 6.26 Magn 1.41 95 301 16.58 17.17 6.82 7.01
-745.0126 c1-sr=-100 67.350
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
MKAID 9A II -712APR19 17.57 18.96 .00 .00 21.85 Magn .61 78 338 18.26 18.46 5.53 5.80
-712.0419 c1-mr<0 10.500
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
BELIB 1A I -701MAR20 3.95 5.43 .00* .00* 7.66* Magn .22 165 231 17.35 17.94 6.05 6.21
-701.0320 c4-ms>0 21.750
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
ASNSM 5 II -694MAY01 .95 2.32 .00 .00 5.41* Magn .74 81 331 18.08 18.63 5.36 5.47
-694.0501 c4-ms>0 c1-sr=-30 -0.90000 -45.600
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
SANH2 3U II -685APR22 .01 1.69 .00 .00 4.52 Magn .55 64 329 18.01 18.49 5.51 5.65
-685.0422 c1-ss=100 108.00
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
SANH2 4 VII -684OCT03 17.80 18.97 20.03 21.61 22.67 Magn 1.83 71 253 17.84 18.03 5.98 6.52
-684.1003 c1-ss=20 14.100
Babyl.Date Jul.Date UT I II III IV Magn E A MR SS SR MS
SSSUK 1 VIII -666OCT15 2.50 3.74 4.80 6.37* 7.43* Magn 1.86 72 253 17.38 17.85 6.16 6.30
-666.1015 c4-ms>0 16.950
```


The following is an annotated excerpt from the analysis section of the computer output. The numbers in parentheses on the right margin refer to the notes below.

```

-----
Gross errors: abs(obs-calc)*w >= 2.9
-745JAN26 first contact to sunrise
-366AUG30 first contact to sunrise
-333MAY29 totality
-316DEC13 totality
-283MAR17 totality
-211OCT24 sunset to first contact
-135APR01 first contact to sunrise
-----
w=1/sqrt(2.8**2 + (0.14*ycalc1)**2)
-----
Regress on all but MR, SS, SR, MS:
regress/const=n/prompt=n (w*x1(*,1 2 4:5)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom: 154 - 4 = 150
sigma     = 0.98175
condition = 2.3091

var       coef        sdev
1         -1.2386    130.64
2         -0.26770   67.373
3         -0.14948   0.39280
4         -0.32000   0.36995
Correlation matrix:                                (1)
  1.00000  -0.023417  -0.40591  -0.087120
 -0.023417      1.00000  0.0060374  -0.0084937
 -0.40591  0.0060374      1.00000  0.29047
 -0.087120  -0.0084937  0.29047      1.00000

Weighted center of dates:           -322.77
coefs      1800      -1925      -81      32.500
ncoefs     1800     -1931.9     -81.268   32.500
ccoefs      -325     14472.0     -1462.3   32.500
nccoefs     -325     14470.8     -1462.5   32.500
          SE      130.64      67.373
ccoefs     DT=241.20 minutes      LOD=-40.034 ms
nccoefs    DT=241.18, SE=2.1773 minutes    LOD=-40.042, SE=1.8446 ms
#####
check biases and weights: #####
type      range    n calc  obs  bias %bias  sdv  %sdv  sdv/s
overall  0.:108.  154 32.54 31.90 -0.64 -1.96 5.89 18.10 0.97
overall  0.: 16.   31  9.81  9.94  0.13  1.30 3.36 34.23 1.04
overall  16.: 20.  31 18.27 19.23  0.95  5.23 2.77 15.14 0.73
overall  20.: 32.  31 24.70 23.00 -1.70 -6.87 5.03 20.37 1.11
overall  32.: 52.  31 42.08 40.97 -1.11 -2.65 6.10 14.49 0.93
overall  52.:108. 30 69.03 67.53 -1.49 -2.16 9.66 13.99 0.94
SS       5.:108.   49 46.20 46.10 -0.09 -0.21 8.05 17.42 1.03
SS       5.: 32.    17 15.56 16.65  1.08  6.95 4.55 29.22 1.09
SS       33.: 60.   17 47.89 47.71 -0.19 -0.39 8.31 17.35 1.08
SS       61.:108.   15 78.99 77.67 -1.32 -1.68 10.77 13.64 0.92
SR       0.: 98.   27 31.07 29.89 -1.18 -3.81 6.23 20.04 1.16
SR       0.: 34.   14 14.40 14.79  0.39  2.68 5.40 37.47 1.34
SR       34.: 98.   13 49.03 46.15 -2.87 -5.86 6.82 13.92 0.92
onset    16.: 26.   20 19.48 19.05 -0.43 -2.23 3.51 18.00 0.90
totality 4.: 25.   20 19.70 18.70 -1.00 -5.05 3.60 18.27 0.90
clearing 16.: 23.   13 18.48 19.15  0.67  3.62 2.87 15.52 0.75
duration 23.: 61.   20 41.73 39.95 -1.78 -4.27 5.03 12.05 0.80
-----
```

(1)

(2)

(3)

(4)

(5)

(6)

(7)

Notes.

- (1) The first two variables refer to ΔT and its slope, expressed in seconds and in seconds/cy, respectively, the third to C1 and C4, the fourth to C2 and C3, shifts of contacts expressed in time degrees. The coefficients ("coef") represent estimated corrections to these parameters, and their estimated standard errors ("sdev"). Time is measured in centuries since -325. Note that all corrections are smaller than their estimated standard errors. For the 3rd and 4th variable, the suggested corrections of $-0.15^\circ = -0.6$ minutes and $-0.32^\circ = -1.3$ minutes imply that shadows of +5.4% and -4.3% should give a slightly, but not significantly, better fit than the values 6% and -3% assumed in the computations.
- (2) Note the relatively high negative correlation (-0.4) between the estimates of the first and the third variable, i.e. between ΔT and C1.
- (3) Values of the input coefficients of ΔT , re-expressed for the epoch -325.
- (4) Estimated improved values for those coefficients, and their estimated standard errors.

- (5) Same as (3), but expressed in minutes and ms, respectively.
 (6) Same as (4), but expressed in minutes and ms, respectively.
 (7) The observations were sorted according to the range of absolute calculated values into groups of approximately equal size. The listed values of calc and obs are group means. The bias is the mean difference between obs and calc; the column %bias expresses this as a percentage of calc. The final three columns concern random errors: sdv is the standard deviation of the (obs-calc) values, expressed also as a percentage of the mean calculated values (%sdv). The final column sdv/s gives the standard deviation of the scaled differences (obs-calc)/ σ ; these values should fluctuate around 1, if the formula for σ is correct. Note that the standard error of the percentage bias (%bias) can be estimated as %sdv/ \sqrt{n} . For example, the percentual bias of the n=27 intervals to sunrise is -3.81%, and is affected by an estimated standard error of $-20.04/\sqrt{27} = 3.86$ percentage points. For the overall bias of -1.96% with n=154 the estimated standard error of the bias amounts to 1.5 percentage points, for the smaller partial ranges typically to about 4 percentage points. — The bias figures for the phases might indicate an asymmetry of approximately ± 2 minutes between the observed durations of onset and clearing, but this discrepancy is well within statistical uncertainty.

Since short and long intervals may show a different behavior with respect to systematic errors, and since short intervals might be less affected by them than large ones, the analysis was repeated, splitting the observations according to the length of the calculated intervals.

(i) Calculated intervals < 20°:

```
Regress on all but MR, SS, SR, MS:
regress/const=n/prompt=n (w*x1(*,1 2 4:5)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom: 63 - 4 = 59
sigma      = 0.90501
condition  = 2.6937

var       coef        sdev
 1       -21.362     142.83
 2       -51.898     77.499
 3        0.62645    0.51042
 4       0.075046   0.44611

Weighted center of dates:          -334.05

Coefficients for -325:
ccoefs    DT=241.20 minutes           LOD=-40.034 ms
nccoefs   DT=240.84, SE=2.3804 minutes LOD=-41.455, SE=2.1218 ms

##### check biases and weights:
type      range      n  calc    obs  bias  %bias    sdv  %sdv  sdv/s
overall   0.: 20.   63  14.13  14.67  0.54  3.79   3.05  21.62  0.89
SS        5.: 17.   12  10.36  11.08  0.72  6.96   3.03  29.28  0.92
SR        0.: 14.   10   8.64   9.60  0.96 11.11   3.38  39.08  1.10
onset     16.: 19.   15  18.24  18.87  0.63  3.44   3.31  18.16  0.88
totality  4.: 20.    9  15.40  15.56  0.16  1.01   2.58  16.72  0.72
clearing  16.: 19.   12  18.09  19.00  0.91  5.04   2.85  15.78  0.75
```

(ii) Calculated intervals > 20°:

```
Regress on all but MR, SS, SR, MS:
regress/const=n/prompt=n (w*x1(*,1 2 4:5)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom: 91 - 4 = 87
sigma      = 1.0207
condition  = 1.7025

var       coef        sdev
 1       -67.390    258.08
 2        111.07   118.60
 3       -0.85419   0.59713
 4       -0.58695   0.62260

Weighted center of dates:          -299.58

Coefficients for -325:
ccoefs    DT=241.20 minutes           LOD=-40.034 ms
nccoefs   DT=240.08, SE=4.3013 minutes LOD=-36.993, SE=3.2471 ms
```

```
#####
# check biases and weights: #####
type    range    n   calc   obs  bias %bias   sdev %sdev sdev/s
overall 20.:108.  91  45.29  43.84 -1.45 -3.21  7.14  15.76  1.00
overall 20.: 25.   19  23.01  21.21 -1.79 -7.80  3.75  16.28  0.90
overall 26.: 37.   19  30.77  28.68 -2.08 -6.77  6.54  21.25  1.31
overall 38.: 50.   19  43.41  42.42 -0.99 -2.29  6.27  14.45  0.91
overall 50.: 61.   19  54.91  54.68 -0.22 -0.41  7.89  14.36  0.95
overall 63.:108.   15  82.09  79.73 -2.36 -2.87 10.95 13.33  0.91
SS      20.:108.   37  57.82  57.46 -0.36 -0.62  9.12  15.78  1.07
SS      20.: 55.    19  41.16  41.21  0.06  0.13  6.74  16.38  1.11
SS      55.:108.   18  75.41  74.61 -0.80 -1.06 11.30 14.99  1.06
SR      25.: 98.    17  44.27  41.82 -2.44 -5.52  7.22  16.30  1.16
onset   20.: 26.    5   23.22  19.60 -3.62 -15.59  1.78  7.66  0.40
totality 20.: 25.   11  23.21  21.27 -1.94 -8.34  4.14  17.83  0.99
clearing 23.: 23.    1   23.25  21.00 -2.25 -9.68
duration 23.: 61.   20  41.73  39.95 -1.78 -4.27  5.03  12.05  0.80
-----
```

The results for ΔT and LOD at the central epoch -325 are remarkably stable. Not unexpectedly, the parameter estimates based on the short intervals are almost as accurate in terms of their estimated standard errors as those based on the full set. In the two separate regressions, most of the suggested parameter shifts stay below their estimated standard errors. The largest among them concern shadow radii: the short intervals suggest that we should increase the Earth's shadow for C1 and C4 by 8% (instead of 6%), while the (less reliable) long intervals would suggest only about 3%; but neither change is statistically significant. The most interesting finding is that the short intervals exhibit a pattern of positive bias (+3.8% overall, with a standard error of 2.7%), the large intervals a pattern of negative bias (-3.2% overall, with a standard error of 1.7%).

An analogous split into early and late observations (before and after the central epoch of -325) yielded the following results.

(iii) Before -325:

```
-----
Regress on all but MR, SS, SR, MS:
regress/const=n/prompt=n (w*x1(*,1 2 4:5)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom:     81 - 4 = 77
sigma     = 0.99594
condition = 2.4147

var       coef      sdev
 1        -35.260   176.19
 2         198.77   157.60
 3         .22906   .53465
 4        -.22914   .54860

Weighted center of dates:          -457.08

Coefficients for -457:
ccoeffs   DT=274.31 minutes           LOD=-42.383 ms
nccoeffs  DT=273.73, SE=2.9364 minutes LOD=-36.941, SE=4.3148 ms

#####
# check biases and weights: #####
type    range    n   calc   obs  bias %bias   sdev %sdev sdev/s
overall 4.:108.   81  33.54  34.11  0.57  1.69  5.92  17.66  0.98
overall 4.: 16.    17  10.74  11.82  1.09  10.11  3.60  33.52  1.09
overall 16.: 19.   17  17.95  19.53  1.58  8.82  2.72  15.15  0.72
overall 19.: 34.   17  25.18  25.12 -0.06 -0.26  5.58  22.16  1.25
overall 36.: 54.   17  45.43  44.76 -0.67 -1.47  5.77  12.71  0.82
overall 54.:108.   13  79.15  80.15  1.00  1.26 10.77 13.61  0.91
SS      6.:108.    28  51.56  53.18  1.62  3.13  7.74  15.00  0.90
SS      6.: 52.    14  25.84  28.00  2.16  8.35  4.06  15.70  0.91
SS      53.:108.   14  77.28  78.36  1.07  1.39 10.35 13.40  0.88
SR      4.: 52.    13  25.74  26.85  1.10  4.29  5.62  21.83  1.00
onset   16.: 24.    11  18.55  18.73  0.18  0.98  3.88  20.93  1.02
totality 17.: 25.    9   20.70  20.22 -0.48 -2.31  4.86  23.49  1.19
clearing 16.: 19.    7   17.79  19.57  1.79  10.04  2.26  12.73  0.59
duration 23.: 54.   10  38.76  37.30 -1.46 -3.77  5.54  14.30  0.89
-----
```

(iv) After -325:

```
-----
Regress on all but MR, SS, SR, MS:
regress/const=n/prompt=n (w*x1(*,1 2 4:5)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom:    73 - 4 = 69
sigma      =      0.94636
condition  =      2.4019

var       coef        sdev
 1        171.89      198.93
 2        -483.33     229.87
 3        -.83714     .58938
 4        -.42349     .49261

Weighted center of dates:          -172.52

Coefficients for -172:
ccoeffs   DT=205.18 minutes           LOD=-37.311 ms
nccoeffs  DT=208.05, SE=3.3155 minutes LOD=-50.544, SE=6.2936 ms

#####
# check biases and weights: #####
type      range    n   calc   obs   bias  %bias    sdv   %sdv   sdv/s
overall   0.: 98.  73  31.43  29.45 -1.98 -6.29   5.59  17.80   0.90
overall   0.: 18.  19  11.11  11.00 -0.11 -0.97   2.88  25.96   0.87
overall   19.: 25.  19  21.62  19.63 -1.99 -9.21   2.10  9.70   0.51
overall   26.: 50.  19  36.19  33.58 -2.61 -7.21   6.49  17.93   1.14
overall   50.: 98.  16  61.55  58.13 -3.42 -5.56   8.79  14.28   0.95

SS        5.: 69.  21  39.04  36.67 -2.38 -6.09   8.06  20.65   1.05
SS        5.: 37.  11  20.80  18.18 -2.61 -12.57  4.30  20.69   0.83
SS        49.: 69.  10  59.12  57.00 -2.12 -3.58  11.12  18.82   1.27

SR        0.: 98.  14  36.02  32.71 -3.31 -9.18   6.19  17.19   1.13

onset    18.: 26.   9  20.63  19.44 -1.19 -5.76   3.04  14.73   0.74
totality 4.: 25.  11  18.87  17.45 -1.42 -7.51   2.29  12.12   0.61
clearing 18.: 23.   6  19.30  18.67 -0.63 -3.28   3.14  16.25   0.82
duration 27.: 61.  10  44.70  42.60 -2.10 -4.70   4.73  10.59   0.73
-----
```

Also here, most of the parameter changes suggested by the separate regressions stay below their estimated standard errors. The two split segments may be too short to provide meaningful separate estimates of the slopes (variable 2), and we better ignore the estimated LOD-values. In the later segment, the estimated value (208.05 min) of ΔT for the year -172 lies 3 minutes above the value (205.18 min) computed from ST82f. While the change is not significant, it points in the direction tentatively discussed in connection with Figure 8 in Section 2.9. — For all practical purposes, the accuracy of the observations is the same in both segments; the values of the overall scaled standard deviations sdv/s are just a shade lower in the later segment (0.90 versus 0.98). The pattern of the biases, however, is intriguing: with the earlier observations, they are mildly positive (overall +1.7%, with standard error 2.0%), with the later ones, they are consistently negative (overall -6.3%, with standard error 2.1%). This may reflect a change in the measuring equipment, apparently for the worse.

2.12 Supplement: Fitting of Solar eclipses

The following pages of computer output are documenting the comprehensive least squares fitting process for the timed solar eclipses. In particular, they show which time measurements entered into it. The header lists the parameters (they correspond to ST82f). There are four lines of output for each eclipse. The first two are extracted from a table of eclipses calculated with the parameters listed in the header. UT(mid)LT gives universal and true local time of mid-eclipse, Alt_m is the corresponding altitude above the horizon, while C₁, Alt₁, C₄ and Alt₄ give local times and altitudes for the first and last contacts. The third line is the input to the program: the date, and one or more observed time differences (in time degrees), taken from the Babylonian records. The fourth lists the corresponding calculated values (in time degrees). The list is followed by details of the least squares fit.

```
***** SOLAR ECLIPSES (Ver. 1.10) *****
Longitude= 44.4200, Latitude= 32.5500
Alternate Delta T, with coeffs 1800 -1925.00 -81.00 32.50
Diameter .0 %, horiz.refr. 56.
-----
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
ARTX2 35U XII -368APR11 3.60 6.54 .41 .328 .018 0 10.2 5.62* -1.3 7.55 23.0 5.63 18.38
-368.0411 tm-sr=6 mag=1/3
13.650 0.41000
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
ARTX3 1 XI -356FEB29 11.40 14.10 .89 -.070 -.015 0 38.4 12.85 46.3 15.26 27.3 6.32 17.69
-356.0229 t1-ss=-76
-72.600
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
PILIP 1 VI -322OCT07 13.88 16.99 .60 -.213 .016 0 10.6 15.83 24.6 18.04* -2.5 6.06 17.93
-322.1007 tm-ss=-9 t4-ss>0
-14.100 1.6500
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
PILIP 2A VI -321SEP26 15.41 18.47* .17 .471 .026 0 -5.6 17.82 2.6 19.09*-13.4 5.89 18.12
-321.0926 t1-ss=-3
-4.5000
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
S.E. 30 X -280JAN30 4.33 7.01 .20 .446 .016 0 1.9 6.26* -6.8 7.82 11.1 6.74 17.26
-280.0130 t1-sr<0 tm-sr=6 t4-sr=20
-7.2000 4.0500 16.200
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
S.E. 56U VI -255SEP16 7.90 10.92 .72 .157 -.014 0 58.1 9.64 46.6 12.26 61.6 5.72 18.28
-255.0916 t4-t1=32
39.300
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
S.E. 57 X -253JAN31 10.90 13.57 .25 -.415 .008 0 34.3 12.49 38.5 14.57 27.1 6.73 17.28
-253.0131 t1-ss=-56 tm-t1=12 t4-tm=11
-71.850 16.200 15
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
S.E. 63 I -248MAY04 9.72 12.77 .80 .121 -.019 0 69.3 11.47 70.8 14.07 56.6 5.26 18.75
-248.0504 t1-sr=90 mag=2/3
93.150 0.80000
Babyl.Date Jul.Date UT(mid)LT Magn Delta Umbra Dur Altm C1 Alt1 C4 Alt4 SR SS
S.E. 71 VIII -240NOV28 12.82 15.92 .37 -.354 .028 0 12.5 14.67 24.2 17.00 .6 6.84 17.15
-240.1128 t4-t1=30
34.950
Following eclipse not found in list:
-226.0303 t1-sr=10?
```

Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 109 I	-202MAY06	15.06	18.13	.41	-.320	.001	0	6.6	17.26	17.3	18.92*	-3.0	5.22	18.78
-202.0506	tm-tl=14		13.050											
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 117 II	-194JUN06	7.20	10.27	.19	.434	-.018	0	64.8	9.55	55.9	11.03	73.5	4.88	19.12
-194.0606	t1-sr=60	mag=4/12		70.050		0.19000								
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 121A XII	-189MAR14	6.67	9.43	.77	-.129	-.009	0	38.3	8.25	25.4	10.71	49.1	6.08	17.92
-189.0314	tm-tl=15	t4-tm=15	mag=1/3		17.700	19.200	0.77000							
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 142A IV	-169JUL28	15.54	18.45	.43	.310	-.002	0	5.3	17.68	14.6	19.17*	-3.1	4.99	19.01
-169.0728	t1-ss=-20	tm-tl=12	mag=1/3		-19.950	11.550	0.43000							
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 146 I	-165MAY17	8.01	11.10	.56	.239	.012	0	71.3	9.56	54.2	12.76	72.5	5.09	18.92
-165.0517	tm-tl=13	mag=1/3		23.100		0.56000								
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 175A XII2	-135APR15	5.51	8.48	1.05	.002	-.013	199	35.8	7.41	22.3	9.66	49.6	5.54	18.47
-135.0415	t1-sr=24	tm-tl=18	t4-tm=17	mag=1		28.050	16.050	17.700	1.0500					
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 178A V	-133AUG19	4.02	6.94	.10	-.489	-.004	0	19.4	6.46	13.3	7.45	25.8	5.27	18.72
-133.0819	t1-sr=48		17.850											
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 178A XI	-132FEB13	12.62	15.28	.88	.053	.017	0	23.5	13.84	36.1	16.55	9.7	6.54	17.47
-132.0213	t1-ss=-51	tm-tl=20	t4-tm=18	mag=2/3		-54.450	21.600	19.050	0.88000					
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 186A VI	-125SEP19	7.13	10.17	.44	.309	.015	0	50.9	8.86	37.0	11.60	60.0	5.77	18.22
-125.0919	t4-tl=35		41.100											
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 187 V	-124SEP07	16.24	19.23*	.98	.008	.004	0	-11.4	18.32*	-.1	20.08*-21.5	5.60	18.41	
-124.0907	t1-ss>0		-1.3500											
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 200 II	-111JUN18	2.04	5.07	.57	.230	.018	0	1.6	4.19*	-8.0	6.03	12.7	4.82	19.18
-111.0618	t4-tm=8		14.400											
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 223 VI	-88SEP29	6.28	9.37	.36	-.348	-.000	0	39.6	8.34	28.1	10.49	49.9	5.96	18.03
-88.0929	t1-sr=45	t4-tl=24		35.700		32.250								
Babyl.Date	Jul.Date	UT(mid)LT	Magn	Delta	Umbra	Dur	Altm	C1	Alt1	C4	Alt4	SR	SS	
S.E. 302 III	-9JUN30	11.44	14.43	1.07	-.010	-.019	280	56.8	13.05	73.4	15.66	41.2	4.81	19.19
-9.0630	t1-ss=-90	tm-tl=24	t4-tm=24		-92.100	20.700	18.450							

```

-----
Gross errors: abs(obs-calc)*w >= 2.9
-133AUG19
-----
Weights:
w=1/sqrt(3**2 + (0.15*ycalc1)**2)
Bias correction (obs/biascorr):           1
Shift of contacts: 0 minutes
-----
Regress on DT and T1+T4:
regress/const=n/prompt=n (w*xl(*,1 4)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom: 32 - 2 = 30
sigma      = 0.97784
condition = 1.6243
-----
var       coef        sdev          (1)
1        -92.685    310.61
2       -1.6475    0.77989
Correlation matrix:
1.00000  -0.20773
-0.20773   1
-----
Weighted center of dates:      -198.22
coefs      1800     -1925      -81      32.500
ncoefs     1800     -2017.7    -81      32.500
ccoeffs     -200     12695     -1381     32.500
nccoeffs    -200     12602.3    -1381     32.500
SE          310.61
ccoeffs    DT=211.58 minutes
nccoeffs   DT=210.04, SE=5.1768 minutes
-----
##### check biases and weights: #####
type      range      n calc   obs bias %bias   sdv %sdv   sdv/s
overall   4.: 93.    32 30.68 28.06 -2.62 -8.53  5.12 16.70  0.94
SR+SS     4.: 93.    14 42.17 39.71 -2.46 -5.83  6.28 14.90  0.99
Phases    12.: 41.   18 21.74 19.00 -2.74 -12.61 4.20 19.32  0.91
SR        4.: 93.    7  37.26 35.86 -1.41 -3.78  6.79 18.22  1.26
SS        5.: 92.    7  47.08 43.57 -3.51 -7.45  6.07 12.90  0.67
onset     12.: 23.   8  17.49 16.00 -1.49 -8.54  4.27 24.39  0.98
clearing   14.: 19.   6  17.30 15.50 -1.80 -10.40 4.18 24.19  1.07
duration  32.: 41.   4  36.90 30.25 -6.65 -18.02 1.43  3.89  0.28
-----
```

(2)

Notes:

- (1) The first variable refers to ΔT , the second to shifts in the contacts. The results for the first variable suggest to decrease ΔT by 93 seconds = 1.5 minutes (with a standard error of 311 seconds = 5 minutes), those for the second variable suggest to delay the first and to advance the last contact by 1.64° = 6.6 minutes (with a standard error of 3.1 minutes, thus only the latter change is statistically significant).
- (2) See the lunar eclipses for an explanation of this table; the sample sizes n of the last 5 rows are too small for reliable results. The phase durations show a large, highly significant bias exceeding -12% (with an estimated standard error of about 4.5 percentage points). Also all other timings have a negative bias.

To compensate these bias features, all observed times were inflated by 5%, and the first and the last calculated contacts were delayed, respectively advanced by 6 minutes. This gave the following results:

```
-----
Weights:
w=1/sqrt(3**2 + (0.15*ycalc1)**2)
Bias correction (obs/biascorr):      0.95000
Shift of contacts: 6 minutes

-----
Regress on DT and T1+T4:
regress/const=n/prompt=n (w*x1(*,1 4)) (w*y1) > resw2 coef2 sd:sd2 cm:cm
degrees of freedom:   32 - 2 = 30
sigma     =      1.0494
condition =      1.5751

var       coef        sdev
1        -105.95    330.10
2        -0.19039   0.80344
Correlation matrix:
1.00000  -0.19738
-0.19738  1.00000

Weighted center of dates:      -196.76
coefs      1800      -1925      -81      32.500
ncoefs     1800      -2030.9    -81      32.500

ccoeffs     -200      12695     -1381     32.500
nccoeffs    -200      12589.1   -1381     32.500
SE          330.10

ccoeffs    DT=211.58 minutes
nccoeffs   DT=209.82, SE=5.5017 minutes

##### check biases and weights: #####
type      range      n calc   obs  bias %bias   sdv  %sdv  sdv/s
overall   3.: 95.    32 29.51 29.54  0.03  0.11  5.12 17.36  1.00
SR+SS     3.: 95.    14 41.85 41.80 -0.05 -0.11  6.48 15.49  1.08
Phases    10.: 38.   18 19.91 20.00  0.09  0.46  3.96 19.89  0.97
SR        4.: 95.    7  37.91 37.74 -0.16 -0.43  6.97 18.38  1.37
SS        3.: 91.    7  45.79 45.86  0.07  0.16  6.52 14.24  0.80
onset     10.: 22.   8  15.99 16.84  0.85  5.30  4.39 27.48  1.07
clearing   13.: 18.   6  15.80 16.32  0.52  3.26  4.47 28.27  1.17
duration   29.: 38.   4  33.90 31.84 -2.06 -6.07  1.58  4.67  0.30
-----
```

Notes:

- (3) The decrease in ΔT remains about the same (106 seconds = 1.8 minutes), but the shift of the contact times is decreased to 0.19° = 0.8 minutes and is no longer significant.
- (4) The biases are no longer significant.

Similar results (not shown here) are obtained if, instead of shifting the times of the contacts by 6 minutes, we assume that the visual beginning and end of the eclipses occur at a magnitude of 0.06.

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4 Transliterations and Translations of Eclipse Reports

The majority of the transliterations and translations given below had been prepared prior to, and independently from, the Sachs-Hunger edition of the diaries (Vols. 1-3) and eclipse texts (Vol. 5). The last-mentioned volume appeared when our manuscript already was in the proof-reading stage, but we tried to take it into account as far as feasible. In particular, we have taken advantage of the Sachs-Hunger edition to extend the coverage and to check our transliterations and translations. While we have streamlined the text to a certain extent, we have not attempted to achieve full consistency, neither internally (e.g. by rendering identical phrases identically), nor externally (e.g. by harmonizing column and line counts with those of Sachs-Hunger). Differences of reading or interpretation against Sachs-Hunger are usually, but not always, mentioned in the comments; in the case of doubtful readings, marked by question marks, we have felt free to disagree without further notice. We believe that most of the remaining inconsistencies in the transliterations and translations are minor and irrelevant, and we hope that not too many unintended ones have slipped through.

Addendum (December 2003).

Hermann Hunger provided us with improved readings of the Goal Year text LBAT 1304, affecting the dates of the supposedly latest lunar and second-but-latest solar eclipses in our corpus.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 92 XII	-218MAR20	.66	2.80	175.3	1.81	3.21	3.82	5.21	1.11	85	311	17.45	18.01	5.98	6.14
S.E. 111 XII	-199MAR19	23.09	2.80	175.6	23.96	1.16	2.49	3.68	1.39	122	274	17.56	18.01	5.98	6.22
S.E. 121A XII	-189FEB28	2.85	2.70	155.8	3.76	5.49	5.75	7.47*	1.05	142	274	17.08	17.68	6.31	6.47
S.E. 176 XII	-134MAR21	.56	2.81	176.9	1.28	2.51	4.11	5.34	1.57	112	307	17.56	18.04	5.96	6.11
S.E. 270A XII	-40MAR02	3.14	2.71	159.6	3.89	5.02	6.58*	7.72*	1.63	111	305	17.09	17.74	6.25	6.37

LBAT 1304, Rev. 3'ff.

3' še ge₆ 15 7,40 me [x x]

4' sin an-mi id ulù u[?] kur[?]

5' ki-i tab-ú ina 20+x ge₆

6' gab-bi-šú šú in 1 x

7' ge₆ ana zalág

3' Month XII 15 7°;40 ME [...]

4' Lunar eclipse, beginning on the south east(?)

5' side. After 20+x° of night

6' in its totality covered. At 1,x°

7' before sunrise

Comments. We had thought this to be the latest lunar eclipse in our corpus (-40MAR02), therefore its date deserves an extensive discussion on the basis of the new evidence. There never was any doubt that the eclipse must have begun after midnight (or at least not more than about an hour before), since it is timed relative to sunrise; the time to sunrise is illegible in the LBAT copy. It occurred in month XII, was total, and the beginning of totality was visible. Among eclipses occurring in Seleucid times, these conditions are satisfied by the five listed above. The eclipse of -218 can be eliminated, its entrance angle is east, certainly not south or south-east. Since the text does not give any other time intervals beyond the time to totality, one is tempted to infer that the other intervals were not available, i.e. that the moon set during totality. This leaves -40MAR02, agreeing with the date given in LBAT. But according to Hunger's new reading, the problematic traces at the end of line 6' seem to contain the numbers 1,5° or even 1,15°. Thus, the eclipse would have begun 4.33 or 5 hours before sunrise (with 2σ limits of approximately ±1.3h). If we accept that, the most plausible candidate is the eclipse of -134MAR21, with SR-C1 = 5.96-1.28 = 4.68h. Also the time 7;40° = 0.51h from moonrise to sunset fits excellently with calculation (18.04-17.56 = 0.48h), contrary to -40MAR02 (17.74-17.09 = 0.65h, outside of 2σ limits of approximately ±0.12h). But the traces of Lunar Sixes for month IV in Col. II do not fit either date; only the second of the above five eclipses gives an acceptable match. The other times fit slightly worse than for -134MAR21, but still within statistical uncertainty. Thus, we accept -199MAR19. Then, also the date of the preceding solar eclipse possibility in LBAT 1304 ought to be changed, namely from -40FEB15 to -199MAR04 (invisible in Babylon).

4.1. List of Eclipses

The following lists give an overview of the types and sources of the eclipse reports. In addition to eclipse observations in the proper sense we have included also all “passing” eclipses (i.e. eclipse predictions) so far as they occur in Babylonian observational texts. Eclipses that can be found in volumes 1 to 3 of the Sachs-Hunger edition of the diaries are cross-referenced by SH(volume),(page); those that have been edited by Hunger in volume 5 are cross-referenced by H5,(page). The latter appeared when our manuscript was in its final stages and could not be utilized fully. If an LBAT number is given in the “Diary” or “Eclipse text” column, the text as a rule had been included already in the 1973 manuscript, but there may be additions due to joins and improved readings. Goal Year texts and eclipse texts were read from Pinches’ copies in LBAT and sometimes from photographs; in addition, we have been able to use Hunger’s transliterations of eclipse texts prior to their publication in volume 5.

Explanation of symbols occurring in the following list of eclipses:

prediction	+ :	eclipse possibility, to be watched
	- :	negative prediction (“passing eclipse”); presumably no need to watch
observation	+ :	watched, eclipse seen
	- :	watched, eclipse not seen

In the Comments column, a Z indicates that there is a timing by the culmination of a *ziqpu*-star. In parentheses, the section(s) are indicated, where a particular eclipse has been mentioned or discussed.

Lunar eclipses	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text: LBAT-Number or Hunger H5,(page)	Comments
1	-746 Feb. 6		+			1413; H5,3	date?
2	-746 Aug. 2		+			1413; H5,3	date?
3	-745 Jan. 26		+			1413; H5,3	date?
4	-745 July 22		+			1413; H5,3	date?
5	-744 Jan. 15	-				1413; H5,3	date?
6	-744 July 10	-				1413; H5,3	date?
7	-730 Apr. 9	-				*1414; H5,3	
8	-712 Apr. 19		+			*1414; H5,5	wrongly filed?
9	-702 Sep. 23	-?				1415; H5,9	
10	-701 Mar. 20		+			1415; H5,9	
11	-694 May 1		+			*1414; H5,5	
12	-685 Apr. 21		+			1417; H5,9	
13	-685 Oct. 15	-				1416; H5,9	at sunrise, visibility?
14	-684 Oct. 3		+			1415; H5,9	
15	-683 Mar. 30	-				1415; H5,9	
16	-676 May 11	-?				*1414; H5,5	
17	-667 May 2	-				1417; H5,11	
18	-667 Oct. 25	-				1416; H5,11	
19	-666 Oct. 15		+			1415; H5,11	
20	-665 Apr. 10		+			1415; H5,11	
21	-658 May 22		+			*1414; H5,5	
22	-651 July 2	-?		SH1,43			
23	-651 Dec. 27	-?		SH1,45			
24	-649 May 13	-				1417; H5,11	
25	-649 Nov. 5		+			1416; H5,11	
26	-631 May 23		+			1417; H5,11	
27	-611 Nov. 5		+			H5,23	
28	-609 Sep. 15		+			H5,23	
29	-608 Sep. 3		+			*1419; H5,17	
30	-605 Jan. 8		+			H5,25	
31	-603 June 12	-				*1420; H5,27	
32	-603 Dec. 6	-				*1420; H5,27	
33	-602 May 3	-				*1420; H5,27	
34	-602 Oct. 27		+			*1420; H5,27	
35	-601 Apr. 22	-				*1420; H5,27	
36	-601 Oct. 17	-				*1420; H5,27	
37	-600 Apr. 10		+			*1420; H5,27	
38	-600 Oct. 5	-				*1420; H5,27	
39	-599 Mar. 31	-				*1420; H5,27	
40	-599 Sep. 24	-				*1420; H5,27	
41	-598 Feb. 19		+			*1420; H5,27	
42	-594 June 3		+?			*1420; H5,27	
43	-594 Nov. 27		+			*1420; H5,27	
44	-593 May 23		+			*1420; H5,27	
45	-593 Nov. 17	-				*1420; H5,27	
46	-592 May 11	-				*1420; H5,29	
47	-592 Nov. 5	-				*1420; H5,29	
48	-591 Apr. 1		+			*1420; H5,29	
49	-591 Sep. 26	-				*1420; H5,29	
50	-590 Mar. 22		+			*1420; H5,29	
51	-590 Sep. 15	-				*1420; H5,29 *1419; H5,17	
52	-589 Mar. 12	-				*1420; H5,29; *1419; H5,17	
53	-589 Sep. 4	-				*1420; H5,29	

Lunar eclipses	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text: LBAT-Number or Hunger H5,(page)	Comments
54	-588 Feb. 29	-				*1420; H5,29	
55	-588 July 25	-				*1420; H5,29	
56	-587 Jan. 19		+			*1420; H5,29	
57	-587 July 15	-				*1420; H5,29	
58	-586 Jan. 8		+			*1420; H5,29	
59	-579 Feb. 19		+?			*1420; H5,29	
60	-579 Aug. 14		+?			*1420; H5,29	
61	-578 Feb. 8		+?			*1420; H5,29	
62	-578 Aug. 4	-				*1420; H5,29	
63	-577 Jan. 28	-				*1420; H5,29	
64	-577 June 25	-				*1420; H5,29	
65	-577 Dec. 19	-				*1420; H5,29	
66	-576 June 14		+			*1420; H5,29	
67	-576 Dec. 7		+			*1420; H5,29	
68	-575 June 3		+			*1420; H5,29	
69	-575 Nov. 27		?			*1420; H5,29	
70	-572 Apr. 1		+			*1419; H5,17	
71	-572 Sep. 25	-				*1419; H5,17	
72	-571 Mar. 22		?			*1419; H5,19	
73	-567 July 4	-	SH1,49				
74	-562 Sep. 5		+			1421; H5,31	
75	-561 Mar. 2		+			1421; H5,31	
76	-554 Oct. 6		+			*1419; H5,19	(2.3)
77	-553 Apr. 2		?			*1419; H5,19	
78	-536 Apr. 23		+			*1419; H5,19	
79	-536 Oct. 17		+			*1419; H5,19	
80	-528 May 24	-?				H5,33	date?
81	-528 Nov. 17		+			H5,33	date?
82	-527 Nov. 6	-?				H5,33	date?
83	-526 April 4	-				H5,33	
84	-526 Sept. 27	-				H5,33	
85	-525 March 24	-				H5,33	
86	-525 Sept. 16		+			H5,33	
87	-522 July 16	+					Strm. Kamb. 400; H5,171
88	-521 Jan. 10	+					Strm. Kamb. 400; H5,171
89	-518 Oct. 28		+?			*1419; H5,19	visibility?
90	-500 Nov. 7		+			*1419; H5,19	(2.3)
91	-482 Nov. 19		+			*1419; H5,21	
92	-464 June 5		+			*1419; H5,21	
93	-464 Nov. 29		+			*1419; H5,21	
94	-446 Dec. 10		?			*1419; H5,21	
95	-441 Mar. 25		+			1426; H5,35	
96	-441 Sep. 18					1426; H5,35	
97	-440 Mar. 13	-				1426; H5,35	
98	-439 Feb. 2		+			1426; H5,37	
99	-439 July 28	-				1426; H5,37	
100	-424 Apr. 14		+			1427; H5,37	
101	-423 Sep. 28		+			1426; H5,37	
102	-422 Mar. 25	-				1426; H5,37	
103	-422 Aug. 19	-				1426; H5,37	
104	-421 Feb. 13	-				1426; H5,37	
105	-421 Aug. 8	-				1426; H5,37	
106	-420 Feb. 2		+			1426; H5,37	
107	-414 Mar. 26	-				1416; H5,11	
108	-414 Sep. 19		+			1416; H5,11	penumbral (2.3)
109	-413 Mar. 16		+?			1415; H5,13	

Lunar eclipses	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text: LBAT-Number or Hunger H5,(page)	Comments
110	-409 June 28	-?				1427; H5,35	
111	-409 Dec. 21		+			1427; H5,35	
112	-408 June 16		+			1427; H5,35	(2.9)
113	-408 Dec. 10	-				1427; H5,35	
114	-407 May 7	-				1427; H5,35	
115	-407 Oct. 31		+			1427; H5,35	
116	-406 Apr. 26	-				1427; H5,37	
117	-406 Oct. 21		+			1427; H5,37	(2.6)
118	-405 Apr. 15		+			1427; H5,37	
119	-405 Oct. 10		+			1427; H5,37	
120	-396 Apr. 5		+			1416; H5,13	
121	-396 Sep. 29	-?	?			1416; H5,13	penumbral (2.3)
122	-395 Mar. 26	-				1415; H5,13	
123	-395 Sep. 18		+			1415; H5,13	
124	-388 Oct. 31	-				*1414; H5,5	
125	-382 June 29	-		SH1,75			
126	-382 Dec. 23	-?				*1429; H5,39	
127	-381 June 18		+			*1429; H5,39	
128	-381 Dec. 12		+			*1429; H5,39	
129	-379 Nov. 20	-?				1416; H5,13	
130	-378 Apr. 17		+			1416; H5,13	penumbral (2.3)
131	-378 Oct. 11	-				1416; H5,15	
132	-377 Apr. 6		+			1415; H5,15	(2.3)
133	-374 Feb. 3		+	SH1,97			
134	-370 May 17		+			*1414; H5,5	
135	-370 Nov. 11		+	181; SH1,123		*1414; H5,5	timing by Jupiter rise (2.3, 2.6)
136	-366 Aug. 30		+	186; SH1,135			
137	-363 Jan. 2		+			*1429; H5,39	
138	-363 June 29		+			*1429; H5,41	
139	-363 Dec. 23		+			*1429; H5,41	
140	-362 June 18		+			*1429; H5,41	
141	-362 Dec. 12		+			*1429; H5,41	
142	-361 June 7	-?				*1429; H5,41	
143	-359 Apr. 17		+			1415; H5,15	
144	-356 Feb. 14	-		SH1,141			
145	-352 May 28	-?				*1414; H5,5	
146	-352 Nov. 22		+			*1414; H5,5	(2.5)
147	-345 Jan. 13		+	SH1,145			
148	-334 Dec. 3	-				*1414; H5,7	
149	-333 May 29		+	SH1,165			
150	-330 Sep. 20		+	SH1,177			
151	-327 Jan. 24	-?				H5,49	
152	-327 July 20	-?				H5,49	
153	-326 Jan. 13		+			H5,49	
154	-326 July 9		+			H5,51	
155	-325 Jan. 3		+			H5,51	
156	-324 May 19	-?		SH1,195			
157	-321 Apr. 17	-		SH1,221			penumbral
158	-316 June 18		+			*1414; H5,7	
159	-316 Dec. 13		+			*1414; H5,7	(2.3)
160	-307 July 9		+	217; SH1,239+243			
161	-304 May 8		+	SH1,243			date?
162	-302 Sep. 11	+	-	SH1,249			penumbral (2.3)
163	-301 Mar. 7	-		SH1,251			
164	-291 Aug. 11	-		222; SH1,273			
165	-286 May 19		+	SH1,289			

Lunar eclipses	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text: LBAT-Number or Hunger H5,(page)	Comments
166	-283 Mar. 17		+?	SH1,303		1452; H5,53	
167	-280 Jan. 16	-		SH1,309+311			
168	-279 Dec. 24	?	?			*1432; H5,55	
169	-278 June 19	+?				*1432; H5,55	
170	-278 Nov. 13	-				*1432; H5,55	
171	-277 May 10	-				*1432; H5,55	
172	-277 Nov. 3	-		SH1,329		*1432; H5,55	
173	-272 Feb. 16		+	SH1,343			
174	-250 Dec. 4		+		1366		
175	-248 Apr. 19	-		SH2,51		**1216	
176	-248 Oct. 13	-				**1216	
177	-247 Oct. 3		+	268; SH2,55			
178	-246 Mar. 29		+	SH2,57			
179	-246 Sep. 22	-		273; SH2,63			
180	-245 Sep. 11	-		SH2,71			
181	-239 Nov. 3		+		**1218		at sunrise (2.9)
182	-238 Apr. 28		+	SH2,85			
183	-232 Dec. 14	-		SH2,109			
184	-230 Apr. 30	-		SH2,119			
185	-225 Feb. 6	-		SH2,137			
186	-225 Aug. 1		+	SH2,141		Z (2.3)	
187	-214 Dec. 25		+	SH2,157		Z (2.3)	
188	-211 Apr. 30		+		**1237		
189	-211 Oct. 24		+		**1237		
190	-202 Nov. 14	-		SH2,213			
191	-194 June 20	-		320; SH2,271	1249		(see also -184 May 30)
192	-194 Nov. 15	-			1249	1436; H5,57	(see also -184 Nov 24)
193	-193 May 11	-				1436; H5,57	
194	-193 Nov. 5		+	324; SH2,279		1436; H5,57	Z
195	-189 Feb. 28		+			1437; H5,61	Z?, just total (2.3)
196	-189 Aug. 23		+		1251		
197	-188 Feb. 17		+		1251		
198	-187 Aug. 1		+			1439; H5,59	Z, penumbral, date? (2.3)
199	-185 Dec. 6	-		SH2,351			
200	-184 May 30		+			1439; H5,59	date?
201	-184 Nov. 24		+	336; SH2,355		1439; H5,59	Z
202	-182 Oct. 4		+	SH2,371			Z
	-177 Jul. 12						(see -187 Aug. 1)
203	-170 Aug. 23		+	SH2,451			
204	-169 Feb. 16	-		SH2,465			
205	-169 Aug. 13	+	-		1263		
206	-168 Jan. 7	-			1263		
207	-162 Mar. 30		+	378,380; SH3,15	1264		Z
208	-162 Sep. 23	-			1264		
209	-161 Feb. 18	-			1264		
210	-161 Aug. 14	-		SH3,37	1266		
211	-160 Feb. 7	-			1266		
212	-159 Jan. 26		+	SH3,41		1436; H5,57	Z
213	-159 July 23	-				1436; H5,57	
214	-158 July 12	-		SH3,47			
215	-158 Dec. 7	-		SH3,53			
216	-156 Nov. 14		+	SH3,65			
217	-153 Mar. 21		+			*1440; H5,63	
218	-149 July 3		+	SH3,85			Z
219	-142 Feb. 17		+		1278		Z
220	-141 Aug. 3	-		SH3,123			

Lunar eclipses	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text: LBAT-Number or Hunger H5,(page)	Comments
221	-140 July 22	-		418; SH3,137			
222	-140 Dec. 17	-		SH3,143			
223	-137 May 22		-	SH3,159			
224	-137 Nov. 15	-?		SH3,167			
225	-136 Oct. 4	-		430			
226	-135 Apr. 1		+	SH3,183	1285	Z	
227	-135 Sep. 24		+		1285	Z	
228	-134 Mar. 21		+	SH3,191	1285	Z	
229	-133 Mar. 10		+	SH3,197			
230	-133 Sep. 3		+	SH3,199			
231	-132 Jan. 29	-		SH3,203			
232	-131 Jan. 17		+	SH3,229			
233	-130 July 2		+	SH3,239			
234	-129 May 23	-		SH3,247			
235	-128 Nov. 5		+		1441; H5,65	Z	
236	-125 Mar. 11	-		SH3,257			
237	-124 Aug. 24		+	SH3,271			
238	-123 Aug. 13		+	SH3,285+289		(2.3)	
239	-122 Aug. 2		+	SH3,295+297		Z	
240	-119 June 1		+	SH3,311	1442; H5,65	Z; not total! (2.3)	
241	-111 July 2	-		463; SH3,341+345			
242	-109 Nov. 5		+	SH3,349			
243	-108 May 1		+	466; SH3,355			
244	-106 Mar. 11	-		SH3,369			
245	-105 Feb. 28		+	SH3,377			
246	-105 Aug. 25		+	SH3,389			
247	-104 Aug. 13		+		**1295	Z	
248	-98 Apr. 11		+	SH3,407			
249	-98 Oct. 5		+	SH3,407			
250	-97 Mar. 31		+	SH3,407			
251	-96 Aug. 14	-?		487; SH3,413			
252	-95 Aug. 3		+	401,492; SH3,425		Z	
253	-93 July 13		+	SH3,429		Z	
254	-90 Nov. 5		+	SH3,433		Z	
255	-88 Sep. 15	-			1334; H5,67		
256	-86 Feb. 28		+	SH3,453	1443; H5,71	Z	
257	-86 Aug. 24	-		SH3,459			
258	-80 Apr. 21		+	SH3,483	1444; H5,71	Z	
259	-79 Apr. 11		+		**1445; H5,73	Z (2.5)	
260	-79 Oct. 5		+		1446; H5,75		
261	-76 Feb. 9	-		516; SH3,503			
262	-75 Jan. 28		+	SH3,505			
263	-72 Nov 16		+	SH3,511			
264	-66 Jan. 19		+		1447f.; H5,75f.		
265	-65 Jan. 8		+		1449; H5,77		
266	-65 Dec. 28		+		*1450; H5,79		
267	-62 May 3	?	?	520; SH3,513			
268	-46 July 4		+	523			date?
269	-40 Mar. 2		+		1304		date: -199MAR19, see p.66

Solar eclipses	Oppolzer Number	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text:	Comments
1	1987	-381 July 3		-	SH1,83			
2	2017	-368 Apr. 11		+	SH1,125			
3	2022	-366 Sep. 14			SH1,135			
4	2043	-356 Feb. 29		+	SH1,141			
5	2067	-345 Jan. 29	-?		SH1,147			
6	2084	-338 Sep. 4		+			H5,45	
7	2098	-332 Oct. 27	-?		SH1,175			
8	2102	-330 Oct. 5	-		SH1,177			
9	2121	-322 Oct. 7		+	SH1,209			
10	2122	-321 Apr. 2			SH1,219			
11	2123	-321 Sep. 26		+	212; SH1,227			at sunset (2.8, 2.9)
12	2160	-304 Apr. 23	-?		SH1,245			
13	2166	-302 Sep. 25	-		SH1,249			
14	2191	-291 Aug. 25		-	SH1,273			
15	2214	-280 Jan. 30		+	SH1,313			
16	2232	-272 Mar. 1	+?		SH1,343			
17	2247	-266 Oct. 17	+		247; SH1,359			
18	2258	-261 Dec. 21			SH1,375			
19	2271	-255 Sep. 16		+	SH2,21			
20	2274	-253 Jan. 31		+	258; SH2,29			
21	2286	-248 May 4		+	267; SH2,51	**1216		
22	2287	-248 Oct. 27	-		SH2,53			
23	2291	-246 Sep. 7		-	SH2,63			
24	2294	-245 Aug. 28	-		SH2,71			
25	2302	-241 June 15		+	276; SH2,77			
26	2305	-240 Nov. 28		+	SH2,79			
27	2310	-239 Oct. 18	-			**1218		
28	2324	-232 Nov. 30		-	SH2,107			
29	2327	-230 May 15	-		SH2,119			
30	2331	-228 Mar. 25	-		SH2,127			
31	2336	-226 Mar. 3		+?	SH2,131			
32	2338	-225 Feb. 20		-	SH2,137			
33	(2339)	-225 Jul. 18	-		SH2,139			
34	2356	-217 Feb. 22			SH2,155			
35	2369	-211 May 15		-		**1237		
36	2376	-209 Sep. 18		-	SH2,187			
37	2391	-202 May 6		+	306; SH2,209			
38	2395	-200 Apr. 13	-		SH2,221			
39	2406	-195 June 16		-	SH2,255			
40	2408	-194 June 6		+	320; SH2,270	1249	(2.8)	
41	2409	-194 Nov. 29	-			1249		
42	2410	-193 May 26	-		SH2,277			
43	2411	-193 Nov. 19		-	324; SH2,281			
44	2420	-189 Mar. 14		+	SH2,315		1438; H5,63	
45	2421	-189 Sep. 7		-		1251		
46	2422	-188 Feb. 2	-			1251		
47	2428	-186 Dec. 31	-		332; SH2,339			weak eclipse (2.8)
48	2444	-179 Aug. 17		+	348; SH2,399			
49	2460	-172 Apr. 4			SH2,433			
50	2468	-169 July 28		+		1263		
51	2469	-168 Jan. 22	-			1263		
52	2477	-165 May 17		+	SH2,487			
53	2480	-164 Oct. 29	-		SH2,497			
54	2484	-162 Mar. 15		-	380; SH3,15			

Solar eclipses	Oppolzer Number	Date	Prediction	Observation	Diary: LBAT-Number or Sachs-Hunger SH(vol),(page)	Goal year text:	Eclipse text:	Comments
55	2485	-162 Sep. 8	-		SH3,27	1264		
56	2486	-161 Mar. 5		-		1264		
57	2487	-161 Aug. 28	-			1266		
58	2498	-156 May 7	-?		SH3,61			
59	2528	-144 Sep. 19		-	SH3,93			
60	2530	-143 Sep. 8	-			1278		
61	2531	-142 Mar. 5		-		1278		
62	2538	-140 Dec. 31	-		SH3,145			
63	2547	-136 Oct. 20		-	430,431; SH3,181			
64	2548	-135 Apr. 15		+	SH3,185	1285		total (2.4, 2.8. 2.9)
65	2549	-135 Oct. 9				1285		
66	2550	-134 Mar. 6		-		1285		
67	2554	-133 Feb. 24			SH3,195			
68	2555	-133 Aug. 19			SH3,199			weak eclipse (2.8)
69	2556	-132 Feb. 13		+	SH3,203			
70	2558	-131 Feb. 1	-		SH3,231			
71	2563	-129 June 7	-		SH3,247			
72	2573	-125 Sep. 19		+	SH3,263			
73	2574	-124 Mar. 15	+	-?	448; SH3,265			
74	2575	-124 Sep. 7		-	SH3,271			at sunset (2.8)
75	2576	-123 Feb. 3		-	SH3,277			weak eclipse
76	2587	-119 May 17		-	SH3,309			
77	2589	-118 May 7	-		SH3,321			
78	2590	-118 Oct. 31	-		SH3,333			
79	2606	-111 June 18		+	462; SH3,341			
80	2617	-106 Mar. 27	-		SH3,371			
81	2635	-99 Oct. 31		-	484; SH3,403			
82	2645	-95 Aug. 19		-	401; SH3,425			
83	2661	-88 Sep. 29		+			1334; H5,69	
84	2665	-86 Feb. 13	-				1435; H5,71	
85	2669	-84 Jan. 23		-	SH3,467			
86	2684	-79 Sep. 20		-	SH3,485			
87	2688	-77 Aug. 30		-	SH3,497			
88	2725	-62 May 18		-	520; SH3,513			weak eclipse (2.8)
89	2779	-40 Feb. 15				1304		-199MAR19!(p.66)
90	2860	-9 June 30		+			1456; H5,79	total; date? (2.9)

4.2. Lunar Eclipse Observations

The reports are ordered chronologically. Texts are quoted by their LBAT-numbers, and cross-references to the Sachs-Hunger edition are given in the form SH(volume),(page) for volumes 1 to 3, and H5,(page) for volume 5. For proper identification, each eclipse or eclipse possibility is preceded by a line of calculated modern data. Since the tables by Neugebauer and Hiller (1934) had proved to be very convenient for working with Babylonian material, we have closely followed their pattern of presentation, but have used more modern programs, based on Stephenson – Morrison – Newcomb. These headers give the following data in this sequence (all times are in hours and decimals):

- Babylonian date: king, year, month. For intercalary years, the type of the intercalary month is indicated by A (second Addaru) or U (second Ululu) after the year.
- Julian date and universal time UT of mid-eclipse (i.e. of the moment when Sun and Moon have opposite longitude).
- Difference LT–UT between true local time LT and universal time UT.
- Geocentric lunar longitude LL at mid-eclipse (= solar longitude + 180°).
- True local times of the four contacts, starred if below the mathematical horizon (for accurate visibility conditions, use MR and MS). For calculating contact times of lunar eclipses, the radius of the Earth's shadow has been modified by 6%, -3%, -3% and 6% for the four contacts, respectively; this is on top of the conventional increase of 2%. See Section 2.3 for details.
- Magnitude (in fractions of the Moon's diameter; ≥ 1 is total; negative if the shadow misses the Moon). For calculating magnitudes, we have stayed with the conventional 2% increase. This convention permits (i) to discriminate between true partial eclipses (magnitudes between 0 and 1) and deep penumbral eclipses observed as partial by the Babylonians (negative magnitudes, but with times for the first and fourth contact), and (ii) among total eclipses to recognize those most likely observed as partial by the Babylonians (magnitudes greater or equal 1, but without times for the second and third contact).
- E and A: entrance and exit angles in degrees (0° north, 90° east, 180° south, 270° west), calculated in the equatorial coordinate system.
- MR, SS, SR, MS: true local times of moonrise, sunset (before the eclipse), sunrise, and moonset (after the eclipse). Setting and rising times were calculated for the upper rim of Sun and Moon, i.e. using a zenith distance of 91°12' for the Sun, plus parallax for the Moon. See Section 2.2 for details.

The calculations behind the headers assume that the Moon's orbital acceleration is $-26''/\text{cy}^2$ and that the difference between Ephemeris Time (ET) and Universal Time (UT) can be represented by

$$(\text{ST82i}) \quad \Delta T = ET - UT = -1740 - 77t + 32.5t^2 \text{ sec}$$

where t is measured in centuries since 1800 AD. (Note that this is based on an intermediate fit which yields values that are 1-2 minutes higher than those of the final fit ST82f.)

For planetary and lunar positions mentioned in the comments, programs based on Bretagnon and Simon (1986), and on Chapront and Chapront (1991) have been used, with the final fit (ST82f) for ΔT , and with a zenith distance of 90°56' for planetary risings and settings. Unless otherwise noted, lunar positions given in the comments are topocentric and calculated for mid-eclipse. All calculations were done for Babylon (44.42°E, 32.55°N).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
	-800JAN05	2.16	2.82	97.1	3.16	4.85	5.24	6.92	1.06	122	256	16.42	17.03	6.97	7.19
	-800JUN30	1.46	3.03	269.0	2.74	3.89	5.16*	6.31*	1.38	70	280	18.68	19.20	4.80	4.93
	-800DEC24	1.73	2.91	85.7	2.60	3.92	5.18	6.50	1.31	78	290	16.48	17.02	6.98	7.18
	-799JUN19	17.25	3.07	258.9	18.53*	—	—	21.94	1.00	116	242	18.97	19.17	4.83	5.35
	-799DEC13	6.59	3.00	74.4	8.56*	—	—	10.22*	.11	24	334	16.38	17.07	6.93	6.92
	-798MAY10	14.12	—	220.5	—	—	—	—	-.85						

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBNSR 0 XII	-746FEB06	1.24	2.65	130.1	2.16	—	—	5.79	.93	139	264	16.74	17.30	6.69	6.91
NBNSR 1U VI	-746AUG02	.62	2.92	300.7	1.92	—	—	5.26*	1.03	46	277	18.65	19.02	4.99	5.17
NBNSR 1U XI	-745JAN26	1.66	2.68	118.9	2.31	3.57	4.98	6.24	1.41	95	301	16.58	17.17	6.82	7.01
NBNSR 2 V	-745JUL22	15.30	2.95	290.4	16.35*	17.56*	18.84*	20.05	1.36	91	240	18.99	19.11	4.89	5.53
NBNSR 2 XI	-744JAN15	8.02	2.74	107.9	9.63*	—	—	11.53*	.17	43	344	16.18	17.08	6.92	6.87
NBNSR 3U V	-744JUL10	23.85	—	280.0	—	—	—	—	-.13						

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ASNSM 6 XII	-692MAR09	22.92	2.72	162.4	.11	—	—	3.39	.67	156	261	17.36	17.79	6.20	6.44
NLUSZ 1U VI	-692SEP03	.77	2.95	333.0	2.25	—	—	5.32	.78	29	277	18.26	18.56	5.45	5.64
NLUSZ 1U XI	-691FEB27	.51	2.68	151.5	1.12	2.31	3.92	5.11	1.62	110	303	17.10	17.61	6.38	6.56
MUSMK 1 V	-691AUG23	14.14	2.92	322.5	15.12*	16.26*	17.83*	18.96	1.64	72	239	18.63	18.72	5.29	5.97
MUSMK 1 XI	-690FEB16	8.57	2.65	140.7	9.86*	—	—	12.22*	.33	63	347	16.50	17.44	6.55	6.50
MUSMK 2U V	-690AUG12	20.92	2.91	311.7	22.61	—	—	.70	.20	127	189	18.58	18.88	5.13	5.49

LBAT 1413 = H5,3

- E. *ina a-mat^den u^dgašan-iá liš-lim*
- 1 1,40 mu-sag nam-lugal la [... ...]
- 2 še 5 itu 14 u₄-zal gar ád šú? [...]
- 3 2,10 mu 1 kin [x]+2[?] gar *ina si šar* [...]
- 4 [...] ulù gin? ád šú kin d[ir]
- 5 [zíz 1]4 gar 1,40 *ana zalág t[il?*, or:tag₄?]
- 6 [mu 2 iz]i 14 til gar
- 7 [zíz] dib
- 8 [mu 3 izi di]b kin dir
- 9 [...] til [...]]
- 10 [...]]

E. Through the word of the Lord and my Lady shall it remain whole.

- 1,40. Accession year of the kingship [...]
- 2 Month XII, 5 months, day 14, morning watch, (an eclipse) occurred, it set(?) eclipsed.
- 3 2,10 Year 1, month VI [1]3(?), [an eclipse] occurred, in the north [...]
- 4 [...] south(wind) blew(?), it set eclipsed. Month VI₂.
- 5 [Month XI 1]4 (an eclipse) occurred, 1,40° before sunrise, total(?, or:remained?).
- 6 [Year 2, month V] 14, a total (eclipse) occurred.
- 7 [Month XI] passed.
- 8 [Year 3, month V, pas]sed. Month VI₂.
- 9 [...] total(?) [...]
- 10 [...]]

Comments. There are difficulties with the reading and interpretation of this poorly preserved fragment. Tentatively, we date it to the beginning of the reign of Nabonassar, but do not exclude a date to the interregnum around -800.

No date between -930 and -310 gives a fully satisfactory agreement; after -310 accession years were no longer used. The rudimentary observations and the somewhat unusual terminology suggest an early date. Astronomically, only -800, -746 and perhaps -692 seem to be compatible, -800 fitting best, but leading to an improbably early date for the beginning of the year. -747/6 is in fact the accession year of Nabonassar, while -693/2 is the accession year of Nergal-ušezip. One would have expected “accession year KN”, as in -667MAY02, and I initially had suspected that “mu-sag nam-lugal” was a misreading by Pinches of the graphically somewhat similar “mu-sag ^dak-šeš” “accession year of Nabu-

nasir”, but this was excluded by Dr. Sollberger after collation. According to the photo there is hardly enough space in the break for this king’s name after the last preserved sign LA of line 1. This LA is puzzling. Either we have here a quaint, fully spelled-out Sumerian genitive construction “mu-sag nam-lugal-a(k)”, “accession year of kingship”, unexpected in an otherwise ungrammatical, stenographic context. Or else, we have an equally unexpected Akkadian negation (to be completed to *la-[aš-šú]*); in this context one would have expected a Sumerian “nu tuk”. Then the line would have to be translated “initial year when there [was] no kingship”, indicating an interregnum. Actually, there was a kingless interval near –800, but usually assumed to begin right after Baba-aha-iddina around 810 BC.

The intercalations in the above lists are taken from the text itself, but a second Ulūlu is also otherwise attested for year 3 of Nabonassar. – The numbers 1,40 (in line 1) and 2,10 (written on the edge in line 3) are unexplained. A similarly unexplained number 1,50 occurs in the next text. Perhaps also the number 1,40 in line 5 belongs into this same category, rather than being a (grossly wrong) indication of the begin of the eclipse. But see Brown (2000, p.205) and Steele, in Hunger (2001, p.392), for a speculative interpretation of these numbers.

Because the text may have potentially important chronological implications, the quality of the fit shall now be discussed item by item.

Eclipse	Item	–800	–746	–692
0 XII	5 mo. day 14 3 rd watch set eclipsed	ok 14 ok MS-C4=4°: ok	ok 14 ok MS-C4=17°: no	ok 14 C1 at midnight: no MS-C4=46°: no
1 VI	New Year north day 13 set eclipsed	JAN19, L=292° maybe 14 ok	FEB20, L=325° ok 14 ok	MAR24, L=357° ok 15: no MS-C4=5°: maybe
XI	100° to SR total day 14	SR-C1=66°: no ok 14	SR-C1=68°: no ok 14	SR-C1=79°: maybe ok 13
2 V	total day 14	ok 15	MR-C3=2°: maybe 14	no 15
XI	passes	ok	ok	ok
3 V	passes	ok	ok	no

For all three chronologies, the first eclipse is preceded by several passing eclipses, bridging a 5-month interval.

For –800, all items fit tolerably well, with two exceptions: (i) The very early beginning of year 1. Though, one sometimes forgot to intercalate in a period of political unrest. Note that Hammurabi’s years 32-35 were four consecutive intercalary years, and in year 32 an almost equally early beginning seems to have occurred, with a New Year solar longitude of 298°, see Huber *et al.* (1982, p. 36, 57, 66). (ii) The time to sunrise for the third eclipse is off by over two hours (perhaps a gross scribal error, but perhaps 1,40 is to be interpreted differently). In the first eclipse, the Moon does not set eclipsed, but 4° after the end of the eclipse. As there are random fluctuations of about 3° in the spotting of the beginning (or end) of eclipses, and for –800 the estimated standard error of ΔT is about 1.5°, this discrepancy is not decisive.

For –746, the Moon in the first eclipse does not set eclipsed, and the time to sunrise in the third is grossly wrong also here.

For –692, the first eclipse definitely occurs too early, the fourth is not total, and the sixth does not pass. Moreover, in Line 6, a new king, Mušezib-Marduk, should have been introduced, but there is not enough space. Also, two days deviation in the date of the second eclipse are too much. Therefore, we reject this date.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
UKNZR 1 I	-730APR09	10.06	2.91	191.2	11.49*	—	—	14.16*	.49	74	344	18.43	18.29	5.70	6.14

LBAT *1414 Obv. I = H5,3

1 1,50 mu-1-kám gub-numun
 2 bar šá dib
 3 *ina* 1 me nim

1 1,50 Year 1 Ukin-zér,
 2 month I, which passed.
 3 At 1,0° after sunrise.

Comments. The number 1,50 is unexplained, but compare the preceding text.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
MKAID 9A II	-712APR19	17.54	2.98	201.7	18.93	—	—	21.82	.61	78	338	18.26	18.46	5.53	5.81

LBAT *1414 Obv. II = H5,5

1 9 gu₄ 15 ád
 2 a ½ hab šú
 3 *ina* 20 ana šú šamáš

1 Year 9 (Marduk-apal-iddina), month II 15. It rose eclipsed,
 2 ½ of the disk was covered.
 3 At 20° before sunset.

Comments. The beginning time does not match at all. Wrongly filed eclipsed? Possibly refers to an eclipse in year 9 of Šamaš-šum-ukin, 54 years later (-658 May 22, see there). Lines 1-2: I take *ád* a to be an abbreviation for *adriš asā*.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SANH1 2 VII	-702SEP23	9.18	3.03	352.7	10.31*	11.38*	12.95*	14.01*	1.80	70	254	18.29	18.22	5.79	6.73

LBAT 1415 Obv. I, top = H5,9

1' [... ...]
 2' [... m]e nim?

1' [... which passed]
 2' [... after] sunrise(?)

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
BELIB 1A I	-701MAR20	3.93	2.78	171.6	5.41	—	—	7.64*	.22	165	231	17.35	17.94	6.05	6.21

LBAT 1415 Obv. I, bottom = H5,9

1 mu? 1 ^den-dù
 2 [bar ...] *ana bi ulù*
 3 [*u kur tab á*]d šú
 4 [... *ge*₆ *ana zal*]ág?

1 Year 1 Bēl-ibni,
 2 [month I ..., beginning] between south
 3 [and east, it] set eclipsed
 4 [...] before sunri]se.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ASNSM 5 II	-694MAY01	.92	3.04	212.2	2.30	—	—	5.39*	.74	81	331	18.08	18.63	5.36	5.47

LBAT *1414 Obv. III = H5,5

- 1 5 gu₄ 14[nu[?]]
 2 til ád šú ina 30[+x]
 3 ge₆ ana zalág

- 1 Year 5 (Aššur-nadin-šum), month II 14[not(?)]
 2 complete, it set eclipsed. At 30°[+x]
 3 before sunrise.

Comments. The conjectural restoration is based on a similar passage in -536 Oct. 17. But perhaps it should be translated: “it set (just after) completion of the eclipse”.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SANH2 3U II	-685APR21	23.98	2.99	203.4	1.67	—	—	4.49	.55	64	329	18.01	18.49	5.51	5.65

LBAT 1417 Obv. I + 1416 Obv. I top = H5,9

- 1 [mu 3 si]n[?]-pap[?]-su[?]
 2 [gu₄ ? ...]5[?] itu zal ina bi
 3 [si] u kur tab 2/3 hab
 4 [šú[?] ma]r[?] gin
 5 [ina] 1,40
 6 [ge₆] gin
 7 [kin] dir

- 1 Year 3 Se]nnacherib
 2 [month II(?) ...] 5 months, morning watch(?), beginning between
 3 [north and] east. 2/3 of the disk
 4 [covered,] west(wind) blew.
 5 [At] 1,40°
 6 after sunset
 7 Month VI₂

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SANH2 3U VII	-685OCT15	4.33	3.12	14.5	6.09	—	—	8.99*	.59	113	212	17.32	17.86	6.15	6.22

LBAT 1416 Obv. I, bottom = H5,9

- 1 [du₆ ? 1]4 šá[?] dib
 2 [ina x]me nim

- 1 [Month VII(?) 1]4 which(?) passed.
 2 [At x°] after sunrise

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SANH2 4 VII	-684OCT03	17.78	3.08	3.7	18.95	20.01	21.59	22.65	1.83	71	253	17.84	18.03	5.98	6.52

LBAT 1415 Obv. II, top = H5,9

- 1' [... ...]
 2' gab[?] šú ina[?] 6[?] uš

- 3' murub₄ hun igi² ulù
 4' gin *ina* 20 ge₆ gin
 1' [...] [uncertain]
 2' totally(?) covered. In 6°(?)
 3' middle (of) Aries South(wind)
 4' blew. At 20° after sunset

Comments. Reading uncertain, meaning unclear. The Moon was at $\lambda=4.14^\circ$, $\beta=-0.78^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SANH2 5 I	-683MAR30	10.73	2.85	182.2	12.11*	—	—	14.71*	.35	159	237	18.17	18.14	5.86	6.41

LBAT 1415 Obv. II, bottom = H5,9

- 1 5 [bar] 15 šá dib
 2 *ina* [... x+]10 me nim
 1 Year 5 (Sennacherib), [month I] 15, which passed
 2 At 10° (or 20°, 30°) after sunrise

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ASRHD 4 II	-676MAY11	8.23	3.08	222.6	9.55*	—	—	12.82*	.87	83	324	17.90	18.79	5.21	5.14

LBAT *1414 Obv. IV = H5,5

- 1 [4 šá dib]
 2 [*ina*?]1? m[e? nim?]
 1 [Year 4 (Asarhaddon),, which passed.]
 2 [At] 1,0°(?) [after sunrise(?)]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ASRHD 13 II	-667MAY02	7.22	3.05	213.8	9.11*	—	—	11.66*	.41	56	333	17.87	18.65	5.34	5.26

LBAT 1417 Obv. II = H5,11

- 1 mu-sag šamáš-mu-gub
 2 gu₄ 5 itu
 3 šá dib
 4 *ina* 40 me nim
 1 Accession year Šamaš-šum-ukin,
 2 month II, 5 months,
 3 which passed.
 4 At 40° after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ASRHD 13 VIII	-667OCT25	12.89	3.15	25.7	14.70*	—	—	17.58*	.58	115	213	17.55	17.66	6.35	7.10

LBAT 1416 Obv. II = H5,11

- 1 apin šá dib
 2 *ina* 30 ana šú šamáš

- 1 Month VIII which passed,
2 at 30° before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 1 VIII	-666OCT15	2.48	3.12	14.8	3.71	4.77	6.35*	7.41*	1.86	72	253	17.38	17.85	6.16	6.30

LBAT 1415 Obv. III top = H5,11

- 1' [...]
 2' ki[?] 10[?] [...]
 3' ád šú ina 20[+x]
 4' ge₆ ana zalág
 1' [...] ...]
 2'
 3' It set eclipsed. At 20[+x]
 4' before sunrise

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 2U II	-665APR10	17.40	2.92	192.7	18.70	—	—	21.63	.48	152	243	18.11	18.31	5.68	6.07

LBAT 1415 Obv. III bottom = H5,11

- 1 2 bar 14 ina k[ur[?] u ulù[?]]
 2 tab[?] ina[?] 6[?]
 3 ge₆ g[in]
 1 Year 2 (Šamaš-šum-ukin), month I, 14, beginning(?) on [south east(?)]
 2 At 6°(?, or 3°?)
 3 after sunset

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 9U III	-658MAY22	15.46	3.10	233.0	16.76*	—	—	20.18	1.01	84	317	18.84	18.94	5.06	5.45

LBAT *1414 Obv. V = H5,5

- 1 [9 ...]
 2 [... ...]
 3 [... ...]
 4 ...[. ...]
 5 ...[. ...]
 6 ina 20[?] [ana] š[ú šamáš]
 7 kin[?] dir[?]
 1 [Year 9 (Šamaš-šum-ukin) ...]
 2 [... ...]
 3 [... ...]
 4 [... ...]
 5 [... ...]
 6 At 20(?) [before sunset]
 7 Month VI₂

Comments. Reading uncertain. See also -712APR19.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 16 IV	-651JUL02	13.93	3.01	272.4	15.05*	16.17*	17.61*	18.73*	1.51	95	252	19.14	19.20	4.80	5.51

SH1,43

Col. ii

1 si gin 15 an-m[i ...]

1 (Month IV.) North (wind) blew. The 15th, an ecli[pse of the moon ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 16 X	-651DEC27	9.51	2.88	89.9	11.21*	—	—	13.19*	.16	35	337	17.09	17.02	6.98	7.64

SH1,45

Col. iii

4' si gin 15 an-mi sin ...[...]

4' (Month X.) North (wind) blew. The 15th, an eclipse of the moon ... [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 18 II	-649MAY13	14.38	3.09	224.3	16.50*	—	—	18.70*	.27	47	337	18.78	18.82	5.17	5.63

LBAT 1417 Obv. III = H5,11

1 18 šamáš-mu-gub

2 gu₄ 5 itu

3 šá dib

4 ina 1 ana šú šamáš

1 Year 18 Šamaš-šum-ukin

2 month II, 5 months

3 which passed.

4 At 1,0° before sunset

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 18 VIII	-649NOV05	21.54	3.16	36.8	23.37	—	—	2.24	.58	117	215	17.10	17.49	6.51	6.91

LBAT 1416 Obv. III = H5,11

1 apin 13 [ina bi kur]

2 u ulù [tab]

3 dir [... ...]

4 ..[. ...]

1 Month VIII 13, [beginning between east]

2 and south [...]

3 clouds [? or red?]

4 ..[. ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
KANDL 16 III	-631MAY23	21.47	3.10	234.7	23.87	—	—	1.57	.12	35	343	18.62	18.96	5.04	5.26

LBAT 1417 Obv. VI = H5,11

- 1 16 *kan-dal-an*
 2 sig 5 itu 15 2 s[1[?]]
 3 *ina bi si u kur šú*[?]
 4 *ina si zalág si g[in[?]]*
 5 20 gar ír[*u zalág*]
 6 ár si₄ [ád]
 7 [... ...]

- 1 Year 16 Kandalanu
 2 month III, 5 months, day 15. 2 Fingers (?)
 3 between north and east covered (?)
 4 On the north it became bright. North (wind) b[lew.]
 5 20° onset, maximal phase [and clearing.]
 6 Behind α Scorpii [eclipsed.]
 7 [... ...]

Comments. Note the "5 months", which are remarkable for an observed eclipse. The Moon ($\lambda=235^\circ$) was not very close to α Scorpii ($\lambda=213^\circ$).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBPLS 14 VIII	-611NOV05	20.86	3.16	37.6	22.41	—	—	1.30	.65	38	295	17.19	17.48	6.53	6.94

BM 38357 'Obv.' I = H5,23

- 1' [...]
 2' [...] šar
 3' [...] šar *u*
 4' [...] an-e *i-te-rim*
 5' [...] dir tu tu
 6' [...] *bi-rit* si *u* mar *iz-za-ku*
 7' [...] ge₆ gin 3 kùš *e-lat*
 8' [...] a]n-mi ^dsag-me-gar 6 šu-si
 9' [...] *nен-mуд*
 10' [...] š]u-si *ina* igi mul_x(ÁB)-meš egir-meš
 11' [...] x itu apin u₄-22-kám ^{lu}di-kud
 12'
 1' [...]
 2' [...] wind
 3' [...] wind and
 4' [...] covered the sky
 5' [...] (repeatedly) entered clouds
 6' [...] in between north and west it cleared
 7' [...] after x°] nighttime, 3 cubits above
 8' [...] in the ec]lipse, Jupiter 6 fingers
 9' [...] stood close (i.e. was stationary)
 10' [...] fi]ngers in front of the rear stars
 11' [...] ... month VIII day 22 the judge
 12' [...].....

Comments. The tablet is a copy of an older exemplar, already broken in antiquity. Obv. II mentions year 16, and Rev. II year 19. Besides three eclipse reports it contains some historical remarks, together

allowing to date it to the reign of Nabopolassar. Thus, Obv. I should contain material from shortly before year 16; the above date was suggested by J. Steele. Jupiter was at $\lambda=333.81^\circ$, $\beta=-1.62^\circ$, and was stationary on that date; it set shortly after the end of the eclipse at 22.49 UT = 1.65 LT. The Moon (at $\lambda=37.52^\circ$, $\beta=-1.01^\circ$) was 6.7° above α Tauri ($\lambda=33.65^\circ$, $\beta=-5.65^\circ$ for -600).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBPLS 16 VI	-609SEP15	21.56	3.00	345.6	23.34	—	—	2.02	.38	122	203	18.03	18.35	5.66	5.98

BM 38357 ‘Obv.’ II = H5,23

4' mu-16-kám itu gu₄ u₄-20-kám [...]

5'

6'

7' itu kin ge₆-14-kám 5 [...]

8' 10 uš ge₆ *ina* murub₄-ti [...]

9' tag₄ sin an-mi al-l[a ...]

10' ad-ra id ulù šú-im [...]

11' sag šá ge₆ egir i-sa [...]

12' ^dné-bu-ú šá m[ul ...]

13' ana ulù im ma? [...]

14' 10 uš ge₆ [...]

15' *ina* ki ... [...]

16' ... [...]

4' Year 16 (Nabopolassar), month II, day 20 [...]

5' (2 lines of

6' historical notes)

7' Month VI, night 14 5 [...]

8' 10° of night; in the middle watch [...]

9' remaining, lunar eclipse, over [...]

10' eclipsed; the south side was covered [...]

11' beginning of the night, after a little [...]

12' the “Bright Star of [...]”

13' toward south ... [...]

14' 10° of night [...]

15' in the region of ... [...]

16' ... [...]

Comments. The Moon was at $\lambda=345.3^\circ$, $\beta=0.2^\circ$. The nearest Normal Star (line 12') was η Piscium (“The bright star of the ribbon of the fishes”), at $\lambda=350.7^\circ$, $\beta=5.2^\circ$ in the year -600.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBPLS 17 VI	-608SEP03	21.38	2.96	334.5	22.29	23.49	1.15	2.36	1.69	78	250	18.26	18.53	5.48	5.79

LBAT *1419 Obv. I = H5,17

1 [17 kin 1]4? 1 me

2 [...]. *ina* 20?

3 [gab šú ... x+]4? ír

4 [... t]a kur *ana* mar

5 [zalág ... x]ge₆

6 [... jigi

7 [... jen?

8 [... ge₆ gi]n

- 1 [Year 17 (Nabopolassar), month VI 1]4(?) ...
 2 [...]. in 20°(?)
 3 [it became total. ... x+]4°(?) (duration of) maximal phase
 4 [In ... x°, from] east to west
 5 [it became bright ...]...
 6 [... ...]
 7 [... ...]
 8 [At ... after sunset]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBPLS 17 VI	-608SEP03	21.38	2.96	334.5	22.29	23.49	1.15	2.36	1.69	78	250	18.26	18.53	5.48	5.79
NBPLS 17 XII	-607FEB28	23.28	2.69	154.0	.47	—	—	3.16	.51	150	242	17.14	17.65	6.34	6.64
NBPLS 18 VI	-607AUG24	1.76	2.93	323.6	3.02	—	—	6.09*	.65	38	295	18.33	18.71	5.30	5.43
NBPLS 19U X	-605JAN08	19.56	2.78	102.5	20.90	—	—	.02	.58	49	310	16.76	17.05	6.95	7.34

BM 38357 ‘Rev.’ I = H5,25

- 1 [... he]-pí eš-šú ta an-mi [...]
 2 [... he]-pí eš-šú gin 1 2/3 danna g[e₆ ...]
 3 [... he]-pí eš-šú -ú ^dsal-ba-ta-a-nu u ^ddele-bat
 4 [... he]-pí eš-šú u ^dsag-me-gar egir gír
 5 [...] he-pí eš-šú gu-la kur 8 uš ana mul lugal
 6 [...] he-pí] eš-šú ina an-mi-šú šit-tú ^dudu-idim-me
 7 [...] ... ina an-mi nim-gír gù
 8 [...] ^dim a-an
 9

- 1 [... new]ly broken from the eclipse [...]
 2 [... new]ly broken went; 1 2/3 bēru of ni[ght ...]
 3 [... new]ly broken ... Mars and Venus
 4 [... new]ly broken and Jupiter behind β Virginis(?) (gír [ár šá mul ur-]gu-la)
 5 [...] newly broken rose, 8° to α Leonis (eclipsed)
 6 [...] newly] broken in its eclipse the other planets
 7 [did not stand there.] ... In the eclipse lightning, thunder
 8 [...] Adad, rain
 9

Comments. Probable date: -605JAN08. From the position on the tablet, between “year 16” in Obv. II and “year 19” in Rev. II, one expects a date between years Nabopolassar 16 and 19, but after the eclipse of -609SEP15, i.e. one of the four eclipses listed above. At first sight, the text seems to suggest that Mars and Venus were above the horizon (line 3), that Jupiter rose or set during the eclipse (line 4), and that the other planets did not stand there (line 6). However, both Venus and Mars were below the horizon for all four eclipses, with the exception of the third, where Mars was above and Venus below. In fact, the fourth eclipse is the only one able to give a convincing fit: The eclipse began 3.85 hours after sunset, reasonably close to the 50° of the text. The gaps in lines 3-5 can be restored: “[Before onset,] Mars (at 19.35 LT) and Venus (at 20.31 LT) [set], and Jupiter (at 20.53 LT, λ=148.80°, β=1.54°) rose behind the [Rear] Foot [of the Li]on (β Virginis, λ=140.49°, β=0.64° in -600).” The moon was at λ=102.83°, β=-0.74, about 11° in front of α Leonis (λ=113.90°, β=0.35° in -600). The other planets were below the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 1 III	-603JUN12	21.63	—	253.9	—	—	—	—	-10						
NBKDR 1 IX	-603DEC06	15.26	—	69.0	—	—	—	—	-59						

LBAT *1420 Obv. I 1f. = H5,27

1 [mu 1 ak-níg-du-]šeš sig dib

2 [gan] dib

1 [Year 1 Nebuchadn]ezzar, month III, passed

2 [Month IX,] passed

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 2U II	-602MAY03	8.38	3.05	215.1	11.00*	—	—	12.23*	.01	188	223	17.88	18.67	5.32	5.39
NBKDR 2U VII	-602OCT27	19.42	3.16	28.2	21.25	—	—	.06	.58	22	284	17.44	17.63	6.38	6.87

LBAT *1420 Obv. I 3ff. = H5,27

3 [mu 2 gu₄ 5] dib kin dir4 [du₆ 1]4' 1 2/3 kas 5 uš šá šamáš 1/3 kas ge₆ gin

5 [...] 2 šar ½ šú ina 2 u 4 šar

6 [...] za]lág [1] ½ kas gar u zalág 4 gin

3 [Year 2, month II, 5(months)], passed. Month VI₂

4 [Month VII 1]4(?) 1 2/3 bēru 5 uš after sun(set). After 1/3 bēru

5 [on the] north side ½ covered. On the northwest side

6 it became bright. [1] ½ bēru total duration. West(wind) blew.

Comments. The terminology of this text is unusual. It uses numerals for the cardinal directions (1 = ulù = south, 2 = si = north, 3 = kur = east, 4 = mar = west) and gives times in KAS (short for KAS.BU = danna = bēru ; 1 danna = 30 uš = 120 minutes).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 3 I	-601APR22	12.24	3.00	204.5	13.29*	14.50*	15.98*	17.19*	1.48	129	286	18.52	18.51	5.48	5.91
NBKDR 3 VII	-601OCT17	6.53	3.13	17.2	7.69*	8.83*	10.46*	11.60*	1.81	61	242	17.39	17.81	6.20	6.17

LBAT *1420 Obv. I 7 = H5,27

7 [mu 3] bar dib du₆ dib

7 [Year 3] month I, passed. Month VII passed.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 4 I	-600APR10	23.15	2.93	194.1	.34	—	—	3.56	.84	87	331	17.86	18.33	5.66	5.82
NBKDR 4 VII	-600OCT05	10.54	3.09	6.0	12.00*	—	—	14.95*	.51	104	197	17.90	17.99	6.02	6.78

LBAT *1420 Obv. I 8ff. = H5,27

8 [mu 4 b]ar 13 [mu]rub₄ 3 kas 5 uš ge₆ gin

9 [...] 3 u 2 šar 3 re-bít

10 [...] ina 2 zalág 2 gin

11 [...] du₆ dib

8 [Year 4], month I 13, middle watch, 3 bēru 5 uš after sunset

9 [...] northeast side, 3 quarters.

10 [...] on north it became bright. North(wind) blew.

11 [...] Month VII passed.

Comments. The reading at the end of line 9 is due to Hunger. I had read: 3 *ri* til, “3(fingers) la(cked) to totality”, which amounts to the same magnitude.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 5U I	-599MAR31	15.17	—	184.0	—	—	—	—	-.43	29	29	18.07	18.16	5.83	6.12
NBKDR 5U VI2	-599SEP24	10.12	—	354.7	—	—	—	—	-.76	151	151	18.06	18.18	5.83	6.59
NBKDR 5U XI	-598FEB19	21.99	2.66	144.9	23.18	—	—	2.30	.75	150	261	17.04	17.51	6.48	6.78

LBAT *1420 Obv. I 12ff. = H5,27

- 12 [mu 5 bar dib] kin-2-kám d[ib]
 13 [zíz] 5 itu 3½ kas ge₆ gin
 14 [...] 2/3 šú *ina* 1 šú *ina* 4[?] [zalág]
 15 [... *ina* an-]mi-šú ge₆[?] u ma[?] [...]

- 12 [Year 5, month I passed.] Month VI₂, passed.
 13 [Month XI,] 5 months 3½ *bēru* after sunset,
 14 [...] 2/3 covered, on the south covered, on the north(?) [it became bright.]
 15 [... during] its eclipse

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 10 II	-594JUN03	18.09	3.10	245.0	19.34	20.80	21.67	23.14	1.15	74	296	18.87	19.07	4.92	5.29
NBKDR 10 VIII	-594NOV27	14.07	3.10	59.6	15.32*	16.38*	17.94	19.00	1.88	83	263	17.07	17.19	6.81	7.58

LBAT *1420 Obv. II 1ff. = H5,27

- 0 [mu 10 gu₄]
 1 [apin] [...]
 2 [4] u 1 zalág [...] 2/3 kas ge₆[?][...]

- 0 [Year 10, month II]
 1 [Month VIII ...]
 2 [on] south[west] it became bright [...] 2/3 *bēru* night [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 11A II	-593MAY23	19.24	3.10	234.4	20.32	21.89	22.57	.14	1.11	121	256	18.69	18.95	5.04	5.40
NBKDR 11A VIII	-593NOV17	5.75	3.14	48.8	7.31*	—	—	10.19*	.65	41	298	16.71	17.33	6.68	6.68

LBAT *1420 Obv. II 3f. = H5,27

- 3 mu 11 gu₄[... ... x+] 10 uš ge₆ gin *u*[?]
 4 til-ma 10[+x ...] apin dib še dir

- 3 Year 11, month II [...] 20°(?) night went by and
 4 it was total 10[+x ...] Month VIII passed. Month XII₂.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 12 I	-592MAY11	21.92	—	223.8	—	—	—	—	-.24						
NBKDR 12 VII	-592NOV05	18.15	—	37.9	—	—	—	—	-.71						
NBKDR 12 XII	-591APR01	22.51	2.87	185.3	.16	—	—	2.79	.48	63	334	17.74	18.18	5.81	6.00

LBAT *1420 Obv. II 5ff. = H5,29

- 5 mu 12 b[ar dib] du₆ dib
 6 še 15 .[.. ...] uš ge₆ g[in ...]

7 1 kas 6 uš gar [ír u zalág]

5 Year 12, month I [passed.] Month VII passed
 6 Month XII 15 [...] ...] uš after sunset [...]
 7 1 *bēru* 6 uš [total duration]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 13 VI	-591SEP26	5.15	3.05	356.6	7.07*	—	—	9.60*	.33	124	200	17.66	18.16	5.84	5.89
NBKDR 13 XII	-590MAR22	15.15	2.80	175.1	16.10*	17.16*	18.74	19.79	1.84	106	290	17.90	18.01	5.98	6.46

LBAT *1420 Obv. II 8f. = H5,29

8 m[u] 13 kin [dib]
 9 [še 1]4[?] ád e 1 kas 10 uš [...]

8 Year 13, month VI [passed]
 9 [Month XII 1]4(?), it rose eclipsed. 1 *bēru* 10 uš [duration(?)].

The second eclipse is also described in

LBAT *1419 Obv. II, top = H5,17:

0' [... ...]
 1' [... ...]...
 2' [ina] 30 ana šú šamáš

0' [... ...]
 1' [... ...]...
 2' [At] 30° before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 14A VI	-590SEP15	4.89	3.00	345.3	5.84*	7.05*	8.67*	9.89*	1.62	79	247	17.89	18.36	5.65	5.70
NBKDR 14A XII	-589MAR12	7.22	2.74	164.8	8.41*	—	—	11.24*	.59	149	246	16.97	17.82	6.17	6.22

LBAT *1420 Obv. II 10f. = H5,29

10 [mu 1]4 [ki]n [dib]
 11 [še dib] ... še [dir]

10 [Year 1]4, month VI, [passed].
 11 [Month XII, passed.] ... Month XII₂.

These two eclipses are also described in

LBAT *1419 Obv. II, middle = H5,17:

1 14 níg-du
 2 kin šá dib
 3 ki kur šamáš

1 Year 14 Kudurru (=Nebuchadnezzar)
 2 month VI, which passed.
 3 With sunrise.

and in LBAT *1419 Obv. II, bottom = H5,17:

1 še 14 šá dib
 2 [in]a[?] 1[?] me[?] nim[?]
 3 [... ...]

1 Month XII 14, which passed
 2 At 1,0 after sunrise(?)

3 [...]

Comments. According to collation, “1 me nim” in line 2 is fairly certain.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 15 V	-589SEP04	9.52	2.96	334.4	10.76*	—	—	13.94*	.72	38	290	18.61	18.53	5.48	6.29
NBKDR 15 XI	-588FEB29	18.21	—	154.2	—	—	—	—	-.89						

LBAT *1420 Obv. II 12 = H5,29

12 [mu 1]5 izi [di]b zí[z dib]

12 [Year 1]5, month V passed. Month XI [passed]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 16 IV	-588JUL25	12.69	—	295.1	—	—	—	—	-.47						
NBKDR 16 X	-587JAN19	3.34	2.71	113.5	4.66	—	—	7.71*	.55	52	316	16.56	17.12	6.87	7.00

LBAT *1420 Obv. II 13ff. = H5,29

13 [mu] 16 šu [dib]

14 [ab]14 zal 2/3 (? or 1 1/3?) kas ge₆ ...

15 1/2-šú šú ád [šú]

13 [Year]16, month IV [passed].

14 [Month X] 14, morning watch(?), 2/3(? or 1 1/3?) *bēru* night [before sunrise]

15 By its 1/2 covered, set eclipsed.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 17A IV	-587JUL15	5.77	2.96	285.0	7.26*	—	—	10.40*	.84	122	237	18.38	19.15	4.85	4.83
NBKDR 17A X	-586JAN08	3.91	2.79	102.2	4.64	5.82	7.48*	8.66*	1.80	90	269	16.43	17.05	6.95	7.10

LBAT *1420 Obv. II 16ff. = H5,29

16 [mu] 17 šu [dib]

17 [ab] 13 zal 1 kas 5 u[š ...]

18 *gab[?]-bi[?]-šú šú* [ád šú]

16 [Year] 17, month IV [passed]

17 [Month X] 13, morning watch(?), 1 *bēru* 5 u[š before sunrise]

18 totally covered, [it set eclipsed].

Comments. In lines 14 and 17 I take zal=NI to be an abbreviation of u₄-zal “morning watch”.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 24 V	-580AUG25	7.10	2.93	325.2	8.86*	—	—	11.44*	.42	17	293	18.25	18.69	5.32	5.21
NBKDR 24 XI	-579FEB19	14.80	2.66	145.0	15.44*	16.61*	18.24	19.42	1.69	111	300	17.40	17.52	6.47	6.86

LBAT *1420 Rev. I 1'f. = H5,29

1' [...] [...]

2' igi[?] gar[?]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 25 V	-579AUG14	20.87	2.91	314.7	21.90	22.97	.55	1.62	1.82	65	249	18.58	18.84	5.17	5.56
NBKDR 25 XI	-578FEB08	16.54	2.65	133.9	17.77	—	—	20.29	.32	61	345	17.17	17.36	6.64	6.95

LBAT *1420 Rev. I 3'f. = H5,29

3' mu 25 izi 1½ kas ge₆ g[in]

4' zíz usan gar

3' Year 25, month V, 1½ *bēru* after sunset.

4' Month XI, it occurred in the evening watch.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 26A V	-578AUG04	13.70	2.91	304.5	15.04*	—	—	17.91*	.64	110	211	18.87	18.97	5.04	5.82
NBKDR 26A XI	-577JAN28	16.58	—	122.7	—	—	—	—	-.92	19	19	17.05	17.22	6.78	7.09

LBAT *1420 Rev. I 5' = H5,29

5' mu 26 izi dib zíz dib še dir

5' Year 26, month V, passed. Month XI, passed. Month XII₂.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 27 III	-577JUN25	18.58	—	265.9	—	—	—	—	-.33	356	356	19.03	19.19	4.81	5.18
NBKDR 27 IX	-577DEC19	8.54	2.95	81.7	10.17*	—	—	13.04*	.60	132	231	16.09	17.04	6.97	6.95

LBAT *1420 Rev. I 6' = H5,29

6' mu 27 sig 5 dib gan dib

6' Year 27, month III, 5 (months), passed. Month IX, passed.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 28A III	-576JUN14	.62	3.08	255.4	1.93	—	—	5.59*	.99	65	297	18.73	19.15	4.85	5.00
NBKDR 28A IX	-576DEC07	23.03	3.03	70.8	.22	1.27	2.84	3.89	1.88	87	268	16.59	17.09	6.91	7.26

LBAT *1420 Rev. I 7'ff. = H5,29

7' mu 28 sig 14' [...]

8' [...] ... 2] *u* 4 šár

9' [...] ...] ád šú

10' [gan 1]5' 3½ kas ge₆ gin

11' [ina] 3 šar gab-bi-šú šú

12' *ina* 4 zalág [...] kas gar *u* zal[ág]

7' Year 28, month III 14(?) [...] ...

8' [...] ... north]west side.

9' [...] ...] it set eclipsed.

10' [Month IX 1]5(?), 3½ *bēru* after sunset.

11' [...] ...] east side, in its totality covered.

12' On the west side it became bright [...] *bēru* total duration.

Comments. An observation of the first eclipse probably is preserved in the form of a prediction for the eclipse of -522JUL16, see there.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 29 II	-575JUN03	1.61	3.10	244.8	2.66	4.03	5.23*	6.60*	1.27	112	257	18.57	19.07	4.93	5.09
NBKDR 29 VIII	-575NOV27	14.66	3.10	60.0	16.17*	—	—	19.06	.65	44	302	17.08	17.19	6.82	7.52

LBAT *1420 Rev. I 13'f. = H5,29

- 13' mu 29 gu₄ 14
 14' 1 kas 10 [u]š ge₆ [*ana zalág*]
 15' [... ...]
- 13' Year 29, month II 14,
 14' 1 *bēru* 10 uš night [before sunrise]
 15' [... ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 31U XII	-572APR01	22.98	2.87	185.7	.00	1.06	2.62	3.68	1.73	103	293	17.71	18.19	5.81	6.03

LBAT *1419 Obv. III, top = H5,17

- 1' [...]
 2' [...] ina [...]
 3' [ta] kur *ana* si *zalág*
 4' ulù gin 1 kùš
 5' *ina* igi rín ád
 6' genna *ina* más kur an
 7' 2 kùš *ina* igi si₄
 8' *ina* 1,30 ge₆ gin
- 1' [...]
 2' [...] in [...]
 3' From east to north it became bright.
 4' South(wind) blew. 1 cubit
 5' in front of Libra eclipsed.
 6' Saturn in Capricorn rose (KUR), Mars
 7' 2 cubits in front of α Scorp.ii.
 8' At 1,30° after sunset.

Comments. One might be tempted to translate: Saturn reaches (KUR) Capricorn, but the zodiacal signs probably had not yet been invented in -572. The Moon was at $\lambda=185.58^\circ$, $\beta=-0.76^\circ$. Saturn was at $\lambda=266.97^\circ$, $\beta=0.45^\circ$, and rose at 21.53 UT = 0.40 LT, i.e. during the onset of the eclipse. Mars was at $\lambda=214.02^\circ$, $\beta=1.25^\circ$, with α Scorp.ii at $\lambda=214.07^\circ$, $\beta=-4.23^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 32 VI	-572SEP25	12.56	3.05	356.3	13.59*	14.81*	16.39*	17.61*	1.57	80	244	18.09	18.16	5.85	6.50

LBAT *1419 Obv. III, middle = H5,17

- 1 32 níg-du
 2 kin šá dib
 3 *ina* 35 *ana* šú šamáš
- 1 Year 32 Kudurru (= Nebuchadnezzar),
 2 Month VI, which passed.
 3 At 35° before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 32 XII	-571MAR22	15.01	2.80	175.4	16.18*	—	—	19.17	.68	146	250	17.90	18.02	5.97	6.49

LBAT *1419 Obv. III, bottom = H5,19

1 še 15⁷ [...]
 2 ... [...]

1 Month XII 15(?) [...]
 2 [...] ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 37 III	-567JUL04	11.03	3.00	274.8	12.83*	—	—	14.87*	.18	34	333	19.29	19.19	4.81	5.43

SH1,49

17 ... 15 dingir ki dingir igi 7,30 na an-mi *sin šā?* dib⁷ [...]

17 ... The 15th, one god was seen with the other; 7;30° NA. A lunar eclipse which passed. [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 42A VI	-562SEP05	15.02	2.96	336.0	16.90*	—	—	19.32	.35	11	294	18.45	18.50	5.51	6.13

LBAT 1421, II 2'ff. = H5,31

2' 42 kin 14 ád [...]
 3' *u* zalág 6 uš *zalág?*-*r*[*u?*]
 4' *ina* 35 [*ana* šú šamáš]

2' Year 42 (Nebuchadnezzar), month VI 14. It [rose] eclipsed [...]
 3' and became bright. 6 uš to become bright.
 4' At 35° [before sunset].

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 42A XII	-561MAR02	22.32	2.69	155.8	22.98	.15	1.81	2.98	1.77	116	300	17.26	17.68	6.31	6.53

LBAT 1421, II 5'ff. = H5,31

5' še 15 1,30 ge₆ [gin ...]
 6' 25 ír *ina* 18 za[lág? ...]
 7' mar gin 2 kùš sig múl
 8' dele igi absin á[d]
 9' [...] ...]

5' Month XII 15, 1,30° after sunset [...].
 6' 25° duration of maximal phase. In 18° it became bright.
 7' West(wind) blew. 2 cubits below
 8' γ Virginis eclipsed
 9' [...] ...]

Comments. Note the abbreviated writing “dele igi absin” in line 8’; it confirms once more that the correct reading is *dele* (*šá*) *igi*, and not *šur-ši*, cf. Sachs and Hunger, I, p.54. The Moon was at $\lambda=155.75^\circ$, $\beta=-0.48^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBNID 1A VII	-554OCT06	20.40	3.10	7.3	21.48	22.71	.25	1.48	1.53	81	243	17.71	17.97	6.03	6.40

LBAT *1419 Obv. IV, middle = H5,19

- 1 du₆ 13 *ina* 17 *id* kur
 2 *gab šú* 28 ír
 3 *ina* 20 ta kur *ana* mar zalág
 4 an-mi-šú sa₅
 5 ár giš-kun hun ád
 6 *ina* gar si *ina* zalág mar gin
 7 *ina* 55 ge₆ *ana* zalág

- 1 Month VII 13. In 17° (from the) east side
 2 total. 28° duration of the maximal phase.
 3 In 20° from east to west it became bright.
 4 Its eclipse was red.
 5 Behind the “Rump of the Hireling” eclipsed.
 6 During onset north (wind), during clearing west (wind) blew.
 7 At 55° of night before sunrise (error for: after sunset).

Comments. The Moon was at $\lambda=7.20^\circ$, $\beta=-0.33^\circ$. The “Rump” (also translated as Thigh, Loin, Hip, ...) is some middle part of the body, and the corresponding star(s) must be somewhere south of the “Head of the Hireling” ($\alpha+\beta$ Arietis).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBNID 1A XII2	-553APR02	22.65	2.87	186.1	23.83	—	—	2.97	.78	142	254	17.74	18.19	5.80	6.08

LBAT *1419 Obv. IV bottom = H5,19

- 1 dir-še 15⁷ [...]
 2 [...] [...]

 1 Month XII₂ 15(?) [...]
 2 [...] [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
CYRUS 2U II	-536APR23	14.33	3.01	206.7	15.54*	16.65*	18.05*	19.16	1.49	94	297	18.49	18.55	5.44	5.95

LBAT *1419 Obv. V top = H5,19

- 1' [...] [...]
 2' zalág [...] [...]
 3' ana šú⁷ [...] [...]
 4' ád [...] [...]
 5' [...] [...]

 1' [...] [...]
 2' becoming bright [...]
 3' before sunset(?) [...]
 4' [it rose] eclipsed. [...]
 5' [...] [...]]

Comments. There were some 6-7 lines of text; the eclipse evidently was observed. The translation of the few preserved signs is conjectural.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
CYRUS 2U VII	-536OCT17	4.37	3.14	18.4	5.51	6.75*	8.27*	9.50*	1.50	83	243	17.32	17.79	6.22	6.29

LBAT *1419 Obv. V middle = H5,19

- 12' du₆ 11[+x *ina kur tab*]
 13' 2/3 hab *ana ti*[l gar]
 14' nu til ád š[ú]
 15' si šá pa mar gar
 16' gin 5 uš
 17' *ina igi mál-mál á*[d]
 18' *ina* 14 ge₆ [*ana zalág*]

- 1 Month VII 11[+x. Beginning on the east,]
 2 [it made] 2/3 of the disk toward totality.
 3 Not (yet) total, it set eclipsed.
 4 North(wind) which was set to the west side
 5 blew. 5 uš
 6 in front of the Pleiades eclipsed.
 7 At 14° night before sunrise.

Comments. Note the use of uš as a measure of angle. The Moon was at $\lambda=17.51^\circ$, $\beta=-0.07^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
CAMBS 1 II	-528MAY24	4.66	3.10	236.0	5.87*	7.04*	8.34*	9.51*	1.39	95	304	18.21	18.97	5.03	5.05
CAMBS 1 VIII	-528NOV17	18.63	3.14	50.6	20.06	—	—	23.16	.58	109	208	17.03	17.30	6.71	7.21

BM 36879 (= 80-6-17, 620), ‘Obv.’ I = H5,33

- 12' [x m]e nim?
 13' apin? 13 2/3? kas 4? uš g[e₆ gin?]
 14' šá hab? tab-tab? *ina* 20 g[e₆]
 15' 5 uš ge₆ ír ta ul[ù ...]
 16' *ina* 2/3 kas ge₆ *ana* ugu ulù za[lág ...]
 17' [...] mál?-sag?-me-gar *ina* murub₄ [...]
 18' [...] [...]

- 12' [x] after sunrise(?).
 13' Month VIII(?) 13, at 2/3(or 1 1/3?) *bēru* 4(?) UŠ after sun[set],
 14' of the disk(?) it began(?), in 20° of night[time(?) ...]
 15' 5° nighttime maximal phase, from the sou[th ...]
 16' in 2/3 *bēru* nighttime to above south it clea[red ...]
 17' [...] Jupiter in the middle [...]
 18' [...] [...]

Comments. Date suggested by J. Steele, uncertain. Jupiter was at $\lambda=334.13^\circ$, $\beta=-1.55^\circ$ and set after the end of the eclipse at 21.66 UT = 24.80 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
CAMBS 2 VIII	-527NOV06	17.78	—	39.1	—	—	—	—	-.63						
CAMBS 3U I	-526APR04	4.91	2.89	187.7	6.69*	—	—	9.14*	.36	170	249	17.49	18.22	5.77	5.90
CAMBS 3U VI2	-526SEP27	7.36	3.06	357.9	9.46*	—	—	11.62*	.26	5	296	17.75	18.14	5.87	5.77
CAMBS 3U XII	-525MAR24	12.82	2.81	177.2	13.61*	14.80*	16.44*	17.63*	1.70	124	295	18.02	18.05	5.94	6.33
CAMBS 4 VI	-525SEP16	21.51	3.01	347.2	22.68	23.76	1.26	2.34	1.61	53	249	18.07	18.32	5.69	6.06

BM 36879 (= 80-6-17, 620), 'Rev.' I = H5,33

- 1' *ina* 12² *gar* ..[.]
 2' mu 3 *bar* 5 *itu* ..[.]
 3' kin-2-kám 13
 4' še 15 *ina* 25 *me ana* šú šamáš
 5' mu 4 kin 13 2 *kas ge*₆ *gin ina* *kur tab ina* 18
 6' [g]e₆ *gab-bi-šú* šú 1/3 *kas 4 uš ge*₆ í[r]
 7' *ta kur ana* *zalág tab ina* ... *ge*₆? *ana mar* *zalág* [...]
 8' *gar ír u* *zalág* [si šá p]a *mar gar* [gin]
 9' *ina u[gu?*]
 10' [d]ur sim-mah K[AxMI? ...]
 11' [...] ... [...]

- 1' At 12 ... (an eclipse which passed).
 2' Year 3 Month I, 5 months (which passed).
 3' Month VI₂ 13,
 4' Month XII 15, at 25° daytime before sunset.
 5' Year 4, Month VI 13, 2 bēru after sunset, beginning on the east side, in 18°
 6' nighttime it was totally covered. 1/3 bēru 4 UŠ nighttime maximal phase.
 7' When from the east (side) it began to clear, in x° it cleared toward west [...].
 8' total duration. [North (wind) which was] set to the west [blew].
 9' ... abo[ve(?)].
 10' [In the "Rib]bon of the Swallow" ecl[ipsed(?)]
 11' [...] ... [...]

Comments. Eclipse of -525SEP16: the Moon was at $\lambda=346.95^\circ$, $\beta=-0.65^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
CAMBS 7 IV	-522JUL16	20.42	2.95	286.8	21.98	—	—	.99	.54	35	300	18.92	19.14	4.86	5.19
CAMBS 7 X	-521JAN10	1.64	2.77	104.4	2.59	3.65	5.21	6.27	1.85	102	281	16.35	17.06	6.94	7.16

Strm. Kamb. 400 Rev. 19 ff.
 = (Kugler, SSB I, p. 70) = H5,171

- 19 mu 7 šu *ge*₆ 14 1 2/3 *danna* *ge*₆ *gin*
 20 *sin an-mi* *til gar i-si i-ri-hi* *si gin*
 21 *ab ge*₆ 14 2½ *danna* *ge*₆ *ana* *zalág i-ri-hi*
 22 *sin an-mi* *til gar ulù u si dir gin*

- 19 Year 7 (Kambyses), month IV, night 14, 1 2/3 *bēru* after sunset,
 20 the moon makes a total eclipse, (but) a little is left over; north(wind) blew.
 21 Month X, night 14, 2½ *bēru* to sunrise are left over,
 22 the moon makes a total eclipse. South and north (perhaps error for southwest(?)) wind, clouded,
 blew.

Comments. Despite the order *sin an-mi*, these must be predictions. The text describes the first eclipse as almost total, which is impossible. Our understanding of the terminology of the eclipse texts is much better than in Kugler's time, and we also now know the likely size of discrepancies between modern calculations and ancient observations. The eclipses 18 and 36 years earlier were invisible in Babylon, the one 54 years earlier (-576 June 14, see there) had magnitude 0.99. I conjecture that observations of

cyclically related earlier eclipses were faithfully recorded here in order to assist with observing anticipated eclipses. The obverse of the text certainly contains predictions. The eclipse of -522 July occurs in the Almagest (V,14), with the correct magnitude: one half of the diameter.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI1 3U VII	-518OCT28	12.47	3.16	29.5	13.63*	14.87*	16.37*	17.60*	1.48	85	245	17.52	17.60	6.41	7.09

LBAT *1419 Rev. I = H5,19

- 1' [... ... g]e₆? *ana*?
- 2' [... ...] *pap*?
- 3' [... *ana* š]ú? šamáš
- 4' [ki *pap nu*] *igi*?
- 5' [... ...]

- 1' [... ...] ...
- 2' [... ...] observed (?)
- 3' [... before] sunset (?)
- 4' [when watched, not] seen (?)
- 5' [... ...]

Comments. This is an interesting eclipse. Obviously it did not simply “pass”. But what was seen, if anything? According to calculation, the eclipsed Moon rose 5 minutes before the end of the eclipse, with the sun still above the horizon, and the end coincided with sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI1 21 VIII	-500NOV07	20.66	3.16	40.6	21.85	23.09	.57	1.81	1.47	88	247	17.12	17.44	6.57	6.96

LBAT *1419 Rev. II = H5,19

- 1 apin 13 *ina* 15 *ina* kur
- 2 *gab* šú 25 ír
- 3 *ina* 25 ta kur *ana* mar
- 4 zalág dir *ina* gar si
- 5 [*ina*] zalág ulù <gin> *ina* 1?,17
- 6 *ge*₆ gin

- 1 Month VIII, 13. In 15° (from) in the east.
- 2 totally covered. 25° duration of the maximal phase.
- 3 In 25° from east to west
- 4 it became bright. Clouded(or red?). During onset, north (wind),
- 5 during clearing south(wind) blew. At 1(?)17°
- 6 after sunset.

Comments. Compare -554OCT06 for parallel passages, and Hunger’s comments to line 1.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
XERXS 3 VIII	-482NOV19	4.93	3.14	51.8	6.10	7.33*	8.81*	10.04*	1.47	91	250	16.72	17.29	6.72	6.80

LBAT *1419 Rev. III = H5,21

- 1 apin 13 *id* ulù
- 2 tab ír nu *pap*? ád
- 3 šú *ina* an-m[i dele-bat] gub

4 tag₄ ^dudu-idim-me
 5 nu gub-me
 6 *ina* 10 uš *ana* zalág

1 Month VIII 13. Beginning on the south (error for east) side.
 2 Maximal phase not observed, it set
 3 eclipsed. During the eclipse, [Venus] stood (there),
 4 the other planets
 5 did not stand (there).
 6 At 10° before sunrise

Comments. The statement about the planets is correct.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
XERXS 21U III	-464JUN05	20.26	3.09	248.5	21.79	—	—	1.06	.95	65	302	18.80	19.10	4.90	5.23

LBAT *1419 Rev. IV top = H5,21

1' [... ...]
 2' *ina* 18[?] [...] ...]
 3' 40 gar í[r u zalág ...] túg an gar
 4' *ina* ki 4-àm ár šá pa ád kin dir
 5' izi 14[+x] *hi*[?]-*ši*[?]-ár-šú dumu-šú gaz-šú

1' [... ...]
 2' In 18°(?) [it became bright.]
 3' 40° total [duration. ...] the ‘garment of the sky’ was in place.
 4' In the region of the 4 rear stars of Sagittarius it was eclipsed. Month VI₂.
 5' Month V 14[+x] Xerxes was murdered by his son.

Comments. The Moon was at $\lambda=248.81^\circ$, $\beta=-1.30^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
XERXS 21U VIII	-464NOV29	13.24	3.09	63.0	14.36*	15.59*	17.06*	18.30	1.47	95	254	17.04	17.16	6.85	7.53

LBAT *1419 Rev. IV bottom = H5,21

1 apin 14 13 ge₆
 2 gin ta dir e
 3 4-ú hab-rat i[d si[?]]
 4 *u* mar šú 7 (? or 8?) [...]
 5 zalág [... ...]
 6 [... ...]

1 Month VIII 14. (After) 13° night
 2 it came out from a cloud (?).
 3 A quarter of the disk [on the north(?)]
 4 west side was covered. 7°(? or 8°?) [until it became]
 5 bright. [... ...]
 6 [... ...]

Comments. The text seems to indicate that the eclipse ended 20° or 21° (=13+7 or 8) after sunset. For “ta dir” see also –189 Aug. 23.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 18 IX	-446DEC10	21.56	3.01	74.2	22.61	23.84	1.30	2.53	1.46	100	258	16.66	17.07	6.93	7.31

LBAT *1419 Rev. V = H5,21

1 gan 13(+x) [...]
 2 [...] [...]

1 Month IX 13(+x) [...]
 2 [...] [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 22 XII	-441MAR25	4.08	2.82	178.4	5.08	—	—	8.49*	1.04	133	263	17.35	18.06	5.93	6.05

LBAT 1426 Col. I –1'ff. = H5,35

-1 [...] ... [...]
 0' [...] ... ád šú [...] ...]
 1' [...] ... ina uru šu-šá-an u edin igi 5 uš [ár ...] sa₄ šá [absin]

 -1 [...] ... [...]
 0' [...] ... it set eclipsed [...] ...]
 1' [...] ... was seen in the town of Susa and the open country. 5 uš [behind(?)] α Virginis(?).

Comments. The text spills far into Col. II, into space belonging to the (passing) eclipse of -423 Apr. 4. The Moon was at $\lambda=177.91^\circ$, $\beta=-0.33^\circ$. Note the use of uš as a measure of angle.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 23 VI	-441SEP18	12.74	3.02	349.5	13.87*	—	—	17.41*	.88	43	282	18.24	18.27	5.73	6.36
ARTX1 23 XII	-440MAR13	20.13	—	168.1	—	—	—	—	-.22	198	198	17.52	17.89	6.10	6.52

LBAT 1426 Col. I 2'ff. = H5,35

2' [...] ...]
 3' [...] ...]
 4' [...] ...] bar dib
 5' [...] ...] ša² dib

 2' [...] ...]
 3' [...] ...]
 4' [...] ...] BAR, passed
 5' [...] ...] which passed

Comments. The text preserved in lines 2' and 3' (not rendered here) seems to be spillover from the right hand column (see eclipse of -423SEP28, 18 years later).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 24A XI	-439FEB02	1.61	2.66	128.6	3.09	—	—	5.68	.44	52	327	16.70	17.28	6.71	6.87

LBAT 1426 Col. I 6'ff. = H5,37

6' [...] x+]8 al ½ hab i šú 10 uš ír
 7' [...] ga]r ír u zalág tíg an gar ulù gin
 8' [...] še] dir

- 6' [...] after $\alpha+\beta$ 8° a little over ½ of the disk was covered. 10° duration of maximal phase.
 7' [...] ... on]set, maximal phase and clearing. The ‘garment of the sky’ was in place, south (wind) blew.
 8' [...] Month] XII₂.

Comments. Translation of line 6' is uncertain.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 25 IV	-439JUL28	3.70	2.92	298.6	5.64*	—	—	7.88*	.28	138	209	18.43	19.04	4.96	5.05

LBAT 1426 Col. I 9' = H5,37

- 9' [2]5 šu ki kur šamáš dib
 10' [...] me n]im?
 9' [Year 2]5 (Artaxerxes I.), month IV, with sunrise, passed.
 10' [...] after sun]rise(?)

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 40A I	-424APR14	23.90	2.96	199.4	1.04	2.43	3.35	4.73	1.18	87	307	17.96	18.42	5.57	5.74

LBAT 1427 Rev. 1 ff. = H5,37

- 1 [...] [...] šú
 2 [...] [...] igi
 3 [...] ád mül-babbar⁷ ina pa genna ár si máš [...]
 1 [...] [...] ...
 2 [...] [...] ...
 3 [...] near star [...] eclipsed. Jupiter(?) in Sagittarius, Saturn behind β Capricorni [...]

Comments. Moon $\lambda=199.09$, $\beta=-1.09^\circ$; Jupiter $\lambda=247.25^\circ$, $\beta=0.49^\circ$; Saturn $\lambda=277.12^\circ$, $\beta=0.04^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 41 VI	-423SEP28	20.38	3.07	.4	21.52	—	—	1.13	.93	45	280	17.87	18.09	5.92	6.27

LBAT 1426 Col. II 2' = H5,37

- 2' [41] kin 14 50⁷ gin ina kur u si tab ina 22 2 si ana til tag₄ 5 ír ina 23 ana [mar zalág ...]
 3' 50 gar ír u zalág túg an gar mar gin 3 kùš sig sag hun [ád]
 2' [Year 41 (Artaxerxes I.)], month VI 14, 50°(?) after sunset, beginning on north-east. After 22° 2 fingers lacked to totality. 5° duration of maximal phase. In 23° toward [west it became bright ...]
 3' 50° onset, maximal phase and clearing. The ‘garment of the sky’ was in place, west (wind) blew. 3 cubits below α+β Arietis [eclipsed.]

Comments. The Moon was at $\lambda=0.34^\circ$, $\beta=-0.96^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 41 XII	-422MAR25	4.08	—	178.8	—	—	—	—	-0.13	198	198	17.32	18.07	5.93	6.09

LBAT 1426 Col. II 4' = H5,37

4' mu-sag ¹ú-ma-kuš šá da-ra-mu-šú mu-šú [... še šá dib ...]

4' Accession year of Umakuš, whose name ist Dareios (II.), [... month XII, which passed ...]

Comments. Dareios II. became king in the year 41 of Artaxerxes, month IX/X.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 1 V	-422AUG19	3.40	—	319.9	—	—	—	—	-1.32						
DARI2 1 VI	-422SEP17	20.00	—	349.2	—	—	—	—	-0.34						

LBAT 1426 Col. II 5' = H5,37

5' 1 izi 5(!) itu dib 1 ... [...]

5' Year 1, month V, 5 months, passed. 1 ...

Comments. Pinches' copy has 4 itu. Note that the lunar latitude in month VI (-422SEP17) is considerably smaller than at the syzygy a month before.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 1 XI	-421FEB13	9.80	2.66	139.5	11.34*	—	—	13.81*	.38	53	332	17.55	17.44	6.55	7.18

LBAT 1426 Col. II 6' = H5,37

6' zíz 14 šá dib *ina* 1,15² [... ...]

6' Month XI 14, which passed. At 1,15° (?) [... ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 2A V	-421AUG08	11.24	2.91	309.2	13.34*	—	—	15.27*	.18	140	200	18.88	18.91	5.10	5.89

LBAT 1426 Col. II 9' = H5,37

9' 2 izi 13 šá dib *ina* 35² [... ...]

9' Year 2, month V 13, which passed. At 35°(?) [... ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 2A XI	-420FEB02	17.65	2.66	128.6	18.32	19.50	21.12	22.30	1.65	94	285	17.04	17.29	6.71	7.14

LBAT 1426 Col. II 11'f. = H5,37

11' zíz 15 19 gin *ina* kur tab *ina* 14[+x ...]12' [... kù]š igi sag *a* ád

11' Month XI 15, 19° after sunset, beginning on the east. In 14°[+x total ...]

12' [... cubits] in front of ε Leonis eclipsed

Comments. On expects giš-kun *a* “θ Leonis”, which does not seem to be compatible with Pinches' copy. The Moon was at $\lambda=129.35^\circ$, $\beta=-0.23^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 8 XII	-414MAR26	11.19	2.83	180.1	13.21*	—	—	15.12*	.19	179	240	18.17	18.10	5.89	6.42

LBAT 1416 Rev. I = H5,11

- 1 [še ...] šá dib
 2 [...] 22[?] ana šú šamáš

- 1 [Month XII ...] which passed.
 2 [...] 22°(?) before sunset.

Comments. Instead of 22, also 12 or 32, perhaps even 15, 25, ... are possible.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 9 VI	-414SEP19	14.94	3.03	351.0	—	—	—	—	-.09	331	331	18.20	18.25	5.76	6.31

LBAT 1416 Rev. I bottom, 1415 Rev. I top = H5,11

- 1 [9 kin 1]4[?] 1 me
 2 [...] ...
 3 [...] ...
 4 [...] ... gle₆[?] gin
 5 [...] .. a-dir
 6 [...] 10
 7 [...] ...]

- 1 [Year 9 (Dareios II.), month VI 1]4(?), 1 me.
 2 [...] ...
 3 [...] ...
 4 [...] ... after sunset(?).
 5 [...] .. eclipsed
 6 [...] 10
 7 [...] ...]

Comments. This is a penumbral eclipse, with a negative magnitude of -0.09. Unfortunately, it is far from clear what was observed. If the Earth's shadow is increased by 7% (instead of 6%), one obtains a short eclipse, lasting from 18.00 to 18.26 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 9 XII	-413MAR16	3.96	2.77	169.8	4.94	6.04	7.47*	8.57*	1.52	130	288	17.16	17.91	6.08	6.19

LBAT 1415 Rev. I middle = H5,13

- 1 [še] dir
 2 [...] nu igi
 3 [...] igi
 4 [...] ge₆] ana zalág

- 1 [Month XII]
 2 [...] not seen
 3 [...] seen(?)
 4 [...] before sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 14 III	-409JUN28	8.47	3.02	269.7	9.54*	10.67*	12.31*	13.43*	1.84	86	263	18.44	19.20	4.80	4.66

LBAT 1427 Obv. 1'f. = H5,35

- 1' [...] 1,10 me n[im ...]
 2' [...] *ina* 2 i 1,8
 1' [...] 1,10° after sunrise [...]
 2' [...]

Comments. I do not understand line 2'; compare -405OCT10 for a similar passage. It possibly is an overflow from an eclipse 18 years earlier, which would have been reported in a column to the left of the preserved portion of the text. (The fragment is the lower right hand corner of a larger tablet.) Compare Obv. 12' and Rev. 1ff. (-407OCT31, -406APR26) for similar overflows.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 14 IX	-409DEC21	22.13	2.93	85.5	23.27	—	—	2.63	.95	66	302	16.58	17.03	6.98	7.31

LBAT 1427 Obv. 3'ff. = H5,35

- 3' [...] *si u k]ur tab ina 27 i ana til tag*₄[... ...]
 4' [...] *ana si zalág 2 kas gar ír [u zalág ...]*
 5' [...] 5 uš ár maš-maš ár *a-dir*[?] [...]
 3' [...] beginning on [north]east. After 27° a li(tle) remained to totality [...]
 4' [...] toward north it became bright. 2 *bēru* onset, maximal phase [and clearing ...]
 5' [...] 5 uš behind β Geminorum eclipsed. [...]

Comments. The Moon was at $\lambda=85.26^\circ$, $\beta=-0.67^\circ$. Note the use of uš as a measure of angle.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 15 III	-408JUN16	15.48	3.06	259.2	17.11*	—	—	19.64	.34	140	217	19.02	19.17	4.83	5.38

LBAT 1427 Obv. 6'f. = H5,35

- 6' [15 sig ... x+] 8 uš ge₆ gin *u zalág dir*[?] *ina ki pa ád*
 7' [...] sud *ana šá si*[?]
 6' [Year 15 (Dareios II.) month III ... x+] 8 uš night went by and it became bright. Clouds(?). In the region of Sagittarius eclipsed.
 7' [...] distant (or: red brown?) toward north(?).

Comments. In line 6', instead of 8, also 18 etc. is possible, but less likely. I do not understand the meaning of line 7'. The Moon was at $\lambda=260.03^\circ$, $\beta=0.33^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 15 IX	-408DEC10	12.12	—	74.6	—	—	—	—	-.21	359	359	17.10	17.07	6.94	7.70

LBAT 1427 Obv. 8' = H5,35

- 8' [...] *ś]á dib* 1,20 m[e nim]
 8' [...] which passed. 1,20 a[fter sunrise]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 16A II	-407MAY07	1.69	—	220.4	—	—	—	—	-.45						

LBAT 1427 Obv. 9' = H5,35

- 8' [16] *gu₄* 14 bar dib
 9' [Year 16], month II 14, BAR, passed.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 16A VIII	-407OCT31	15.85	3.17	33.7	18.20	—	—	20.08	.18	135	195	17.31	17.54	6.47	7.13

LBAT 1427 Obv. 10'ff. = H5,35

- 10' [a]pin 15 15 *ge₆* gin *ina* kur *u* ulù tab 4-ù hab šú *ana* dir *ku₄* *ina* zalág nu e
 11' [] 27 gar ír *u* zalág *ina* gar *u* zalág né-hi si gin 1 kùš *ina* igi // *gu₄-an ád*
 12' [...].. *u* an gub-me
 10' Month VIII 15, 15° after sunset, beginning on southeast. A quarter of the disk was eclipsed, (then) it entered a cloud, during clearing it did not come out.
 11' [] 27° onset, maximal phase and clearing. During onset and when it became bright, it was slow, north (wind) blew. 1 cubit in front of Taurus eclipsed.
 12' [...].. and Mars stood there, [the other planets did not stand there (?)].

Comments. Line 10': the remains of apin are clear, but conflict with LBAT *1422 – *1424, which has *du₆* “month VII”. The question is whether the intercalary month of year 16 is a VI₂ or a XII₂. Line 12' probably does not belong to this eclipse description; it seems to be an overflow from 18 years earlier, apart from the last three signs (*gu₄-an ád*), which continue line 11'. The Moon was at $\lambda=34.34^\circ$, $\beta=0.19^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 17 I	-406APR26	6.96	3.02	209.8	8.23*	9.90*	10.12*	11.80*	1.05	81	310	17.83	18.59	5.41	5.37

LBAT 1427 Rev. 1 = H5,37

- 1 17 bar 14 *šá* [dib]
 1 Year 17, month I 14, which [passed].

Comments. Lines 1 to 3 also contain text overflowing from 18 years earlier (-424 Apr. 14, see there).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 17 VII	-406OCT21	1.56	3.15	22.7	2.82	4.06	5.41	6.65*	1.39	87	240	17.29	17.72	6.29	6.48

LBAT 1427 Rev. 4ff. = H5,37

- 4 *du₆* 14 48 *ana* zalág *ina* kur tab *ina* 21[?] *gab* šú 12[?] [...]
 5 *ina* 15 nu nim[?] dir [...] ...]
 6 [múl-babbar *u* an] *ina* alla *gu₄-ud* *ina* rín [... *ina* igi[?]] múl-múl á[d[?]] [...]
 4 Month VII 14, 48° before sunrise, beginning in the east. In 21°(?) total, 12°(?) [duration of maximal phase]
 5 In 15° not [complete(?), it set (?) ...]
 6 [Jupiter and Mars] in Cancer, Mercury in Libra [...] in front of] the Pleiades eclipsed.

Comments. Jupiter $\lambda=101.46^\circ$, $\beta=0.39^\circ$, Mars $\lambda=90.99^\circ$, $\beta=1.34^\circ$, Mercury $\lambda=186.98^\circ$, $\beta=1.83^\circ$, Moon $\lambda=21.85^\circ$, $\beta=0.07^\circ$. Note that $21^\circ+12^\circ+15^\circ=48^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 18A I	-405APR15	19.29	2.96	199.5	20.37	21.60	22.71	23.94	1.27	125	269	18.13	18.43	5.57	5.93

LBAT 1427 Rev. 7f. = H5,37

- 7 [18 bar ge₆] gin *ina* kur tab *ina* 25° *gab šú* 19 ír [...] *ana* mar *zalág*
 8 [... *ina* an-]mi ...-... mül-babbar an *u* genna gub-me 1+[x kùš ár rín š]á ulù ád

7 [Year 18, month I x° after] sunset, beginning in the east. In 25°(?) total. 19° duration of maximal phase [...] toward west it became bright.

8 [... During the] eclipse, ..., Jupiter, Mars and Saturn stood there 1+[x cubits behind] α Librae eclipsed.

Comments. Jupiter, Mars and Saturn were above the horizon. Moon at $\lambda=200.16^\circ$, $\beta=-0.09^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 18A VII	-405OCT10	4.14	3.12	11.5	5.32	—	—	8.97*	.96	46	279	17.50	17.91	6.10	6.18

LBAT 1427 Rev. 9f. = H5,37

- 9 [du₆ ...] ... kur *ina* 2 i 14 *ana* *zalág* *ina* kur tab [...] ...]... ak⁷ šá
 10 [...] mül-babbar *dele-bat* gu₄-ud *u* ge[nna gub-me ...]

9 [Month VII ...] 14° before sunrise, beginning in the east. [...] ...

10 [...] Jupiter, Venus, Mercury and Sa[turn stood there ...]

Comments. I do not understand the “*ina* 2 *i*” in line 9. Compare -409JUN28 for a similar passage. All planets except Mars were above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 7A XII ₂	-396APR05	18.92	2.91	190.7	21.19	—	—	22.72	.09	185	233	17.98	18.28	5.72	6.08

LBAT 1416 Rev. II middle, = H5,13

- 1 dir-še 14
 2 *id* ulù tab
 3 4-ú hab šú
 4 *ana* mar *zalág* 27
 5 gar ír *u* *zalág*
 6 túg an gar ulù gin
 7 *ina* 48 ge₆ gin

- 1 Month XII₂ 14.
 2 Beginning on the south side,
 3 a quarter of the disk covered.
 4 It became bright toward west. 27°
 5 onset, maximal phase and clearing
 6 The ‘garment of the sky’ was in place, south(wind) blew.
 7 At 48° after sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 8 VI	-396SEP29	22.53	3.07	2.0	—	—	—	—	-0.14			17.88	18.07	5.94	6.21

LBAT 1416 Rev. II, bottom, 1415 Rev. II top = H5,13

- 1 8 kin 14 1½
 2 si [...]
 3 *ina* 1,20 *ge*₆ *ana* *zalág*

- 1 Year 8 (Artaxerxes II.) month VI 14, 1½
 2 fingers(?) [...]]
 3 At 1,20° before sunrise.

Comments. What was observed? Fractions of fingers are very unusual, and therefore questionable. It is doubtful whether the penumbral eclipse of -396SEP29 was visible (negative magnitude -0.14), but the time is at least approximately correct. If the radius of the Earth's shadow is increased to just a little above 11% (11.1%, instead of 6%), one obtains a short eclipse lasting from 1.71 to 1.88 LT. Compare -302SEP11.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 8 XII	-395MAR26	11.88	2.84	180.5	12.95*	14.08*	15.41*	16.54*	1.43	133	286	18.16	18.11	5.89	6.36

LBAT 1415 Rev. II middle = H5,13

- 1 še 14 šá dib
 2 *ina* 1/3 *kas* *ana* šú šamáš

 1 Month XII 14, which passed
 2 At 1/3 *bēru* before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 9 VI	-395SEP18	22.69	3.03	350.7	23.85	1.29	2.22	3.65	1.17	41	261	18.03	18.26	5.75	6.02

LBAT 1415 Rev. II bottom = H5,13

- 1 9 kin 13
 2 [... ... *ina*] 21?
 3 [gab šú]

 1 Year 9, month VI 13
 2 [... after] 21°(?)
 3 [total ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 16U VII	-388OCT31	9.87	3.17	33.9	11.15*	12.40*	13.73*	14.98*	1.37	90	242	17.52	17.53	6.48	7.31

LBAT *1414 Rev. I = H5,5

- 1 [du₆ 1]4 šá dib
 2 [*ina*] 1 me nim
 3 [...]
 4 [kin] dir

 1 [Month VII 1]4, which passed
 2 [At] 1,0° after sunrise.
 3 [...]
 4 [Month VII]₂.

Comments. Restored according to LBAT *1422 - *1424; but as the present text mentions the intercalary month *after* the eclipse, a month XII₂ in line 3 would certainly look more natural.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 22 III	-382JUN29	13.46	—	271.3	—	—	—	—	-81						

SH1,75, Obv.

16' [... g]e₆ gin nu pap

16' [... lunar eclipse which passed. x°] after sunset; I did not watch.

Comments. To my knowledge, this damaged passage is unique in that a passing eclipse is accompanied by the comment “I did not watch”. There is no lunar eclipse (the moon does not enter the earth’s shadow). The syzygy occurs at 16.5h true local time, i.e. more than 2 hours *before* sunset (19.1h). Note that this eclipse possibility is farther away from the node than the one a month later: -382JUN29 has lunar latitude +1.36° and magnitude -0.81, while the following one of -382JUL29 has latitude -1.21° and magnitude -0.39.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 22 IX	-382DEC23	4.85	2.91	87.2	6.92*	—	—	8.90*	.21	25	321	16.39	17.02	6.98	7.03
ARTX2 23 III	-381JUN18	18.01	3.05	260.7	19.72	—	—	22.64	.49	145	235	18.93	19.18	4.82	5.23
ARTX2 23 IX	-381DEC12	19.97	3.00	76.4	21.21	22.32	23.70	.80	1.48	66	270	16.73	17.06	6.94	7.47

LBAT *1429 = BM 37088+37652, Col. I' = H5,39

1' [...] ... alla

2' [...] ...

3' [... gi]n 2/3 hab

4' [...] ád

5' [...] gab šú

6' [...]

7' [... maš-maš] igi ád

1' [...] ... Cancer

2' [...] ...

3' [... after x night]time 2/3 of the disk [covered]

4' [...] eclipsed.

5' [...] totally covered

6' [...]

7' [...] α Gem[inorum] eclipsed.

Comments. Dated and restored (by Hunger and Walker) on the assumption that col. I' contains eclipses 18 years earlier than col. II'.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 25 VIII	-379NOV20	22.10	—	54.6	—	—	—	—	-.35						

LBAT 1416 Rev. III top = H5,13

8' [...] ...]

9' ...[...]

10' ina 20 me nim

- 1' [...] ...]
 2' ...[...]
 3' At 20° after sunrise

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 26A I	-378APR17	2.56	2.97	201.2	5.21	—	—	6.14*	-0.02	193	222	17.77	18.45	5.54	5.73

LBAT 1416 Rev. II middle = H5,13

1 26 bar 13[]

2 *id kur tab ád šú*3 1 2/3 kùš *ina igi si*4 máš *ád si šá pa*5 *kur gar gin*6 *ina 10 uš ge₆*7 *ana kur šamáš*

1 Year 26, month I 13

2 beginning on the east side. It set eclipsed.

3 1 2/3 cubit in front of the horn

4 of Capricorn (β Capricorni) eclipsed. North(wind) which was set
to the east side blew.

5 At 10° night

6 before sunrise

Comments. Calculation gives a deep penumbral eclipse (magnitude -0.02). But, (i) instead of east side, one expects south side, and (ii) β Capricorni ($\lambda = 271.0$) is impossible. The Moon was at $\lambda=200.71^\circ$, $\beta=0.22^\circ$. Scribal errors? The date is fixed by the position on the grid of the compilation, and there is no other eclipse on a year 26, month I.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 26A VII	-378OCT11	6.27	—	13.0	—	—	—	—	-0.19						

LBAT 1416 Rev. III bottom, 1415 Rev. III top = H5,15

1 *du₆ 13 šá dib*2 *ina 15[?] me[?] [nim]*

1 Month VII 13 which passed.

2 At 15°(?) [after sunrise].

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 26A XII	-377APR06	19.68	2.91	191.1	20.85	22.03	23.20	.39	1.32	136	282	17.95	18.28	5.71	6.01

LBAT 1415 Rev. III middle = H5,15

1 *dir-še 15 id ulù*2 *ki tab [ina] 15 gab šú 21*3 *ír ta kur ana zalág*4 *ki tab [ina] 19 ge₆ ana mar*

5 zalág 45 gar ír u za[lág]
 6 14 si *ina* igi rín šá [ulù]
 7 ád an-mi-šú m[ar²]
 8 šá ana ulù sal[-pu gin]
 9 *ina* 37 [ge₆ gin]

1 Month XII₂ 15, beginning on the south[east]
 2 side. [After] 15° total. 21° duration of
 3 maximal phase. When it began to get bright from the east,
 4 [in] 19° toward west it became
 5 bright. 45° (error for 55°) total duration
 6 14 fingers in front of α Librae
 7 eclipsed. (During) its eclipse, we[st(wind) blew],
 8 which was slan[ted] toward south.
 9 At 37° [after sunset]

Comments. The Moon was at $\lambda=191.67^\circ$, $\beta=-0.13^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 29A XI	-374FEB03	4.33	2.66	129.9	6.43	—	—	7.90*	.05	180	222	16.60	17.30	6.70	6.88

SH1,97

Rev.'

2 ... ge₆ 14 12 me *in* 6 uš ge₆ *ana* zalág *si*[n an-mi ...]

2 (Month XI ...) Night of the 14th, moonrise to sunset: 12°. At 6° night before sunrise, lu[nar
eclipse ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 34 II	-370MAY17	20.96	3.09	230.7	22.50	—	—	1.74	.78	66	314	18.58	18.90	5.09	5.34

LBAT *1414 Rev. II top = H5,5

1' [...] ...]
 2' [...] m]ar²
 3' [...] ...] si gin
 4' [...] ád *ina* an-mi genna
 / e si₄ gub
 / *ina* 1,6 ge₆ gin

1' [...] ...]
 2' [...] ...]
 3' [...] north(wind) blew.
 4' [...] eclipsed. During the eclipse, Saturn
 stood above α Scorpii.
 At 1,6° after sunset.

Comments. On the tablet, the last three lines from a single line, spilling into the next two columns (18 and 36 years later). The column boundaries are indicated by slashes. Saturn at $\lambda=218.38^\circ$, $\beta=2.28^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 34 VIII	-370NOV11	18.24	3.16	45.0	19.51	20.78	22.09	23.35	1.36	93	244	17.11	17.37	6.63	7.14

LBAT *1414 Rev. II bottom = H5,5

- 1 apin 15 *id si*
 2 *u kur ki tab ina 22 gab šú*
 3 20 ír *ina 21 ta*
 4 *kur ana bi si u mar zalág*
 5 2 uš *al zalág tag₄*
 6 mál-babbar *ina a e 1,3 gar*
 7 ír *u zalág an-mi-šú sa₅ šú?*
 8 [...] *igi² šur gigir šá ulù*
 9 [...] *ana si sal-pu gin*
 10 *ina an-m[i-š]ú gír gír gù dIM*
 11 *ina 30 ge₆ gin*

- 1 Month VIII 15, beginning on the
 2 northeast side. After 22° total.
 3 20° duration of maximal phase. In 21° from
 4 east to between north and west it became bright.
 5 (When) 2° remained to clearing,
 6 Jupiter came out in Leo. 63° onset,
 7 maximal phase and clearing. Its eclipse was red(?) or clouded(?)
 8 in front of(?) ζ Tauri.
 9 [...] to north slanted, blew.
 10 During its eclipse lightning flashed, thunder (“roaring of Adad”)
 11 At 30° after sunset.

Comments. The passage about Jupiter ($\lambda=115.30^\circ$, $\beta=0.75^\circ$), if it has been correctly interpreted, is significant because it gives a tight timing. I assume that the sign E stands for e (also written e-a, è, è-a), “to come out”, and according to calculation, Jupiter rose 3.2 uš before the end of totality, see Section 2.6. The Moon was at $\lambda=45.42^\circ$, $\beta=-0.21^\circ$. The interpretation of l. 10 was suggested by Sachs.

The eclipse is also reported in

LBAT 181 Rev. 8'f. = SH1,123

- 8' *ki tab-ú ina 21 ge₆ gab-bi-šú šú 20 ge₆ [ír ...]*
 9' *rín šá ulù a-dir ina an-mi-šú gír gù u an [...]*
 10' *maš-maš igi 1 kùš in en 18 mál-babbar ana nim ki [uš-ú ...]*
 8' [...] beginning in the [northeast]. After 21° covered in its totality. 20° duration [of maximal phase ...]
 9' α Librae eclipsed. During its eclipse, lightning, thunder, rain[...]
 10' α Geminorum 1 cubit. Around the 18th Jupiter became stationary in the morning. [...]

Comments. Note the variant in the duration of the first phase. The first sign in line 9' perhaps should be emended into gigir, cf. LBAT *1414, line 8. The second part of line 10' does not belong to the eclipse report anymore, but it was included here because it mentions a Jupiter event.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 38 V	-366AUG30	1.67	2.95	331.0	2.85	4.03	5.23	6.40*	1.34	91	238	18.12	18.59	5.42	5.58

LBAT 186 Rev. 5f. = SH1,135

- 5 [...] 5,30 šú ge₆ 13 9 me 56 ge₆ *ana kur šamáš tag₄ sin an-mi id kur u ul[ù ki tab-ú ...]*
 6 [...] kùš ár *qup-pu ár šá gu a-dir si gin áš-šá an-mi-šú a[n ...]*

- 5 [... ... 1]5;30° šú. Night 13, 9° me.[When] 56° night were remaining to sunrise, a lunar eclipse began on the southeast side[... ...].
 6 [...] cubits behind the rear *quppu* (container) of Aquarius eclipsed. Northwind blew. In its eclipse Mars(?) [rose(?).]

Comments. The star mentioned in 1. 6 is not otherwise known to me; it is situated in the big gap between 290° and 350° in the list of Normal Stars. Compare also the eclipse of -123AUG13. The Moon was at $\lambda=330.09^\circ$, $\beta=0.02^\circ$. According to calculation, Mars rose at 3.58 LT, i.e. during onset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 40A X	-363JAN02	13.58	2.82	98.4	15.58*	—	—	17.55	.21	30	326	16.98	17.03	6.96	7.66
ARTX2 41 III	-363JUN29	.51	3.01	271.1	2.39	—	—	4.94*	.33	147	224	18.71	19.20	4.81	5.03
ARTX2 41 IX	-363DEC23	4.90	2.91	87.6	6.05	7.16*	8.53*	9.64*	1.48	71	275	16.33	17.02	6.98	7.05
ARTX2 42 III	-362JUN18	1.24	3.05	260.4	2.23	3.43	5.11*	6.32*	1.73	103	277	18.68	19.17	4.82	4.98
ARTX2 42 IX	-362DEC12	20.12	3.00	76.8	21.32	—	—	.70	1.03	104	233	16.69	17.06	6.95	7.48
ARTX2 43A III	-361JUN07	5.95	3.08	249.9	7.42*	—	—	10.33*	.55	62	326	18.39	19.11	4.89	4.85

LBAT *1429 = BM 37088+37652, Col. II' = H5,39f.

- 1' [a]b[?] [1]4[?] 1 me *a-kám muš* [...]
 2' ta *a-kám ki e* 2,10[+20[?] ...]
 3' ád 10 uš [zal]ág[?] *ina ki alla a-[dir]*
 4' 41 sig 14 40 [ge₆] *ana zalág [al]*
 5' ½ hab *i šú* 2 kùš *ina igi si* [máš *adir*]
 6' gan 14 14 ge₆ *ana zalág* 2,10+[20[?] ...]
 7' 1 s[i ta]g₄ ád *šú* 2 ½ kù[š]
 8' [ár maš-maš] ár ád
 9' [42 sig[?] 1]4 41 <ge₆> *ana zalág gab šú* ...
 10' [...]
 !! continued by BM 37088:
 1' gan ge₆ 15 an-[mi[?] ...]
 2' til-tim[?] dir nu pap [...]
 3' *ina* 1,4 ge₆ [...]
 4' 43 sig 13 ... [...]
 5' [...] ... [...]
 1' Month X 14, 1 ME, mist, measured [...].
 2' When it rose from the mist, the left[? (side) was]
 3' eclipsed. In 10° it cleared. In the region of Cancer eclipsed.
 4' Year 41, month III 14, at 40° before sunrise
 5' a little [over] ½ of the disk was covered. 2 cubits in front of β Cap[ricorni eclipsed.]
 6' Month IX 14, 14° before sunrise, the left[? (side) ...]
 7' 1 finger remained, it set eclipsed. 2 ½ cubits
 8' [behind] β Gem[inorum] eclipsed.
 9' [Year 42, month III(?) 1]4, 41° <nighttime> before sunrise, totally covered ...
 10' [...]
 !! continued by BM 37088:
 1' Month IX, night of the 15th, ec[lipse(?) ...]
 2' totality, cloudy, not observed [...]
 3' At 64° nighttime [after sunset].
 4' Year 43, month III 13, ... [...]
 5' [...] ... [...]

Comments. Date: for eclipses in a regnal year 41, months III and IX, the only possibility is in the reign of Artaxerxes II. In lines 2' and 6', reading 2,30 “left (side)” follows a suggestion by C. B. F.

Walker. Moon positions: -363JAN02 $\lambda=99.20^\circ$, $\beta=-1.46^\circ$; -363JUN29 $\lambda=270.53^\circ$, $\beta=0.10^\circ$; -363DEC23 $\lambda=86.87^\circ$, $\beta=-0.85^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 45A I	-359APR17	3.36	2.98	201.7	4.64	5.92*	6.84*	8.11*	1.20	138	277	17.75	18.46	5.54	5.66

LBAT 1415 Rev. IV = H5,15

- 1 45 bar 10[+x ...]
 2 ana kur šamáš ...[...]
 3 ta ... [...] ... [...]

- 1 Year 45 (Artaxerxes II.), month I 10[X ...]
 2 before sunrise ...[...]
 3 from ... [...] ... [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX3 1 XI	-356FEB14	11.83	2.66	140.8	14.13*	—	—	15.19*	-0.01	189	219	17.42	17.46	6.54	7.04

SH1,141

- 5' ina 40 me ana šú šamáš an-mi sin bar dib ...
 5' At 40° of day before sunset, lunar eclipse, BAR, passed. ...

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX3 6 II	-352MAY28	3.97	3.09	241.1	5.65*	—	—	8.68*	.64	58	315	18.41	19.03	4.97	4.98

LBAT *1414 Rev. III top = H5,5

- 1' [...] ...]
 2' ina 7 me? nim?
 1' [...] ...]
 2' At 7° after sunrise(?)

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX3 6 VIII	-352NOV22	2.63	3.13	56.2	3.86	5.13	6.43	7.70*	1.35	96	248	16.70	17.24	6.77	6.95

LBAT *1414 Rev. III bottom = H5,5f.

- 1 apin 14 id ulù
 2 u kur ki tab ina 23
 3 gab šú 18 ír ina? 6
 4 ge₆ 4-ú id kur zalág
 5 ád šú an-mi sa₅ 1½ kùš
 6 ár šur gigir šá ulù ád
 7 ina an-mi genna gub
 / íb ^dudu-idim-me
 8 nu gub-me si ana
 / mar sal-pu gin
 9 ina 47 ge₆ ana zalág

1 Month VIII 14, beginning on the
 2 southeast side. After 23°
 3 total. 18° duration of maximal phase. After 6° night,
 4 a quarter of the disk on the east side had become bright, (and)
 5 it set eclipsed. The eclipse was red. $1\frac{1}{2}$ cubits
 6 behind ζ Tauri eclipsed.
 7 During the eclipse, Saturn stood there
 the other planets
 8 did not stand there. North(wind), to
 west slanted, blew
 9 At 47° before sunrise.

Comments. Lines 7 and 8 spill into the next column. Calculation gives end of totality at 6.43 LT, moonset at 6.95; the difference is $0.52h = 8^\circ$. The Moon was at $\lambda=55.35^\circ$, $\beta=-0.03^\circ$. Saturn was the only planet above the horizon. Note that the intervals given in the text: onset ($C_2-C_1=23^\circ$), totality ($C_3-C_2=18^\circ$) and $MS-C_3=6^\circ$ add up to $MS-C_1=47^\circ$. On the other hand, the text states that $SR-C_1=47^\circ$, and calculation has $MS-SR=3^\circ$, so there is a 3° discrepancy!

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX3 12 X	-345JAN13	22.25	2.75	109.5	.19	—	—	2.11	.20	34	332	16.66	17.09	6.90	7.21

SH1,145

Obv.

20 ... in 1,25 [...]
 21 sin an-mi id si u kur ki tab-ú [...] 14 ge₆ ana si zalág 23 gar u zalág [...]
 22 si šár ina gar an šú mól-babbar u [genna g]ub-meš si šá [...] ... 5 kùš sig sag ur-a 2 kù[š ana ...]

 20 ... At 85° [after sunset(?)]
 21 a lunar eclipse, on the north and east side when it began [...] in 14° night, it cleared toward the
 north(?) ... ; (duration of) onset and clearing 23° [...]
 22 gusty north wind; during onset, Mars set, Jupiter and [Saturn st]ood there; north wind which [...] ... 5 cubits below ε Leonis, 2 cubi[ts to ...]

Comments. Mars set at 22.06 UT = 0.81 LT. The Moon was at $\lambda=109.34^\circ$, $\beta=-1.14^\circ$. Note that the duration of maximal phase appears to be zero. Jupiter and Saturn were the only planets above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI3 1A IX	-334DEC03	11.02	3.07	67.4	12.20*	13.48*	14.77*	16.05*	1.34	101	252	17.07	17.12	6.89	7.66

LBAT *1414 Rev. IV bottom = H5,7

1 gan 14 šá dib
 2 ina 1 me ana šú šamáš
 3 še dir

 1 Month IX 14, which passed.
 2 At $1,0^\circ$ before sunset.
 3 Month XII₂.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI3 2 II	-333MAY29	1.02	3.09	241.4	2.21	3.28	4.88	5.94*	1.81	99	274	18.48	19.03	4.96	5.13

SH1,165

1 [...] 4² sin an-mi ina si² u² [kur] ki tab-ú ina 10 uš g[e₆] [...]8' [...] 4th, lunar eclipse; when it began in the north[-east], in 10° night [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI3 5 VI	-330SEP20	18.34	3.04	352.8	19.66	20.91	21.88	23.13	1.22	92	232	17.99	18.22	5.79	6.31

SH1,177

3' [...] ge₆ gab-šú šú 10 uš ge₆ [gin ...] ^{he-pī} mál-babbar šú genna [...]4' [...] ina ír mar ina zalág kur gin-me x [...] 4-ú KAxŠID ina an-mi NAM.ÚŠ-me u šip-ti ina² [...]3' [...] lunar eclipse] ... in its totality covered; 10° of night [totality(?)] ^{broken} Jupiter set; Saturn [...]4' [...] during maximal phase west wind, during clearing east wind blew; ... [...] fourth(?) ... ;
during the eclipse, deaths and plague(?) [...] in [...]

Comments. Jupiter set during onset at 17.31 UT = 20.35 LT. Saturn was the only other planet above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ALEXG 8 X	-327JAN24	6.81	2.69	120.6	8.73*	—	—	10.59*	.18	37	337	16.36	17.19	6.81	6.77
ALEXG 9 IV	-327JUL20	13.71	2.93	292.1	16.09*	—	—	17.52*	.04	156	197	18.98	19.10	4.91	5.52
ALEXG 9 X	-326JAN13	22.54	2.74	109.9	23.54	.66	2.01	3.13	1.45	80	286	16.60	17.09	6.90	7.25
ALEXG 10A IV	-326JUL09	14.37	2.97	281.3	15.36*	16.63*	18.08*	19.35	1.43	103	258	19.08	19.17	4.83	5.38
ALEXG 10A X	-325JAN03	13.65	2.82	99.2	14.66*	—	—	18.07	1.04	113	244	16.91	17.04	6.96	7.74

BM 36612+37043+37107 (= 80-6-17, 342+787+856), Col. II = H5,49f.

2 ab 13 20+[x ...]

3 mu 9 ¹a-le[k-...]4 ab² [g]e₆ 14 8 [...] ge₆ gin sin an-mi ina kur ki tab-[ú]5 [ina x ge₆] gab-bi-šú šú 7 ge₆ ír ina 16 ge₆ ta [...]

6 [...] ulù u kur ana mar zalág 4 kùš sig sag ur-a ád 50+[x]

7 ge₆ gar ír u zalág ina gar u zalág ha-muṭ ina ír né-hi ina g[ar]8 genna šú an-mi-šú an gub íb-tag₄ ^dudu-idim-me nu gub-m[eš]9 an-mi-š[ú] sa₅ ina gar mál gal šá ma-gal kur u meš-hat tuk-ú10 ta ki nu-nu² [...]

11 mu 10 ... [...]

12 sin ta a-k[ám] ...]

13 ina 9 ge₆ zalág-i[r]

14 nu gub-meš an-m[i] ...]

15 ab ge₆ 15 2 me [...]

16 al-la 4-ú hab-rat [...]

17 ana id si u mar² [...]

18 ... [...]

- 1 Month X, the 13th, 20+[x after sunrise(?), lunar eclipse which passes.]
- 2 Year 9 Ale[xander...]
- 3 Month X, night of the 14th, 8 [...] after sunset, lunar eclipse. When it began on the east side,
- 4 [after x° of nighttime] it was totally covered. 7° of nighttime maximal phase. In 16° nighttime from [...]
- 5 ... south-east toward west it cleared. 4 cubits below ε Leonis eclipsed. 50+[x]
- 6 of nighttime total duration. During onset and clearing it was fast, during maximal phase it was slow. During o[nset],
- 7 Saturn set. (In) its eclipse, Mars stood there, the other planets did not stand there.
- 8 Its eclipse was red. During onset, there was a meteor, which was very bright and had a tail.
- 9 [It moved] from the area of the Fishes [...]
-
- 10 Year 10 ... [...]
- 11 [when] the moon [rose] from mist [...]
- 12 in 9° of nighttime it clear[ed ...]
- 13 did not stand there. Eclip[se ...]
-
- 14 Month X, night of the 15th, 2 ME [...]
- 15 over a quarter of the disk [...]
- 16 toward the north-west side [...]
- 17 ... [...]

Comments. The 7° in line 4 is too small (expected: 20°) and probably should be emended to 17°, since onset+totality+clearing must add up to at least 50° (line 5). Eclipse of -326JAN13: Moon $\lambda=109.68^\circ$, $\beta=-0.47^\circ$; Mars was the only planet above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ALEXG 12 II	-324MAY19	1.09	—	232.6	—	—	—	—	-39						

SH1,195

5' ... an-mi s[in ...]

5' ... lu[nar] eclipse.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
PILIP 2A I	-321APR17	17.40	2.98	202.0	20.00	—	—	20.31	-07	32	23	18.28	18.47	5.52	5.76

SH1,221

9 ... an-mi sin šá dib ...

9 ... lunar eclipse which passed ...

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
PILIP 7 III	-316JUN18	18.08	3.05	262.0	20.02	—	—	22.49	.37	38	318	19.01	19.18	4.82	5.23

LBAT *1414 Rev. IV+V top = H5,7

- 1' [...] ...]
 2' [...] an[?][-mi]
 3' mar ana si sal-pu gin 5[?] [kùš]
 4' ina igi si máš ád ina 10 uš
 5' ge₆ gin

- 1' [...] ...]
 2' [...] eclipse
 3' West wind, to north slanted, blew. 5(?) [cubits]
 4' in front of β Capricorni eclipsed. At 10°
 5' after sunset

Comments. The text properly belongs into Col. V, but all lines, except the last, start in Col. IV. The Moon was at $\lambda=262.56^\circ$, $\beta=-1.46^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
PILIP 7 IX	-316DEC13	19.39	2.99	78.6	20.48	21.76	23.05	.33	1.34	105	256	16.70	17.05	6.96	7.41

LBAT *1414 Rev. V bottom = H5,7

- 1 gan 15 id ulù u kur
 2 ki tab ina 19[!] gab šú 5 ír
 3 ina 16 ana bi si u kur zalág
 4 40 gar ír u zalág ina gar ír
 5 né-hi ina zalág ha-mut
 6 an-mi-šú sa₅ 1½ kùš
 7 ina igi maš-maš ár ád ina 44 g[e₆ g]in
 8 gan ina 27 pi-il-l[i- ...]
 9 1 mu-2-kám ¹an-ti-gu-nu-su
 10 dumu pi[?]-ru

- 1 Month IX 15, beginning on the southeast side.
 2 After 19° total. 5° duration of maximal phase.
 3 In 16° to between north and east it became bright.
 4 40° total duration. During onset (and) maximal phase
 5 it was slow, when clearing, it was fast.
 6 Its eclipse was red. 1½ cubits
 7 in front of β Geminorum eclipsed. At 44° after sunset.
 8 Month IX 27 Phil[ip died(?)].
 9 1 (The following year is) Year 2 Antigonus,
 10 son of Piru (?).

Comments. Reading of 1. 5 suggested by Sachs; note that the onset (19°) took longer than the clearing (16°), so the latter was “fast”. The duration of totality is about an hour too short, and this error is inherited by the total duration. The Moon was at $\lambda=78.94^\circ$, $\beta=0.03^\circ$. Lines 9f. apparently serve as catchlines: they are at the very end of the tablet, and they are set off from the preceding text by a vertical wedge (the number 1 at the beginning of line 9).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 4A IV	-307JUL09	2.94	2.97	281.2	4.06	—	—	7.55*	.99	64	297	18.63	19.17	4.83	4.90

LBAT 217 = SH1,243

5' 10 uš ge₆ ana zalág sin an-mi [...]

6' [...] ... ár si más ár 13 50 gar na ...

SH1,239

6' ^dudu-idim-meš gab-bi nu gub-meš [...]*Composite translation:*

5' ... 10° before sunrise lunar eclipse [...]

[... during the eclipse]

none of the planets stood there.

6' [...] behind the rear horn of the goat fish. On the 13th 50 GAR (= 0°;50) NA.

Comments. The Moon was at $\lambda=280.42^\circ$, $\beta=-0.87$. The “horn of the goat fish” is identified with β Capricorni, the “rear star of the goat fish” with δ Capricorni. What is the “rear horn”? The Moon was near θ Capricorni ($\lambda=281.84^\circ$, $\beta=-0.31^\circ$ in -300).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 7A II	-304MAY08	16.39	3.07	222.9	17.51*	18.66*	20.18	21.33	1.57	105	302	18.65	18.80	5.20	5.55

SH1,243

6' [... a-kám mu]š sin ta a-kám ki e-a al ½ i

7' [tag₄ ... s]i u mar zalág 1,7 gar ír u zalág8' [... ki² i]z-ku-ú mól-babbar e-a ina 10 uš me ana šú šamáš

6' [...] measured (despite) [mist]; when the moon came out from the mist, a little more than half

7' [of the disk was eclipsed ...] it cleared on the north-west side; 1,7° onset, totality and clearing;

8' [... when(?)] it had cleared, Jupiter came out; (the eclipse began) at 10° before sunset.

Comments. The date (taken from Sachs and Hunger) is questionable and may be wrong. Hunger's statement that Jupiter rose after totality, but before the end of the eclipse, is in error (mix-up between UT and LT?). Actually, Jupiter ($\lambda=297.05^\circ$, $\beta=-0.74^\circ$) rose at 21.07 UT = 0.14 LT, i.e. 2.8 hours after the end of the eclipse. Also the other times do not fit well.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 9A VI	-302SEP11	17.73	3.00	344.0	20.55	—	—	21.21	-.05	341	321	18.27	18.37	5.64	6.16

SH1,249

19' ge₆ 15 an-mi sin 1 si ki pap nu igi19' Night of the 15th, lunar eclipse of 1 finger; when I watched I did not see it.

Comments. One of the rare cases where a predicted lunar eclipse, contrary to expectation, did not occur. Apparently, a grazing eclipse had been expected. Calculation gives a penumbral eclipse (negative magnitude -0.05). If the radius of the shadow of the earth is increased by 4%, we obtain a short eclipse (11 minutes), with 3.5% no eclipse.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 9A XII	-301MAR07	13.53	2.73	162.3	14.43*	15.82*	16.71*	18.11	1.17	139	278	17.73	17.80	6.20	6.61

SH1,251

17 ge₆ 14 an-mi *sin in[a?* ...]17 Night of the 14th, lunar eclipse ...[...]

Comments. The wording of the text (“an-mi *sin*”) suggests a predicted eclipse, not observed. According to calculation, the eclipse ended 23 minutes after moonrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 20A V	-291AUG11	3.31	—	313.3	—	—	—	—	-.21						

SH1,273

*Text B:*16 ... ge₆ 1[4]17 4,40° me 27 me nim an-mi *sin bar dib* 14 1,30 na ...16 Night of the 14th,17 4;40° ME; at 27° of day after sunrise, lunar eclipse, BAR, passes; on the 14th, 1;30° NA ...*Text A records the NA before the eclipse:*14' 14 1,30 na an-mi *sin bar* [dib ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 25 II	-286MAY19	23.49	3.09	233.3	.61	1.74	3.35	4.47	1.71	106	295	18.46	18.94	5.06	5.25

SH1,289, Obv.

9' [...] 8 ... [x x x] ... ge₆ ír [...]10' [...] gar í[r u zalág ... ina í]r genna šú íb-[tag₄ ^dudu-idim-meš nu gub-meš ...]

9' [...] 8 ... [...] ... night, totality [...]

10' [...] ... onset, totality, and clearing ... during totality, Saturn set; the remainder of the planets did not stand there ...]

Comments. Saturn ($\lambda=166.61^\circ$, $\beta=2.63^\circ$) set at 23.16 UT = 2.25 LT. Mars was above the horizon (and probably was mentioned in the gap).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 27 XII	-283MAR17	21.01	2.79	173.0	22.03	23.57	.08	1.63	1.08	143	276	17.60	17.97	6.02	6.29

SH1,303, Rev.

40' [...] 53° g[e₆ ...]40' (Month XII.) Night of the 13th ... [...] after] 53°(?) ni[ght lunar eclipse...]

Possibly, this eclipse is also reported in

LBAT 1452 = H5,53

- 1' [...] [...]
 2' [... sin] an-mi ki tab-ú ina 22 ge₆ gab-bi
 3' [...] šú 22 ge₆ ír ana zalág-ru ki tab-ú
 4' [ina 21 ge₆ ta] kur ana mar zalág-ir 1^{?,5} gar
 5' [ír u zalág] an-mi-šú sa₅ nim-gír id ulù
 6' [...] nim-gír?
 7' [...] u kur gin ina zalág-ru si gin ina an-mi-šú dele<-bat?
 8' [... u ge]nna gub-meš ina sag gar mál kak-ban šú
 9' [... s]a₄ šá absin a-dir ... [...] ...]
 10' [...] ... [...] ...]

- 1' [...] ... [...] ...
 2' [... lunar] eclipse; when it began, in 22° it was completely
 3' [...] covered. 22° of night maximal phase. When it began to clear,
 4' it cleared [in 21° of night from] east to west. 65° onset,
 5' [maximal phase and clearing.] Its eclipse was red. Lightning on the south
 6' [...] lightning flashed(?).
 7' [...] and east wind blew; during clearing, north wind blew. In its eclipse, Venus(?)
 8' [... and Sa]turn stood there; in the beginning of onset, Sirius set.
 9' [...] α Virginis it was eclipsed ... [...] ...]
 10' [...] ... [...] ...]

Comments. Interchange obverse and reverse in LBAT 1452. The Moon was at $\lambda = 173.23^\circ$, $\beta = -0.03^\circ$, near α Virginis. Only Jupiter and Saturn were above the horizon. Sirius set at 22.08 UT = 22.87 LT. For the date of LBAT 1452 see Steele (2000). I have reservations about this date because (i) the duration of totality is grossly off (it calculates as 8°, or as 11° for the conventional shadow radius, respectively), and (ii) the earliest other eclipse text treating Sirius like a planet is -214DEC25.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 30 X	-280JAN16	4.74	2.73	112.0	6.83	—	—	8.42*	.09	170	219	16.27	17.11	6.89	7.06

SH1,309+311

5 ... 15 3,20 na dir nu pap an-mi sin šá dib

5 The 15th, 3;20° NA; clouds, I did not watch. Lunar eclipse which passes.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 32 IX	-279DEC24	12.37	2.90	89.5	13.28*	14.97*	15.36*	17.05*	1.06	72	299	16.97	17.02	6.98	7.57
S.E. 33 III	-278JUN19	16.70	3.04	262.7	18.05*	—	—	21.22	.87	119	236	19.00	19.18	4.82	5.40
S.E. 33 VIII	-278NOV13	19.14	—	47.8	—	—	—	—	-1.57						
S.E. 33 IX	-278DEC13	12.35	—	78.1	—	—	—	—	-.14						
S.E. 34A II	-277MAY10	21.67	—	224.5	—	—	—	—	-.51	12	12	18.48	18.82	5.18	5.36
S.E. 34A VIII	-277NOV03	5.19	—	36.7	—	—	—	—	-.16	166	166	16.84	17.50	6.51	6.57

LBAT *1432 = H5,55

- 1
 2 [... m]e ana šú šamáš ...
 3 33 sig 14 an-mi [sin ...]
 4 in 18 me ana šú šamáš
 5 [ap]in ge₆ 13 an-mi sin [...] ...
 6 [šá d]ib ina 45 ge₆ gin
 7 [... g]e₆ 15 an-mi [sin]

8 [...] 19 ge₆ ana z[alág]
 9 [... an]-mi [...]

- 1
 2 [...] Begin ...] before sunset.
 3 Year 33 month III 14 [lunar] eclipse
 4 At 18° day before sunset.
 5 Month VIII 13, lunar eclipse,
 6 [which] passed. At 45° after sunset.
 7 [Year 34, month II] 15 [lunar] eclipse,
 8 [which passed. At x+] 19° before sunrise.
 9 [...] eclipse [.....]

The last eclipse (line 9) is also mentioned in SH1,329
 C15 [... an-mi] sin bar dib ...

C15 [... eclipse of the] moon, BAR, passed.

Comments. Note that the passing eclipse of -278NOV13 (latitude 1.75°, magnitude -1.57) is much farther away from the node than that of -278DEC13 (latitude -1.00, magnitude -0.14).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 38 XI	-272FEB16	.20	2.66	142.9	1.15	2.32	3.52	4.69	1.34	87	300	16.92	17.48	6.51	6.73

SH1,343, Rev.

- 7' 19 ge₆ ír ana zalág ki tab-ú ina 22 ge₆ ta ulù u mar ana si zalág 2+[...]
 8' 1 kùš 4 si ina igi gír ár šá a a-dir mar u ulù gin-me ina gar ana dir ku₄ [...]
 7' 19° nighttime was totality; when it began to clear, it cleared in 22° nighttime from the south and west to the north; 2+[x ...]
 8' it was eclipsed 1 cubit 4 fingers in front of β Virginis; the west and south winds blew; during onset, it entered a cloud [...]

Comments. The Moon was at λ=142.53°, β=-0.85°.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 61A IX	-250DEC04	.73	3.06	68.6	1.91	3.11	4.37	5.56	1.36	90	241	16.63	17.11	6.89	7.18

LBAT 1366, Rev. 3'ff.

- 3' mu-1+ŠU-1-kám ¹an-ti-['u-uk-su ...]
 4' ge₆ 13 7,20 me [...]
 5' id kur ki tab-ú ...[.]
 6' ír² ana zalág-ru ki [...]
 7' ana mar iš-ta-hat[...]
 8' 2½ kùš e maš-maš šá s[ipa...]
 3' Year 61 Anti[ochus ...]
 4' Night of the 13th, 7;20° ME [...]
 5' When (the eclipse) began on the east side ... [...]
 6' maximal phase; when it [began] to clear [...]
 7' it threw off (the shadow) toward west [...]
 8' 2 ½ cubits above γ Geminorum [...]

Comments. The Moon was at $\lambda=67.88^\circ$, $\beta=0.08^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 63 I	-248APR19	5.93	—	204.8	—	—	—	—	-63						

LBAT **1216, Obv. 1f. Or. N.S. 2 (1933) 113.

- 1 bar 13 an-mi *sin* 5 itu
 2 bar dib *in* 39 me *ana šú šamáš*

- 1 Month I 13, lunar eclipse, 5 months,
 2 BAR, passed. At 39° daytime before sunset.

SH2,51, Obv.

- 3' ... an-mi *sin* 5 áb bar dib *in* 39 me *ana šú šamáš* [...]
 3' ... lunar eclipse, 5 months, BAR, passed; at 39° daytime before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 63 VII	-248OCT13	18.80	—	17.0	—	—	—	—	-20						

LBAT **1216, Obv. 5. Or N.S. 2(1933) 113

- 5 du₆ 15 an-mi *sin*
 6 [šá dib] *in* 30 ge₆ gin
 5 Month VII lunar eclipse,
 6 [which passed]. At 30° nighttime after sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 64A VII	-247OCT03	3.99	3.10	6.0	5.37	—	—	8.95*	1.01	35	266	17.67	18.00	6.01	6.08

LBAT 268; SH2,55

- 5 [...] *rad i-sa šú ád šú an-mi-šú túg an-e gar ina an-mi-šú dele-bat gu₄-ud u a[n?* ...]
 5 [...] a little cloudburst, overcast, it set eclipsed. (In) its eclipse, the ‘garment of the sky’ was in place. During its eclipse, Venus, Mercury and M[ars(?)] stood there ...]

Comments. Venus and Mercury were above the horizon, but Mars was below.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 64A XII2	-246MAR29	.32	2.86	183.8	1.28	2.41	3.80	4.94	1.46	107	312	17.61	18.15	5.84	5.99

SH2,57, Rev. B2'

- 2' [...] nu gub-u' *ina* an-mi [...]
 2' [...] did not stand there. In the eclipse [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 65 VI	-246SEP22	6.20	3.05	354.9	7.18*	8.50*	9.83*	11.15*	1.34	75	226	17.80	18.19	5.82	5.81

LBAT 273, Rev. 11'; SH2,63

11' ... 14 30 ninda šú 16 me nim-a an-mi *sin* šá dib ge₆ 15 me nu tuk11' ... On the 14th 0;30 ŠÚ. At 16° after sunrise lunar eclipse which passed. On the 15th ME did not exist.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 66A VI	-245SEP11	6.07	3.00	343.7	8.09*	—	—	9.61*	.06	129	173	17.93	18.38	5.62	5.63

SH2,71

10' [... a]n-mi *sin* bar dib

10' [...] lunar eclipse, BAR, passed.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 72A VIII	-239NOV03	5.25	3.17	37.5	6.52*	7.68*	9.00*	10.16*	1.40	63	270	16.91	17.49	6.52	6.55

LBAT *1218, Rev. 3ff. Orientalia N.S. 2 (1933) 114

3 itu apin ge₆ 14 in 3 uš

4 ana kur šamáš id kur ki-i

5 tab-ú ád šú še[?] dir

3 Month VIII 14, at 3°

4 before sunrise, beginning on the east side.

5 It set eclipsed. Month XII₂(?).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 73 I	-238APR28	21.06	3.04	213.6	22.59	—	—	1.21	.41	153	236	18.30	18.65	5.34	5.66

SH2,85

Obv.

1 itu bar ge₆ 13 5 me dir muš2 1,20 ge₆ gin ^d*sin* an-mi id ulù3 u kur ki-i tab-ú ina 15 ge₆ al-la4 2/3[?] hab i-si gar-an 10 uš ge₆ ír5 ana zalág ki-i <tab>-ú ina 15 ge₆ ta kur

6 ana mar zalág 40 gar ír u zalág an-mi-šú

7 túg an-e gar-in ina an-mi-šú si gin

8 ina an-mi-šú mül-babar gub-uz í[b-tag₄]9 ^dudu-idim-me nu gub[-me ...]

Rev.

1 gír gír gù x gù-šú šub-di [x]

2 sin túr [nig]ín ana[?] ulù[?] ù ana[?] [ni]m[?] ka [x x]3 ½ kùš ár mül murub₄ šá sag gír-tab ír[?]4 ina zalág sin ina igi si₄ 2 kùš

5 13 4,40 na dir nu pap šú-šú

6 ina še-rì an dul

Obv.

- 1 Month I, night of the 13th, 5° ME, clouds, measured.
 2 At 80° night after sunset, lunar eclipse, beginning on the south
 3 east side. In 15° night it made a little
 4 over 2/3(?) of the disk. 10° night maximal phase.
 5 When it began to clear, in 15° night it cleared from east
 6 to west. 40° onset, maximal phase and clearing. (In) its eclipse,
 7 the ‘garment of the sky’ was in place. In its eclipse, north wind blew.
 8 In its eclipse Jupiter stood there; the remainder of
 9 the planets did not stand there. [...]

Rev.

- 1 lightning flashed, it thundered once(?) [...].
 2 The moon was surrounded by a halo, toward south(?) and east(?) an opening(?) [...].
 3 ½ cubit behind δ Scorpii it was eclipsed(?).
 4 Last part of the night, the moon was 2 cubits in front of α Scorpii.
 5 On the 13th, 4;40° NA; clouds, not observed. Very overcast.
 6 In the morning, rain DUL.

Comments. At mid-eclipse, the Moon was at $\lambda=213.82^\circ$, $\beta=0.13^\circ$, at sunrise $\lambda=215.89$, $\beta=0.26$. Jupiter was the only planet above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 79 IX	-232DEC14	9.49	2.98	79.8	10.59*	11.78*	13.05*	14.24*	1.37	94	245	17.06	17.04	6.96	7.95

SH2,109

- 30 13 1,40 šú an-mi be dib *in* 1,14 me nim-[a ...]
 30 The 13th, 1;40 ŠÚ. Lunar eclipse, BE, passed. At 74° after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 81 I	-230APR30	12.57	—	215.2	—	—	—	—	-.77						

SH2,119

- 7 [... g]e₆ gin an-mi *sin* 5 itu bar dib
 7 [...] after sunset, lunar eclipse, 5 months, BAR, passed.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 85A XI	-225FEB06	11.74	2.66	134.0	12.55*	13.96*	14.94*	16.35*	1.19	132	273	17.34	17.36	6.63	7.13

SH2,137

- 8' ... ge₆ 14 ...
 9' [an]-mi *sin* be dib *in* 1 danna me *ana* šú šamáš ge₆ 15 ...
 8' ... Night of the 14th,
 9' lunar eclipse, BE, passed, at 30° daytime before sunset. Night of the 15th, ...

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 86 IV	-225AUG01	22.36	2.91	304.3	23.57	.83	1.78	3.04	1.21	50	271	18.68	18.97	5.03	5.34

SH2,141, Rev.

3 ... ge₆ 14 4 m[e]
 4 *a muš* 52 ge₆ gin sa₄ šá gaba-šú *ziq-pi sin* an-mi
 5 *id kur ki tab-ú ina* 17 ge₆ *gab-šú šú* 10 uš ge₆ ír *ana zalág*
 6 *ki-i tab-ú ina* 15 ge₆ ta ulù *ana si* *zalág ina gar né-hi ina* *zalág ha-mut*
 7 42 *gar ír u* *zalág an-mi-šú sa₅*? *an-mi-šú si* šár *gin an[?]-mi[?]-šú[?]*
 8 ^dudu-idim-meš *gab-bi* nu *gub-meš* 5 kùš ár mûl ár šá suhur máš KAxMI?

3 ... Night of the 14th, 4 ME,
 4 measured (despite) mist; at 52° after sunset, when the “Bright Star of his Breast” (IX)
 culminated, lunar eclipse
 5 when it began on the east side, in 17° nighttime it covered it completely; 10° nighttime
 maximum phase. When it began to clear,
 6 it cleared in 15° nighttime from south to north. During onset it was slow, during clearing fast.
 7 42° onset, maximum phase and clearing. Its eclipse was red(?); (in) its eclipse a gusty north
 wind blew; (in) its eclipse
 8 all the planets did not stand there; 5 cubits behind δ Capricorni it was eclipsed.

Comments. The Moon was at $\lambda=303.91^\circ$, $\beta=-1.06^\circ$. All planets were below the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 97 IX	-214DEC25	18.23	2.89	91.0	19.25	20.43	21.71	22.90	1.37	99	250	16.72	17.02	6.98	7.56

SH2,157

Obv.

1 mu-1,37-kám gan ge₆ 1[3[?] x] x x x *muš*
 2 sa₄ šá mûl šu-gi *a-[n]a ziq-pi*
 3 *gub-uz* ^d*sin* an-mi *id kur-ra*
 4 *ki tab-ú ina* 21 ge₆ *gab-šú šú-im*
 5 16 ge₆ ír *ana zalág-ru* *ki tab-ú*
 6 *ina* 19 ge₆ ta *kur-ra u si a-na*
 7 ^{im}*mar[?]-tu* *zalág-ir* 56 *gar ír*
 8 [*u zalág-r*] *u in* 30 *danna* ge₆ *gin*
 9 [x x x] an-mi *ina* an-mi-šú mûl kak-ban

Rev.

1 [*gub-uz* *ge*] *nna šú* an e-a [í]b-tag₄ ^dudu-idim-me
 2 [*n*] *u gub-u'* *ina* an-mi-šú [s]i šá pa mar
 3 *gar gin* *shed₇* 2 kùš *ina i[gi]* mûl-meš igi-meš
 4 šá alla *a-dir* 13 9,10 [*n*] *a muš* ...

Obv.

1 Year 97, month IX, night of the 1[3th, ...] ..., measured.
 2 The “Bright Star of the Old Man” (XIV) stood in culmination,
 3 lunar eclipse. On the east side
 4 when it began, in 21° of night all of it became covered;
 5 16° of night maximum phase. When it began to clear,
 6 it cleared in 19° of night from northeast to
 7 west. 56° onset, maximum phase
 8 [and clear]ing. At 30° (= 1) *bēru* after sunset.
 9 [...] eclipse. In its eclipse, Sirius

Rev.

1 [stood there; Sa]turn set; Mars came out; the remainder of the planets
 2 did not stand there. In its eclipse, the north wind which was set to the west side
 3 blew. It was cold. 2 cubits in front of the front stars
 4 of Cancer (η and θ Cancer) it became eclipsed. The 13th, 9;10° NA, measured. ...

Comments. The translation of Obv. 8 in SH2 is in error. The Moon was at $\lambda=91.59^\circ$, $\beta=0.04^\circ$. Altitude of Sirius 33.9°. Saturn set at 18.05 UT = 20.94 LT and Mars rose at 17.74 UT = 20.63 LT, i.e. during totality.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 100 I	-211APR30	1.97	3.04	215.2	3.60	—	—	6.59*	.62	155	256	18.08	18.68	5.32	5.49

LBAT **1237, Rev. 48ff. ZA 6 (1881) 89ff., 231

48 mu-1,40-kám ¹*an* lugal
 49 bar ge₆ 13 9 na me *muš*
 50 *sin* an-mi *id* ulù
 51 *ki* tab-ú gar *u* ír
 52 dir nu pap *ád* šú *ina* 20 ge₆ *ana*
 53 zalág

48 Year 100, king Antiochus (III)
 49 Month I 13, 9 NA ME measured
 50 Lunar eclipse, beginning on the south
 side. Onset (and) maximal phase
 52 cloudy, not observed. It set eclipsed. At 20°
 53 before sunrise.

Comments. The combination NA ME in line 49 is curious and probably a scribal error; the NA should be deleted.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 100 VII	-211OCT24	20.21	3.17	28.2	21.69	—	—	1.21	.94	35	271	17.42	17.63	6.38	6.78

LBAT **1237, Rev. 56ff. ZA 6 (1891) 89 ff., 231

56 du₆ ge₆ 15 3 me *muš*
 57 *sin* an-mi *id* si *u* kur
 58 *ki* tab-ú 2 si *ana* til *tag*₄
 59 *ina* 28 ge₆ g[in]

56 Month VII 15 3° ME measured.
 57 Lunar eclipse, beginning on the north-east
 side. 2 fingers were lacking to totality.
 59 At 28° after sunset.

Comments. The number 28 in line 59 is grossly wrong (expected: ca. 60°).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 109 VIII	-202NOV14	8.64	3.16	48.9	10.94*	—	—	12.28*	.04	9	330	16.72	17.33	6.68	6.58

SH2,213, Obv.

13' [... ...]. me nim-a ge₆ 15 ...13' [Lunar eclipse, which passed. ...] x° after sunrise. Night of the 15th, ...

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 117 III	-194JUN20	16.29	—	264.2	—	—	—	—	-.42	8	8	19.10	19.19	4.81	5.18

LBAT 1249, Rev. 8'f. (also LBAT 320, 10' = SH2,271)

8' sig 13 an-mi sin bar dib

9' in 15 me ana šú šamáš

8' Month III 13. Lunar eclipse, BAR, passed.

9' At 15° of day before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 117 VIII	-194NOV15	20.68	—	50.4	—	—	—	—	-.26						

LBAT 1249, Rev. 10'ff. (also LBAT 1436, II' 1) = H5,57

10' apin ge₆ 15 an-mi sin

11' 5 itu dib

12' in 45 ge₆ gin

10' Month VIII 15. Lunar eclipse,

11' 5 months, passed

12' At 45° after sunset. (Variant: 46°)

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 118A II	-193MAY11	9.07	3.08	225.6	10.86*	—	—	13.60*	.49	158	248	19.00	18.84	5.15	5.77

LBAT 1436, Obv. II' 2f. = H5,57

2 mu-1-me-18-kám gu₄ 13 šá dib in 1,34

3 [me n]im-a

2 Year 118, month II 13, which passed. At 94°

3 [after sun]rise

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 118A VIII	-193NOV05	4.45	3.18	39.3	5.95	—	—	9.45*	.92	37	274	17.08	17.46	6.55	6.62

LBAT 1436, Obv. II' 4ff. = H5,57

4 apin ge₆ 14 4 šá gaba-šú ziq-pi id kur5 ki tab-ú ina 12 ge₆ 2-ta šu_{II} h[ab? ...]6 šú?-im in 12 ge₆ ana zalág? [...]

LBAT 324 = SH2,279

- 18' [... *ziq-p*] *i id kur ki tab-ú in 12 ge*₆ [...] *a-na dir ku₄-ub ina an-mi-šú mél-babbar dele-bat an u kak-ban gub-meš íb-[tag₄ ...]*
 19' [... *i*] *s le₁₀ 1 kùš a-dir in 12 uš ge*₆ *ana z[alág ...]*

Composite translation:

Month VIII 14, when the “4 of his Breast” (XXII) culminated, (lunar eclipse), beginning on the [north]-east side.

In 12° night it made two thirds of the disk, [then the moon] entered a cloud. In its eclipse, Jupiter, Venus, Mars and Sirius stood there, the rem[ainer of the planets did not stand there.] [...] it was eclipsed 1 cubit [...] α Tauri. At 12° of night before sunrise.

Comments. The reading of line 6 is quite uncertain. The Moon was at $\lambda=38.48^\circ$, $\beta=-0.75^\circ$. Jupiter, Venus, Mars and Sirius were above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 121A XII	-189FEB28	2.82	2.70	155.8	3.74	5.46	5.72	7.44*	1.05	142	274	17.09	17.68	6.31	6.48

LBAT 1437 = H5,61

Obv.

- 1 mu-1-me-21-kám [...]
 2 itu še *ge*₆ 15 [...]
 3 *ki šá' maš-[šá']-tú? a'-na' ziq'-pi'*
 4 *sin an-mi id ulù u kur*
 5 *ki-i tab-ú ina 20 ge*₆
 6 *gab-bi šú 5' ge*₆ ír'
 7 *a-na zalág-ru ki-i tab-ú*
 8 *id kur a-na mar 2' si' zalág'*
 9 *íb-tag₄ zalág-ru nu pap*
 10 *an-mi-šú sa₅ an-mi-šú ...*
 11 *si' gin' ina an-mi-šú*
 12 *mél-babbar dele-bat u g[enna']*
 13 *gub-meš ina gar gu₄-ud*

Rev.

- 1 è-a íb-tag₄
 2 udu-idim-meš nu gub-meš
 3 2 kùš *ina* igi dele šá igi absin
 4 *a-dir ina* 30 danna
 5 *ge*₆ *ana* *zalág ád šú*
 6 15 3,30 na dir *muš*

Obv.

- 1 Year 121
 2 month XII 15
 3 When the “Star from the Doublets” (IV) (?) culminated (?)
 4 lunar eclipse, beginning on the southeast
 5 side. After 20° of nighttime
 6 totally covered. 5°(?) nighttime maximal phase.
 7 When it began to clear
 8 (from) the east side to the west, it cleared(?) 2(?) fingers(?),
 9 the remainder of the clearing was not observed.
 10 Its eclipse was red. Its eclipse was ...
 11 North(?) wind blew. In its eclipse

12 Jupiter, Venus and [Saturn]
 13 stood there. During onset, Mercury

Rev.

1 rose. The other
 2 planets did not stand there.
 3 2 cubits in front of γ Virginis
 4 eclipsed. At 30° (= 1) *bēru*
 5 nighttime before sunrise. It set eclipsed.
 6 On the 15th, 3;30 NA, cloudy, measured.

Comments. Poorly preserved; readings uncertain. The Moon was at $\lambda=155.23^\circ$, $\beta=-0.34^\circ$. Jupiter, Venus and Saturn were above the horizon, Mars below. Mercury rose at 2.37 UT = 5.07 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 122 V	-189AUG23	14.28	2.93	325.7	15.60*	—	—	18.91	1.02	38	270	18.62	18.67	5.34	6.06

LBAT 1251, Rev. 14ff.

14 mu-1-me-22-kám ¹*an* lugal
 15 izi ge₆ 14 1 me dir *m[uš]*
 16 *sin* ta dir *ki e-a* 2 si *id* [mar]
 17 *ana* zalág *tag₄* *in* 1 *danna*
 18 me *ana* šú *šamáš*

14 Year 122, king An(tiochus III.),
 15 month V 14, 1° ME, cloudy, measured.
 16 When the moon rose from a cloud, 2 fingers
 17 on the [west] side lacked to brightness. At
 18 1 *bēru* before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 122 XI	-188FEB17	3.02	2.67	144.7	3.65	5.01	6.22	7.58*	1.28	99	312	16.91	17.51	6.49	6.61

LBAT 1251, Rev.23ff.

23 zíz ge₆ 14 9 me *a-kám muš*
 24 *sin an-mi id kur ki tab-ú*
 25 *ina* 16 ge₆ *gab-bi šú-im*
 26 *ád š[ú]* *in* 34 ge₆ *ana* *zalág*

23 Month XI 14 9° ME, mist, measured.
 24 Lunar eclipse, beginning on the east side.
 25 After 16° night totally covered.
 26 It set eclipsed. At 34° before sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 124 IV	-187AUG01	20.01	2.91	305.0	22.21	—	—	23.28	-.01	144	176	18.67	18.96	5.04	5.48

LBAT 1439, Obv. 1ff. = H5,59

1 mu-1-me-24-kám šu ...
 2 *ku-mar šá mül u₄-ka-du₈-[a ziq-pi]*
 3 *id?* ...

- 1 Year 124 month IV ...
 2 When the “Shoulder of the Panther” (VIII) [culminated]
 3 [beginning on the ...] side ...

Comments. There are problems with this fragment. According to Pinches’ copy, it lists eclipses (or eclipse possibilities) for S.E. 124 IV on the obverse, 127 III and VIII on the reverse. The first corresponds to a deep penumbral eclipse (negative magnitude -0.01). The eclipse clearly was observed (in view of the timing through culmination of a *ziqpu* star). Hunger thought that the eclipse of -187AUG01 was invisible (but see the discussion in Section 2.3), and he suggested to emend the damaged year number 1-*me*-24 of Pinches’ copy into 1-*me*-34 (visible total eclipse of -177JUL12). This also gives a better agreement with the *ziqpu*-timing (the difference is improved from -10.4° to -2.8° , cf. Section 2.7). However, it creates problems with the chronological sequence of the eclipses on the tablet, necessitating an interchange of obverse and reverse. But then the new reverse would follow the obverse without gap, and the three eclipse possibilities of the fragment ought to be consecutive, which they are not. In view of these unsolved difficulties, it seems preferable to me to list and discuss the three eclipses using Pinches’ original dates (at least, these are not influenced by the results of modern calculations).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 126A IX	-185DEC06	7.64	3.05	71.1	8.78*	9.95*	11.27*	12.44*	1.40	74	282	16.30	17.10	6.91	6.87

SH2,351, Rev.

- 2' [... an-mi *s*]in šá dib in
 2' [...] lun[ar eclipse] which passed; at [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 127 II	-184MAY30	17.85	3.09	244.9	19.14	—	—	22.49	.86	126	243	18.84	19.07	4.93	5.38
S.E. 127 VIII	-184NOV24	17.08	3.12	60.1	19.32	—	—	20.66	.03	13	334	17.02	17.19	6.82	7.33

LBAT 1439, Rev. 1'f. = H5,59

- 1' mu-1-*me*-27-kám s[ig ...]
 2' in 15 me *ana*? šú? [šamáš?]
 3' apin ge₆ 15 [...]

- 1' Year 127 month III [...]
 2' At 15° before sunset(?).
 3' Month VIII 15, [...]

Comments. Cf. the remarks on the eclipse of -187AUG01. There are doubts about the date. In line 1', one expects month II (both from calculation and from Month VIII in line 3'), and the shortness of the text might argue for a passing eclipse. Hunger reads the year number as 117, rather than as 127 (so the copy in LBAT). This creates even more severe problems with the chronological sequence, respectively with the gap between obverse and reverse, but it has the advantage that the data for the eclipse possibilities of 117 III = -194JUN20 and 117 VIII = -194NOV15 in the present text agree with those of the Goal Year text LBAT 1249 (see under those dates).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 127 VIII	-184NOV24	17.08	3.12	60.1	19.32	—	—	20.66	.03	13	334	17.02	17.19	6.82	7.33

LBAT 336, Obv. 7'ff. = SH2,355

Obv.

- 7' ge₆ 15 2,20 me muš 4 šá múl lu-lim z[iq-p]i [sin]
 8' an-mi ki <tab->-ú 2 si id s[i ...]
 9' ina 44 ge₆ zalág in 25'[...]

Rev.

- 1 múl-babbar u genna gub-meš ina an-mi-šú múl[?] [kak[?]-ban[?] ...]
 2 íb-tag₄ udu-idim-meš nu gub-meš ina[?] an-mi-šú mar [gin[?] ...]
 3 1 2/3 kùš ina[?] igi múl igi šá še-pít maš-maš a-dir 15 8,40 [na]

Obv.

- 7' (Month VIII) 15, 2;20 ME measured, when the “4 of the Stag” (XII) culminated [lunar]
 8' eclipse; when it began, 2 fingers on the north side ...
 9' After 44° night it became bright. (Begin) 25°(?) [after sunset]

Rev.

- 1 Jupiter and Saturn stood there; in its eclipse Si[rius(?)] and Mars(??) rose,
 2 the remainder of the planets did not stand there; in its eclipse, the west wind [blew ...]
 3 it was eclipsed 1 2/3 cubits in front of η Geminorum. The 15th, 8;40° NA

Comments. The terminology is somewhat unusual. This is a small eclipse, with a poorly defined maximal phase, as it seems. The timing 44° in line 6' appears to indicate the *end* of the eclipse relative to *sunset*, which is quite unique. Sachs-Hunger propose an emendation, making 44° the time from the *begin* to *sunrise*, but this disagrees with calculation and leaves the number 25° unexplained. Jupiter and Saturn were above the horizon, Sirius rose at 16.81 UT = 19.93 LT, Mars rose at 17.65 UT = 20.77 LT. The Moon was at λ=60.66°, β=-1.41°, η Geminorum at λ=63.12, β=-1.16°.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 129A VII	-182OCT04	.63	3.11	7.1	2.22	—	—	5.43	.69	109	215	17.58	17.98	6.03	6.25

SH2,371, Rev.

- 4' [...] ... múl rit gám ziq-pi [... ki tab]-ú [ina x+]8 ge₆ a[l ...]
 5' [... gar] u zalág-ru an-mi-šú sa₅ dir ... [...] ina an-mi-šú gu₄-ud genna an u[... gub-meš ...]
 4' [...] ... when the “Hand of the Crook” (XVII) culminated, [lunar eclipse ... When it be]gan, in
 [x+]8° of night [it made] mo[re than ...]
 5' [... onset] and clearing. Its eclipse was red; clouds(?) ... [...] In its eclipse, Mercury, Saturn, Mars
 and [...] stood there ...]

Comments. The statement about the planets is not quite in order. Jupiter, Saturn and Mars were above the horizon, Mercury rose at 1.44 UT = 4.55 LT, Saturn set at 2.11 UT = 5.22 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 141 V	-170AUG23	14.80	2.93	326.1	15.85*	16.96*	18.41*	19.52	1.53	75	234	18.55	18.66	5.35	6.04

SH2,451

- 12' [...] ... sin ki è-a gab-bi-šú šú-im ana zalág-ru ki tab-ú [...]
 13' [... íb-tag₄ dudu-idim]-meš nu gub-meš ina til gu a-dir in 42 me ana šú šamáš 15 [...]

- 12' [...] ... when the moon came out, it was completely covered; when it began to clear [...]
 13' [... the remainder of the pla]nets did not stand there; it was eclipsed in the end of Aquarius; at
 42° before sunset. The 15th, [...]]

Comments. According to calculation, the Moon rose 2° *after* the end of totality.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 141 XI	-169FEB16	12.57	2.67	144.4	14.20*	—	—	15.81*	.08	49	2	17.50	17.51	6.48	6.86

SH2,465

- 10' ... 13 an-mi *sin šá* dib in 31° me *ana šú* [šamáš ...]
 10' ... The 13th, lunar eclipse, which passed.; at 31°(?) before sun[set ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 142A V	-169AUG13	3.45	2.91	315.7	5.39*	—	—	6.99*	.09	133	181	18.35	18.83	5.18	5.28

LBAT 1263, Rev. 8'ff.

- 8' izi ge₆ 15 an-mi *sin*
 9' 2 me *ki* pap nu igi
 10' in 4 uš ge₆ *ana zalág*
 8' Month V 15, lunar eclipse.
 9' 2 ME (?). Watched, but not seen.
 10' At 4° before sunrise.

Comments. Reading and interpretation of the first signs of line 9' are uncertain.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 142A X	-168JAN07	10.08	—	103.9	—	—	—	—	-.15	191	191	17.09	17.06	6.94	7.75

LBAT 1263, Rev. 11'f.

- 11' ab 13 an-mi *sin* 5 itu
 12' šá dib in 7 uš me nim-a
 11' Month X 13, lunar eclipse, 5 months,
 12' which passed. At 7° after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 148A XII2	-162MAR30	21.42	2.87	186.3	23.20	—	—	1.00	.12	171	225	17.84	18.20	5.79	6.11

LBAT 1264, Rev. 3'ff.

- 3' mu-1-me-4[8-kám¹ *an lugal*]
 4' dir-še [ge₆ 15]
 5' 3 uš ár mól [... ...]
 6' *ziq-pi*^d *sin* [an-mi]
 7' *id ulù ki-i* [tab-ú]
 8' *ina* 10 uš ge₆ 3 si *gar-an*
 9' *in* 1,25 ge₆ *ana zalág*
 3' Year 14[8, king Antiochus IV./V.,]

- 4' month XII₂ [15]
 5' 3° after [...]
 6' culminated, lunar eclipse,
 7' beginning on the south side.
 8' In 10° night it made 3 fingers.
 9' At 85° before sunrise.

LBAT 378, Rev. 12'f., = SH3,23

- 12' [t]a ulù ana mar zalág-ir 20 gar u zalág an-mi-šú túg an-e [gar-in ..]
 13' [... in 1,25] ge₆ ana zalág 15 5,30 na dir muš dir an za si [gin]

LBAT 380, Rev. 20'ff. =SH3,15

- 20' [...] dir muš kal ge₆ dir an za 3 uš ár múl na-ad-dul ár ziq-pi ^d[sin an-mi ...]
 21' [... tú]g an-e gar-in ina an-mi-šú šú? si šá pa mar gar gin ina an-mi-šú [...]
 22' [...] 15 5,30 na dir muš dir an za si gin

Composite translation of LBAT 378, 380, with restorations from LBAT 1264:

[on the 15th, ... x° ME], cloudy, measured. During the whole night cirrus clouds (?). 3° after the “Rear Harness” (XXVI) culminated, [lunar eclipse, beginning on the south side. In 10° night it made 3 fingers.] From south to west it became bright. 20° onset and clearing. During its eclipse the ‘garment of the sky’ was in place. During its eclipse, ... north(wind) which was set toward the west blew. During its eclipse [...] Begin 85°] before sunrise. On the 15th 5;30° NA, cloudy, measured. ...

Comments. Interestingly, this description allots zero time to maximal phase. See also Schaumberger, ZA N.F. 16 (1952) 219.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 149 VI	-162SEP23	7.33	3.06	356.5	8.95*	—	—	11.48*	.45	25	299	17.61	18.17	5.84	5.73
S.E. 149 XI	-161FEB18	5.22	—	146.2	—	—	—	—	-.48	14	14	16.89	17.53	6.46	6.48

LBAT 1264, Rev. 13ff.

- 13' (mu-1-me-49-kám) kin 13
 14' an-mi sin šá dib in 48
 15' me nim-a zíz 13 an-mi sin
 16' 5 itu dib in 31 me
 17' ana šú šamáš

 13' (Year 149) Month VI 13,
 14' lunar eclipse which passed. At 48°
 15' after sunrise. Month XI 13, lunar eclipse,
 16' 5 months, passed. At 31°
 17' before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 150 V	-161AUG14	13.93	—	317.1	—	—	—	—	-.23						

LBAT 1266, Rev. 14ff.

- 14 [m]u-1-me-50-kám ¹an lugal
 15 [iz]i 14 5 me muš
 16 an-mi sin šá dib
 17 in 25 me ana šú šamáš

SH3,37, Rev. 6'

- 6' [...] a]n-mi *sin* bar dib *in* 25 me *ana šú šamáš* ...
- 14 Year 150, king An(tiochus),
15 month V 14, 5° ME measured.
- 16 Lunar eclipse which passed (var.: BAR, passed).
- 17 At 25° day before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 150 XI	-160FEB07	9.10	2.66	135.2	10.09*	—	—	13.55*	.93	73	310	17.49	17.38	6.61	7.26

LBAT 1266, Rev. 20ff.

- 20 zíz 13 1 me *muš*
21 an-mi *sin* šá dib
22 [in] 10°? me nim-a
- 20 Month XI 13, 1° ME measured,
21 lunar eclipse, which passed.
22 [At] 10°(?) after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 151U X	-159JAN26	20.05	2.68	124.3	20.85	22.00	23.37	.51	1.44	111	266	16.85	17.23	6.76	7.19

SH3,41, Rev. 3'ff.

- 3' [...] ... mól maš-maš *ziq-pi*
4' [...] si? *gin ina* an-mi-šú dir an za
5' [...] lugal KAxA MI *in* 48 *ge₆ gin*
- 3' [...] ... when the “Twins” (XVIII) culminated
4' [lunar eclipse] north(?) wind blew; in its eclipse, clouds were in the sky;
5' [...] α Leonis it was eclipsed; at 48° after sunset.

LBAT 1436, Rev II' = H5,57

- 1' ab *ge₆* 10+[x ...]
2' *id kur ki tab-ú ina* ..[.]
3' 48°? *ge₆ gin* [...]
- 1' Month X 10+[x ...]
2' Beginning on the east side ...[...]
3' After 48°(?) nighttime [...]

Comments. The eclipse of LBAT 1436 is dated by the next line of the text (see next eclipse). The Moon was at $\lambda=124.69^\circ$, $\beta=0.08^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 152 IV	-159JUL23	4.82	2.92	295.9	5.70*	7.08*	8.23*	9.61*	1.25	67	282	18.54	19.07	4.94	4.96

LBAT 1436, Rev II' = H5,57

- 4' mu-1-me-52-kám šú 14 šá dib *in* [...]
4' Year 152, Month IV, which passed. At [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 153A IV	-158JUL12	5.37	—	285.1	—	—	—	—	-12						

SH3,47

10 13 1 šú muš an-mi *sin šá dib* in 58 me nim-a10 The 13th, 1° ŠÚ, measured. Lunar eclipse which passed; at 58° after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 153A IX	-158DEC07	14.10	—	72.9	—	—	—	—	-28						

SH3,53, Obv.10

10 5 áb bar dib *in 55 [...]*

10 [lunar eclipse ...] 5 months, BAR, passed; at 55° [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 155 VIII	-156NOV14	21.43	3.16	50.2	22.50	23.76	1.29	2.54	1.50	78	239	17.01	17.31	6.70	7.08

SH3,65, Obv. 6'

6' [...] 22(!) ge₆ ír *ana zalág-ru ki-i tab-ú* ... [...]7' [... a]n utah *i-sa ina an-mi-šú mól-babbar an u kak-s[i-sá gub-meš ...]*

6' [...] 22°(!) of night maximal phase; when it began to clear, ... [...]

7' [...] a little rain shower; in its eclipse, Jupiter, Mars and Siri[us] stood there ...]

Comments. 42° is impossibly long for a duration of totality; the photo suggests to read the number as a damaged 22. Jupiter, Mars and Sirius were above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 157 XII	-153MAR21	17.21	2.81	177.2	18.36	—	—	21.86	.85	150	269	17.84	18.05	5.95	6.27

LBAT *1440 = H5,63

Obv.

1 [mu-1-me-57-kám ¹*di-mit-ri*]2 [itu še g]e₆ 15 3? me dir muš3 [*sin*] an-mi *id ulù u kur*4 *ki tab-ú ina* 20 ge₆ 10 si *gar-an*5 6 ge₆ ír *ana zalág-ru ki tab-ú*6 *ina* 18 ge₆ ta si *u kur ana ulù*7 *u mar zalág-ir* 44 *gar ír*8 *u zalág-ru an-mi-šú sa₅ sa₅-šú sud*9 *ina an-mi-šú si šá pa mar* [gar gin]10 *ina sag gar ulù gin* [...]

Rev.

11 *ina an-mi-šú dele-bat an u mól* [kak-si-sá]12 *gub-meš ina gar mól-babbar è-a*13 *ina til gar dele-bat šú íb-tag₄ ^dudu-idim-m[eš]*14 *nu gub-meš 2 kùš [ár] sa₄ šá absin*15 *1 kùš ana si nim KAxA MI*16 *in 4 u š ge₆ gin 15 6 na*17 *[di]r muš*

1 [Year 157, king Demetrius]
 2 [Month XII] 15 5(?) ME, cloudy, measured.
 3 Lunar eclipse, beginning on the south-east
 4 side. In 20° night it made 10 fingers
 5 6° duration of maximal phase.
 6 In 18° from north-east to south-
 7 west it became bright. 44° total
 8 duration. Its eclipse was red, its redness was red brown.
 9 During its eclipse, north(wind) which was set to the west blew.
 10 In the beginning of onset, south (wind) blew[... ...]
 11 During its eclipse, Venus, Mars and S[irius]
 12 stood there. During onset, Jupiter rose.
 13 Toward the end of the onset, Venus set. The other planets
 14 did not stand there. 2 cubits behind α Virginis,
 15 1 cubit toward north above eclipsed.
 16 At 4° after sunset. 6° NA
 17 cloudy, measured.

Comments. The Moon was at $\lambda=178.00^\circ$, $\beta=0.30^\circ$. Jupiter rose at 16.11 UT = 18.92 LT, Venus set at 16.94 UT = 19.75 LT. The statement about visibility of planets and Sirius is correct.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 162 III	-149JUL03	1.24	2.98	276.2	2.40	3.94	4.62	6.16*	1.11	60	284	18.78	19.19	4.81	4.96

SH3,85

5' ... 4 uš *ina* igi múl *kin-sa ziq-pi* ^d*sin* a[n-mi ...]
 6' [...] *ki tab-ú ina* 20 *ge₆ gab-bi šú-im* 12 *ge₆ ír ád šú* 32 *gar u* [ír ...]
 7' [...] *an-mi-šú si šá kap mar gar gin ina an-mi-šú* múl-babbar *u genna gub[-meš ...]*
 8' [... *í]b-tag₄* ^d*udu-idim-meš nu gub-meš* 2 ½ kùš sig si máš *i-sa ana* n[im dib ...]

5' ... 4° before the “Knee” (X) culminated, lunar ec[lipse ...]
 6' [...] when it began, in 20° of night it was completely covered. 12° of night maximal phase; it set
 eclipsed; 32° onset and [maximal phase ...]
 7' [...] in its eclipse, north wind which was set to the west side blew; in its eclipse Jupiter and
 Saturn stood there [...]
 8' [...] the other planets did not stand there. 2 ½ cubits below β Capricorni, [having passed] a little
 to the east, [it became eclipsed].

Comments. The Moon was at $\lambda=275.46^\circ$, $\beta=-0.91^\circ$. Venus rose during onset at 0.20 UT = 3.18 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 168 XI	-142FEB17	17.02	2.67	146.1	18.05	—	—	21.44	.88	74	314	17.33	17.53	6.46	6.85

LBAT 1278, Rev. 3'ff.

3' zíz *ge₆* 13 3 me *muš*
 4' 5 uš *ár rit* gám *ziq-[pi]*
 5' *sin an-mi id ulù u kur*
 6' *ki tab-ú ina* 20 *ge₆* 9 si
 7' *gar-an* 5 *ge₆* ír
 8' *in* 7 uš *ge₆* *gin*

- 3' Month XI 13, 3° ME measured
 4' 5° after the “Hand of the Crook” (XVII) culminated,
 5' lunar eclipse, beginning on the south-east
 6' side. In 20° night it made 9 fingers.
 7' 5° duration of maximal phase.
 8' At 7° after sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 170U V	-141AUG03	11.60	2.91	306.5	12.44*	13.74*	15.13*	16.43*	1.37	67	275	18.95	18.94	5.06	5.73

SH3,123, Rev.

- 6' ... 14 4 šú an-mi *sin* šá dib in 40[+x ...]
 6' ... The 14th, 4° ŠÚ. Lunar eclipse, which passed; at 40[+x ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 171 IV	-140JUL22	12.06	2.92	295.6	14.12*	—	—	15.41*	.02	13	336	19.12	19.06	4.94	5.56

LBAT 418, Rev. 15' = SH3,137

- 15' ... 13 an-mi *sin* šá dib in 34 me *ana* šú šamáš
 15' (Month IV) 13 lunar eclipse, which passed. At 34° before sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 171 IX	-140DEC17	22.78	—	84.1	—	—	—	—	-.29						

SH3,143

- 12 ... an-mi *sin* 5 áb bar dib in 1,18 ge₆ gin ...
 12 ... lunar eclipse, 5 months, BAR, passed; at 78° after sunset ...

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 174 II	-137MAY22	14.86	3.09	236.8	16.24*	—	—	19.43	.88	79	320	18.93	18.98	5.01	5.45

SH3,159

- 7' ... ge₆ 15 1 me dir nu pap an-m[i] *s[in]* x x x dir kalag *ki* pap nu igi in 35 me *ana* šú š[amáš ...]
 7' ... Night of the 15th, 1° ME, clouds, I did not watch. Lunar eclipse, ... ; dense clouds; when I watched, I did not see it; at 35° before sunset [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 174 VIII	-137NOV15	5.65	3.16	50.0	7.42*	—	—	9.80*	.29	122	195	16.79	17.32	6.69	6.76

SH3,167

- 3' [...] muš an-mi *sin* [...]
 3' [...] measured; lunar eclipse [which passed ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 175A VII	-136OCT04	23.62	—	8.9	—	—	—	—	-.48						

LBAT 430, Rev. = SH3,181

- 2 [...] šá di]b in 1,19 ge₆ ana zalág
 2 [...] which passed]. At 79° before sunrise

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 175A XII2	-135APR01	.16	2.88	187.8	1.48	—	—	4.82	.73	154	264	17.76	18.22	5.77	5.97

LBAT 1285, Rev. 17ff.

- 17 mu-1-me-1,15-kám
 18 dir-še g[e₆] 15 17,40 me
 19 dir nu pap *kip-pat ziq-pi*
 20 *sin an-mi id ulù u kur*
 21 *ki?* [tab-]ú *ina* 18² ge₆
 22 7 si [gar]-an in 1 danna
 23 ge₆ ana [zalág]

- 17 Year 175,
 18 month XII₂ 15 17;40 ME,
 19 cloudy, not observed. When the “Circle” (III) culminated,
 20 lunar eclipse, beginning on the south-east
 21 side. In 18°(?) night
 22 it made 7 fingers. At 1 *bēru*
 23 before sunrise.

SH3,183

- 7' [...] 15 ge₆ ír ana zalág-ru *ki-i tab-ú ina* 18 ge₆ ta kur *ana si u mar* *zalág-i[r ...]*
 8' [...] *gub īb-tag₄ ḫudu-idim-meš nu gub-meš* 3 ½ kùš *ina igi rín šá ulù a-dir in [...]*
 7' [...] 15° of night maximal phase; when it began to clear, it cleared in 18° from east to northwest
 [...]
 8' [...] stood there, the remainder of the planets did not stand there; 3 ½ cubits in front of α Librae it was eclipsed; at [...]

Comments. The timing “1 *bēru*” in line 22 is a gross error (expected: 2 *bēru* = 60°). Note that this text elsewhere expresses “1 *bēru*” by “30 *bēru*”, see next eclipse, line 34, so the number 1 probably should be emended to 2.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 176 VI	-135SEP24	15.16	3.07	358.3	16.72*	—	—	19.83	.83	28	273	18.05	18.12	5.88	6.57

LBAT 1285, Rev. 29ff.

- 29 mu-1-me- 1,16-kám
 30 kin ge₆ 14 1,30 [me]
 31 [di]r² u a-kám muš
 32 [...]. a-kám ki pap [...].
 33 [...]. *id si u mar*
 34 [... ...] in 30 danna
 35 [... ...]

- 29 Year 176
 30 month VI 14, 1° ;30 ME,
 31 cloudy and misty, measured [...]
 32 [...] mist when observed [...]
 33 [...] north-west side
 34 [...] At 30° (= 1) *bēru*
 35 [before sunset]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 176 XII	-134MAR21	.53	2.81	176.9	1.25	2.48	4.08	5.31	1.57	112	307	17.57	18.04	5.96	6.11

LBAT 1285, Rev. Edge

Edge

- 1' [...] *i*]n(?) 18 me *ana šú šamáš*
 2' [...] *an-mi*] *šamáš?* *a*²-kám *ki* pap nu *igi* in 1,8 me *ana šú šamáš*
 3' [...] *a-kám muš* mál *šudun* anše [*ár-ku*]-ú *ziq-pi*
 4' [...] *ul]ù u kur ki-i tab-ú ina* 30[...] *gab-bi šú-im* in 1,5 *ge*₆ *ana zalág*

Edge

- 1' [...] solar eclipse(?), not seen, ar]ound 18° day before sunset.
 2' [...] solar eclipse,] mist(?), when watched, not seen. At $1,8^\circ$ day before sunset.
 3' [...] mist, measured. When the “Rear Donkey Yoke” (II) culminated
 4' [lunar eclipse,] beginning on the south-east side. After 30° it was totally covered. At $1,5^\circ$ night before sunrise.

Comments. The reading of these lines and the separation into three eclipses is conjectural; the text ought to be collated. Note that the eclipse portion of this Goal Year text (the final part of the leftmost column of the reverse) is expected to cover the eclipses and eclipse possibilities of one year, that is the following:

1. 17-23: lunar eclipse of S.E. 175 XII 15 = -135APR01 (see there)
 1. 24-28: solar eclipse of S.E. 175 XII 29 = -135APR15 (see there)
 1. 29-35: lunar eclipse of S.E. 176 VI 14 = -135SEP24 (see there)
 1. 36f.: one or two(?) lines almost completely destroyed, possibly empty.
- Edge, 1. 1': solar eclipse possibility of S.E. 176 VI = -135OCT09
 1. 2': solar eclipse possibility of S.E. 176 XI = -134MAR06
 1. 3'-4': lunar eclipse of S.E. 176 XII = -134MAR21

The text on the tablet passed from the reverse to the lower edge after line 36(?); the precise line count is questionable, but the traces appear compatible with the assumed distribution of eclipses. The lunar eclipse of -134MAR21 occurs also in a diary:

SH3,191

- 8' [...] ... mar *zalág-ir* 1 gar ír *u* *zalág-ru* *an-mi-šú* *sa*₅ *ina* *an-m[i-šú* ...
 8' [...] ... cleared to [...] west; $1,0^\circ$ onset, maximal phase, and clearing; its eclipse was red; in its ecl[ipse ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 177 XII	-133MAR10	3.75	2.75	166.1	5.16	—	—	7.40*	.25	63	355	17.22	17.85	6.14	6.20

SH3,197

- 16' [...] *š]ā?* *gaš[an]* *tin ziq-pi sin* *an-mi id* *kur ki-i tab-ú ina* 9 *uš ge*₆ 2 *si šú-im* ... [...]
 17' [...] *ár dele šá igi ab]sin KAxMI in* 9 *uš ge*₆ *ana zalág* 13 1 *na dir u a-kám muš* ...

- 16' [...] when the “Lady of Life” (VII) culminated, lunar eclipse; when it began on the east side, it covered 2 fingers in 9° of night [...]
 17' [... behind] γ Virginis it became eclipsed; at 9° before sunrise. The 13th, 1° NA, measured (despite clouds and mist. ...)

Comments. The Moon was at $\lambda=165.55^\circ$, $\beta=-1.61^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 178A VI	-133SEP03	18.65	2.97	337.1	20.37	—	—	22.55	.25	119	186	18.25	18.49	5.52	5.99

SH3,199

- 7' *ki-i tab-ú ina* 10 uš ge₆ ta kur *ana* mar zalág ... [...]
 8' *in* 32 ge₆ gin

 7' when it began [to clear], in 10° of night it cleared from east to west ... [...]
 8' At 32° after sunset.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 178A XI	-132JAN29	3.34	—	126.1	—	—	—	—	-.19						

SH3,203

- 7' [...] ... an-mi *sin* 5 áb bar dib *in* 1,32 ge₆ *ana* zalág ...
 7' [...] ... lunar eclipse, 5 months, BAR, passed; at $1,32^\circ$ before sunrise ...

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 179 X	-131JAN17	19.37	2.72	115.5	20.50	22.00	22.35	23.85	1.06	131	262	16.74	17.14	6.85	7.29

SH3,229

- 2' [...] ul]ù u kur *ki-i tab-ú ina* 10[+x ge₆ ...]
 2' [...] when [the eclipse] began on the southeast side, in $10[+x^\circ]$ of night ...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 181 III	-130JUL02	14.94	2.98	276.2	16.00*	17.26*	18.45*	19.71	1.30	99	244	19.08	19.19	4.82	5.44

SH3,239

- 7' [...] zalág-ru? ... in? 10 uš ge₆ ta kur [*ana* x zalág ...]
 8' [...] ... *ina* an-mi-šú mól-babbar genna u an [gub-meš ...]

 7' [...] when it cleared ... in 10° of night [it cleared] from east [to ...]
 8' [...] ... in its eclipse, Jupiter, Saturn and Mars [stood there ...]

Comments. Jupiter, Saturn and Mars were the only planets above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 182 II	-129MAY23	21.67	—	238.1	—	—	—	—	-.78						

SH3,247

- 7' [...] an-mi *sin* 5 áb bar dib *in* [...]
 7' [...] lunar eclipse, 5 months, BAR, passed; at [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 183A VIII	-128NOV05	1.12	3.18	40.4	2.84	—	—	5.92	.63	116	218	16.97	17.44	6.56	6.80

LBAT 1441 = H5,65

- E. *ina a-mat* ^den *u* ^dgašan-*iá liš-lim*
 1 mu-1-*me*-20-kám šá ší-i mu-1-m[e-1,23-kám]
 2 ^lar-šá-ka-a lugal
 3 apin ge₆ 13 4°,30 me dir *muš* [...]
 4 ár maš-maš *ziq-pi sin* an-mi *id* [si *u kur*]
 5 *ki-i tab-ú* [*ina* 18] ge₆[... ...]
 6 6 ge₆ ír *ana z[alág-ru ki-i tab-ú]*
 7 *ina* 16 ge₆ ta si⁷ [*u kur ana ulù u mar zalág-ir*]
 8 40 gar ír *u zalág-ru a[n-mi-šú sa₅]*
 9 sa₅-šú sud *ina sag gar tūr* [...]
 10 *ina an-mi-šú ana dir ku₄-ub*⁷ [...]
 11 *ina an-mi-šú si šá pa mar gar* [gin]
 12 *ina an-mi-šú műl kak-si-sá* [gub]
 13 íb-tag₄ ^dudu-idim-meš nu [gub-meš]
 14 2 kùš e is *le₁₀* KAxA MI
 15 *in* 55 ge₆ *ana zalág*
 16 3,30 na dir nu pap

- E. Through the word of the Lord and my Lady shall it remain whole.
 1 Year 120(!), i.e. year [183],
 2 king Arsaces,
 3 month VIII 13, 4°(?);30 ME, cloudy, measured. [...]
 4 after the “Twins” (XVIII) culminated, lunar eclipse, beginning
 5 on the [north-east]side. [in 18°] night [it made ... fingers]
 6 6° duration of maximal phase [(until) it began to become bright]
 7 In 16° from north(?) east to south-west it became bright.]
 8 40° total duration. [Its eclipse was red,]
 9 its redness was red brown; in the beginning of onset a halo [...]
 10 During its eclipse, it entered a cloud [...]
 11 During its eclipse, north(wind) which was set to the west side [blew]
 12 During its eclipse, Sirius [stood] there,
 13 The other planets did not [stand there]
 14 2 cubits above α Tauri eclipsed.
 15 At 55° before sunrise.
 16 On the 13th, 3°;30 NA, cloudy, not observed.

Comments. Line 1: one expects year 119 Arsacid era. The Moon was at $\lambda=39.62^\circ$, $\beta=0.46^\circ$. The planets were below the horizon, Sirius was above (Altitude 36.0°).

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 185 XII	-125MAR11	19.82	—	167.7	—	—	—	—	-.63						

SH3,257

- 15 ... an-mi *sin* 5 áb bar dib *in* 28 me [...]
 15 ... lunar eclipse, 5 months, BAR, passed; at 28° of day [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 187 V	-124AUG24	15.59	2.94	328.0	16.95*	—	—	20.32	.83	107	223	18.48	18.63	5.37	5.94

SH3,271

- 11' [...] *ana zalág-ru ki]-i tab-ú ina* 20 *ge*₆ *ta si u mar ana ulù u kur zalág-ir an-mi-šú tíg an-e gar-in ina* an-mi-šú *si šá pa mar gar gin ina zalág-ru* [...]
 11' [...] when it began [to clear], it cleared in 20° of night from northwest to southeast. Its eclipse had the ‘garment of the sky’; during its eclipse, the north wind which was set to the west side blew; during clearing [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 188 V	-123AUG13	18.50	2.91	317.1	19.32	20.58	22.11	23.36	1.49	68	268	18.61	18.80	5.21	5.62

SH3,285 (+ duplicate: 289)

- 14 [...] *ina* 19 *ge*₆ *gab-bi šú-im* 24 *ge*₆ ír [...] 19 *ge*₆ [...] *ta* [x *ana*] *mar* *zalág-ir* 1,2 *gar* ír *u* *zalág-ru* an-mi-šú [...]
 15 [...] *an* *gu*₄-ud *u dele-bat šú-u'* *ina sag* ír *genna e-a ina* *zalág-ru* *múl-[babbar e-a ...]* ... *dib* ... [...] *ana tar-ša qup-pu igi-ú šá gu KAxMI* ...
 14 [...] in 19° of night it was completely covered; 24° of night maximal phase; [when it began to clear, in] 19° of night it cleared fr[om x] to west; 1,2° onset, maximal phase and clearing. Its eclipse [...]
 15 [...] during onset, Mars,] Mercury and Venus set; in the beginning of maximal phase, Saturn came out; during clearing, Jupiter came out [...] ... [...] opposite the front *quppu* (container, basket) of Aquarius it was eclipsed.

Comments. The Moon was at $\lambda=317.36^\circ$, $\beta=-0.93^\circ$. Mars set at 16.98 UT = 19.89 LT; Mercury set at 16.90 UT = 19.81 LT; Venus set at 17.18 UT = 20.09 LT. Saturn rose at 17.92 UT = 20.83 LT; Jupiter rose at 20.10 UT = 23.01 LT. See the eclipse of -366AUG30 for the “rear *quppu*”.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 189 U V	-122AUG02	18.90	2.91	306.2	20.63	—	—	22.56	.15	19	323	18.79	18.95	5.06	5.44

SH3,297 (+ duplicate: 295)

- 8' ... *ge*₆ 14 2,20 *me a-kám muš* 5 *uš ár* *múl dele ziq-pi sin* an-mi *id ulù u kur ki-i tab-ú* [...] [...] *ana* *zalág-ru k]i-i tab-ú ina* 13 *ge*₆ *ta ulù ana si u kur* *zalág-ir* 27 *gar u* *zalág-ru* an-mi-šú tíg an-e *gar-in ina* (an-mi-šú *mar*[?] *gin ina*[?] an-mi-šú[?]) [...]
 10' [...] *gu*₄-ud *šú <ina> zalág-ru genna e-a íb-tag⁴ udu-idim-meš nu* *gub-meš* 3 *kùš ár* *múl tur šá* 2 ½ *kùš ár* [múl ár šá suhur máš *a-dir* ...]
 8' ... Night of the 14th, 2;20° ME, measured (despite) mist. 5° after the “Single Star” (VI) culminated, lunar eclipse; when it began on the southeast side, [...]

- 9' [...] when it began [to clear], it cleared in 13° of night from south to northeast; 27° onset and clearing; its eclipse had the ‘garment of the sky’; in (its eclipse, west[?]) wind blew, in its eclipse [...]
- 10' [... Mer]cury set; <during> clearing Saturn came out; the remainder of the planets did not stand there; 3 cubits behind the small star which is $2 \frac{1}{2}$ cubits behind [δ Capricorni it was eclipsed ...]

Comments. The Moon was at $\lambda=306.43^\circ$, $\beta=-1.62^\circ$. Mercury set shortly before the beginning of the eclipse at 17.26 UT = 20.17 LT. Saturn rose at 19.29 UT = 22.20 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 192 II	-119JUN01	22.30	3.08	247.2	23.61	—	—	2.94	1.02	79	311	18.66	19.09	4.91	5.13

LBAT 1442 = H5,65

- E. *ina a-mat^den u^dgašan-iá liš-lim*
 1 *mu-1-me-28-kám šá ši-i*
 2 *mu-1-me-1,32-kám^lar-šá-kám lugal*
 3 *itu gu₄ ge₆ 14 6,30 me muš*
 4 *5 uš ár mól tak-šat ziq-pi*
 5 *sin an-mi id kur u si*
 6 *ki-i tab-ú ina 24 ge₆*
 7 *1 si ana til-tim tag₄*
 8 *6 ge₆ ír ana zalág-ru*
 9 *ki-i tab-ú in 24 ge₆*
 10 *ta kur u si ana ulù*
 11 *[u] mar zalág-ir 54 gar*
 12 *[ír] u zalág-ru*

Rev.

- 13 *[an-mi]-šú sa₅ sa₅-šú*
 14 *sud ina an-mi-šú ina gar-in*
 15 *né-hi ina ír u zalág-ru*
 16 *[ha[?]-mu[?]]-ut[?] ina sag gar-in*
 17 *mól-babbar u an šú-meš íb-tag₄*
 18 *^dudu-idim-meš nu gub-meš*
 19 *[ina] pa ád in 1,6 ge₆ gin*
 20 *14 3 na muš*

E. Through the word of the Lord and my Lady shall it remain whole.

1 Year 128, i.e.

2 year 192, king Arsaces.

3 Month II 14, 6° ;30 ME measured.

4 5° after the “Triplets” (V) culminated,

5 lunar eclipse, beginning on the north-east side. After 24°

7 1 finger lacked to totality

8 6° duration of maximal phase. When it began

9 to become bright, in 24° of nighttime

10 it became bright from north-east to south-west. 54 total duration

13 Its eclipse was red, its redness was

14 red brown; in its eclipse, during onset

15 it was slow, during maximal phase and clearing

16 [it was fa]st(?). In the beginning of onset,

- 17 Jupiter and Mars set, the other
 18 planets did not stand there.
 19 [In] Sagittarius eclipsed. At 66° after sunset.
 20 On the 14th 3° NA measured.

SH3,311

(Composite text, CI'ff.+B₂):

[...] ana zalág-ru ki-i tab-[ú ...] [... ana u]lù u mar zalág-ir 45[?] gar ír u zalág-ru an-mi-šú sa₅ sa₅-šú [sud [...] [...] si š]á pa mar gar gin ina an-mi-šú ... [...] [...] id si ád ina an-mi-šú mul[?] gal[?] ... [...] mól-babbar u an šú-meš[?] íb-tag₄^d udu-idim-meš nu gub-meš 2 kùš ár 4-àm igi-meš šá pa KAxMI in 1,6 g[e₆ gin]

[...] when it began to clear, [in 24° of night] it cleared from [] to southwest; 45° ? onset, maximal phase and clearing; its eclipse was red, its redness [was red brown ...] [... north wind] which was set to the west side blew; in its eclipse ... [...] [...] the north side was eclipsed; in its eclipse a meteor(?) ... [...] Jupiter and Mars set; the remainder of the planets did not stand there; 2 cubits behind the four front stars of Sagittarius it became eclipsed; at $1,6^\circ$ [after sunset].

Comments. In view of LBAT 1442, the damaged number 45 in SH3,311 should be emended to either 54 or 55. The Moon was at $\lambda=247.07^\circ$, $\beta=-1.34^\circ$. Jupiter set at 20.87 UT = 23.95 LT, Mars set at 20.94 UT = 0.02 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 200 III	-111JUL02	12.33	2.98	276.4	14.32*	—	—	15.96*	.12	145	197	19.15	19.18	4.82	5.65

SH3,341

- 14' ... 13 4 šú a-kám muš an-m[i ...]

SH3,345

- 5' [...] 4,40 šú a-kám muš an-mi sin šá dib in 1 x[...]

... The 13th, 4° (Var.: 4;40°) ŠÚ, mist, measured. Lunar eclipse, which passed; at $1,x^\circ$ [...]

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 202A VIII	-109NOV05	18.60	3.18	40.5	19.86	20.96	22.54	23.63	1.75	74	261	17.18	17.44	6.57	7.08

SH3,349

- 5' [...] 20 ge₆ ír ana zalág-ru ki-i tab-ú [in[?] x+]6 ge₆ ta kur [...]
 6' [...] íb-ta]g₄ udu-idim-meš nu gub-meš 2 kùš e is le₁₀ ád [i]n 25 ge₆ gin

- 5' [...] 20° of night maximal phase; when it began to clear, [it cleared in x+]6° of night from the east? [...]
 6' [...] the remain]der of the planets did not stand there; 2 cubits above α Tauri it became eclipsed; at 25° after sunset.

Comments. The Moon was at $\lambda=40.88^\circ$, $\beta=-0.54^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 203 I	-108MAY01	17.84	3.05	217.8	19.26	—	—	22.21	.51	147	240	18.50	18.72	5.27	5.67

LBAT 466 = SH3,355

(Composite text, B7 + A2' f.:)

... ge₆ 15 3 me *a-kám muš* 8 uš ge₆ gin *sin* an-mi *id* ulù
 [... *ki]-i tab*[?]-ú *ina* [1?]8 ge₆ 6 si *gar-a[n ...]*
 [...]r *u zalág-ru* an-mi-šú sa₅ sa₅-šú sud *ina* an-mi-šú kur gin *ina* an-mi-šú
 mál-babar *dele-bat* genn[a *u* an gub-meš ...]

Night of the 15th, 3° ME, mist, measured. After 8° of night, lunar eclipse; when it began on the south [...] side, in 8°(? or 18°) of night it made 6 fingers [...] [... x° onset,] maximal phase and clearing; its eclipse was red, its redness was red brown; In its eclipse, east(wind) blew. In its eclipse, Jupiter, Venus, Saturn[and Mars stood there ...]

Comments. Jupiter, Venus, Saturn and Mars were above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 204 XII	-106MAR11	8.47	2.76	167.7	9.69*	—	—	12.88*	.75	73	323	17.04	17.87	6.12	6.06

SH3,369

- 8' 13 30 ninda šú *muš* an-mi *sin šá* dib *in* 1,2 me nim-*a*
 8' The 13th, 0;30° ŠÚ, measured. Lunar eclipse which passed; at 1,2° after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 205A XII	-105FEB28	20.92	2.70	157.1	21.73	22.83	.34	1.43	1.61	114	279	17.31	17.71	6.29	6.62

SH3,377

- 5' [...] ta kur *ana* si *u* mar *zalág-ir* 1 *gar ír u zalág-r[u ...]*
 6' [...] *dele*] šá igi absin 2/3 kùš *ana* ulù sig ád *in* 1,6 ge₆ gin [...]
 5' [...] from east to northwest it cleared; 1,0° onset, maximal phase and clearing
 6' [...] of γ Virginis, 2/3 cubits toward south below, it became eclipsed. At 1,6° after sunset [...]

Comments. The Moon was at λ=157.38°, β=-0.18°.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 206 V	-105AUG25	1.53	2.94	327.8	2.37	3.60	5.22	6.45*	1.59	69	262	18.27	18.64	5.37	5.52

SH3,389

- 11' [...] *sin an]-mi* ta kur *ki-i tab-ú ina* 21 ge₆ *gab-bi* šú-im 21 ge₆ ír *ana* *zalág-ru* *ki-i tab-ú ana a-kám*
 ku₄ ád šú
 12' an-mi-šú sa₅ *ina* an-m[i-šú] genna [...] *u* mál kak-s]i-sá gub-meš íb-tag₄^d udu-idim-meš nu gub-
 meš *ina* sag zib-me ád *in* 50 ge₆ *ana* *zalág*
 11' [...] lunar eclips[e; when it began from the east, in 21° of night all was covered; 21° of night
 maximal phase; when it began to clear, it entered into mist; it set eclipsed;
 12' its eclipse was red; in its eclipse, Saturn [...] and Sir]ius stood there; the remainder of the planets
 did not stand there; in the beginning of Pisces it became eclipsed; at 50° before sunrise.

Comments. In line 12', one should emend the damaged sign genna=Saturn into an=Mars; Mars was the only planet above the horizon; Sirius: altitude 27.5°.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 207 V	-104AUG13	1.88	2.91	316.8	3.42	—	—	5.76*	.27	23	313	18.45	18.81	5.20	5.32

LBAT **1295

Eclipse beginning 7° before the “Bright Star of Old Man” (*nibū šá šu-gi*) (XIV) culminated. ... At 14° before sunrise.

Comments. Excerpts from this Goal Year text were quoted by Epping and Strassmaier (ZA 6 (1891), 218ff., and by Schaumberger (ZA NF 16 (1952), 214ff.). I have not seen the text.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 213A I	-98APR11	14.19	2.95	198.1	15.06*	16.26*	17.96*	19.16	1.83	118	299	18.33	18.40	5.59	5.94
S.E. 213A VII	-98OCT05	23.72	3.12	9.7	.92	2.01	3.58	4.67	1.75	64	237	17.63	17.94	6.07	6.34
S.E. 213A XII ₂	-97MAR31	18.45	2.88	187.4	19.75	—	—	22.52	.48	74	345	17.98	18.22	5.77	6.01

SH3,407

Obv.

- 4 mu-2-me-13(text: 14)-kám bar ... ge₆ 14 sin
 5 ki e-a 3 si id kur ina til {gír-tab} rín 2 kùš ár rín šá ulù
 6 a-dir ina an-mi-šú mül-babbar ina maš-maš u mül kak-si-sá gub-meš
 11 du₆ ge₆ 14 sin an-mi ina hun id kur ki tab-ú gab-bi šú-im
 12 ina an-mi-šú mül-babbar ina alla u mül kak-si-sá gub-meš

Rev.

- 4 dir-še ge₆ 14 sin an-mi id si u kur ki tab-ú
 5 al-la šal-šú hab-rat dir gar-an ina an-mi-šú mül-babbar
 6 ina alla gub an u dele-bat ina mül-mül šú-ú ina zalág mül kak-si-sá šú
 7 ina rín a-dir

Obv.

- 4 Year 213, month I, ... Night of the 14th, when the moon
 5 came out, it was eclipsed 3 fingers on the east side in the end of Libra, 2 cubits behind α Librae;
 6 in its eclipse, Jupiter in Gemini and Sirius stood there.
 11 Month VII, night of the 14th, lunar eclipse in Aries; when it began on the east side, it became all
 covered;
 12 in its eclipse, Jupiter in Cancer and Sirius stood there.

Rev.

- 4 Month XII₂, night of the 14th, lunar eclipse; when it began on the northeast side,
 5 it made (an eclipse) for more than a third of the disk; in its eclipse, Jupiter
 6 in Cancer stood there, Mars and Venus set in Taurus; during clearing, Sirius set;
 7 (the moon) became eclipsed in Libra.

Comments. In -98APR11 at moonrise, the Moon was at $\lambda=199.55^\circ$, $\beta=-0.23^\circ$; Jupiter at $\lambda=60.22^\circ$, $\beta=-0.25^\circ$; Sirius: Altitude 39.2°.

In -98OCT05, the Moon was at $\lambda=9.02^\circ$, $\beta=-0.14^\circ$; Jupiter at $\lambda=93.26^\circ$, $\beta=0.08^\circ$.

In -97MAR31, the Moon was at $\lambda=188.09^\circ$, $\beta=-1.02^\circ$; Jupiter at $\lambda=85.99^\circ$, $\beta=0.42^\circ$. Mars set at 17.77 UT = 20.65 LT, at $\lambda=38.26^\circ$, $\beta=0.51^\circ$; Venus set at 17.59 UT = 20.47 LT, at $\lambda=35.95^\circ$, $\beta=0.59^\circ$. Sirius set at 19.25 UT = 22.13 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 215 V	-96AUG14	20.48	—	318.6	—	—	—	—	-.68						

SH3,413

- 4' ... ge₆ 14 2,40 me an-mi *sin*
 5' [...] *a-kám* nu pap dir *u a-kám* an-ú šú-im
 4' ... Night of the 14th, 2;40° ME; lunar eclipse
 5' [...] mist, I did not watch; clouds and mist covered the sky.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 216A V	-95AUG03	21.75	2.91	307.7	23.12	—	—	2.38	.71	34	285	18.70	18.93	5.08	5.37

LBAT 401 = SH3,425

- 4' [...] ... 5 uš ár sa₄ šá gaba-šú *ziq-pi sin* an-mi *i[d?* ...]
 5' [...]. an-mi-šú túg an *gar-in* an-mi-šú si *gin ina* an-mi-šú *gen[na?* ...]
 4' [...] ... 5° after the “Bright Star of his Breast” (IX) culminated, lunar eclipse, on [...]
 5' [... During] its eclipse, the ‘garment of the sky’ was in place. During its eclipse, north(wind) blew. During its eclipse Sat[urn(?)] ...]

LBAT 492 = SH3,425

- 7' [...] *zalág-r]u ki-i tab-ú ina* 20 ge₆ ta ulù *ana si u mar* [*zalág-ir* ...]
 8' [...] nu? *gub-u' ina gu ád in* 57 ge₆ *gin* 13 [...]
 7' [...] until it began to become bright. In 20° it [became bright] from south to northwest [...]
 8' [... the other planets] did not stand there. In Aquarius it was eclipsed. At 57° after sunset. On the 13th [...]

Comments. The Moon was at $\lambda=307.41^\circ$, $\beta=-1.22^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 218A IV	-93JUL13	19.89	2.94	286.9	21.64	—	—	23.70	.25	133	200	18.82	19.14	4.87	5.34

SH3,429

- 3 [...] ge₆ 14 4 me *muš mól gašan* *tin* [...] *ziq-pi sin* an-mi *id ulù ki tab-ú ina* 13 ge₆ 3 *si gar-an*
 4 [...] *ina an-mi-šú si gin ina an-mi-šú* [mú]l-babbar *gub ina* *zalág genna e-a íb-tag₄ udu-idim-*
meš nu gub-meš
 3 [...] Night of the 14th, 4 ME, measured. When the “Lady of Life” (VII) culminated, lunar eclipse; when it began on the south side, in 13° of night it made 3 fingers;
 4 [...] in its eclipse, the north wind blew; in its eclipse, Jupiter stood there; during clearing, Saturn came out; the remainder of the planets did not stand there.

Comments. Saturn rose at 20.32 UT = 23.26 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 221A VIII	-90NOV05	18.13	3.18	40.9	19.80	—	—	22.51	.55	35	300	17.23	17.43	6.57	7.12

SH3,433

- 6' [...] ge₆ 14 3 me mól *a-si-du ziq-pi sin* an-mi *id s[i ...]*
 7' [... *ina* an-m]i-šú si *gin ina* an-mi-šú mól-babbar *u* genna gub-meš *ina* sag zalág an *u* k[ak-ban][?]
 è-meš ...]
 6' [...] Night of the 14th, 3° ME. When the “Heel” (XI) culminated, lunar eclipse; [when it began] on the nor[th ...] side, [...]
 7' [... in its ecli]pse, the north wind blew; in its eclipse, Jupiter and Saturn stood there; at the beginning of clearing, Mars and S[irius](?) came out ...]

Comments. Mars rose at 18.02 UT = 21.20 LT, Sirius at 18.11 UT = 21.29 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 223 VI	-88SEP15	6.76	3.03	349.6	8.33*	—	—	11.48*	.66	110	215	17.73	18.28	5.72	5.70

LBAT 1334+1435+1443, Obv. IV' = H5,67f.

- 5' 14 šú *u* na nu tuk *muš*
 6' 14 an-mi *sin*
 7' šá dib
 8' *ina* 30+[x m]e nim-*a*
 5' (Month VI, day) 14 ŠÚ and NA did not exist, measured.
 6' (Day) 14 lunar eclipse
 7' which passed.
 8' At 30+[x af]ter sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 224A XII	-86FEB28	21.41	2.71	157.5	22.76	—	—	1.20	.41	155	238	17.27	17.71	6.28	6.65

LBAT 1443, Col. II = H5,71

- 1' ge₆ 14 7 *muš*
 2' 2 šá giš-kun-šú
 3' *ziq-pi*^d *sin*
 4' an-mi ta ulù
 5' [ki tab]-ú *ina* 12 ge₆
 6' [... ...]
 1' Night of the 14th 7° (ME) measured, (when)
 2' the “2 of his Thigh” (XXIII)
 3' culminated, lunar
 4' eclipse, beginning from the south.
 5' In 12° night
 6' [it made ...]

SH3,453

- 18' mól 2 šá giš-kun-šú *ziq-pi sin* an-mi ta ulù *ki tab-ú ina* 12 ge₆ šal-[šú ...]
 19' 30 gar ír *u* zalág-*ru* an-mi-šú tág an-e gar-in *ina* an-mi-šú mól-babbar genna *u* [mól kak-ban
 gub-*u*']
 20' íb-tag₄^d udu-idim-meš nu gub-*u*' 2 kùš *ina* igi mól dele šá igi absin 8 si *ana* ulù [sig *a-dir* ...]

- 18' when the “2 Stars of his Thigh” (XXIII) culminated, lunar eclipse; when it began from the south, in 12° of night it [made] one third [of the disk ...]
- 19' 30° onset, maximal phase and clearing; its eclipse had the ‘garment of the sky’; in its eclipse, Jupiter, Saturn and [Sirius stood there,]
- 20' the remainder of the planets did not stand there; 2 cubits in front of γ Virginis, 8 fingers below to the south [it was eclipsed ...]

Comments. The Moon was at $\lambda=157.68^\circ$, $\beta=0.46^\circ$. Saturn was above the horizon; Jupiter set at 21.33 UT = 0.04 LT, and Sirius set at 21.27 UT = 23.98 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 225 V	-86AUG24	9.03	2.94	327.5	10.46*	—	—	13.08*	.37	25	305	18.11	18.65	5.36	5.22

SH3,459

11' [...] ... 13 2,30 šú muš an-mi sin šá dib in 1 danna me n[im-a]

11' [...] ... The 13th, 2;30° ŠÚ, measured, lunar eclipse which passed; at 1 *bēru* after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 231 I	-80APR21	20.87	3.01	208.6	21.83	23.04	.71	1.92	1.70	121	293	18.24	18.57	5.42	5.66

LBAT 1444 = H5,71

- E. *ina a-mat* ^den *u* ^dgašan-iá [*liš-lim*]
 1 mu-1-me-1+ŠU-7[-kám ...]
 2 ⁱar-šá-ka-a [...]
 3 itu bar ge₆ 14 5 m[e ...]
 4 5 uš *ina* igi šudun [anše *ziq-pi*]
 5 *sin* an-mi [...]
 6 [... ...]
 7 [... ...]
 8 14 3,30 [na ...]

E. Through the word of the Lord and my Lady [shall it remain whole]

1 Year 167, [i.e. year 231]

2 [king] Arsaces.

3 Month I 14, 5° ME [...]

4 5°(?) before the “[Donkey] Yoke” (XXVI) [culminated]

5 lunar eclipse.

6 [... ...]

7 [... ...]

8 On the 14th, 3°;30 [NA ...]

SH3,483

6' [...] ge₆ gab-bi-šú šú-im 22 ge₆ ír ana zalág-ru ki [tab-ú ...]

7' [...] gin *ina* an-mi-šú šú aš gar-in tūr nu kád nigin ... [...]

8' [...] šá sag gír-tab ád in 1 ge₆ gin 14 3,30? [na ...]

6' [...] of night all of it was covered; 22° of night maximal phase; when [it began] to clear, [...]

7' [...] blew; in its eclipse, there was ...; it was surrounded by a halo which was not closed ... [...]

8' [...] δ/β] Scorpii it became eclipsed; at 1,0° after sunset. The 14th, 3;30° [NA].

Comments. The Moon was at $\lambda=208.82^\circ$, $\beta=-0.53^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 232A I	-79APR11	1.65	2.95	198.0	2.94	—	—	5.93*	.60	78	339	17.85	18.39	5.60	5.69

LBAT **1445, ZA 3 (1888) 147 = H5,73

- E. *ina a-mat* ^den *u* ^d[gašan-iá liš-lim]
 1 mu-1-me-1+ŠU-8-kám šá ši-i
 2 mu-2-me-32-kám ^lar-šá-kám lugal lugal-meš
 3 šá *it-tar-ri-du* ^lú-ru-da-a lugal
 4 itu bar ge₆ 13 5,50 me dir *muš*(? or: nu pap?)
 5 5 uš *ina* igi dele *ziq-pi*
 6 *sin* an-mi *id* ulù *u* kur
 7 *ki-i* tab-ú *ina* 20 ge₆ 6 si *gar-an*
 8 7 ge₆ ír *ana* zalág-ru *ki-i* tab-ú
 9 *ina* 13 ge₆ ta ulù *u* kur
 10 *ana* si *u* mar 4 si *zalág* tag₄ šú

Rev.

- 11
 12 *an-mi-šú* *ina* [túg an] *gar-in*
 13 *ina* an-mi-šú si šár gin
 14 *ina* an-mi-šú mûl-babbar genna *u* an gub-u'
 15 *ina* zalág-ru genna šú íb-tag₄
 16 ^dudu-idim-meš nu gub-u'
 17 2/3 kùš ár rín šá ulù 6 si
 18 *ana* ulù sig ád in 40 ge₆ *ana* zalág
 19 13 1 na *a-kám* *muš*

- E. Through the word of the Lord and my Lady shall it remain whole.
 1 Year 168, i.e.
 2 year 232, Arsaces, king of the kings,
 3 which is in the time(?) of king Orodes (I.).
 4 Month I 13, 5°;50 ME, cloudy(?), measured(? or: not observed?).
 5° before the “Single Star” (VI) culminated,
 6 lunar eclipse, beginning on the south-east
 7 side. In 20° night it made 6 fingers.
 8 7° duration of maximal phase, until it began to clear.
 9 In 13° from south-east
 10 to north-west, 4 fingers lacking to brightness, it set.
 11 ...
 12 (During) its eclipse the ['garment of the sky'] was in place.
 13 During its eclipse, north (wind) blew.
 14 During its eclipse, Jupiter, Saturn and Mars stood there.
 15 When becoming bright, Saturn set. The other
 16 planets did not stand there.
 17 2/3 cubits behind α Librae, 6 fingers
 18 toward south beneath. At 40° before sunrise.
 19 On the 13th 1° NA, mist, measured.

Comments. Note that 40° = 20°+7°+13° is the time from beginning to *moonset* (lines 7-10), but also the time from beginning to *sunrise* (line 18), while the time from sunrise to moonset is measured as 1° (line 19)! Saturn set at 2.22 UT = 5.17 LT; Mercury rose at 1.87 UT = 4.82 LT. The Moon was at λ=197.49°, β=-1.45°.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 232A VII	-79OCT05	18.36	3.12	9.9	20.03	—	—	22.62	.39	110	192	17.69	17.93	6.08	6.57

LBAT 1446 = H5,75

- 1 [... šá] ši-i mu-2-me-32-[kám]
 2 [’ar-šá]-ka-a šá it-ṭar-ri-d[u]
 3 [’ú-r]u-da-a lugal ù is-[pu-bar-za-a]
 4 [nin-šú] gašan [...] ...]
 5 [... m]úl ár [šá sag hun]
 6 [...] ina 30 ge₆ gin
 7 [...] na muš

- 1 [Year 168, i.e.] year 232,
 2 [king Arsa]ces, which is in the time(?) of
 3 king Orodes and Is[pubarza]
 4 [his sister], the Lady [...] ...]
 5 [... α Arietis ...]
 6 [...] At 30° after sunset
 7 [...] NA measured

Comments. The Moon was at $\lambda=10.14^\circ$, $\beta=0.15^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 234 XI	-76FEB09	11.04	2.66	137.8	11.76*	12.91*	14.37*	15.53*	1.51	103	304	17.47	17.42	6.58	7.09

LBAT 516 = SH3,503

- 5' ... 14 1,40 šú dir nu pap an-mi sin šá dib in 1,16 me nim-a
 5' (Month XI) The 14th, 1;40° ŠÚ, clouds, not observed. Lunar eclipse, which passed. At 76° after sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 235A XI	-75JAN28	18.66	2.68	126.9	20.31	—	—	21.98	.10	45	356	16.99	17.27	6.73	7.02

SH3,505

- 5' [...] ta si ki tab-ú ina 8 ge₆ 3 si [...] ...]
 6' [...] mól-babar u mól kak-si-sá gub-m[eš ...]
 7' [...] sin ½ kùš ana [...] ...]
 5' [...] when it began from the north, in 8° night [it made] 3 fingers [...] ...]
 6' [...] Jupiter and Sirius stood there [...] ...]
 7' [...] the moon being ½ cubit to [...] ...]

Comments. The Moon was at $\lambda=127.47^\circ$, $\beta=-1.04^\circ$. Jupiter and Sirius were the only planets above the horizon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 239 VIII	-72NOV16	3.04	3.16	52.1	4.69	—	—	7.40*	.56	38	303	16.74	17.29	6.72	6.85

SH3,511

- 16' [...] sin an-mi id si u kur ki-i tab-ú ina 18 ge₆ ½ hab-rat gar-an 4 ge₆ ír [...] ...]

- 17' [...] x x x x an-mi-šú túg an gar-in *ina* an-mi-šú x x [...]
 18' [...] ½ kùš *ana* šú lal ád in 37° ge₆ *ana* zalág
- 16' [...] lunar eclipse; when it began on the north-east side, in 18° of night it made ½ of the disk; 4° of night maximal phase [...]
 17' [...] ... its eclipse had the 'garment of the sky'; in its eclipse ... [...]
 18' [...] ..., ½ cubit back to the west, it became eclipsed; at 37°(?) before sunrise.

Comments. The Moon was at $\lambda=51.18^\circ$, $\beta=-1.05^\circ$.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 244 X	-66JAN19	13.95	2.71	117.5	15.05*	—	—	18.47	.81	63	308	17.07	17.16	6.83	7.37

LBAT 1448 + Dupl. 1447 = H5,75f.

- E. *ina a-mat*^den *u* gašan-iá liš-lim
 1 mu-1-me-1,20-kám šá ší-i
 2 mu-2-me-44-kám ^lar-šá-kám lugal
 3 *u* pi-ir(var.: *ri*)-muš-ta-na-a
 4 dam-šú gašan itu ab ge₆ 15
 5 1 me a-kám muš sin ki e-a
 6 2-ta šu_{II} hab-rat id si
 7 *u* kur a-rim 6 ge₆ ír
 8 *ana* zalág-ru ki-i tab-ú *ina* 16 ge₆
 9 ta ulù *u* kur *ana* si *u* mar
 10 [zalá]g-ir 23 ír [*u*] *zalág-r[u]*
 11 an-mi-šú túg an gar-in [...]
 12 *ina* an-mi-šú si gin *ina* an-mi-šú
 13 dele-bat genna *u* mál kak-si-sá gub-u'
 14 fb-tag₄^dudu-idim-meš nu gub-meš
 15 ½ kùš *ina* igi mál lug[al KAxM]I?
 16 in 16 me *ana* šú šamáš
 17 15 9 na a-kám [mu]š

- E. Through the word of the Lord and my Lady shall it remain whole.
 1 Year 180, i.e.
 2 year 244, king Arsaces
 3 and Pir'uštanā,
 4 his wife, the lady, Month X 15
 5 1 ME, mist, measured. As the moon rose,
 6 two thirds of the disk on the north-
 7 east side were eclipsed. 6° night duration of maximal
 8 phase, until it began to become bright. In 16° night
 9 from south-east to north-west
 10 it became bright. 23° total duration
 11 Its eclipse had the 'garment of the sky'.
 12 During its eclipse, north(wind) blew. During its eclipse
 13 Venus, Saturn and Sirius stood there,
 14 the other planets did not stand there.
 15 ½ cubits in front of α Leonis [eclipsed].
 16 At 16° before sunset.
 17 On the 15th 9° NA, mist, [measu]red.

Comments. The Moon was at $\lambda=118.28^\circ$, $\beta=-0.89^\circ$. The statement about the planets is not quite correct: Jupiter set at 14.85 UT = 17.56 LT (24 minutes after sunset, probably visible), and Mercury set at 14.51 UT = 17.22 LT (probably not visible). Sirius rose at 13.18 UT = 15.89 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 245 X	-65JAN08	13.66	2.78	106.1	14.35*	15.59*	17.18	18.42	1.57	98	264	16.95	17.07	6.92	7.54

LBAT 1449 = H5,77

- 0'
 1' [...] gin *ina an-mi-š[ú mál-babbar dele-bat]*
 2' genna *an u mál kak-s[i-sá gub-meš]*
 3' *ina zalág-ru dele-bat šú í[b-tag₄]*
 4' ^d*udu-idim-meš nu gub-[meš]*
 5' 2 kùš *ina igi sag a 3[?] [kùš]*
 6' *ana ulù sig ád[?] in 30 d[anna]*
 7' [m]e *ana šú šamáš*
 8' [1]4 9 na *a-kám muš*

- 0' ...
 1' [... wind] blew. During its eclipse [Jupiter, Venus]
 2' Saturn, Mars and Sirius [stood there]
 3' When becoming bright, Venus set. The other
 4' planets did not stand there.
 5' 2 cubits in front of ε Leonis, 3(?) [cubits]
 6' toward south beneath. eclipsed(?). At 30° (= 1) b[ēru]
 7' day before sunset.
 8' On the 14th 9 NA, mist, measured.

Comments. The Moon was at $\lambda=106.85^\circ$, $\beta=-0.34^\circ$. Venus set at 15.10 UT = 17.88 LT. Sirius rose at 13.92 UT = 16.70 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 246 IX	-65DEC28	14.90	2.87	94.7	16.33*	—	—	18.82	.34	138	215	16.82	17.03	6.97	7.65

LBAT *1450 = H5,79

- 1 mu-1-*me*-1, 22-*kám šá ši-i* mu-[2-*me*-46-*kám*]
 2 ⁱ*ar-šá-kám lugal lugal-meš u* ^f[*pi-ir-muš-ta-na-a (?)*]
 3 ^dXV-AMA-šú gašan gan *ge₆* 14 [... me]
 4 *sin ki-i e-a 2 si id ulù [... ...]*
 5 *ina 9 ge₆ al-la šal-šú hab-rat ..[.]*
 6 8 *ge₆ ír ana zalág-ru ki tab-ú ina 15[ge₆ ta ...]*
 7 *ana ulù u mar zalág-ru 32 g[ar ír u zalág]*
 8 *an-mi-šú túg an-e gar-in ina [...]*
 9 *ina an-mi-šú si šá kap-p[i ... gar gin]*
 10 *ina an-mi-šú tür la-[mu[?]]*
 11 *mál-babbar u genna gub-m[eš ina ... kak-ban]*
 12 *e-a íb-tag₄* ^d[*udu-idim-meš nu gub-meš*]
 13 4½ kùš *ár maš-maš á[r ád ...]*
 14 *in 6 uš me [ana šú šamáš 14 ... na]*
 15 *dir nu pap []*

1 Year 182, i.e. year 246,

2 Arsaces, king of kings, and ^f[Pir'uštanā (?)],
 3 his “mother-goddess”, the lady. Month IX 14, [x° ME ...]

- 4 When the moon rose, 2 fingers on the south side [were eclipsed]
 5 In 9° night, over a third of the disk [was eclipsed]
 6 8° duration of maximal phase, until it began to become bright. In 15° [from ...] to southwest it
 became
 7 bright. 32° [onset, maximal phase and clearing].
 8 Its eclipse had the ‘garment of the sky’. [...]
 9 During its eclipse, northwind which ...[...]
 10 During its eclipse, a halo enci[rcled(?) ...]
 11 Jupiter and Saturn stood there [... Sirius]
 12 rose. The other p[lanets did not stand there].
 13 $4\frac{1}{2}$ cubits behind β Geminorum [eclipsed ...].
 14 At 6° before [sunset . On the 14th, x° NA]
 15 clouded, not observed.

Comments. The Moon was at $\lambda=95.54^\circ$, $\beta=0.32^\circ$. Jupiter and Saturn were above the horizon. Sirius rose at 14.65 UT = 17.52 LT.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 249 I	-62MAY03	3.47	3.05	219.0	4.50	5.73*	7.31*	8.54*	1.55	123	286	18.14	18.73	5.26	5.37

LBAT 520 = SH3,513

7 [...] in 9 uš me nim ...

7 [...] At 9° day after sunrise ...

Comments. According to calculation, the eclipse began 11° before sunrise.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 265U IV	-46JUL04	17.47	2.97	278.8	19.52	—	—	21.00	.07	24	339	19.05	19.18	4.82	5.24

LBAT 523

2 [...]7 ge₆ ír id kur ana zalág ki [...]
 3 [...] nu gub-u' ina an-mi-šú im [...]

2 [...]7° night duration of maximal phase. When on the east side [it began] to become bright [...]
 3 [...] The other planets] did not stand there. During its eclipse ...[...].

Comments. Date uncertain, probably wrong.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 270A XII	-40MAR02	3.11	2.71	159.6	3.86	4.99	6.55*	7.69*	1.63	111	305	17.09	17.74	6.25	6.37

LBAT 1304, Rev. 3'ff.

3' še ge₆ 15 7,40 me [...]
 4' sin an-mi id ulù [...]
 5' ki-i tab-ú ina 21?
 6' gab-bi ... [...]
 7' ge₆ ana zalág

3' Month XII 15 7°;40 ME [...]
 4' Lunar eclipse, beginning on the south [...]
 5' side. After 21° (?)
 6' total ... [At ...]
 7' before sunrise

Comments. Re-dated to -199MAR19, see p. 66!

4.3. Solar Eclipse Observations

The reports are ordered chronologically. Texts are quoted by their LBAT-numbers, and cross-references to the Sachs-Hunger edition are given in the form SH(volume),(page) for volumes 1 to 3, and H5,(page) for volume 5. For proper identification, each eclipse or eclipse possibility is preceded by a line of calculated modern data, calculated with programs, based on Stephenson – Morrison – Newcomb. These headers give the following data in this sequence (all times are in hours and decimals):

- Babylonian date: king, year, month. For intercalary years, the type of the intercalary month is indicated by A (second Addaru) or U (second Ululu) after the year.
- Julian date and universal time UT of mid-eclipse.
- True local times (T1, Tm, T4) and altitudes (Alt1, Altm, Alt4) for first contact, mid-eclipse and last contact. The contact times T1 and T4 were not adjusted for differences between calculation and naked-eye observation (cf. Section 2.8).
- Magnitude.
- Duration of totality/annularity, in seconds.
- True local times of sunrise and sunset. Setting and rising times were calculated for the upper rim of the Sun, i.e. using a zenith distance of $91^{\circ}12'$. See Section 2.2 for details.

The calculations behind the headers assume that the Moon's orbital acceleration is $-26''/\text{cy}^2$ and that the difference between Ephemeris Time (ET) and Universal Time (UT) can be represented by

$$(\text{ST82i}) \quad \Delta T = ET - UT = -1740 - 77 t + 32.5 t^2 \text{ sec}$$

where t is measured in centuries since 1800 AD. (Note that this is based on an intermediate fit which yields values that are 1-2 minutes higher than those of the final fit ST82f.)

For planetary and lunar positions mentioned in the comments, programs based on Bretagnon and Simon (1986), and on Chapront and Chapront (1991) have been used, with the final fit (ST82f) for ΔT , and with a zenith distance of $90^{\circ}56'$ for planetary risings and settings. All calculations were done for Babylon (44.42°E , 32.55°N).

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX2 23 III	-381JUL03											

SH1,83

2' *ki pap nu igi ...*

2' when I watched I did not see it ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX2 35U XII	-368APR11	3.57	5.60	-1.6	6.51	9.8	7.52	22.6	.41	0	5.63	18.38

SH1,125

4' [... ul]ù šár šir *ina* 6 uš me 1/3 hab-rat šú-im

4' [...] gusty south wind; in 6° day 1/3 of the disk was covered.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX2 38 V	-366SEP14											

SH1,135

28' ... 28 an-mi šamáš [...]

28' ... The 28th, solar eclipse [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX3 1 XI	-356FEB29	11.37	12.81	46.4	14.06	38.7	15.22	27.6	.90	0	6.32	17.69

SH1,141

6 [...] 1⁷,16 me *ana* šú-e šamáš šamáš an-mi id [...]7 [...] *u* zalág *ina* an-mi-šú ulù šá [...]

6 [...] At 1,16° of day before sunset, solar eclipse; on the [...] side [...]

7 [...] and clearing; in its eclipse, south(wind) which [...]

Comments. According to calculation, the eclipse began 4.88h = 73° before sunset, and the traces at the beginning of line 6 are compatible with the number 1.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX3 12 X	-345JAN29											

SH1,147

28 28 an-m[i šamáš šá dib]

28 The 28th, eclip[se of the sun, which passed.]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX3 20 V	-338SEP04	5.02	7.09	18.8	7.99	30.0	8.96	42.0	.26	0	5.50	18.49

BM 71537, III' Rev. = H5,45

- 1 [20 izi ...]
 2 ... [...]
 3 2[?]-ú hab i dir [...]
 4 ulù u kur zalág 25 gar u zalág s[i[?] gin[?]]

- 1 [(Year) 20, month V, ...]
 2 ... [...]
 3 it exceeded(?) a little one-xth of the disc ...
 4 it cleared in the southeast. 25° onset and clearing. The nor[th(?)] wind blew(?).

Comments. This badly damaged text contains a large number of eclipse possibilities. The above is the only clearly observed solar eclipse among them.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
DARI3 3 VII	-332OCT27											

SH1,175

- 10 [...] 1 danna me nim-a an-mi ^dš[amáš šá dib ...]
 10 [...] at 1 *bēru* after sunrise, eclipse of the sun, which passed ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
DARI3 5 VI	-330OCT05											

SH1,177

- 12' ge₆ 29 an-mi šamáš šá dib in 1 ge₆ gin ...
 12' Night of the 29th, solar eclipse which passed; at 1,0 of night after sunset

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
PILIP 1 VI	-322OCT07	13.85	15.80	25.0	16.96	11.0	18.01	-2.2	.60	0	6.06	17.93

SH1,209

- 13' [...] id s[i u k]ur ana zalág ki tab-ú ina 9 uš me al-la 2 si i ana zalág tag₄ 5 ... [...]
 13' [...] solar eclipse ...] when it began to clear on the no[rth-ea]st side, in 9° of day a little over 2 fingers remained to clear ; 5 ... [...]

Comments. At the end of line 13' one expects: “and it set eclipsed”. If the number 5 still is part of the eclipse description, the text perhaps had something like “5° [later the sun set among clouds]”. The magnitude at sunset is a barely perceptible 0.08; 5° earlier it is 0.32. Note that 9°+5°=14° is the approximate time between mid-eclipse and sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
PILIP 1 XII	-321APR02											

SH1,219

32 [...] an-mi šam]áš bar dib

32 [...] eclipse of the su]n, BAR, passed.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
PILIP 2A VI	-321SEP26	15.38	17.79	2.9	18.44	-5.3	19.06	-13.0	.17	0	5.89	18.12

LBAT 212, Rev. 23' = SH1,227

23' 28 in 3 uš me ana šú šamáš an-mi [...] ... mar u si šár šir ád šú

23' On the 28th, at 3° before sunset, (solar) eclipse [...] ... gusty north-west wind; it set eclipsed.

Comments. The details indicate observations rather than predictions. For an observed eclipse, one would expect *ana šú šamáš šamáš an-mi*, as in -253JAN21; probably haplography. Magnitude at sunset: 0.12.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 7A I	-304APR23											

SH1,245

2 28 an-mi ša[máš]

3 [...]

2 The 28th, solar eclipse
3 [which passed]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 9A VI	-302SEP25											

SH1,249

21' 29 an-mi šamáš šá dib in 1,18 ge₆ gin [...]21' The 29th, solar eclipse which passed; at 1,18° of night after sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 20A V	-291AUG25											

SH1,273

B22 ... 28 25 me ana šú šamáš

B23 an-mi šamáš ki pap nu igi

B22 The 28th, at 25° of day before sunset,
B23 solar eclipse; when I watched, I did not see it.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 30 X	-280JAN30	4.30	6.23	-7.3	6.97	1.5	7.79	10.7	.20	0	6.74	17.26

SH1,313

- 9 29 ^dutu [an-mi *ki*[?]] e-a 2 si *id ulù a-dir ina* 6 me
 10 [...] ... 20 me *gar u zalág ina* an-[mi]-šú si š[á *ana* x] *sal-pu gin ina* an-mi-šú an *dele-bat* ... [...]

- 9 The 29th, solar [eclipse]; when it rose, 2 fingers on the south side were eclipsed; in 6° of day
 10 [it made ...] ... 20° of day onset and clearing; during its eclipse, north wind which was slanted
 toward the [...] blew; during its eclipse, Mars, Venus ... [...]

Comments. Magnitude at sunrise: 0.17. The statement about the planets is puzzling: all were above the horizon, and the order of listing is non-standard.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 38 XI	-272MAR01											

SH1,343

- 14' an-mi *šamáš* dir nu pap
 14' solar eclipse, clouds, I did not watch.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 45A VII	-266OCT17											

LBAT 247, Obv. 2' = SH1,359

- 2' 28 57 me *ana šú šamáš* an-mi [...]
 2' Month VII 28, 57° of day before sunset, [solar] eclipse [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 50A IX	-261DEC21											

SH1,375

- 11' [...] 2]8 an-mi *šam*[áš ...]
 11' [...] The 2]8th, solar eclipse [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 56U VI	-255SEP16	7.86	9.60	46.1	10.88	57.8	12.22	61.7	.73	0	5.72	18.28

SH2,21

- 1' [...] ... 32 *gar u zalág ina* an-mi-šú si šá pa [...]
 2' [...] 2[?] si itu bi ...
 1' [...] ... 32° onset and clearing; during its eclipse, north wind which [...]
 2' [...] 2[?] fingers. That month ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 57 X	-253JAN31	10.85	12.44	38.6	13.52	34.5	14.54	27.4	.25	0	6.73	17.28

LBAT 258, Rev. 11f. = SH2,29

- 11 28 56 me *ana šú šamáš šamáš* an-mi *ki tab-ú ina* 12 me
 12 [... *zalág ki tab-ú ina* 11 me ta ulù *ana si zalág-ir* 23 gar *u zalág-ru ina* an-mi-šú mar šá *ana si sal-pu gin*.

- 11 On the 28th, 56° before sunset, solar eclipse. When it began, in 12° of day [it made ... fingers]
 12 when it began to [cle]ar, in 11° of day from south to north it became bright; 23° onset and clearing. During its eclipse, west(wind), which was slanted toward north blew.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 63 I	-248MAY04	9.67	11.43	70.6	12.73	69.6	14.03	57.1	.79	0	5.26	18.75

LBAT **1216, Obv. 3f., Orientalia N.S. 2 (1933) 113
(also LBAT 267 = SH2,51)

- 3 (bar) 28 an-mi *šamáš al 2-ta*
 4 šu_{II} hab-rat(!) gar in 1,30 me nim

- 3 (Month I) 28 solar eclipse; over two
 4 thirds of the disk it made. At 90° after sunrise.

LBAT 267, Obv. 9'f. = SH2,51

- 9' ... 28 dir an za 1,30 me [...]
 10' [...] ... [...] gar[?] u *zalág ina* an-mi-šú [...]

- 9' ... The 28th, clouds were in the sky; 1,30° of day [after sunrise, solar eclipse ...]
 10' [...] ... [...] onset and clearing; in its eclipse [...]

Comments. The terminology of the goal year text (*an-mi šamáš*) seems to indicate a prediction, but the fact that a magnitude is mentioned, and the diary make it clear that it was an observation.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 63 VII	-248OCT27											

LBAT 267, Rev. 2' = SH2,53

- 2' [...] ge₆ 29 an-mi *šamáš bar dib* [...]
 2' [...] Night of the 29th, solar eclipse, BAR, passed [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 65 V	-246SEP07											

SH2,63

- 4' 28 1,14 me nim-a an-mi [*šamáš*] 5 áb[?] *ki pap nu igi*
 4' The 28th, 74° of day after sunrise, [solar] eclipse; 5 months[?]; when I watched, I did not see it.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 66A V	-245AUG28											

SH2,71

- 2' ge₆ 29 an-mi šamáš šá dib *in* 40[+x ...]
 2' Night of the 29th, solar eclipse which passed; at 40[+x° ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 70 II	-241JUN15	9.69	11.08	74.6	12.74	76.4	14.31	58.1	.98	0	4.83	19.17

LBAT 276, 6'f. = SH2,77

- 6' [... x]+6 gar *ana* zalág *ki* tab-ú *ina* 18 me ta mar *ana* kur zalág
 6' [... x]+6 it made. When it began to clear, in 18° from west to east it became bright.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 71 VIII	-240NOV28	12.79	14.63	24.5	15.88	12.8	16.97	.9	.37	0	6.84	17.15

SH2,79

- 3' [...] ... [...] zalág 30 gar u zalág *ina* an-[mi ...]
 3' [...] ... [...] cleared; 30° onset and clearing; during the eclip[se ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 72A VII	-239OCT18											

LBAT **1218, Rev. 1'f., Orientalia N.S. 2 (1933) 114

- 1' [itu] du₆ 9[?] 28[?] 1[?],40[?] me n[im[?]]
 2' an-mi šamáš šá dib ...
 1' [Month] VII, ... the 28th, 100[?] after[?] su[nrise[?]]
 2' solar eclipse which passed

Comments. The reading of line 1' is very uncertain; from calculation, one would expect a time after sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 79 VIII	-232NOV30											

SH2,107

- 22 29 an-mi šamáš *ki* pap nu igi *in* 44 me n[im-a ...]
 22 The 29th, solar eclipse; when I watched, I did not see it; at 44° of day after [sunrise ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 81 I	-230MAY15											

SH2,119

13 5 uš g[e₆ gin an-mi šamáš š]á dib

13 5° of nig[ht after sunset, solar eclipse whi]ch passed.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 82 XII	-228MAR25											

SH2,127

10 [... a]n-mi šamáš 5 áb bar dib *ina* 28 ge₆ gin ...

10 [... so]llar eclipse which passed; 5 months, BAR; at 28° night after sunset ... []

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 84 XI	-226MAR03											

SH2,131

12' [...] 10⁷ uš me nim-a ^dutu [...]

12' [...] 10°(?) of day after sunrise, solar [eclipse ...]

Comments. The wording might seem to indicate a visible eclipse.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 85A XI	-225FEB20											

SH2,137

15' 28 an-mi šamáš *ki* pap nu [igi ...]15' The 28th, solar eclipse; when I watched, I did not [see it ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 86 III	-225JUL18											

SH2,139

11 28 an-mi šamáš 5 áb bar dib *in* 1,13 me *ana* šú šamáš11 The 28th, solar eclipse; 5 months, BAR, passed; at 73° of day before sunset.**Comments.** Note that Oppolzer lists eclipse #2339 one month later (-225AUG17).

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 93 XI	-217FEB22											

SH2,155

2' [...] an-mi šamáš 5 áb ...

2' [...] solar eclipse; 5 months, ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 100 I	-211MAY15											

LBAT **1237, ZA 6 (1891) 89ff., 233.

54 (bar) 28 an-mi šamáš ki pap nu igi
55 ina 35 me ana šú šamáš54 (Month I) 28 solar eclipse; when I watched, I did not see it.
55 At 35° day before sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 102A VI	-209SEP18											

SH2,187

29 28 ki šú šamáš an-mi šamáš ki pap nu igi in [...]

29 The 28th, at sunset, solar eclipse; when I watched, I did not see it; at [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 109 I	-202MAY06	15.03	17.23	17.7	18.10	6.9	18.89	-2.6	.41	0	5.23	18.78

LBAT 306, Obv. 6' = SH2,209

6' [...] muš 28 ^dutu an-mi id kur ki tab-ú ina 14 me [...]6' [(Month I) ...] measured. On the 28th, solar eclipse; when it began on the east side, in 14° of day [it made ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 110A XII2	-200APR13											

SH2,221

6 an-mi šamáš šá dib in 58 ge₆
7 ana zalág ...6 (Month XII2, night of the 29th,) solar eclipse which passed; at 58° of night
7 before sunrise ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 116 II	-195JUN16											

SH2,255

- 2' [...] *ki [pap] nu igi [...]*
 2' [...] when I [watched] I did not see it [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 117 II	-194JUN06	7.16	9.52	55.6	10.23	64.4	10.98	72.9	.18	0	4.88	19.12

LBAT 1249, (also LBAT 320, Obv. 2' = SH2,270)

- 3' mu-1-me-1,17-kám
 4' *gu₄ 28 šamáš an-mi*
 5' *id ulù ki tab-ú*
 6' 4 si gar-an
 7' *in 2 danna me nim-a*

 3' Year 177,
 4' month II 28, solar eclipse;
 5' when it began on the south side,
 6' it made 4 fingers.
 7' At 2 *bēru* after sunrise.

SH2,270

- 2' [...] *id ul]ù ki-i [tab-ú]*
 2' [...] when it [began on the sou]th [side ...]

Comments. Sachs and Hunger had not recognized that the traces in line 2' of the diary must refer to this eclipse.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 117 VIII	-194NOV29											

LBAT 1249

- 13' *ge₆ 29 an-mi šamáš*
 14' [šá] dib *in 1,31*
 15' *ge₆ gin*

 13' (Month VIII) night 29 solar eclipse
 14' [which] passed. At 91°
 15' after sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 118A II	-193MAY26											

SH2,277

- 5' ... ge₆ 29 1,17
 6' ge₆ gin an-mi šamáš šá dib
 5' ... Night of the 29th, at 77°
 6' of night after sunset, solar eclipse, which passed.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 118A VIII	-193NOV19											

LBAT 324, Obv. 26' = SH2,281

- 26' ... 28 dir an za an-mi šamáš ki pap [nu igi ...]
 26' The 28th, clouds were in the sky; solar eclipse, when I watched, [I did not see it.]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 121A XII	-189MAR14	6.63	8.21	25.0	9.40	37.9	10.67	48.8	.78	0	6.08	17.92

LBAT 1438 = H5,63

- 1 mu-1-me-21-kám ¹an lugal
 2 itu še 29 šamáš an-mi
 3 id si u mar ki tab-ú
 4 ina 15 me ... al šal-šú hab-rat dir gar-an
 5 ana zalág ki tab-ú ina 15 me
 6 ta si u mar ana kur zalág
 7 30 gar u zalág [ina an-mi-šú]
 8 kur gin ina an-mi-[šú ...]
 9 dele-bat gu₄-ud u genna [gub-meš]
 10 ina til zalág an è-a
 11 ñb-tag₄ ^dudu-idim-meš
 12 nu gub-meš in 30 danna
 13 me nim-a

- 1 Year 121, king An(tiochus)
 2 month XII 29 solar eclipse,
 3 beginning on the north-west side.
 4 In 15° day ... over a third of the disk was eclipsed.
 5 When it began to clear, in 15° day
 6 from northwest to east it became bright.
 7 30° total duration. [During its eclipse]
 8 east(wind) blew. During its eclipse [...]
 9 Venus, Mercury and Saturn [stood there].
 10 Toward the end of clearing Mars came out.
 11 The other planets
 12 did not stand there. At 30 (= 1) bēru
 13 after sunrise.

SH2,315

- 6' [... šal]-šú hab-rat dir gar-an ana zalág-ru ki tab-ú [...]
 7' [... gub]-meš ina zalág-ru an e-a íb-[tag₄ udu-idim-meš nu gub-meš ...]
 6' [... over a thi]rd of the disk it made. When it began to clear [...]
 7' [... stood] there. During clearing, Mars came out. The rema[inder of the planets did not stand
 there ...]

Comments. The planets of course were invisible! Mars rose during onset(!) at 5.81 UT = 8.59 LT.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 122 V	-189SEP07											

LBAT 1251, Rev.

- 18 (izi) 28 an-m[i šamáš]
 19 ki pap nu pap in 28
 20 [me] ana šú šamáš
 18 (Month V) 28, [solar]eclipse,
 19 when watched, not watched. At 28°
 20 [day] before sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 122 X	-188FEB02											

LBAT 1251, Rev.

- 20 ... ab 28
 21 an-mi šamáš 5 áb bar dib
 22 in 1,18 me ana šú šamáš
 20 ... Month X 28,
 21 solar eclipse, 5 months, BAR, passed.
 22 At 78° day before sunset

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 125 IX	-186DEC31	13.18	15.46	15.3	16.02	9.8	16.55	4.2	.08	0	6.97	17.03

LBAT 332, Obv. 12' = SH2,339

- 12' [... an-]mi šamáš šá dib in [...]
 12' [...] solar eclipse which passed; at [...]

Comments. Note that this was a real, but weak eclipse!

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 132U V	-179AUG17	10.13	11.32	70.1	13.05	67.3	14.63	50.2	.68	0	5.24	18.75

LBAT 348, Rev. 1'f. = SH2,399

- 1' [...] *id ulù u mar² ki tab-ú* [...]
 2' [...] *ina an-mi-šú mar gin ina til zalág-r[u ...]*

- 1' [...] when the eclipse began on the south west side [...]
 2' [...] ... During its eclipse west(wind) blew. Toward the end of clearing [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 138 XII	-172APR04											

SH2,433, 17'

- 17' [...] 1 me nim-a *ge₆* 30 ...
 17' [...] 1,0° of day after sunrise. The night of the 30th, ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 142A IV	-169JUL28	15.51	17.65	15.0	18.42	5.6	19.15	-2.8	.44	0	4.99	19.01

LBAT 1263, Rev. 3'ff.

- 3' mu-1-me-42-kám ¹*an u* ¹*an a-šú lugal-meš*
 4' šu 28 *šamáš* an-mi *id si*
 5' *u mar ki-i tab-ú ina* 12 me
 6' *šal-šú hab-rat gar-an*
 7' *in* 20 me *ana šú šamáš*

- 3' Year 142 of the king An(tiochus) and An(tiochus) his son,
 4' month IV 28 solar eclipse, beginning on the
 5' north-west side. In 12° day
 6' it made one third of the disk.
 7' At 20° day before sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 142A X	-168JAN22											

LBAT 1263, Rev. 13'f.

- 13' (ab) *ge₆* 29 an-mi *šamáš šá dib*
 14' *in* 1,33 *ge₆* *gin*
 13' (Month X) night of the 29th solar eclipse which passed.
 14' At 93° after sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 146 I	-165MAY17	7.97	9.52	53.8	11.05	70.9	12.71	72.9	.56	0	5.09	18.92

SH2,487

A14 *ina 13 me al-la šal-šú hab-rat [...]*

A14 in 13° of day [it made] more than a third of the disk [...]

Comments. One expects 23° instead of 13°.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 147 VII	-164OCT29											

SH2,497

B12' [... an-mi] šamáš šá dib in 1,4 ge₆ gin 29 šú-šú ...B12' [...] solar [eclipse] which passed; at 1,4° of night after sunset. The 29th, very overcast. ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 148A XII	-162MAR15											

LBAT 380 Rev. 8' = SH3,15

8' 28 an-bar₇ dir an za si gin an-mi šamáš ki pap nu igi in 20[+x...]8' (Month XII) The 28th, at noon, clouds were in the sky, north wind blew; solar eclipse, when I watched, I did not see it. At 20[+x° ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 149 V	-162SEP08											

LBAT 1264, Rev. 10'ff.

10' mu-1-me-49-kám ¹an lugal11' izi ge₆ 29 an-mi šamáš

12' šá dib in 1 danna

13' ge₆ ana zalág3 [... an-mi š]amáš šá dib in 1 danna ge₆ ana zalág [...]

10' Year 149, king An(tiochus),

11' month V, night 29 solar eclipse

12' which passed. At 1 bēru

13' night before sunrise.

SH3,27

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 149 XI	-161MAR05											

LBAT 1264, Rev. 17'ff.

- 17' (zíz) 28 an-mi šamáš
 18' gar'-in nu igi in 30 danna
 19' me nim-a
- 17' (Month XI) 28 solar eclipse
 18' occurred(?), not seen. At 30° (=1) bēru
 19' after sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 150 V	-161AUG28											

LBAT 1266, Rev. 18f.

- 18 ge₆ 29 an-mi šamáš šá dib
 19 in 16 ge₆ gin
- 18 (Month V) night 29 solar eclipse which passed
 19 At 16° after sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 155 I	-156MAY07											

SH3,61

- 15' ... an-mi šamáš 5 áb [...]
 15' ... solar eclipse, 5 months, [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 167A VI	-144SEP19											

SH3,93

- 10' ... 28 an-mi šamáš ki pap nu igi
 11' in 59 me nim-a ...
- 10' ... The 28th, solar eclipse; when I watched, I did not see it;
 11' at 59° of day after sunrise ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 168 V	-143SEP08											

LBAT 1278, Rev. 1'f.

- 1' ge₆ 28 an-mi [šamáš]
 2' šá dib in 39 ge₆ ana zalág
- 1' (Month V) night 28 [solar] eclipse
 2' which passed. At 39° of night before sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 168 XI	-142MAR05											

LBAT 1278, Rev. 9'ff.

9' (zíz) 28 an-mi šamáš

10' ki pap nu igi

11' [... ...]

9' (Month XI) 28 solar eclipse,
10' when I watched, I did not see it.

11' [... ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 171 IX	-140DEC31											

SH3,145

28 ... ge₆ 2[9]29 [an-mi šamáš] š šá dib in 1,27° ge₆ ana zalág28 ... Night of the 2[9th],

29 [solar eclipse] which passed; at 87° of night before sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 175A VII	-136OCT20											

LBAT 430 + 431, Rev. 7 = SH3,181

7 28 an-mi šam[áš ki pap nu] igi in 1,21 ana šú šamáš

7 (Month VII) 28 solar eclipse, [when I watched, I did not] see it; at 81° before sunset.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 175A XII2	-135APR15	5.48	7.38	21.9	8.45	35.3	9.62	49.2	1.05	183	5.54	18.47

LBAT 1285, Rev. 24ff. + SH3,185

24 (dir-še) 29 šamáš an-[mi i]d

25 ulù u mar [ki tab-ú]

26 ina 18 me ana nim [...]

27 til-ma til mu (or: til-tim?) gar-an

28 in 24 me nim-a

24 (Month XII₂) 29 solar eclipse, [beginning] on the
25 south-west side.

26 In 18° day ...

27 it became completely total (?).

28 At 24° after sunrise.

Comments. The terminology of lines 26-27 is unclear. Perhaps: "it became total and made complete night".

A more detailed report of the same eclipse is contained in a diary:

SH3,185

- 13' ... 29 24 me nim-a šamáš an-mi *id ulù [u] mar⁷ ki-i tab-[ú ...]*
 14' [*dele*]-*bat gu₄-ud u mál šid-meš igi-meš mál-babbar u an šá ina bi-ib-lu ina an-mi-šú igi-me[š*
 ...]
 15' *ta mar u ulù ana si u kur iš-ta-haṭ 35 gar ír u zalág-ru ina an-mi-šú si šá p[a mar⁷ gar gin ...]*

- 13' ... The 29th, 24° of day after sunrise, solar eclipse; when it began on the south west side [...]
 14' [Venus], Mercury, and the Normal Stars were visible; Jupiter and Mars, which were in the period of invisibility, were visible in its eclipse [...]
 15' it threw off (the shadow) from southwest to northeast; 35° onset, maximal phase and clearing; in its eclipse, north wind which was set [to the west⁷ side blew ...]

Comments. Note the explicit statement about the visibility of fixed stars and of planets during their period of invisibility. Sun: $\lambda=21.52^\circ$; Venus: $\lambda=52.52^\circ$, $\beta=5.16^\circ$; Mercury: $\lambda=41.49^\circ$, $\beta=2.47^\circ$; Jupiter: $\lambda=22.65^\circ$, $\beta=-0.98$; Mars $\lambda=3.01^\circ$, $\beta=-0.77^\circ$. Jupiter and Mars were indeed in the period of invisibility.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 176 VI	-135OCT09											
S.E. 176 XI	-134MAR06											

LBAT 1285, Rev. Edge

- 1' [... i]n(?) 18 me *ana šú šamáš*
 2' [... an-mi] *šamáš² a²-kám ki pap nu igi in 1,8 me ana šú šamáš*
 1' [... solar eclipse(?), not seen, ar]ound 18° day before sunset.
 2' [... solar eclipse,] mist(?), when watched, not seen. At 1,8° day before sunset.

Comments. See the lunar eclipse of -134MAR21 for the context and the date

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 177 XI	-133FEB24											

SH3,195

- 5' ... ge₆ 29 an-mi šamáš [...]
 5' ... Night of the 29th, solar eclipse [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 178A V	-133AUG19	3.98	6.42	12.9	6.90	18.9	7.41	25.4	.10	0	5.27	18.72

SH3,199

- 2' [... an-mi šamáš ...]
 3' *in 48 me nim-a ...*
 2' [... solar eclipse ...]
 3' at 48° of day after sunrise [...]

Comments. Almost certainly not observed. Note the small magnitude. The time is grossly wrong, according to calculation, the eclipse began 17° after sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 178A XI	-132FEB13	12.58	13.80	36.4	15.25	23.9	16.52	10.1	.87	0	6.54	17.47

SH3,203

Composite text:

- 16' [...] *u mar ki-i tab-ú ina* 20 me 2-ta šu_{II} hab-rat gar-an a-na zalág-ru *ki-i tab-ú ina* 18 me
- 17' [...] ... igi *in* 51 (var.: 50) me *ana šú šamáš* dir an za si gin ...
- 16' [...] when it began [on the ...] and west side, in 20° of day it made two thirds of the disk; when it began to clear, in 18° of day
- 17' [...] ... was visible²; at 51° (var. 50°) of day before sunset; clouds were in the sky, north wind blew. ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 179 X	-131FEB01											

SH3,231

- 10' ... ge₆ 29 an-mi šamáš šá dib *in* 21 ge₆ gin ...
- 10' ... Night of the 29th, solar eclipse which passed; at 21° of night after sunset. ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 182 II	-129JUN07											

SH3,247

- 13' ... ge₆ 29 an-mi šamáš šá dib *in* [...]
- 13' ... Night of the 29th, solar eclipse which passed; at [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 186A VI	-125SEP19	7.09	8.82	36.5	10.13	50.5	11.56	59.8	.44	0	5.77	18.22

SH3,263

- 17' [...] zalág-ir 35 gar *u* zalág² [...]
- 17' [...] it cleared; 35° onset and clearing [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 186A XII	-124MAR15											

LBAT 448, 7' = SH3,265

- 7' ... *i-ru-up* 28 an-mi šamáš dir nu p[ap]
- 7' ... clouded over. On the 28th solar eclipse; clouds, I did not w[atch ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 187 V	-124SEP07	16.21	18.29	.3	19.20	-11.1	20.06	-21.3	.98	0	5.60	18.41

SH3,271

16' 28 an-mi šamáš ki pap nu igi *in* 1 uš me *ana* šú šamáš ...16' The 28th, solar eclipse; when I watched, I did not see it; at 1° of day before sunset. ...

Comments. “1 uš” apparently stresses that 1°, and not 1,0°, is intended. Is this to be interpreted as a remarkably precise prediction, or as an observation made by somebody else, somewhere else? Magnitude at sunset: 0.10 (upper rim), 0.05 (lower rim).

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 187 X	-123FEB03	5.30	7.20	5.1	7.96	13.7	8.79	22.2	.16	0	6.67	17.34

SH3,277

8' 29 an-mi šamáš 5 áb ki pap nu igi *in* [...]8' The 29th, solar eclipse; 5 months; when I watched, I did not see it; at [...]

Comments. Weak eclipse, but close to the horizon, so it might have been visible under good atmospheric conditions.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 192 I	-119MAY17											

SH3,309

A₂10' and B₁6':... 29 an-mi šamáš ki pap nu igi *in* 10[+x ...]... The 29th, solar eclipse; when I watched, I did not see it; at 10[+x° ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 193 I	-118MAY07											

SH3,321

A14 ... an-mi šamáš šá dib *in* 13 ge₆ *ana* zalág ...

A14 ... solar eclipse which passed; at 13° of night before sunrise ...

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 193 VII	-118OCT31											

SH3,333

17' ge₆ 29 an-mi šamáš 5 áb bar dib *in* 10[+x ...]17' Night of the 29th, solar eclipse; 5 months, BAR; passed; at 10[+x° ...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 200 II	-111JUN18	2.01	4.17	-8.3	5.05	1.3	6.00	12.3	.57	0	4.82	19.18

LBAT 462, Obv. 28 = SH3,341

28 [...] 8² me² [...] zalág-ru ki-i tab-ú ina 8 me ta ulù ana mar² [zalág-ir]

28 [...] in 8°(?) [it made(?)...]. When it began to clear, in 8° daytime from south to west(?) or north) [it became bright]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 204 XII	-106MAR27											

SH3,371

12' ge₆ 29 an-mi šamáš šá dib in 1,21 ge₆ ana zalág12' Night of the 29th, solar eclipse which passed; at 1,21° of night before sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 212 VII	-99OCT31											

LBAT 484, Obv. 5' = SH3,403

5' 28 an-mi šamáš ki pap nu igi [...]

5' The 28th, solar eclipse; when I watched, I did not see it [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 216A V	-95AUG19											

LBAT 401 = SH3,425

10' [... an-m]i šamáš ki pap nu igi in ... [...]

10' [...] solar eclipse; when I watched, I did not see it; at ... [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 223 VI	-88SEP29	6.23	8.30	27.7	9.33	39.2	10.44	49.5	.36	0	5.96	18.03

LBAT 1334, 1'ff. = H5,69

1' [...] tab [...]

2' ana zalág ki tab-ú ina 12²

3' me ta si u mar

4' ana kur zalág-ir 24 gar

5' u zalág-ru ina an-mi-š[ú]

6' si gin ina 45 me nim-a

7' du₆ 30 12 muš8' 27 23² kur mus²

9' apin 1 16 m[uš...]

10' 27 16 [kur]

11' gan 30 .[..]

12' 28 [...]

13' ab [...]

- 1' [...] it began [...]
 2' when it began to clear. In 12° (?) (or 11, 13)
 3' from northwest to east
 4' it cleared. 24°
 5' onset and clearing. During its eclipse
 6' north(wind) blew. At 45° after sunrise.
 7' Month VII 30 12 (NA) measured.
 8' (Day) 27 23(?) KUR, measured
 9' VIII 1 16 (NA)
 10' (Day) 27 16 [KUR]
 11' IX 30[...]
 12' (Day) 28 [...]
 13' X [...]

Comments. Between the years -437 and +5, only -173 Oct. 10, -125 Sep. 19, -88 Sep. 29 seem possible; -88 fits best. Since the tablet “clearly belongs to LBAT 1435 + 1443” (Sachs), which contains lunar and eclipse date for -877-86, the last choice is almost certainly correct. The month lengths fit.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 224A XI	-86FEB13											

LBAT 1435 = H5,71

- 5' ge₆ 29 an-mi šamáš šá dib
 6' ina 1,16 ge₆ ana zalág

 5' Night of the 29th, solar eclipse which passes,
 6' at 76° night before sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 226 X	-84JAN23											

SH3,467

- 7' [... nu ig]i in 1,3 me nim-a
 7' [... solar eclipse ... I did not] see it; at $1,3^\circ$ of day after sunrise

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 232A VI	-79SEP20											

SH3,485

- 6' [... an-m]i šamáš ki pap nu igi in 10 uš me [...]
 6' [...] solar eclipse; when I watched, I did not see it; at 10° of day [...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 234 V	-77AUG30											

SH3,497

- 26 28 an-mi šamáš ki pap nu igi
 27 in 3+[x ...]
- 26 The 28th solar eclipse; when I watched, I did not see it;
 27 at 3+[x°...]

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 249 I	-62MAY18	4.19	6.93	21.4	7.28	25.8	7.64	30.3	.07	0	5.06	18.95

LBAT 520, Obv.12 = SH3,513

- 12 [... a]n-mi šamáš ki pap nu igi in 30 me nim-a
- 12 [...] solar eclipse; when I watched, I did not see it. At 30° of day after sunrise.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 270A XI	-40FEB15											

LBAT 1304, Rev. 1'f.

- 1' zíz 29 an-mi [šamáš ...]
 2' in 57 me ana š[ú šamáš]
- 1' Month XI 29 solar eclipse [watched, (but) not seen]
 2' At 57° before [sunset].

Comments. Re-dated to -199MAR04, see p. 66!

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 302 III	-9JUN30	11.40	13.00	73.9	14.38	57.3	15.62	41.7	1.07	258	4.81	19.19

LBAT 1456 = H5,79

- 1' [x x x] ... ¹ar²-šá²-k[a² ...]
 2' [x x x] ... 28-kám šamáš an-mi t[a ...]
 3' [x x] tab 23 me ana šá² šamáš da[r? x x]
 4' [x (x)] uš² tu-šú zalág²-meš 2 uš [ír]
 5' dele-bat gu₄-ud an mi gar-nu šít-tí² [...]
 6' múl kak-si-sá šá šú-ma ina la [...]
 7' ina an-mi-meš DI IR GUB u² [...]
 8' un-meš dug-silà gaz-meš [...]
 9' gaz-meš ina 23 me ta si [u mar]
 10' ana ulù u kur zalág-ir 48 gar [ír]
 11' u zalág ina an-mi-meš si u mar gin
 12' 1,30 me ana šú šamáš 28 17,30 kur muš

- 1' [...] ... Arsac[es(?)] ...]
 2' [...] the 28th day, solar eclipse, from [...]
 3' [...] it began; 23° of day to the inside of the sun ... [...]
 4' [...] its ... were clear(?); 2° [maximal phase(?);]
 5' Venus, Mercury, Mars(?, or: eclipse) ... the remainder(?) [...]
 6' Sirius, which had set, in its non-[...]
 7' In its eclipse, ... stood there(?) ... [...]
 8' people broke pots [...]
 9' they broke. In 23° of day it cleared from north [and west]
 10' to south and east. 48° onset, [maximal phase,]
 11' and clearing. In its eclipse, the north and west winds blew.
 12' At 1,30° of day before sunset. The 28th, 17;30 KUR, measured.

Comments. The terminology of the text is quite unusual (note for example the unique use of the plural an-mi-meš in place of an-mi in lines 7' and 11'). I have accepted Hunger's transliteration and translation and the date as determined by Steele (2000), but in view of several uncertainties in the interpretation of this text, I would put a question mark after the date. Admittedly, the date fits the data very well: the planets mentioned in the text, Venus, Mercury, Mars and Sirius, were above the horizon, Sirius was in its annual period of invisibility, and also the timings agree well. But as the text does not explicitly state that the planets were seen (as is done in the case of the eclipse of -135APR15), it is by no means certain that they were visible, contrary to Steele's assumption (cf. the mentioning of planets in the eclipses of -280JAN30 and -189MAR14). This undermines Steele's argumentation. Nevertheless, in view of the fact that a timed maximal phase is mentioned, it is highly plausible that the eclipse was central (total or annular); the only other solar eclipse report mentioning the maximal phase is that of the total eclipse of -135APR15. I do not claim to understand the details, but some of the phrases perhaps suggest that the eclipse was annular rather than total. In particular, note in line 3' "to the inside of the sun" (if the reading šà is correct), and in line 4' zalág ("clear, bright") in connection with the maximal phase. This would seem to indicate that there was a bright rim around the dark part. Of course, such a bright rim could also refer to the inner corona in the case of a total eclipse.

The numbers 28 in lines 2' and 12' cannot be simultaneously correct (the lunar crescent could not have been seen on the morning of the eclipse, at best on the morning before).

If the date is correct, this eclipse confirms (but does not improve) our determination of ΔT . For the year -9, it puts limits $144.1 \leq \Delta T \leq 178.6$ minutes on the clock-time error. This compares to the values 177.2, 173.0, 169.5, 167.7 obtained with ST82, ST84f, ST82f, ST84, respectively.

5. Eclipse Canons for Babylon

5.1. Canon of Lunar Eclipses from -800 to 0

The following tables are patterned after those of Neugebauer and Hiller (1934), which had proved to be very convenient for working with Babylonian data, but we have used more modern programs, based on Stephenson - Morrison – Newcomb, after cross-checking them against programs by Bretagnon-Simon, Chapront-Chapront, and Meeus. We have assumed that the Moon's orbital acceleration is $-26''/\text{cy}^2$ and that the difference between Ephemeris Time (ET) and Universal Time (UT) can be represented by

$$(\text{ST82f}) \quad \Delta T = ET - UT = -1925 - 81 t + 32.5 t^2 \text{ sec}$$

where t is measured in centuries since 1800 AD. This is the final fit we have obtained from the timed lunar eclipse observations. All calculations were done for Babylon (44.42°E , 32.55°N).

The tables include “ordinary” eclipses (with positive magnitudes), deep penumbral eclipses (with negative magnitudes between 0 and -0.08 and apparently treated like partial eclipses by the Babylonians), and invisible “eclipse possibilities”, that is, eclipses below the horizon of Babylon, and non-eclipses with negative magnitudes between -0.09 and -0.99. The last-mentioned correspond to lunar syzygies at which the sun is within about half a month’s progress from a lunar node.

The following lunar eclipse data are given in this sequence (all times are in hours and decimals):

- Babylonian date: king, year, month. For intercalary years, the type of the intercalary month is indicated by A (second Addaru) or U (second Ululu) after the year (unreliable before about -600).
- Julian date and universal time UT of mid-eclipse (i.e. of the moment when Sun and Moon have opposite longitude).
- Difference LT–UT between true local time LT and universal time UT.
- Geocentric lunar longitude LL at mid-eclipse.
- True local times of the four contacts, starred if below the mathematical horizon (for accurate visibility conditions, use MR and MS). The radius of the Earth’s shadow has been modified by 6%, -3%, -3% and 6% for the four contacts, respectively; this is on top of the conventional increase of 2%. See Section 2.3 for details
- Magnitude (in fractions of the Moon’s diameter; ≥ 1 is total; negative if the shadow misses the Moon). For calculating magnitudes, we have stayed with the conventional 2% increase. This convention permits (i) to discriminate between true partial eclipses (magnitudes between 0 and 1) and deep penumbral eclipses observed as partial by the Babylonians (negative magnitudes between 0 and -0.08, but with times for the first and fourth contact), and (ii) among total eclipses to recognize those most likely observed as partial by the Babylonians (magnitudes between 1.00 and 1.04, but without times for the second and third contact).
- E and A: entrance and exit angles in degrees (0° north, 90° east, 180° south, 270° west), calculated in the equatorial coordinate system. For non-eclipses: angle of closest approach.
- MR, SS, SR, MS: true local times of moonrise, sunset (before the eclipse), sunrise, and moonset (after the eclipse). They have been calculated for the upper rim of Sun and Moon, i.e. using a zenith distance of $91^\circ 12'$ for the Sun, plus parallax for the Moon.

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
-800JAN05	2.19	2.82	97.1	3.19	4.87	5.26	6.95	1.06	122	256	16.42	17.03	6.97	7.19	
-800JUN30	1.49	3.03	269.0	2.76	3.91	5.19*	6.34*	1.38	70	280	18.68	19.20	4.80	4.93	
-800DEC24	1.76	2.91	85.7	2.63	3.95	5.21	6.53	1.31	78	290	16.48	17.02	6.98	7.18	
-799JUN19	17.28	3.07	258.9	18.55*	—	—	21.96	1.00	116	242	18.97	19.17	4.83	5.35	
-799DEC13	6.61	3.00	74.4	8.58*	—	—	10.24*	.11	24	334	16.38	17.07	6.93	6.92	
-798MAY10	14.14	—	220.5	—	—	—	—	-.85	13	13	18.73	18.77	5.23	5.60	
-798JUN09	3.45	—	248.6	—	—	—	—	-.53	183	183	18.48	19.10	4.89	5.05	
-798NOV03	7.05	—	33.4	—	—	—	—	-.20	165	165	16.81	17.55	6.46	6.42	
-798DEC02	18.48	—	63.5	—	—	—	—	-.99	354	354	16.96	17.15	6.85	7.34	
-797APR29	15.23	3.03	209.8	16.92*	—	—	19.85	.49	61	330	18.50	18.60	5.40	5.76	
-797OCT23	22.77	3.14	22.6	.29	—	—	3.60	.99	100	227	17.32	17.72	6.29	6.62	
-796APR17	17.85	2.97	199.2	18.76	19.93	21.59	22.76	1.76	110	284	18.20	18.42	5.57	5.92	
-796OCT12	11.15	3.11	11.7	12.30*	13.48*	14.91*	16.09*	1.46	61	264	17.89	17.89	6.12	6.90	
-795APR07	3.21	2.90	188.7	4.66	—	—	7.19*	.41	157	239	17.59	18.24	5.76	5.91	
-795OCT01	16.70	3.06	.6	18.77	—	—	20.38	.08	5	318	17.98	18.09	5.92	6.41	
-794FEB26	10.10	2.67	149.9	12.75*	—	—	13.13*	-.07	21	9	17.73	17.60	6.40	7.01	
-794MAR27	18.43	—	178.5	—	—	—	—	-.83	198	198	17.78	18.07	5.92	6.40	
-794AUG21	22.96	—	319.8	—	—	—	—	-.57	167	167	18.36	18.76	5.24	5.52	
-793FEB16	1.83	2.65	139.5	2.78	4.12	4.96	6.30	1.17	81	304	16.81	17.43	6.56	6.73	
-793AUG11	4.02	2.91	309.0	5.32*	—	—	8.71*	.89	110	230	18.36	18.92	5.09	5.15	
-792FEB05	12.42	2.65	128.7	13.13*	14.50*	15.49*	16.85*	1.20	119	261	17.24	17.29	6.70	7.33	
-792JUL30	16.41	2.93	298.6	17.45*	18.59*	19.96	21.10	1.45	71	276	18.91	19.04	4.97	5.53	
-791JAN24	15.57	—	117.6	—	—	—	—	-.18	186	186	16.95	17.16	6.83	7.42	
-791JUN21	1.57	—	260.3	—	—	—	—	-.98	190	190	18.51	19.18	4.82	5.05	
-791JUL20	9.07	2.95	288.4	10.96*	—	—	12.72*	.16	26	329	19.37	19.13	4.88	5.77	
-791DEC14	20.76	—	76.1	—	—	—	—	-.43	348	348	16.80	17.06	6.95	7.32	
-790JUN10	16.19	3.10	250.1	18.34*	—	—	20.53	.26	160	229	18.94	19.12	4.88	5.38	
-790DEC04	3.74	3.06	64.9	5.17	—	—	8.56*	.96	46	281	16.65	17.14	6.86	6.98	
-789MAY31	.32	3.11	239.8	1.44	2.64	4.26	5.45*	1.63	115	282	18.53	19.02	4.98	5.16	
-789NOV23	17.14	3.12	54.0	18.38	19.49	20.89	22.00	1.50	81	239	17.03	17.26	6.75	7.43	
-788MAY19	2.16	3.10	229.1	3.52	—	—	6.71*	.62	72	331	18.36	18.88	5.11	5.20	
-788NOV12	8.90	3.15	43.2	10.79*	—	—	12.95*	.29	121	192	16.75	17.41	6.60	6.47	
-787APR08	14.98	—	190.2	—	—	—	—	-.63	209	209	18.15	18.27	5.72	6.16	
-787MAY08	3.89	—	218.5	—	—	—	—	-.72	25	24	18.13	18.73	5.27	5.27	
-787OCT03	8.02	—	2.3	—	—	—	—	-.41	331	331	17.70	18.07	5.94	5.83	
-786MAR29	2.24	2.83	179.8	3.50	—	—	6.75*	.88	150	269	17.45	18.08	5.91	6.08	
-786SEP22	11.63	3.02	351.2	13.02*	—	—	16.46*	.80	28	273	18.22	18.24	5.76	6.45	
-785MAR18	18.35	2.77	169.6	19.25	20.35	21.79	22.88	1.54	109	309	17.64	17.91	6.08	6.38	
-785SEP11	11.31	2.97	340.0	12.18*	13.42*	15.00*	16.23*	1.55	70	233	18.38	18.43	5.57	6.28	
-784MAR07	10.88	2.71	159.3	12.45*	—	—	14.37*	.20	59	357	17.84	17.75	6.24	6.67	
-784AUG30	14.53	2.94	328.9	16.15*	—	—	18.42*	.27	118	189	18.47	18.62	5.39	6.02	
-783JAN26	8.68	—	119.4	—	—	—	—	-.20	198	198	16.24	17.17	6.82	6.90	
-783JUL21	16.02	2.95	289.7	18.98*	—	—	19.24	-.08	350	342	19.07	19.12	4.88	5.48	
-783AUG20	1.16	—	318.3	—	—	—	—	-.91	156	156	18.32	18.79	5.22	5.43	
-782JAN15	10.02	2.74	108.2	10.97*	—	—	14.70*	1.03	128	259	17.10	17.08	6.91	7.54	
-782JUL11	9.11	2.99	279.6	10.39*	11.61*	12.67*	13.89*	1.26	62	279	19.34	19.18	4.82	5.79	
-781JAN04	9.83	2.82	96.8	10.61*	11.92*	13.21*	14.52*	1.33	84	294	17.07	17.03	6.97	7.63	
-781JUL01	.57	3.03	269.4	1.76	3.17	3.88	5.29*	1.13	107	242	18.72	19.20	4.80	5.01	
-781DEC24	15.16	2.91	85.6	17.03	—	—	18.74	.12	30	338	16.90	17.02	6.98	7.53	
-780JUN19	10.22	—	259.0	—	—	—	—	-.39	179	179	19.20	19.17	4.82	5.62	
-780NOV13	15.99	—	44.6	—	—	—	—	-.20	168	168	17.11	17.38	6.63	7.34	
-780DEC13	3.36	—	74.7	—	—	—	—	-.98	359	359	16.48	17.07	6.94	7.02	
-779MAY09	21.66	3.08	220.2	23.59	—	—	2.16	.34	52	334	18.42	18.76	5.24	5.44	
-779NOV03	7.60	3.15	33.8	9.14*	—	—	12.44*	.98	103	228	16.85	17.55	6.46	6.39	
-778APR29	.68	3.03	209.6	1.68	2.84	4.51	5.67*	1.79	104	287	18.11	18.59	5.40	5.57	
-778OCT23	19.60	3.14	22.9	20.77	21.96	23.39	.58	1.48	62	265	17.47	17.71	6.30	6.73	
-777APR18	10.59	2.97	199.3	12.01*	—	—	14.79*	.53	150	244	18.51	18.43	5.57	6.20	
-777OCT13	.65	3.11	11.7	2.68	—	—	4.42	.10	8	317	17.60	17.90	6.11	6.31	
-776MAR08	18.20	—	160.7	—	—	—	—	-.15	17	17	17.52	17.76	6.23	6.56	
-776APR07	2.17	—	189.1	—	—	—	—	-.71	198	198	17.59	18.24	5.75	5.98	
-776SEP01	6.32	—	330.6	—	—	—	—	-.64	165	165	18.01	18.60	5.41	5.41	
-775FEB26	9.91	2.67	150.3	10.89*	12.35*	12.91*	14.36*	1.09	82	309	17.72	17.60	6.39	7.02	
-775AUG21	11.66	2.92	319.8	13.02*	—	—	16.30*	.81	110	224	18.72	18.76	5.25	5.99	
-774FEB15	20.24	2.65	139.6	20.92	22.23	23.37	.69	1.26	120	266	17.08	17.43	6.56	6.93	
-774AUG11	.27	2.91	309.3	1.29	2.40	3.87	4.98	1.55	70	270	18.50	18.91	5.09	5.30	
-773FEB04	23.18	—	128.6	—	—	—	—	-.13	190	190	16.81	17.28	6.71	7.05	
-773JUL31	16.90	2.92	299.0	18.62*	—	—	20.69	.26	28	319	18.94	19.03	4.97	5.51	
-773DEC26	5.02	—	87.3	—	—	—	—	-.43	353	353	16.48	17.02	6.98	7.02	
-772JUN20	23.31	3.06	260.6	1.69	—	—	3.38	.12	164	216	18.68	19.18	4.82	5.09	
-772DEC14	12.43	2.98	76.1	13.80*	—	—	17.19	.96	51	286	17.01	17.06	6.95	7.76	
-771JUN10	6.93	3.10	250.1	8.06*	9.30*	10.80*	12.03*	1.47	116	273	18.36	19.11	4.88	4.89	

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
-771DEC04	2.08	3.06	65.3	3.29	4.40	5.80	6.91	1.50	.85	243	16.62	17.14	6.87	7.09	
-770MAY30	8.52	3.11	239.5	9.77*	—	—	13.22*	.78	.75	321	18.24	19.01	4.99	4.93	
-770NOV23	17.85	3.11	54.5	19.72	—	—	21.87	.28	125	196	16.96	17.25	6.76	7.42	
-769APR19	22.01	—	200.7	—	—	—	—	-.74	208	208	18.03	18.44	5.55	5.85	
-769MAY19	10.52	—	228.9	—	—	—	—	-.56	22	22	19.01	18.89	5.11	5.53	
-769OCT14	16.26	—	13.4	—	—	—	—	-.45	331	331	17.80	17.87	6.14	6.70	
-768APR08	9.79	2.91	190.4	11.23*	—	—	14.33*	.77	154	265	18.41	18.28	5.71	6.24	
-768OCT02	19.37	3.07	2.2	20.85	—	—	.22	.75	26	275	17.90	18.06	5.95	6.35	
-767MAR29	2.20	2.84	180.2	3.17	4.24	5.76	6.83*	1.64	112	307	17.44	18.09	5.90	6.02	
-767SEP21	18.89	3.02	350.9	19.82	21.04	22.65	23.87	1.61	.67	234	18.06	18.25	5.75	6.17	
-766MAR18	18.75	2.77	170.0	20.27	—	—	22.45	.28	65	354	17.65	17.92	6.07	6.31	
-766SEP10	22.34	2.97	339.8	23.90	—	—	2.37	.34	113	190	18.14	18.44	5.56	5.87	
-765FEB06	16.51	—	130.3	—	—	—	—	-.25	201	201	17.07	17.31	6.69	7.15	
-765AUG01	23.82	—	300.3	—	—	—	—	-.18	342	342	18.72	19.02	4.98	5.19	
-765AUG31	9.22	—	329.1	—	—	—	—	-.83	154	154	18.55	18.61	5.40	6.35	
-764JAN26	17.71	2.68	119.2	18.63	—	—	22.32	.99	134	262	16.90	17.18	6.82	7.23	
-764JUL21	16.82	2.95	290.1	18.10*	19.45	20.19	21.53	1.14	.54	278	18.99	19.12	4.89	5.47	
-763JAN14	17.81	2.74	107.9	18.50	19.79	21.14	22.42	1.37	.89	298	16.81	17.08	6.92	7.32	
-763JUL11	7.91	2.98	279.9	9.03*	10.31*	11.38*	12.66*	1.25	.99	241	18.46	19.18	4.82	4.70	
-762JAN03	23.64	2.82	96.8	1.37	—	—	3.16	.14	36	341	16.53	17.03	6.97	7.21	
-762JUN30	17.02	—	269.5	—	—	—	—	-.26	174	174	18.98	19.20	4.80	5.34	
-762NOV25	.97	—	55.8	—	—	—	—	-.20	171	171	16.63	17.24	6.77	7.06	
-762DEC24	12.22	—	85.9	—	—	—	—	-.97	4	4	17.07	17.02	6.98	7.66	
-761MAY21	4.06	3.10	230.6	6.28*	—	—	8.34*	.18	40	340	18.34	18.90	5.09	5.11	
-761NOV14	16.47	3.14	45.0	18.01	—	—	21.31	.97	106	231	17.14	17.37	6.64	7.29	
-760MAY09	7.47	3.08	220.0	8.55*	9.72*	11.34*	12.51*	1.65	.97	289	17.99	18.75	5.25	5.21	
-760NOV03	4.12	3.15	34.0	5.31	6.49*	7.94*	9.12*	1.48	.65	267	17.04	17.54	6.47	6.56	
-759APR28	17.91	3.03	209.7	19.29	—	—	22.29	.67	143	247	18.36	18.60	5.40	5.82	
-759OCT23	8.69	3.14	22.8	10.74*	—	—	12.54*	.12	10	317	17.22	17.72	6.29	6.19	
-758MAR20	2.16	—	171.3	—	—	—	—	-.24	18	18	17.31	17.94	6.05	6.12	
-758APR18	9.81	—	199.6	—	—	—	—	-.60	197	197	18.57	18.43	5.56	6.31	
-758SEP12	13.86	—	341.5	—	—	—	—	-.70	163	163	18.24	18.41	5.60	6.21	
-757MAR09	17.82	2.72	161.0	18.90	—	—	22.30	1.01	81	313	17.54	17.77	6.22	6.59	
-757SEP01	19.46	2.94	330.6	20.91	—	—	.08	.74	110	219	18.32	18.59	5.41	5.84	
-756FEB27	3.89	2.67	150.4	4.58	5.85	7.13*	8.41*	1.34	120	270	16.95	17.59	6.40	6.53	
-756AUG21	8.28	2.92	320.0	9.29*	10.38*	11.90*	12.99*	1.63	.70	264	18.08	18.77	5.24	5.08	
-755FEB15	6.62	2.65	139.4	8.82*	—	—	9.31*	-.06	186	200	16.69	17.42	6.57	6.69	
-755AUG11	.85	2.91	309.7	2.45	—	—	4.75	.35	28	311	18.51	18.91	5.10	5.26	
-754JAN05	13.20	—	98.4	—	—	—	—	-.44	358	358	16.99	17.03	6.97	7.57	
-754JUL02	6.46	3.02	271.0	9.22*	—	—	10.13*	-.03	172	199	18.40	19.20	4.80	4.82	
-754DEC25	21.09	2.90	87.3	22.37	—	—	1.75	.96	55	291	16.66	17.02	6.98	7.40	
-753JUN21	13.55	3.06	260.6	14.71*	16.03*	17.29*	18.61*	1.31	116	264	19.13	19.18	4.82	5.36	
-753DEC15	11.02	2.98	76.5	12.15*	13.25*	14.66*	15.76*	1.50	.89	248	17.03	17.05	6.95	7.93	
-752JUN09	14.91	3.10	249.9	16.04*	—	—	19.69	.95	77	312	19.04	19.12	4.88	5.29	
-752DEC04	2.79	3.06	65.7	4.61	—	—	6.76	.28	129	200	16.55	17.14	6.87	7.09	
-751APR30	5.01	—	211.2	—	—	—	—	-.87	206	206	17.89	18.61	5.38	5.54	
-751MAY29	17.17	—	239.3	—	—	—	—	-.40	18	18	18.87	19.01	4.98	5.27	
-751OCT25	.58	—	24.5	—	—	—	—	-.47	332	332	17.45	17.69	6.32	6.53	
-750APR19	17.29	2.98	200.9	18.89	—	—	21.81	.65	157	259	18.24	18.45	5.54	5.92	
-750OCT14	3.24	3.11	13.2	4.78	—	—	8.10*	.71	25	277	17.58	17.88	6.13	6.24	
-749APR09	9.95	2.91	190.8	10.99*	12.04*	13.61*	14.67*	1.76	115	303	18.44	18.28	5.71	6.21	
-749OCT03	2.64	3.07	1.9	3.62	4.83	6.47*	7.68*	1.65	.65	235	17.74	18.07	5.94	6.07	
-748MAR29	2.48	2.84	180.6	3.94	—	—	6.38*	.38	70	349	17.47	18.10	5.89	5.96	
-748SEP21	6.32	3.02	350.7	7.88*	—	—	10.47*	.40	110	192	17.80	18.26	5.74	5.72	
-747FEB17	.17	—	141.2	—	—	—	—	-.33	204	204	16.92	17.45	6.54	6.82	
-747AUG12	7.77	—	311.0	—	—	—	—	-.26	339	338	18.37	18.90	5.11	4.91	
-747SEP10	17.44	—	340.0	—	—	—	—	-.77	152	152	18.18	18.44	5.57	6.14	
-746FEB06	1.26	2.65	130.1	2.18	—	—	5.81	.93	139	264	16.74	17.30	6.69	6.91	
NBNSR 1U VI	.64	2.92	300.7	1.94	—	—	5.28*	1.03	46	277	18.65	19.02	4.99	5.17	
NBNSR 1U XI	1.68	2.68	118.9	2.33	3.59	5.00	6.26	1.41	95	301	16.58	17.17	6.82	7.01	
NBNSR 2 V	-745JUL22	15.33	2.95	290.4	16.37*	17.58*	18.87*	20.08	1.36	91	240	18.99	19.11	4.89	5.53
NBNSR 2 XI	-744JAN15	8.04	2.74	107.9	9.65*	—	—	11.55*	.17	43	344	16.18	17.08	6.92	6.87
NBNSR 3U V	-744JUL10	23.87	—	280.0	—	—	—	—	-.13	170	170	18.74	19.18	4.82	5.09
NBNSR 3U IX	-744DEC05	9.94	—	67.1	—	—	—	—	-.20	176	176	17.09	17.12	6.89	7.89
NBNSR 3U X	-743JAN03	20.98	—	97.0	—	—	—	—	-.95	9	9	16.65	17.03	6.97	7.28
NBNSR 4 III	-743MAY31	10.46	3.11	241.0	13.07*	—	—	14.38*	.02	25	348	19.13	19.04	4.96	5.53
NBNSR 4 IX	-743NOV25	1.36	3.11	56.2	2.87	—	—	6.17	.97	109	234	16.67	17.23	6.77	7.02
NBNSR 5 III	-742MAY20	14.27	3.10	230.4	15.44*	16.64*	18.14*	19.34	1.50	90	290	18.84	18.91	5.09	5.58
NBNSR 5 IX	-742NOV14	12.67	3.14	45.2	13.83*	15.02*	16.47*	17.66	1.48	67	270	17.30	17.37	6.64	7.38
NBNSR 6 A III	-741MAY10	1.20	3.08	220.2	2.56	—	—	5.74*	.81	136	250	18.19	18.75	5.24	5.43
NBNSR 6 A IX	-741NOV03	16.80	3.15	33.9	18.84	—	—	20.69	.13	13	319	17.40	17.53	6.47	6.98
NBNSR 7 I	-740MAR30	10.01	—	182.0	—	—	—	—	-.34	18	18	18.29	18.13	5.86	6.41

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBNSR 7 II	-740APR28	17.39	—	210.1	—	—	—	—	-.47	195	195	18.37	18.60	5.39	5.90
NBNSR 7 VII	-740SEP22	21.57	—	352.4	—	—	—	—	-.75	162	162	17.87	18.23	5.78	6.11
NBNSR 8A I	-739MAR20	1.58	2.78	171.7	2.76	—	—	6.07	.91	78	317	17.38	17.95	6.05	6.17
NBNSR 8A VII	-739SEP12	3.45	2.98	341.5	4.99	—	—	8.07*	.68	110	216	17.92	18.42	5.59	5.68
NBNSR 8A XII2	-738MAR09	11.36	2.72	161.1	12.05*	13.29*	14.71*	15.94*	1.43	119	275	17.80	17.78	6.21	6.77
NBNSR 9 VI	-738SEP01	16.44	2.94	330.8	17.48*	18.56	20.11	21.19	1.70	69	260	18.45	18.59	5.42	6.01
NBNSR 9 XII	-737FEB26	13.90	2.67	150.2	15.72*	—	—	17.01*	.02	177	214	17.49	17.60	6.39	6.92
NBNSR 10 VI	-737AUG22	8.93	2.92	320.4	10.44*	—	—	12.92*	.43	29	304	18.08	18.76	5.24	5.03
NBNSR 10 XI	-736JAN16	21.30	—	109.5	—	—	—	—	-.46	3	3	16.75	17.09	6.91	7.20
NBNSR 11A V	-736JUL12	13.67	—	281.5	—	—	—	—	-.16	181	181	19.07	19.17	4.83	5.50
NBNSR 11A VI	-736AUG11	.25	—	310.0	—	—	—	—	-.95	349	349	18.59	18.90	5.10	5.27
NBNSR 11A XI	-735JAN05	5.68	2.81	98.5	6.89	—	—	10.25*	.95	60	296	16.32	17.03	6.97	7.01
NBNSR 12 IV	-735JUL01	20.21	3.02	271.0	21.38	22.83	23.72	1.18	1.16	116	254	18.89	19.20	4.80	5.15
NBNSR 12 X	-735DEC25	19.89	2.89	87.7	20.96	22.06	23.47	.57	1.51	94	253	16.65	17.02	6.98	7.52
NBNSR 13 IV	-734JUN20	21.31	3.06	260.3	22.36	23.93	.61	2.18	1.11	78	302	18.86	19.18	4.82	5.07
NBNSR 13 X	-734DEC15	11.70	2.98	76.9	13.45*	—	—	15.60*	.28	133	204	16.96	17.05	6.95	7.93
NBNSR 14A IV	-733JUN09	23.86	—	249.7	—	—	—	—	-.24	14	14	18.69	19.11	4.89	5.01
NBNSR 14A IX	-733NOV05	8.97	—	35.7	—	—	—	—	-.49	335	335	17.09	17.52	6.49	6.36
NBNZD 1 II	-732APR30	.72	3.04	211.4	2.50	—	—	5.21	.53	160	252	18.04	18.62	5.38	5.58
NBNZD 1 VIII	-732OCT24	11.20	3.14	24.4	12.80*	—	—	16.08*	.68	26	279	17.66	17.68	6.33	7.05
NBNZD 2A II	-731APR19	17.61	2.98	201.3	18.72	19.77	21.36	22.42	1.88	118	298	18.23	18.46	5.54	5.87
NBNZD 2A VIII	-731OCT13	10.53	3.11	12.9	11.56*	12.77*	14.41*	15.62*	1.69	65	237	17.82	17.87	6.14	6.89
UKNZR 1 I	-730APR09	10.08	2.91	191.2	11.51*	—	—	14.18*	.49	74	344	18.43	18.29	5.70	6.14
UKNZR 1 VII	-730OCT02	14.47	3.07	1.7	16.03*	—	—	18.71	.44	107	194	17.91	18.06	5.94	6.59
UKNZR 1 XII	-729FEB28	7.64	—	152.0	—	—	—	—	-.41	207	207	16.79	17.62	6.38	6.50
UKNZR 2 VI	-729AUG23	15.85	—	321.8	—	—	—	—	-.34	336	335	18.70	18.73	5.28	5.90
UKNZR 2 VII	-729SEP22	1.80	—	350.9	—	—	—	—	-.71	151	151	17.82	18.26	5.75	5.93
UKNZR 2 XII	-728FEB17	8.65	2.65	141.0	9.61*	—	—	13.16*	.86	145	264	16.61	17.45	6.55	6.61
UKNZR 3A VI	-728AUG12	8.57	2.91	311.4	9.91*	—	—	13.16*	.94	39	277	18.31	18.89	5.12	4.90
UKNZR 3A XII	-727FEB05	9.43	2.65	129.8	10.02*	11.26*	12.74*	13.98*	1.47	100	303	17.39	17.30	6.69	7.21
PULU 1 V	-727AUG01	22.83	2.92	301.0	23.83	1.00	2.43	3.60	1.47	83	240	18.68	19.01	4.99	5.28
PULU 1 XI	-726JAN25	16.34	2.68	118.9	17.82	—	—	19.85	.21	50	346	16.99	17.17	6.82	7.22
PULU 2 V	-726JUL22	6.79	2.95	290.5	9.03*	—	—	10.07*	-.01	151	180	18.50	19.12	4.89	4.86
PULU 2 X	-726DEC16	18.89	—	78.3	—	—	—	—	-.20	180	180	16.63	17.05	6.96	7.55
PULU 2 XI	-725JAN15	5.69	—	108.1	—	—	—	—	-.92	13	13	16.26	17.08	6.92	6.90
ULULA 1A IV	-725JUN11	16.88	—	251.4	—	—	—	—	-.13	3	3	19.00	19.13	4.87	5.25
ULULA 1A X	-725DEC06	10.25	3.05	67.5	11.70*	—	—	15.01*	.97	113	239	17.11	17.11	6.89	7.82
ULULA 2 III	-724MAY30	21.09	3.11	240.8	22.30	23.56	.87	2.12	1.35	82	291	18.70	19.03	4.97	5.24
ULULA 2 IX	-724NOV24	21.24	3.11	56.5	22.37	23.57	1.01	2.21	1.48	71	273	16.88	17.23	6.78	7.16
ULULA 3 III	-723MAY20	8.48	3.10	230.6	9.80*	—	—	13.14*	.96	128	252	17.99	18.90	5.10	5.03
ULULA 3 IX	-723NOV14	.97	3.14	45.1	3.00	—	—	4.86	.13	16	321	17.01	17.38	6.63	6.83
ULULA 4A II	-722APR10	17.73	—	192.5	—	—	—	—	-.46	18	18	18.10	18.31	5.68	5.99
ULULA 4A III	-722MAY10	.92	—	220.5	—	—	—	—	-.34	193	193	18.17	18.76	5.23	5.48
ULULA 4A VIII	-722OCT04	5.44	—	3.4	—	—	—	—	-.78	162	162	17.49	18.05	5.96	6.01
ULULA 5 I	-721MAR31	9.19	2.85	182.3	10.52*	—	—	13.72*	.80	75	321	18.30	18.14	5.85	6.44
ULULA 5 VII	-721SEP23	11.60	3.03	352.4	13.21*	—	—	16.22*	.64	111	213	18.16	18.22	5.79	6.55
MKAID 1A I	-720MAR19	18.66	2.78	171.8	19.41	20.61	22.15	23.35	1.53	117	278	17.69	17.95	6.04	6.39
MKAID 1A VII	-720SEP12	.75	2.98	341.7	1.83	2.90	4.47	5.54	1.76	69	256	18.01	18.41	5.59	5.80
MKAID 1A XII2	-719MAR08	21.00	2.72	160.9	22.63	—	—	.43	.11	171	223	17.41	17.77	6.22	6.56
MKAID 2 VI	-719SEP01	17.14	2.94	331.2	18.61	—	—	21.22	.49	29	299	18.47	18.58	5.43	5.98
MKAID 2 XI	-718JAN27	5.29	—	120.5	—	—	—	—	-.49	7	7	16.53	17.19	6.81	6.82
MKAID 3 V	-718JUL23	20.94	—	292.1	—	—	—	—	-.29	176	176	18.72	19.10	4.90	5.28
MKAID 3 VI	-718AUG22	8.09	—	320.8	—	—	—	—	-.88	346	346	18.20	18.76	5.25	5.08
MKAID 3 XI	-717JAN16	14.19	2.73	109.6	15.33*	—	—	18.66	.93	64	301	16.99	17.09	6.90	7.54
MKAID 4A V	-717JUL13	2.92	2.98	281.5	4.13	—	—	7.81*	1.02	116	245	18.63	19.17	4.83	4.95
MKAID 4A XI	-716JAN06	4.71	2.81	98.8	5.68	6.78	8.20*	9.30*	1.53	98	258	16.28	17.03	6.97	7.08
MKAID 5 IV	-716JUL01	3.80	3.02	270.7	4.76*	6.13*	7.31*	8.69*	1.26	78	292	18.64	19.20	4.80	4.86
MKAID 5 X	-716DEC25	20.55	2.89	88.1	22.21	—	—	.37	.29	138	210	16.58	17.02	6.98	7.52
MKAID 6 IV	-715JUN20	6.62	—	260.1	—	—	—	—	-.09	10	10	18.48	19.17	4.82	4.75
MKAID 6 IX	-715NOV15	17.39	—	46.9	—	—	—	—	-.50	337	337	17.23	17.35	6.66	7.19
MKAID 7A III	-714MAY11	8.12	3.08	221.8	10.09*	—	—	12.53*	.40	163	245	17.83	18.78	5.22	5.24
MKAID 7A IX	-714NOV04	19.25	3.16	35.5	20.88	—	—	.13	.67	27	282	17.33	17.51	6.50	6.93
MKAID 8 II	-713MAY01	1.18	3.04	211.8	2.37	3.43	5.00	6.06*	1.78	120	293	18.02	18.62	5.37	5.52
MKAID 8 VIII	-713OCT24	18.55	3.14	24.0	19.62	20.82	22.47	23.68	1.71	65	239	17.49	17.69	6.32	6.78
MKAID 9A II	-712APR19	17.57	2.98	201.7	18.96	—	—	21.85	.61	78	338	18.26	18.46	5.53	5.80
MKAID 9A VIII	-712OCT12	22.77	3.11	12.8	.36	—	—	3.09	.47	106	196	17.56	17.88	6.13	6.44
MKAID 9A XII2	-711MAR10	14.94	—	162.7	—	—	—	—	-.51	208	208	17.67	17.80	6.19	6.62
MKAID 10 I	-711APR09	4.80	—	191.4	—	—	—	—	-.91	29	29	17.63	18.28	5.71	5.70
MKAID 10 VI	-711SEP03	.07	—	332.6	—	—	—	—	-.41	333	333	18.33	18.56	5.44	5.66
MKAID 10 VII	-711OCT02	10.31	—	2.0	—	—	—	—	-.67	151	151	17.95	18.06	5.95	6.87
MKAID 10 XII	-710FEB27	15.87	2.68	151.7	16.94*	—	—	20.37	.77	150	263	17.45	17.62	6.37	6.75
MKAID 11 VI	-710AUG23	16.61	2.92	322.2	18.02*	—	—	21.18	.85	34	277	18.63	18.73	5.28	5.88

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
MKAID 11 XII	-709FEB16	17.05	2.65	140.7	17.65	18.86	20.41	21.62	1.54	106	304	17.24	17.45	6.54	6.88
MKAID 12A VI	-709AUG13	6.44	2.91	311.7	7.41*	8.56*	10.08*	11.22*	1.56	77	239	18.37	18.88	5.12	5.06
MKAID 12A XII	-708FEB06	.53	2.65	129.9	1.92	—	—	4.10	.26	56	347	16.73	17.30	6.70	6.86
SARG2 1 V	-708AUG01	13.81	2.92	301.1	15.69*	—	—	17.39*	.10	137	186	18.88	19.01	5.00	5.66
SARG2 1 X	-708DEC27	3.78	—	89.5	—	—	—	—	-.21	185	185	16.17	17.02	6.98	7.19
SARG2 1 XI	-707JAN25	14.28	—	119.2	—	—	—	—	-.89	18	18	17.12	17.18	6.82	7.26
SARG2 2 IV	-707JUN21	23.37	—	261.8	—	—	—	—	-.28	358	358	18.85	19.18	4.82	4.98
SARG2 2 X	-707DEC16	19.09	2.97	78.7	20.46	—	—	23.77	.96	118	243	16.67	17.04	6.96	7.49
SARG2 3A IV	-706JUN11	3.95	3.09	251.2	5.23*	6.59*	7.60*	8.96*	1.21	73	292	18.53	19.12	4.87	4.91
SARG2 3A X	-706DEC06	5.79	3.05	67.7	6.85*	8.05*	9.50*	10.70*	1.47	75	277	16.46	17.12	6.88	6.93
SARG2 4 III	-705MAY31	15.78	3.11	241.0	17.06*	18.50*	19.08	20.52	1.10	120	253	18.90	19.03	4.96	5.51
SARG2 4 IX	-705NOV25	9.16	3.11	56.3	11.13*	—	—	13.01*	.14	20	325	17.30	17.22	6.78	7.56
SARG2 5 II	-704APR21	1.36	—	203.0	—	—	—	—	-.58	17	17	17.91	18.48	5.51	5.57
SARG2 5 III	-704MAY20	8.41	—	231.0	—	—	—	—	-.21	190	190	17.94	18.90	5.09	5.05
SARG2 5 VIII	-704OCT14	13.46	—	14.5	—	—	—	—	-.81	162	162	17.67	17.85	6.16	6.82
SANH1 1A II	-703APR10	16.66	2.93	192.9	18.14*	—	—	21.18	.68	70	325	18.15	18.31	5.68	6.04
SANH1 1A VIII	-703OCT03	19.90	3.08	3.4	21.61	—	—	.55	.61	112	212	17.74	18.04	5.97	6.39
SANH1 2 I	-702MAR31	1.79	2.85	182.4	2.60	3.78	5.40	6.58*	1.64	114	282	17.60	18.13	5.86	6.02
SANH1 2 VII	-702SEP23	9.21	3.03	352.7	10.33*	11.40*	12.97*	14.04*	1.80	70	254	18.29	18.22	5.79	6.73
BELIB 1A I	-701MAR20	3.95	2.78	171.6	5.43	—	—	7.66*	.22	165	231	17.35	17.94	6.05	6.21
BELIB 1A VII	-701SEP13	1.48	2.98	342.1	2.95	—	—	5.65	.55	30	295	18.02	18.41	5.60	5.76
BELIB 1A XII	-700FEB07	13.16	—	131.4	—	—	—	—	-.53	11	11	17.29	17.32	6.67	7.15
BELIB 2 V	-700AUG03	4.31	—	302.7	—	—	—	—	-.41	172	172	18.37	19.00	5.01	5.09
BELIB 2 VI	-700SEP01	16.05	—	331.6	—	—	—	—	-.83	344	344	18.54	18.58	5.43	5.99
BELIB 2 XI	-699JAN26	22.60	2.68	120.6	23.71	—	—	3.00	.91	67	307	16.72	17.19	6.80	7.10
BELIB 3 V	-699JUL23	9.73	2.94	292.0	10.98*	—	—	14.52*	.88	117	236	19.14	19.10	4.91	5.66
BELIB 3 XI	-698JAN16	13.43	2.73	109.9	14.33*	15.42*	16.87*	17.96	1.55	102	264	17.00	17.10	6.90	7.65
ASNSM 1A V	-698JUL12	10.38	2.98	281.2	11.28*	12.56*	14.00*	15.29*	1.41	78	283	19.24	19.17	4.83	5.50
ASNSM 1A XI	-697JAN06	5.33	2.80	99.2	6.89	—	—	9.09*	.30	142	215	16.23	17.03	6.96	7.10
ASNSM 2 IV	-697JUL01	13.46	3.02	270.5	15.53*	—	—	17.04*	.06	27	343	19.22	19.20	4.80	5.33
ASNSM 2 IX	-697NOV27	1.83	—	58.1	—	—	—	—	-.51	341	341	16.87	17.21	6.79	6.96
ASNSM 3A III	-696MAY21	15.51	3.10	232.3	17.67*	—	—	19.79	.26	166	235	18.79	18.93	5.07	5.56
ASNSM 3A IX	-696NOV15	3.35	3.14	46.7	4.97	—	—	8.21*	.65	29	285	16.99	17.36	6.65	6.77
ASNSM 4 II	-695MAY11	8.71	3.08	222.2	9.96*	11.03*	12.55*	13.63*	1.64	121	286	17.79	18.78	5.21	5.16
ASNSM 4 VIII	-695NOV04	2.68	3.16	35.2	3.76	4.96	6.61*	7.81*	1.73	67	242	17.15	17.52	6.49	6.64
ASNSM 5 II	-694MAY01	.95	3.04	212.2	2.32	—	—	5.41*	.74	81	331	18.08	18.63	5.36	5.47
ASNSM 5 VIII	-694OCT24	7.19	3.14	23.9	8.78*	—	—	11.55*	.50	107	198	17.20	17.70	6.31	6.26
ASNSM 6A I	-693MAR21	22.07	—	173.4	—	—	—	—	-.62	209	209	17.57	17.98	6.02	6.31
ASNSM 6A II	-693APR20	11.83	—	201.9	—	—	—	—	-.79	28	28	18.52	18.47	5.52	5.85
ASNSM 6A VII	-693SEP14	8.45	—	343.5	—	—	—	—	-.46	332	332	17.95	18.39	5.62	5.43
ASNSM 6A VIII	-693OCT13	18.95	—	13.1	—	—	—	—	-.64	151	151	17.58	17.88	6.13	6.66
ASNSM 6A XII2	-692MAR09	22.94	2.72	162.4	.14	—	—	3.41	.67	156	261	17.36	17.79	6.20	6.44
NLUSZ 1 VI	-692SEP03	.79	2.95	333.0	2.27	—	—	5.34	.78	29	277	18.26	18.56	5.45	5.64
NLUSZ 1 XII	-691FEB27	.53	2.68	151.5	1.14	2.33	3.94	5.13	1.62	110	303	17.10	17.61	6.38	6.56
MUSMK 1 VI	-691AUG23	14.16	2.92	322.5	15.15*	16.28*	17.85*	18.99	1.64	72	239	18.63	18.72	5.29	5.96
MUSMK 1 XII	-690FEB16	8.59	2.65	140.7	9.88*	—	—	12.24*	.33	63	347	16.50	17.44	6.55	6.50
MUSMK 2 VI	-690AUG12	20.94	2.91	311.7	22.63	—	—	.73	.20	127	189	18.58	18.88	5.13	5.49
MUSMK 2 XI	-689JAN07	12.60	—	100.6	—	—	—	—	-.22	190	190	16.94	17.04	6.96	7.73
MUSMK 2A XII	-689FEB05	22.75	—	130.2	—	—	—	—	-.84	21	21	16.81	17.30	6.69	6.86
MUSMK 3 IV	-689JUL03	5.94	—	272.2	—	—	—	—	-.43	354	354	18.67	19.20	4.80	4.73
MUSMK 3 X	-689DEC28	3.87	2.88	89.9	5.17	—	—	8.48*	.95	123	248	16.24	17.02	6.98	7.15
MUSMK 4 IV	-688JUN21	10.89	3.06	261.7	12.20*	13.79*	14.21*	15.80*	1.07	64	292	19.26	19.18	4.82	5.52
MUSMK 4 X	-688DEC16	14.29	2.97	78.9	15.28*	16.48*	17.93	19.13	1.48	80	282	16.91	17.04	6.96	7.59
SANH2 1A IV	-687JUN10	23.10	3.09	251.4	.33	1.59	2.63	3.89	1.24	112	253	18.67	19.13	4.87	5.14
SANH2 1A X	-687DEC05	17.33	3.05	67.5	19.25	—	—	21.14	.14	24	329	16.93	17.12	6.89	7.36
SANH2 2 II	-686MAY02	8.91	—	213.5	—	—	—	—	-.70	15	15	17.72	18.65	5.35	5.15
SANH2 2 III	-686MAY31	15.90	3.11	241.4	18.64*	—	—	18.99	-.07	181	192	18.87	19.04	4.96	5.57
SANH2 2 VIII	-686OCT25	21.61	—	25.6	—	—	—	—	-.82	164	164	17.27	17.67	6.34	6.70
SANH2 3U II	-685APR22	.01	2.99	203.4	1.69	—	—	4.52	.55	64	329	18.01	18.49	5.51	5.65
SANH2 3U VII	-685OCT15	4.35	3.12	14.5	6.11	—	—	9.02*	.59	113	212	17.32	17.86	6.15	6.22
SANH2 4 I	-684APR10	8.77	2.92	192.9	9.65*	10.83*	12.50*	13.67*	1.77	110	285	17.52	18.30	5.69	5.66
SANH2 4 VII	-684OCT03	17.80	3.08	3.7	18.97	20.03	21.61	22.67	1.83	71	253	17.84	18.03	5.98	6.52
SANH2 5 I	-683MAR30	10.75	2.85	182.2	12.14*	—	—	14.73*	.35	159	237	18.17	18.14	5.86	6.41
SANH2 5 VII	-683SEP23	9.96	3.03	353.1	11.43*	—	—	14.21*	.59	31	293	18.30	18.21	5.80	6.70
SANH2 5 XII	-682FEB17	20.91	—	142.3	—	—	—	—	-.58	14	14	17.13	17.47	6.52	6.76
SANH2 6A I	-682MAR19	11.73	—	171.3	—	—	—	—	-.95	198	198	17.94	17.95	6.04	6.63
SANH2 6A VI	-682AUG14	11.78	—	313.4	—	—	—	—	-.51	169	169	18.77	18.85	5.15	5.91
SANH2 6A VII	-682SEP13	.14	—	342.5	—	—	—	—	-.78	343	343	18.13	18.40	5.61	5.81
SANH2 6A XII	-681FEB07	6.89	2.65	131.5	8.01*	—	—	11.25*	.87	69	312	16.48	17.32	6.68	6.66
SANH2 7 V	-681AUG03	16.63	2.92	302.6	17.96*	—	—	21.33	.75	117	228	18.81	18.99	5.01	5.51
SANH2 7 XI	-680JAN27	22.04	2.68	120.9	22.88	23.97	1.44	2.52	1.59	105	269	16.70	17.19	6.80	7.17
SANH2 8 V	-680JUL22	17.08	2.94	291.7	17.93*	19.17	20.75	21.99	1.54	78	275	18.95	19.10	4.90	5.35

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SANH2 8 XI	-679JAN16	14.00	2.73	110.3	15.45*	—	—	17.70	.32	146	221	16.95	17.10	6.90	7.65
ASRHD 1A V	-679JUL11	20.43	2.98	281.0	22.20	—	—	.26	.20	32	329	18.93	19.17	4.83	5.13
ASRHD 1A X	-679DEC07	10.24	—	69.3	—	—	—	—	-.52	345	345	17.15	17.10	6.90	7.72
ASRHD 2 III	-678JUN01	22.90	3.10	242.7	1.30	—	—	2.99	.13	170	224	18.53	19.05	4.95	5.23
ASRHD 2 IX	-678NOV26	11.47	3.10	57.9	13.07*	—	—	16.29*	.64	33	289	17.18	17.21	6.80	7.55
ASRHD 3A III	-677MAY22	16.20	3.10	232.7	17.50*	18.60*	20.02	21.12	1.50	122	279	18.78	18.93	5.06	5.50
ASRHD 3A IX	-677NOV15	10.88	3.14	46.4	11.96*	13.16*	14.81*	16.01*	1.74	70	245	17.29	17.35	6.66	7.46
ASRHD 4 II	-676MAY11	8.25	3.08	222.6	9.58*	—	—	12.84*	.87	83	324	17.90	18.79	5.21	5.14
ASRHD 4 VIII	-676NOV03	15.71	3.16	35.1	17.32*	—	—	20.11	.51	108	201	17.32	17.52	6.49	7.15
ASRHD 5 I	-675APR01	5.03	—	183.9	—	—	—	—	-.75	209	209	17.49	18.15	5.84	6.01
ASRHD 5 II	-675APR30	18.73	—	212.3	—	—	—	—	-.66	26	26	18.40	18.64	5.36	5.56
ASRHD 5 VII	-675SEP24	16.95	—	354.5	—	—	—	—	-.50	331	331	18.13	18.19	5.82	6.40
ASRHD 5 VIII	-675OCT24	3.70	—	24.2	—	—	—	—	-.62	153	153	17.19	17.70	6.31	6.43
ASRHD 6A I	-674MAR21	5.87	2.79	173.1	7.24*	—	—	10.32*	.56	161	258	17.29	17.97	6.03	6.14
ASRHD 6A VII	-674SEP14	9.10	2.99	343.9	10.66*	—	—	13.65*	.72	25	278	18.44	18.37	5.64	6.60
ASRHD 6A XII2	-673MAR10	7.89	2.72	162.2	8.57*	9.74*	11.39*	12.57*	1.72	115	302	16.97	17.78	6.21	6.24
ASRHD 7 VI	-673SEP03	22.00	2.95	333.3	23.00	.13	1.73	2.86	1.72	67	239	18.29	18.55	5.46	5.78
ASRHD 7 XII	-672FEB27	16.54	2.68	151.6	17.78	—	—	20.31	.41	68	345	17.44	17.62	6.37	6.69
ASRHD 8 VI	-672AUG23	4.20	2.92	322.4	5.76*	—	—	8.14*	.29	119	191	18.29	18.73	5.28	5.35
ASRHD 8 XI	-671JAN17	21.33	—	111.7	—	—	—	—	-.25	195	195	16.57	17.11	6.89	7.33
ASRHD 8 XII	-671FEB16	7.10	—	141.1	—	—	—	—	-.78	24	24	16.53	17.45	6.54	6.48
ASRHD 9A V	-671JUL13	12.62	—	282.7	—	—	—	—	-.56	349	349	19.20	19.16	4.84	5.45
ASRHD 9A XI	-670JAN07	12.56	2.79	101.0	13.78*	—	—	17.08*	.93	129	252	16.97	17.04	6.95	7.66
ASRHD 10 IV	-670JUL02	17.92	3.02	272.1	19.29	—	—	22.74	.94	55	292	19.03	19.20	4.80	5.25
ASRHD 10 X	-670DEC27	22.71	2.88	90.0	23.60	.80	2.26	3.46	1.48	85	287	16.55	17.02	6.98	7.29
ASRHD 11 IV	-669JUN22	6.49	3.06	261.9	7.67*	8.84*	10.12*	11.30*	1.38	103	253	18.41	19.18	4.82	4.76
ASRHD 11 X	-669DEC17	1.47	2.97	78.7	3.29	—	—	5.21	.15	29	333	16.57	17.05	6.96	7.14
ASRHD 12A III	-668MAY12	16.39	—	223.9	—	—	—	—	-.84	12	12	18.70	18.82	5.18	5.55
ASRHD 12A IV	-668JUN10	23.40	3.09	251.8	1.61	—	—	2.99	.06	160	204	18.61	19.13	4.87	5.17
ASRHD 12A IX	-668NOV05	5.86	—	36.8	—	—	—	—	-.82	166	166	16.87	17.50	6.51	6.57
ASRHD 13 II	-667MAY02	7.25	3.05	213.8	9.13*	—	—	11.69*	.41	56	333	17.87	18.65	5.34	5.26
ASRHD 13 VIII	-667OCT25	12.91	3.15	25.7	14.72*	—	—	17.60*	.58	115	213	17.54	17.66	6.35	7.10
SSSUK 1 II	-666APR21	15.61	2.99	203.4	16.57*	17.75*	19.42	20.60	1.77	104	288	18.37	18.49	5.50	5.91
SSSUK 1 VIII	-666OCT15	2.50	3.12	14.8	3.74	4.80	6.37*	7.43*	1.86	72	253	17.38	17.85	6.16	6.30
SSSUK 2U II	-665APR10	17.43	2.92	192.7	18.73	—	—	21.65	.48	152	243	18.11	18.31	5.68	6.07
SSSUK 2U VII	-665OCT04	18.54	3.08	4.1	20.05	—	—	22.88	.62	32	292	17.85	18.03	5.98	6.48
SSSUK 2U XII	-664FEB29	4.53	—	153.1	—	—	—	—	-.65	16	16	16.99	17.63	6.36	6.37
SSSUK 3 I	-664MAR29	18.73	—	181.9	—	—	—	—	-.82	198	198	17.86	18.13	5.87	6.28
SSSUK 3 VI	-664AUG24	19.37	—	324.1	—	—	—	—	-.61	166	166	18.38	18.70	5.31	5.75
SSSUK 3 VII	-664SEP23	8.35	—	353.4	—	—	—	—	-.75	342	342	17.72	18.22	5.79	5.65
SSSUK 3 XII	-663FEB17	15.06	2.65	142.4	16.21*	—	—	19.38	.81	71	316	17.36	17.48	6.51	7.00
SSSUK 4A VI	-663AUG13	23.66	2.91	313.2	1.08	—	—	4.28	.64	118	220	18.47	18.86	5.15	5.39
SSSUK 4A XII	-662FEB07	6.54	2.65	131.9	7.36*	8.43*	9.93*	11.01*	1.64	108	274	16.43	17.32	6.67	6.71
SSSUK 5 V	-662AUG02	23.92	2.92	302.3	.74	1.96	3.61	4.83	1.67	78	267	18.63	19.00	5.01	5.22
SSSUK 5 XI	-661JAN27	22.54	2.68	121.4	23.92	—	—	2.24	.35	149	226	16.67	17.20	6.80	7.19
SSSUK 6 V	-661JUL23	3.53	2.94	291.6	5.08*	—	—	7.53*	.33	34	318	18.61	19.11	4.90	4.94
SSSUK 6 X	-661DEC18	18.59	—	80.5	—	—	—	—	-.54	350	350	16.83	17.04	6.96	7.42
SSSUK 7A IV	-660JUN12	6.32	3.08	253.1	9.02*	—	—	10.09*	.00	176	210	18.24	19.14	4.86	4.90
SSSUK 7A V	-660JUL11	14.47	—	281.2	—	—	—	—	-.90	0	0	19.21	19.17	4.83	5.38
SSSUK 7A X	-660DEC06	19.58	3.04	69.1	21.13	—	—	.33	.64	37	294	16.86	17.11	6.90	7.33
SSSUK 8 III	-659JUN01	23.66	3.10	243.1	1.02	2.18	3.43	4.59	1.36	123	271	18.51	19.05	4.94	5.16
SSSUK 8 IX	-659NOV25	19.12	3.11	57.6	20.16	21.35	23.00	.20	1.74	73	249	16.96	17.22	6.79	7.27
SSSUK 9U III	-658MAY22	15.49	3.10	233.0	16.79*	—	—	20.21	1.01	84	317	18.84	18.94	5.06	5.45
SSSUK 9U VIII	-658NOV15	.31	3.15	46.3	1.90	—	—	4.70	.52	111	204	16.95	17.36	6.65	6.94
SSSUK 10 I	-657APR12	11.85	—	194.5	—	—	—	—	-.89	209	209	18.34	18.34	5.65	6.13
SSSUK 10 II	-657MAY12	1.54	—	222.7	—	—	—	—	-.53	23	23	18.28	18.79	5.20	5.26
SSSUK 10 VII	-657OCT06	1.58	—	5.5	—	—	—	—	-.53	331	331	17.74	18.01	6.00	6.16
SSSUK 10 VIII	-657NOV04	12.53	—	35.4	—	—	—	—	-.61	155	155	17.35	17.51	6.50	7.39
SSSUK 11 I	-656MAR31	12.66	2.86	183.7	14.24*	—	—	17.05*	.44	166	253	18.13	18.16	5.83	6.25
SSSUK 11 VII	-656SEP24	17.53	3.04	354.9	19.17	—	—	22.10	.67	23	279	18.07	18.18	5.82	6.38
SSSUK 12A I	-655MAR20	15.13	2.79	172.9	15.86*	17.02*	18.69	19.85	1.83	119	300	17.85	17.97	6.02	6.36
SSSUK 12A VII	-655SEP14	5.97	2.99	344.2	7.01*	8.14*	9.76*	10.89*	1.77	64	239	17.96	18.38	5.63	5.61
SSSUK 12A XII2	-654MAR10	.36	2.72	162.3	1.56	—	—	4.28	.50	74	343	17.25	17.79	6.20	6.34
SSSUK 13 VI	-654SEP03	11.59	2.95	333.2	13.08*	—	—	15.67*	.36	113	192	18.45	18.55	5.46	6.18
SSSUK 13 XI	-653JAN29	5.93	—	122.7	—	—	—	—	-.28	199	199	16.23	17.21	6.78	6.93
SSSUK 13 XII	-653FEB27	15.32	—	151.9	—	—	—	—	-.71	27	27	17.51	17.62	6.37	6.68
SSSUK 14 V	-653JUL24	19.42	—	293.2	—	—	—	—	-.69	345	345	18.95	19.09	4.91	5.27
SSSUK 14 VI	-653AUG23	11.91	—	322.2	—	—	—	—	-.97	155	155	18.58	18.72	5.28	5.99
SSSUK 14 XI	-652JAN18	21.14	2.72	112.1	22.30	—	—	1.58	.91	134	256	16.63	17.11	6.89	7.27
SSSUK 15A V	-652JUL13	1.07	2.97	282.6	2.48	—	—	5.77*	.81	46	292	18.77	19.17	4.84	4.98
SSSUK 15A XI	-651JAN07	7.03	2.79	101.2	7.83*	9.03*	10.52*	11.71*	1.50	90	291	16.22	17.04	6.96	6.99
SSSUK 16 IV	-651JUL02	13.95	3.01	272.4	15.07*	16.19*	17.63*	18.75*	1.51	95	252	19.14	19.20	4.80	5.51

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
SSSUK 16 X	-651DEC27	9.53	2.88	89.9	11.23*	—	—	13.21*	.16	35	337	17.09	17.02	6.98	7.64
SSSUK 17A III	-650MAY23	23.84	—	234.4	—	—	—	—	-.97	9	9	18.49	18.95	5.04	5.14
SSSUK 17A IV	-650JUN22	6.92	3.05	262.3	8.87*	—	—	10.75*	.19	147	208	18.34	19.18	4.82	4.77
SSSUK 17A IX	-650NOV16	14.18	—	48.0	—	—	—	—	-.82	169	169	17.11	17.33	6.68	7.36
SSSUK 18 II	-649MAY13	14.40	3.09	224.3	16.53*	—	—	18.73*	.27	47	337	18.78	18.82	5.17	5.63
SSSUK 18 VIII	-649NOV05	21.57	3.16	36.8	23.39	—	—	2.26	.58	117	215	17.10	17.49	6.51	6.91
SSSUK 19 II	-648MAY01	22.35	3.05	213.9	23.39	.59	2.21	3.41	1.63	98	291	18.28	18.66	5.34	5.56
SSSUK 19 VIII	-648OCT25	11.32	3.15	26.0	12.58*	13.64*	15.21*	16.27*	1.87	74	254	17.64	17.66	6.35	7.23
SSSUK 20 II	-647APR20	23.99	2.99	203.2	1.23	—	—	4.44	.63	145	247	18.04	18.48	5.51	5.73
SSSUK 20 VIII	-647OCT15	3.24	3.12	15.2	4.77	—	—	7.63*	.64	33	292	17.40	17.84	6.16	6.26
KANDL 1A I	-646MAR11	12.03	—	163.8	—	—	—	—	-.72	17	17	17.84	17.82	6.17	6.60
KANDL 1A II	-646APR10	1.63	—	192.5	—	—	—	—	-.69	198	198	17.77	18.30	5.69	5.93
KANDL 1A VII	-646SEP05	3.08	—	334.9	—	—	—	—	-.69	164	164	18.00	18.53	5.48	5.60
KANDL 1A VIII	-646OCT04	16.67	—	4.5	—	—	—	—	-.72	342	342	17.95	18.02	5.99	6.53
KANDL 1A XII	-645FEB28	23.11	2.68	153.2	.33	—	—	3.41	.75	71	321	17.16	17.64	6.35	6.57
KANDL 2 VI	-645AUG25	6.83	2.93	324.0	8.35*	—	—	11.37*	.54	119	214	18.13	18.71	5.30	5.28
KANDL 2 XII	-644FEB18	14.90	2.65	142.8	15.70*	16.77*	18.31	19.37	1.70	109	278	17.36	17.48	6.51	7.07
KANDL 3A VI	-644AUG13	6.92	2.91	312.9	7.74*	8.94*	10.63*	11.83*	1.78	78	260	18.31	18.87	5.14	5.10
KANDL 3A XII	-643FEB07	6.95	2.65	132.3	8.23*	—	—	10.67*	.39	151	232	16.43	17.33	6.67	6.74
KANDL 4 V	-643AUG02	10.78	2.92	302.2	12.20*	—	—	14.91*	.45	36	309	19.09	18.99	5.01	5.74
KANDL 4 X	-643DEC29	2.87	—	91.7	—	—	—	—	-.56	355	355	16.53	17.02	6.98	7.10
KANDL 5U IV	-642JUN23	13.80	—	263.6	—	—	—	—	-.13	189	189	19.11	19.19	4.81	5.49
KANDL 5U V	-642JUL22	22.03	—	291.7	—	—	—	—	-.78	356	356	18.83	19.10	4.90	5.15
KANDL 5U IX	-642DEC18	3.66	2.96	80.3	5.14	—	—	8.33*	.62	41	299	16.56	17.04	6.96	7.09
KANDL 6 III	-641JUN13	7.14	3.08	253.5	8.52*	9.77*	10.75*	12.00*	1.22	123	263	18.22	19.14	4.86	4.82
KANDL 6 IX	-641DEC07	3.38	3.04	68.8	4.37	5.56	7.21*	8.40*	1.75	77	253	16.62	17.11	6.89	7.05
KANDL 7 III	-640JUN01	22.69	3.10	243.4	23.93	1.30	2.10	3.48	1.15	85	308	18.62	19.06	4.94	5.14
KANDL 7 IX	-640NOV25	8.95	3.11	57.5	10.52*	—	—	13.32*	.53	114	208	16.56	17.22	6.78	6.69
KANDL 8 III	-639MAY22	8.29	—	233.1	—	—	—	—	-.38	20	20	18.14	18.93	5.06	4.96
KANDL 8 VIII	-639OCT16	10.34	—	16.6	—	—	—	—	-.56	332	332	17.89	17.81	6.20	7.13
KANDL 8 IX	-639NOV14	21.42	—	46.6	—	—	—	—	-.60	158	158	16.94	17.35	6.65	7.13
KANDL 9A II	-638APR11	19.32	2.93	194.2	21.18	—	—	23.65	.30	172	246	18.05	18.34	5.66	5.96
KANDL 9A VIII	-638OCT06	2.07	3.09	5.9	3.79	—	—	6.66*	.63	21	280	17.69	18.00	6.01	6.15
KANDL 10 I	-637MAR31	22.26	2.86	183.5	23.10	.26	1.91	3.08	1.74	123	296	17.75	18.15	5.84	6.05
KANDL 10 VII	-637SEP25	14.06	3.04	355.1	15.14*	16.27*	17.89*	19.02	1.82	62	240	18.08	18.18	5.83	6.50
KANDL 11 I	-636MAR20	8.06	2.79	173.0	9.25*	—	—	12.14*	.60	79	340	17.08	17.96	6.03	6.00
KANDL 11 VII	-636SEP13	19.12	2.99	344.1	20.56	—	—	23.32	.43	109	194	18.13	18.37	5.64	6.06
KANDL 11 XII	-635FEB08	14.41	—	133.7	—	—	—	—	-.33	202	202	17.21	17.35	6.64	7.21
KANDL 12U I	-635MAR09	23.40	—	162.6	—	—	—	—	-.62	28	28	17.29	17.79	6.20	6.31
KANDL 12U VI	-635AUG04	2.37	—	303.8	—	—	—	—	-.80	341	341	18.68	18.98	5.02	5.10
KANDL 12U VI2	-635SEP02	19.16	—	332.9	—	—	—	—	-.89	153	153	18.28	18.56	5.45	5.88
KANDL 12U XI	-634JAN29	5.59	2.67	123.1	6.71	—	—	9.95*	.87	140	258	16.34	17.21	6.78	6.90
KANDL 13 V	-634JUL24	8.35	2.94	293.2	9.84*	—	—	12.95*	.69	38	291	18.49	19.10	4.91	4.73
KANDL 13 XI	-633JAN18	15.22	2.72	112.2	15.94*	17.13	18.65	19.84	1.53	96	295	16.95	17.11	6.88	7.36
KANDL 14A V	-633JUL13	21.51	2.97	282.9	22.58	23.67	1.20	2.29	1.64	86	251	18.83	19.16	4.84	5.19
KANDL 14A XI	-632JAN07	17.49	2.79	101.0	19.06	—	—	21.13	.18	41	340	16.82	17.04	6.96	7.35
KANDL 15 IV	-632JUL02	14.51	3.01	272.8	16.24*	—	—	18.47*	.32	136	210	19.09	19.20	4.81	5.54
KANDL 15 IX	-632NOV26	22.55	—	59.2	—	—	—	—	-.82	173	173	16.71	17.20	6.81	7.19
KANDL 16 III	-631MAY23	21.49	3.10	234.7	23.89	—	—	1.59	.12	35	343	18.62	18.96	5.04	5.26
KANDL 16 IX	-631NOV16	6.29	3.14	48.0	8.11*	—	—	10.97*	.58	120	218	16.64	17.34	6.67	6.69
KANDL 17A III	-630MAY13	4.99	3.09	224.3	6.11*	7.35*	8.84*	10.08*	1.47	91	293	18.18	18.81	5.18	5.22
KANDL 17A IX	-630NOV05	20.20	3.16	37.2	21.48	22.54	.11	1.17	1.88	76	257	17.17	17.49	6.52	6.99
KANDL 18 II	-629MAY02	6.45	3.05	213.6	7.65*	—	—	11.10*	.78	138	251	17.97	18.65	5.34	5.40
KANDL 18 VIII	-629OCT26	12.03	3.15	26.4	13.59*	—	—	16.47*	.65	35	293	17.66	17.65	6.36	7.19
KANDL 19U I	-628MAR21	19.41	—	174.5	—	—	—	—	-.81	18	18	17.72	18.00	5.99	6.22
KANDL 19U II	-628APR20	8.45	—	202.9	—	—	—	—	-.55	196	197	17.68	18.47	5.52	5.57
KANDL 19U VI2	-628SEP15	10.92	—	345.8	—	—	—	—	-.76	162	162	18.24	18.33	5.67	6.44
KANDL 19U VII	-628OCT15	1.10	—	15.5	—	—	—	—	-.71	342	342	17.53	17.84	6.17	6.35
KANDL 19U XII	-627MAR11	7.03	2.73	164.0	8.37*	—	—	11.33*	.67	69	325	16.97	17.81	6.18	6.14
KANDL 20 VI	-627SEP04	14.13	2.96	334.8	15.79*	—	—	18.63	.46	120	208	18.39	18.52	5.49	6.08
KANDL 20 XII	-626FEB28	23.12	2.68	153.6	23.96	1.02	2.58	3.64	1.77	109	282	17.13	17.65	6.34	6.61
KANDL 21 VI	-626AUG24	14.08	2.93	323.7	14.92*	16.12*	17.81*	19.01	1.78	78	255	18.62	18.70	5.31	5.89
KANDL 21 XII	-625FEB18	15.20	2.65	143.2	16.45*	—	—	19.00	.44	151	237	17.33	17.49	6.50	7.08
KANDL 22A VI	-625AUG13	18.20	2.91	312.8	19.50	—	—	22.42	.56	37	301	18.71	18.86	5.14	5.58
KANDL 22A XI	-624JAN09	11.04	—	102.8	—	—	—	—	-.58	360	360	17.09	17.05	6.95	7.60
NBPLS 1 IV	-624JUL03	21.34	—	274.0	—	—	—	—	-.25	184	184	18.75	19.19	4.81	5.19
NBPLS 1 V	-624AUG02	5.73	—	302.3	—	—	—	—	-.67	352	352	18.44	19.00	5.00	4.92
NBPLS 1 X	-624DEC28	11.66	2.87	91.4	13.07*	—	—	16.22*	.61	45	304	16.99	17.02	6.98	7.67
NBPLS 2A IV	-623JUN23	14.64	3.05	264.0	16.05*	17.49*	18.01*	19.44	1.09	123	254	19.11	19.19	4.81	5.42
NBPLS 2A X	-623DEC17	11.62	2.96	80.0	12.52*	13.71*	15.36*	16.55*	1.76	81	258	16.98	17.04	6.96	7.74
NBPLS 3 III	-622JUN13	5.87	3.08	253.9	7.06*	8.32*	9.47*	10.72*	1.29	85	300	18.38	19.14	4.86	4.84
NBPLS 3 IX	-622DEC06	17.61	3.04	68.7	19.10	—	—	21.91	.53	118	212	16.82	17.11	6.90	7.53

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBPLS 4 III	-621JUN02	14.98	—	243.5	—	—	—	—	-.24	17	16	19.00	19.06	4.94	5.31
NBPLS 4 VIII	-621OCT27	19.16	—	27.8	—	—	—	—	-.57	333	333	17.50	17.63	6.38	6.88
NBPLS 4 IX	-621NOV26	6.34	—	57.8	—	—	—	—	-.59	161	162	16.53	17.22	6.79	6.82
NBPLS 5U II	-620APR22	1.90	3.00	204.6	4.06	—	—	6.04*	.16	179	236	17.97	18.51	5.49	5.68
NBPLS 5U VII	-620OCT16	10.72	3.13	17.0	12.50*	—	—	15.34*	.60	21	282	17.83	17.80	6.21	7.10
NBPLS 6 I	-619APR11	5.30	2.93	194.0	6.23*	7.41*	9.00*	10.18*	1.61	126	292	17.63	18.33	5.67	5.75
NBPLS 6 VII	-619OCT05	22.26	3.09	6.1	23.38	.52	2.15	3.28	1.84	61	241	17.74	17.99	6.01	6.33
NBPLS 7A I	-618MAR31	15.67	2.86	183.6	16.84*	—	—	19.91	.72	83	336	18.03	18.16	5.84	6.15
NBPLS 7A VII	-618SEP25	2.78	3.04	355.0	4.23	—	—	7.10*	.48	106	195	17.82	18.19	5.82	5.95
NBPLS 7A XII	-617FEB19	22.75	—	144.6	—	—	—	—	-.39	205	205	16.95	17.51	6.49	6.82
NBPLS 7A XII2	-617MAR21	7.36	—	173.3	—	—	—	—	-.53	29	29	17.07	17.97	6.02	5.95
NBPLS 8 V	-617AUG15	9.49	—	314.5	—	—	—	—	-.90	337	337	18.94	18.83	5.17	5.94
NBPLS 8 VI	-617SEP14	2.57	—	343.8	—	—	—	—	-.81	151	151	17.97	18.38	5.63	5.77
NBPLS 8 XI	-616FEB09	13.88	2.65	134.1	15.02*	—	—	18.21	.82	145	260	17.26	17.36	6.63	7.15
NBPLS 9 V	-616AUG03	15.78	2.92	303.8	17.34*	—	—	20.28	.59	30	292	18.90	18.98	5.03	5.60
NBPLS 9 XI	-615JAN28	23.26	2.67	123.2	23.92	1.11	2.66	3.85	1.57	101	298	16.72	17.22	6.78	7.02
NBPLS 10U V	-615JUL24	5.18	2.94	293.4	6.21*	7.29*	8.86*	9.94*	1.75	79	250	18.51	19.09	4.91	4.88
NBPLS 10U X	-614JAN18	1.33	2.72	112.0	2.79	—	—	4.97	.21	47	343	16.58	17.11	6.89	7.05
NBPLS 11 IV	-614JUL13	22.15	2.97	283.3	23.72	—	—	2.21	.43	126	211	18.76	19.16	4.84	5.20
NBPLS 11 IX	-614DEC08	6.93	—	70.4	—	—	—	—	-.81	177	177	16.30	17.10	6.91	6.98
NBPLS 12A III	-613JUN04	4.54	3.10	245.1	7.38*	—	—	8.24*	-.03	18	352	18.45	19.07	4.93	4.89
NBPLS 12A IV	-613JUL03	14.07	—	273.1	—	—	—	—	-.98	173	173	19.06	19.19	4.81	5.56
NBPLS 12A IX	-613NOV27	15.05	3.10	59.3	16.83*	—	—	19.70	.59	124	222	16.99	17.20	6.81	7.51
NBPLS 13 II	-612MAY23	11.57	3.10	234.7	12.75*	14.07*	15.34*	16.66*	1.31	83	294	19.00	18.96	5.03	5.60
NBPLS 13 VIII	-612NOV16	5.13	3.14	48.4	6.41	7.47*	9.03*	10.09*	1.88	79	260	16.68	17.33	6.67	6.72
NBPLS 14 II	-611MAY12	12.88	3.08	224.0	14.03*	—	—	17.68*	.94	130	254	18.78	18.82	5.18	5.70
NBPLS 14 VIII	-611NOV05	20.88	3.16	37.6	22.44	—	—	1.33	.65	38	295	17.19	17.48	6.53	6.94
NBPLS 15U I	-610APR02	2.69	—	185.1	—	—	—	—	-.91	18	18	17.61	18.17	5.82	5.85
NBPLS 15U II	-610MAY01	15.22	—	213.4	—	—	—	—	-.40	195	195	18.52	18.66	5.34	5.84
NBPLS 15U VI2	-610SEP26	18.88	—	356.8	—	—	—	—	-.81	162	162	17.85	18.15	5.86	6.31
NBPLS 15U VII	-610OCT26	9.60	—	26.7	—	—	—	—	-.71	344	344	17.76	17.64	6.36	7.22
NBPLS 15U XII	-609MAR22	14.84	2.80	174.7	16.32*	—	—	19.13	.58	67	330	17.91	18.00	5.99	6.42
NBPLS 16 VI	-609SEP15	21.59	3.00	345.6	23.37	—	—	2.04	.38	122	203	18.03	18.35	5.66	5.98
NBPLS 16 XII	-608MAR11	7.21	2.74	164.4	8.09*	9.14*	10.72*	11.77*	1.85	108	286	16.93	17.82	6.17	6.17
NBPLS 17 VI	-608SEP03	21.41	2.96	334.5	22.31	23.52	1.17	2.38	1.69	78	250	18.26	18.53	5.48	5.79
NBPLS 17 XII	-607FEB28	23.30	2.69	154.0	.49	—	—	3.18	.51	150	242	17.14	17.65	6.34	6.64
NBPLS 18 VI	-607AUG24	1.79	2.93	323.6	3.05	—	—	6.11*	.65	38	295	18.33	18.71	5.30	5.43
NBPLS 18 XI	-606JAN19	19.07	—	113.8	—	—	—	—	-.62	4	4	16.87	17.13	6.87	7.22
NBPLS 18 XII	-606FEB18	10.54	—	143.4	—	—	—	—	-.96	194	194	17.52	17.50	6.50	7.21
NBPLS 19U V	-606JUL15	4.98	—	284.6	—	—	—	—	-.36	179	179	18.38	19.16	4.85	4.89
NBPLS 19U VI	-606AUG13	13.57	—	313.0	—	—	—	—	-.57	349	349	18.91	18.86	5.15	5.83
NBPLS 19U X	-605JAN08	19.59	2.78	102.5	20.93	—	—	.04	.58	49	310	16.76	17.05	6.95	7.34
NBPLS 20A IV	-605JUL04	22.18	3.00	274.5	23.62	—	—	2.89	.96	122	245	18.75	19.19	4.81	5.12
NBPLS 20A X	-605DEC28	19.81	2.87	91.1	20.65	21.83	23.48	.66	1.78	86	264	16.69	17.02	6.98	7.43
NBPLS 21 III	-604JUN23	13.06	3.05	264.3	14.18*	15.37*	16.74*	17.92*	1.42	85	291	19.21	19.19	4.81	5.41
NBPLS 21 IX	-604DEC17	2.25	2.96	80.0	3.67	—	—	6.49	.54	123	217	16.46	17.04	6.96	7.21
NBKDR 1 III	-603JUN12	21.66	—	253.9	—	—	—	—	-.10	12	12	18.82	19.14	4.85	5.05
NBKDR 1 VIII	-603NOV07	4.07	—	39.0	—	—	—	—	-.58	336	336	17.08	17.47	6.54	6.60
NBKDR 1 IX	-603DEC06	15.28	—	69.0	—	—	—	—	-.59	166	166	16.85	17.10	6.90	7.73
NBKDR 2U II	-602MAY03	8.41	3.05	215.1	11.02*	—	—	12.26*	.01	188	223	17.88	18.67	5.32	5.39
NBKDR 2U VII	-602OCT27	19.45	3.16	28.2	21.27	—	—	.08	.58	22	284	17.44	17.63	6.38	6.87
NBKDR 3 I	-601APR22	12.26	3.00	204.5	13.32*	14.52*	16.00*	17.21*	1.48	129	286	18.52	18.51	5.48	5.91
NBKDR 3 VII	-601OCT17	6.56	3.13	17.2	7.71*	8.85*	10.48*	11.62*	1.81	61	242	17.39	17.81	6.20	6.17
NBKDR 4 I	-600APR10	23.17	2.93	194.1	.36	—	—	3.58	.84	87	331	17.86	18.33	5.66	5.82
NBKDR 4 VII	-600OCT05	10.57	3.09	6.0	12.02*	—	—	14.98*	.51	104	197	17.90	17.99	6.02	6.78
NBKDR 4 XII	-599MAR02	6.95	—	155.4	—	—	—	—	-.46	207	207	16.72	17.67	6.32	6.44
NBKDR 5U I	-599MAR31	15.20	—	184.0	—	—	—	—	-.43	29	29	18.07	18.16	5.83	6.12
NBKDR 5U VI	-599AUG25	16.78	—	325.2	—	—	—	—	-.98	335	335	18.63	18.68	5.33	5.81
NBKDR 5U VI2	-599SEP24	10.14	—	354.7	—	—	—	—	-.76	151	151	18.06	18.18	5.83	6.59
NBKDR 5U XI	-598FEB19	22.02	2.66	144.9	23.20	—	—	2.32	.75	150	261	17.04	17.51	6.48	6.78
NBKDR 6 V	-598AUG14	23.37	2.91	314.5	1.02	—	—	3.78	.50	23	292	18.58	18.84	5.16	5.40
NBKDR 6 XI	-597FEB09	7.13	2.65	134.2	7.76*	8.94*	10.53*	11.71*	1.62	106	299	16.53	17.35	6.64	6.69
NBKDR 7U V	-597AUG04	12.96	2.91	304.1	13.99*	15.06*	16.65*	17.72*	1.85	72	249	18.94	18.97	5.03	5.82
NBKDR 7U X	-596JAN29	9.03	2.67	123.0	10.35*	—	—	12.69*	.26	54	345	16.38	17.21	6.78	6.75
NBKDR 8 IV	-596JUL24	5.88	2.93	293.8	7.32*	—	—	10.03*	.54	117	211	18.43	19.09	4.92	4.87
NBKDR 8 IX	-596DEC18	15.28	—	81.6	—	—	—	—	-.81	182	182	16.77	17.03	6.97	7.62
NBKDR 8 X	-595JAN17	8.80	—	111.7	—	—	—	—	-.96	15	15	16.30	17.10	6.89	6.81
NBKDR 9U III	-595JUN14	11.58	—	255.5	—	—	—	—	-.18	1	1	19.25	19.15	4.84	5.48
NBKDR 9U IV	-595JUL13	21.48	—	283.6	—	—	—	—	-.87	168	169	18.75	19.16	4.84	5.25
NBKDR 9U VIII	-595DEC07	23.82	3.03	70.5	1.53	—	—	4.40	.59	128	226	16.54	17.10	6.91	7.24
NBKDR 10 II	-594JUN03	18.11	3.10	245.0	19.36	20.83	21.69	23.16	1.15	74	296	18.87	19.07	4.92	5.29
NBKDR 10 VIII	-594NOV27	14.09	3.10	59.6	15.35*	16.40*	17.97	19.02	1.88	83	263	17.07	17.19	6.81	7.58

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 11A II	-593MAY23	19.26	3.10	234.4	20.35	21.92	22.59	.16	1.11	121	256	18.69	18.95	5.04	5.40
NBKDR 11A VIII	-593NOV17	5.77	3.14	48.8	7.33*	—	—	10.22*	.65	41	298	16.71	17.33	6.68	6.68
NBKDR 12 I	-592MAY11	21.95	—	223.8	—	—	—	—	-.24	192	192	18.41	18.81	5.18	5.50
NBKDR 12 VI	-592OCT07	2.95	—	7.8	—	—	—	—	-.85	162	162	17.45	17.97	6.04	6.18
NBKDR 12 VII	-592NOV05	18.17	—	37.9	—	—	—	—	-.71	346	346	17.33	17.48	6.53	7.02
NBKDR 12 XII	-591APR01	22.54	2.87	185.3	.19	—	—	2.82	.48	63	334	17.74	18.18	5.81	6.00
NBKDR 13 VI	-591SEP26	5.18	3.05	356.6	7.09*	—	—	9.62*	.33	124	200	17.66	18.16	5.84	5.89
NBKDR 13 XII	-590MAR22	15.18	2.80	175.1	16.13*	17.18*	18.76	19.82	1.84	106	290	17.90	18.01	5.98	6.46
NBKDR 14A VI	-590SEP15	4.91	3.00	345.3	5.86*	7.08*	8.70*	9.91*	1.62	79	247	17.89	18.36	5.65	5.69
NBKDR 14A XII	-589MAR12	7.25	2.74	164.8	8.43*	—	—	11.27*	.59	149	246	16.97	17.82	6.17	6.22
NBKDR 15 V	-589SEP04	9.55	2.96	334.4	10.78*	—	—	13.96*	.72	38	290	18.61	18.53	5.48	6.29
NBKDR 15 X	-588JAN31	2.95	—	124.8	—	—	—	—	-.67	8	8	16.68	17.23	6.76	6.84
NBKDR 15 XI	-588FEB29	18.24	—	154.2	—	—	—	—	-.89	196	196	17.38	17.66	6.33	6.80
NBKDR 16 IV	-588JUL25	12.72	—	295.1	—	—	—	—	-.47	175	175	19.00	19.07	4.93	5.74
NBKDR 16 V	-588AUG23	21.55	—	323.8	—	—	—	—	-.49	346	346	18.48	18.70	5.30	5.62
NBKDR 16 X	-587JAN19	3.37	2.71	113.5	4.68	—	—	7.73*	.55	52	316	16.56	17.12	6.87	6.99
NBKDR 17A IV	-587JUL15	5.80	2.96	285.0	7.28*	—	—	10.42*	.84	122	237	18.38	19.15	4.85	4.83
NBKDR 17A X	-586JAN08	3.94	2.79	102.2	4.67	5.85	7.50*	8.68*	1.80	90	269	16.43	17.05	6.95	7.10
NBKDR 18 III	-586JUL04	20.28	3.00	274.8	21.35	22.50	.01	1.16	1.55	84	283	18.89	19.19	4.81	5.15
NBKDR 18 IX	-586DEC28	10.86	2.87	91.1	12.17*	—	—	15.01*	.56	127	223	16.97	17.02	6.98	7.88
NBKDR 19 III	-585JUN24	4.34	3.04	264.3	6.47*	—	—	7.90*	.04	29	347	18.61	19.19	4.81	4.81
NBKDR 19 VIII	-585NOV18	13.02	—	50.2	—	—	—	—	-.58	339	339	17.31	17.30	6.71	7.54
NBKDR 19 IX	-585DEC18	.19	—	80.2	—	—	—	—	-.58	170	170	16.45	17.04	6.96	7.35
NBKDR 20 II	-584MAY13	14.86	—	225.5	—	—	—	—	-.14	203	203	18.72	18.84	5.16	5.60
NBKDR 20 VIII	-584NOV07	4.24	3.16	39.4	6.08	—	—	8.88*	.57	24	287	17.05	17.46	6.55	6.61
NBKDR 21U II	-583MAY02	19.18	3.05	214.9	20.33	21.59	22.88	.15	1.34	131	280	18.40	18.68	5.32	5.61
NBKDR 21U VII	-583OCT27	14.94	3.16	28.4	16.13*	17.27*	18.90	20.04	1.80	62	245	17.49	17.62	6.39	7.04
NBKDR 22 I	-582APR22	6.61	3.00	204.6	7.81*	—	—	11.17*	.97	90	325	17.68	18.50	5.49	5.48
NBKDR 22 VII	-582OCT16	18.47	3.13	17.1	19.94	—	—	22.95	.54	104	199	17.58	17.81	6.20	6.66
NBKDR 22 XII	-581MAR13	15.01	—	166.1	—	—	—	—	-.55	209	209	17.73	17.86	6.13	6.62
NBKDR 23A I	-581APR11	22.94	—	194.5	—	—	—	—	-.31	29	29	17.87	18.34	5.65	5.77
NBKDR 23A VII	-581OCT05	17.87	—	5.7	—	—	—	—	-.71	151	151	17.74	18.00	6.01	6.49
NBKDR 23A XII	-580MAR02	5.99	2.69	155.7	7.27*	—	—	10.28*	.67	155	260	16.85	17.68	6.32	6.42
NBKDR 24 V	-580AUG25	7.12	2.93	325.2	8.88*	—	—	11.46*	.42	17	293	18.25	18.69	5.32	5.21
NBKDR 24 XI	-579FEB19	14.83	2.66	145.0	15.46*	16.64*	18.27	19.44	1.69	111	300	17.39	17.52	6.47	6.86
NBKDR 25 V	-579AUG14	20.90	2.91	314.7	21.93	22.99	.58	1.64	1.82	65	249	18.58	18.84	5.17	5.56
NBKDR 25 XI	-578FEB08	16.57	2.65	133.9	17.80	—	—	20.31	.32	61	345	17.17	17.36	6.64	6.95
NBKDR 26A V	-578AUG04	13.72	2.91	304.5	15.07*	—	—	17.93*	.64	110	211	18.87	18.97	5.04	5.82
NBKDR 26A X	-578DEC29	23.60	—	92.7	—	—	—	—	-.81	187	187	16.43	17.02	6.98	7.35
NBKDR 26A XI	-577JAN28	16.60	—	122.7	—	—	—	—	-.92	19	19	17.05	17.22	6.78	7.09
NBKDR 27 III	-577JUN25	18.60	—	265.9	—	—	—	—	-.33	356	356	19.03	19.19	4.81	5.18
NBKDR 27 IV	-577JUL25	4.95	—	294.2	—	—	—	—	-.77	164	164	18.45	19.08	4.92	4.97
NBKDR 27 IX	-577DEC19	8.57	2.95	81.7	10.20*	—	—	13.06*	.60	132	231	16.09	17.04	6.97	6.94
NBKDR 28A III	-576JUN14	.64	3.08	255.4	1.96	—	—	5.62*	.99	65	297	18.73	19.15	4.85	5.00
NBKDR 28A IX	-576DEC07	23.06	3.03	70.8	.24	1.29	2.86	3.92	1.88	87	268	16.59	17.09	6.91	7.26
NBKDR 29 II	-575JUN03	1.64	3.10	244.8	2.69	4.06	5.25*	6.62*	1.27	112	257	18.57	19.07	4.93	5.09
NBKDR 29 VIII	-575NOV27	14.69	3.10	60.0	16.20*	—	—	19.09	.65	44	302	17.08	17.19	6.82	7.52
NBKDR 30 II	-574MAY23	4.68	—	234.2	—	—	—	—	-.09	189	189	18.28	18.95	5.05	5.16
NBKDR 30 VII	-574OCT18	11.12	—	18.9	—	—	—	—	-.89	163	163	17.65	17.77	6.24	7.02
NBKDR 30 VIII	-574NOV17	2.77	—	49.1	—	—	—	—	-.72	350	349	16.90	17.32	6.68	6.81
NBKDR 31U I	-573APR13	6.14	2.94	195.8	7.99*	—	—	10.39*	.37	57	338	17.56	18.36	5.64	5.59
NBKDR 31U VII	-573OCT07	12.91	3.10	7.6	14.94*	—	—	17.34*	.28	126	198	17.84	17.96	6.05	6.69
NBKDR 31U XII	-572APR01	23.00	2.87	185.7	.03	1.09	2.65	3.71	1.73	103	293	17.71	18.19	5.81	6.03
NBKDR 32 VI	-572SEP25	12.59	3.05	356.3	13.61*	14.83*	16.42*	17.64*	1.57	80	244	18.09	18.16	5.85	6.50
NBKDR 32 XII	-571MAR22	15.03	2.80	175.4	16.20*	—	—	19.19	.68	146	250	17.90	18.02	5.97	6.48
NBKDR 33A VI	-571SEP14	17.48	3.00	345.2	18.73	—	—	21.99	.79	39	286	18.21	18.35	5.66	6.15
NBKDR 33A XI	-570FEB10	10.66	—	135.7	—	—	—	—	-.73	12	12	17.44	17.38	6.61	7.13
NBKDR 33A XII	-570MAR12	1.75	—	164.9	—	—	—	—	-.81	198	198	17.27	17.83	6.16	6.42
NBKDR 34 IV	-570AUG05	20.58	—	305.8	—	—	—	—	-.56	171	171	18.57	18.96	5.05	5.48
NBKDR 34 V	-570SEP04	5.69	—	334.6	—	—	—	—	-.41	344	344	18.05	18.54	5.47	5.42
NBKDR 34 X	-569JAN30	11.04	2.67	124.5	12.36*	—	—	15.32*	.50	54	322	17.25	17.24	6.75	7.33
NBKDR 35 IV	-569JUL26	13.49	2.93	295.6	15.01*	—	—	18.01*	.72	122	228	19.00	19.07	4.94	5.68
NBKDR 35 X	-568JAN19	11.97	2.72	113.3	12.64*	13.82*	15.47*	16.65*	1.83	94	274	17.08	17.12	6.87	7.53
NBKDR 36A IV	-568JUL15	3.55	2.96	285.3	4.57	5.70*	7.29*	8.42*	1.67	84	274	18.57	19.15	4.85	4.91
NBKDR 36A X	-567JAN07	19.39	2.79	102.3	20.61	—	—	23.48	.58	131	229	16.68	17.05	6.95	7.48
NBKDR 37 III	-567JUL04	11.05	3.00	274.8	12.85*	—	—	14.89*	.18	34	333	19.29	19.19	4.81	5.43
NBKDR 37 VIII	-567NOV28	21.99	—	61.4	—	—	—	—	-.58	343	342	16.89	17.18	6.83	7.20
NBKDR 37 IX	-567DEC28	9.04	—	91.4	—	—	—	—	-.57	175	175	16.06	17.02	6.98	6.95
NBKDR 38 II	-566MAY24	21.31	—	235.9	—	—	—	—	-.30	200	200	18.59	18.97	5.02	5.34
NBKDR 38 VIII	-566NOV18	13.07	3.14	50.6	14.90*	—	—	17.68	.56	26	291	17.25	17.30	6.71	7.53
NBKDR 39 II	-565MAY14	2.08	3.09	225.4	3.34	4.70	5.69*	7.05*	1.20	133	273	18.24	18.83	5.16	5.31
NBKDR 39 VIII	-565NOV07	23.38	3.16	39.5	.56	1.71	3.34	4.48	1.78	64	247	17.14	17.45	6.55	6.85

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
NBKDR 40 II	-564MAY02	13.99	3.05	215.1	15.20*	16.62*	17.25*	18.67*	1.11	92	318	18.65	18.68	5.31	5.71
NBKDR 40 VIII	-564OCT27	2.47	3.16	28.2	3.94	—	—	6.99*	.56	104	202	17.25	17.63	6.38	6.54
NBKDR 41U I	-563MAR23	22.93	—	176.8	—	—	—	—	-.64	209	209	17.52	18.03	5.96	6.26
NBKDR 41U II	-563APR22	6.57	—	205.0	—	—	—	—	-.19	27	27	17.66	18.51	5.48	5.42
NBKDR 41U VII	-563OCT16	1.74	—	16.8	—	—	—	—	-.67	152	152	17.42	17.82	6.19	6.38
NBKDR 41U XII	-562MAR13	13.80	2.75	166.5	15.20*	—	—	18.07	.58	160	258	17.80	17.86	6.13	6.57
NBKDR 42A VI	-562SEP05	15.05	2.96	336.0	16.93*	—	—	19.34	.35	11	294	18.45	18.50	5.51	6.12
NBKDR 42A XII	-561MAR02	22.34	2.69	155.8	23.00	.18	1.83	3.01	1.77	116	300	17.26	17.68	6.31	6.53
NBKDR 43 V	-561AUG26	4.96	2.93	325.5	6.02*	7.09*	8.65*	9.72*	1.74	60	249	18.22	18.68	5.33	5.32
NBKDR 43 XI	-560FEB19	23.95	2.66	144.8	1.08	—	—	3.79	.40	67	344	17.05	17.51	6.48	6.64
AMLMK 1 V	-560AUG14	21.68	2.91	315.2	22.96	—	—	1.96	.73	103	211	18.51	18.83	5.17	5.55
AMLMK 1 X	-559JAN09	7.84	—	103.9	—	—	—	—	-.82	191	191	16.11	17.05	6.94	7.05
AMLMK 1 XI	-559FEB08	.29	—	133.6	—	—	—	—	-.85	23	23	16.87	17.35	6.64	6.77
AMLMK 2A IV	-559JUL06	1.67	—	276.4	—	—	—	—	-.47	352	352	18.79	19.19	4.81	4.89
AMLMK 2A V	-559AUG04	12.52	—	304.8	—	—	—	—	-.68	160	160	18.85	18.96	5.04	5.85
AMLMK 2A X	-559DEC29	17.27	2.86	92.9	18.82	—	—	21.68	.59	137	236	16.71	17.02	6.98	7.55
NLSUS 1 III	-558JUN25	7.19	3.04	265.9	8.57*	—	—	12.05*	.84	55	298	18.57	19.19	4.81	4.72
NLSUS 1 IX	-558DEC19	7.99	2.95	82.1	9.10*	10.16*	11.72*	12.78*	1.88	92	272	16.10	17.03	6.97	6.92
NLSUS 2 III	-557JUN14	8.04	3.08	255.2	9.03*	10.30*	11.77*	13.05*	1.43	103	258	18.44	19.15	4.85	4.79
NLSUS 2 IX	-557DEC08	23.59	3.03	71.3	1.04	—	—	3.93	.64	49	307	16.62	17.09	6.91	7.20
NLSUS 3A III	-556JUN02	11.42	3.10	244.6	13.54*	—	—	15.09*	.07	162	208	19.08	19.07	4.93	5.62
NLSUS 3A VIII	-556OCT28	19.37	—	30.0	—	—	—	—	-.91	164	165	17.25	17.60	6.41	6.87
NLSUS 3A IX	-556NOV27	11.39	—	60.3	—	—	—	—	-.73	353	353	17.24	17.18	6.82	7.57
NLSUS 4 I	-555APR23	13.67	3.01	206.3	15.75*	—	—	17.85*	.26	50	342	18.53	18.54	5.45	5.92
NLSUS 4 VII	-555OCT17	20.76	3.14	18.7	22.88	—	—	1.18	.25	129	197	17.46	17.78	6.23	6.59
NBNID 1A I	-554APR13	6.73	2.94	196.2	7.85*	8.93*	10.44*	11.52*	1.62	99	295	17.52	18.36	5.63	5.61
NBNID 1A VII	-554OCT06	20.42	3.10	7.3	21.50	22.73	.28	1.51	1.53	81	243	17.71	17.97	6.03	6.40
NBNID 1A XII	-553APR02	22.67	2.88	186.1	23.85	—	—	3.00	.78	142	254	17.74	18.19	5.80	6.08
NBNID 2 VI	-553SEP26	1.58	3.05	356.2	2.85	—	—	6.16*	.84	40	284	17.80	18.17	5.84	6.00
NBNID 2 XI	-552FEB21	18.20	—	146.6	—	—	—	—	-.80	15	15	17.31	17.54	6.45	6.74
NBNID 2 XII	-552MAR22	9.10	—	175.6	—	—	—	—	-.72	198	198	18.13	18.02	5.97	6.64
NBNID 3A V	-552AUG16	4.56	—	316.5	—	—	—	—	-.65	168	168	18.14	18.82	5.19	5.24
NBNID 3A VI	-552SEP14	13.98	—	345.5	—	—	—	—	-.35	342	342	18.35	18.34	5.67	6.35
NBNID 3A XI	-551FEB09	18.55	2.65	135.4	19.90	—	—	22.74	.44	55	328	17.12	17.38	6.62	6.95
NBNID 4 IV	-551AUG05	21.29	2.91	306.2	22.89	—	—	1.73	.61	122	221	18.58	18.95	5.05	5.43
NBNID 4 X	-550JAN29	19.88	2.67	124.3	20.52	21.69	23.34	.52	1.79	97	280	16.90	17.23	6.76	7.14
NBNID 5 IV	-550JUL26	10.89	2.93	295.8	11.88*	13.00*	14.63*	15.75*	1.79	83	267	19.12	19.06	4.94	5.71
NBNID 5 X	-549JAN19	3.84	2.72	113.3	4.96	—	—	7.87*	.61	134	234	16.39	17.12	6.88	7.06
NBNID 6A IV	-549JUL15	17.83	2.96	285.3	19.39	—	—	21.85	.31	36	321	19.00	19.15	4.85	5.25
NBNID 6A IX	-549DEC10	6.96	—	72.6	—	—	—	—	-.58	347	347	16.46	17.08	6.92	6.83
NBNID 6A X	-548JAN08	17.82	—	102.6	—	—	—	—	-.55	180	180	16.70	17.05	6.95	7.62
NBNID 7 II	-548JUN04	3.76	—	246.2	—	—	—	—	-.45	196	196	18.43	19.08	4.92	5.07
NBNID 7 VIII	-548NOV28	21.90	3.09	61.8	23.70	—	—	2.48	.56	30	295	16.86	17.17	6.83	7.22
NBNID 8 II	-547MAY24	8.97	3.10	235.8	10.33*	11.96*	12.28*	13.92*	1.06	134	265	18.07	18.96	5.03	5.00
NBNID 8 VIII	-547NOV18	7.85	3.14	50.7	9.01*	10.16*	11.79*	12.94*	1.78	67	251	16.77	17.31	6.70	6.65
NBNID 9 II	-546MAY13	21.34	3.09	225.6	22.56	23.81	.87	2.12	1.25	94	311	18.44	18.83	5.16	5.39
NBNID 9 VIII	-546NOV07	10.54	3.16	39.4	12.01*	—	—	15.09*	.57	106	205	17.36	17.45	6.56	7.37
NBNID 10U I	-545APR04	6.72	—	187.4	—	—	—	—	-.75	209	209	17.33	18.21	5.78	5.91
NBNID 10U II	-545MAY03	14.14	3.05	215.5	16.74*	—	—	17.26*	-.06	33	17	18.67	18.69	5.30	5.67
NBNID 10U VII	-545OCT27	9.73	—	27.9	—	—	—	—	-.65	153	153	17.51	17.62	6.38	7.21
NBNID 10U XII	-544MAR23	21.44	2.81	177.1	23.01	—	—	1.70	.48	165	254	17.64	18.04	5.95	6.23
NBNID 11 VI	-544SEP15	23.14	3.01	346.9	1.14	—	—	3.41	.30	8	295	18.10	18.32	5.68	5.95
NBNID 11 XII	-543MAR13	5.68	2.75	166.5	6.40*	7.57*	9.24*	10.42*	1.81	120	298	17.15	17.85	6.14	6.22
NBNID 12A VI	-543SEP05	13.18	2.96	336.3	14.28*	15.36*	16.89*	17.96*	1.67	56	249	18.45	18.50	5.51	6.28
NBNID 12A XII	-542MAR02	7.16	2.69	155.6	8.25*	—	—	11.17*	.48	73	342	16.94	17.67	6.32	6.33
NBNID 13 V	-542AUG26	5.75	2.93	325.9	6.99*	—	—	10.10*	.81	97	211	18.15	18.67	5.33	5.30
NBNID 13 X	-541JAN20	15.99	—	114.9	—	—	—	—	-.84	196	196	16.88	17.14	6.86	7.41
NBNID 13 XI	-541FEB19	7.84	—	144.5	—	—	—	—	-.78	25	25	16.71	17.50	6.49	6.45
NBNID 14 IV	-541JUL17	8.79	—	286.9	—	—	—	—	-.61	347	347	18.55	19.14	4.86	4.64
NBNID 14 V	-541AUG15	20.19	—	315.5	—	—	—	—	-.60	157	157	18.51	18.83	5.18	5.62
NBNID 14 X	-540JAN10	1.90	2.78	104.0	3.38	—	—	6.21	.58	143	240	16.33	17.06	6.94	7.19
NBNID 15A IV	-540JUL05	13.78	2.99	276.3	15.24*	—	—	18.51*	.68	45	298	19.16	19.19	4.81	5.39
NBNID 15A X	-540DEC29	16.86	2.86	93.2	17.89	18.94	20.51	21.56	1.87	97	277	16.76	17.02	6.98	7.55
NBNID 16 III	-539JUN24	14.50	3.04	265.6	15.45*	16.68*	18.30*	19.53	1.59	94	259	19.10	19.19	4.81	5.37
NBNID 16 IX	-539DEC19	8.44	2.95	82.5	9.81*	—	—	12.70*	.64	53	312	16.16	17.03	6.97	6.88
NBNID 17 III	-538JUN13	18.23	3.08	255.0	20.05	—	—	22.19	.23	148	213	18.90	19.15	4.85	5.32
NBNID 17 VIII	-538NOV09	3.68	—	41.2	—	—	—	—	-.93	167	167	16.84	17.43	6.57	6.73
NBNID 17 IX	-538DEC08	19.97	—	71.5	—	—	—	—	-.74	358	358	16.82	17.09	6.92	7.30
CYRUS 1 II	-537MAY04	21.15	3.06	216.8	23.48	—	—	1.18	.13	41	347	18.34	18.70	5.29	5.51
CYRUS 1 VIII	-537OCT29	4.71	3.16	29.8	6.89*	—	—	9.12*	.23	132	198	17.08	17.61	6.40	6.49
CYRUS 2U II	-536APR23	14.36	3.01	206.7	15.56*	16.67*	18.08*	19.19	1.49	94	297	18.49	18.55	5.44	5.95
CYRUS 2U VII	-536OCT17	4.40	3.14	18.4	5.54	6.77*	8.29*	9.53*	1.50	83	243	17.32	17.79	6.22	6.29

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
CYRUS 3A I	-535APR13	6.18	2.95	196.6	7.35*	—	—	10.65*	.89	137	257	17.59	18.37	5.62	5.67
CYRUS 3A VII	-535OCT06	9.84	3.10	7.2	11.15*	—	—	14.49*	.87	42	282	18.02	17.97	6.04	6.86
CYRUS 3A XII	-534MAR04	1.56	—	157.4	—	—	—	—	-.89	17	17	17.21	17.71	6.29	6.37
CYRUS 3A XII2	-534APR02	16.28	—	186.2	—	—	—	—	-.62	198	198	18.03	18.20	5.79	6.27
CYRUS 4 V	-534AUG27	12.70	—	327.2	—	—	—	—	-.72	165	165	18.53	18.64	5.36	6.17
CYRUS 4 VI	-534SEP25	22.41	—	356.5	—	—	—	—	-.31	342	342	17.91	18.16	5.85	6.15
CYRUS 4 XI	-533FEB21	1.90	2.66	146.3	3.38	—	—	6.04	.37	55	334	17.02	17.53	6.46	6.59
CYRUS 5 V	-533AUG17	5.20	2.92	316.9	6.87*	—	—	9.55*	.52	122	214	18.17	18.81	5.20	5.20
CYRUS 5 XI	-532FEB10	3.68	2.65	135.2	4.31	5.48	7.12*	8.30*	1.74	99	285	16.73	17.37	6.63	6.76
CYRUS 6A V	-532AUG05	18.32	2.91	306.5	19.29	20.42	22.05	23.18	1.82	82	260	18.74	18.95	5.06	5.52
CYRUS 6A XI	-531JAN29	12.17	2.67	124.4	13.24*	—	—	16.21*	.65	137	240	17.19	17.24	6.76	7.47
CYRUS 7 IV	-531JUL26	.68	2.93	295.8	2.07	—	—	4.84	.44	38	311	18.70	19.07	4.94	5.10
CYRUS 7 IX	-531DEC20	15.89	—	83.8	—	—	—	—	-.59	352	352	16.91	17.03	6.97	7.62
CYRUS 7 X	-530JAN19	2.51	—	113.7	—	—	—	—	-.52	185	185	16.38	17.12	6.87	7.16
CYRUS 8 III	-530JUN15	10.25	—	256.7	—	—	—	—	-.60	192	192	19.19	19.16	4.84	5.51
CYRUS 8 IV	-530JUL15	1.61	—	285.0	—	—	—	—	-.95	359	359	18.77	19.15	4.85	4.94
CYRUS 8 IX	-530DEC10	6.72	3.02	73.0	8.45*	—	—	11.23*	.55	34	299	16.46	17.08	6.92	6.89
CYRUS 9U III	-529JUN04	15.89	3.10	246.2	17.35*	—	—	20.77	.91	135	256	18.93	19.08	4.91	5.37
CYRUS 9U VIII	-529NOV29	16.32	3.09	61.9	17.43	18.58	20.21	21.37	1.77	70	255	16.98	17.17	6.84	7.46
CAMBS 1 II	-528MAY24	4.68	3.10	236.0	5.90*	7.06*	8.37*	9.54*	1.39	95	304	18.21	18.97	5.03	5.05
CAMBS 1 VIII	-528NOV17	18.65	3.14	50.6	20.08	—	—	23.19	.58	109	208	17.03	17.30	6.71	7.21
CAMBS 2 I	-527APR14	14.41	—	197.9	—	—	—	—	-.87	208	208	18.31	18.40	5.59	6.10
CAMBS 2 II	-527MAY13	21.66	3.09	226.0	23.86	—	—	1.27	.07	45	360	18.44	18.84	5.15	5.33
CAMBS 2 VIII	-527NOV06	17.80	—	39.1	—	—	—	—	-.63	156	156	17.18	17.46	6.55	7.09
CAMBS 3U I	-526APR04	4.94	2.89	187.7	6.72*	—	—	9.16*	.36	170	249	17.49	18.22	5.77	5.90
CAMBS 3U VI2	-526SEP27	7.39	3.06	357.9	9.49*	—	—	11.65*	.26	5	296	17.75	18.14	5.87	5.77
CAMBS 3U XII	-525MAR24	12.84	2.81	177.2	13.64*	14.82*	16.47*	17.66*	1.70	124	295	18.02	18.05	5.94	6.33
CAMBS 4 VI	-525SEP16	21.54	3.01	347.2	22.70	23.78	1.28	2.36	1.61	53	249	18.07	18.32	5.69	6.06
CAMBS 4 XII	-524MAR12	14.21	2.75	166.3	15.24*	—	—	18.37	.59	78	339	17.78	17.86	6.13	6.44
CAMBS 5A VI	-524SEP05	13.95	2.97	336.8	15.20*	—	—	18.38*	.88	93	211	18.38	18.49	5.52	6.27
CAMBS 5A XI	-523JAN31	.04	—	125.9	—	—	—	—	-.87	200	200	16.66	17.25	6.74	7.07
CAMBS 5A XII	-523MAR01	15.25	—	155.3	—	—	—	—	-.69	27	27	17.57	17.68	6.31	6.58
CAMBS 6 IV	-523JUL27	15.98	—	297.5	—	—	—	—	-.74	343	343	19.01	19.05	4.96	5.49
CAMBS 6 V	-523AUG26	3.97	—	326.2	—	—	—	—	-.53	154	154	18.17	18.67	5.34	5.42
CAMBS 6 X	-522JAN20	10.44	2.71	115.1	11.87*	—	—	14.66*	.56	148	244	17.18	17.14	6.85	7.56
CAMBS 7 IV	-522JUL16	20.45	2.95	286.8	22.01	—	—	1.02	.54	35	300	18.92	19.14	4.86	5.19
CAMBS 7 X	-521JAN10	1.66	2.77	104.4	2.62	3.67	5.24	6.29	1.85	102	281	16.35	17.06	6.94	7.16
CAMBS 8A IV	-521JUL05	21.04	3.00	276.0	21.93	23.14	.82	2.03	1.74	85	259	18.90	19.19	4.81	5.14
CAMBS 8A X	-521DEC30	17.24	2.85	93.6	18.52	—	—	21.43	.65	58	316	16.78	17.02	6.98	7.48
DARI1 1 III	-520JUN24	1.10	3.04	265.4	2.69	—	—	5.25*	.38	136	216	18.69	19.19	4.81	5.02
DARI1 1 VIII	-520NOV19	12.02	—	52.4	—	—	—	—	-.94	170	170	17.11	17.27	6.73	7.52
DARI1 1 IX	-520DEC19	4.52	—	82.7	—	—	—	—	-.74	2	2	16.42	17.03	6.97	7.02
DARI1 2 II	-519MAY15	4.58	3.09	227.2	7.26*	—	—	8.37*	.01	29	354	18.14	18.85	5.14	5.10
DARI1 2 III	-519JUN13	12.41	—	255.2	—	—	—	—	-.88	181	181	19.11	19.15	4.85	5.63
DARI1 2 VIII	-519NOV08	12.74	3.16	40.9	14.95*	—	—	17.13*	.21	135	199	17.29	17.43	6.58	7.27
DARI1 3U II	-518MAY04	21.90	3.06	217.2	23.21	.37	1.62	2.78	1.37	88	299	18.30	18.71	5.28	5.53
DARI1 3U VII	-518OCT28	12.50	3.16	29.5	13.66*	14.90*	16.39*	17.63	1.48	85	245	17.52	17.60	6.41	7.09
DARI1 4 I	-517APR24	13.57	3.01	207.1	14.75*	—	—	18.18*	1.02	132	260	18.52	18.55	5.44	5.98
DARI1 4 VII	-517OCT17	18.23	3.14	18.3	19.57	—	—	22.93	.90	44	283	17.60	17.79	6.22	6.71
DARI1 5A I	-516APR12	23.30	—	196.7	—	—	—	—	-.50	197	197	17.93	18.38	5.62	5.91
DARI1 5A VI	-516SEP06	20.95	—	338.1	—	—	—	—	-.78	163	163	18.08	18.47	5.54	5.95
DARI1 5A VII	-516OCT06	6.98	—	7.5	—	—	—	—	-.27	342	342	17.46	17.98	6.03	5.94
DARI1 5A XII	-515MAR03	9.11	2.70	157.1	10.74*	—	—	13.17*	.29	53	340	17.81	17.71	6.28	6.79
DARI1 6 V	-515AUG27	13.23	2.94	327.7	15.01*	—	—	17.53*	.43	123	208	18.54	18.64	5.37	6.12
DARI1 6 XI	-514FEB20	11.35	2.66	146.1	11.99*	13.17*	14.79*	15.96*	1.67	99	289	17.55	17.54	6.46	7.02
DARI1 7 V	-514AUG17	1.86	2.92	317.1	2.85	3.98	5.60*	6.73*	1.72	82	254	18.36	18.81	5.20	5.35
DARI1 7 XI	-513FEB09	20.41	2.65	135.3	21.41	—	—	.45	.70	138	245	16.98	17.37	6.62	7.03
DARI1 8A V	-513AUG06	7.64	2.91	306.4	8.89*	—	—	11.91*	.55	39	303	18.38	18.95	5.05	4.96
DARI1 8A X	-512JAN01	.76	—	95.0	—	—	—	—	-.60	357	357	16.53	17.02	6.97	7.18
DARI1 8A XI	-512JAN30	11.10	—	124.7	—	—	—	—	-.48	189	189	17.24	17.24	6.75	7.59
DARI1 9 III	-512JUN25	16.81	—	267.1	—	—	—	—	-.75	187	187	18.96	19.19	4.81	5.30
DARI1 9 IV	-512JUL25	8.30	—	295.5	—	—	—	—	-.82	355	355	18.50	19.07	4.93	4.79
DARI1 9 IX	-512DEC20	15.50	2.93	84.2	17.15	—	—	19.92	.54	39	305	16.89	17.03	6.97	7.64
DARI1 10 III	-511JUN14	22.87	3.07	256.6	.41	—	—	3.64	.77	136	247	18.70	19.16	4.84	5.10
DARI1 10 IX	-511DEC10	.78	3.02	73.1	1.81	2.97	4.61	5.76	1.77	75	259	16.64	17.08	6.93	7.19
DARI1 11U III	-510JUN04	12.04	3.09	246.4	13.23*	14.34*	15.80*	16.92*	1.54	96	296	19.16	19.09	4.91	5.50
DARI1 11U VIII	-510NOV29	2.79	3.09	61.8	4.17	—	—	7.29*	.59	113	212	16.70	17.18	6.83	7.03
DARI1 12 II	-509MAY25	5.14	3.10	236.4	7.11*	—	—	9.03*	.20	50	348	18.19	18.97	5.02	4.98
DARI1 12 VIII	-509NOV18	1.97	—	50.2	—	—	—	—	-.62	159	159	16.84	17.31	6.70	6.93
DARI1 13A I	-508APR14	12.30	2.96	198.2	14.32*	—	—	16.42*	.23	175	241	18.42	18.41	5.58	6.07
DARI1 13A VII	-508OCT07	15.78	3.11	8.9	17.98	—	—	20.05	.23	4	298	17.87	17.94	6.07	6.67
DARI1 13A XII2	-507APR03	19.85	2.89	187.7	20.75	21.96	23.54	.75	1.57	127	291	17.93	18.22	5.77	6.02

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI1 14 VI	-507SEP27	6.04	3.06	358.2	7.25*	8.34*	9.80*	10.89*	1.57	51	250	17.70	18.14	5.87	5.83
DARI1 14 XII	-506MAR23	21.11	2.81	176.9	22.13	—	—	1.46	.70	83	336	17.70	18.04	5.95	6.14
DARI1 15 VI	-506SEP16	22.29	3.01	347.7	23.54	—	—	2.79	.93	90	212	18.00	18.31	5.70	6.03
DARI1 15 XI	-505FEB11	7.96	—	136.8	—	—	—	—	-.91	203	203	16.46	17.39	6.60	6.73
DARI1 15 XII	-505MAR12	22.54	—	166.0	—	—	—	—	-.59	29	29	17.45	17.85	6.14	6.27
DARI1 16A V	-505AUG07	23.27	—	308.1	—	—	—	—	-.86	339	339	18.71	18.93	5.08	5.29
DARI1 16A VI	-505SEP06	11.87	—	337.1	—	—	—	—	-.47	152	152	18.36	18.48	5.53	6.32
DARI1 16A XI	-504JAN31	18.87	2.67	126.1	20.29	—	—	23.02	.53	153	247	16.89	17.25	6.74	7.17
DARI1 17 IV	-504JUL27	3.20	2.92	297.3	4.90	—	—	7.63*	.40	25	301	18.68	19.05	4.95	5.01
DARI1 17 X	-503JAN20	10.37	2.71	115.5	11.24*	12.30*	13.86*	14.92*	1.83	108	285	17.23	17.14	6.85	7.54
DARI1 18 IV	-503JUL16	3.68	2.95	286.5	4.56	5.76*	7.45*	8.66*	1.78	76	258	18.68	19.14	4.86	4.93
DARI1 18 X	-502JAN10	1.94	2.77	104.8	3.12	—	—	6.06	.66	64	321	16.40	17.06	6.94	7.10
DARI1 19U IV	-502JUL05	8.06	3.00	275.9	9.48*	—	—	12.34*	.52	125	218	18.46	19.19	4.81	4.72
DARI1 19U VIII	-502NOV30	20.37	—	63.6	—	—	—	—	-.95	174	174	16.72	17.15	6.85	7.32
DARI1 19U IX	-502DEC30	12.98	—	93.8	—	—	—	—	-.74	7	7	17.01	17.02	6.98	7.54
DARI1 20 II	-501MAY26	12.00	—	237.7	—	—	—	—	-.12	8	8	19.09	19.00	5.00	5.61
DARI1 20 III	-501JUN24	19.75	—	265.6	—	—	—	—	-.74	176	176	18.84	19.19	4.81	5.29
DARI1 20 VIII	-501NOV19	20.82	3.14	52.1	23.03	—	—	1.17	.20	139	202	16.91	17.28	6.73	7.13
DARI1 21 II	-500MAY15	5.39	3.09	227.7	6.77*	8.02*	9.02*	10.26*	1.23	81	300	18.09	18.86	5.13	5.11
DARI1 21 VIII	-500NOV07	20.69	3.16	40.6	21.87	23.11	.59	1.83	1.47	88	247	17.12	17.44	6.57	6.96
DARI1 22A II	-499MAY04	20.85	3.06	217.6	22.04	23.42	.21	1.59	1.15	126	262	18.36	18.72	5.28	5.60
DARI1 22A VIII	-499OCT28	2.75	3.16	29.5	4.11	—	—	7.48*	.92	46	284	17.17	17.61	6.40	6.53
DARI1 23 I	-498APR24	6.20	—	207.2	—	—	—	—	-.38	196	196	17.84	18.55	5.45	5.55
DARI1 23 VI	-498SEP18	5.35	—	349.0	—	—	—	—	-.83	162	162	17.64	18.29	5.71	5.72
DARI1 23 VII	-498OCT17	15.68	—	18.6	—	—	—	—	-.25	343	343	17.71	17.78	6.23	6.86
DARI1 23 XII	-497MAR14	16.16	2.75	167.8	18.02	—	—	20.13	.19	48	347	17.74	17.89	6.11	6.44
DARI1 24A VI	-497SEP07	21.38	2.97	338.5	23.27	—	—	1.64	.36	124	203	18.11	18.47	5.54	5.91
DARI1 24A XII	-496MAR02	18.89	2.70	156.9	19.59	20.78	22.36	23.54	1.60	99	294	17.43	17.70	6.29	6.63
DARI1 25 V	-496AUG27	9.51	2.94	327.9	10.53*	11.68*	13.26*	14.41*	1.64	82	249	18.68	18.63	5.38	6.21
DARI1 25 XI	-495FEB20	4.51	2.66	146.2	5.49	—	—	8.62*	.77	139	250	16.78	17.53	6.46	6.60
DARI1 26 V	-495AUG16	14.72	2.92	317.1	15.89*	—	—	19.09	.65	40	296	18.74	18.80	5.21	5.76
DARI1 26 X	-494JAN11	9.54	—	106.2	—	—	—	—	-.62	1	1	17.22	17.07	6.92	7.75
DARI1 26 XI	-494FEB09	19.56	—	135.7	—	—	—	—	-.44	192	192	16.99	17.38	6.61	7.12
DARI1 27A IV	-494JUL06	23.46	—	277.5	—	—	—	—	-.88	182	182	18.70	19.19	4.82	5.10
DARI1 27A V	-494AUG05	15.12	—	306.1	—	—	—	—	-.70	351	351	18.93	18.95	5.06	5.56
DARI1 27A X	-493JAN01	.20	2.84	95.4	1.77	—	—	4.53	.53	43	310	16.54	17.02	6.97	7.23
DARI1 28 III	-493JUN26	5.91	3.03	267.0	7.54*	—	—	10.56*	.64	136	238	18.43	19.19	4.81	4.83
DARI1 28 IX	-493DEC21	9.17	2.93	84.3	10.11*	11.28*	12.91*	14.07*	1.76	79	264	17.06	17.03	6.98	7.87
DARI1 29A III	-492JUN14	19.42	3.07	256.8	20.59	21.68	23.23	.31	1.68	95	287	18.87	19.16	4.84	5.20
DARI1 29A IX	-492DEC09	10.90	3.02	72.9	12.21*	—	—	15.34*	.60	117	217	16.99	17.08	6.93	7.75
DARI1 30 II	-491JUN04	12.62	3.09	246.8	14.42*	—	—	16.70*	.34	53	337	19.17	19.09	4.91	5.45
DARI1 30 VIII	-491NOV28	10.16	—	61.4	—	—	—	—	-.60	163	163	17.06	17.17	6.83	7.72
DARI1 31 I	-490APR25	19.52	3.02	208.7	21.87	—	—	23.49	.10	182	232	18.26	18.58	5.42	5.75
DARI1 31 VII	-490OCT19	.31	3.14	20.0	2.58	—	—	4.59	.21	4	300	17.50	17.76	6.25	6.48
DARI1 32A I	-489APR15	2.70	2.96	198.2	3.69	4.94	6.40*	7.65*	1.44	131	286	17.83	18.40	5.59	5.73
DARI1 32A VII	-489OCT08	14.66	3.11	9.3	15.94*	17.04*	18.47	19.57	1.53	51	251	17.84	17.94	6.07	6.79
DARI1 32A XII2	-488APR03	3.87	2.88	187.5	4.87	—	—	8.39*	.84	88	331	17.63	18.21	5.78	5.85
DARI1 33 VI	-488SEP27	6.74	3.06	358.7	8.04*	—	—	11.32*	.97	88	213	17.64	18.13	5.88	5.81
DARI1 33 XI	-487FEB21	15.76	—	147.7	—	—	—	—	-.96	206	206	17.37	17.56	6.43	6.91
DARI1 33 XII	-487MAR23	5.70	—	176.7	—	—	—	—	-.47	29	29	17.35	18.03	5.96	5.96
DARI1 34 V	-487AUG18	6.66	—	318.8	—	—	—	—	-.96	336	336	18.41	18.78	5.22	5.13
DARI1 34 VI	-487SEP16	19.90	—	348.0	—	—	—	—	-.42	151	151	18.01	18.30	5.70	6.14
DARI1 34 XI	-486FEB11	3.19	2.65	137.0	4.64	—	—	7.29*	.49	158	248	16.63	17.39	6.60	6.79
DARI1 35A V	-486AUG07	10.07	2.91	307.9	11.92*	—	—	14.31*	.28	15	304	18.98	18.92	5.08	5.83
DARI1 35A XI	-485JAN31	18.95	2.67	126.5	19.80	20.86	22.42	23.48	1.79	113	288	16.91	17.26	6.73	7.13
DARI1 36 IV	-485JUL27	10.44	2.93	297.0	11.31*	12.53*	14.17*	15.38*	1.64	68	258	19.06	19.05	4.95	5.71
DARI1 36 X	-484JAN21	10.53	2.71	115.9	11.64*	—	—	14.61*	.68	69	324	17.24	17.15	6.85	7.46
XERXS 1 IV	-484JUL15	15.15	2.95	286.4	16.42*	—	—	19.51	.66	116	219	19.00	19.14	4.86	5.49
XERXS 1 IX	-484DEC11	4.68	—	74.8	—	—	—	—	-.97	179	179	16.34	17.07	6.93	7.11
XERXS 1 X	-483JAN09	21.33	—	105.0	—	—	—	—	-.73	12	12	16.69	17.06	6.93	7.20
XERXS 2U III	-483JUN05	19.44	—	248.1	—	—	—	—	-.25	4	4	18.86	19.10	4.90	5.22
XERXS 2U IV	-483JUL05	3.17	—	276.1	—	—	—	—	-.61	172	172	18.55	19.19	4.81	4.95
XERXS 2U VIII	-483NOV30	4.91	3.08	63.3	7.09*	—	—	9.20*	.19	143	205	16.53	17.16	6.84	6.97
XERXS 3 II	-482MAY26	12.85	3.10	238.1	14.31*	15.74*	16.28*	17.71*	1.09	74	301	19.04	19.00	4.99	5.62
XERXS 3 VIII	-482NOV19	4.96	3.14	51.8	6.12	7.36*	8.83*	10.07*	1.47	91	250	16.72	17.29	6.72	6.80
XERXS 4A II	-481MAY16	4.05	3.09	228.0	5.24*	6.49*	7.64*	8.89*	1.28	119	263	18.20	18.86	5.13	5.21
XERXS 4A VIII	-481NOV08	11.35	3.16	40.6	12.71*	—	—	16.08*	.93	49	286	17.43	17.43	6.58	7.37
XERXS 5 I	-480MAY04	12.99	—	217.6	—	—	—	—	-.24	194	194	18.68	18.72	5.27	5.85
XERXS 5 VI	-480SEP28	13.88	—	.0	—	—	—	—	-.87	157	158	17.91	18.09	5.91	6.67
XERXS 5 VII	-480OCT28	.47	—	29.8	—	—	—	—	-.23	345	345	17.25	17.61	6.40	6.63
XERXS 5 XII	-479MAR24	23.08	2.82	178.4	1.24	—	—	2.88	.08	42	354	17.67	18.06	5.93	6.09
XERXS 6 VI	-479SEP18	5.66	3.02	349.4	7.67*	—	—	9.90*	.30	126	199	17.68	18.29	5.72	5.71

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
XERXS 6 XII	-478MAR14	2.30	2.75	167.6	3.09	4.29	5.80	7.00*	1.51	97	298	17.31	17.88	6.12	6.25
XERXS 7A VI	-478SEP07	17.29	2.97	338.7	18.35*	19.52	21.05	22.22	1.56	82	245	18.28	18.46	5.55	6.06
XERXS 7A XII	-477MAR03	12.50	2.70	157.0	13.46*	—	—	16.68*	.85	138	255	17.69	17.71	6.28	6.88
XERXS 8 V	-477AUG27	21.93	2.94	327.8	23.06	—	—	2.41	.74	40	290	18.39	18.64	5.37	5.65
XERXS 8 X	-476JAN22	18.23	—	117.2	—	—	—	—	-.64	6	6	16.91	17.16	6.84	7.26
XERXS 8 XI	-476FEB21	3.89	—	146.5	—	—	—	—	-.38	195	195	16.75	17.53	6.46	6.66
XERXS 9 V	-476AUG15	22.08	—	316.8	—	—	—	—	-.59	348	348	18.59	18.81	5.20	5.46
XERXS 9 X	-475JAN11	8.80	2.76	106.5	10.32*	—	—	13.04*	.51	47	316	16.22	17.07	6.93	6.83
XERXS 10A IV	-475JUL06	13.06	2.99	277.5	14.78*	—	—	17.56*	.51	137	228	19.13	19.18	4.82	5.49
XERXS 10A X	-475DEC31	17.49	2.84	95.5	18.34	19.51	21.14	22.31	1.75	84	270	16.78	17.03	6.97	7.51
XERXS 11 III	-474JUN26	2.87	3.03	267.3	4.01	5.07*	6.67*	7.74*	1.81	95	279	18.54	19.19	4.81	4.89
XERXS 11 IX	-474DEC20	18.98	2.93	84.1	20.20	—	—	23.36	.61	121	222	16.71	17.03	6.97	7.48
XERXS 12A III	-473JUN15	20.10	3.07	257.2	21.73	—	—	.30	.47	55	327	18.86	19.16	4.84	5.14
XERXS 12A IX	-473DEC09	18.37	—	72.6	—	—	—	—	-.59	167	167	16.75	17.08	6.92	7.50
XERXS 13 I	-472MAY06	2.64	3.07	219.2	5.51*	—	—	6.23*	-.05	194	215	18.11	18.74	5.26	5.44
XERXS 13 II	-472JUN04	12.14	—	247.2	—	—	—	—	-.96	15	15	19.21	19.09	4.90	5.40
XERXS 13 VII	-472OCT29	8.95	3.16	31.2	11.26*	—	—	13.23*	.20	5	302	17.11	17.59	6.42	6.26
XERXS 14 I	-471APR25	9.43	3.02	208.7	10.54*	11.87*	13.10*	14.44*	1.29	133	280	18.70	18.58	5.41	5.89
XERXS 14 VII	-471OCT18	23.40	3.14	20.4	.72	1.82	3.23	4.34	1.51	51	253	17.45	17.76	6.25	6.55
XERXS 15A I	-470APR14	10.52	2.95	198.0	11.53*	—	—	15.21*	.98	92	325	18.47	18.41	5.59	5.97
XERXS 15A VII	-470OCT08	15.31	3.11	9.7	16.63*	—	—	19.95	1.00	88	214	17.77	17.93	6.08	6.77
XERXS 15A XII2	-469APR03	12.74	—	187.2	—	—	—	—	-.35	29	29	18.22	18.22	5.77	6.08
XERXS 16 VI	-469SEP28	4.05	—	358.9	—	—	—	—	-.39	151	151	17.67	18.12	5.89	5.97
XERXS 16 XI	-468FEB22	11.38	2.67	147.9	12.90*	—	—	15.43*	.43	163	249	17.60	17.56	6.43	6.98
XERXS 17 V	-468AUG17	17.08	2.92	318.6	19.13	—	—	21.15	.17	6	307	18.68	18.78	5.23	5.70
XERXS 17 XI	-467FEB11	3.41	2.65	137.4	4.25	5.31	6.86*	7.92*	1.74	118	290	16.62	17.40	6.59	6.73
XERXS 18A V	-467AUG06	17.36	2.91	307.6	18.26*	19.50	21.05	22.29	1.52	60	258	18.79	18.93	5.08	5.55
XERXS 18A XI	-466JAN31	19.00	2.67	126.9	20.02	—	—	23.06	.72	74	327	16.94	17.26	6.73	7.06
XERXS 19 IV	-466JUL26	22.37	2.92	296.9	23.54	—	—	2.81	.78	107	219	18.71	19.06	4.95	5.26
XERXS 19 IX	-466DEC22	12.94	—	86.0	—	—	—	—	-.98	184	184	16.85	17.02	6.98	7.70
XERXS 19 X	-465JAN21	5.56	—	116.0	—	—	—	—	-.71	17	17	16.41	17.14	6.85	6.86
XERXS 20 III	-465JUN17	2.90	—	258.5	—	—	—	—	-.38	360	360	18.60	19.17	4.83	4.83
XERXS 20 IV	-465JUL16	10.69	—	286.6	—	—	—	—	-.48	167	167	19.12	19.14	4.86	5.79
XERXS 20 IX	-465DEC11	13.01	3.01	74.5	15.13*	—	—	17.21	.18	148	209	16.91	17.07	6.94	7.61
XERXS 21U III	-464JUN05	20.29	3.09	248.5	21.81	—	—	1.08	.95	65	302	18.80	19.10	4.90	5.23
XERXS 21U VIII	-464NOV29	13.27	3.09	63.0	14.39*	15.62*	17.09*	18.32	1.47	95	254	17.04	17.16	6.85	7.53
ARTX1 1 II	-463MAY26	11.20	3.10	238.4	12.36*	13.55*	14.92*	16.11*	1.42	111	264	19.07	19.00	4.99	5.68
ARTX1 1 VIII	-463NOV18	20.02	3.14	51.9	21.37	—	—	.74	.93	52	289	17.00	17.29	6.72	7.16
ARTX1 2A II	-462MAY15	19.68	—	228.0	—	—	—	—	-.10	191	191	18.56	18.87	5.12	5.51
ARTX1 2A VII	-462OCT09	22.54	—	11.1	—	—	—	—	-.90	162	162	17.46	17.91	6.10	6.45
ARTX1 2A XII	-462NOV08	9.32	—	40.9	—	—	—	—	-.22	347	347	17.56	17.43	6.58	7.53
ARTX1 2A XII2	-461APR05	5.87	2.89	189.0	8.52*	—	—	9.36*	-.04	30	6	17.60	18.24	5.75	5.74
ARTX1 3 VI	-461SEP29	14.06	3.07	.4	16.19*	—	—	18.30	.26	126	196	17.94	18.09	5.92	6.63
ARTX1 3 XII	-460MAR24	9.61	2.82	178.2	10.49*	11.73*	13.12*	14.35*	1.41	95	301	18.18	18.07	5.92	6.47
ARTX1 4 VI	-460SEP18	1.19	3.02	349.6	2.31	3.50	4.98	6.17*	1.50	83	242	17.89	18.28	5.73	5.91
ARTX1 4 XII	-459MAR13	20.36	2.75	167.7	21.35	—	—	.66	.94	136	259	17.52	17.88	6.11	6.46
ARTX1 5A VI	-459SEP07	5.28	2.97	338.6	6.39*	—	—	9.85*	.82	41	285	18.04	18.47	5.54	5.56
ARTX1 5A XI	-458FEB02	2.79	—	128.2	—	—	—	—	-.68	10	10	16.62	17.28	6.72	6.79
ARTX1 5A XII	-458MAR03	12.10	—	157.4	—	—	—	—	-.31	197	197	17.72	17.72	6.28	6.96
ARTX1 6 V	-458AUG27	5.23	—	327.5	—	—	—	—	-.49	345	345	18.25	18.65	5.36	5.36
ARTX1 6 X	-457JAN22	17.29	2.70	117.6	18.77	—	—	21.44	.48	50	321	16.94	17.16	6.83	7.31
ARTX1 7 IV	-457JUL17	20.32	2.95	288.0	22.14	—	—	.67	.39	137	219	18.79	19.13	4.87	5.27
ARTX1 7 X	-456JAN17	1.69	2.76	106.6	2.45	3.62	5.26	6.43	1.72	88	275	16.53	17.07	6.93	7.15
ARTX1 8A IV	-456JUL06	10.39	2.99	277.8	11.51*	12.57*	14.17*	15.23*	1.84	94	271	19.31	19.18	4.82	5.63
ARTX1 8A X	-456DEC31	2.98	2.85	95.3	4.08	—	—	7.27*	.63	125	228	16.45	17.02	6.97	7.19
ARTX1 9 III	-455JUN26	3.62	3.03	267.7	5.12*	—	—	7.92*	.60	56	317	18.53	19.19	4.81	4.82
ARTX1 9 IX	-455DEC20	2.55	—	83.8	—	—	—	—	-.58	172	172	16.44	17.03	6.97	7.23
ARTX1 10A II	-454MAY17	9.68	—	229.6	—	—	—	—	-.20	202	202	19.01	18.90	5.10	5.73
ARTX1 10A III	-454JUN15	19.38	—	257.6	—	—	—	—	-.84	11	11	18.94	19.16	4.83	5.11
ARTX1 10A VIII	-454NOV09	17.67	3.16	42.4	19.98	—	—	21.95	.20	8	305	17.26	17.41	6.60	7.16
ARTX1 11 I	-453MAY06	16.06	3.06	219.1	17.27*	18.76	19.57	21.06	1.14	136	273	18.59	18.74	5.25	5.62
ARTX1 11 VII	-453OCT30	8.23	3.16	31.5	9.59*	10.69*	12.09*	13.19*	1.50	52	255	17.05	17.58	6.43	6.29
ARTX1 12 I	-452APR24	17.07	3.02	208.4	18.06*	19.58	20.36	21.89	1.13	95	318	18.40	18.57	5.42	5.70
ARTX1 12 VII	-452OCT18	23.99	3.15	20.8	1.34	—	—	4.68	1.02	88	216	17.39	17.75	6.26	6.54
ARTX1 13A I	-451APR13	19.71	—	197.8	—	—	—	—	-.21	28	28	18.12	18.40	5.60	5.78
ARTX1 13A VII	-451OCT08	12.30	—	10.0	—	—	—	—	-.36	151	151	17.78	17.92	6.09	6.86
ARTX1 13A XII	-450MAR04	19.45	2.71	158.7	21.09	—	—	23.47	.37	168	247	17.39	17.73	6.26	6.61
ARTX1 14 V	-450AUG29	.22	2.94	329.3	2.52	—	—	4.10	.07	356	311	18.39	18.62	5.39	5.59
ARTX1 14 XI	-449FEB22	11.75	2.67	148.3	12.60*	13.67*	15.20*	16.27*	1.68	122	290	17.61	17.57	6.42	6.94
ARTX1 15 V	-449AUG18	.44	2.92	318.3	1.37	2.64	4.07	5.34*	1.41	54	259	18.49	18.79	5.22	5.42
ARTX1 15 XI	-448FEB12	3.31	2.65	137.8	4.30	—	—	7.41*	.76	79	328	16.69	17.40	6.59	6.68
ARTX1 16A V	-448AUG06	5.74	2.91	307.6	6.85*	—	—	10.25*	.90	99	219	18.41	18.94	5.07	5.05

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX1 16A XI	-447JAN31	13.64	—	127.0	—	—	—	—	-.68	21	21	17.22	17.27	6.72	7.12
ARTX1 17 III	-447JUN27	10.42	—	269.0	—	—	—	—	-.50	355	355	19.38	19.20	4.80	5.62
ARTX1 17 IV	-447JUL26	18.34	—	297.2	—	—	—	—	-.36	163	163	18.78	19.05	4.95	5.51
ARTX1 17 IX	-447DEC21	21.06	2.92	85.7	23.12	—	—	1.16	.17	154	213	16.59	17.02	6.98	7.38
ARTX1 18 III	-446JUN17	3.73	3.06	259.0	5.32*	—	—	8.44*	.81	56	302	18.54	19.17	4.83	4.84
ARTX1 18 IX	-446DEC10	21.59	3.01	74.2	22.63	23.87	1.33	2.56	1.46	100	258	16.66	17.07	6.93	7.31
ARTX1 19A III	-445JUN06	18.30	3.09	248.8	19.44	20.59	22.11	23.25	1.56	103	264	18.87	19.10	4.89	5.33
ARTX1 19A IX	-445NOV30	4.73	3.09	63.1	6.03	—	—	9.40*	.94	56	293	16.54	17.16	6.84	6.91
ARTX1 20 II	-444MAY26	2.32	3.10	238.4	4.50	—	—	5.92*	.04	167	208	18.44	19.00	5.00	5.18
ARTX1 20 VII	-444OCT20	7.29	—	22.2	—	—	—	—	-.92	163	163	16.99	17.73	6.28	6.22
ARTX1 20 VIII	-444NOV18	18.24	—	52.2	—	—	—	—	-.21	351	351	17.08	17.28	6.73	7.26
ARTX1 21A I	-443APR15	12.56	—	199.5	—	—	—	—	-.17	17	17	18.43	18.43	5.56	5.97
ARTX1 21A VII	-443OCT09	22.57	3.12	11.5	.80	—	—	2.81	.22	130	195	17.50	17.91	6.10	6.43
ARTX1 21A XII2	-442APR04	16.81	2.89	188.8	17.82*	19.10	20.31	21.60	1.30	91	304	18.07	18.25	5.75	6.11
ARTX1 22 VI	-442SEP29	9.21	3.07	.6	10.39*	11.60*	13.03*	14.24*	1.45	84	240	18.10	18.08	5.93	6.77
ARTX1 22 XII	-441MAR25	4.11	2.82	178.4	5.11	—	—	8.52*	1.04	133	263	17.35	18.06	5.93	6.05
ARTX1 23 VI	-441SEP18	12.77	3.02	349.5	13.89*	—	—	17.44*	.88	43	282	18.24	18.27	5.73	6.36
ARTX1 23 XI	-440FEB13	11.23	—	139.2	—	—	—	—	-.73	13	13	17.52	17.43	6.56	7.14
ARTX1 23 XII	-440MAR13	20.16	—	168.1	—	—	—	—	-.22	198	198	17.52	17.89	6.10	6.52
ARTX1 24A VI	-440SEP06	12.54	—	338.3	—	—	—	—	-.41	343	343	18.49	18.46	5.55	6.17
ARTX1 24A XI	-439FEB02	1.63	2.66	128.6	3.12	—	—	5.71	.44	52	327	16.70	17.28	6.71	6.87
ARTX1 25 IV	-439JUL28	3.72	2.92	298.6	5.67*	—	—	7.90*	.28	138	209	18.43	19.04	4.96	5.05
ARTX1 25 X	-438JAN22	9.76	2.70	117.7	10.47*	11.65*	13.28*	14.46*	1.69	91	280	17.22	17.17	6.83	7.54
ARTX1 26 IV	-438JUL17	18.01	2.95	288.3	19.09	20.16	21.72	22.80	1.72	93	263	18.91	19.13	4.87	5.37
ARTX1 26 X	-437JAN11	10.89	2.76	106.4	11.90*	—	—	15.14*	.65	129	234	17.03	17.07	6.92	7.65
ARTX1 27A IV	-437JUL07	11.19	2.98	278.2	12.55*	—	—	15.54*	.73	56	308	19.32	19.18	4.82	5.59
ARTX1 27A X	-437DEC31	10.69	—	95.0	—	—	—	—	-.56	177	177	16.94	17.03	6.97	7.81
ARTX1 28 II	-436MAY27	16.67	—	240.0	—	—	—	—	-.35	198	198	18.82	19.02	4.98	5.44
ARTX1 28 III	-436JUN26	2.62	—	268.0	—	—	—	—	-.72	6	6	18.66	19.19	4.81	4.83
ARTX1 28 VIII	-436NOV20	2.45	3.13	53.6	4.74	—	—	6.71	.21	11	308	16.87	17.27	6.74	6.89
ARTX1 29A II	-435MAY16	22.61	3.09	229.6	23.95	—	—	3.60	.98	138	265	18.47	18.89	5.11	5.34
ARTX1 29A VIII	-435NOV09	17.13	3.16	42.7	18.48	19.59	20.98	22.09	1.49	55	258	17.22	17.41	6.60	7.25
ARTX1 30 I	-434MAY05	23.54	3.06	218.9	.56	1.91	3.14	4.50	1.28	98	311	18.31	18.73	5.26	5.42
ARTX1 30 VII	-434OCT30	8.74	3.17	31.9	10.11*	—	—	13.47*	1.03	89	218	17.00	17.58	6.43	6.29
ARTX1 31 I	-433APR25	2.61	3.01	208.3	5.14	—	—	5.63*	-.06	34	20	18.00	18.56	5.43	5.48
ARTX1 31 VII	-433OCT19	20.66	—	21.0	—	—	—	—	-.35	152	152	17.42	17.74	6.27	6.69
ARTX1 31 XII	-432MAR15	3.39	2.76	169.4	5.19	—	—	7.37*	.29	173	245	17.18	17.91	6.09	6.26
ARTX1 32A VI	-432SEP08	7.52	2.98	340.1	10.14*	—	—	11.18*	-.02	347	317	18.09	18.44	5.56	5.49
ARTX1 32A XII	-431MAR04	19.93	2.71	159.1	20.83	21.91	23.40	.48	1.61	126	290	17.37	17.74	6.25	6.56
ARTX1 33 V	-431AUG28	7.69	2.94	329.0	8.69*	10.01*	11.29*	12.61*	1.32	48	259	18.20	18.63	5.38	5.30
ARTX1 33 XI	-430FEB22	11.48	2.67	148.7	12.44*	—	—	15.63*	.82	84	329	17.63	17.58	6.42	6.87
ARTX1 34 V	-430AUG17	13.28	2.92	318.2	14.35*	—	—	17.84*	1.00	93	220	18.69	18.78	5.23	5.93
ARTX1 34 XI	-429FEB11	21.55	—	138.0	—	—	—	—	-.63	24	24	17.03	17.41	6.58	6.77
ARTX1 35A IV	-429JUL08	18.00	—	279.5	—	—	—	—	-.62	351	351	19.06	19.18	4.82	5.29
ARTX1 35A V	-429AUG07	2.11	—	307.8	—	—	—	—	-.26	159	159	18.43	18.93	5.07	5.24
ARTX1 35A X	-428JAN02	5.04	2.83	96.8	7.05*	—	—	9.02*	.15	160	217	16.29	17.03	6.97	7.13
ARTX1 36 III	-428JUN27	11.20	3.02	269.4	12.85*	—	—	15.79*	.68	47	303	19.31	19.20	4.80	5.61
ARTX1 36 IX	-428DEC21	5.88	2.93	85.4	6.86	8.09*	9.55*	10.78*	1.46	105	263	16.29	17.03	6.98	7.06
ARTX1 37 III	-427JUN17	1.40	3.06	259.2	2.50	3.63	5.24*	6.36*	1.70	94	264	18.66	19.17	4.83	4.98
ARTX1 37 IX	-427DEC10	13.45	3.01	74.3	14.69*	—	—	18.05	.94	61	297	16.99	17.07	6.94	7.62
ARTX1 38A III	-426JUN06	8.92	3.09	248.8	10.78*	—	—	12.85*	.19	152	214	18.31	19.10	4.90	4.85
ARTX1 38A VIII	-426OCT31	16.14	—	33.3	—	—	—	—	-.93	165	165	17.26	17.54	6.46	7.16
ARTX1 38A IX	-426NOV30	3.19	—	63.4	—	—	—	—	-.21	355	355	16.59	17.16	6.85	6.96
ARTX1 39 I	-425APR26	19.17	—	209.9	—	—	—	—	-.31	15	15	18.36	18.60	5.40	5.64
ARTX1 39 VII	-425OCT21	7.19	3.15	22.6	9.49*	—	—	11.42*	.20	132	194	17.06	17.73	6.28	6.23
ARTX1 40A I	-424APR14	23.93	2.96	199.4	1.07	2.46	3.37	4.76	1.18	87	307	17.96	18.42	5.57	5.74
ARTX1 40A VII	-424OCT09	17.35	3.12	11.6	18.57	19.80	21.19	22.41	1.41	85	240	17.70	17.90	6.11	6.62
ARTX1 40A XII2	-423APR04	11.75	2.89	189.0	12.80*	14.16*	14.95*	16.30*	1.15	130	266	18.29	18.25	5.74	6.33
ARTX1 41 VI	-423SEP28	20.40	3.07	.4	21.54	—	—	1.15	.93	45	280	17.87	18.09	5.92	6.27
ARTX1 41 XI	-422FEB23	19.52	—	150.1	—	—	—	—	-.79	15	15	17.28	17.59	6.40	6.68
ARTX1 41 XII	-422MAR25	4.10	—	178.8	—	—	—	—	-.13	198	198	17.32	18.06	5.93	6.08
DARI2 1 VI	-422SEP17	20.02	—	349.2	—	—	—	—	-.34	342	342	18.12	18.28	5.72	6.08
DARI2 1 XI	-421FEB13	9.83	2.66	139.5	11.36*	—	—	13.84*	.38	53	332	17.55	17.44	6.55	7.18
DARI2 2 A	-421AUG08	11.26	2.91	309.2	13.36*	—	—	15.30*	.18	140	200	18.88	18.91	5.10	5.89
DARI2 2A XI	-420FEB02	17.68	2.66	128.6	18.34	19.53	21.14	22.33	1.65	94	285	17.04	17.29	6.71	7.14
DARI2 3 IV	-420JUL28	1.74	2.92	298.9	2.82	3.91	5.41*	6.50*	1.61	92	255	18.51	19.04	4.97	5.11
DARI2 3 X	-419JAN21	18.68	2.70	117.4	19.59	—	—	22.89	.69	132	240	16.85	17.16	6.83	7.29
DARI2 4 IV	-419JUL17	18.83	2.95	288.7	20.10	—	—	23.23	.84	56	299	18.92	19.13	4.88	5.31
DARI2 4 X	-418JAN10	18.75	—	106.1	—	—	—	—	-.53	182	182	16.72	17.07	6.93	7.46
DARI2 5A III	-418JUN07	23.61	—	250.4	—	—	—	—	-.50	194	194	18.60	19.12	4.88	5.16
DARI2 5A IV	-418JUL07	9.91	—	278.5	—	—	—	—	-.60	2	2	19.39	19.18	4.82	5.56
DARI2 5A IX	-418DEC01	11.26	3.08	64.8	13.50*	—	—	15.48*	.21	15	312	17.16	17.14	6.87	7.75

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
DARI2 6 II	-417MAY28	5.10	3.10	239.9	6.54*	—	—	10.00*	.82	141	256	18.34	19.01	4.98	5.07
DARI2 6 VIII	-417NOV21	2.07	3.13	54.0	3.42	4.53	5.91	7.02*	1.49	58	262	16.81	17.26	6.74	6.94
DARI2 7A II	-416MAY16	5.97	3.09	229.3	6.98*	8.25*	9.74*	11.01*	1.45	100	303	18.20	18.88	5.11	5.14
DARI2 7A VIII	-416NOV09	17.57	3.16	43.1	18.93	—	—	22.29	1.03	92	221	17.16	17.40	6.61	7.24
DARI2 8 I	-415MAY05	9.46	3.06	218.7	11.50*	—	—	13.11*	.09	48	1	18.90	18.74	5.25	5.70
DARI2 8 VII	-415OCT30	5.10	—	32.2	—	—	—	—	-.34	154	154	17.06	17.57	6.44	6.50
DARI2 8 XII	-414MAR26	11.22	2.83	180.1	13.24*	—	—	15.14*	.19	179	240	18.17	18.10	5.89	6.42
DARI2 9 VI	-414SEP19	14.96	—	351.0	—	—	—	—	-.09	331	331	18.20	18.25	5.76	6.31
DARI2 9 XII	-413MAR16	3.98	2.77	169.8	4.96	6.06	7.49*	8.59*	1.52	130	288	17.16	17.91	6.08	6.19
DARI2 10A VI	-413SEP08	15.11	2.98	339.9	16.20*	17.57*	18.68	20.05	1.24	44	260	18.34	18.44	5.57	6.13
DARI2 10A XII	-412MAR04	19.48	2.71	159.5	20.44	—	—	23.72	.90	88	328	17.43	17.75	6.25	6.50
DARI2 11 V	-412AUG27	20.99	2.94	329.0	22.06	23.58	.10	1.62	1.08	87	220	18.36	18.62	5.39	5.76
DARI2 11 XI	-411FEB22	5.30	—	148.8	—	—	—	—	-.58	26	26	16.87	17.57	6.42	6.43
DARI2 12 IV	-411JUL19	1.68	—	290.0	—	—	—	—	-.74	346	346	18.74	19.12	4.89	4.97
DARI2 12 V	-411AUG17	10.02	—	318.5	—	—	—	—	-.16	156	156	18.73	18.78	5.23	6.17
DARI2 12 X	-401JAN12	12.94	2.75	107.9	14.92*	—	—	16.78*	.13	166	220	16.96	17.08	6.91	7.50
DARI2 13A IV	-410JUL08	18.72	2.98	279.9	20.45	—	—	23.18	.55	37	303	19.00	19.18	4.83	5.28
DARI2 13A X	-409JAN01	14.14	2.84	96.6	15.03*	16.26*	17.70	18.93	1.45	110	267	16.88	17.03	6.97	7.55
DARI2 14 III	-409JUN28	8.50	3.02	269.7	9.57*	10.69*	12.33*	13.45*	1.84	86	263	18.44	19.20	4.80	4.66
DARI2 14 IX	-409DEC21	22.15	2.93	85.5	23.30	—	—	2.66	.95	66	302	16.58	17.03	6.98	7.31
DARI2 15 III	-408JUN16	15.51	3.06	259.2	17.13*	—	—	19.66	.34	140	217	19.02	19.17	4.83	5.38
DARI2 15 VIII	-408NOV11	1.05	—	44.5	—	—	—	—	-.94	168	168	16.78	17.38	6.62	6.90
DARI2 15 IX	-408DEC10	12.15	—	74.6	—	—	—	—	-.21	359	359	17.09	17.07	6.94	7.70
DARI2 16A II	-407MAY07	1.71	—	220.4	—	—	—	—	-.45	13	13	18.28	18.76	5.24	5.30
DARI2 16A VIII	-407OCT31	15.88	3.17	33.7	18.22	—	—	20.11	.18	135	195	17.31	17.54	6.47	7.13
DARI2 17 I	-406APR26	6.98	3.02	209.8	8.25*	9.93*	10.14*	11.82*	1.05	81	310	17.83	18.59	5.41	5.37
DARI2 17 VII	-406OCT21	1.58	3.15	22.7	2.85	4.09	5.44	6.68*	1.39	87	240	17.29	17.72	6.29	6.48
DARI2 18A I	-405APR15	19.32	2.96	199.5	20.39	21.63	22.73	23.97	1.27	125	269	18.13	18.43	5.57	5.93
DARI2 18A VII	-405OCT10	4.17	3.12	11.5	5.35	—	—	9.00*	.96	46	279	17.50	17.91	6.10	6.17
DARI2 18A XII	-404MAR06	3.67	—	160.9	—	—	—	—	-.87	17	17	17.07	17.76	6.23	6.24
DARI2 18A XII2	-404APR04	11.93	2.90	189.4	14.18*	—	—	15.08*	-.02	184	212	18.29	18.26	5.73	6.38
DARI2 19 VI	-404SEP28	3.67	—	.1	—	—	—	—	-.29	342	342	17.75	18.10	5.91	5.99
DARI2 19 XI	-403FEB23	17.86	2.68	150.4	19.51	—	—	21.82	.31	52	338	17.37	17.60	6.39	6.75
ARTX2 1 V	-403AUG18	18.98	2.92	319.9	21.24	—	—	22.85	.10	142	192	18.47	18.76	5.25	5.71
ARTX2 1 XI	-402FEB13	1.43	2.66	139.6	2.11	3.31	4.89	6.09	1.59	95	290	16.90	17.43	6.56	6.75
ARTX2 2A V	-402AUG08	9.59	2.91	309.5	10.68*	11.79*	13.21*	14.32*	1.50	92	249	19.00	18.90	5.10	6.03
ARTX2 2A XI	-401FEB02	2.32	2.66	128.4	3.18	—	—	6.56	.74	134	245	16.71	17.28	6.71	6.93
ARTX2 3 IV	-401JUL29	2.56	2.92	299.3	3.74	—	—	7.00*	.95	55	292	18.51	19.03	4.97	5.06
ARTX2 3 X	-400JAN22	2.72	—	117.1	—	—	—	—	-.49	186	186	16.52	17.15	6.84	7.10
ARTX2 4 III	-400JUN18	6.54	—	260.8	—	—	—	—	-.66	190	190	18.37	19.18	4.82	4.88
ARTX2 4 IV	-400JUL17	17.25	—	289.0	—	—	—	—	-.49	357	357	19.03	19.12	4.88	5.33
ARTX2 4 IX	-400DEC11	20.08	3.00	76.0	22.24	—	—	22	.21	20	316	16.78	17.06	6.94	7.40
ARTX2 5A III	-399JUN07	11.57	3.08	250.3	13.15*	—	—	16.38*	.65	142	246	19.13	19.12	4.88	5.45
ARTX2 5A IX	-399DEC01	11.05	3.08	65.2	12.34*	13.45*	14.83*	15.94*	1.48	62	266	17.13	17.14	6.87	7.85
ARTX2 6 II	-398MAY27	12.38	3.10	239.7	13.39*	14.62*	16.25*	17.47*	1.61	102	295	19.03	19.02	4.98	5.45
ARTX2 6 VIII	-398NOV21	2.43	3.13	54.4	3.76	—	—	7.13*	1.03	95	225	16.76	17.26	6.75	6.95
ARTX2 7A II	-397MAY16	16.29	3.09	229.1	18.09*	—	—	20.28	.24	55	348	18.76	18.89	5.11	5.42
ARTX2 7A VIII	-397NOV10	13.60	—	43.4	—	—	—	—	-.34	157	157	17.21	17.39	6.61	7.39
ARTX2 7A XII2	-396APR05	18.95	2.91	190.7	21.22	—	—	22.75	.09	185	233	17.97	18.28	5.72	6.07
ARTX2 8 VI	-396SEP29	22.56	—	2.0	—	—	—	—	-.14	331	331	17.88	18.07	5.94	6.21
ARTX2 8 XII	-395MAR26	11.91	2.84	180.5	12.98*	14.11*	15.44*	16.57*	1.43	133	286	18.15	18.11	5.89	6.36
ARTX2 9 VI	-395SEP18	22.72	3.03	350.7	23.88	1.32	2.25	3.68	1.17	41	261	18.03	18.26	5.75	6.02
ARTX2 9 XII	-394MAR16	3.33	2.77	170.2	4.29	—	—	7.68*	.98	92	326	17.25	17.92	6.07	6.15
ARTX2 10A VI	-394SEP08	4.87	2.98	339.8	5.96*	7.35*	8.19*	9.57*	1.16	83	221	18.02	18.45	5.56	5.59
ARTX2 10A XII	-393MAR05	12.86	—	159.6	—	—	—	—	-.50	28	28	17.74	17.75	6.24	6.56
ARTX2 11 IV	-393JUL30	9.46	—	300.6	—	—	—	—	-.84	342	342	19.20	19.01	4.99	5.94
ARTX2 11 V	-393AUG28	18.08	2.94	329.3	20.69	—	—	20.92	-.08	150	157	18.37	18.61	5.39	5.94
ARTX2 11 X	-392JAN23	20.71	2.69	118.9	22.72	—	—	.42	.09	173	222	16.76	17.17	6.82	7.19
ARTX2 12 IV	-392JUL19	2.31	2.94	290.4	4.13	—	—	6.63*	.42	28	304	18.68	19.11	4.89	4.97
ARTX2 12 X	-391JAN11	22.32	2.76	107.7	23.13	.37	1.78	3.02	1.43	115	271	16.60	17.08	6.92	7.23
ARTX2 13A IV	-391JUL08	15.64	2.98	280.2	16.68*	17.81*	19.44	20.57	1.76	77	263	19.06	19.17	4.83	5.41
ARTX2 13A X	-390JAN01	6.80	2.84	96.7	7.87*	—	—	11.24*	.96	71	306	16.17	17.03	6.97	6.98
ARTX2 14 III	-390JUN27	22.11	3.02	269.7	23.52	—	—	2.41	.49	129	219	18.83	19.20	4.80	5.12
ARTX2 14 VIII	-390NOV22	10.00	—	55.8	—	—	—	—	-.94	171	171	17.16	17.23	6.77	7.80
ARTX2 14 IX	-390DEC21	21.05	—	85.8	—	—	—	—	-.20	4	4	16.64	17.02	6.98	7.34
ARTX2 15 II	-389MAY18	8.23	—	230.8	—	—	—	—	-.60	10	10	18.18	18.90	5.09	4.96
ARTX2 15 III	-389JUN16	23.21	—	259.0	—	—	—	—	-.92	179	179	18.73	19.17	4.83	5.14
ARTX2 15 VIII	-389NOV12	.62	3.16	44.9	2.99	—	—	4.84	.17	139	198	16.85	17.38	6.63	6.91
ARTX2 16U II	-388MAY06	14.00	3.07	220.3	15.41*	—	—	18.83	.92	74	312	18.72	18.76	5.23	5.70
ARTX2 16U VII	-388OCT31	9.90	3.17	33.9	11.17*	12.43*	13.76*	15.01*	1.37	90	242	17.52	17.53	6.48	7.31
ARTX2 17 I	-387APR26	2.81	3.02	210.1	3.94	5.10	6.42*	7.58*	1.40	120	271	17.95	18.59	5.40	5.52
ARTX2 17 VII	-387OCT20	12.05	3.15	22.5	13.23*	—	—	16.92*	.99	48	279	17.68	17.71	6.30	6.96

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX2 17 XII	-386MAR17	11.68	—	171.6	—	—	—	—	-.96	18	18	18.02	17.95	6.04	6.52
ARTX2 18A I	-386APR15	19.65	2.97	200.0	21.69	—	—	23.19	.09	173	221	18.10	18.43	5.56	5.97
ARTX2 18A VII	-386OCT09	11.48	—	11.1	—	—	—	—	-.25	342	342	17.93	17.90	6.11	6.78
ARTX2 18A XII	-385MAR07	1.72	2.72	161.2	3.53	—	—	5.62	.23	50	344	17.21	17.77	6.22	6.33
ARTX2 19 V	-385AUG30	2.85	2.95	330.7	5.32	—	—	6.57*	.02	146	184	18.07	18.60	5.41	5.53
ARTX2 19 XI	-384FEB24	9.01	2.68	150.4	9.71*	10.93*	12.46*	13.68*	1.52	96	295	16.78	17.59	6.40	6.38
ARTX2 20A V	-384AUG18	17.58	2.92	320.2	18.71	19.85	21.16	22.30	1.41	91	243	18.56	18.75	5.25	5.80
ARTX2 20A XI	-383FEB12	9.82	2.66	139.3	10.61*	—	—	14.08*	.80	135	251	17.48	17.44	6.56	7.18
ARTX2 21 IV	-383AUG08	10.39	2.91	309.9	11.53*	13.12*	13.29*	14.89*	1.05	55	285	19.01	18.90	5.11	5.98
ARTX2 21 X	-382FEB01	10.58	—	128.1	—	—	—	—	-.44	190	190	17.28	17.28	6.71	7.42
ARTX2 22 III	-382JUN29	13.49	—	271.3	—	—	—	—	-.81	185	185	19.09	19.19	4.81	5.46
ARTX2 22 IV	-382JUL29	.66	—	299.6	—	—	—	—	-.39	353	353	18.66	19.03	4.98	5.12
ARTX2 22 IX	-382DEC23	4.87	2.91	87.2	6.94*	—	—	8.93*	.21	25	321	16.39	17.02	6.98	7.02
ARTX2 23 III	-381JUN18	18.04	3.05	260.7	19.75	—	—	22.67	.49	145	235	18.93	19.18	4.82	5.23
ARTX2 23 IX	-381DEC12	20.00	3.00	76.4	21.24	22.34	23.72	.83	1.48	66	270	16.73	17.06	6.94	7.47
ARTX2 24A III	-380JUN06	18.80	3.08	250.0	19.80	21.00	22.70	23.90	1.77	103	286	18.87	19.11	4.88	5.21
ARTX2 24A IX	-380DEC01	11.29	3.08	65.6	12.58*	—	—	15.95*	1.03	99	229	17.07	17.13	6.87	7.84
ARTX2 25 II	-379MAY26	23.12	3.10	239.5	.74	—	—	3.34	.40	59	337	18.59	19.01	4.98	5.14
ARTX2 25 VIII	-379NOV20	22.12	—	54.6	—	—	—	—	-.35	160	160	16.85	17.25	6.75	7.17
ARTX2 26A I	-378APR17	2.58	2.97	201.2	5.24	—	—	6.17*	-.02	193	222	17.77	18.45	5.54	5.73
ARTX2 26A II	-378MAY16	10.60	—	229.3	—	—	—	—	-.87	21	21	19.07	18.89	5.10	5.57
ARTX2 26A VII	-378OCT11	6.30	—	13.0	—	—	—	—	-.19	331	331	17.56	17.89	6.12	6.11
ARTX2 26A XII2	-377APR06	19.70	2.91	191.1	20.87	22.06	23.23	.42	1.32	136	282	17.95	18.28	5.71	6.01
ARTX2 27 VI	-377SEP30	6.49	3.08	1.7	7.73*	9.24*	9.98*	11.48*	1.12	39	262	17.70	18.08	5.93	5.91
ARTX2 27 XII	-376MAR26	11.02	2.84	180.9	12.01*	13.52*	13.99*	15.50*	1.08	95	323	18.19	18.11	5.88	6.30
ARTX2 28 VI	-376SEP18	12.92	3.03	350.7	14.05*	15.36*	16.37*	17.69*	1.22	80	222	18.16	18.25	5.76	6.48
ARTX2 28 XII	-375MAR15	20.25	—	170.3	—	—	—	—	-.41	29	29	17.62	17.93	6.07	6.24
ARTX2 29A V	-375AUG09	17.35	—	311.3	—	—	—	—	-.93	339	339	18.83	18.88	5.12	5.67
ARTX2 29A VI	-375SEP08	2.29	2.98	340.1	4.55	—	—	5.57	-.01	136	168	18.00	18.44	5.57	5.71
ARTX2 29A XI	-374FEB03	4.36	2.66	129.9	6.46	—	—	7.92*	.05	180	222	16.59	17.30	6.70	6.88
ARTX2 30 IV	-374JUL30	9.98	2.92	301.0	11.91*	—	—	14.15*	.31	18	305	19.13	19.01	5.00	5.91
ARTX2 30 X	-373JAN23	6.40	2.70	118.7	7.17*	8.41*	9.79*	11.03*	1.40	121	275	16.34	17.17	6.83	6.91
ARTX2 31 IV	-373JUL19	22.83	2.94	290.7	23.86	1.01	2.59	3.74	1.63	69	262	18.78	19.11	4.89	5.16
ARTX2 31 X	-372JAN12	15.39	2.76	107.8	16.36*	—	—	19.74	.99	76	310	16.92	17.08	6.91	7.42
ARTX2 32A IV	-372JUL08	4.76	2.98	280.1	6.01*	—	—	9.18*	.63	119	221	18.62	19.18	4.83	4.88
ARTX2 32A IX	-372DEC02	18.97	—	67.0	—	—	—	—	-.95	175	175	16.69	17.12	6.88	7.49
ARTX2 32A X	-371JAN01	5.91	—	97.0	—	—	—	—	-.19	9	9	16.20	17.03	6.97	6.96
ARTX2 33 II	-371MAY28	14.73	—	241.2	—	—	—	—	-.75	7	7	18.99	19.03	4.96	5.37
ARTX2 33 III	-371JUN27	5.66	—	269.4	—	—	—	—	-.77	175	175	18.55	19.19	4.80	4.88
ARTX2 33 VIII	-371NOV22	9.40	3.13	56.1	11.74*	—	—	13.57*	.16	143	201	17.21	17.23	6.78	7.75
ARTX2 34 II	-370MAY17	20.99	3.09	230.7	22.53	—	—	1.77	.78	66	314	18.58	18.90	5.09	5.34
ARTX2 34 VIII	-370NOV11	18.26	3.16	45.0	19.54	20.80	22.12	23.38	1.36	93	244	17.11	17.37	6.63	7.14
ARTX2 35U II	-369MAY07	10.24	3.07	220.5	11.40*	12.51*	13.97*	15.08*	1.54	113	272	18.90	18.77	5.23	5.92
ARTX2 35U VII	-369OCT31	20.02	3.17	33.7	21.23	—	—	.93	1.01	51	281	17.30	17.54	6.47	6.85
ARTX2 36 I	-368APR26	3.28	3.02	210.5	5.17	—	—	7.10*	.21	164	227	17.90	18.60	5.39	5.54
ARTX2 36 VII	-368OCT19	19.42	—	22.2	—	—	—	—	-.21	344	344	17.55	17.72	6.29	6.68
ARTX2 36 XII	-367MAR17	9.42	2.78	171.9	11.45*	—	—	13.23*	.14	45	351	18.10	17.96	6.03	6.58
ARTX2 37A VI	-367SEP09	10.88	2.99	341.5	13.61*	—	—	14.43*	-.03	150	175	18.35	18.41	5.60	6.42
ARTX2 37A XII	-366MAR06	16.41	2.72	161.2	17.18*	18.44	19.88	21.13	1.43	95	299	17.60	17.77	6.22	6.60
ARTX2 38 V	-366AUG30	1.70	2.95	331.0	2.88	4.05	5.25	6.43*	1.34	91	238	18.12	18.59	5.42	5.58
ARTX2 38 XI	-365FEB23	17.16	2.68	150.1	17.94	—	—	21.51	.88	135	256	17.38	17.60	6.40	6.81
ARTX2 39 V	-365AUG19	18.34	2.92	320.6	19.45	20.81	21.53	22.88	1.13	54	279	18.57	18.75	5.26	5.75
ARTX2 39 XI	-364FEB12	18.31	—	139.0	—	—	—	—	-.38	193	193	17.14	17.43	6.57	7.03
ARTX2 40A IV	-364JUL09	20.47	—	281.8	—	—	—	—	-.95	181	181	18.78	19.17	4.83	5.24
ARTX2 40A V	-364AUG08	8.17	—	310.2	—	—	—	—	-.30	349	349	18.30	18.90	5.10	4.94
ARTX2 40A X	-363JAN02	13.61	2.82	98.4	15.61*	—	—	17.58	.21	30	326	16.97	17.03	6.96	7.66
ARTX2 41 III	-363JUN29	.54	3.01	271.1	2.42	—	—	4.97*	.33	147	224	18.71	19.20	4.81	5.02
ARTX2 41 IX	-363DEC23	4.93	2.91	87.6	6.08	7.19*	8.56*	9.67*	1.48	71	275	16.33	17.02	6.98	7.05
ARTX2 42 III	-362JUN18	1.26	3.05	260.4	2.25	3.46	5.14*	6.35*	1.73	103	277	18.68	19.17	4.82	4.98
ARTX2 42 IX	-362DEC12	20.14	3.00	76.8	21.35	—	—	.73	1.03	104	233	16.69	17.06	6.95	7.48
ARTX2 43A III	-361JUN07	5.98	3.08	249.9	7.44*	—	—	10.36*	.55	62	326	18.39	19.11	4.89	4.85
ARTX2 43A IX	-361DEC02	6.65	—	65.8	—	—	—	—	-.35	164	164	16.48	17.14	6.87	6.92
ARTX2 44 I	-360APR27	10.14	—	211.7	—	—	—	—	-.14	206	206	18.76	18.63	5.36	5.97
ARTX2 44 II	-360MAY26	17.90	—	239.7	—	—	—	—	-.72	18	18	18.84	19.02	4.98	5.26
ARTX2 44 VII	-360OCT21	14.15	—	24.1	—	—	—	—	-.22	332	332	17.64	17.69	6.32	6.92
ARTX2 45A I	-359APR17	3.39	2.98	201.7	4.67	5.95*	6.87*	8.14*	1.20	138	277	17.75	18.46	5.54	5.66
ARTX2 45A VII	-359OCT10	14.42	3.12	12.7	15.74*	17.31*	17.87*	19.45	1.09	38	264	17.79	17.88	6.13	6.74
ARTX2 45A XII2	-358APR06	18.55	2.91	191.4	19.57	20.90	21.82	23.16	1.19	99	319	18.03	18.29	5.70	5.97
ARTX2 46 VII	-358SEP29	21.13	3.08	1.7	22.30	23.57	.69	1.96	1.27	78	223	17.81	18.07	5.94	6.31
ARTX2 46 XII	-357MAR27	3.47	—	180.9	—	—	—	—	-.31	29	29	17.51	18.10	5.89	5.93
ARTX3 1 VI	-357SEP19	10.65	3.03	351.0	12.81*	—	—	14.14*	.05	130	172	18.17	18.25	5.76	6.67
ARTX3 1 XI	-356FEB14	11.86	2.66	140.8	14.16*	—	—	15.21*	-.01	189	219	17.42	17.46	6.54	7.04

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ARTX3 2 A V	-356AUG09	17.75	2.91	311.7	19.84	—	—	21.77	.20	9	307	18.77	18.88	5.13	5.65
ARTX3 2 A XI	-355FEB02	14.38	2.66	129.7	15.13*	16.39*	17.71	18.97	1.36	126	277	17.18	17.30	6.69	7.15
ARTX3 3 IV	-355JUL30	6.10	2.92	301.2	7.13*	8.31*	9.79*	10.98*	1.50	61	262	18.50	19.01	4.99	4.94
ARTX3 3 X	-354JAN22	23.88	2.70	118.9	.79	—	—	4.19	1.02	82	314	16.61	17.17	6.82	7.04
ARTX3 4 IV	-354JUL19	11.48	2.94	290.6	12.59*	—	—	15.97*	.76	110	221	19.07	19.11	4.89	5.63
ARTX3 4 IX	-354DEC14	3.91	—	78.2	—	—	—	—	-.95	180	180	16.21	17.05	6.95	7.16
ARTX3 4 X	-353JAN12	14.70	—	108.1	—	—	—	—	-.17	14	13	16.99	17.08	6.91	7.43
ARTX3 5 A III	-353JUN08	21.27	—	251.6	—	—	—	—	-.89	3	3	18.85	19.12	4.87	5.08
ARTX3 5 A IV	-353JUL08	12.18	—	279.8	—	—	—	—	-.62	170	170	19.08	19.17	4.83	5.54
ARTX3 5 A IX	-353DEC03	18.18	3.07	67.3	20.48	—	—	22.29	.16	147	204	16.77	17.12	6.88	7.47
ARTX3 6 II	-352MAY28	3.99	3.09	241.1	5.68*	—	—	8.70*	.64	58	315	18.41	19.03	4.97	4.98
ARTX3 6 VIII	-352NOV22	2.66	3.13	56.2	3.89	5.16	6.46	7.73*	1.35	96	248	16.70	17.24	6.77	6.95
ARTX3 7 II	-351MAY17	17.65	3.09	231.0	18.84	19.93	21.48	22.56	1.67	106	273	18.70	18.91	5.08	5.53
ARTX3 7 VIII	-351NOV11	4.07	3.16	44.8	5.26	—	—	8.98*	1.02	54	283	16.91	17.38	6.62	6.72
ARTX3 8U II	-350MAY07	10.84	3.07	220.9	12.61*	—	—	14.89*	.34	155	231	18.87	18.77	5.22	5.95
ARTX3 8U VII	-350OCT31	3.49	—	33.3	—	—	—	—	-.19	346	346	17.16	17.55	6.46	6.56
ARTX3 8U XII	-349MAR28	16.95	2.85	182.5	19.31	—	—	20.59	.03	37	359	17.96	18.14	5.86	6.18
ARTX3 9 VI	-349SEP20	19.08	3.04	352.4	22.21	—	—	22.27	-.08	160	162	17.93	18.23	5.78	6.25
ARTX3 9 XII	-348MAR16	23.63	2.78	171.9	.48	1.78	3.08	4.39	1.33	93	303	17.52	17.95	6.04	6.23
ARTX3 10A VI	-348SEP09	9.97	2.99	341.9	11.22*	12.43*	13.51*	14.73*	1.27	91	235	18.43	18.40	5.61	6.52
ARTX3 10A XII	-347MAR06	.35	2.72	160.9	1.11	—	—	4.80	.97	133	260	17.30	17.77	6.23	6.45
ARTX3 11 V	-347AUG30	2.41	2.95	331.4	3.52	4.79	5.74*	7.01*	1.21	55	274	18.14	18.58	5.42	5.54
ARTX3 11 XI	-346FEB23	1.91	—	149.9	—	—	—	—	-.30	195	195	17.01	17.59	6.41	6.65
ARTX3 12 V	-346AUG19	15.78	—	320.9	—	—	—	—	-.21	347	346	18.70	18.74	5.26	5.82
ARTX3 12 X	-345JAN13	22.27	2.75	109.5	.21	—	—	2.14	.20	34	332	16.66	17.09	6.90	7.21
ARTX3 13A IV	-345JUL10	7.10	2.97	281.6	9.18*	—	—	11.24*	.18	151	211	18.46	19.17	4.83	4.83
ARTX3 13A X	-344JAN03	13.79	2.82	98.8	14.86*	15.97*	17.34	18.45	1.47	76	281	16.94	17.04	6.96	7.72
ARTX3 14 III	-344JUN28	7.79	3.01	270.9	8.77*	10.00*	11.60*	12.82*	1.58	103	267	18.46	19.20	4.81	4.76
ARTX3 14 IX	-344DEC23	4.94	2.91	88.0	6.06	—	—	9.45*	1.03	109	238	16.31	17.02	6.98	7.09
ARTX3 15 III	-343JUN17	12.89	3.05	260.3	14.23*	—	—	17.39*	.70	63	316	19.21	19.18	4.82	5.36
ARTX3 15 IX	-343DEC12	15.16	—	77.0	—	—	—	—	-.36	169	169	16.82	17.05	6.95	7.69
ARTX3 16A II	-342MAY08	17.65	—	222.2	—	—	—	—	-.26	204	204	18.54	18.79	5.21	5.64
ARTX3 16A III	-342JUN07	1.22	—	250.1	—	—	—	—	-.58	14	14	18.58	19.11	4.88	4.95
ARTX3 16A VIII	-342NOV01	22.11	—	35.2	—	—	—	—	-.24	334	334	17.31	17.52	6.49	6.79
ARTX3 17 I	-341APR28	10.98	3.03	212.2	12.38*	13.86*	14.27*	15.75*	1.07	141	271	18.74	18.64	5.36	5.90
ARTX3 17 VII	-341OCT21	22.49	3.16	23.8	23.86	1.51	1.87	3.53	1.06	39	266	17.45	17.70	6.31	6.61
ARTX3 18A I	-340APR17	1.96	2.98	202.0	3.01	4.25	5.45	6.69*	1.31	101	315	17.88	18.46	5.53	5.64
ARTX3 18A VII	-340OCT10	5.49	3.13	12.7	6.70*	7.94*	9.13*	10.37*	1.30	78	225	17.45	17.89	6.12	6.13
ARTX3 18A XII2	-339APR06	10.52	—	191.5	—	—	—	—	-.20	29	29	18.38	18.30	5.70	6.06
ARTX3 19 VI	-339SEP29	19.14	3.08	2.0	21.24	—	—	22.77	.10	126	175	17.79	18.06	5.94	6.45
ARTX3 19 XI	-338FEB24	19.20	—	151.6	—	—	—	—	-.09	207	207	17.31	17.62	6.37	6.72
ARTX3 20 V	-338AUG21	1.64	2.92	322.4	3.91	—	—	5.50*	.10	0	310	18.42	18.73	5.28	5.42
ARTX3 20 XI	-337FEB13	22.23	2.66	140.6	22.99	.28	1.51	2.80	1.31	130	279	17.00	17.45	6.54	6.81
ARTX3 21A V	-337AUG10	13.46	2.91	311.9	14.52*	15.75*	17.10*	18.33*	1.39	54	262	18.82	18.87	5.13	5.82
ARTX3 21A XI	-336FEB03	8.26	2.66	129.9	9.11*	10.65*	11.01*	12.55*	1.06	87	316	16.32	17.29	6.70	6.68
ARSES 1 IV	-336JUL29	18.29	2.92	301.2	19.32	—	—	22.87	.89	101	222	18.79	19.01	5.00	5.46
ARSES 1 IX	-336DEC24	12.82	—	89.4	—	—	—	—	-.96	185	185	16.86	17.02	6.98	7.82
ARSES 1 X	-335JAN22	23.38	—	119.2	—	—	—	—	-.14	18	18	16.63	17.18	6.82	7.02
ARSES 2 IV	-335JUL18	18.81	—	290.3	—	—	—	—	-.48	165	166	18.84	19.11	4.89	5.35
ARSES 2 IX	-335DEC14	2.94	2.99	78.6	5.17	—	—	6.96	.15	152	209	16.34	17.05	6.95	7.17
DARI3 1A III	-334JUN08	11.02	3.08	251.5	12.82*	—	—	15.59*	.50	48	317	19.23	19.13	4.87	5.54
DARI3 1A IX	-334DEC03	11.05	3.07	67.4	12.23*	13.51*	14.80*	16.08*	1.34	101	252	17.07	17.12	6.89	7.66
DARI3 2 II	-333MAY29	1.05	3.08	241.4	2.24	3.31	4.90	5.97*	1.81	99	274	18.48	19.03	4.96	5.13
DARI3 2 VIII	-333NOV22	12.16	3.13	56.0	13.32*	—	—	17.05*	1.03	58	287	17.18	17.23	6.77	7.45
DARI3 3 II	-332MAY17	18.34	3.09	231.4	20.00	—	—	22.57	.47	146	233	18.65	18.91	5.08	5.55
DARI3 3 VIII	-332NOV10	11.64	—	44.5	—	—	—	—	-.18	348	348	17.39	17.38	6.63	7.32
DARI3 4U I	-331APR08	.33	—	193.1	—	—	—	—	-.09	18	18	17.84	18.31	5.68	5.79
DARI3 4U II	-331MAY07	10.30	—	221.3	—	—	—	—	-.97	193	193	18.86	18.78	5.22	5.97
DARI3 4U VI2	-331OCT01	3.42	—	3.4	—	—	—	—	-.11	162	162	17.50	18.05	5.96	6.07
DARI3 4U XII	-330MAR28	6.68	2.85	182.5	7.66*	9.05*	10.11*	11.50*	1.22	89	307	17.44	18.13	5.87	5.88
DARI3 5 VI	-330SEP20	18.37	3.04	352.8	19.69	20.94	21.91	23.16	1.22	92	232	17.98	18.22	5.79	6.31
DARI3 5 XII	-329MAR17	7.37	2.78	171.6	8.16*	9.79*	10.31*	11.95*	1.08	131	265	17.23	17.94	6.05	6.10
ALEXG 1A VI	-329SEP10	10.61	2.99	342.3	11.73*	12.96*	14.05*	15.27*	1.27	55	271	18.45	18.39	5.61	6.48
ALEXG 1A XII	-328MAR05	9.38	—	160.7	—	—	—	—	-.21	197	197	17.85	17.77	6.22	6.87
ALEXG 2 V	-328AUG29	23.50	—	331.7	—	—	—	—	-.14	344	344	18.30	18.58	5.43	5.66
ALEXG 2 X	-327JAN24	6.84	2.69	120.6	8.76*	—	—	10.61*	.18	37	337	16.35	17.19	6.81	6.77
ALEXG 3 IV	-327JUL20	13.74	2.93	292.1	16.12*	—	—	17.54*	.04	156	197	18.98	19.10	4.91	5.52
ALEXG 3 X	-326JAN13	22.57	2.74	109.9	23.57	.69	2.04	3.16	1.45	80	286	16.60	17.09	6.90	7.25
ALEXG 4A IV	-326JUL09	14.40	2.97	281.3	15.39*	16.65*	18.11*	19.37	1.43	103	258	19.08	19.17	4.83	5.38
ALEXG 4A X	-325JAN03	13.67	2.82	99.2	14.69*	—	—	18.10	1.04	113	244	16.91	17.04	6.96	7.73
ALEXG 5 III	-325JUN28	19.88	3.01	270.8	21.10	—	—	.45	.85	64	306	18.93	19.19	4.81	5.13
ALEXG 5 IX	-325DEC23	23.60	—	88.2	—	—	—	—	-.35	174	174	16.50	17.02	6.98	7.36

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
ALEXG 6 II	-324MAY19	1.12	—	232.6	—	—	—	—	-.39	201	201	18.29	18.93	5.07	5.30
ALEXG 6 III	-324JUN17	8.58	—	260.6	—	—	—	—	-.44	9	9	18.29	19.17	4.82	4.63
ALEXG 6 VIII	-324NOV12	6.14	—	46.4	—	—	—	—	-.26	337	337	16.97	17.36	6.64	6.65
ALEXG 7A II	-323MAY08	18.49	3.07	222.6	20.00	—	—	23.26	.94	143	265	18.52	18.79	5.20	5.57
ALEXG 7A VIII	-323NOV01	6.68	3.17	34.9	8.07*	9.83*	9.96*	11.72*	1.04	40	269	17.10	17.53	6.48	6.46
PILIP 1 I	-322APR28	9.24	3.03	212.5	10.32*	11.50*	12.89*	14.08*	1.44	103	309	18.82	18.64	5.35	5.86
PILIP 1 VII	-322OCT21	13.98	3.16	23.8	15.23*	16.46*	17.68	18.90	1.33	78	227	17.57	17.69	6.32	7.04
PILIP 2A I	-321APR17	17.43	2.98	202.0	20.03	—	—	20.34	-.07	32	23	18.28	18.47	5.52	5.76
PILIP 2A VII	-321OCT11	3.75	3.13	13.1	5.85	—	—	7.51*	.13	124	178	17.41	17.88	6.13	6.22
PILIP 2A XII	-320MAR07	2.42	—	162.4	—	—	—	—	-.17	208	208	17.22	17.79	6.20	6.41
PILIP 3 V	-320AUG31	9.64	2.96	333.1	12.14*	—	—	13.34*	.02	352	314	18.64	18.55	5.46	6.37
PILIP 3 XI	-319FEB24	5.96	2.68	151.5	6.78*	8.10*	9.21*	10.53*	1.25	135	279	16.84	17.61	6.38	6.48
PILIP 4 V	-319AUG20	20.93	2.92	322.6	22.03	23.32	.51	1.80	1.29	48	262	18.50	18.72	5.29	5.64
PILIP 4 XI	-318FEB13	16.52	2.66	140.8	17.37	18.77	19.44	20.84	1.12	92	317	17.26	17.45	6.54	6.91
PILIP 5A V	-318AUG10	1.21	2.91	311.8	2.16	—	—	5.85*	1.01	94	222	18.52	18.88	5.13	5.31
PILIP 5A X	-317JAN04	21.66	—	100.6	—	—	—	—	-.97	190	190	16.46	17.04	6.96	7.43
PILIP 5A XI	-317FEB03	7.95	—	130.2	—	—	—	—	-.10	22	22	16.31	17.30	6.69	6.62
PILIP 6 IV	-317JUL30	1.56	—	300.9	—	—	—	—	-.35	161	161	18.58	19.01	4.99	5.18
PILIP 6 IX	-317DEC25	11.64	2.90	89.8	13.80*	—	—	15.55*	.14	158	213	16.95	17.02	6.98	7.77
PILIP 7 III	-316JUN18	18.11	3.05	262.0	20.05	—	—	22.52	.37	38	318	19.01	19.18	4.82	5.23
PILIP 7 IX	-316DEC13	19.42	2.99	78.6	20.51	21.79	23.08	.36	1.34	105	256	16.70	17.05	6.96	7.41
ALEX4 1A III	-315JUN08	8.45	3.08	251.8	9.66*	10.72*	12.32*	13.38*	1.83	91	274	18.23	19.12	4.87	4.72
ALEX4 1A IX	-315DEC02	20.27	3.07	67.2	21.35	—	—	1.09	1.04	62	291	16.82	17.12	6.88	7.27
ALEX4 2 II	-314MAY29	1.81	3.09	241.8	3.37	—	—	6.17*	.60	137	235	18.42	19.04	4.96	5.14
ALEX4 2 VIII	-314NOV21	19.87	—	55.7	—	—	—	—	-.16	352	352	17.00	17.24	6.77	7.16
ALEX4 3 I	-313APR19	7.57	—	203.6	—	—	—	—	-.22	17	17	17.72	18.49	5.51	5.41
ALEX4 3 II	-313MAY18	17.56	—	231.7	—	—	—	—	-.85	190	190	18.68	18.92	5.08	5.60
ALEX4 3 VII	-313OCT12	11.91	—	14.5	—	—	—	—	-.14	162	162	17.74	17.85	6.16	6.97
ALEX4 4U I	-312APR07	13.58	2.92	193.0	14.68*	16.26*	16.85*	18.43	1.09	85	310	18.27	18.32	5.67	6.09
ALEX4 4U VI2	-312OCT01	2.91	3.09	3.8	4.29	5.58	6.44*	7.73*	1.18	93	231	17.53	18.04	5.97	6.09
ALEX4 4U XII	-311MAR27	14.26	2.85	182.2	15.07*	16.50*	17.52*	18.96	1.20	127	269	18.04	18.13	5.86	6.30
ALEX4 5 VI	-311SEP20	18.92	3.04	353.2	20.09	21.28	22.46	23.66	1.32	56	269	18.01	18.21	5.79	6.27
ALEX4 5 XII	-310MAR16	16.72	—	171.4	—	—	—	—	-.11	198	198	17.75	17.95	6.05	6.50
S.E. 1A VI	-310SEP10	7.35	—	342.5	—	—	—	—	-.09	343	343	17.91	18.40	5.60	5.51
S.E. 1A XI	-309FEB04	15.29	2.66	131.6	17.24*	—	—	18.98	.14	38	343	17.20	17.33	6.67	7.16
S.E. 2 IV	-309JUL31	20.48	—	302.6	—	—	—	—	-.09	173	173	18.66	18.99	5.01	5.38
S.E. 2 X	-308JAN25	7.25	2.69	121.0	8.20*	9.33*	10.64*	11.77*	1.42	83	291	16.29	17.19	6.80	6.78
S.E. 3 IV	-308JUL19	21.13	2.93	291.8	22.14	23.48	.70	2.04	1.29	103	250	18.78	19.10	4.90	5.23
S.E. 3 X	-307JAN13	22.30	2.74	110.3	23.25	.83	1.09	2.68	1.05	118	249	16.61	17.10	6.90	7.29
S.E. 4A IV	-307JUL09	2.97	2.97	281.2	4.09	—	—	7.58*	.99	64	297	18.63	19.17	4.83	4.90
S.E. 4A X	-306JAN03	7.96	—	99.3	—	—	—	—	-.35	179	179	16.22	17.04	6.96	7.02
S.E. 5 II	-306MAY30	8.58	—	243.1	—	—	—	—	-.52	197	197	18.02	19.05	4.95	4.95
S.E. 5 III	-306JUN28	15.99	—	271.0	—	—	—	—	-.30	5	5	19.14	19.19	4.81	5.28
S.E. 5 VIII	-306NOV23	14.22	—	57.5	—	—	—	—	-.27	341	341	17.15	17.22	6.79	7.41
S.E. 6 II	-305MAY20	1.94	3.09	233.1	3.56	—	—	6.67*	.80	144	257	18.28	18.93	5.06	5.23
S.E. 6 VIII	-305NOV12	14.96	3.16	46.1	16.35*	—	—	19.98	1.03	43	272	17.24	17.36	6.65	7.29
S.E. 7A II	-304MAY08	16.42	3.07	222.9	17.54*	18.69*	20.21	21.36	1.57	105	302	18.65	18.80	5.20	5.55
S.E. 7A VIII	-304OCT31	22.58	3.17	35.0	23.83	1.05	2.29	3.51	1.34	80	229	17.20	17.52	6.48	6.83
S.E. 8 I	-303APR28	.21	3.03	212.5	2.29	—	—	3.80	.06	48	4	18.18	18.63	5.36	5.47
S.E. 8 VII	-303OCT21	12.49	3.16	24.2	14.57*	—	—	16.32*	.15	124	181	17.56	17.69	6.32	7.19
S.E. 8 XII	-302MAR18	9.48	—	173.1	—	—	—	—	-.27	209	209	18.06	17.98	6.01	6.51
S.E. 9A VI	-302SEP11	17.76	3.00	344.0	20.58	—	—	21.24	-.05	341	321	18.27	18.37	5.64	6.16
S.E. 9A XII	-301MAR07	13.56	2.73	162.3	14.45*	15.85*	16.74*	18.14	1.17	139	278	17.73	17.80	6.20	6.61
S.E. 10 V	-301SEP01	4.52	2.96	333.3	5.69*	7.06*	8.04*	9.41*	1.20	43	262	18.19	18.55	5.45	5.49
S.E. 10 XI	-300FEB25	.66	2.68	151.7	1.49	2.80	3.70	5.01	1.19	96	317	17.03	17.62	6.38	6.54
S.E. 11 V	-300AUG20	8.25	2.92	322.4	9.19*	10.74*	11.42*	12.98*	1.11	87	223	18.24	18.73	5.28	5.18
S.E. 11 XI	-299FEB13	16.39	2.66	141.2	18.56	—	—	19.22	-.05	35	14	17.28	17.46	6.53	6.88
S.E. 12A V	-299AUG09	8.45	—	311.5	—	—	—	—	-.22	158	158	18.31	18.89	5.12	5.03
S.E. 12A X	-298JAN04	20.26	2.81	100.9	22.37	—	—	.06	.12	164	217	16.59	17.04	6.95	7.41
S.E. 13 III	-298JUN30	1.27	3.00	272.4	3.35	—	—	5.47*	.24	27	320	18.76	19.19	4.81	4.92
S.E. 13 IX	-298DEC25	3.71	2.90	89.8	4.72	6.02	7.29*	8.58*	1.33	111	261	16.35	17.02	6.98	7.14
S.E. 14 III	-297JUN19	15.90	3.04	262.2	17.08*	18.15*	19.71	20.78	1.69	82	273	19.07	19.18	4.82	5.40
S.E. 14 IX	-297DEC14	4.36	2.99	78.4	5.37	7.13*	7.36*	9.12*	1.05	67	295	16.46	17.05	6.95	7.06
S.E. 15A III	-296JUN08	9.27	3.08	252.2	10.72*	—	—	13.73*	.74	128	236	19.28	19.13	4.86	5.77
S.E. 15A IX	-296DEC02	4.12	—	66.9	—	—	—	—	-.15	356	356	16.61	17.13	6.88	6.96
S.E. 16 I	-295APR29	14.69	—	214.1	—	—	—	—	-.36	15	15	18.61	18.67	5.33	5.72
S.E. 16 II	-295MAY29	.76	—	242.1	—	—	—	—	-.72	186	186	18.48	19.04	4.96	5.22
S.E. 16 VII	-295OCT22	20.52	—	25.6	—	—	—	—	-.15	164	164	17.30	17.67	6.34	6.78
S.E. 17 I	-294APR18	20.33	2.99	203.6	21.58	—	—	1.20	.95	79	314	18.20	18.49	5.50	5.75
S.E. 17 VII	-294OCT12	11.57	3.13	14.8	13.00*	14.33*	15.09*	16.41*	1.15	94	231	17.80	17.84	6.17	7.03
S.E. 18U I	-293APR07	21.01	2.92	192.8	21.87	23.20	.51	1.84	1.33	123	272	17.98	18.31	5.68	5.96
S.E. 18U VI2	-293OCT02	3.36	3.09	4.2	4.56	5.74	6.98*	8.16*	1.36	57	267	17.57	18.03	5.98	6.07

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 18U XII	-292MAR26	23.95	2.85	182.0	1.97	—	—	3.14	.01	181	215	17.65	18.12	5.87	6.13
S.E. 19 VI	-292SEP20	15.32	3.04	353.4	17.77*	—	—	18.56	-.04	354	330	18.15	18.21	5.80	6.38
S.E. 19 XI	-291FEB14	23.63	2.66	142.5	1.67	—	—	3.24	.10	39	349	16.96	17.48	6.52	6.71
S.E. 20A V	-291AUG11	3.34	—	313.3	—	—	—	—	-.21	169	169	18.34	18.86	5.15	5.26
S.E. 20A XI	-290FEB04	15.80	2.66	132.0	16.74*	17.88	19.15	20.30	1.38	86	296	17.16	17.33	6.66	7.20
S.E. 21 IV	-290JUL31	3.99	2.91	302.4	5.04*	6.50*	7.39*	8.85*	1.16	103	242	18.47	19.00	5.01	5.08
S.E. 21 X	-289JAN25	6.81	2.69	121.4	7.68*	9.17*	9.65*	11.14*	1.08	121	254	16.34	17.20	6.80	6.85
S.E. 22 IV	-289JUL20	10.17	2.93	291.8	11.22*	12.67*	13.38*	14.82*	1.12	64	289	19.21	19.10	4.91	5.67
S.E. 22 X	-288JAN14	16.20	—	110.4	—	—	—	—	-.33	183	183	16.85	17.10	6.89	7.52
S.E. 23A III	-288JUN09	16.03	—	253.5	—	—	—	—	-.65	193	193	18.95	19.14	4.86	5.44
S.E. 23A IV	-288JUL08	23.49	—	281.5	—	—	—	—	-.17	0	0	18.78	19.17	4.83	5.01
S.E. 23A IX	-288DEC03	22.32	—	68.7	—	—	—	—	-.28	345	345	16.83	17.11	6.89	7.20
S.E. 24 II	-287MAY30	9.35	3.09	243.5	11.09*	—	—	14.00*	.66	146	248	19.24	19.06	4.94	5.68
S.E. 24 VIII	-287NOV22	23.31	3.12	57.3	.67	—	—	4.29	1.03	46	276	16.89	17.22	6.78	7.09
S.E. 25 II	-286MAY19	23.52	3.09	233.3	.64	1.76	3.38	4.50	1.71	106	295	18.46	18.94	5.06	5.24
S.E. 25 VIII	-286NOV12	7.25	3.16	46.2	8.52*	9.72*	10.98*	12.19*	1.35	82	232	16.80	17.37	6.64	6.60
S.E. 26A II	-285MAY09	6.88	3.07	222.9	8.70*	—	—	10.82*	.20	55	352	18.07	18.79	5.20	5.17
S.E. 26A VIII	-285NOV01	21.30	3.17	35.3	23.39	—	—	1.19	.17	125	184	17.16	17.52	6.49	6.94
S.E. 26A XII2	-284MAR28	16.41	—	183.7	—	—	—	—	-.38	209	209	17.98	18.16	5.83	6.21
S.E. 27 VI	-284SEP22	2.00	—	354.9	—	—	—	—	-.11	331	331	17.92	18.19	5.82	5.96
S.E. 27 XII	-283MAR17	21.04	2.79	173.0	22.06	23.60	.11	1.66	1.08	143	276	17.60	17.97	6.02	6.28
S.E. 28A VI	-283SEP11	12.23	3.00	344.2	13.46*	14.94*	15.65*	17.12*	1.12	39	263	18.33	18.36	5.64	6.36
S.E. 28A XII	-282MAR07	8.67	2.73	162.5	9.54*	10.78*	11.87*	13.11*	1.27	100	317	16.83	17.79	6.21	6.18
S.E. 29 V	-282AUG31	15.43	2.96	333.2	16.36*	17.79*	18.80	20.23	1.20	82	224	18.41	18.55	5.46	6.01
S.E. 29 XI	-281FEB25	.70	2.68	152.0	2.66	—	—	3.79	.01	45	9	17.03	17.62	6.37	6.49
S.E. 30 V	-281AUG20	15.50	—	322.1	—	—	—	—	-.12	155	155	18.54	18.72	5.28	5.85
S.E. 30 X	-280JAN16	4.77	2.73	112.0	6.86	—	—	8.45*	.09	170	219	16.27	17.11	6.89	7.06
S.E. 31A IV	-280JUL10	8.52	2.96	282.9	10.80*	—	—	12.49*	.12	15	323	18.50	19.16	4.84	4.62
S.E. 31A X	-279JAN04	11.92	2.81	100.9	12.84*	14.14*	15.39*	16.69*	1.31	116	265	16.99	17.05	6.95	7.58
S.E. 32 III	-279JUN29	23.39	3.00	272.7	.57	1.67	3.14	4.24	1.56	74	272	18.78	19.19	4.81	5.05
S.E. 32 IX	-279DEC24	12.40	2.90	89.5	13.31*	15.00*	15.39*	17.08	1.06	72	299	16.97	17.02	6.98	7.57
S.E. 33 III	-278JUN19	16.73	3.04	262.7	18.08*	—	—	21.25	.87	119	236	19.00	19.18	4.82	5.40
S.E. 33 IX	-278DEC13	12.38	—	78.1	—	—	—	—	-.14	1	1	17.03	17.05	6.95	7.57
S.E. 34A II	-277MAY10	21.69	—	224.5	—	—	—	—	-.51	12	12	18.48	18.82	5.18	5.35
S.E. 34A III	-277JUN09	7.92	—	252.6	—	—	—	—	-.59	182	182	18.28	19.13	4.87	4.85
S.E. 34A VIII	-277NOV03	5.22	—	36.7	—	—	—	—	-.16	166	166	16.84	17.50	6.51	6.57
S.E. 35 I	-276APR29	2.96	3.04	214.0	4.36	—	—	7.81*	.81	72	317	18.12	18.66	5.34	5.41
S.E. 35 VII	-276OCT22	20.32	3.16	26.0	21.81	23.16	23.85	1.20	1.13	96	232	17.33	17.66	6.34	6.80
S.E. 36 I	-275APR18	3.66	2.98	203.3	4.56	5.83*	7.34*	8.60*	1.47	117	275	17.91	18.48	5.51	5.62
S.E. 36 VII	-275OCT12	11.91	3.14	15.2	13.14*	14.31*	15.59*	16.76*	1.38	58	267	17.82	17.83	6.17	6.99
S.E. 37 U I	-274APR07	7.07	2.92	192.6	8.86*	—	—	10.66*	.13	171	225	17.54	18.30	5.69	5.76
S.E. 37U VI2	-274OCT01	23.40	3.09	4.4	1.77	—	—	2.84	-.01	358	326	17.75	18.03	5.98	6.23
S.E. 37U XI	-273FEB26	7.84	2.69	153.4	10.03*	—	—	11.34*	.04	37	355	16.74	17.64	6.35	6.27
S.E. 38 V	-273AUG22	10.34	—	323.9	—	—	—	—	-.32	166	166	18.63	18.69	5.31	6.05
S.E. 38 XI	-272FEB16	.23	2.66	142.9	1.18	2.35	3.54	4.72	1.34	87	300	16.92	17.48	6.51	6.73
S.E. 39A V	-272AUG10	11.01	2.91	313.0	12.12*	13.85*	14.09*	15.82*	1.05	104	235	18.84	18.85	5.15	5.87
S.E. 39A XI	-271FEB04	15.18	2.66	132.4	16.01*	17.43	18.09	19.51	1.12	123	258	17.18	17.34	6.66	7.23
S.E. 40 IV	-271JUL30	17.52	2.91	302.3	18.52*	19.82	20.89	22.20	1.24	64	281	18.84	18.99	5.01	5.49
S.E. 40 X	-270JAN25	.31	—	121.5	—	—	—	—	-.31	188	188	16.65	17.20	6.79	7.12
S.E. 41 III	-270JUN20	23.52	—	263.9	—	—	—	—	-.78	188	188	18.62	19.19	4.81	5.12
S.E. 41 IV	-270JUL20	7.08	2.93	292.0	9.45*	—	—	10.16*	-.05	7	345	18.40	19.10	4.90	4.75
S.E. 41 IX	-270DEC15	6.41	—	79.9	—	—	—	—	-.28	350	350	16.51	17.04	6.96	6.96
S.E. 42A III	-269JUN10	16.75	3.07	253.9	18.60*	—	—	21.28	.52	147	239	18.94	19.14	4.86	5.36
S.E. 42A IX	-269DEC04	7.68	3.06	68.5	8.99*	—	—	12.60*	1.03	50	280	16.53	17.12	6.89	6.85
S.E. 43 II	-268MAY30	6.56	3.09	243.8	7.69*	8.82*	10.46*	11.58*	1.85	107	287	18.26	19.05	4.94	4.94
S.E. 43 VIII	-268NOV22	15.99	3.13	57.4	17.22	18.42	19.68	20.88	1.36	86	236	17.02	17.22	6.79	7.48
S.E. 44 II	-267MAY19	13.48	3.09	233.3	15.12*	—	—	17.68*	.35	60	341	18.93	18.94	5.05	5.44
S.E. 44 VIII	-267NOV12	6.19	3.16	46.5	8.25*	—	—	10.08*	.18	128	187	16.75	17.36	6.65	6.65
S.E. 45A I	-266APR08	23.23	—	194.3	—	—	—	—	-.50	209	209	17.90	18.33	5.66	5.92
S.E. 45A VII	-266OCT03	10.36	—	5.9	—	—	—	—	-.16	331	331	18.05	17.99	6.02	6.89
S.E. 45A XII2	-265MAR29	4.40	2.86	183.6	5.54	—	—	9.03*	.98	146	272	17.47	18.15	5.84	5.96
S.E. 46 VI	-265SEP22	20.06	3.05	355.1	21.38	23.02	23.36	1.00	1.06	37	265	18.00	18.18	5.83	6.22
S.E. 46 XII	-264MAR17	16.57	2.79	173.2	17.47*	18.65	19.91	21.09	1.36	104	315	17.80	17.98	6.01	6.34
S.E. 47A VI	-264SEP10	22.76	3.00	344.0	23.71	1.07	2.28	3.63	1.28	78	225	18.10	18.37	5.63	5.91
S.E. 47A XII	-263MAR07	8.87	2.73	162.8	10.69*	—	—	12.19*	.09	52	5	16.80	17.79	6.20	6.12
S.E. 48 V	-263AUG30	22.71	2.95	332.9	.94	—	—	1.93	-.02	139	167	18.24	18.56	5.45	5.74
S.E. 48 X	-262JAN26	13.15	2.68	123.1	15.27*	—	—	16.70*	.06	177	221	17.13	17.22	6.77	7.36
S.E. 49 IV	-262JUL21	15.89	2.93	293.4	18.43*	—	—	19.53	.00	2	328	19.03	19.09	4.92	5.49
S.E. 49 X	-261JAN15	20.02	2.73	112.0	20.87	22.20	23.39	.72	1.28	121	269	16.74	17.11	6.88	7.25
S.E. 50A IV	-261JUL11	6.96	2.96	283.2	8.14*	9.27*	10.61*	11.75*	1.44	66	272	18.47	19.16	4.84	4.70
S.E. 50A X	-260JAN04	20.36	2.81	100.7	21.19	22.81	23.35	.97	1.08	78	303	16.69	17.04	6.95	7.29
S.E. 51 III	-260JUN30	.23	3.00	273.1	1.48	—	—	4.79	1.00	110	236	18.71	19.19	4.81	5.0

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 51 IX	-260DEC23	20.62	—	89.3	—	—	—	—	-.13	6	6	16.69	17.02	6.98	7.31
S.E. 52 II	-259MAY21	4.62	—	235.0	—	—	—	—	-.66	9	9	18.34	18.95	5.04	4.99
S.E. 52 III	-259JUN19	15.07	—	263.0	—	—	—	—	-.47	177	177	19.03	19.18	4.81	5.48
S.E. 52 VIII	-259NOV13	14.00	—	47.9	—	—	—	—	-.15	169	169	17.14	17.33	6.67	7.45
S.E. 53A II	-258MAY10	9.50	3.08	224.4	11.07*	—	—	14.29*	.65	64	320	18.94	18.82	5.17	5.74
S.E. 53A VIII	-258NOV03	5.17	3.17	37.1	6.68*	8.05*	8.69*	10.06*	1.12	99	233	16.85	17.50	6.51	6.55
S.E. 54 I	-257APR29	10.22	3.04	213.7	11.17*	12.39*	14.03*	15.25*	1.62	111	278	18.73	18.66	5.33	5.89
S.E. 54 VII	-257OCT23	20.55	3.17	26.4	21.81	22.98	.28	1.44	1.40	60	268	17.37	17.66	6.35	6.77
S.E. 55 I	-256APR17	14.11	2.98	203.1	15.77*	—	—	18.03*	.26	162	231	18.41	18.49	5.50	6.02
S.E. 55 VII	-256OCT12	7.60	3.14	15.4	9.92*	—	—	11.15*	.02	1	324	17.35	17.84	6.16	6.09
S.E. 55 XII	-255MAR08	15.92	2.74	164.2	18.37	—	—	19.27	-.02	31	3	17.69	17.83	6.17	6.56
S.E. 56U I	-255APR07	1.04	—	192.7	—	—	—	—	-.97	198	198	17.73	18.31	5.69	5.96
S.E. 56U VI	-255SEP01	17.49	—	334.7	—	—	—	—	-.41	164	164	18.28	18.52	5.48	5.95
S.E. 56U XI	-254FEB26	8.51	2.69	153.8	9.50*	10.71*	11.80*	13.01*	1.27	88	304	16.69	17.64	6.35	6.28
S.E. 57 V	-254AUG21	18.19	2.93	323.7	19.38	—	—	22.97	.95	104	229	18.48	18.70	5.31	5.75
S.E. 57 XI	-253FEB15	23.40	2.66	143.3	.20	1.55	2.40	3.75	1.17	125	263	16.98	17.49	6.51	6.79
S.E. 58A V	-253AUG11	1.01	2.91	313.0	2.00	3.23	4.50	5.73*	1.35	64	274	18.46	18.86	5.14	5.32
S.E. 58A XI	-252FEB05	8.26	—	132.4	—	—	—	—	-.27	191	191	16.48	17.33	6.66	6.74
S.E. 59 III	-252JUL01	7.07	—	274.4	—	—	—	—	-.90	184	184	18.26	19.19	4.81	4.80
S.E. 59 IV	-252JUL30	14.78	2.91	302.6	16.81*	—	—	18.22*	.07	14	330	18.98	18.99	5.02	5.65
S.E. 59 IX	-252DEC25	14.46	—	91.1	—	—	—	—	-.30	355	355	16.93	17.02	6.98	7.54
S.E. 60 III	-251JUN21	.15	3.03	264.4	2.11	—	—	4.52	.38	148	228	18.63	19.19	4.81	5.05
S.E. 60 IX	-251DEC14	16.07	2.98	79.7	17.30	—	—	20.90	1.03	55	285	16.87	17.04	6.96	7.56
S.E. 61A III	-250JUN10	13.57	3.07	254.2	14.68*	15.82*	17.44*	18.57*	1.73	107	278	19.12	19.14	4.85	5.40
S.E. 61A IX	-250DEC04	.76	3.06	68.6	1.94	3.13	4.40	5.59	1.36	90	241	16.63	17.11	6.89	7.18
S.E. 62 II	-249MAY30	20.02	3.09	243.7	21.47	—	—	.40	.51	63	330	18.78	19.06	4.94	5.19
S.E. 62 VIII	-249NOV23	15.12	3.12	57.7	17.16	—	—	18.99	.18	131	191	17.00	17.21	6.79	7.61
S.E. 63 I	-248APR19	5.95	—	204.8	—	—	—	—	-.63	207	207	17.80	18.51	5.49	5.63
S.E. 63 II	-248MAY18	21.12	—	233.1	—	—	—	—	-.91	20	20	18.63	18.93	5.06	5.21
S.E. 63 VII	-248OCT13	18.83	—	17.0	—	—	—	—	-.20	332	332	17.68	17.81	6.20	6.68
S.E. 64A I	-247APR08	11.67	2.93	194.2	12.97*	—	—	16.34*	.87	149	268	18.37	18.34	5.65	6.11
S.E. 64A VII	-247OCT03	4.02	3.10	6.0	5.40	—	—	8.97*	1.01	35	266	17.67	18.00	6.01	6.08
S.E. 64A XII2	-246MAR29	.34	2.86	183.8	1.31	2.44	3.83	4.97	1.46	107	312	17.61	18.15	5.84	5.99
S.E. 65 VI	-246SEP22	6.23	3.05	354.9	7.21*	8.53*	9.86*	11.18*	1.34	75	226	17.80	18.19	5.82	5.81
S.E. 65 XII	-245MAR18	16.91	2.79	173.6	18.64	—	—	20.45	.17	59	360	17.80	17.98	6.01	6.29
S.E. 66A VI	-245SEP11	6.10	3.00	343.7	8.12*	—	—	9.64*	.06	129	173	17.93	18.38	5.62	5.63
S.E. 66A XI	-244FEB06	21.38	2.66	134.1	23.62	—	—	.78	.01	185	220	16.90	17.36	6.64	6.99
S.E. 67 IV	-244JUL31	23.40	—	304.0	—	—	—	—	-.10	341	341	18.71	18.98	5.03	5.25
S.E. 67 X	-243JAN26	3.97	2.68	123.1	4.78	6.14	7.26*	8.62*	1.24	127	272	16.52	17.22	6.78	6.93
S.E. 68 IV	-243JUL21	14.62	2.93	293.7	15.80*	16.99*	18.16*	19.35	1.32	58	271	19.03	19.08	4.92	5.62
S.E. 68 X	-242JAN15	4.23	2.74	111.8	4.96	6.51	7.22*	8.78*	1.11	83	307	16.45	17.11	6.89	7.00
S.E. 69A IV	-242JUL11	7.77	2.96	283.6	8.94*	10.32*	10.99*	12.36*	1.12	102	235	18.41	19.16	4.84	4.70
S.E. 69A X	-241JAN04	4.80	—	100.4	—	—	—	—	-.11	10	10	16.37	17.04	6.96	7.02
S.E. 70 II	-241JUN01	11.49	—	245.4	—	—	—	—	-.81	5	5	19.18	19.08	4.92	5.49
S.E. 70 III	-241JUN30	22.24	—	273.4	—	—	—	—	-.34	173	173	18.77	19.19	4.81	5.16
S.E. 70 VIII	-241NOV24	22.83	—	59.1	—	—	—	—	-.15	173	173	16.68	17.20	6.80	7.19
S.E. 71 II	-240MAY20	15.97	3.09	234.8	17.73*	—	—	20.65	.49	54	323	18.84	18.96	5.04	5.43
S.E. 71 VIII	-240NOV13	14.07	3.16	48.3	15.58*	16.96*	17.57	18.95	1.11	102	236	17.18	17.33	6.68	7.46
S.E. 72A II	-239MAY09	16.72	3.07	224.2	17.72*	18.92	20.61	21.82	1.78	104	280	18.65	18.82	5.18	5.57
S.E. 72A VIII	-239NOV03	5.27	3.18	37.5	6.55*	7.71*	9.03*	10.19*	1.40	63	270	16.91	17.49	6.52	6.55
S.E. 73 I	-238APR28	21.09	3.04	213.6	22.62	—	—	1.24	.41	153	236	18.29	18.65	5.34	5.66
S.E. 73 VII	-238OCT23	15.88	3.17	26.5	18.20	—	—	19.51	.03	4	325	17.56	17.65	6.36	6.93
S.E. 73 XII	-237MAR19	23.88	—	174.9	—	—	—	—	-.10	18	18	17.49	18.00	5.99	6.13
S.E. 74 I	-237APR18	8.54	—	203.3	—	—	—	—	-.84	197	197	17.56	18.48	5.51	5.55
S.E. 74 VI	-237SEP13	.81	—	345.5	—	—	—	—	-.49	163	163	17.93	18.35	5.66	5.87
S.E. 74 XII	-236MAR08	16.65	2.74	164.6	17.72*	18.99	19.91	21.18	1.20	87	308	17.65	17.83	6.16	6.58
S.E. 75U VI	-236SEP01	1.54	2.96	334.4	2.84	—	—	6.31*	.86	105	224	18.12	18.53	5.47	5.64
S.E. 75U XI	-235FEB26	7.46	2.69	154.1	8.27*	9.56*	10.59*	11.88*	1.23	125	267	16.80	17.65	6.34	6.37
S.E. 76 V	-235AUG21	8.66	2.93	323.7	9.65*	10.83*	12.23*	13.41*	1.44	64	268	18.07	18.71	5.30	5.14
S.E. 76 XI	-234FEB15	16.05	—	143.4	—	—	—	—	-.22	194	194	17.30	17.49	6.50	7.02
S.E. 77A V	-234AUG10	22.62	2.91	313.3	.44	—	—	2.25	.17	18	319	18.56	18.86	5.15	5.42
S.E. 77A X	-233JAN05	22.44	—	102.2	—	—	—	—	-.31	359	359	16.69	17.05	6.95	7.22
S.E. 78 III	-233JUL02	7.58	2.99	274.8	9.69*	—	—	11.75*	.24	150	217	18.30	19.19	4.81	4.75
S.E. 78 IX	-233DEC26	.43	2.89	90.9	1.57	—	—	5.16	1.02	59	290	16.56	17.02	6.98	7.24
S.E. 79 III	-232JUN20	20.56	3.03	264.6	21.68	22.85	.39	1.55	1.58	107	269	18.86	19.19	4.81	5.14
S.E. 79 IX	-232DEC14	9.52	2.98	79.8	10.62*	11.81*	13.08*	14.27*	1.37	94	245	17.06	17.04	6.96	7.95
S.E. 80A III	-231JUN10	2.53	3.07	254.1	3.84	—	—	7.06*	.66	65	320	18.61	19.14	4.86	4.94
S.E. 80A IX	-231DEC04	.07	3.06	69.0	2.04	—	—	3.89	.18	135	196	16.58	17.11	6.89	7.26
S.E. 81 I	-230APR30	12.60	—	215.2	—	—	—	—	-.77	205	205	18.65	18.68	5.31	5.81
S.E. 81 II	-230MAY30	3.50	—	243.5	—	—	—	—	-.74	17	17	18.50	19.05	4.95	4.96
S.E. 81 VII	-230OCT25	3.39	—	28.1	—	—	—	—	-.22	333	333	17.30	17.63	6.37	6.47
S.E. 82 I	-229APR19	18.86	2.99	204.7	20.32	—	—	23.51	.75	152	262	18.24	18.51	5.48	5.80

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 82 VII	-229OCT14	12.08	3.14	17.1	13.53*	—	—	17.07*	.97	34	268	17.76	17.80	6.21	6.94
S.E. 83A I	-228APR08	8.02	2.93	194.4	9.04*	10.14*	11.63*	12.73*	1.58	110	308	17.42	18.33	5.66	5.65
S.E. 83A VII	-228OCT02	13.85	3.10	5.8	14.87*	16.17*	17.57*	18.87	1.39	74	228	17.88	17.99	6.01	6.63
S.E. 83A XII2	-227MAR29	.82	2.86	184.2	2.47	—	—	4.58	.27	64	354	17.59	18.16	5.83	5.93
S.E. 84 VI	-227SEP21	13.67	3.05	354.6	15.57*	—	—	17.41*	.13	124	177	18.04	18.19	5.82	6.45
S.E. 84 XI	-226FEB17	5.46	2.67	145.0	7.95*	—	—	8.63*	-.05	195	216	16.70	17.51	6.48	6.64
S.E. 85A V	-226AUG12	7.05	—	314.6	—	—	—	—	-.20	337	337	18.38	18.84	5.16	5.03
S.E. 85A XI	-225FEB06	11.77	2.66	134.0	12.57*	13.99*	14.97*	16.38*	1.19	132	273	17.34	17.36	6.63	7.13
S.E. 86 IV	-225AUG01	22.39	2.91	304.3	23.60	.86	1.80	3.07	1.21	50	271	18.68	18.97	5.03	5.34
S.E. 86 X	-224JAN26	11.98	2.68	122.8	12.66*	14.14*	15.02*	16.50*	1.15	89	310	17.20	17.22	6.77	7.25
S.E. 87 IV	-224JUL21	15.39	2.93	294.2	16.49*	17.74*	18.76*	20.00	1.24	94	235	18.95	19.08	4.93	5.61
S.E. 87 X	-223JAN14	12.91	2.74	111.5	15.30*	—	—	15.50*	-.08	18	13	17.08	17.11	6.88	7.36
S.E. 88A III	-223JUN11	18.33	—	255.8	—	—	—	—	-.97	1	1	19.00	19.15	4.85	5.18
S.E. 88A IV	-223JUL11	5.44	—	283.9	—	—	—	—	-.22	168	168	18.51	19.16	4.84	4.87
S.E. 88A IX	-223DEC05	7.69	—	70.4	—	—	—	—	-.14	177	177	16.20	17.10	6.90	6.91
S.E. 89 II	-222MAY31	22.40	3.09	245.2	.35	—	—	2.89	.33	43	327	18.73	19.07	4.93	5.12
S.E. 89 VIII	-222NOV24	23.02	3.12	59.5	.49	1.87	2.48	3.86	1.11	106	240	16.70	17.20	6.81	7.17
S.E. 90 II	-221MAY20	23.19	3.09	234.6	.23	1.43	3.11	4.32	1.73	96	281	18.55	18.95	5.04	5.25
S.E. 90 VIII	-221NOV14	14.05	3.16	48.7	15.30*	16.46*	17.78	18.95	1.41	66	273	17.22	17.32	6.68	7.42
S.E. 91A II	-220MAY09	4.03	3.07	224.0	5.48*	—	—	8.39*	.55	144	239	18.16	18.81	5.19	5.30
S.E. 91A VIII	-220NOV03	.25	3.18	37.7	2.55	—	—	3.90	.04	6	327	17.14	17.48	6.52	6.76
S.E. 91A XII2	-219MAR30	7.72	—	185.5	—	—	—	—	-.20	18	18	17.30	18.18	5.81	5.70
S.E. 92 I	-219APR28	15.98	—	213.8	—	—	—	—	-.71	195	195	18.50	18.66	5.33	5.88
S.E. 92 VI	-219SEP23	8.26	—	356.4	—	—	—	—	-.56	162	162	17.57	18.17	5.84	5.78
S.E. 92 XII	-218MAR20	.66	2.80	175.3	1.81	3.21	3.82	5.21	1.11	85	311	17.45	18.01	5.98	6.14
S.E. 93 VI	-218SEP12	9.07	3.01	345.3	10.48*	—	—	13.85*	.79	106	220	18.34	18.34	5.67	6.46
S.E. 93 XII	-217MAR09	15.36	2.74	164.9	16.17*	17.41*	18.60	19.84	1.31	124	271	17.71	17.84	6.15	6.63
S.E. 94U VI	-217SEP01	16.49	2.96	334.4	17.51*	18.66	20.14	21.29	1.52	64	264	18.39	18.53	5.48	6.03
S.E. 94U XI	-216FEB26	23.66	—	154.2	—	—	—	—	-.16	196	196	17.18	17.66	6.33	6.63
S.E. 95 V	-216AUG21	6.59	2.93	324.0	8.29*	—	—	10.38*	.26	20	312	18.13	18.70	5.30	5.20
S.E. 95 X	-215JAN16	6.32	—	113.3	—	—	—	—	-.34	4	4	16.47	17.12	6.88	6.87
S.E. 96A IV	-215JUL12	15.06	2.95	285.3	17.35*	—	—	18.97*	.11	154	205	19.00	19.15	4.86	5.51
S.E. 96A X	-214JAN05	8.73	2.80	102.0	9.81*	—	—	13.38*	1.02	64	295	16.27	17.05	6.95	6.89
S.E. 97 III	-214JUL02	3.57	2.99	275.0	4.68	5.89*	7.30*	8.50*	1.43	106	261	18.58	19.19	4.81	4.89
S.E. 97 IX	-214DEC25	18.26	2.89	91.0	19.28	20.46	21.74	22.93	1.37	99	250	16.72	17.02	6.98	7.56
S.E. 98 III	-213JUN21	9.04	3.03	264.5	10.21*	—	—	13.67*	.82	66	310	18.42	19.19	4.81	4.70
S.E. 98 IX	-213DEC15	9.01	2.98	80.2	10.91*	—	—	12.77*	.19	140	201	16.17	17.04	6.96	6.88
S.E. 99A II	-212MAY10	19.21	—	225.7	—	—	—	—	-.91	203	203	18.53	18.84	5.16	5.53
S.E. 99A III	-212JUN09	9.89	—	253.8	—	—	—	—	-.58	12	12	19.30	19.14	4.85	5.38
S.E. 99A VIII	-212NOV04	12.03	—	39.3	—	—	—	—	-.24	335	335	17.46	17.45	6.56	7.38
S.E. 100 I	-211APR30	2.00	3.04	215.2	3.63	—	—	6.62*	.62	155	256	18.08	18.68	5.32	5.49
S.E. 100 VII	-211OCT24	20.24	3.17	28.2	21.72	—	—	1.24	.94	35	271	17.42	17.63	6.38	6.78
S.E. 101 I	-210APR19	15.61	2.99	205.0	16.70*	17.77*	19.34	20.41	1.70	112	303	18.40	18.52	5.48	5.85
S.E. 101 VII	-210OCT13	21.59	3.14	16.9	22.65	23.93	1.39	2.67	1.43	73	230	17.56	17.81	6.19	6.53
S.E. 102A I	-209APR09	8.61	2.93	194.8	10.20*	—	—	12.58*	.38	69	349	17.38	18.34	5.66	5.58
S.E. 102A VII	-209OCT02	21.40	3.10	5.5	23.26	—	—	1.30	.18	120	181	17.72	18.00	6.00	6.35
S.E. 102A XII	-208FEB28	13.36	—	155.8	—	—	—	—	-.12	207	207	17.62	17.69	6.30	6.79
S.E. 103 V	-208AUG22	14.85	—	325.3	—	—	—	—	-.28	335	335	18.65	18.67	5.33	5.97
S.E. 103 VI	-208SEP21	2.80	—	354.5	—	—	—	—	-.98	151	151	17.75	18.20	5.81	5.95
S.E. 103 XI	-207FEB16	19.40	2.67	144.9	20.24	21.74	22.51	.01	1.13	137	274	17.20	17.51	6.48	6.79
S.E. 104A V	-207AUG12	6.28	2.91	315.0	7.54*	8.93*	9.54*	10.93*	1.11	44	270	18.33	18.84	5.17	5.07
S.E. 104A XI	-206FEB05	19.59	2.66	133.8	20.22	21.64	22.69	.11	1.21	94	312	17.04	17.35	6.64	6.92
S.E. 105 IV	-206AUG01	23.10	2.91	304.8	.15	1.33	2.55	3.73	1.34	86	234	18.61	18.97	5.04	5.33
S.E. 105 X	-205JAN25	20.92	2.69	122.6	22.94	—	—	23.80	-.03	32	7	16.85	17.21	6.78	7.03
S.E. 106 IV	-205JUL22	12.71	—	294.4	—	—	—	—	-.11	164	164	18.98	19.07	4.93	5.71
S.E. 106 IX	-205DEC16	16.53	—	81.6	—	—	—	—	-.14	182	182	16.73	17.04	6.97	7.63
S.E. 107A III	-204JUN11	4.81	3.06	255.6	7.02*	—	—	9.04*	.17	30	331	18.60	19.15	4.85	4.83
S.E. 107A IX	-204DEC05	7.97	3.05	70.8	9.39*	10.78*	11.38*	12.77*	1.11	110	244	16.20	17.10	6.91	6.86
S.E. 108 II	-203MAY31	5.65	3.09	245.0	6.71*	7.93*	9.53*	10.76*	1.57	87	282	18.43	19.06	4.93	4.94
S.E. 108 VIII	-203NOV24	22.86	3.12	59.9	.07	1.24	2.56	3.72	1.41	69	277	16.76	17.19	6.81	7.15
S.E. 109 II	-202MAY20	10.94	3.09	234.5	12.30*	—	—	15.46*	.71	135	242	19.01	18.96	5.04	5.71
S.E. 109 VIII	-202NOV14	8.67	3.16	48.9	10.96*	—	—	12.31*	.04	9	330	16.72	17.33	6.68	6.57
S.E. 110A I	-201APR10	15.46	—	196.1	—	—	—	—	-.30	18	18	18.27	18.37	5.62	6.01
S.E. 110A II	-201MAY09	23.37	—	224.2	—	—	—	—	-.57	192	192	18.31	18.81	5.18	5.49
S.E. 110A VII	-201OCT04	15.88	—	7.4	—	—	—	—	-.61	162	162	17.74	17.97	6.04	6.58
S.E. 110A XII2	-200MAR30	8.53	2.87	186.0	9.81*	—	—	13.13*	1.01	82	314	17.27	18.18	5.81	5.72
S.E. 111 VI	-200SEP22	16.78	3.06	356.2	18.28	—	—	21.56	.73	107	217	17.96	18.16	5.85	6.36
S.E. 111 XII	-199MAR19	23.09	2.80	175.6	23.96	1.16	2.49	3.68	1.39	122	274	17.56	18.01	5.98	6.22
S.E. 112 VI	-199SEP12	.47	3.01	345.3	1.53	2.66	4.19	5.32	1.59	65	261	17.98	18.35	5.66	5.87
S.E. 112 XII	-198MAR09	7.10	2.74	165.0	9.55*	—	—	9.73*	-.08	195	200	17.08	17.83	6.16	6.26
S.E. 113U VI	-198SEP01	14.71	2.96	334.7	16.34*	—	—	18.62	.34	22	306	18.49	18.52	5.49	6.15
S.E. 113U X	-197JAN27	14.10	—	124.3	—	—	—	—	-.37	8	8	17.16	17.24	6.76	7.22

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 114 IV	-197JUL23	22.60	2.92	295.9	1.21	—	—	2.19	-.01	160	190	18.61	19.06	4.94	5.26
S.E. 114 V	-197AUG22	7.37	—	324.4	—	—	—	—	-.92	346	346	18.15	18.70	5.31	5.15
S.E. 114 X	-196JAN16	16.97	2.73	113.1	17.97	—	—	21.51	1.00	68	300	16.91	17.12	6.87	7.36
S.E. 115A IV	-196JUL12	10.62	2.95	285.5	11.75*	13.03*	14.23*	15.51*	1.29	106	252	19.20	19.14	4.86	5.61
S.E. 115A X	-195JAN05	2.95	2.80	102.2	3.88	5.05	6.35	7.52*	1.39	104	256	16.38	17.05	6.95	7.15
S.E. 116 III	-195JUL01	15.58	2.99	275.0	16.63*	—	—	20.28	.97	67	300	19.10	19.19	4.81	5.28
S.E. 116 IX	-195DEC25	17.92	2.89	91.4	19.71	—	—	21.60	.20	144	206	16.68	17.02	6.98	7.65
S.E. 117 III	-194JUN20	16.32	—	264.2	—	—	—	—	-.42	8	8	19.10	19.19	4.81	5.18
S.E. 117 VIII	-194NOV15	20.71	—	50.4	—	—	—	—	-.26	339	339	17.08	17.30	6.70	7.12
S.E. 118A II	-193MAY11	9.10	3.08	225.6	10.89*	—	—	13.63*	.49	158	248	19.00	18.84	5.15	5.77
S.E. 118A VIII	-193NOV05	4.48	3.18	39.3	5.98	—	—	9.48*	.92	37	274	17.07	17.46	6.55	6.62
S.E. 119 I	-192APR29	23.13	3.04	215.5	.28	1.34	2.94	4.01	1.83	114	297	18.19	18.68	5.31	5.51
S.E. 119 VII	-192OCT24	5.46	3.17	27.9	6.54*	7.81*	9.30*	10.57*	1.46	74	232	17.23	17.64	6.37	6.41
S.E. 120 I	-191APR19	16.30	2.99	205.4	17.84*	—	—	20.45	.50	72	342	18.38	18.52	5.47	5.78
S.E. 120 VII	-191OCT13	5.28	3.14	16.6	7.13*	—	—	9.31*	.22	119	184	17.39	17.82	6.18	6.23
S.E. 120 XII	-190MAR10	21.10	—	166.6	—	—	—	—	-.21	209	209	17.47	17.86	6.13	6.45
S.E. 121A I	-190APR09	7.99	—	195.2	—	—	—	—	-.93	28	28	17.49	18.34	5.65	5.55
S.E. 121A VI	-190SEP02	22.82	—	336.1	—	—	—	—	-.35	333	333	18.30	18.50	5.50	5.78
S.E. 121A VII	-190OCT02	10.96	—	5.5	—	—	—	—	-.93	151	151	17.86	18.00	6.01	6.84
S.E. 121A XII	-189FEB28	2.85	2.70	155.8	3.76	5.49	5.75	7.47*	1.05	142	274	17.08	17.68	6.31	6.47
S.E. 122 V	-189AUG23	14.31	2.93	325.7	15.62*	—	—	18.94	1.02	38	270	18.62	18.67	5.34	6.06
S.E. 122 XI	-188FEB17	3.05	2.67	144.7	3.68	5.04	6.25	7.61*	1.28	99	312	16.91	17.51	6.49	6.61
S.E. 123A V	-188AUG12	6.91	2.91	315.4	7.94*	9.08*	10.44*	11.58*	1.44	80	234	18.27	18.83	5.17	5.07
S.E. 123A XI	-187FEB05	4.82	2.66	133.5	6.64*	—	—	7.89*	.02	41	5	16.65	17.34	6.65	6.69
S.E. 124 IV	-187AUG01	20.04	2.91	305.0	22.24	—	—	23.30	-.01	144	176	18.66	18.96	5.04	5.48
S.E. 124 IX	-187DEC27	1.35	—	92.8	—	—	—	—	-.14	186	187	16.30	17.02	6.98	7.28
S.E. 125 III	-186JUN22	11.24	3.03	266.0	13.83*	—	—	15.04*	.01	13	339	19.26	19.19	4.81	5.44
S.E. 125 IX	-186DEC16	16.92	2.97	82.0	18.26	19.65	20.24	21.63	1.10	115	249	16.75	17.03	6.97	7.59
S.E. 126A III	-185JUN11	12.13	3.06	255.3	13.22*	14.49*	15.93*	17.20*	1.41	78	283	19.16	19.15	4.85	5.45
S.E. 126A IX	-185DEC06	7.67	3.05	71.1	8.81*	9.98*	11.30*	12.47*	1.40	74	282	16.30	17.10	6.91	6.86
S.E. 127 II	-184MAY30	17.88	3.09	244.9	19.17	—	—	22.52	.86	126	243	18.84	19.07	4.93	5.38
S.E. 127 VIII	-184NOV24	17.11	3.12	60.1	19.35	—	—	20.69	.03	13	334	17.02	17.19	6.82	7.33
S.E. 128 I	-183APR20	23.11	—	206.7	—	—	—	—	-.41	16	16	18.08	18.54	5.45	5.59
S.E. 128 II	-183MAY20	6.73	—	234.7	—	—	—	—	-.44	189	189	18.10	18.95	5.05	5.08
S.E. 128 VII	-183OCT14	23.62	—	18.4	—	—	—	—	-.64	163	163	17.37	17.79	6.22	6.49
S.E. 129A I	-182APR10	16.27	2.94	196.5	17.67*	—	—	20.89	.90	77	317	18.23	18.38	5.62	6.02
S.E. 129A VII	-182OCT04	.66	3.11	7.1	2.25	—	—	5.46	.69	109	215	17.58	17.98	6.03	6.24
S.E. 129A XII2	-181MAR31	6.67	2.87	186.3	7.57*	8.73*	10.19*	11.35*	1.49	119	277	17.42	18.19	5.80	5.83
S.E. 130 VI	-181SEP23	8.63	3.06	356.2	9.74*	10.86*	12.42*	13.54*	1.65	66	258	17.57	18.17	5.84	5.70
S.E. 130 XII	-180MAR19	14.36	2.80	175.7	16.32*	—	—	17.58*	.02	180	216	17.92	18.02	5.97	6.47
S.E. 131 VI	-180SEP11	22.96	3.01	345.6	.58	—	—	3.01	.40	24	301	18.05	18.35	5.66	5.94
S.E. 131 XI	-179FEB06	21.74	—	135.3	—	—	—	—	-.42	12	12	17.01	17.37	6.62	6.84
S.E. 132U V	-179AUG03	6.23	—	306.4	—	—	—	—	-.13	171	171	18.23	18.95	5.05	5.03
S.E. 132U VI	-179SEP01	15.46	—	335.2	—	—	—	—	-.85	344	343	18.51	18.52	5.49	6.11
S.E. 132U X	-178JAN27	1.10	2.68	124.2	2.09	—	—	5.59	.97	71	305	16.69	17.23	6.76	6.96
S.E. 133 IV	-178JUL23	17.73	2.92	296.0	18.88*	20.29	21.15	22.56	1.16	106	244	18.85	19.06	4.94	5.42
S.E. 133 X	-177JAN16	11.56	2.73	113.3	12.42*	13.58*	14.91*	16.07*	1.41	108	261	17.11	17.13	6.87	7.64
S.E. 134A IV	-177JUL12	22.17	2.95	285.4	23.13	.67	1.37	2.92	1.11	67	291	18.83	19.15	4.86	5.11
S.E. 134A X	-176JAN06	2.77	2.80	102.6	4.47	—	—	6.39	.21	148	212	16.32	17.05	6.95	7.20
S.E. 135 III	-176JUN30	22.81	—	274.7	—	—	—	—	-.27	3	3	18.87	19.19	4.81	5.00
S.E. 135 VIII	-176NOV26	5.42	—	61.7	—	—	—	—	-.27	342	342	16.70	17.18	6.83	6.84
S.E. 136 II	-175MAY21	16.18	3.09	236.1	18.17*	—	—	20.61	.36	160	238	18.81	18.97	5.02	5.48
S.E. 136 VIII	-175NOV15	12.76	3.16	50.5	14.25*	—	—	17.75	.90	39	278	17.24	17.30	6.71	7.44
S.E. 137A II	-174MAY11	6.60	3.08	225.9	7.80*	8.86*	10.45*	11.52*	1.82	115	290	17.96	18.83	5.16	5.16
S.E. 137A VIII	-174NOV04	13.42	3.18	39.1	14.51*	15.77*	17.28*	18.55	1.48	75	235	17.34	17.46	6.55	7.23
S.E. 138 I	-173APR30	23.89	3.04	215.9	1.39	—	—	4.22	.62	75	335	18.17	18.69	5.31	5.44
S.E. 138 VII	-173OCT24	13.31	3.17	27.7	15.13*	—	—	17.41*	.25	119	188	17.48	17.63	6.38	7.07
S.E. 138 XII	-172MAR21	4.67	—	177.3	—	—	—	—	-.31	209	209	17.33	18.04	5.95	6.12
S.E. 139 I	-172APR19	15.44	—	205.7	—	—	—	—	-.82	27	27	18.44	18.53	5.46	5.74
S.E. 139 VI	-172SEP13	6.94	—	347.0	—	—	—	—	-.40	331	331	17.95	18.33	5.68	5.58
S.E. 139 VII	-172OCT12	19.27	—	16.5	—	—	—	—	-.89	152	152	17.51	17.82	6.19	6.67
S.E. 139 XII	-171MAR10	10.13	2.75	166.5	11.15*	—	—	14.77*	.96	146	272	17.93	17.87	6.12	6.58
S.E. 140A VI	-171SEP02	22.46	2.97	336.5	23.85	—	—	3.09	.94	34	271	18.25	18.50	5.51	5.82
S.E. 140A XII	-170FEB27	10.37	2.70	155.5	11.00*	12.31*	13.67*	14.98*	1.36	103	312	17.74	17.69	6.31	6.72
S.E. 141 V	-170AUG23	14.83	2.93	326.1	15.88*	16.99*	18.44*	19.55	1.53	75	234	18.55	18.66	5.35	6.04
S.E. 141 XI	-169FEB16	12.60	2.67	144.4	14.23*	—	—	15.84*	.08	49	2	17.50	17.51	6.48	6.86
S.E. 142A V	-169AUG13	3.47	2.91	315.7	5.42*	—	—	7.02*	.09	133	181	18.35	18.83	5.18	5.28
S.E. 142A X	-168JAN07	10.11	—	103.9	—	—	—	—	-.15	191	191	17.09	17.06	6.94	7.75
S.E. 143 III	-168JUL02	17.71	—	276.4	—	—	—	—	-.15	352	352	19.06	19.19	4.82	5.22
S.E. 143 IX	-168DEC27	1.82	2.87	93.2	3.08	4.48	5.04	6.45	1.10	120	254	16.30	17.02	6.98	7.22
S.E. 144 III	-167JUN21	18.66	3.03	265.7	19.77	21.13	22.29	23.66	1.26	69	284	18.98	19.19	4.81	5.20
S.E. 144 IX	-167DEC16	16.45	2.96	82.4	17.52	18.69	20.01	21.19	1.40	78	286	16.81	17.03	6.97	7.55

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 145A III	-166JUN11	.84	3.06	255.3	2.03	—	—	5.54*	1.01	117	244	18.64	19.15	4.85	5.05
S.E. 145A IX	-166DEC06	1.55	3.05	71.3	3.75	—	—	5.06	.03	17	338	16.62	17.09	6.91	7.09
S.E. 146 I	-165MAY02	6.69	—	217.2	—	—	—	—	-.53	14	14	17.88	18.70	5.29	5.17
S.E. 146 II	-165MAY31	14.09	—	245.1	—	—	—	—	-.29	185	185	18.98	19.07	4.92	5.61
S.E. 146 VII	-165OCT26	7.51	—	29.5	—	—	—	—	-.67	165	165	16.99	17.62	6.39	6.39
S.E. 147 I	-164APR20	23.91	3.00	207.1	1.45	—	—	4.53	.78	72	320	18.04	18.55	5.45	5.60
S.E. 147 VII	-164OCT14	8.69	3.15	18.2	10.35*	—	—	13.50*	.66	111	215	17.18	17.80	6.21	6.12
S.E. 148A I	-163APR10	14.10	2.94	196.9	15.07*	16.21*	17.76*	18.90	1.61	115	279	18.32	18.38	5.61	6.10
S.E. 148A VII	-163OCT03	16.94	3.11	7.2	18.10	19.21	20.78	21.89	1.69	67	257	17.81	17.97	6.04	6.59
S.E. 148A XII2	-162MAR30	21.45	2.87	186.3	23.23	—	—	1.03	.12	171	225	17.84	18.20	5.79	6.11
S.E. 149 VI	-162SEP23	7.36	3.06	356.5	8.98*	—	—	11.51*	.45	25	299	17.61	18.17	5.84	5.73
S.E. 149 XI	-161FEB18	5.25	—	146.2	—	—	—	—	-.48	14	14	16.89	17.53	6.46	6.48
S.E. 150 V	-161AUG14	13.96	—	317.1	—	—	—	—	-.23	168	168	18.66	18.80	5.21	5.92
S.E. 150 VI	-161SEP12	23.69	—	346.0	—	—	—	—	-.80	342	342	18.07	18.34	5.67	5.90
S.E. 150 XI	-160FEB07	9.13	2.66	135.2	10.12*	—	—	13.58*	.93	73	310	17.49	17.38	6.61	7.26
S.E. 151U V	-160AUG03	.92	2.91	306.6	2.13	—	—	5.71*	1.04	106	236	18.50	18.95	5.06	5.25
S.E. 151U X	-159JAN26	20.08	2.68	124.3	20.88	22.03	23.40	.54	1.44	111	266	16.85	17.23	6.76	7.19
S.E. 152 IV	-159JUL23	4.85	2.92	295.9	5.73*	7.11*	8.26*	9.64*	1.25	67	282	18.54	19.07	4.94	4.96
S.E. 152 X	-158JAN16	11.54	2.73	113.7	13.13*	—	—	15.12*	.23	152	217	17.10	17.13	6.87	7.72
S.E. 153A IV	-158JUL12	5.40	—	285.1	—	—	—	—	-.12	359	359	18.61	19.15	4.85	4.82
S.E. 153A IX	-158DEC07	14.13	—	72.9	—	—	—	—	-.28	347	347	17.02	17.08	6.92	7.63
S.E. 154 II	-157JUN01	23.28	3.08	246.5	1.46	—	—	3.52	.22	163	228	18.58	19.08	4.92	5.18
S.E. 154 VIII	-157NOV26	21.08	3.11	61.7	22.52	—	—	2.01	.89	43	282	16.90	17.18	6.83	7.22
S.E. 155 II	-156MAY21	14.04	3.09	236.4	15.28*	16.35*	17.90*	18.98*	1.68	116	283	18.94	18.98	5.02	5.53
S.E. 155 VIII	-156NOV14	21.46	3.16	50.2	22.53	23.79	1.32	2.57	1.50	78	239	17.01	17.31	6.70	7.07
S.E. 156A II	-155MAY11	7.42	3.08	226.3	8.85*	—	—	11.88*	.75	77	328	17.94	18.84	5.16	5.09
S.E. 156A VIII	-155NOV03	21.45	3.18	38.8	23.26	—	—	1.60	.28	120	191	17.14	17.47	6.54	6.93
S.E. 156A XII2	-154APR01	12.08	—	187.9	—	—	—	—	-.43	209	209	18.24	18.23	5.76	6.25
S.E. 157 I	-154APR30	22.77	—	216.2	—	—	—	—	-.70	25	25	18.27	18.69	5.30	5.41
S.E. 157 VI	-154SEP24	15.22	—	357.9	—	—	—	—	-.45	331	331	18.10	18.13	5.88	6.52
S.E. 157 VII	-154OCT24	3.71	—	27.6	—	—	—	—	-.86	153	153	17.14	17.64	6.37	6.49
S.E. 157 XII	-153MAR21	17.24	2.81	177.2	18.39	—	—	21.89	.85	150	269	17.84	18.05	5.95	6.27
S.E. 158 VI	-153SEP14	6.76	3.02	347.4	8.24*	—	—	11.40*	.88	30	272	17.88	18.32	5.69	5.59
S.E. 158 XII	-152MAR09	17.54	2.75	166.2	18.22	19.49	20.98	22.25	1.46	108	310	17.65	17.86	6.13	6.41
S.E. 159A VI	-152SEP02	22.88	2.97	336.9	23.93	1.03	2.54	3.64	1.60	71	234	18.20	18.49	5.52	5.81
S.E. 159A XII	-151FEB26	20.25	2.70	155.3	21.78	—	—	23.70	.16	57	359	17.35	17.68	6.32	6.52
S.E. 160 V	-151AUG23	11.02	2.93	326.4	12.81*	—	—	14.75*	.17	125	184	18.58	18.65	5.35	6.16
S.E. 160 X	-150JAN17	18.79	—	115.1	—	—	—	—	-.16	196	196	16.74	17.14	6.86	7.35
S.E. 161A IV	-150JUL14	.25	—	286.9	—	—	—	—	-.30	347	347	18.84	19.14	4.86	5.02
S.E. 161A X	-149JAN07	10.66	2.79	104.4	11.84*	13.27*	13.76*	15.20*	1.08	126	258	17.10	17.06	6.93	7.70
S.E. 162 III	-149JUL03	1.27	2.98	276.2	2.43	3.97	4.65	6.19*	1.11	60	284	18.78	19.19	4.81	4.96
S.E. 162 IX	-149DEC28	1.18	2.87	93.5	2.14	3.32	4.65	5.82	1.41	84	291	16.41	17.02	6.98	7.20
S.E. 163 III	-148JUN21	7.86	3.03	265.7	9.00*	10.39*	11.22*	12.62*	1.15	108	245	18.43	19.19	4.81	4.72
S.E. 163 IX	-148DEC16	9.96	2.96	82.5	12.07*	—	—	13.38*	.03	22	343	17.11	17.03	6.97	7.68
S.E. 164A II	-147MAY12	14.21	—	227.6	—	—	—	—	-.65	11	11	18.86	18.87	5.13	5.60
S.E. 164A III	-147JUN10	21.47	—	255.5	—	—	—	—	-.15	181	181	18.73	19.15	4.85	5.23
S.E. 164A VIII	-147NOV05	15.49	—	40.6	—	—	—	—	-.69	167	167	17.19	17.44	6.57	7.17
S.E. 165 I	-146MAY02	7.44	3.05	217.6	9.13*	—	—	12.04*	.65	65	323	17.86	18.71	5.28	5.18
S.E. 165 VII	-146OCT25	16.86	3.17	29.3	18.58	—	—	21.69	.64	113	216	17.38	17.61	6.40	6.94
S.E. 166 I	-145APR21	21.38	3.00	207.4	22.40	23.53	1.14	2.27	1.73	110	282	18.18	18.55	5.44	5.71
S.E. 166 VII	-145OCT15	1.38	3.15	18.3	2.60	3.71	5.28	6.39*	1.72	69	257	17.37	17.79	6.22	6.41
S.E. 167A I	-144APR10	4.39	2.94	196.8	6.02*	—	—	8.27*	.24	163	231	17.75	18.37	5.62	5.75
S.E. 167A VII	-144OCT03	15.90	3.11	7.5	17.53*	—	—	20.14	.49	27	297	17.87	17.97	6.04	6.67
S.E. 167A XII	-143FEB28	12.62	—	157.0	—	—	—	—	-.55	16	16	17.69	17.71	6.28	6.69
S.E. 168 V	-143AUG24	21.81	—	327.8	—	—	—	—	-.33	165	165	18.25	18.64	5.37	5.72
S.E. 168 VI	-143SEP23	8.05	—	357.0	—	—	—	—	-.75	342	342	17.63	18.16	5.85	5.70
S.E. 168 XI	-142FEB17	17.04	2.67	146.1	18.08	—	—	21.47	.88	74	314	17.33	17.53	6.46	6.85
S.E. 169 V	-142AUG14	8.21	2.91	317.3	9.48*	—	—	12.96*	.93	107	229	18.15	18.81	5.20	5.10
S.E. 169 XI	-141FEB07	4.49	2.66	135.3	5.28	6.41	7.82*	8.95*	1.49	113	271	16.60	17.37	6.62	6.74
S.E. 170U V	-141AUG03	11.63	2.91	306.5	12.47*	13.77*	15.16*	16.46*	1.37	67	275	18.95	18.94	5.06	5.73
S.E. 170U X	-140JAN27	20.20	2.68	124.7	21.71	—	—	23.78	.26	154	223	16.81	17.24	6.75	7.24
S.E. 171 IV	-140JUL22	12.09	2.92	295.6	14.15*	—	—	15.44*	.02	13	336	19.11	19.06	4.94	5.56
S.E. 171 IX	-140DEC17	22.81	—	84.1	—	—	—	—	-.29	352	352	16.66	17.03	6.97	7.27
S.E. 172A III	-139JUN12	6.41	3.06	256.9	8.83*	—	—	10.39*	.09	168	215	18.32	19.16	4.84	4.88
S.E. 172A IX	-139DEC07	5.39	3.04	72.9	6.77	—	—	10.25*	.88	47	287	16.56	17.08	6.92	6.98
S.E. 173 II	-138JUN01	21.48	3.08	246.8	22.74	23.84	1.30	2.40	1.54	116	275	18.67	19.08	4.91	5.20
S.E. 173 VIII	-138NOV26	5.54	3.11	61.4	6.56	7.81*	9.35*	10.61*	1.51	81	243	16.68	17.18	6.82	6.89
S.E. 174 II	-137MAY22	14.89	3.09	236.8	16.27*	—	—	19.46	.88	79	320	18.93	18.98	5.01	5.45
S.E. 174 VIII	-137NOV15	5.68	3.16	50.0	7.45*	—	—	9.83*	.29	122	195	16.79	17.32	6.69	6.76
S.E. 175A I	-136APR11	19.33	—	198.5	—	—	—	—	-.55	208	208	18.10	18.41	5.59	5.94
S.E. 175A II	-136MAY11	6.01	—	226.7	—	—	—	—	-.58	22	22	18.09	18.84	5.15	5.09
S.E. 175A VII	-136OCT04	23.65	—	8.9	—	—	—	—	-.48	331	331	17.73	17.95	6.06	6.31

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 175A VIII	-136NOV03	12.27	—	38.8	—	—	—	—	-.84	156	156	17.29	17.46	6.55	7.40
S.E. 175A XII2	-135APR01	.19	2.88	187.8	1.51	—	—	4.85	.73	154	264	17.76	18.22	5.77	5.97
S.E. 176 VI	-135SEP24	15.19	3.07	358.3	16.75*	—	—	19.86	.83	28	273	18.05	18.12	5.88	6.57
S.E. 176 XII	-134MAR21	.56	2.81	176.9	1.28	2.51	4.11	5.34	1.57	112	307	17.56	18.04	5.96	6.11
S.E. 177 VI	-134SEP14	7.05	3.02	347.8	8.15*	9.24*	10.78*	11.87*	1.66	67	235	17.84	18.32	5.69	5.60
S.E. 177 XII	-133MAR10	3.78	2.75	166.1	5.19	—	—	7.43*	.25	63	355	17.21	17.85	6.14	6.20
S.E. 178A VI	-133SEP03	18.68	2.97	337.1	20.40	—	—	22.58	.25	119	186	18.25	18.49	5.52	5.99
S.E. 178A XI	-132JAN29	3.37	—	126.1	—	—	—	—	-.19	200	200	16.43	17.25	6.74	6.96
S.E. 178A XII	-132FEB27	13.96	—	155.4	—	—	—	—	-.94	27	27	17.64	17.68	6.31	6.63
S.E. 179 IV	-132JUL24	6.88	—	297.4	—	—	—	—	-.44	343	343	18.61	19.05	4.95	4.86
S.E. 179 X	-131JAN17	19.40	2.72	115.5	20.53	22.03	22.38	23.88	1.06	131	262	16.74	17.14	6.85	7.29
S.E. 180A IV	-131JUL13	7.98	2.95	286.6	9.17*	—	—	12.79*	.97	50	284	18.56	19.14	4.86	4.74
S.E. 180A X	-130JAN07	9.83	2.79	104.7	10.72*	11.89*	13.24*	14.41*	1.42	89	295	17.15	17.07	6.93	7.64
S.E. 181 III	-130JUL02	14.97	2.98	276.2	16.03*	17.29*	18.48*	19.74	1.30	99	244	19.08	19.19	4.82	5.44
S.E. 181 IX	-130DEC27	18.30	2.87	93.7	20.32	—	—	21.65	.03	27	348	16.77	17.02	6.97	7.37
S.E. 182 II	-129MAY23	21.70	—	238.1	—	—	—	—	-.78	8	8	18.64	18.99	5.00	5.19
S.E. 182 III	-129JUN22	4.89	3.02	266.0	7.23*	—	—	8.20*	-.01	161	191	18.46	19.19	4.81	4.86
S.E. 182 VIII	-129NOV16	23.55	—	51.8	—	—	—	—	-.70	170	170	16.81	17.29	6.72	7.04
S.E. 183A II	-128MAY12	14.91	3.08	228.0	16.76*	—	—	19.44	.52	57	325	18.81	18.87	5.12	5.61
S.E. 183A VIII	-128NOV05	1.15	3.18	40.4	2.87	—	—	5.95	.63	116	218	16.97	17.44	6.56	6.79
S.E. 184 I	-127MAY02	4.56	3.05	217.9	5.64*	6.76*	8.41*	9.53*	1.86	104	283	18.05	18.72	5.28	5.33
S.E. 184 VII	-127OCT25	9.96	3.18	29.4	11.21*	12.31*	13.89*	14.99*	1.74	71	259	17.63	17.60	6.41	7.29
S.E. 185 I	-126APR21	11.19	3.00	207.4	12.71*	—	—	15.33*	.37	155	236	18.59	18.56	5.43	6.01
S.E. 185 VII	-126OCT15	.55	3.15	18.6	2.21	—	—	4.86	.52	29	297	17.41	17.79	6.22	6.45
S.E. 185 XII	-125MAR11	19.85	—	167.7	—	—	—	—	-.63	18	18	17.60	17.88	6.11	6.33
S.E. 186A VI	-125SEP05	5.77	—	338.6	—	—	—	—	-.41	163	163	17.84	18.47	5.54	5.54
S.E. 186A VII	-125OCT04	16.52	—	8.0	—	—	—	—	-.72	342	342	17.89	17.96	6.05	6.63
S.E. 186A XII	-124FEB29	.83	2.70	156.9	1.94	—	—	5.24	.82	74	319	17.18	17.70	6.29	6.45
S.E. 187 V	-124AUG24	15.62	2.94	328.0	16.98*	—	—	20.35	.83	107	223	18.48	18.63	5.37	5.94
S.E. 187 XI	-123FEB17	12.78	2.67	146.3	13.57*	14.68*	16.14*	17.25*	1.54	114	275	17.51	17.54	6.45	7.06
S.E. 188 V	-123AUG13	18.53	2.91	317.1	19.35	20.61	22.14	23.39	1.49	68	268	18.61	18.80	5.21	5.62
S.E. 188 XI	-122FEB07	4.74	2.66	135.7	6.18	—	—	8.36*	.30	156	228	16.55	17.38	6.62	6.77
S.E. 189U V	-122AUG02	18.93	2.91	306.2	20.66	—	—	22.59	.15	19	323	18.79	18.95	5.06	5.44
S.E. 189U IX	-122DEC29	7.43	—	95.3	—	—	—	—	-.30	357	357	16.32	17.03	6.97	6.90
S.E. 190 III	-121JUN23	13.59	3.02	267.3	16.39*	—	—	17.14*	-.04	176	198	19.12	19.19	4.81	5.46
S.E. 190 IX	-121DEC18	13.66	2.95	84.1	14.96*	—	—	18.44	.87	51	292	16.93	17.03	6.97	7.64
S.E. 191A III	-120JUN12	4.93	3.06	257.2	6.21*	7.35*	8.66*	9.80*	1.41	116	267	18.36	19.16	4.84	4.87
S.E. 191A IX	-120DEC06	13.63	3.04	72.6	14.59*	15.84*	17.38	18.64	1.52	85	248	16.95	17.08	6.92	7.62
S.E. 192 II	-119JUN01	22.33	3.08	247.2	23.64	—	—	2.97	1.02	79	311	18.65	19.09	4.91	5.13
S.E. 192 VIII	-119NOV25	13.97	3.11	61.2	15.70*	—	—	18.10	.30	125	199	17.00	17.18	6.83	7.56
S.E. 193 I	-118APR23	2.45	—	209.0	—	—	—	—	-.69	207	207	17.97	18.58	5.42	5.63
S.E. 193 II	-118MAY22	13.17	—	237.1	—	—	—	—	-.45	19	19	19.03	18.99	5.01	5.43
S.E. 193 VII	-118OCT16	8.21	—	20.0	—	—	—	—	-.50	332	332	17.35	17.77	6.24	6.09
S.E. 193 VIII	-118NOV14	20.91	—	50.0	—	—	—	—	-.82	159	159	16.92	17.31	6.70	7.18
S.E. 194A I	-117APR12	7.00	2.95	198.4	8.50*	—	—	11.63*	.60	159	258	17.68	18.40	5.60	5.68
S.E. 194A VII	-117OCT05	23.75	3.12	9.3	1.39	—	—	4.44	.78	27	275	17.67	17.94	6.07	6.33
S.E. 194A XII2	-116MAR31	7.45	2.88	187.5	8.25*	9.46*	11.13*	12.34*	1.69	115	303	17.48	18.21	5.78	5.82
S.E. 195 VI	-116SEP24	15.34	3.07	358.7	16.48*	17.57*	19.14	20.22	1.71	65	236	17.99	18.12	5.89	6.55
S.E. 195 XII	-115MAR20	11.19	2.81	176.8	12.55*	—	—	15.06*	.36	69	350	18.10	18.04	5.95	6.32
S.E. 196 VI	-115SEP14	2.46	3.02	348.0	4.13	—	—	6.49*	.31	114	188	17.92	18.31	5.70	5.84
S.E. 196 XI	-114FEB08	11.84	—	137.1	—	—	—	—	-.22	203	203	17.40	17.40	6.59	7.20
S.E. 196 XII	-114MAR09	21.94	—	166.2	—	—	—	—	-.85	29	29	17.44	17.86	6.14	6.27
S.E. 197A V	-114AUG04	13.63	—	308.0	—	—	—	—	-.57	339	339	18.92	18.92	5.08	5.67
S.E. 197A XI	-113JAN29	4.04	2.68	126.5	5.14	—	—	8.46*	1.03	136	265	16.42	17.26	6.74	6.89
S.E. 198 IV	-113JUL24	14.80	2.92	297.2	16.09*	—	—	19.54	.84	42	284	18.98	19.05	4.96	5.53
S.E. 198 X	-112JAN18	18.38	2.72	115.8	19.18	20.35	21.73	22.89	1.44	94	299	16.84	17.15	6.85	7.25
S.E. 199A IV	-112JUL12	22.17	2.95	286.6	23.18	.37	1.77	2.96	1.43	90	244	18.80	19.14	4.86	5.18
S.E. 199A X	-111JAN07	2.56	2.79	104.8	4.44	—	—	5.85	.04	33	352	16.47	17.06	6.93	7.06
S.E. 200 II	-111JUN03	5.18	—	248.5	—	—	—	—	-.90	4	4	18.40	19.10	4.90	4.78
S.E. 200 III	-111JUL02	12.36	2.98	276.4	14.35*	—	—	15.99*	.12	145	197	19.15	19.18	4.82	5.65
S.E. 200 VIII	-111NOV27	7.66	—	63.0	—	—	—	—	-.71	174	174	16.42	17.17	6.84	6.88
S.E. 201 II	-110MAY23	22.31	3.09	238.5	.31	—	—	2.72	.38	48	327	18.60	19.00	5.00	5.21
S.E. 201 VIII	-110NOV16	9.52	3.16	51.6	11.23*	—	—	14.30*	.63	119	221	17.26	17.28	6.72	7.58
S.E. 202A II	-109MAY13	11.63	3.08	228.3	12.75*	13.89*	15.51*	16.65*	1.72	97	284	18.93	18.88	5.12	5.72
S.E. 202A VIII	-109NOV05	18.63	3.18	40.5	19.89	20.99	22.57	23.66	1.75	74	261	17.18	17.44	6.57	7.08
S.E. 203 I	-108MAY01	17.87	3.05	217.8	19.29	—	—	22.24	.51	147	240	18.50	18.72	5.27	5.67
S.E. 203 VII	-108OCT25	9.31	3.18	29.7	10.99*	—	—	13.68*	.54	32	298	17.70	17.60	6.41	7.38
S.E. 203 XII	-107MAR22	2.95	—	178.4	—	—	—	—	-.72	18	18	17.52	18.06	5.93	5.97
S.E. 204 I	-107APR20	18.79	—	207.1	—	—	—	—	-.88	196	196	18.28	18.55	5.44	5.85
S.E. 204 VI	-107SEP15	13.86	—	349.5	—	—	—	—	-.48	162	162	18.11	18.27	5.73	6.44
S.E. 204 VII	-107OCT15	1.11	—	19.0	—	—	—	—	-.70	343	343	17.44	17.78	6.23	6.42
S.E. 204 XII	-106MAR11	8.50	2.76	167.7	9.72*	—	—	12.91*	.75	73	323	17.04	17.87	6.12	6.06

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 205A VI	-106SEP04	23.14	2.98	338.7	.61	—	—	3.86	.74	109	218	18.10	18.46	5.55	5.81
S.E. 205A XII	-105FEB28	20.95	2.70	157.1	21.76	22.86	.37	1.46	1.61	114	279	17.31	17.71	6.29	6.62
S.E. 206 V	-105AUG25	1.56	2.94	327.8	2.40	3.63	5.25	6.48*	1.59	69	262	18.27	18.64	5.37	5.52
S.E. 206 XI	-104FEB18	13.17	2.67	146.7	14.56*	—	—	16.86*	.35	156	233	17.49	17.55	6.45	7.10
S.E. 207 V	-104AUG13	1.91	2.91	316.8	3.45	—	—	5.79*	.27	23	313	18.45	18.81	5.20	5.32
S.E. 207 X	-103JAN08	15.95	—	106.4	—	—	—	—	-.32	1	1	16.93	17.07	6.92	7.44
S.E. 207 XI	-103FEB07	4.57	—	136.1	—	—	—	—	-.98	192	192	16.59	17.38	6.61	6.82
S.E. 208U IV	-103JUL03	20.86	—	277.8	—	—	—	—	-.17	182	182	18.79	19.18	4.82	5.21
S.E. 208U V	-103AUG02	7.41	—	306.1	—	—	—	—	-.97	351	351	18.39	18.95	5.05	4.91
S.E. 208U IX	-103DEC28	21.87	2.86	95.3	23.09	—	—	2.56	.86	56	297	16.66	17.03	6.97	7.31
S.E. 209 III	-102JUN23	12.41	3.02	267.7	13.70*	14.92*	16.00*	17.22*	1.27	115	258	19.23	19.19	4.81	5.52
S.E. 209 IX	-102DEC17	21.71	2.96	83.8	22.57	23.82	1.38	2.63	1.53	90	253	16.66	17.03	6.97	7.35
S.E. 210A III	-101JUN13	5.75	3.05	257.6	7.01*	8.34*	9.13*	10.46*	1.15	79	303	18.36	19.16	4.84	4.80
S.E. 210A IX	-101DEC06	22.30	3.04	72.3	23.93	—	—	2.36	.31	129	204	16.67	17.08	6.92	7.32
S.E. 211 I	-100MAY03	9.45	—	219.4	—	—	—	—	-.83	204	204	18.86	18.75	5.24	5.86
S.E. 211 II	-100JUN01	20.27	—	247.5	—	—	—	—	-.33	15	15	18.81	19.09	4.91	5.14
S.E. 211 VII	-100OCT26	16.87	—	31.1	—	—	—	—	-.52	334	334	17.49	17.58	6.43	7.02
S.E. 211 VIII	-100NOV25	5.60	—	61.2	—	—	—	—	-.81	163	163	16.52	17.18	6.82	6.91
S.E. 212 I	-99APR22	13.67	3.01	208.8	15.38*	—	—	18.23*	.46	163	251	18.52	18.58	5.41	5.83
S.E. 212 VII	-99OCT16	8.42	3.16	20.4	10.13*	—	—	13.14*	.75	27	277	17.28	17.76	6.25	6.09
S.E. 213A I	-98APR11	14.22	2.95	198.1	15.09*	16.29*	17.99*	19.19	1.83	118	299	18.33	18.40	5.59	5.94
S.E. 213A VII	-98OCT05	23.75	3.12	9.7	.95	2.04	3.61	4.70	1.75	64	237	17.63	17.94	6.07	6.34
S.E. 213A XII2	-97MAR31	18.48	2.88	187.4	19.78	—	—	22.55	.48	74	345	17.98	18.22	5.77	6.01
S.E. 214 VI	-97SEP25	10.37	3.07	358.9	12.04*	—	—	14.53*	.36	111	190	18.03	18.11	5.90	6.72
S.E. 214 XI	-96FEB19	20.18	—	148.0	—	—	—	—	-.27	206	206	17.15	17.56	6.43	6.81
S.E. 214 XII	-96MAR20	5.78	—	176.9	—	—	—	—	-.76	29	29	17.25	18.03	5.96	5.92
S.E. 215 V	-96AUG14	20.51	—	318.6	—	—	—	—	-.68	336	336	18.64	18.78	5.23	5.55
S.E. 215 XI	-95FEB08	12.56	2.66	137.5	13.66*	—	—	16.95*	.99	140	267	17.39	17.41	6.58	7.14
S.E. 216A V	-95AUG03	21.78	2.91	307.7	23.15	—	—	2.41	.71	34	285	18.70	18.93	5.08	5.37
S.E. 216A XI	-94JAN29	2.80	2.68	126.9	3.55	4.72	6.13	7.29*	1.47	99	302	16.57	17.26	6.73	6.88
S.E. 217 IV	-94JUL24	5.50	2.92	297.2	6.47*	7.62*	9.13*	10.28*	1.56	82	244	18.50	19.05	4.95	4.93
S.E. 217 X	-93JAN18	10.70	2.72	115.9	12.47*	—	—	13.98*	.06	39	354	17.21	17.15	6.84	7.37
S.E. 218A IV	-93JUL13	19.92	2.94	286.9	21.67	—	—	23.73	.25	133	200	18.82	19.14	4.87	5.34
S.E. 218A IX	-93DEC08	15.78	—	74.2	—	—	—	—	-.71	179	179	16.80	17.07	6.93	7.54
S.E. 219 II	-92JUN03	5.67	3.08	248.9	7.87*	—	—	9.92*	.24	37	330	18.38	19.10	4.90	4.81
S.E. 219 VIII	-92NOV26	17.95	3.11	62.8	19.62	—	—	22.68	.63	123	225	16.86	17.16	6.84	7.38
S.E. 220 II	-91MAY23	18.63	3.09	238.7	19.79	20.95	22.50	23.66	1.58	89	285	18.77	19.00	4.99	5.37
S.E. 220 VIII	-91NOV16	3.38	3.16	51.7	4.62	5.72	7.29*	8.39*	1.75	77	264	16.72	17.29	6.72	6.85
S.E. 221A II	-90MAY13	.46	3.08	228.2	1.78	—	—	5.00	.66	138	243	18.40	18.87	5.13	5.34
S.E. 221A VIII	-90NOV05	18.16	3.18	40.9	19.83	—	—	22.54	.55	35	300	17.23	17.43	6.57	7.12
S.E. 221A XII2	-89APR02	9.92	—	189.0	—	—	—	—	-.83	18	18	18.35	18.25	5.74	6.18
S.E. 222 I	-89MAY02	1.31	—	217.5	—	—	—	—	-.73	194	194	18.21	18.71	5.28	5.52
S.E. 222 VI	-89SEP26	22.07	—	.4	—	—	—	—	-.54	162	162	17.69	18.09	5.92	6.26
S.E. 222 VII	-89OCT26	9.79	—	30.1	—	—	—	—	-.69	345	345	17.72	17.59	6.42	7.33
S.E. 222 XII	-88MAR21	16.05	2.82	178.4	17.41*	—	—	20.47	.66	70	326	17.92	18.07	5.93	6.30
S.E. 223 VI	-88SEP15	6.79	3.03	349.6	8.36*	—	—	11.51*	.66	110	215	17.73	18.28	5.72	5.70
S.E. 223 XII	-87MAR11	4.99	2.76	167.9	5.85	6.93*	8.48*	9.56*	1.69	113	282	17.11	17.88	6.11	6.18
S.E. 224A VI	-87SEP04	8.74	2.98	338.5	9.62*	10.84*	12.50*	13.72*	1.68	69	258	17.93	18.47	5.54	5.44
S.E. 224A XII	-86FEB28	21.44	2.71	157.5	22.79	—	—	1.23	.41	155	238	17.27	17.71	6.28	6.64
S.E. 225 V	-86AUG24	9.06	2.94	327.5	10.50*	—	—	13.11*	.37	25	305	18.73	18.64	5.37	6.14
S.E. 225 X	-85JAN20	.37	—	117.5	—	—	—	—	-.35	6	6	16.67	17.16	6.83	7.02
S.E. 225 XI	-85FEB18	12.82	—	147.0	—	—	—	—	-.94	195	195	17.49	17.55	6.44	7.12
S.E. 226 IV	-85JUL15	4.22	—	288.3	—	—	—	—	-.28	178	178	18.43	19.13	4.87	4.96
S.E. 226 V	-85AUG13	14.86	—	316.7	—	—	—	—	-.86	348	348	18.81	18.80	5.20	5.78
S.E. 226 X	-84JAN09	5.99	2.78	106.4	7.13*	—	—	10.58*	.84	60	303	16.41	17.07	6.93	6.97
S.E. 227U IV	-84JUL03	19.94	2.98	278.1	21.26	22.60	23.34	.68	1.14	115	250	18.85	19.18	4.82	5.23
S.E. 227U IX	-84DEC28	5.74	2.86	95.0	6.53	7.77*	9.34*	10.58*	1.54	94	259	16.39	17.03	6.97	7.06
S.E. 228 III	-83JUN23	13.19	3.02	268.1	14.36*	15.57*	16.70*	17.91*	1.29	79	294	19.22	19.19	4.81	5.45
S.E. 228 IX	-83DEC17	6.63	2.96	83.5	8.17*	—	—	10.63*	.33	134	210	16.34	17.03	6.97	7.04
S.E. 229A II	-82MAY14	16.35	—	229.9	—	—	—	—	-.98	201	201	18.70	18.90	5.10	5.57
S.E. 229A III	-82JUN13	3.35	—	257.9	—	—	—	—	-.19	11	11	18.57	19.16	4.84	4.85
S.E. 229A VIII	-82NOV07	1.65	—	42.3	—	—	—	—	-.52	336	336	17.09	17.42	6.59	6.77
S.E. 229A IX	-82DEC06	14.32	—	72.4	—	—	—	—	-.80	167	167	16.85	17.08	6.92	7.75
S.E. 230 I	-81MAY03	20.23	3.05	219.3	22.19	—	—	.66	.30	168	241	18.42	18.74	5.25	5.55
S.E. 230 VII	-81OCT27	17.20	3.18	31.5	18.94	—	—	21.93	.73	28	280	17.43	17.57	6.43	7.05
S.E. 231 I	-80APR21	20.90	3.01	208.6	21.86	23.07	.74	1.95	1.70	121	293	18.24	18.57	5.42	5.65
S.E. 231 VII	-80OCT16	8.27	3.16	20.8	9.49*	10.58*	12.17*	13.25*	1.78	65	239	17.25	17.76	6.25	6.13
S.E. 232A I	-79APR11	1.68	2.95	198.0	2.97	—	—	5.96*	.60	78	339	17.85	18.39	5.60	5.69
S.E. 232A VII	-79OCT05	18.39	3.12	9.9	20.06	—	—	22.65	.39	110	192	17.69	17.93	6.08	6.57
S.E. 232A XII	-78MAR02	4.40	—	158.9	—	—	—	—	-.33	208	208	16.92	17.73	6.26	6.44
S.E. 232A XII2	-78MAR31	13.50	—	187.6	—	—	—	—	-.65	29	29	18.21	18.23	5.77	6.08
S.E. 233 V	-78AUG26	3.52	—	329.3	—	—	—	—	-.79	334	334	18.35	18.62	5.39	5.45

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 233 XI	-77FEB19	20.93	2.68	148.4	22.08	—	—	1.32	.93	145	267	17.13	17.57	6.42	6.74
S.E. 234 V	-77AUG15	4.91	2.92	318.4	6.40*	—	—	9.48*	.61	26	286	18.41	18.79	5.22	5.23
S.E. 234 XI	-76FEB09	11.07	2.66	137.8	11.79*	12.94*	14.40*	15.56*	1.51	103	304	17.47	17.42	6.58	7.09
S.E. 235A V	-76AUG03	12.96	2.91	307.8	13.93*	15.05*	16.63*	17.75*	1.67	75	243	18.87	18.92	5.08	5.82
S.E. 235A XI	-75JAN28	18.69	2.68	126.9	20.34	—	—	22.01	.10	45	356	16.99	17.27	6.73	7.02
S.E. 236 IV	-75JUL24	3.58	2.92	297.5	5.15*	—	—	7.51*	.37	124	202	18.48	19.05	4.95	5.03
S.E. 236 IX	-75DEC18	23.89	—	85.4	—	—	—	—	.72	183	183	16.46	17.03	6.97	7.31
S.E. 237A III	-74JUN14	13.02	3.05	259.3	15.45*	—	—	17.00*	.09	24	335	19.22	19.17	4.83	5.48
S.E. 237A IV	-74JUL13	20.73	—	287.4	—	—	—	—	.93	167	167	18.74	19.13	4.87	5.33
S.E. 237A IX	-74DEC08	2.41	3.03	74.0	4.00	—	—	7.06*	.63	128	230	16.45	17.08	6.93	7.15
S.E. 238 II	-73JUN04	1.57	3.08	249.1	2.75	3.96	5.37*	6.58*	1.43	81	286	18.60	19.10	4.89	5.02
S.E. 238 VIII	-73NOV27	12.18	3.11	62.9	13.39*	14.48*	16.05*	17.14*	1.76	81	268	17.11	17.16	6.85	7.65
S.E. 239 II	-72MAY23	6.97	3.09	238.6	8.19*	—	—	11.65*	.82	129	245	18.29	19.00	5.00	5.01
S.E. 239 VIII	-72NOV16	3.07	3.16	52.1	4.72	—	—	7.43*	.56	38	303	16.74	17.29	6.72	6.85
S.E. 240A I	-71APR12	16.79	—	199.6	—	—	—	—	.94	17	17	18.28	18.43	5.57	5.84
S.E. 240A II	-71MAY12	7.80	—	228.0	—	—	—	—	.58	191	191	18.11	18.86	5.13	5.18
S.E. 240A VII	-71OCT07	6.39	—	11.4	—	—	—	—	.58	162	162	17.27	17.91	6.10	6.08
S.E. 240A VIII	-71NOV05	18.55	—	41.3	—	—	—	—	.69	347	347	17.26	17.43	6.58	7.08
S.E. 240A XII2	-70APR01	23.49	2.89	189.0	1.01	—	—	3.90	.56	66	330	17.79	18.24	5.75	5.91
S.E. 241 VI	-70SEP26	14.57	3.08	.5	16.24*	—	—	19.29	.60	112	212	17.94	18.09	5.92	6.53
S.E. 241 XII	-69MAR22	12.91	2.82	178.6	13.84*	14.91*	16.50*	17.57*	1.78	111	285	18.07	18.07	5.92	6.46
S.E. 242 VI	-69SEP15	16.07	3.03	349.4	17.00*	18.21*	19.89	21.11	1.76	71	254	18.14	18.28	5.73	6.24
S.E. 242 XII	-68MAR11	5.58	2.76	168.3	6.92*	—	—	9.52*	.49	153	243	17.07	17.89	6.11	6.20
S.E. 243A VI	-68SEP03	16.37	2.98	338.2	17.75*	—	—	20.58	.46	28	299	18.37	18.46	5.54	6.04
S.E. 243A XI	-67JAN30	8.64	—	128.6	—	—	—	—	.39	10	10	16.45	17.28	6.71	6.61
S.E. 243A XII	-67FEB28	20.91	—	157.9	—	—	—	—	.89	197	197	17.31	17.72	6.27	6.69
S.E. 244 IV	-67JUL25	11.69	—	298.8	—	—	—	—	.39	174	174	18.98	19.03	4.97	5.78
S.E. 244 V	-67AUG23	22.46	—	327.4	—	—	—	—	.76	345	345	18.42	18.64	5.36	5.63
S.E. 244 X	-66JAN19	13.98	2.71	117.5	15.08*	—	—	18.50	.81	63	308	17.07	17.16	6.83	7.37
S.E. 245 IV	-66JUL15	3.56	2.94	288.6	4.90*	—	—	8.22*	1.02	114	241	18.46	19.13	4.88	4.95
S.E. 245 X	-65JAN08	13.69	2.78	106.1	14.38*	15.62*	17.21	18.45	1.57	98	264	16.95	17.07	6.92	7.54
S.E. 246U IV	-65JUL04	20.66	2.97	278.6	21.78	22.92	.25	1.40	1.41	78	285	18.86	19.18	4.82	5.17
S.E. 246U IX	-65DEC28	14.93	2.87	94.7	16.36*	—	—	18.85	.34	138	215	16.82	17.03	6.97	7.65
S.E. 247 III	-64JUN23	10.42	3.01	268.4	13.00*	—	—	13.51*	-.06	13	358	19.36	19.19	4.81	5.47
S.E. 247 VIII	-64NOV17	10.48	—	53.5	—	—	—	—	-.52	340	340	17.33	17.26	6.75	7.68
S.E. 247 IX	-64DEC16	23.04	—	83.6	—	—	—	—	-.79	172	172	16.49	17.03	6.97	7.41
S.E. 248A II	-63MAY14	2.70	3.08	229.7	4.97	—	—	6.91*	.15	174	230	18.31	18.89	5.11	5.28
S.E. 248A VIII	-63NOV07	2.05	3.18	42.7	3.81	—	—	6.78*	.72	30	283	17.02	17.41	6.60	6.77
S.E. 249 I	-62MAY03	3.50	3.05	219.0	4.53	5.76*	7.34*	8.57*	1.55	123	286	18.14	18.73	5.26	5.37
S.E. 249 VII	-62OCT27	16.88	3.18	31.9	18.13	19.22	20.81	21.90	1.79	66	242	17.39	17.57	6.44	7.06
S.E. 250 I	-61APR22	8.81	3.01	208.5	10.06*	—	—	13.26*	.74	81	332	17.71	18.56	5.43	5.38
S.E. 250 VII	-61OCT17	2.52	3.16	20.9	4.20	—	—	6.85*	.42	110	194	17.35	17.75	6.26	6.42
S.E. 250 XII	-60MAR12	12.49	—	169.6	—	—	—	—	-.40	209	209	17.92	17.92	6.07	6.60
S.E. 251A I	-60APR10	21.14	—	198.2	—	—	—	—	-.53	28	28	18.03	18.40	5.59	5.74
S.E. 251A VI	-60SEP05	10.71	—	340.1	—	—	—	—	-.88	332	332	18.48	18.43	5.58	6.28
S.E. 251A VII	-60OCT05	5.08	—	9.7	—	—	—	—	-.95	151	151	17.48	17.94	6.07	6.13
S.E. 251A XII	-59MAR02	5.17	2.71	159.3	6.38*	—	—	9.56*	.87	149	267	16.91	17.74	6.26	6.37
S.E. 252 V	-59AUG25	12.21	2.94	329.1	13.81*	—	—	16.71*	.51	20	288	18.61	18.61	5.39	6.08
S.E. 252 XI	-58FEB19	19.19	2.68	148.8	19.91	21.06	22.57	23.71	1.57	107	305	17.26	17.57	6.42	6.72
S.E. 253 V	-58AUG14	20.57	2.92	318.4	21.55	22.66	.27	1.38	1.78	69	243	18.54	18.78	5.22	5.62
S.E. 253 XI	-57FEB09	2.53	2.66	137.9	4.07	—	—	5.94	.14	51	356	16.82	17.41	6.59	6.69
S.E. 254A V	-57AUG04	11.34	2.91	308.1	12.80*	—	—	15.39*	.48	115	203	18.88	18.92	5.09	5.98
S.E. 254A X	-57DEC30	7.96	—	96.5	—	—	—	—	-.73	188	188	16.15	17.03	6.97	7.06
S.E. 255 III	-56JUN24	20.37	3.01	269.8	23.20	—	—	23.91	-.05	6	344	18.95	19.19	4.81	5.14
S.E. 255 IV	-56JUL24	4.38	—	297.9	—	—	—	—	-.82	163	163	18.41	19.05	4.96	5.02
S.E. 255 IX	-56DEC18	10.86	2.95	85.2	12.38*	—	—	15.42*	.63	132	234	16.98	17.03	6.97	7.74
S.E. 256A III	-55JUN14	8.48	3.05	259.5	9.69*	10.99*	12.15*	13.45*	1.28	72	286	18.42	19.17	4.83	4.69
S.E. 256A IX	-55DEC07	21.00	3.03	74.2	22.14	23.22	.80	1.88	1.76	85	272	16.66	17.07	6.93	7.35
S.E. 257 II	-54JUN03	13.44	3.07	249.0	14.57*	—	—	18.22*	.97	120	246	19.04	19.11	4.89	5.47
S.E. 257 VIII	-54NOV27	12.02	3.10	63.3	13.61*	—	—	16.33*	.56	42	307	17.16	17.16	6.85	7.68
S.E. 258 II	-53MAY23	14.24	—	238.4	—	—	—	—	-.42	187	187	18.89	19.00	4.99	5.56
S.E. 258 VII	-53OCT18	14.82	—	22.5	—	—	—	—	-.62	163	163	17.50	17.72	6.29	6.98
S.E. 258 VIII	-53NOV17	3.36	—	52.5	—	—	—	—	-.69	351	351	16.79	17.28	6.72	6.82
S.E. 259A I	-52APR12	6.84	2.96	199.6	8.55*	—	—	11.22*	.45	61	333	17.65	18.42	5.57	5.52
S.E. 259A VII	-52OCT06	22.47	3.13	11.5	.23	—	—	3.20	.55	114	210	17.55	17.90	6.10	6.41
S.E. 259A XII2	-51APR01	20.71	2.89	189.3	21.72	22.78	.38	1.44	1.89	108	288	17.88	18.25	5.74	6.04
S.E. 260 VI	-51SEP25	23.55	3.08	.3	.54	1.75	3.43	4.65	1.82	72	252	17.78	18.10	5.91	6.15
S.E. 260 XII	-50MAR22	13.59	2.82	179.0	14.90*	—	—	17.66*	.58	150	246	18.04	18.08	5.91	6.49
S.E. 261 VI	-50SEP14	23.87	3.03	349.1	1.24	—	—	4.22	.54	30	295	18.00	18.29	5.72	5.94
S.E. 261 XI	-49FEB10	16.77	—	139.5	—	—	—	—	-.44	13	13	17.26	17.44	6.56	6.93
S.E. 261 XII	-49MAR12	4.84	—	168.7	—	—	—	—	-.82	198	198	17.15	17.89	6.10	6.27
S.E. 262A V	-49AUG05	19.30	—	309.4	—	—	—	—	-.49	170	170	18.58	18.91	5.10	5.57

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 262A VI	-49SEP04	6.24	—	338.2	—	—	—	—	-.67	343	343	18.02	18.47	5.53	5.48
S.E. 262A XI	-48JAN30	21.84	2.67	128.5	22.93	—	—	2.30	.77	65	313	16.90	17.28	6.71	6.98
S.E. 263 IV	-48JUL25	11.26	2.91	299.2	12.64*	—	—	15.83*	.90	114	233	19.06	19.03	4.98	5.84
S.E. 263 X	-47JAN18	21.54	2.72	117.2	22.18	23.42	1.03	2.26	1.60	102	269	16.77	17.16	6.84	7.18
S.E. 264 IV	-47JUL15	4.18	2.94	289.0	5.23*	6.34*	7.80*	8.91*	1.54	78	277	18.49	19.12	4.88	4.90
S.E. 264 X	-46JAN07	23.17	2.78	105.9	.50	—	—	3.04	.36	142	221	16.57	17.07	6.93	7.29
S.E. 265U IV	-46JUL04	17.50	2.97	278.8	19.55	—	—	21.03	.07	24	339	19.05	19.18	4.82	5.24
S.E. 265U VIII	-46NOV28	19.34	—	64.7	—	—	—	—	-.52	344	344	16.94	17.15	6.86	7.35
S.E. 265U IX	-46DEC28	7.73	—	94.8	—	—	—	—	-.77	177	177	16.14	17.03	6.97	7.03
S.E. 266 II	-45MAY25	9.12	3.09	240.1	11.86*	—	—	12.92*	-.01	183	213	19.12	19.02	4.97	5.59
S.E. 266 VIII	-45NOV18	10.96	3.15	53.9	12.70*	—	—	15.65*	.71	33	286	17.28	17.26	6.75	7.72
S.E. 267A II	-44MAY13	10.05	3.08	229.4	11.17*	12.45*	13.86*	15.14*	1.40	125	278	18.99	18.89	5.10	5.62
S.E. 267A VIII	-44NOV07	1.55	3.18	43.1	2.80	3.89	5.48	6.58	1.80	68	245	17.00	17.41	6.60	6.82
S.E. 268 I	-43MAY02	15.87	3.05	218.9	17.10*	—	—	20.47	.88	84	325	18.62	18.74	5.25	5.59
S.E. 268 VII	-43OCT27	10.74	3.18	32.0	12.41*	—	—	15.11*	.44	111	197	17.47	17.56	6.45	7.29
S.E. 268 XII	-42MAR23	20.45	—	180.3	—	—	—	—	-.49	209	209	17.71	18.10	5.89	6.25
S.E. 269 I	-42APR22	4.69	—	208.7	—	—	—	—	-.41	27	26	17.83	18.57	5.42	5.40
S.E. 269 VI	-42SEP16	18.06	—	350.9	—	—	—	—	-.95	331	331	18.17	18.25	5.76	6.18
S.E. 269 VII	-42OCT16	12.86	—	20.7	—	—	—	—	-.92	152	152	17.56	17.74	6.26	6.96
S.E. 269 XII	-41MAR13	13.26	2.77	170.1	14.57*	—	—	17.65*	.79	153	265	17.90	17.93	6.06	6.53
S.E. 270A VI	-41SEP05	19.68	2.98	339.8	21.43	—	—	.14	.43	15	289	18.29	18.44	5.57	5.96
S.E. 270A XII	-40MAR02	3.14	2.71	159.6	3.89	5.02	6.58*	7.72*	1.63	111	305	17.09	17.74	6.25	6.37
S.E. 271 V	-40AUG25	4.34	2.94	329.1	5.35*	6.45*	8.07*	9.17*	1.87	64	244	18.20	18.62	5.39	5.42
S.E. 271 XI	-39FEB19	10.20	2.68	148.8	11.64*	—	—	13.74*	.20	58	355	17.66	17.58	6.41	6.82
S.E. 272 V	-39AUG14	19.23	2.92	318.7	20.62	—	—	23.38	.58	108	204	18.52	18.78	5.23	5.73
S.E. 272 X	-38JAN09	15.95	—	107.6	—	—	—	—	-.74	193	193	16.82	17.08	6.91	7.46
S.E. 273A IV	-38JUL06	3.75	—	280.2	—	—	—	—	-.18	350	350	18.67	19.17	4.83	4.81
S.E. 273A V	-38AUG04	12.13	—	308.5	—	—	—	—	-.72	159	159	18.81	18.91	5.09	5.96
S.E. 273A X	-38DEC29	19.28	2.85	96.4	20.72	—	—	23.75	.63	137	239	16.65	17.03	6.97	7.43
S.E. 274 III	-37JUN25	15.38	3.01	270.0	16.63*	18.09*	18.83*	20.29	1.13	63	286	19.11	19.19	4.81	5.36
S.E. 274 IX	-37DEC19	5.81	2.95	85.4	6.87	7.95*	9.52*	10.61*	1.76	90	277	16.21	17.03	6.97	7.03
S.E. 275A III	-36JUN13	19.89	3.05	259.4	20.92	22.43	23.23	.74	1.13	110	247	18.89	19.17	4.83	5.20
S.E. 275A IX	-36DEC07	20.97	3.03	74.6	22.51	—	—	1.23	.56	47	311	16.69	17.07	6.93	7.34
S.E. 276 II	-35JUN02	20.65	—	248.7	—	—	—	—	-.26	183	183	18.76	19.10	4.90	5.27
S.E. 276 VII	-35OCT28	23.33	—	33.6	—	—	—	—	-.64	165	165	17.07	17.55	6.46	6.79
S.E. 276 VIII	-35NOV27	12.20	—	63.7	—	—	—	—	-.70	355	355	17.19	17.15	6.85	7.62
S.E. 277 I	-34APR23	14.11	3.01	210.1	16.03*	—	—	18.42*	.34	54	337	18.56	18.60	5.39	5.83
S.E. 277 VII	-34OCT18	6.47	3.17	22.6	8.31*	—	—	11.22*	.51	117	210	17.16	17.73	6.28	6.29
S.E. 278A I	-33APR13	4.42	2.96	199.9	5.50	6.57*	8.15*	9.22*	1.78	104	290	17.70	18.42	5.57	5.62
S.E. 278A VII	-33OCT07	7.18	3.13	11.2	8.22*	9.44*	11.11*	12.33*	1.76	74	251	17.41	17.92	6.09	6.07
S.E. 278A XII2	-32APR01	21.46	2.89	189.7	22.78	—	—	1.70	.67	146	250	17.84	18.26	5.74	6.06
S.E. 279 VI	-32SEP25	7.54	3.08	360.0	8.90*	—	—	11.99*	.60	32	292	17.62	18.11	5.90	5.84
S.E. 279 XI	-31FEB21	.73	—	150.4	—	—	—	—	-.51	15	15	17.09	17.60	6.40	6.52
S.E. 279 XII	-31MAR22	12.62	—	179.4	—	—	—	—	-.74	198	198	18.07	18.09	5.91	6.52
S.E. 280 V	-31AUG16	3.05	—	320.1	—	—	—	—	-.58	167	167	18.17	18.76	5.25	5.37
S.E. 280 VI	-31SEP14	14.19	—	349.1	—	—	—	—	-.60	342	342	18.28	18.28	5.73	6.36
S.E. 280 XI	-30FEB10	5.53	2.66	139.4	6.65*	—	—	9.95*	.71	67	318	16.77	17.43	6.56	6.61
S.E. 281A V	-30AUG05	19.06	2.91	309.8	20.51	—	—	23.58	.80	114	226	18.62	18.90	5.10	5.59
S.E. 281A XI	-29JAN30	5.28	2.68	128.2	5.87	7.10*	8.73*	9.95*	1.64	104	274	16.61	17.28	6.72	6.82
S.E. 282 IV	-29JUL26	11.77	2.91	299.6	12.80*	13.89*	15.43*	16.52*	1.65	77	270	19.07	19.02	4.98	5.78
S.E. 282 X	-28JAN19	7.33	2.72	116.9	8.56*	—	—	11.17*	.39	144	227	16.34	17.15	6.84	6.91
S.E. 283 IV	-28JUL15	.62	2.94	289.3	2.41	—	—	4.39	.19	28	327	18.72	19.12	4.88	5.03
S.E. 283 IX	-28DEC09	4.24	—	75.9	—	—	—	—	-.51	348	348	16.52	17.06	6.94	6.99
S.E. 283 X	-27JAN07	16.37	—	106.0	—	—	—	—	-.75	182	182	16.79	17.07	6.92	7.62
S.E. 284U III	-27JUN04	15.51	—	250.5	—	—	—	—	-.18	194	194	18.96	19.12	4.88	5.36
S.E. 284U VIII	-27NOV28	19.89	3.10	65.1	21.59	—	—	.54	.71	37	291	16.87	17.14	6.86	7.37
S.E. 285 II	-26MAY24	16.57	3.09	239.8	17.76*	19.13	20.25	21.63	1.24	127	270	18.85	19.02	4.98	5.37
S.E. 285 VIII	-26NOV18	10.28	3.15	54.3	11.50*	12.59*	14.19*	15.28*	1.81	71	248	17.23	17.25	6.75	7.73
S.E. 286A II	-25MAY13	22.90	3.08	229.4	.09	—	—	3.61	1.02	86	317	18.45	18.88	5.11	5.29
S.E. 286A VIII	-25NOV07	19.04	3.18	43.2	20.70	—	—	23.42	.44	113	200	17.12	17.40	6.61	7.11
S.E. 286A XII2	-24APR03	4.29	—	191.0	—	—	—	—	-.58	209	209	17.50	18.27	5.72	5.89
S.E. 287 I	-24MAY02	12.16	—	219.2	—	—	—	—	-.27	24	24	18.83	18.74	5.25	5.67
S.E. 287 VII	-24OCT26	20.74	—	31.8	—	—	—	—	-.90	154	154	17.24	17.57	6.44	6.84
S.E. 287 XII	-23MAR23	21.20	2.84	180.8	22.65	—	—	1.61	.69	157	262	17.69	18.10	5.89	6.18
S.E. 288 VI	-23SEP16	3.33	3.03	350.7	5.22	—	—	7.76*	.36	11	291	17.97	18.26	5.75	5.83
S.E. 288 XII	-22MAR13	10.92	2.77	170.4	11.71*	12.84*	14.45*	15.57*	1.72	115	303	18.00	17.93	6.06	6.50
S.E. 289A VI	-22SEP05	12.26	2.98	339.9	13.33*	14.43*	16.03*	17.13*	1.79	60	244	18.39	18.43	5.57	6.34
S.E. 289A XII	-21MAR02	17.69	2.71	159.6	19.07	—	—	21.41	.27	63	353	17.53	17.75	6.24	6.49
S.E. 290 V	-21AUG26	3.25	2.94	329.5	4.59	—	—	7.49*	.66	102	205	18.16	18.62	5.39	5.48
S.E. 290 X	-20JAN20	23.85	—	118.7	—	—	—	—	-.77	197	197	16.61	17.17	6.82	7.15
S.E. 291 IV	-20JUL16	11.18	—	290.7	—	—	—	—	-.32	346	346	19.22	19.10	4.90	5.71
S.E. 291 V	-20AUG14	19.97	—	319.2	—	—	—	—	-.63	156	156	18.45	18.77	5.24	5.71

Babyl.Date	Jul.Date	UT	LT-UT	LL	I	II	III	IV	Magn	E	A	MR	SS	SR	MS
S.E. 291 X	-19JAN09	3.65	2.77	107.5	5.02	—	—	8.03*	.62	143	244	16.33	17.08	6.92	7.11
S.E. 292A IV	-19JUL05	22.30	2.97	280.4	23.58	—	—	3.11	.98	53	286	18.87	19.17	4.83	5.10
S.E. 292A X	-19DEC29	14.58	2.85	96.6	15.55*	16.63*	18.21	19.29	1.77	95	282	16.88	17.03	6.97	7.58
S.E. 293 III	-18JUN25	2.35	3.01	269.8	3.31	4.66	5.89*	7.25*	1.29	101	247	18.71	19.19	4.81	4.94
S.E. 293 IX	-18DEC19	5.90	2.94	85.8	7.35*	—	—	10.08*	.57	52	316	16.22	17.03	6.97	6.98
S.E. 294A III	-17JUN14	3.10	—	259.1	—	—	—	—	-.10	179	179	18.60	19.17	4.83	4.98
S.E. 294A VIII	-17NOV09	7.90	—	44.8	—	—	—	—	-.66	168	168	16.63	17.39	6.62	6.59
S.E. 294A IX	-17DEC08	21.03	—	74.9	—	—	—	—	-.70	359	359	16.74	17.07	6.93	7.29
S.E. 295 I	-16MAY03	21.32	3.06	220.6	23.48	—	—	1.52	.22	45	341	18.41	18.76	5.23	5.45
S.E. 295 VII	-16OCT28	14.57	3.18	33.7	16.45*	—	—	19.30	.49	120	211	17.36	17.54	6.47	7.10
S.E. 296 I	-15APR23	12.03	3.02	210.4	13.19*	14.27*	15.80*	16.88*	1.66	99	292	18.66	18.61	5.39	5.97
S.E. 296 VII	-15OCT17	14.94	3.17	22.3	16.03*	17.25*	18.92	20.13	1.73	76	251	17.58	17.72	6.29	6.86
S.E. 297A I	-14APR13	5.21	2.96	200.3	6.51*	—	—	9.58*	.78	141	253	17.65	18.43	5.56	5.64
S.E. 297A VII	-14OCT06	15.36	3.13	11.0	16.76*	—	—	19.92	.65	34	291	17.81	17.91	6.10	6.65
S.E. 297A XII	-13MAR04	8.52	—	161.2	—	—	—	—	-.58	17	17	16.96	17.77	6.23	6.12
S.E. 297A XII2	-13APR02	20.23	—	190.0	—	—	—	—	-.65	198	198	17.92	18.26	5.73	6.12
S.E. 298 V	-13AUG27	10.95	—	330.8	—	—	—	—	-.65	165	165	18.52	18.58	5.42	6.27
S.E. 298 VI	-13SEP25	22.29	—	.0	—	—	—	—	-.54	338	338	17.87	18.10	5.91	6.20
S.E. 298 XI	-12FEB21	13.06	2.68	150.3	14.26*	—	—	17.46*	.64	67	323	17.56	17.60	6.39	6.84
S.E. 299 V	-12AUG16	2.99	2.92	320.5	4.51	—	—	7.45*	.70	114	220	18.19	18.75	5.25	5.36
S.E. 299 XI	-11FEB09	12.88	2.66	139.1	13.48*	14.69*	16.35*	17.56	1.70	106	279	17.37	17.43	6.56	7.08
S.E. 300A V	-11AUG05	19.45	2.91	310.2	20.45	21.53	23.12	.19	1.76	76	263	18.65	18.90	5.11	5.55
S.E. 300A XI	-10JAN29	15.39	2.68	128.0	16.55*	—	—	19.24	.43	147	233	17.10	17.28	6.71	7.27
S.E. 301 IV	-10JUL26	7.80	2.91	299.8	9.40*	—	—	11.74*	.30	30	316	18.39	19.03	4.98	4.85
S.E. 301 IX	-10DEC20	13.11	—	87.1	—	—	—	—	-.51	353	353	17.01	17.02	6.98	7.73
S.E. 301 X	-9JAN19	.93	—	117.1	—	—	—	—	-.72	186	186	16.51	17.16	6.84	7.18
S.E. 302 III	-9JUN15	21.89	—	260.9	—	—	—	—	-.34	190	190	18.77	19.17	4.82	5.14
S.E. 302 IX	-9DEC10	4.83	3.02	76.3	6.47	—	—	9.41*	.71	41	295	16.45	17.06	6.94	6.99
S.E. 303U III	-8JUN03	23.11	3.07	250.2	.36	1.95	2.51	4.10	1.09	128	261	18.67	19.11	4.88	5.12
S.E. 303U VIII	-8NOV28	19.03	3.09	65.5	20.19	21.28	22.88	23.98	1.81	75	253	16.86	17.14	6.87	7.42
S.E. 304 II	-7MAY24	5.91	3.08	239.8	7.08*	8.45*	9.34*	10.71*	1.17	87	309	18.25	19.01	4.99	4.98
S.E. 304 VIII	-7NOV18	3.38	3.15	54.4	5.00	—	—	7.74*	.45	116	204	16.77	17.26	6.75	6.91
S.E. 305A I	-6APR14	12.03	—	201.6	—	—	—	—	-.69	208	208	18.50	18.46	5.53	6.10
S.E. 305A II	-6MAY13	19.60	—	229.6	—	—	—	—	-.14	21	21	18.61	18.89	5.10	5.34
S.E. 305A VIII	-6NOV07	4.72	—	43.0	—	—	—	—	-.88	157	157	16.90	17.41	6.60	6.71
S.E. 305A XII2	-5APR04	5.00	2.90	191.4	6.61*	—	—	9.42*	.59	160	258	17.50	18.28	5.71	5.82
S.E. 306 VI	-5SEP27	11.15	3.09	1.6	13.16*	—	—	15.56*	.31	8	294	18.07	18.06	5.94	6.68
S.E. 306 XII	-4MAR23	18.53	2.84	181.0	19.39	20.51	22.15	23.27	1.81	118	301	17.85	18.11	5.88	6.17
S.E. 307 VI	-4SEP15	20.35	3.03	350.8	21.48	22.58	.16	1.26	1.72	57	245	18.04	18.26	5.75	6.16
S.E. 307 XII	-3MAR13	1.01	2.77	170.3	2.31	—	—	4.90	.36	69	349	17.43	17.92	6.07	6.18
S.E. 308A VI	-3SEP05	11.41	2.99	340.3	12.74*	—	—	15.74*	.74	98	206	18.37	18.43	5.58	6.46
S.E. 308A XI	-2JAN31	7.64	—	129.7	—	—	—	—	-.80	201	201	16.43	17.29	6.70	6.83
S.E. 309 IV	-2JUL27	18.67	—	301.3	—	—	—	—	-.44	342	342	18.89	19.01	5.00	5.45
S.E. 309 V	-2AUG26	3.93	—	329.9	—	—	—	—	-.56	154	154	18.09	18.61	5.40	5.47
S.E. 309 X	-1JAN20	11.94	2.71	118.6	13.25*	—	—	16.23*	.60	148	247	17.14	17.18	6.82	7.42
S.E. 310 IV	-1JUL17	5.26	2.93	290.9	6.61*	—	—	9.99*	.84	44	287	18.62	19.11	4.89	4.87
S.E. 310 X	0JAN09	23.29	2.77	107.7	.20	1.28	2.85	3.93	1.79	101	286	16.51	17.08	6.91	7.21
S.E. 311A IV	0JUL05	8.84	2.97	280.3	9.72*	11.00*	12.48*	13.75*	1.44	92	248	18.52	19.17	4.83	4.71
S.E. 311A X	0DEC29	14.79	2.85	97.0	16.16*	—	—	18.90	.57	57	321	16.91	17.03	6.97	7.56

5.2. Canon of Solar Eclipses from -800 to 0

The following tables were calculated with programs based on Stephenson - Morrison - Newcomb. We have assumed that the Moon's orbital acceleration is $-26''/\text{cy}^2$ and that the difference between Ephemeris Time (ET) and Universal Time (UT) can be represented by

$$(\text{ST82f}) \quad \Delta T = ET - UT = -1925 - 81 t + 32.5 t^2 \text{ sec}$$

where t is measured in centuries since 1800 AD. This is the final fit we have obtained from the timed lunar eclipse observations. All calculations were done for Babylon (44.42°E , 32.55°N).

The following solar eclipse data are given in this sequence (all times are in hours and decimals):

- Babylonian date: king, year, month. For intercalary years, the type of the intercalary month is indicated by A (second Addaru) or U (second Ululu) after the year (unreliable before about -600).
- Julian date and universal time UT of mid-eclipse.
- True local times (T1, Tm, T4) and altitudes (Alt1, Altm, Alt4) for first contact, mid-eclipse and last contact. The contact times were not adjusted for differences between calculation and naked-eye observation (i.e. on average, the observed first and last contacts will be about 6 minutes later and earlier, respectively, than the calculated T1 and T4, cf. Section 2.8).
- Magnitude (≥ 1 is total).
- Duration of totality/annularity, in seconds.
- True local times of sunrise and sunset. Setting and rising times were calculated for the upper rim of the Sun, i.e. using a zenith distance of $91^\circ 12'$. See Section 2.2 for details.

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
	-799JUN04	3.96	6.44	16.5	7.06	24.2	7.73	32.6	.19	0	4.94	19.07
	-798NOV18	9.11	11.22	38.7	12.25	39.8	13.29	36.6	.13	0	6.68	17.32
	-797NOV07	7.67	9.40	30.3	10.82	40.5	12.37	43.1	.42	0	6.51	17.48
	-790JUN24	16.32	18.43	7.3	19.38	-3.4	20.26	-12.5	.82	0	4.81	19.19
	-787OCT17	6.26	8.54	27.2	9.38	36.0	10.28	43.9	.25	0	6.18	17.81
	-784AUG16	16.36	18.64	1.0	19.27	-6.4	19.87	-13.2	.29	0	5.18	18.83
	-783FEB09	10.78	12.25	40.4	13.43	36.5	14.51	28.8	.41	0	6.65	17.35
	-777APR04	11.06	12.34	59.5	13.93	49.4	15.38	33.8	.62	0	5.81	18.20
	-776MAR23	13.53	15.60	28.4	16.33	19.7	17.02	11.3	.15	0	6.00	18.01
	-776SEP16	11.59	13.94	51.9	14.59	45.0	15.20	37.9	.13	0	5.65	18.34
	-774JAN31	7.76	9.27	25.0	10.42	33.4	11.65	37.9	.42	0	6.77	17.24
	-771NOV19	12.82	14.88	24.7	15.94	14.2	16.90	3.5	.26	0	6.70	17.30
	-770NOV08	11.76	13.35	39.1	14.91	27.1	16.30	12.5	.53	0	6.54	17.46
	-769MAY05	10.83	12.53	69.7	13.89	57.9	15.18	42.6	.74	0	5.32	18.69
	-765AUG17	3.25	5.32	.6	6.16	10.8	7.08	22.2	.34	0	5.17	18.82
	-764FEB10	8.31	9.65	30.2	10.96	38.4	12.29	40.5	.77	0	6.65	17.36
	-762JUN15	7.70	9.40	54.4	10.78	71.1	12.27	79.6	.86	0	4.85	19.15
	-757SEP17	9.19	11.18	60.7	12.19	63.0	13.18	58.4	.23	0	5.66	18.33
	-755JAN31	7.28	8.98	22.5	9.94	30.3	10.96	36.1	.30	0	6.76	17.24
	-754JUL16	3.21	5.27	3.5	6.17	14.2	7.18	26.4	.57	0	4.84	19.15
	-750MAY05	1.86	4.05	-16.0	4.92	-5.9	5.85	5.3	.73	0	5.31	18.68
	-748SEP07	5.75	7.96	29.6	8.72	39.0	9.52	48.4	.16	0	5.51	18.48
NBNR 3U IV	-744JUN25	16.79	19.22	-1.6	19.83	-8.1	20.42	-14.0	.35	0	4.81	19.19
NBNR 3U IX	-744DEC20	10.74	12.87	32.6	13.67	29.1	14.41	24.3	.08	0	6.97	17.03
NBNR 4 IX	-743DEC09	8.65	9.87	27.3	11.68	35.0	13.55	30.8	.75	0	6.91	17.09
NBNR 7 VII	-740OCT08	2.56	4.82	-16.6	5.66	-6.0	6.56	5.4	.75	0	6.04	17.97
NBNR 11A V	-736JUL26	13.18	14.92	49.7	16.11	34.6	17.17	21.5	.55	0	4.92	19.07
NBNDZ 1 II	-732MAY15	9.94	12.19	74.1	13.04	68.9	13.88	60.1	.12	0	5.16	18.85
UKNZR 1 VI	-730SEP18	15.92	18.10	1.3	18.93	-9.0	19.70	-18.5	.46	0	5.70	18.31
UKNZR 1 XII	-729MAR14	10.42	12.02	51.9	13.17	48.4	14.26	40.1	.45	0	6.15	17.86
ULULA 3 II	-723MAY06	5.20	7.14	21.7	8.27	36.0	9.56	51.9	.56	0	5.29	18.72
ULULA 4A II	-722APR25	7.30	9.29	46.5	10.31	57.8	11.40	66.4	.20	0	5.46	18.55
ULULA 5 XII	-720MAR04	8.44	10.92	45.6	11.13	46.6	11.35	47.4	.01	0	6.30	17.71
MKAID 4A X	-717DEC22	13.35	16.01	9.8	16.27	7.1	16.53	4.3	.02	0	6.97	17.03
MKAID 5 IX	-716DEC10	13.31	14.88	21.2	16.32	7.2	17.54	-6.4	.64	0	6.92	17.08
MKAID 8 VII	-713OCT10	12.56	14.96	34.5	15.66	26.6	16.33	18.7	.20	0	6.06	17.93
MKAID 10 XII	-710MAR14	9.06	10.64	47.3	11.80	51.9	12.97	49.6	.57	0	6.15	17.86
SARG2 1 IV	-708JUL17	5.47	7.51	30.4	8.43	42.0	9.45	54.9	.38	0	4.86	19.14
SARG2 5 II	-704MAY05	15.83	17.90	8.6	18.89	-3.4	19.79	-13.9	.57	0	5.28	18.71
SANH1 1A VIII	-703OCT19	10.55	12.13	49.9	13.69	43.2	15.13	30.0	.80	0	6.23	17.77
SANH1 2 XII	-701MAR05	8.98	10.32	42.1	11.68	48.3	13.04	46.0	.78	0	6.29	17.71
BELIB 3 V	-699AUG06	16.08	18.14	8.4	18.99	-1.7	19.79	-10.7	.84	0	5.05	18.95
ASNSM 5 VII	-694OCT10	6.15	8.31	26.2	9.25	36.6	10.25	45.9	.27	0	6.07	17.92
MUSMK 2A V	-690JUL28	15.61	17.75	14.2	18.54	4.7	19.28	-3.9	.58	0	4.95	19.05
MUSMK 2A XI	-689JAN22	10.78	12.39	36.0	13.48	32.3	14.45	25.8	.18	0	6.86	17.15
MUSMK 3 IV	-689JUL18	6.51	8.47	42.5	9.47	55.1	10.54	68.2	.42	0	4.86	19.14
MUSMK 3 X	-688JAN11	9.51	10.44	30.2	12.27	34.4	14.00	27.6	.78	0	6.94	17.06
SANH2 2 VIII	-686NOV10	5.11	7.49	9.7	8.26	18.2	9.09	26.5	.29	0	6.57	17.42
SANH2 6A VI	-682AUG28	10.93	12.92	66.5	13.86	57.6	14.75	47.4	.20	0	5.35	18.65
ASRHD 2 III	-678JUN17	4.27	6.25	15.2	7.34	28.5	8.58	44.0	.74	0	4.84	19.17
ASRHD 5 I	-675APR15	8.61	11.09	61.5	11.57	63.8	12.05	64.5	.07	0	5.61	18.40
ASRHD 12A III	-668MAY27	1.55	4.00	-12.4	4.66	-5.2	5.35	2.8	.28	0	5.00	18.99
SSSUK 4A VI	-663AUG28	5.48	7.83	29.7	8.41	37.1	9.03	44.7	.13	0	5.35	18.64
SSSUK 5 X	-661JAN12	14.22	15.70	13.5	16.98	-.1	18.10	-13.1	.86	0	6.93	17.07
SSSUK 7A IV	-660JUN27	13.90	15.60	42.0	16.93	25.4	18.08	11.5	.96	0	4.80	19.20
SSSUK 11 I	-656APR15	8.13	9.89	51.2	11.08	61.6	12.33	64.2	.76	0	5.60	18.41
SSSUK 17A III	-650JUN07	9.64	10.90	71.8	12.73	75.5	14.47	55.6	.61	0	4.90	19.10
SSSUK 18 VIII	-649NOV21	13.06	14.81	24.8	16.19	11.1	17.38	-2.4	.86	0	6.73	17.27
SSSUK 20 I	-647APR06	8.44	10.09	50.6	11.34	59.7	12.64	59.8	.66	0	5.75	18.26
KANDL 2 VI	-645SEP08	16.12	18.23	1.7	19.09	-8.9	19.89	-18.4	.80	0	5.54	18.47
KANDL 7 VIII	-640NOV11	7.58	9.28	27.9	10.73	38.3	12.32	41.3	.82	0	6.60	17.39
KANDL 11 VI	-636AUG29	15.44	17.54	12.1	18.38	1.6	19.17	-8.0	.67	0	5.39	18.62
KANDL 12U VI	-635AUG19	5.90	7.66	29.0	8.81	43.5	10.07	58.6	.81	0	5.22	18.77

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
KANDL 12U XI	-634FEB12	8.72	9.68	31.3	11.37	40.8	13.04	39.4	.83	0	6.60	17.41
KANDL 21 XI	-625FEB03	3.15	4.80	-24.6	5.81	-12.1	6.94	1.4	.90	0	6.72	17.28
NBPLS 2A IV	-623JUL08	1.04	3.23	-17.4	4.03	-9.6	4.88	-5	.56	0	4.82	19.19
NBPLS 12A IX	-613DEC13	3.55	5.66	-16.1	6.55	-5.5	7.54	5.5	.47	0	6.94	17.06
NBPLS 16 VI	-609SEP30	7.06	8.94	35.9	10.12	48.0	11.39	56.4	.59	0	5.90	18.09
NBPLS 17 XI	-607FEB13	13.95	15.51	20.6	16.60	8.6	17.58	-3.0	.46	0	6.58	17.43
NBPLS 19U V	-606JUL30	8.28	9.45	54.0	11.20	73.9	13.04	71.6	.80	0	4.97	19.03
NBKDR 2U II	-602MAY18	6.24	8.24	37.5	9.33	51.2	10.53	65.2	.85	0	5.11	18.89
NBKDR 8 III	-596JUL09	2.99	5.08	1.6	5.98	12.0	6.98	24.1	.45	0	4.82	19.18
NBKDR 9U III	-595JUN28	9.58	11.24	76.5	12.60	78.0	13.91	63.3	.42	0	4.80	19.20
NBKDR 11A I	-593MAY09	6.44	8.91	44.6	9.52	52.0	10.16	59.5	.14	0	5.24	18.77
NBKDR 18 VIII	-586DEC14	9.88	11.13	33.1	12.87	33.1	14.56	23.5	.67	0	6.95	17.05
NBKDR 20 II	-584MAY28	15.99	18.21	8.2	19.09	-2.1	19.91	-11.1	1.00	0	4.98	19.02
NBKDR 21U II	-583MAY18	5.32	8.20	37.0	8.42	39.7	8.63	42.5	.02	0	5.11	18.90
NBKDR 23A VI	-581SEP21	6.76	8.60	34.3	9.78	47.5	11.04	58.0	.76	0	5.75	18.24
NBKDR 23A XII	-580MAR16	6.18	7.61	17.7	8.95	33.1	10.43	47.0	.74	0	6.09	17.92
NBKDR 26A IV	-578JUL20	12.93	14.59	54.2	15.87	38.0	17.00	23.9	.58	0	4.88	19.12
NBKDR 26A X	-577JAN14	13.25	15.21	18.4	15.99	10.8	16.71	3.1	.26	0	6.92	17.09
NBKDR 30 I	-574MAY09	4.64	6.87	19.0	7.72	29.7	8.64	41.3	.36	0	5.23	18.78
NBKDR 33A XI	-570FEB24	15.47	17.31	2.3	18.14	-7.9	18.91	-17.7	.51	0	6.40	17.59
NBKDR 35 IX	-568JAN05	10.32	12.51	33.6	13.13	31.9	13.72	28.9	.08	0	6.97	17.04
NBKDR 41U I	-563APR07	13.46	15.07	38.6	16.37	22.9	17.52	8.4	.60	0	5.73	18.28
NBKDR 41U XII	-562MAR27	13.91	15.54	30.4	16.81	15.0	18.72	-9.1	.92	0	5.91	18.10
AMLMK 2A X	-558JAN14	5.10	6.60	-4.8	7.84	9.1	9.30	22.8	.95	218	6.91	17.09
NLSUS 3A II	-556MAY19	14.51	16.51	28.2	17.61	14.5	18.59	2.6	.97	0	5.09	18.92
NLSUS 4 VII	-555NOV01	10.42	12.21	44.7	13.58	39.4	14.88	28.7	.68	0	6.45	17.54
NBNID 1A XII	-553MAR18	12.16	14.15	42.8	14.93	34.9	15.67	26.7	.15	0	6.06	17.94
NBNID 3A V	-552AUG31	4.34	6.27	9.3	7.29	22.2	8.44	36.6	.42	0	5.42	18.57
NBNID 4 IV	-551AUG20	4.06	6.08	9.0	6.98	20.2	8.00	33.1	.31	0	5.24	18.75
NBNID 7 II	-548JUN19	4.21	6.54	18.8	7.27	27.8	8.06	37.6	.36	0	4.82	19.18
NBNID 9 VII	-546OCT23	8.95	10.86	45.1	12.10	48.1	13.36	43.8	.68	0	6.31	17.69
NBNID 11 XII	-543MAR27	4.12	6.01	.1	7.02	12.8	8.13	26.5	.90	0	5.90	18.10
NBNID 14 IV	-541JUL31	5.69	7.31	26.9	8.61	43.3	10.09	61.7	.93	0	4.98	19.01
NBNID 17 VIII	-538NOV23	3.73	6.75	-1.3	6.85	-.1	6.95	1.0	.00	0	6.76	17.23
CYRUS 2U VII	-536NOV01	11.43	13.89	37.1	14.59	31.3	15.27	24.8	.16	0	6.46	17.53
CYRUS 5 V	-533AUG31	14.44	16.16	29.2	17.39	13.7	18.47	.1	.79	0	5.41	18.58
CYRUS 6A X	-531JAN15	11.56	12.54	34.8	14.30	26.2	15.79	13.0	.91	0	6.90	17.10
CYRUS 8 III	-530JUN30	14.32	16.44	31.4	17.34	20.4	18.16	10.6	.53	0	4.80	19.20
CYRUS 9U III	-529JUN20	2.72	4.99	.6	5.78	9.7	6.63	19.9	.57	0	4.82	19.18
CAMBS 2 VII	-527OCT23	9.02	11.73	47.8	12.17	47.9	12.61	47.1	.05	0	6.31	17.68
CAMBS 3U I	-526APR18	2.90	5.20	-5.5	5.88	2.9	6.60	12.0	.26	0	5.55	18.45
CAMBS 5A XI	-523FEB15	14.49	16.16	14.1	17.14	2.7	18.05	-8.3	.69	0	6.54	17.46
DARI1 1 II	-520JUN10	1.69	3.96	-11.0	4.78	-2.3	5.65	7.7	.72	0	4.87	19.13
DARI1 2 II	-519MAY30	11.04	13.48	66.9	14.14	59.1	14.77	51.3	.08	0	4.96	19.04
DARI1 4 XII	-516MAR28	14.97	16.82	15.3	17.81	2.8	18.72	-8.7	.85	0	5.88	18.13
DARI1 13A I	-508APR28	12.01	13.72	58.8	15.05	43.5	16.25	28.5	.46	0	5.38	18.63
DARI1 16A XI	-504FEB16	5.31	6.71	1.0	7.97	15.6	9.40	30.1	.72	0	6.54	17.47
DARI1 19U III	-502JUN21	11.04	12.83	75.7	14.09	61.0	15.22	46.8	.39	0	4.82	19.19
DARI1 20 VIII	-501DEC04	14.38	16.41	6.8	17.44	-4.9	18.38	-16.0	.96	0	6.88	17.12
DARI1 23 VI	-498OCT03	2.77	5.14	-11.7	5.85	-2.7	6.61	6.9	.25	0	5.97	18.04
DARI1 24A VI	-497SEP22	2.22	4.36	-18.8	5.26	-7.7	6.24	4.6	.52	0	5.78	18.23
DARI1 27A IV	-494JUL22	2.79	5.42	4.6	5.73	8.3	6.04	12.0	.06	0	4.90	19.10
DARI1 29A VIII	-492NOV24	12.99	14.88	23.3	16.11	11.3	17.20	-1.0	.90	0	6.78	17.21
DARI1 32A I	-489APR29	3.72	5.92	5.6	6.76	16.0	7.65	27.4	.56	0	5.37	18.64
DARI1 34 V	-487SEP01	4.29	6.16	7.7	7.24	21.3	8.45	36.5	.73	0	5.44	18.55
XERXS 4A XII2	-480APR19	3.37	5.85	2.9	6.35	9.3	6.88	15.9	.16	0	5.52	18.49
XERXS 6 VI	-479OCT02	12.85	14.54	40.5	15.93	24.9	17.14	10.0	.54	0	5.96	18.03
XERXS 7A XI	-477FEB17	10.86	11.84	43.5	13.52	38.7	15.02	26.5	.66	0	6.52	17.49
XERXS 8 X	-476FEB06	11.94	13.96	32.8	14.59	27.8	15.19	22.4	.07	0	6.67	17.33
XERXS 15A XII	-469MAR20	14.21	16.00	23.5	17.00	11.2	17.93	-.5	.62	0	6.02	17.99
XERXS 20 III	-465JUL02	4.45	6.46	17.9	7.46	30.2	8.58	44.3	.40	0	4.81	19.19
XERXS 20 IX	-465DEC26	5.84	7.64	6.1	8.73	16.9	9.95	26.6	.63	0	6.98	17.02
ARTX1 2A I	-462APR30	13.48	15.38	39.8	16.52	25.4	17.55	12.5	.81	0	5.35	18.66
ARTX1 7 IV	-457AUG02	9.73	11.44	75.1	12.65	74.5	13.79	62.8	.30	0	5.01	18.98

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
ARTX1 8A IX	-456DEC16	4.68	6.81	-2.8	7.64	6.4	8.55	15.5	.44	0	6.96	17.04
ARTX1 10A II	-454MAY31	6.85	8.71	44.8	9.95	60.3	11.33	75.3	.58	0	4.95	19.05
ARTX1 13A XII	-450MAR20	3.57	5.43	-8.6	6.36	3.2	7.38	16.0	.47	0	6.01	17.99
ARTX1 14 XI	-449MAR09	5.22	7.27	12.1	7.95	20.2	8.67	28.4	.14	0	6.20	17.81
ARTX1 17 III	-447JUL12	13.80	16.35	32.3	16.76	27.2	17.15	22.3	.05	0	4.84	19.16
ARTX1 18 IX	-446DEC26	6.55	8.69	16.5	9.44	22.9	10.24	28.4	.19	0	6.98	17.02
ARTX1 24A V	-440AUG23	2.29	5.16	-3.1	5.22	-2.3	5.29	-1.5	.00	0	5.31	18.70
ARTX1 27A IX	-437DEC17	4.18	6.34	-8.2	7.15	1.0	8.02	10.3	.41	0	6.96	17.04
ARTX1 28 II	-436JUN10	15.93	18.23	9.1	19.01	.2	19.74	-7.8	.39	0	4.86	19.14
ARTX1 29A II	-435MAY31	1.72	4.03	-11.4	4.82	-2.8	5.65	6.9	1.00	0	4.95	19.05
ARTX1 31 VI	-433OCT04	4.81	6.83	9.4	7.90	22.5	9.08	36.1	.68	0	5.99	18.00
ARTX1 31 XII	-432MAR30	13.22	15.20	35.5	16.08	25.0	16.90	14.9	.22	0	5.84	18.17
ARTX1 34 IV	-430AUG03	15.98	17.96	10.7	18.90	-.5	19.77	-10.3	.94	0	5.04	18.97
ARTX1 38A II	-426MAY22	1.67	4.04	-12.5	4.77	-4.5	5.53	4.5	.62	0	5.05	18.95
ARTX1 39 VII	-425NOV04	13.11	15.01	26.6	16.28	13.1	17.38	.1	.43	0	6.51	17.49
ARTX1 40A XII	-423MAR21	7.44	8.90	34.2	10.24	47.5	11.71	55.4	.46	0	5.99	18.02
ARTX1 41 XI	-422MAR10	8.48	10.02	42.1	11.21	49.7	12.43	50.9	.22	0	6.17	17.83
DARI2 7A XII2	-415APR21	12.29	14.46	49.2	15.29	39.4	16.07	29.7	.23	0	5.48	18.53
DARI2 9 VI	-414OCT04	3.03	5.62	-5.9	6.12	.3	6.63	6.8	.17	0	6.00	18.01
DARI2 12 X	-410JAN27	9.75	11.10	36.2	12.43	37.5	13.69	32.5	.67	0	6.78	17.22
DARI2 15 II	-408JUN01	11.20	13.27	69.6	14.29	57.5	15.23	45.8	.31	0	4.93	19.07
ARTX2 1 V	-403SEP03	7.69	9.18	44.9	10.66	60.6	12.21	67.0	.67	0	5.48	18.51
ARTX2 2A V	-402AUG23	15.03	17.69	11.1	17.96	7.7	18.22	4.4	.03	0	5.30	18.69
ARTX2 2A X	-401JAN18	8.30	9.62	26.0	11.02	34.1	12.49	35.5	1.04	228	6.88	17.13
ARTX2 11 IV	-393AUG14	8.89	10.02	58.7	11.81	73.7	13.53	63.8	.94	345	5.17	18.82
ARTX2 12 X	-391JAN27	9.61	11.75	37.8	12.28	37.7	12.81	36.6	.07	0	6.78	17.23
ARTX2 15 II	-389JUN02	12.09	14.22	58.5	15.18	46.3	16.07	35.1	.37	0	4.93	19.07
ARTX2 15 VIII	-389NOV26	2.69	4.80	-25.5	5.80	-13.1	6.91	.0	.85	0	6.80	17.20
ARTX2 16U VII	-388NOV14	10.89	12.74	39.0	14.04	32.1	15.25	21.8	.44	0	6.67	17.33
ARTX2 18A VI	-386SEP25	2.86	5.78	-2.1	5.92	-.4	6.05	1.3	.01	0	5.85	18.16
ARTX2 22 III	-382JUL13	12.71	15.11	47.9	15.67	40.9	16.20	34.2	.10	0	4.85	19.15
ARTX2 25 VII	-379NOV05	6.83	8.78	24.2	10.00	35.0	11.34	42.1	.73	0	6.53	17.46
ARTX2 26A I	-378MAY02	8.10	9.61	52.3	11.15	67.8	12.80	68.1	.85	0	5.31	18.70
ARTX2 28 V	-376SEP04	14.39	16.28	26.6	17.36	12.9	18.34	.6	.70	0	5.50	18.49
ARTX2 33 VIII	-371DEC06	14.30	16.11	9.6	17.34	-3.9	18.41	-16.7	.71	0	6.90	17.09
ARTX2 35U I	-369APR23	2.99	5.33	-2.8	6.00	5.6	6.72	14.6	.24	0	5.45	18.54
ARTX2 35U XII	-368APR11	3.60	5.62	-1.3	6.54	10.2	7.55	23.0	.41	0	5.63	18.38
ARTX2 41 III	-363JUL13	8.32	10.17	63.8	11.28	76.3	12.43	78.6	.35	0	4.85	19.15
ARTX2 42 VIII	-362NOV27	7.61	9.66	27.2	10.71	33.8	11.84	36.9	.26	0	6.82	17.18
ARTX2 44 I	-360MAY12	16.56	18.64	1.2	19.64	-10.4	20.56	-20.2	.88	0	5.15	18.85
ARTX3 1 XI	-356FEB29	11.40	12.85	46.3	14.10	38.4	15.26	27.3	.89	0	6.32	17.69
ARTX3 8U I	-350APR22	13.13	14.75	46.0	16.13	29.1	17.32	14.2	.53	0	5.46	18.55
ARTX3 9 VI	-349OCT06	7.46	9.06	35.2	10.56	48.9	12.20	54.2	.88	0	6.04	17.95
ARTX3 10A VI	-348SEP24	13.08	15.16	35.6	16.14	24.0	17.02	13.0	.27	0	5.85	18.15
ARTX3 10A XI	-347FEB19	10.78	12.29	44.5	13.44	40.2	14.53	32.0	.46	0	6.46	17.54
ARTX3 19 V	-339SEP15	5.32	7.11	16.7	8.34	32.0	9.72	47.9	.48	0	5.69	18.30
ARTX3 20 V	-338SEP04	5.05	7.12	19.2	8.02	30.4	8.99	42.4	.26	0	5.50	18.49
ARSES 2 III	-335JUL04	9.76	11.30	77.0	12.74	76.6	14.10	60.8	.91	0	4.81	19.19
ARSES 2 IX	-335DEC28	3.69	5.53	-18.1	6.55	-5.9	7.72	6.9	.61	0	6.98	17.02
DARI3 1A IX	-334DEC17	13.73	16.33	6.6	16.69	2.7	17.04	-1.1	.05	0	6.96	17.03
ALEXG 1A XI	-328FEB20	9.07	10.95	42.4	11.73	44.7	12.50	44.3	.12	0	6.46	17.55
ALEXG 5 VIII	-325DEC08	10.74	13.39	31.5	13.78	29.4	14.16	26.9	.03	0	6.92	17.08
ALEXG 7A II	-323MAY23	3.28	5.35	2.6	6.38	14.9	7.51	29.1	.82	0	5.02	18.98
PILIP 1 VI	-322OCT07	13.88	15.83	24.6	16.99	10.6	18.04	-2.5	.60	0	6.06	17.93
PILIP 2A VI	-321SEP26	15.41	17.82	2.6	18.47	-5.6	19.09	-13.4	.17	0	5.89	18.12
PILIP 6 IX	-316JAN08	15.15	16.85	1.3	17.93	-11.3	18.92	-23.2	.79	0	6.94	17.06
S.E. 2 IV	-309AUG15	7.24	8.85	44.3	10.15	60.0	11.55	72.4	.79	0	5.19	18.80
S.E. 3 IX	-308DEC29	9.70	10.97	32.0	12.55	33.4	14.09	26.4	.58	0	6.98	17.03
S.E. 5 II	-306JUN14	11.33	12.69	76.8	14.39	57.1	15.88	38.3	.69	0	4.84	19.16
S.E. 8 XII	-302APR02	11.29	12.91	57.9	14.18	47.6	15.37	34.4	.88	0	5.78	18.23
S.E. 13 IX	-297JAN08	4.57	6.46	-6.6	7.36	3.5	8.34	13.8	.41	0	6.94	17.06
S.E. 15A II	-296MAY24	5.80	7.85	33.4	8.90	46.7	10.10	61.5	.34	0	5.01	19.00
S.E. 16 I	-295MAY13	13.99	16.14	32.3	17.07	20.7	17.91	10.2	.37	0	5.14	18.86
S.E. 16 VII	-295NOV07	8.84	10.66	38.4	12.01	42.2	13.40	38.1	.35	0	6.57	17.42

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 17 VII	-294OCT27	12.40	14.20	35.9	15.57	22.6	16.76	8.9	.44	0	6.40	17.59
S.E. 26A VII	-285OCT18	4.10	6.26	-1.1	7.25	11.2	8.35	24.0	.40	0	6.25	17.74
S.E. 27 VI	-284OCT06	3.83	6.03	-1.6	6.95	9.9	7.95	22.2	.41	0	6.06	17.93
S.E. 30 IV	-281AUG06	8.02	9.58	54.5	10.93	69.8	12.30	75.3	.72	0	5.08	18.92
S.E. 30 X	-280JAN30	4.33	6.26	-6.8	7.01	1.9	7.82	11.1	.20	0	6.74	17.26
S.E. 33 II	-278JUN04	15.35	17.60	16.4	18.44	6.3	19.21	-2.5	.36	0	4.90	19.10
S.E. 36 XII	-274MAR24	8.09	9.55	42.3	10.91	53.7	12.34	56.8	.59	0	5.92	18.08
S.E. 40 IX	-270JAN09	14.16	15.93	11.2	16.93	.4	17.84	-10.0	.57	0	6.93	17.07
S.E. 43 VII	-268NOV08	14.51	16.65	7.7	17.68	-4.6	18.62	-16.1	.44	0	6.59	17.40
S.E. 44 VII	-267OCT28	14.96	17.17	3.7	18.13	-8.2	19.01	-19.1	.34	0	6.42	17.57
S.E. 48 X	-262FEB09	15.19	16.84	5.6	17.84	-6.5	18.77	-18.0	.61	0	6.59	17.40
S.E. 56U VII	-255SEP16	7.90	9.64	46.6	10.92	58.1	12.26	61.6	.72	0	5.72	18.28
S.E. 57 X	-253JAN31	10.90	12.49	38.5	13.57	34.3	14.57	27.1	.25	0	6.73	17.28
S.E. 60 III	-251JUL05	5.00	6.75	21.3	7.98	36.7	9.44	55.0	.78	0	4.82	19.18
S.E. 63 I	-248MAY04	9.72	11.47	70.8	12.77	69.3	14.07	56.6	.80	0	5.26	18.75
S.E. 67 X	-243FEB09	6.37	7.81	12.9	9.03	25.6	10.36	36.3	.72	0	6.60	17.41
S.E. 70 II	-241JUN15	9.74	11.13	75.1	12.79	75.9	14.35	57.6	.98	0	4.83	19.17
S.E. 70 VIII	-241DEC10	11.54	13.33	31.5	14.56	23.7	15.64	14.1	.29	0	6.93	17.06
S.E. 71 VIII	-240NOV28	12.82	14.67	24.2	15.92	12.5	17.00	.6	.37	0	6.84	17.15
S.E. 75U VII	-236SEP16	9.09	11.30	60.1	12.11	61.6	12.91	58.9	.17	0	5.72	18.27
S.E. 76 X	-234JAN31	4.42	6.29	-6.3	7.09	3.1	7.96	12.8	.36	0	6.72	17.29
S.E. 78 III	-233JUL16	14.69	16.45	30.7	17.63	16.2	18.68	3.8	.78	0	4.87	19.12
S.E. 80A VIII	-231NOV19	4.08	6.13	-8.4	7.22	4.4	8.45	17.7	.60	0	6.74	17.25
S.E. 81 VII	-230NOV08	4.07	6.51	-2.1	7.24	6.6	8.03	15.4	.24	0	6.59	17.40
S.E. 82 I	-229MAY05	6.86	8.92	44.6	9.93	56.6	11.01	67.8	.40	0	5.25	18.75
S.E. 84 V	-227SEP07	7.71	9.44	46.7	10.69	59.3	11.97	65.2	.61	0	5.57	18.42
S.E. 91A I	-220APR25	5.12	6.99	18.8	8.15	33.4	9.45	49.3	.94	0	5.39	18.62
S.E. 91A XII2	-219APR14	14.13	16.34	25.3	17.10	15.7	17.80	6.8	.20	0	5.57	18.44
S.E. 94U X	-216FEB11	15.69	17.43	-1.2	18.35	-12.5	19.20	-23.1	.85	0	6.56	17.43
S.E. 102A XII	-208MAR13	14.06	15.64	26.6	16.82	12.5	17.89	-.9	.75	0	6.09	17.92
S.E. 109 I	-202MAY06	15.06	17.26	17.3	18.13	6.6	18.92	-3.0	.41	0	5.22	18.78
S.E. 114 IV	-197AUG07	1.26	3.36	-20.2	4.17	-11.8	5.03	-2.0	.54	0	5.10	18.91
S.E. 117 II	-194JUN06	7.20	9.55	55.9	10.27	64.8	11.03	73.5	.19	0	4.88	19.12
S.E. 121A XII	-189MAR14	6.67	8.25	25.4	9.43	38.3	10.71	49.1	.77	0	6.08	17.92
S.E. 124 III	-187JUL17	5.73	7.55	30.8	8.67	44.8	9.92	60.5	.49	0	4.89	19.11
S.E. 124 IX	-186JAN11	12.93	14.32	25.9	15.69	13.8	16.88	1.2	.71	0	6.91	17.09
S.E. 125 IX	-186DEC31	13.21	15.52	14.7	16.05	9.4	16.56	4.0	.07	0	6.97	17.03
S.E. 129A VII	-182OCT19	11.19	12.96	46.4	14.35	36.7	15.63	23.7	.84	0	6.28	17.71
S.E. 130 XI	-180MAR04	5.62	7.40	13.2	8.34	24.2	9.37	35.0	.42	0	6.23	17.77
S.E. 132U V	-179AUG17	10.17	11.37	70.4	13.09	66.9	14.66	49.7	.67	0	5.24	18.75
S.E. 133 IX	-177JAN02	5.51	7.75	7.4	8.34	13.4	8.97	19.3	.09	0	6.96	17.04
S.E. 134A IX	-177DEC22	4.44	6.16	-10.5	7.36	3.1	8.76	17.2	.91	445	6.98	17.02
S.E. 136 II	-175JUN06	3.60	5.71	8.3	6.68	19.9	7.74	33.1	.91	0	4.88	19.12
S.E. 138 VI	-173OCT10	8.86	10.61	47.4	11.99	52.2	13.40	47.3	1.00	0	6.13	17.86
S.E. 142A IV	-169JUL28	15.54	17.68	14.6	18.45	5.3	19.17	-3.1	.43	0	4.99	19.01
S.E. 143 III	-168JUL17	3.72	6.45	17.0	6.66	19.6	6.87	22.2	.02	0	4.89	19.11
S.E. 145A II	-166MAY28	1.82	4.07	-11.0	4.91	-1.8	5.81	8.7	.74	0	4.96	19.04
S.E. 146 I	-165MAY17	8.01	9.56	54.2	11.10	71.3	12.76	72.5	.56	0	5.09	18.92
S.E. 154 II	-157JUN17	13.53	15.45	43.7	16.57	29.7	17.56	17.5	.52	0	4.82	19.18
S.E. 156A XII2	-154APR15	11.35	12.88	63.0	14.31	49.9	15.65	34.0	.78	0	5.55	18.46
S.E. 159A V	-152AUG18	14.63	17.20	17.6	17.55	13.2	17.90	8.9	.06	0	5.26	18.73
S.E. 164A II	-147MAY27	16.27	18.64	3.3	19.36	-4.9	20.04	-12.2	.29	0	4.96	19.04
S.E. 164A VIII	-147NOV20	14.38	17.18	-.5	17.52	-4.5	17.85	-8.5	.06	0	6.76	17.24
S.E. 173 VII	-138NOV11	12.91	15.14	23.1	16.08	13.5	16.94	3.8	.39	0	6.64	17.35
S.E. 175A XII2	-135APR15	5.51	7.41	22.3	8.48	35.8	9.66	49.6	1.05	199	5.54	18.47
S.E. 178A V	-133AUG19	4.02	6.46	13.3	6.94	19.4	7.45	25.8	.10	0	5.27	18.72
S.E. 178A XI	-132FEB13	12.62	13.84	36.1	15.28	23.5	16.55	9.7	.88	0	6.54	17.47
S.E. 183A VIII	-128NOV20	14.25	16.35	8.9	17.38	-2.9	18.32	-14.2	.68	0	6.76	17.23
S.E. 184 XII	-126APR06	5.24	7.10	16.6	8.15	29.7	9.32	43.6	.87	0	5.69	18.32
S.E. 186A VI	-125SEP19	7.13	8.86	37.0	10.17	50.9	11.60	60.0	.44	0	5.77	18.22
S.E. 187 V	-124SEP07	16.24	18.32	-.1	19.23	-11.4	20.08	-21.5	.98	0	5.60	18.41
S.E. 187 X	-123FEB03	5.34	7.23	5.5	8.00	14.1	8.84	22.6	.17	0	6.67	17.34
S.E. 188 X	-122JAN23	4.39	5.91	-11.8	7.09	2.1	8.47	17.0	.73	0	6.80	17.20
S.E. 192 VII	-119NOV11	11.71	13.64	35.2	14.88	25.5	16.02	14.1	.45	0	6.65	17.35

Babyl.Date	Jul.Date	UT	T1	Alt1	Tm	Altm	T4	Alt4	Magn	Dur	SR	SS
S.E. 196 V	-115AUG29	14.49	16.49	24.7	17.45	12.6	18.33	1.6	.61	0	5.44	18.56
S.E. 197A V	-114AUG19	3.05	5.17	-2.6	5.98	7.3	6.85	18.2	.56	0	5.28	18.72
S.E. 200 II	-111JUN18	2.04	4.19	-8.0	5.07	1.6	6.03	12.7	.57	0	4.82	19.18
S.E. 202A XII2	-108APR16	15.52	17.85	6.8	18.50	-1.3	19.11	-8.9	.30	0	5.50	18.49
S.E. 206 X	-104FEB03	15.36	16.96	3.2	18.03	-9.6	19.00	-21.6	.58	0	6.66	17.33
S.E. 208U IV	-103JUL19	9.26	10.50	67.3	12.19	78.8	13.83	63.3	.84	0	4.91	19.09
S.E. 209 III	-102JUL08	15.92	18.48	6.5	18.88	1.8	19.28	-2.5	.08	0	4.84	19.16
S.E. 218A III	-93JUN29	10.92	12.12	80.8	13.91	63.2	15.43	44.1	.71	0	4.81	19.19
S.E. 219 VIII	-92DEC12	5.49	7.35	3.3	8.49	15.1	9.78	25.9	.75	0	6.95	17.05
S.E. 221A XII2	-89APR17	16.14	18.43	-4	19.12	-8.9	19.77	-16.6	.41	0	5.50	18.50
S.E. 223 VI	-88SEP29	6.28	8.34	28.1	9.37	39.6	10.49	49.9	.36	0	5.96	18.03
S.E. 228 VIII	-83DEC03	3.09	5.36	-19.4	6.16	-9.7	7.02	.3	.47	0	6.89	17.10
S.E. 230 I	-81MAY18	3.67	5.93	9.0	6.76	19.2	7.65	30.5	.60	0	5.07	18.94
S.E. 232A XII	-78MAR17	10.21	11.55	54.5	13.00	52.3	14.38	41.5	.52	0	6.02	17.99
S.E. 233 XI	-77MAR06	9.95	11.51	50.1	12.68	49.5	13.82	42.9	.26	0	6.20	17.81
S.E. 235A IV	-76JUL20	15.25	17.71	14.8	18.18	9.2	18.63	3.8	.12	0	4.93	19.08
S.E. 239 I	-72MAY08	3.73	5.93	7.8	6.80	18.5	7.74	30.4	.69	0	5.18	18.82
S.E. 240A VII	-71OCT21	6.66	9.31	32.7	9.83	37.4	10.36	41.5	.06	0	6.33	17.66
S.E. 242 XI	-68FEB25	3.23	4.87	-19.8	5.93	-6.4	7.12	8.3	.80	0	6.35	17.66
S.E. 245 IV	-66JUL30	1.77	4.09	-11.5	4.68	-5.1	5.30	2.1	.21	0	5.02	18.99
S.E. 246U VIII	-65DEC14	14.79	16.69	2.8	17.78	-9.6	18.75	-21.3	.85	0	6.96	17.04
S.E. 248A II	-63MAY28	13.71	15.80	38.4	16.79	26.0	17.68	15.0	.51	0	4.95	19.06
S.E. 249 I	-62MAY18	4.23	6.97	21.9	7.31	26.2	7.66	30.5	.07	0	5.06	18.95
S.E. 250 VI	-61OCT01	15.03	17.17	9.3	18.13	-2.8	19.01	-14.0	.68	0	5.99	18.00
S.E. 251A VI	-60SEP20	3.72	5.84	-9	6.78	11.0	7.80	23.7	.90	0	5.81	18.18
S.E. 258 I	-53MAY09	4.68	7.12	22.6	7.75	30.6	8.42	39.1	.21	0	5.18	18.83
S.E. 260 XI	-50MAR07	13.49	15.13	31.0	16.23	18.5	17.22	6.5	.34	0	6.18	17.83
S.E. 262A V	-49AUG21	5.73	7.36	24.3	8.66	40.6	10.14	58.2	.75	0	5.31	18.68
S.E. 263 IV	-48AUG09	11.49	13.45	64.9	14.40	54.0	15.26	43.4	.16	0	5.15	18.84
S.E. 263 IX	-47JAN04	8.50	10.37	29.7	11.31	33.6	12.27	34.3	.26	0	6.95	17.05
S.E. 272 IV	-39JUL31	4.03	6.32	14.1	6.93	21.7	7.59	30.0	.12	0	5.03	18.96
S.E. 273A IV	-38JUL20	5.26	6.99	23.4	8.19	38.4	9.56	55.8	.54	0	4.92	19.08
S.E. 273A X	-37JAN14	8.99	10.18	29.8	11.73	35.6	13.24	32.9	.95	0	6.89	17.12
S.E. 276 I	-35MAY19	14.69	16.82	24.8	17.78	12.9	18.65	2.4	.73	0	5.04	18.96
S.E. 277 VII	-34NOV01	8.42	10.10	36.3	11.60	43.3	13.17	40.7	.96	0	6.51	17.49
S.E. 282 IX	-28JAN05	5.35	7.00	-6	8.16	11.9	9.50	23.9	.84	0	6.95	17.06
S.E. 284U III	-27JUN19	1.88	4.44	-5.4	4.91	-2	5.41	5.4	.20	0	4.81	19.19
S.E. 286A VII	-25OCT23	6.03	8.45	23.4	9.20	31.2	10.00	38.2	.22	0	6.36	17.63
S.E. 287 XII	-23APR07	5.51	7.14	17.5	8.44	33.7	9.90	50.4	.86	0	5.66	18.35
S.E. 290 IV	-21AUG11	13.89	15.52	39.8	16.80	23.7	17.94	9.5	.93	0	5.17	18.82
S.E. 293 II	-18JUN10	1.99	4.59	-4.2	5.05	.9	5.53	6.4	.19	0	4.85	19.15
S.E. 302 III	-9JUN30	11.44	13.05	73.4	14.43	56.8	15.66	41.2	1.07	280	4.81	19.19
S.E. 303U III	-8JUN19	2.43	4.77	-1.8	5.45	6.0	6.18	14.5	.47	0	4.81	19.19
S.E. 305A I	-6APR29	14.34	16.20	29.9	17.38	15.0	18.43	2.0	.57	0	5.31	18.70
S.E. 305A VII	-6OCT23	5.74	7.95	17.8	8.92	28.2	9.95	37.8	.55	0	6.37	17.63
S.E. 308A XI	-2FEB15	12.80	14.44	32.3	15.47	22.4	16.42	11.9	.59	0	6.49	17.52

6. Indices

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Index to the transliterations

This index provides cross-references to the words occurring in the transliterations (mostly single-sign logograms, sometimes with phonetic or grammatical complements). It was prepared by machine, first and primarily for checking the consistency of spelling, then enhanced by manual post-editing. In particular, some Akkadian equivalents and approximate English meanings have been added. Parentheses and question marks in the transliterations were ignored. It is complete, except that (1) damaged words whose beginnings are beyond reconstruction, and (2) numbers (apart from the special fraction signs) are not referenced. Some grossly different meanings were separated (for example *si* = “finger”, *si* = “horn”, *si* = “north”), but subtler differences as a rule were disregarded (say between *si* = “north wind” and *si* = “north side of the lunar disk”).

Numbers in parentheses refer to items in Section 1.7 (pp. 10-16), where the particular word is discussed. Repeated dates correspond to multiple occurrences. The letters L and S at the end of the dates distinguish between lunar and solar eclipses.

- 1/2 “1/2”: -712APR19L, -602OCT27L, -602OCT27L, -598FEB19L, -587JAN19L, -579AUG14L, -576DEC07L, -521JAN10L, -439FEB02L, -396SEP29L, -363JUN29L, -363DEC23L, -352NOV22L, -316DEC13L, -304MAY08L, -250DEC04L, -238APR28L, -149JUL03L, -135APR01L, -122AUG02L, -75JAN28L, -72NOV16L, -72NOV16L, -66JAN19L, -65DEC28L
- 1/3 “1/3”: -602OCT27L, -525SEP16L, -395MAR26L, -368APR11S
- 2/3 “2/3”: -685APR21L, -605JAN08L, -602OCT27L, -598FEB19L, -594NOV27L, -587JAN19L, -536OCT17L, -528NOV17L, -528NOV17L, -522JUL16L, -381JUN18L, -378APR17L, -238APR28L, -184NOV24L, -105FEB28L, -79APR11L
- a “Leo”: -420FEB02L, -370NOV11L, -272FEB16L, -65JAN08L
- a (short for *a-kám*) “mist”: p.17, -225AUG01L
- a (short for *a-su*) “rise”: p.17, -712APR19L
- ab “month X”: (1), -587JAN19L, -586JAN08L, -521JAN10L, -363JAN02L, -327JAN24L, -326JAN13L, -325JAN03L, -188FEB02S, -168JAN07L, -168JAN22S, -159JAN26L, -66JAN19L
- áb “month”: -248APR19L, -246SEP07S, -228MAR25S, -225JUL18S, -217FEB22S, -188FEB02S, -158DEC07L, -156MAY07S, -140DEC17L, -132JAN29L, -129MAY23L, -125MAR11L, -123FEB03S, -118OCT31S
- absin “Virgo”: -561MAR02L, -441MAR25L, -283MAR17L, -189FEB28L, -153MAR21L, -133MAR10L, -105FEB28L, -86FEB28L
- ád (short for *adriš*) “eclipsed”: (13), p.17, -746FEB06L, -746AUG02L, -712APR19L, -701MAR20L, -694MAY01L, -666OCT15L, -631MAY23L, -590MAR22L, -587JAN19L, -586JAN08L, -576JUN14L, -572APR01L, -562SEP05L, -561MAR02L, -554OCT06L, -536APR23L, -536OCT17L, -536OCT17L, -482NOV19L, -464JUN05L, -441MAR25L, -424APR14L, -423SEP28L, -420FEB02L, -408JUN16L, -407OCT31L, -406OCT21L, -405APR15L, -381JUN18L, -381DEC12L, -378APR17L, -378APR17L, -377APR06L, -370MAY17L, -363JAN02L, -363DEC23L, -363DEC23L, -352NOV22L, -352NOV22L, -326JAN13L, -321SEP26S, -316JUN18L, -316DEC13L, -247OCT03L, -239NOV03L, -211APR30L, -189FEB28L, -188FEB17L, -149JUL03L, -119JUN01L, -119JUN01L, -109NOV05L, -105FEB28L, -105AUG25L, -105AUG25L, -95AUG03L, -80APR21L, -79APR11L, -72NOV16L, -65JAN08L, -65DEC28L
- a-dir* “eclipsed”: -414SEP19L, -409DEC21L, -370NOV11L, -366AUG30L, -363JAN02L, -363JUN29L, -283MAR17L, -280JAN30S, -272FEB16L, -214DEC25L, -193NOV05L, -189FEB28L, -184NOV24L, -170AUG23L, -135APR01L, -122AUG02L, -98APR11L, -97MAR31L, -86FEB28L
- ad-ra* “eclipsed”: -609SEP15L
- ak ?: -405OCT10L
- a-kám* “mist”: (2), p.17, -363JAN02L, -363JAN02L, -326JUL09L, -304MAY08L, -304MAY08L, -188FEB17L, -135SEP24L, -135SEP24L, -134MAR06S, -134MAR21L, -133MAR10L, -122AUG02L, -111JUL02L, -111JUL02L, -108MAY01L, -105AUG25L, -96AUG14L, -96AUG14L, -79APR11L, -66JAN19L, -66JAN19L, -65JAN08L
- ak-níg-du-šeš “Nebuchadnezzar”: -603JUN12L
- al* “over, beyond”: (6), -439FEB02L, -370NOV11L, -363JUN29L, -304MAY08L, -248MAY04S, -189MAR14S, -182OCT04L
- al-la* “over, beyond”: (6), -609SEP15L, -325JAN03L, -322OCT07S, -238APR28L, -165MAY17S, -97MAR31L, -65DEC28L
- alla “Cancer”: -406OCT21L, -382DEC23L, -363JAN02L, -214DEC25L, -98OCT05L, -97MAR31L

- ¹*a-lek-*... “Alexander”: -327JUL20L
- a-mat* “word”: -746FEB06L, -128NOV05L, -119JUN01L, -80APR21L, -79APR11L, -66JAN19L
- a-an* “rain”: -605JAN08L
- an* “rain”: -370NOV11L
- an* “Mars”: (12), -572APR01L, -407OCT31L, -406OCT21L, -405APR15L, -366AUG30L, -345JAN13L, -326JAN13L, -280JAN30S, -247OCT03L, -214DEC25L, -193NOV05L, -189MAR14S, -189MAR14S, -182OCT04L, -156NOV14L, -153MAR21L, -135APR15S, -130JUL02L, -123AUG13L, -119JUN01L, -108MAY01L, -97MAR31L, -90NOV05L, -79APR11L, -65JAN08L, -9JUN30S
- an* “sky”: (11), -464JUN05L, -439FEB02L, -423SEP28L, -396APR05L, -248MAY04S, -238APR28L, -193NOV19S, -162MAR15S, -162MAR30L, -162MAR30L, -162MAR30L, -159JAN26L, -156NOV14L, -132FEB13S, -95AUG03L, -79APR11L, -72NOV16L, -66JAN19L
- an-e* “sky (gen.”): (11), -611NOV05L, -247OCT03L, -238APR28L, -162MAR30L, -162MAR30L, -124AUG24L, -122AUG02L, -86FEB28L, -65DEC28L
- an-ú* “sky”: -96AUG14L
- ¹*an* “An(tiochus)”: -211APR30L, -189MAR14S, -189AUG23L, -169JUL28S, -169JUL28S, -162MAR30L, -162SEP08S, -161AUG14L
- a-na* “to”: -214DEC25L, -214DEC25L, -193NOV05L, -189FEB28L, -189FEB28L, -189FEB28L, -132FEB13S
- ana* “to”: (9), -745JAN26L, -712APR19L, -701MAR20L, -701MAR20L, -694MAY01L, -667OCT25L, -666OCT15L, -658MAY22L, -649MAY13L, -609SEP15L, -608SEP03L, -605JAN08L, -590MAR22L, -575JUN03L, -572APR01L, -572SEP25L, -562SEP05L, -554OCT06L, -554OCT06L, -536APR23L, -536OCT17L, -536OCT17L, -528NOV17L, -525MAR24L, -525SEP16L, -525SEP16L, -521JAN10L, -518OCT28L, -518OCT28L, -500NOV07L, -482NOV19L, -423SEP28L, -423SEP28L, -414MAR26L, -413MAR16L, -409DEC21L, -409DEC21L, -408JUN16L, -407OCT31L, -406OCT21L, -405APR15L, -405OCT10L, -396APR05L, -396SEP29L, -395MAR26L, -378APR17L, -377APR06L, -377APR06L, -377APR06L, -374FEB03L, -370NOV11L, -370NOV11L, -370NOV11L, -366AUG30L, -363JUN29L, -363DEC23L, -362JUN18L, -359APR17L, -356FEB14L, -356FEB29S, -352NOV22L, -352NOV22L, -345JAN13L, -345JAN13L, -334DEC03L, -326JAN13L, -325JAN03L, -322OCT07S, -322OCT07S, -321SEP26S, -316JUN18L, -316DEC13L, -307JUL09L, -304MAY08L, -291AUG25S, -283MAR17L, -283MAR17L, -280JAN30S, -279DEC24L, -278JUN19L, -277MAY10L, -272FEB16L, -272FEB16L, -272FEB16L, -266OCT17S, -253JAN31S, -253JAN31S, -253JAN31S, -250DEC04L, -250DEC04L, -248APR19L, -248APR19L, -241JUN15S, -241JUN15S, -239NOV03L, -238APR28L, -238APR28L, -238APR28L, -238APR28L, -225FEB06L, -225JUL18S, -225AUG01L, -225AUG01L, -214DEC25L, -211APR30L, -211MAY15S, -211OCT24L, -200APR13S, -194JUN20L, -193NOV05L, -193NOV05L, -189FEB28L, -189MAR14S, -189MAR14S, -189MAR14S, -189AUG23L, -189AUG23L, -189SEP07S, -188FEB02S, -188FEB17L, -184MAY30L, -170AUG23L, -170AUG23L, -169FEB16L, -169JUL28S, -169AUG13L, -162MAR30L, -162MAR30L, -162MAR30L, -162SEP08S, -162SEP08S, -161FEB18L, -161AUG14L, -161AUG14L, -156NOV14L, -153MAR21L, -153MAR21L, -153MAR21L, -149JUL03L, -143SEP08S, -140JUL22L, -140DEC31S, -137MAY22L, -136OCT04L, -136OCT20S, -135APR01L, -135APR01L, -135APR01L, -135APR15S, -135APR15S, -135OCT09S, -134MAR06S, -134MAR21L, -133MAR10L, -133SEP03L, -132JAN29L, -132FEB13S, -130JUL02L, -128NOV05L, -128NOV05L, -128NOV05L, -128NOV05L, -124AUG24L, -124AUG24L, -124SEP07S, -123AUG13L, -123AUG13L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -118MAY07S, -111JUN18S, -109NOV05L, -106MAR27S, -105FEB28L, -105FEB28L, -105AUG25L, -105AUG25L, -105AUG25L, -95AUG03L, -88SEP29S, -88SEP29S, -86FEB13S, -86FEB28L, -80APR21L, -79APR11L, -79APR11L, -79APR11L, -75JAN28L, -72NOV16L, -72NOV16L, -66JAN19L, -66JAN19L, -65JAN08L, -65JAN08L, -65DEC28L, -65DEC28L, -65DEC28L, -46JUL04L, -40FEB15S, -40MAR02L, -9JUN30S, -9JUN30S, -9JUN30S
- an-bar₇* “noon”: -162MAR15S
- an-mi* “eclipse”: -651JUL02L, -651DEC27L, -611NOV05L, -609SEP15L, -605JAN08L, -605JAN08L, -567JUL04L, -522JUL16L, -521JAN10L, -482NOV19L, -405APR15L, -374FEB03L, -370MAY17L, -366AUG30L, -366SEP14S, -362DEC12L, -356FEB14L, -356FEB29S, -352NOV22L, -352NOV22L, -345JAN13L, -345JAN29S, -333MAY29L, -332OCT27S, -330SEP20L, -330OCT05S, -326JAN13L, -326JUL09L, -324MAY19L, -321APR02S, -321APR17L, -321SEP26S, -316JUN18L, -307JUL09L, -304APR23S, -302SEP11L, -302SEP25S, -301MAR07L, -291AUG11L, -291AUG25S, -283MAR17L, -280JAN16L, -280JAN30S, -278JUN19L, -278NOV13L, -277MAY10L, -277NOV03L, -272MAR01S, -266OCT17S, -261DEC21S, -253JAN31S, -248APR19L, -248APR19L, -248MAY04S, -248OCT13L, -248OCT27S, -246MAR29L, -246SEP07S, -246SEP22L, -245AUG28S, -245SEP11L, -240NOV28S, -239OCT18S, -238APR28L, -232NOV30S, -232DEC14L, -230APR30L, -230MAY15S, -228MAR25S, -225FEB06L, -225FEB20S, -225JUL18S, -225AUG01L, -217FEB22S, -214DEC25L, -214DEC25L, -211APR30L, -211MAY15S, -211OCT24L, -209SEP18S, -202MAY06S, -200APR13S, -194JUN06S,

- 194JUN20L, -194NOV15L, -194NOV29S, -193MAY26S, -193NOV19S, -189FEB28L, -189MAR14S, -189SEP07S, -188FEB02S, -188FEB17L, -186DEC31S, -185DEC06L, -184NOV24L, -179AUG17S, -169FEB16L, -169JUL28S, -169AUG13L, -168JAN07L, -168JAN22S, -164OCT29S, -162MAR15S, -162MAR30L, -162MAR30L, -162SEP08S, -162SEP08S, -162SEP23L, -161FEB18L, -161MAR05S, -161AUG14L, -161AUG14L, -161AUG28S, -160FEB07L, -158JUL12L, -156MAY07S, -153MAR21L, -149JUL03L, -144SEP19S, -143SEP08S, -142FEB17L, -142MAR05S, -141AUG03L, -140JUL22L, -140DEC17L, -140DEC31S, -137MAY22L, -137NOV15L, -136OCT20S, -135APR01L, -135APR15S, -135APR15S, -134MAR06S, -133FEB24S, -133MAR10L, -133AUG19S, -132JAN29L, -131FEB01S, -129MAY23L, -129JUN07S, -128NOV05L, -125MAR11L, -124MAR15S, -124SEP07S, -123FEB03S, -122AUG02L, -119MAY17S, -119JUN01L, -118MAY07S, -118OCT31S, -111JUL02L, -111JUL02L, -108MAY01L, -106MAR11L, -106MAR27S, -105AUG25L, -99OCT31S, -98OCT05L, -97MAR31L, -96AUG14L, -95AUG03L, -95AUG19S, -93JUL13L, -90NOV05L, -88SEP15L, -86FEB13S, -86FEB28L, -86FEB28L, -86AUG24L, -80APR21L, -79APR11L, -79SEP20S, -77AUG30S, -76FEB09L, -72NOV16L, -65JAN08L, -62MAY18S, -40FEB15S, -40MAR02L, -9JUN30S
- an-mi-meš “eclipses”: -9JUN30S, -9JUN30S
- an-mi-šú “its eclipse”: (11), -605JAN08L, -598FEB19L, -554OCT06L, -377APR06L, -370NOV11L, -370NOV11L, -370NOV11L, -366AUG30L, -356FEB29S, -326JAN13L, -326JAN13L, -316DEC13L, -283MAR17L, -283MAR17L, -280JAN30S, -280JAN30S, -255SEP16S, -253JAN31S, -248MAY04S, -247OCT03L, -247OCT03L, -238APR28L, -238APR28L, -238APR28L, -225AUG01L, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L, -193NOV05L, -189FEB28L, -189FEB28L, -189FEB28L, -189MAY14S, -189MAY14S, -184NOV24L, -184NOV24L, -182OCT04L, -182OCT04L, -162MAR30L, -162MAR30L, -162MAR30L, -159JAN26L, -156NOV14L, -153MAR21L, -153MAR21L, -153MAR21L, -149JUL03L, -149JUL03L, -135APR15S, -135APR15S, -134MAR21L, -134MAR21L, -130JUL02L, -128NOV05L, -128NOV05L, -128NOV05L, -128NOV05L, -124AUG24L, -124AUG24L, -123AUG13L, -122AUG02L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -108MAY01L, -108MAY01L, -108MAY01L, -105AUG25L, -105AUG25L, -98APR11L, -98OCT05L, -97MAR31L, -95AUG03L, -95AUG03L, -95AUG03L, -93JUL13L, -93JUL13L, -90NOV05L, -90NOV05L, -88SEP29S, -86FEB28L, -86FEB28L, -80APR21L, -79APR11L, -79APR11L, -79APR11L, -72NOV16L, -72NOV16L, -66JAN19L, -66JAN19L, -66JAN19L, -65DEC28L, -65DEC28L, -65DEC28L, -46JUL04L
- anše “donkey”: -134MAR21L, -80APR21L
- ¹an-ti-gu-nu-su “Antigonus”: -316DEC13L
- ¹an-ti-‘u-uk-su “Antiochus”: -250DEC04L
- apin “month VIII”: (1), -667OCT25L, -649NOV05L, -611NOV05L, -594NOV27L, -593NOV17L, -528NOV17L, -500NOV07L, -482NOV19L, -464NOV29L, -407OCT31L, -370NOV11L, -352NOV22L, -278NOV13L, -239NOV03L, -194NOV15L, -193NOV05L, -184NOV24L, -128NOV05L
- ár (short for arku) “after”: (3,13), -631MAY23L, -554OCT06L, -464JUN05L, -441MAR25L, -424APR14L, -409DEC21L, -409DEC21L, -405APR15L, -366AUG30L, -366AUG30L, -363DEC23L, -363DEC23L, -352NOV22L, -316DEC13L, -307JUL09L, -307JUL09L, -272FEB16L, -238APR28L, -225AUG01L, -225AUG01L, -162MAR30L, -162MAR30L, -162MAR30L, -153MAR21L, -142FEB17L, -133MAR10L, -128NOV05L, -122AUG02L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -98APR11L, -95AUG03L, -79APR11L, -79OCT05L, -65DEC28L, -65DEC28L
- a-rim “covered”: (6), -66JAN19L
- ár-ku-ú “rear”: -134MAR21L
- ¹ar-šá-ka “Arsaces”: -9JUN30S
- ¹ar-šá-ka-a “Arsaces”: -128NOV05L, -80APR21L, -79OCT05L
- ¹ar-šá-kám “Arsaces”: -119JUN01L, -79APR11L, -66JAN19L, -65DEC28L
- aš ?: -80APR21L
- a-si-du “heel”: -90NOV05L
- a-šú “his son”: -169JUL28S
- áš-šá “then, that (*ana šá*)”: -366AUG30L
- bar “month I”: (1), -730APR09L, -701MAR20L, -683MAR30L, -665APR10L, -601APR22L, -600APR10L, -599MAR31L, -592MAY11L, -526APR04L, -406APR26L, -405APR15L, -378APR17L, -359APR17L, -248APR19L, -248MAY04S, -238APR28L, -211APR30L, -211MAY15S, -98APR11L, -80APR21L, -79APR11L
- bar “eclipse excluded”: p.7f., -441SEP18L, -407MAY07L, -356FEB14L, -321APR02S, -291AUG11L, -277NOV03L, -248APR19L, -248APR19L, -248OCT27S, -245SEP11L, -230APR30L, -228MAR25S, -225JUL18S, -194JUN20L, -188FEB02S, -161AUG14L, -158DEC07L, -140DEC17L, -132JAN29L, -129MAY23L, -125MAR11L, -118OCT31S
- be “eclipse excluded”: p.7f., -232DEC14L, -225FEB06L

- bi* “between (short for *bi-rit*)”: (4), -701MAR20L, -685APR21L, -649NOV05L, -631MAY23L, -370NOV11L, -316DEC13L, -255SEP16S
- bi-ib-lu* “invisibility”: -135APR15S
- bi-rit* “between”: (4), -611NOV05L
- dam-šú “his wife”: -66JAN19L
- danna “double hour”: (14), -605JAN08L, -522JUL16L, -521JAN10L, -332OCT27S, -225FEB06L, -214DEC25L, -194JUN06S, -189FEB28L, -189MAR14S, -189AUG23L, -162SEP08S, -162SEP08S, -161MAR05S, -135APR01L, -135SEP24L, -86AUG24L, -65JAN08L
- dar ?: -9JUN30S
- da-ra-mu-šú* “Dareios”: -422MAR25L
- dele “single”: -561MAR02L, -189FEB28L, -133MAR10L, -122AUG02L, -105FEB28L, -86FEB28L, -79APR11L
- ^d*dele-bat* “Venus”: (12), -605JAN08L
- dele-bat* “Venus”: (12), -482NOV19L, -405OCT10L, -283MAR17L, -280JAN30S, -247OCT03L, -193NOV05L, -189FEB28L, -189MAR14S, -153MAR21L, -153MAR21L, -135APR15S, -123AUG13L, -108MAY01L, -97MAR31L, -66JAN19L, -65JAN08L, -65JAN08L, -9JUN30S
- DI ?: -9JUN30S
- dib “to pass”: p.7,17, -744JAN15L, -744JUL10L, -730APR09L, -685OCT15L, -683MAR30L, -676MAY11L, -667MAY02L, -667OCT25L, -649MAY13L, -603JUN12L, -603DEC06L, -602MAY03L, -601APR22L, -601OCT17L, -600OCT05L, -599MAR31L, -599SEP24L, -593NOV17L, -592MAY11L, -592NOV05L, -591SEP26L, -590SEP15L, -590SEP15L, -589MAR12L, -589MAR12L, -589SEP04L, -588FEB29L, -588JUL25L, -587JUL15L, -578AUG04L, -577JAN28L, -577JUN25L, -577DEC19L, -572SEP25L, -567JUL04L, -441SEP18L, -440MAR13L, -439JUL28L, -422MAR25L, -422AUG19L, -421FEB13L, -421AUG08L, -414MAR26L, -408DEC10L, -407MAY07L, -406APR26L, -395MAR26L, -388OCT31L, -378OCT11L, -356FEB14L, -345JAN29S, -334DEC03L, -332OCT27S, -330OCT05S, -321APR02S, -321APR17L, -302SEP25S, -291AUG11L, -280JAN16L, -278NOV13L, -277NOV03L, -248APR19L, -248APR19L, -248OCT13L, -248OCT27S, -246SEP22L, -245AUG28S, -245SEP11L, -239OCT18S, -232DEC14L, -230APR30L, -230MAY15S, -228MAR25S, -225FEB06L, -225JUL18S, -200APR13S, -194JUN20L, -194NOV15L, -194NOV29S, -193MAY11L, -193MAY26S, -188FEB02S, -186DEC31S, -185DEC06L, -169FEB16L, -168JAN07L, -168JAN22S, -164OCT29S, -162SEP08S, -162SEP08S, -162SEP23L, -161FEB18L, -161AUG14L, -161AUG14L, -161AUG28S, -160FEB07L, -159JUL23L, -158JUL12L, -158DEC07L, -149JUL03L, -143SEP08S, -141AUG03L, -140JUL22L, -140DEC17L, -140DEC31S, -136OCT04L, -132JAN29L, -131FEB01S, -129MAY23L, -129JUN07S, -125MAR11L, -123AUG13L, -118MAY07S, -118OCT31S, -111JUL02L, -106MAR11L, -106MAR27S, -88SEP15L, -86FEB13S, -86AUG24L, -76FEB09L
- ^{lú}*di-kud* “judge”: -611NOV05L
- ^l*di-mit-ri* “Demetrius”: -153MAR21L
- dingir “god”: -567JUL04L, -567JUL04L
- dir “cloud”: (2), p.17, -649NOV05L, -611NOV05L, -521JAN10L, -500NOV07L, -464NOV29L, -413MAR16L, -408JUN16L, -407OCT31L, -406OCT21L, -362DEC12L, -338SEP04S, -280JAN16L, -272FEB16L, -272MAR01S, -248MAY04S, -238APR28L, -238APR28L, -211APR30L, -193NOV05L, -193NOV19S, -189FEB28L, -189AUG23L, -189AUG23L, -182OCT04L, -162MAR15S, -162MAR30L, -162MAR30L, -162MAR30L, -162MAR30L, -162MAR30L, -162MAR30L, -159JAN26L, -153MAR21L, -153MAR21L, -137MAY22L, -137MAY22L, -135APR01L, -135SEP24L, -133MAR10L, -132FEB13S, -128NOV05L, -128NOV05L, -128NOV05L, -124MAR15S, -97MAR31L, -96AUG14L, -79APR11L, -76FEB09L, -65DEC28L
- dir “dark, eclipsed”: -189MAR14S, -189MAR14S
- dir “intercalary month”: (1), -746AUG02L, -744JUL10L, -685APR21L, -658MAY22L, -602MAY03L, -593NOV17L, -589MAR12L, -577JAN28L, -464JUN05L, -439FEB02L, -388OCT31L, -334DEC03L, -239NOV03L
- dir-še “month XII₂”: (1), -553APR02L, -396APR05L, -377APR06L, -162MAR30L, -135APR01L, -135APR15S, -97MAR31L
- du₆ “month VII”: (1), -685OCT15L, -602OCT27L, -601OCT17L, -600OCT05L, -592NOV05L, -554OCT06L, -536OCT17L, -406OCT21L, -405OCT10L, -388OCT31L, -378OCT11L, -248OCT13L, -239OCT18S, -211OCT24L, -98OCT05L
- dug-sila₃ “pot”: -9JUN30S
- dul ?: -238APR28L
- dumu “son”: -316DEC13L
- dumu-šú “his son”: -464JUN05L
- dur “ribbon”: -525SEP16L

- e “above”: (13), -370MAY17L, -250DEC04L, -128NOV05L, -109NOV05L
e-lat “above”: -611NOV05L
e “to come out, rise”: p.16f., -590MAR22L, -464NOV29L, -407OCT31L, -370NOV11L, -363JAN02L
e-a “to come out, rise”: p.16f., -304MAY08L, -304MAY08L, -280JAN30S, -214DEC25L, -189MAR14S, -189AUG23L, -123AUG13L, -123AUG13L, -122AUG02L, -98APR11L, -93JUL13L, -66JAN19L, -65DEC28L, -65DEC28L
è-a “to come out, rise”: p.16f., -189FEB28L, -189MAR14S, -170AUG23L, -153MAR21L
è-meš “to come out, rise”: p.16f., -90NOV05L
edin “open country”: -441MAR25L
egir “behind”: -609SEP15L, -605JAN08L
egir-meš “behind (pl.)”: -611NOV05L
^den “the god Bel”: -746FEB06L, -128NOV05L, -119JUN01L, -80APR21L, -79APR11L, -66JAN19L
^den-dù “Bel-ibni”: -701MAR20L
en ?: -608SEP03L
en “toward”: -370NOV11L
eš-šú “newly”: -605JAN08L, -605JAN08L, -605JAN08L, -605JAN08L, -605JAN08L, -605JAN08L
gab “completely”: (6), -684OCT03L, -608SEP03L, -554OCT06L, -500NOV07L, -406OCT21L, -405APR15L, -395SEP18L, -381DEC12L, -377APR06L, -370NOV11L, -362JUN18L, -352NOV22L, -316DEC13L
gab-bi “completely”: (6), -307JUL09L, -283MAR17L, -225AUG01L, -189FEB28L, -188FEB17L, -149JUL03L, -134MAR21L, -123AUG13L, -105AUG25L, -98OCT05L, -40MAR02L
gab-bi-šú “in its totality”: (6), -586JAN08L, -576DEC07L, -525SEP16L, -370NOV11L, -326JAN13L, -170AUG23L, -80APR21L
gab-šú “in its totality”: (6), -330SEP20L, -225AUG01L, -214DEC25L
gaba-šú “its breast”: -225AUG01L, -193NOV05L, -95AUG03L
gal “múl/mul gal = meteor”: -326JAN13L, -119JUN01L
gàm “Crook”: -182OCT04L, -142FEB17L
gan “month IX”: (1), -603DEC06L, -577DEC19L, -576DEC07L, -446DEC10L, -363DEC23L, -362DEC12L, -334DEC03L, -316DEC13L, -316DEC13L, -214DEC25L, -65DEC28L
gar = šakānu “to put; to make; onset (phase of an eclipse)": (10,11), -746FEB06L, -746AUG02L, -745JAN26L, -745JUL22L, -631MAY23L, -602OCT27L, -591APR01L, -579FEB19L, -578FEB08L, -576DEC07L, -554OCT06L, -536OCT17L, -536OCT17L, -527NOV06L, -525SEP16L, -525SEP16L, -522JUL16L, -521JAN10L, -500NOV07L, -464JUN05L, -464JUN05L, -439FEB02L, -439FEB02L, -423SEP28L, -423SEP28L, -409DEC21L, -407OCT31L, -407OCT31L, -396APR05L, -396APR05L, -378APR17L, -377APR06L, -370NOV11L, -345JAN13L, -345JAN13L, -338SEP04S, -326JAN13L, -326JAN13L, -326JAN13L, -316DEC13L, -316DEC13L, -307JUL09L, -304MAY08L, -286MAY19L, -283MAR17L, -283MAR17L, -280JAN30S, -272FEB16L, -255SEP16S, -253JAN31S, -248MAY04S, -248MAY04S, -247OCT03L, -241JUN15S, -240NOV28S, -238APR28L, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L, -211APR30L, -189FEB28L, -189MAR14S, -182OCT04L, -162MAR30L, -162MAR30L, -153MAR21L, -153MAR21L, -153MAR21L, -153MAR21L, -149JUL03L, -149JUL03L, -135APR15S, -135APR15S, -134MAR21L, -128NOV05L, -128NOV05L, -128NOV05L, -125SEP19S, -124AUG24L, -123AUG13L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -105FEB28L, -88SEP29S, -86FEB28L, -65DEC28L, -65DEC28L, -9JUN30S
gar-an = išakkan “to put; to make; onset (phase of an eclipse)": -238APR28L, -194JUN06S, -189MAR14S, -189MAR14S, -169JUL28S, -162MAR30L, -153MAR21L, -142FEB17L, -135APR01L, -135APR15S, -132FEB13S, -108MAY01L, -97MAR31L, -93JUL13L, -79APR11L, -72NOV16L
gar-in = šakin “to put; to make; onset (phase of an eclipse)": (11), -238APR28L, -162MAR30L, -162MAR30L, -161MAR05S, -124AUG24L, -122AUG02L, -119JUN01L, -119JUN01L, -95AUG03L, -86FEB28L, -80APR21L, -79APR11L, -72NOV16L, -66JAN19L, -65DEC28L
gar-nu ?: -9JUN30S
gašan “Lady”: -133MAR10L, -93JUL13L, -79OCT05L, -66JAN19L, -65DEC28L
^dgašan-iá “my Lady”: -746FEB06L, -128NOV05L, -119JUN01L, -80APR21L, -79APR11L, -66JAN19L
gaz-meš “to break (pl.)”: -9JUN30S, -9JUN30S
gaz-šú “killed him”: -464JUN05L
ge₆ “night(time)": (2,5,7,8,14), -701MAR20L, -694MAY01L, -685APR21L, -684OCT03L, -666OCT15L, -665APR10L, -611NOV05L, -609SEP15L, -609SEP15L, -609SEP15L, -608SEP03L, -608SEP03L, -605JAN08L, -602OCT27L, -600APR10L, -598FEB19L, -598FEB19L, -594NOV27L, -593MAY23L, -591APR01L, -587JAN19L, -579AUG14L, -576DEC07L, -575JUN03L, -572APR01L, -561MAR02L, -554OCT06L, -536OCT17L, -528NOV17L, -528NOV17L, -528NOV17L, -525SEP16L, -525SEP16L, -525SEP16L, -522JUL16L, -522JUL16L, -521JAN10L, -521JAN10L, -518OCT28L, -500NOV07L, -464NOV29L, -414SEP19L, -413MAR16L, -408JUN16L, -407OCT31L,

-405APR15L, -396APR05L, -396SEP29L, -382JUN29L, -378APR17L, -377APR06L, -377APR06L,
 -374FEB03L, -374FEB03L, -370MAY17L, -370NOV11L, -370NOV11L, -366AUG30L,
 -366AUG30L, -363JUN29L, -363DEC23L, -362JUN18L, -362DEC12L, -362DEC12L, -352NOV22L,
 -352NOV22L, -345JAN13L, -333MAY29L, -330SEP20L, -330SEP20L, -330OCT05S, -330OCT05S,
 -326JAN13L, -326JAN13L, -326JAN13L, -326JAN13L, -326JAN13L, -326JAN13L, -326JUL09L,
 -325JAN03L, -316JUN18L, -316DEC13L, -307JUL09L, -302SEP11L, -302SEP25S, -301MAR07L,
 -291AUG11L, -286MAY19L, -283MAR17L, -283MAR17L, -283MAR17L, -283MAR17L, -278NOV13L,
 -278NOV13L, -277MAY10L, -277MAY10L, -272FEB16L, -272FEB16L, -250DEC04L, -248OCT13L,
 -248OCT27S, -246SEP22L, -245AUG28S, -239NOV03L, -238APR28L, -238APR28L, -238APR28L,
 -238APR28L, -238APR28L, -230APR30L, -230MAY15S, -228MAR25S, -225FEB06L, -225FEB06L,
 -225AUG01L, -225AUG01L, -225AUG01L, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L,
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 -202NOV14L, -200APR13S, -194NOV15L, -194NOV15L, -194NOV29S, -194NOV29S, -193MAY26S,
 -193MAY26S, -193NOV05L, -193NOV05L, -193NOV05L, -193NOV05L, -193NOV05L, -189FEB28L,
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 gigir “chariot”: -370NOV11L, -352NOV22L
 gin “to go, to blow”: (11), -746AUG02L, -685APR21L, -685APR21L, -684OCT03L, -684OCT03L,
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 gin-me “to go, to blow (pl.)”: -330SEP20L, -272FEB16L
 gir “lightning; to flash”: (11), -370NOV11L, -370NOV11L, -370NOV11L, -238APR28L, -238APR28L

gír-tab “Scorpius”: -238APR28L, -98APR11L, -80APR21L
 gír “foot”: -605JAN08L, -272FEB16L
 giš-kun “rump”: -554OCT06L
 giš-kun-šú “its rump”: -86FEB28L, -86FEB28L
 gu “Aquarius”: -366AUG30L, -170AUG23L, -123AUG13L, -95AUG03L
 gù “thunder”: (11), -605JAN08L, -370NOV11L, -370NOV11L, -238APR28L
 gù-šú “its thunder”: -238APR28L
 gu₄ “month II”: (1), -712APR19L, -694MAY01L, -685APR21L, -667MAY02L, -649MAY13L, -609SEP15L,
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 -119JUN01L
 gu₄-an “Taurus”: -407OCT31L
 gu₄-ud “Mercury”: (12), -406OCT21L, -405OCT10L, -247OCT03L, -189FEB28L, -189MAR14S,
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 gub “to stand”: (12), -482NOV19L, -370MAY17L, -352NOV22L, -326JAN13L, -135APR01L, -128NOV05L,
 -97MAR31L, -93JUL13L
 GUB “to stand?”: -9JUN30S
 gub-me “to stand (pl.)”: (12), -482NOV19L, -407OCT31L, -405APR15L, -405OCT10L, -352NOV22L,
 -238APR28L
 gub-meš “to stand (pl.)”: (12), -345JAN13L, -326JAN13L, -326JUL09L, -307JUL09L, -286MAY19L,
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 -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -109NOV05L, -108MAY01L, -105AUG25L,
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 gub-uz “it stood”: (12), -238APR28L, -214DEC25L, -214DEC25L
 gub-numun “Ukin-zer”: -730APR09L
 hab “disk”: (6), -712APR19L, -685APR21L, -536OCT17L, -528NOV17L, -439FEB02L, -407OCT31L,
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 ha-mu-ut “fast”: (10), -119JUN01L
 he-pí “broken”: -605JAN08L, -605JAN08L, -605JAN08L, -605JAN08L, -605JAN08L, -605JAN08L,
 -330SEP20L
 hi-ši-á-šú “Xerxes”: -464JUN05L
 hun “Aries”: -684OCT03L, -554OCT06L, -423SEP28L, -98OCT05L, -79OCT05L
 i (short for *i-sa, i-si*) “a little”: (6), -439FEB02L, -409JUN28L, -409DEC21L, -405OCT10L, -363JUN29L,
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 íb (short for íb-tag4) “the remaining”: -352NOV22L
 íb-tag₄ “the remaining”: (12), -326JAN13L, -286MAY19L, -238APR28L, -214DEC25L, -193NOV05L,
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 -66JAN19L, -66JAN19L, -66JAN19L, -65JAN08L, -65JAN08L, -65JAN08L, -65DEC28L,
 -65DEC28L, -65DEC28L, -65DEC28L, -65DEC28L, -46JUL04L, -40MAR02L, -9JUN30S,
 -9JUN30S, -9JUN30S, -9JUN30S

IR ?: -9JUN30S

ír “weeping; maximal phase”: (7,10), -631MAY23L, -608SEP03L, -591APR01L, -561MAR02L, -554OCT06L,
 -528NOV17L, -525SEP16L, -525SEP16L, -500NOV07L, -482NOV19L, -464JUN05L, -439FEB02L,
 -439FEB02L, -423SEP28L, -423SEP28L, -409DEC21L, -407OCT31L, -405APR15L, -396APR05L,
 -377APR06L, -377APR06L, -370NOV11L, -370NOV11L, -370NOV11L, -352NOV22L, -330SEP20L,
 -326JAN13L, -326JAN13L, -326JAN13L, -316DEC13L, -316DEC13L, -316DEC13L, -304MAY08L,
 -286MAY19L, -286MAY19L, -286MAY19L, -283MAR17L, -283MAR17L, -272FEB16L, -250DEC04L,
 -238APR28L, -238APR28L, -238APR28L, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L,
 -211APR30L, -189FEB28L, -156NOV14L, -153MAR21L, -153MAR21L, -149JUL03L, -149JUL03L,
 -142FEB17L, -135APR01L, -135APR15S, -134MAR21L, -128NOV05L, -128NOV05L, -123AUG13L,
 -123AUG13L, -123AUG13L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -109NOV05L,
 -108MAY01L, -105FEB28L, -105AUG25L, -86FEB28L, -80APR21L, -79APR11L, -72NOV16L,
 -66JAN19L, -66JAN19L, -65DEC28L, -65DEC28L, -46JUL04L, -9JUN30S, -9JUN30S

i-ri-hi “remains”: -522JUL16L, -521JAN10L

i-ru-up “clouded”: -124MAR15S

is “jaw”: -193NOV05L, -128NOV05L, -109NOV05L

i-sa “a little”: (6), -609SEP15L, -247OCT03L, -156NOV14L, -149JUL03L

i-si “a little”: (6), -522JUL16L, -238APR28L

is-pu-bar-za-a “Ispubarza”: -79OCT05L

iš-ta-hat “threw off”: -250DEC04L, -135APR15S

i-te-rim “covered”: -611NOV05L

it-tar-ri-du “in the time of (?)”: -79APR11L, -79OCT05L

itu “month”: (1), -746FEB06L, -685APR21L, -667MAY02L, -649MAY13L, -631MAY23L, -611NOV05L,
 -609SEP15L, -609SEP15L, -598FEB19L, -526APR04L, -422AUG19L, -255SEP16S, -248APR19L,
 -239OCT18S, -239NOV03L, -238APR28L, -230APR30L, -194NOV15L, -189FEB28L, -189MAR14S,
 -168JAN07L, -161FEB18L, -153MAR21L, -119JUN01L, -80APR21L, -79APR11L, -66JAN19L

izi “month V”: (1), -745JUL22L, -744JUL10L, -589SEP04L, -579AUG14L, -578AUG04L, -464JUN05L,
 -422AUG19L, -421AUG08L, -338SEP04S, -189AUG23L, -189SEP07S, -169AUG13L, -162SEP08S,
 -161AUG14L

iz-ku-ú “it cleared”: -304MAY08L

iz-za-ku “it cleared”: -611NOV05L

ka “mouth?”: -238APR28L

kád “closed”: -80APR21L

kak-ban “Sirius”: (12), -283MAR17L, -214DEC25L, -193NOV05L, -184NOV24L, -90NOV05L, -86FEB28L,
 -65DEC28L

kak-si-sá “Sirius”: (12), -156NOV14L, -153MAR21L, -128NOV05L, -105AUG25L, -98APR11L, -98OCT05L,
 -97MAR31L, -75JAN28L, -66JAN19L, -65JAN08L, -9JUN30S

kal “whole”: -162MAR30L

kalag “dense”: -137MAY22L

kan-dal-an “Kandalanu”: -631MAY23L

- kap* “wing” (see also *pa*): (11), -149JUL03L
kap-pi “wing” (see also *pa*): (11), -65DEC28L
kas (short for KAS.BU = *danna*) “double hour”: (14), -602OCT27L, -602OCT27L, -602OCT27L, -600APR10L, -598FEB19L, -594NOV27L, -591APR01L, -590MAR22L, -587JAN19L, -586JAN08L, -579AUG14L, -576DEC07L, -576DEC07L, -575JUN03L, -528NOV17L, -528NOV17L, -525SEP16L, -525SEP16L, -409DEC21L, -395MAR26L
KAxMI “eclipse”: -525SEP16L, -225AUG01L, -159JAN26L, -153MAR21L, -133MAR10L, -128NOV05L, -123AUG13L, -119JUN01L, -66JAN19L
KAxSID ?: -330SEP20L
ki “place, location”: -609SEP15L, -464JUN05L, -408JUN16L, -363JAN02L, -326JAN13L
ki (=*itti*) “with”: p.17, -590SEP15L, -567JUL04L, -439JUL28L, -209SEP18S
ki “when”: (4), -666OCT15L, -518OCT28L, -381JUL03S, -377APR06L, -377APR06L, -370NOV11L, -370NOV11L, -370NOV11L, -366AUG30L, -363JAN02L, -352NOV22L, -345JAN13L, -333MAY29L, -326JAN13L, -322OCT07S, -316DEC13L, -304MAY08L, -304MAY08L, -302SEP11L, -291AUG25S, -283MAR17L, -283MAR17L, -280JAN30S, -272FEB16L, -253JAN31S, -253JAN31S, -250DEC04L, -250DEC04L, -246SEP07S, -241JUN15S, -232NOV30S, -225FEB20S, -225AUG01L, -214DEC25L, -214DEC25L, -211APR30L, -211MAY15S, -211OCT24L, -209SEP18S, -202MAY06S, -195JUN16S, -194JUN06S, -193NOV05L, -193NOV05L, -193NOV19S, -189FEB28L, -189MAR14S, -189MAR14S, -189AUG23L, -189SEP07S, -188FEB17L, -184NOV24L, -182OCT04L, -179AUG17S, -170AUG23L, -170AUG23L, -169AUG13L, -162MAR15S, -159JAN26L, -153MAR21L, -153MAR21L, -149JUL03L, -144SEP19S, -142FEB17L, -142MAR05S, -137MAY22L, -136OCT20S, -135APR01L, -135APR15S, -135SEP24L, -134MAR06S, -124SEP07S, -123FEB03S, -119MAY17S, -99OCT31S, -98APR11L, -98OCT05L, -97MAR31L, -95AUG19S, -93JUL13L, -88SEP29S, -86FEB28L, -86FEB28L, -80APR21L, -79SEP20S, -77AUG30S, -75JAN28L, -66JAN19L, -65DEC28L, -62MAY18S, -46JUL04L
ki-i “when”: (4), -239NOV03L, -238APR28L, -238APR28L, -225AUG01L, -194JUN06S, -189FEB28L, -189FEB28L, -169JUL28S, -162MAR30L, -156NOV14L, -135APR01L, -135APR15S, -134MAR21L, -133MAR10L, -133SEP03L, -132FEB13S, -132FEB13S, -131JAN17L, -128NOV05L, -128NOV05L, -124AUG24L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -111JUN18S, -109NOV05L, -108MAY01L, -105AUG25L, -105AUG25L, -95AUG03L, -79APR11L, -79APR11L, -72NOV16L, -66JAN19L, -65DEC28L, -40MAR02L
kin “month VI”: (1), -746AUG02L, -746AUG02L, -744JUL10L, -685APR21L, -658MAY22L, -609SEP15L, -608SEP03L, -602MAY03L, -591SEP26L, -590SEP15L, -590SEP15L, -572SEP25L, -562SEP05L, -525SEP16L, -464JUN05L, -423SEP28L, -414SEP19L, -396SEP29L, -395SEP18L, -388OCT31L, -162SEP23L, -135SEP24L
kin-2-kám “month VI₂”: (1), -599SEP24L, -526SEP27L
kin-sa “Knee”: -149JUL03L
kip-pat “Circle”: -135APR01L
ku₄ (=tu) “to enter”: -407OCT31L, -272FEB16L, -105AUG25L
ku₄-ub “entered”: -193NOV05L, -128NOV05L
ku-mar “shoulder”: -187AUG01L
kur “bright”: -326JAN13L
kur “east”: (4,11), -701MAR20L, -685APR21L, -665APR10L, -649NOV05L, -631MAY23L, -608SEP03L, -572APR01L, -554OCT06L, -554OCT06L, -536OCT17L, -525SEP16L, -525SEP16L, -500NOV07L, -500NOV07L, -423SEP28L, -420FEB02L, -409DEC21L, -407OCT31L, -406OCT21L, -405APR15L, -405OCT10L, -405OCT10L, -378APR17L, -378APR17L, -377APR06L, -370NOV11L, -370NOV11L, -366AUG30L, -352NOV22L, -352NOV22L, -345JAN13L, -338SEP04S, -333MAY29L, -330SEP20L, -326JAN13L, -326JAN13L, -322OCT07S, -316DEC13L, -316DEC13L, -283MAR17L, -283MAR17L, -250DEC04L, -241JUN15S, -239NOV03L, -238APR28L, -238APR28L, -225AUG01L, -211OCT24L, -202MAY06S, -193NOV05L, -193NOV05L, -189FEB28L, -189FEB28L, -189MAR14S, -189MAR14S, -188FEB17L, -159JAN26L, -153MAR21L, -153MAR21L, -142FEB17L, -135APR01L, -135APR01L, -135APR15S, -134MAR21L, -133MAR10L, -133SEP03L, -131JAN17L, -130JUL02L, -128NOV05L, -128NOV05L, -124AUG24L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -109NOV05L, -108MAY01L, -105FEB28L, -105AUG25L, -98APR11L, -98OCT05L, -97MAR31L, -79APR11L, -79APR11L, -72NOV16L, -66JAN19L, -66JAN19L, -46JUL04L, -09JUN30S
kur “moonrise to sunrise”: (2), -88SEP29S, -09JUN30S
kur “to rise (planet)": -605JAN08L, -572APR01L
kur “to rise (sun)": (14), -590SEP15L, -439JUL28L, -378APR17L, -366AUG30L, -359APR17L, -239NOV03L
kur-ra “east”: -214DEC25L, -214DEC25L
kùš “cubit”: (13), -611NOV05L, -572APR01L, -572APR01L, -561MAR02L, -423SEP28L, -420FEB02L, -407OCT31L, -405APR15L, -378APR17L, -370NOV11L, -366AUG30L, -363JUN29L, -363DEC23L,

- 352NOV22L, -345JAN13L, -345JAN13L, -326JAN13L, -316JUN18L, -316DEC13L, -272FEB16L,
 -250DEC04L, -238APR28L, -238APR28L, -225AUG01L, -214DEC25L, -193NOV05L, -189FEB28L,
 -184NOV24L, -153MAR21L, -153MAR21L, -149JUL03L, -135APR01L, -128NOV05L, -122AUG02L,
 -122AUG02L, -119JUN01L, -109NOV05L, -105FEB28L, -98APR11L, -86FEB28L, -79APR11L,
 -75JAN28L, -72NOV16L, -66JAN19L, -65JAN08L, -65JAN08L, -65DEC28L
- la* “not”: -746FEB06L, -09JUN30S
- lal* “back”: -72NOV16L
- la-mu* “encircle”: -65DEC28L
- le₁₀* “bull”: -193NOV05L, -128NOV05L, -109NOV05L
- liš-lim* “let it remain whole”: -746FEB06L, -128NOV05L, -119JUN01L, -80APR21L, -79APR11L, -66JAN19L
- lugal* “king”: -211APR30L, -189MAR14S, -189AUG23L, -162MAR30L, -162SEP08S, -161AUG14L,
 -128NOV05L, -119JUN01L, -79APR11L, -79APR11L, -79OCT05L, -66JAN19L, -65DEC28L
- lugal* “Regulus”: -605JAN08L, -159JAN26L, -66JAN19L
- lugal-meš* “kings”: -169JUL28S, -79APR11L, -65DEC28L
- lu-lim* “stag”: -184NOV24L
- ma* ?: -609SEP15L, -598FEB19L
- ma-gal* “very”: -326JAN13L
- mar* “west”: (4,11), -685APR21L, -611NOV05L, -608SEP03L, -561MAR02L, -554OCT06L, -554OCT06L,
 -536OCT17L, -525SEP16L, -525SEP16L, -500NOV07L, -464NOV29L, -423SEP28L, -423SEP28L,
 -405APR15L, -396APR05L, -377APR06L, -377APR06L, -370MAY17L, -370NOV11L, -352NOV22L,
 -330SEP20L, -326JAN13L, -325JAN03L, -321SEP26S, -316JUN18L, -304MAY08L, -283MAR17L,
 -272FEB16L, -272FEB16L, -253JAN31S, -250DEC04L, -241JUN15S, -238APR28L, -214DEC25L,
 -189FEB28L, -189MAR14S, -189MAR14S, -189AUG23L, -184NOV24L, -179AUG17S, -179AUG17S,
 -169JUL28S, -162MAR30L, -162MAR30L, -153MAR21L, -153MAR21L, -149JUL03L, -135APR01L,
 -135APR15S, -135APR15S, -135APR15S, -135SEP24L, -134MAR21L, -133SEP03L,
 -132FEB13S, -128NOV05L, -128NOV05L, -124AUG24L, -124AUG24L, -123AUG13L, -122AUG02L,
 -119JUN01L, -119JUN01L, -119JUN01L, -111JUN18S, -105FEB28L, -95AUG03L, -88SEP29S,
 -79APR11L, -66JAN19L, -65DEC28L, -09JUN30S, -09JUN30S
- ^{im}*mar-tu* “west”: -214DEC25L
- máš* “Capricornus”: -572APR01L, -424APR14L, -378APR17L, -363JUN29L, -316JUN18L, -307JUL09L,
 -225AUG01L, -149JUL03L, -122AUG02L
- maš-maš* “Gemini”: -409DEC21L, -381DEC12L, -370NOV11L, -363DEC23L, -316DEC13L, -250DEC04L,
 -184NOV24L, -159JAN26L, -128NOV05L, -98APR11L, -65DEC28L
- maš-šá-tú* “doublets”: -189FEB28L
- me* “day(time)": (2,14), -730APR09L, -702SEP23L, -685OCT15L, -683MAR30L, -676MAY11L,
 -667MAY02L, -608SEP03L, -589MAR12L, -528MAY24L, -525MAR24L, -439JUL28L, -414SEP19L,
 -409JUN28L, -408DEC10L, -388OCT31L, -379NOV20L, -378OCT11L, -374FEB03L, -368APR11S,
 -366AUG30L, -363JAN02L, -356FEB14L, -356FEB29S, -352MAY28L, -334DEC03L, -332OCT27S,
 -325JAN03L, -322OCT07S, -321SEP26S, -304MAY08L, -291AUG11L, -291AUG11L, -291AUG25S,
 -280JAN30S, -280JAN30S, -279DEC24L, -278JUN19L, -266OCT17S, -253JAN31S, -253JAN31S,
 -253JAN31S, -250DEC04L, -248APR19L, -248APR19L, -248MAY04S, -248MAY04S, -246SEP07S,
 -246SEP22L, -246SEP22L, -241JUN15S, -239OCT18S, -238APR28L, -232NOV30S, -232DEC14L,
 -226MAR03S, -225FEB06L, -225JUL18S, -225AUG01L, -211APR30L, -211MAY15S, -211OCT24L,
 -202MAY06S, -202NOV14L, -194JUN06S, -194JUN20L, -193MAY11L, -189MAR14S, -189MAR14S,
 -189MAR14S, -189AUG23L, -189AUG23L, -189SEP07S, -188FEB02S, -188FEB17L, -184MAY30L,
 -184NOV24L, -172APR04S, -170AUG23L, -169FEB16L, -169JUL28S, -169JUL28S, -169AUG13L,
 -168JAN07L, -165MAY17S, -162SEP23L, -161FEB18L, -161MAR05S, -161AUG14L, -161AUG14L,
 -161AUG14L, -160FEB07L, -160FEB07L, -158JUL12L, -153MAR21L, -144SEP19S, -142FEB17L,
 -140JUL22L, -137MAY22L, -137MAY22L, -135APR01L, -135APR15S, -135APR15S, -135APR15S,
 -135SEP24L, -135OCT09S, -134MAR06S, -133AUG19S, -132FEB13S, -132FEB13S, -132FEB13S,
 -128NOV05L, -125MAR11L, -124SEP07S, -122AUG02L, -119JUN01L, -111JUN18S, -111JUN18S,
 -108MAY01L, -106MAR11L, -96AUG14L, -93JUL13L, -90NOV05L, -88SEP15L, -88SEP29S, -88SEP29S,
 -86AUG24L, -84JAN23S, -80APR21L, -79APR11L, -79SEP20S, -76FEB09L, -66JAN19L, -66JAN19L,
 -65JAN08L, -65DEC28L, -65DEC28L, -62MAY03L, -62MAY18S, -40FEB15S, -40MAR02L, -09JUN30S,
 -09JUN30S, -09JUN30S
- meš-hat* “tail (of meteor)”: -326JAN13L
- mi* ?: -09JUN30S
- mu* (short for *mušu*?) “night”: -135APR15S
- mu x* “year x”: (1), -746AUG02L, -745JUL22L, -744JUL10L, -701MAR20L, -685APR21L, -603JUN12L,
 -602MAY03L, -601APR22L, -600APR10L, -599MAR31L, -594JUN03L, -593MAY23L, -592MAY11L,

- 591SEP26L, -590SEP15L, -589SEP04L, -588JUL25L, -587JUL15L, -579AUG14L, -578AUG04L,
 -577JUN25L, -576JUN14L, -575JUN03L, -526APR04L, -525SEP16L, -522JUL16L, -327JUL20L,
 -326JUL09L
- mu-x-kám “year x”: (1), -730APR09L, -609SEP15L, -316DEC13L, -250DEC04L, -214DEC25L, -211APR30L,
 -194JUN06S, -193MAY11L, -189FEB28L, -189MAR14S, -189AUG23L, -187AUG01L, -184MAY30L,
 -169JUL28S, -162MAR30L, -162SEP08S, -162SEP23L, -161AUG14L, -159JUL23L, -153MAR21L,
 -135APR01L, -135SEP24L, -128NOV05L, -128NOV05L, -119JUN01L, -119JUN01L, -98APR11L,
 -80APR21L, -79APR11L, -79APR11L, -79OCT05L, -66JAN19L, -66JAN19L, -65DEC28L, -65DEC28L
- mu-sag “accession year”: -746FEB06L, -667MAY02L, -422MAR25L
- mul “star”: -609SEP15L, -605JAN08L, -119JUN01L
- múl “star”: -561MAR02L, -326JAN13L, -283MAR17L, -238APR28L, -225AUG01L, -214DEC25L,
 -214DEC25L, -187AUG01L, -184NOV24L, -184NOV24L, -184NOV24L, -182OCT04L, -162MAR30L,
 -162MAR30L, -159JAN26L, -153MAR21L, -149JUL03L, -135APR15S, -134MAR21L, -128NOV05L,
 -122AUG02L, -122AUG02L, -122AUG02L, -119JUN01L, -105AUG25L, -98APR11L, -98OCT05L,
 -97MAR31L, -93JUL13L, -90NOV05L, -86FEB28L, -86FEB28L, -86FEB28L, -79OCT05L, -75JAN28L,
 -66JAN19L, -66JAN19L, -65JAN08L, -09JUN30S
- múl-babbar “Jupiter”: (12), -424APR14L, -406OCT21L, -405APR15L, -405OCT10L, -370NOV11L,
 -370NOV11L, -345JAN13L, -330SEP20L, -304MAY08L, -238APR28L, -193NOV05L, -189FEB28L,
 -184NOV24L, -156NOV14L, -153MAR21L, -149JUL03L, -135APR15S, -130JUL02L, -123AUG13L,
 -119JUN01L, -119JUN01L, -108MAY01L, -98APR11L, -98OCT05L, -97MAR31L, -93JUL13L,
 -90NOV05L, -86FEB28L, -79APR11L, -75JAN28L, -65JAN08L, -65DEC28L
- múl-meš “stars”: -214DEC25L
- múl-múl “Pleiades”: -536OCT17L, -406OCT21L, -97MAR31L
- múl-sag-me-gar “Jupiter”: (12), -528NOV17L
- mul_x(ÁB)-meš “stars”: -611NOV05L
- murub₄ “middle watch”: (14), -600APR10L
- murub₄ “middle”: -684OCT03L, -528NOV17L, -238APR28L
- murub_{4-ti} “middle”: -609SEP15L
- muš (short for *muššuh*) “measured”: (2), -363JAN02L, -304MAY08L, -238APR28L, -225AUG01L,
 -214DEC25L, -214DEC25L, -211APR30L, -211OCT24L, -202MAY06S, -189FEB28L, -189AUG23L,
 -188FEB17L, -184NOV24L, -162MAR30L, -162MAR30L, -162MAR30L, -161AUG14L, -160FEB07L,
 -158JUL12L, -153MAR21L, -153MAR21L, -142FEB17L, -137NOV15L, -135SEP24L, -134MAR21L,
 -133MAR10L, -128NOV05L, -122AUG02L, -119JUN01L, -119JUN01L, -111JUL02L, -111JUL02L,
 -108MAY01L, -106MAR11L, -93JUL13L, -88SEP15L, -86FEB28L, -86AUG24L, -79APR11L,
 -79APR11L, -79OCT05L, -66JAN19L, -66JAN19L, -65JAN08L, -09JUN30S
- mu-šú “his name”: -422MAR25L
- na “sunrise to moonset”: (2,15), -567JUL04L, -307JUL09L, -291AUG11L, -280JAN16L, -238APR28L,
 -214DEC25L, -211APR30L, -189FEB28L, -184NOV24L, -162MAR30L, -162MAR30L, -153MAR21L,
 -133MAR10L, -128NOV05L, -119JUN01L, -88SEP15L, -80APR21L, -80APR21L, -79APR11L,
 -79OCT05L, -66JAN19L, -65JAN08L, -65DEC28L
- na-ad-dul* “harness”: -162MAR30L
- NAM.ÚŠ-me “deaths”: -330SEP20L
- nam-lugal “kingship”: -746FEB06L
- ^dné-bu-ú “the Bright one”: -609SEP15L
- né-hi* “slow”: (10), -407OCT31L, -326JAN13L, -316DEC13L, -225AUG01L, -119JUN01L
- nē-nē* “stood close”: -611NOV05L
- nibu* “the Bright one”: -104AUG13L
- níg-du “Kudurru (Nebuchadnezzar)": -590SEP15L, -572SEP25L
- nigín “surround”: -238APR28L
- nigin “surround”: -80APR21L
- nim “high; to rise”: (14), -730APR09L, -702SEP23L, -685OCT15L, -683MAR30L, -676MAY11L,
 -667MAY02L, -589MAR12L, -528MAY24L, -439JUL28L, -409JUN28L, -408DEC10L, -406OCT21L,
 -388OCT31L, -379NOV20L, -378OCT11L, -370NOV11L, -352MAY28L, -291AUG11L, -248MAY04S,
 -239OCT18S, -238APR28L, -153MAR21L, -149JUL03L, -135APR15S, -62MAY03L
- nim-a “high; to rise”: (14), -332OCT27S, -246SEP07S, -246SEP22L, -232NOV30S, -232DEC14L,
 -226MAR03S, -202NOV14L, -194JUN06S, -193MAY11L, -189MAR14S, -172APR04S, -168JAN07L,
 -162SEP23L, -161MAR05S, -160FEB07L, -158JUL12L, -144SEP19S, -135APR15S, -135APR15S,
 -133AUG19S, -106MAR11L, -88SEP15L, -88SEP29S, -86AUG24L, -84JAN23S, -76FEB09L, -62MAY18S
- nim-gír “lightning”: -605JAN08L, -283MAR17L, -283MAR17L
- nin-šú “his sister”: -79OCT05L

- ninda (= GAR) “measure of time, 1 ninda = 4 seconds”: -246SEP22L, -106MAR11L
- nu “not”: -694MAY01L, -536OCT17L, -518OCT28L, -482NOV19L, -482NOV19L, -413MAR16L, -407OCT31L, -406OCT21L, -382JUN29L, -381JUL03S, -362DEC12L, -352NOV22L, -326JAN13L, -326JUL09L, -307JUL09L, -302SEP11L, -291AUG25S, -286MAY19L, -280JAN16L, -272MAR01S, -246MAR29L, -246SEP07S, -246SEP22L, -238APR28L, -238APR28L, -232NOV30S, -225FEB20S, -225AUG01L, -214DEC25L, -211APR30L, -211MAY15S, -209SEP18S, -195JUN16S, -193NOV19S, -189FEB28L, -189FEB28L, -189MAR14S, -189MAR14S, -189SEP07S, -184NOV24L, -170AUG23L, -169AUG13L, -162MAR15S, -161MAR05S, -153MAR21L, -149JUL03L, -144SEP19S, -142MAR05S, -137MAY22L, -137MAY22L, -136OCT20S, -135APR01L, -135APR01L, -134MAR06S, -128NOV05L, -128NOV05L, -124MAR15S, -124SEP07S, -123FEB03S, -122AUG02L, -119MAY17S, -119JUN01L, -119JUN01L, -109NOV05L, -105AUG25L, -99OCT31S, -96AUG14L, -95AUG03L, -95AUG19S, -93JUL13L, -88SEP15L, -86FEB28L, -84JAN23S, -80APR21L, -79APR11L, -79APR11L, -79SEP20S, -77AUG30S, -76FEB09L, -66JAN19L, -65JAN08L, -65DEC28L, -65DEC28L, -62MAY18S, -46JUL04L
- nu-nu* “Fishes”: -326JAN13L
- pa “Sagittarius”: -464JUN05L, -424APR14L, -408JUN16L, -119JUN01L, -119JUN01L
- pa (=kappa) “wing”: (11), -536OCT17L, -525SEP16L, -378APR17L, -255SEP16S, -214DEC25L, -162MAR30L, -153MAR21L, -135APR15S, -128NOV05L, -124AUG24L, -119JUN01L
- pap “to watch”: (2), p.17, -518OCT28L, -518OCT28L, -482NOV19L, -382JUN29L, -381JUL03S, -362DEC12L, -302SEP11L, -291AUG25S, -280JAN16L, -272MAR01S, -246SEP07S, -238APR28L, -232NOV30S, -225FEB20S, -211APR30L, -211MAY15S, -209SEP18S, -195JUN16S, -193NOV19S, -189FEB28L, -189SEP07S, -189SEP07S, -169AUG13L, -162MAR15S, -144SEP19S, -142MAR05S, -137MAY22L, -137MAY22L, -136OCT20S, -135APR01L, -135SEP24L, -134MAR06S, -128NOV05L, -124MAR15S, -124SEP07S, -123FEB03S, -119MAY17S, -99OCT31S, -96AUG14L, -95AUG19S, -79APR11L, -79SEP20S, -77AUG30S, -76FEB09L, -65DEC28L, -62MAY18S
- pi-il-li-* “Philip”: -316DEC13L
- ^f*pi-ir-muš-ta-na-a* “Pir’uštana”: -66JAN19L, -65DEC28L
- pi-ru* “Piru(?)”: -316DEC13L
- qup-pu* “container”: -366AUG30L, -123AUG13L
- rad* “cloudburst”: -247OCT03L
- re-bít* “quarter”: (6), -600APR10L
- rín “Libra”: -572APR01L, -406OCT21L, -405APR15L, -377APR06L, -370NOV11L, -135APR01L, -98APR11L, -98APR11L, -97MAR31L, -79APR11L
- rit “handle”: -182OCT04L, -142FEB17L
- sa₄ “bright”: -441MAR25L, -283MAR17L, -225AUG01L, -214DEC25L, -153MAR21L, -95AUG03L
- sa₅ “red”: (11), -554OCT06L, -370NOV11L, -352NOV22L, -326JAN13L, -316DEC13L, -283MAR17L, -225AUG01L, -189FEB28L, -182OCT04L, -153MAR21L, -134MAR21L, -128NOV05L, -119JUN01L, -119JUN01L, -108MAY01L, -105AUG25L
- sa₅-šú “its redness”: -153MAR21L, -128NOV05L, -119JUN01L, -119JUN01L, -108MAY01L
- sag “head”: -609SEP15L, -423SEP28L, -420FEB02L, -345JAN13L, -326JAN13L, -283MAR17L, -238APR28L, -153MAR21L, -128NOV05L, -123AUG13L, -119JUN01L, -105AUG25L, -90NOV05L, -80APR21L, -79OCT05L, -65JAN08L
- ^dsag-me-gar “Jupiter”: (12), -611NOV05L, -605JAN08L
- si “finger”: (6,13), -631MAY23L, -572APR01L, -423SEP28L, -396SEP29L, -377APR06L, -363DEC23L, -322OCT07S, -302SEP11L, -280JAN30S, -272FEB16L, -255SEP16S, -211OCT24L, -194JUN06S, -189FEB28L, -189AUG23L, -184NOV24L, -162MAR30L, -159JAN26L, -153MAR21L, -142FEB17L, -135APR01L, -133MAR10L, -119JUN01L, -108MAY01L, -97MAR31L, -93JUL13L, -86FEB28L, -79APR11L, -79APR11L, -75JAN28L, -65DEC28L
- si “horn”: -424APR14L, -378APR17L, -363JUN29L, -316JUN18L, -307JUL09L, -149JUL03L
- si “north”: (4,11), -746AUG02L, -685APR21L, -651JUL02L, -651DEC27L, -631MAY23L, -631MAY23L, -631MAY23L, -611NOV05L, -554OCT06L, -536OCT17L, -525SEP16L, -522JUL16L, -521JAN10L, -500NOV07L, -464NOV29L, -423SEP28L, -409DEC21L, -409DEC21L, -408JUN16L, -407OCT31L, -378APR17L, -370MAY17L, -370NOV11L, -370NOV11L, -370NOV11L, -366AUG30L, -352NOV22L, -345JAN13L, -345JAN13L, -345JAN13L, -345JAN13L, -338SEP04S, -333MAY29L, -325JAN03L, -322OCT07S, -321SEP26S, -316JUN18L, -316DEC13L, -304MAY08L, -283MAR17L, -280JAN30S, -272FEB16L, -255SEP16S, -253JAN31S, -253JAN31S, -238APR28L, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L, -211OCT24L, -189FEB28L, -189MAR14S, -189MAR14S, -184NOV24L, -169JUL28S, -162MAR15S, -162MAR30L, -162MAR30L, -162MAR30L, -153MAR21L, -153MAR21L, -153MAR21L, -149JUL03L, -135APR01L, -135APR15S, -135APR15S, -135SEP24L, -134MAR21L, -132FEB13S, -128NOV05L, -128NOV05L, -128NOV05L, -124AUG24L, -124AUG24L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -105FEB28L, -98APR11L, -95AUG03L,

- 95AUG03L, -93JUL13L, -90NOV05L, -90NOV05L, -88SEP29S, -88SEP29S, -79APR11L, -79APR11L,
 -75JAN28L, -72NOV16L, -66JAN19L, -66JAN19L, -66JAN19L, -65DEC28L, -09JUN30S, -09JUN30S
^{si₄} “red; Alpha Scorpii”: -631MAY23L, -572APR01L, -370MAY17L, -238APR28L
^{sig} “below”: (13), -561MAR02L, -423SEP28L, -345JAN13L, -326JAN13L, -149JUL03L, -105FEB28L,
 -86FEB28L, -79APR11L, -65JAN08L
^{sig} “month III”: (1), -631MAY23L, -603JUN12L, -577JUN25L, -576JUN14L, -408JUN16L, -363JUN29L,
 -362JUN18L, -361JUN07L, -278JUN19L, -194JUN20L, -184MAY30L
^{sim-mah} “Swallow”: -525SEP16L
^d^{sin} “the moon god”: -238APR28L, -214DEC25L, -162MAR30L, -162MAR30L, -149JUL03L, -86FEB28L
^{sin} “moon”: -651DEC27L, -609SEP15L, -567JUL04L, -522JUL16L, -521JAN10L, -374FEB03L,
 -366AUG30L, -356FEB14L, -345JAN13L, -333MAY29L, -326JAN13L, -326JUL09L, -324MAY19L,
 -321APR17L, -307JUL09L, -304MAY08L, -302SEP11L, -301MAR07L, -291AUG11L, -283MAR17L,
 -280JAN16L, -278JUN19L, -278NOV13L, -277MAY10L, -277NOV03L, -248APR19L, -248APR19L,
 -248OCT13L, -246SEP22L, -245SEP11L, -238APR28L, -238APR28L, -230APR30L, -225FEB06L,
 -225AUG01L, -211APR30L, -211OCT24L, -194JUN20L, -194NOV15L, -189FEB28L, -189AUG23L,
 -188FEB17L, -185DEC06L, -184NOV24L, -170AUG23L, -169FEB16L, -169AUG13L, -168JAN07L,
 -162SEP23L, -161FEB18L, -161AUG14L, -161AUG14L, -160FEB07L, -158JUL12L, -153MAR21L,
 -142FEB17L, -141AUG03L, -140JUL22L, -140DEC17L, -137MAY22L, -137NOV15L, -135APR01L,
 -133MAR10L, -132JAN29L, -129MAY23L, -128NOV05L, -125MAR11L, -122AUG02L, -119JUN01L,
 -111JUL02L, -108MAY01L, -106MAR11L, -105AUG25L, -98APR11L, -98OCT05L, -97MAR31L,
 -96AUG14L, -95AUG03L, -93JUL13L, -90NOV05L, -88SEP15L, -86FEB28L, -86AUG24L, -80APR21L,
 -79APR11L, -76FEB09L, -75JAN28L, -72NOV16L, -66JAN19L, -65DEC28L, -40MAR02L
^{sin-pap-su} “Sennacherib”: -685APR21L
^{sipa} “shepherd”: -250DEC04L
^{sud} “distant(?)”: -408JUN16L
^{sud} “red brown”: -153MAR21L, -128NOV05L, -119JUN01L, -119JUN01L, -108MAY01L
^{suhur} “Capricorn”: -225AUG01L, -122AUG02L
^d^{sal-ba-ta-a-nu} “Mars”: (12), -605JAN08L
^{sal-pu} “slanted”: (11), -377APR06L, -370NOV11L, -352NOV22L, -316JUN18L, -280JAN30S, -253JAN31S
^{šá} “of; which”: -730APR09L, -685OCT15L, -683MAR30L, -676MAY11L, -667MAY02L, -667OCT25L,
 -649MAY13L, -609SEP15L, -609SEP15L, -602OCT27L, -590SEP15L, -589MAR12L, -572SEP25L,
 -567JUL04L, -536OCT17L, -528NOV17L, -525SEP16L, -464JUN05L, -441MAR25L, -440MAR13L,
 -422MAR25L, -422MAR25L, -421FEB13L, -421AUG08L, -414MAR26L, -408JUN16L, -408DEC10L,
 -406APR26L, -405APR15L, -405OCT10L, -395MAR26L, -388OCT31L, -378APR17L, -378OCT11L,
 -377APR06L, -377APR06L, -370NOV11L, -370NOV11L, -366AUG30L, -356FEB29S, -352NOV22L,
 -345JAN13L, -345JAN29S, -334DEC03L, -332OCT27S, -330OCT05S, -326JAN13L, -321APR17L,
 -302SEP25S, -283MAR17L, -280JAN16L, -280JAN30S, -278NOV13L, -272FEB16L, -255SEP16S,
 -253JAN31S, -250DEC04L, -248OCT13L, -246SEP22L, -245AUG28S, -239OCT18S, -238APR28L,
 -230MAY15S, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L, -214DEC25L, -200APR13S,
 -194NOV29S, -193MAY11L, -193MAY26S, -193NOV05L, -189FEB28L, -189FEB28L, -187AUG01L,
 -186DEC31S, -185DEC06L, -184NOV24L, -184NOV24L, -169FEB16L, -168JAN07L, -168JAN22S,
 -164OCT29S, -162MAR30L, -162SEP08S, -162SEP08S, -162SEP23L, -161AUG14L, -161AUG28S,
 -160FEB07L, -159JUL23L, -158JUL12L, -153MAR21L, -153MAR21L, -149JUL03L, -143SEP08S,
 -141AUG03L, -140JUL22L, -140DEC31S, -136OCT04L, -135APR01L, -135APR15S, -135APR15S,
 -133MAR10L, -133MAR10L, -131FEB01S, -129JUN07S, -128NOV05L, -128NOV05L, -124AUG24L,
 -123AUG13L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -118MAY07S,
 -111JUL02L, -106MAR11L, -106MAR27S, -105FEB28L, -104AUG13L, -98APR11L, -95AUG03L,
 -88SEP15L, -86FEB13S, -86FEB28L, -86FEB28L, -86FEB28L, -86AUG24L, -80APR21L, -79APR11L,
 -79APR11L, -79APR11L, -79OCT05L, -79OCT05L, -79OCT05L, -76FEB09L, -66JAN19L, -65DEC28L,
 -65DEC28L, -09JUN30S
^{šá} “heart”: -09JUN30S
^{šal-šú} “third”: (6), -189MAR14S, -189MAR14S, -169JUL28S, -165MAY17S, -97MAR31L, -86FEB28L,
 -65DEC28L
^d^{šamáš} “the sun god”: -332OCT27S
^{šamáš} “sun”: -712APR19L, -667OCT25L, -658MAY22L, -649MAY13L, -602OCT27L, -590MAR22L,
 -590SEP15L, -572SEP25L, -562SEP05L, -525MAR24L, -518OCT28L, -439JUL28L, -414MAR26L,
 -395MAR26L, -378APR17L, -366AUG30L, -366SEP14S, -359APR17L, -356FEB14L, -356FEB29S,
 -356FEB29S, -345JAN29S, -334DEC03L, -330OCT05S, -321APR02S, -321SEP26S, -304APR23S,
 -304MAY08L, -302SEP25S, -291AUG25S, -291AUG25S, -279DEC24L, -278JUN19L, -272MAR01S,
 -266OCT17S, -261DEC21S, -253JAN31S, -253JAN31S, -248APR19L, -248APR19L, -248MAY04S,

- 248OCT27S, -246SEP07S, -245AUG28S, -239OCT18S, -239NOV03L, -232NOV30S, -230MAY15S,
 -228MAR25S, -225FEB06L, -225FEB20S, -225JUL18S, -225JUL18S, -217FEB22S, -211MAY15S,
 -211MAY15S, -209SEP18S, -209SEP18S, -200APR13S, -194JUN06S, -194JUN20L, -194NOV29S,
 -193MAY26S, -193NOV19S, -189MAR14S, -189AUG23L, -189SEP07S, -189SEP07S, -188FEB02S,
 -188FEB02S, -186DEC31S, -184MAY30L, -170AUG23L, -169FEB16L, -169JUL28S, -169JUL28S,
 -168JAN22S, -164OCT29S, -162MAR15S, -162SEP08S, -162SEP08S, -161FEB18L, -161MAR05S,
 -161AUG14L, -161AUG14L, -161AUG28S, -156MAY07S, -144SEP19S, -143SEP08S, -142MAR05S,
 -140JUL22L, -140DEC31S, -137MAY22L, -136OCT20S, -136OCT20S, -135APR15S, -135APR15S,
 -135OCT09S, -134MAR06S, -134MAR06S, -133FEB24S, -133AUG19S, -132FEB13S, -131FEB01S,
 -129JUN07S, -124MAR15S, -124SEP07S, -124SEP07S, -123FEB03S, -119MAY17S, -118MAY07S,
 -118OCT31S, -106MAR27S, -99OCT31S, -95AUG19S, -86FEB13S, -79SEP20S, -77AUG30S, -66JAN19L,
 -65JAN08L, -65DEC28L, -62MAY18S, -40FEB15S, -40FEB15S, -09JUN30S, -09JUN30S, -09JUN30S
 šamáš-mu-gub “Šamasžumukin”: -667MAY02L, -649MAY13L
 šar “wind, direction”: (4), -746AUG02L, -611NOV05L, -611NOV05L, -602OCT27L, -602OCT27L,
 -600APR10L, -576DEC07L
 šár “wind, direction”: (4), -576JUN14L, -368APR11S, -345JAN13L, -321SEP26S, -225AUG01L, -79APR11L
 še “month XII”: (1) -746FEB06L, -593NOV17L, -591APR01L, -590MAR22L, -589MAR12L, -589MAR12L,
 -589MAR12L, -577JAN28L, -571MAR22L, -561MAR02L, -525MAR24L, -439FEB02L, -422MAR25L,
 -414MAR26L, -413MAR16L, -395MAR26L, -334DEC03L, -239NOV03L, -189FEB28L, -189MAR14S,
 -153MAR21L, -40MAR02L
 šed₇ “cold”: -214DEC25L
 še-pút “feet”: -184NOV24L
 še-ri “morning”: -238APR28L
 ši-i “this (fem.)”: -128NOV05L, -119JUN01L, -79APR11L, -79OCT05L, -66JAN19L, -65DEC28L
 šid-meš “Normal (Stars)": -135APR15S
 šip-ti “plague(?)”: -330SEP20L
 šir “to blow”: -368APR11S, -321SEP26S
 šit-ti “other”: -09JUN30S
 šit-tú “other”: -605JAN08L
 šu “month IV”: (1), -588JUL25L, -587JUL15L, -522JUL16L, -439JUL28L, -187AUG01L, -169JUL28S,
 -159JUL23L
 šu_{II} “hand (dual), in: 2-ta šu_{II} = 2/3”: (6), -248MAY04S, -193NOV05L, -132FEB13S, -66JAN19L
 šú ?: -424APR14L, -370NOV11L, -162MAR30L, -80APR21L, -80APR21L
 šú “moonset to sunrise”: (2), -366AUG30L, -246SEP22L, -232DEC14L, -158JUL12L, -141AUG03L,
 -111JUL02L, -111JUL02L, -106MAR11L, -88SEP15L, -86AUG24L, -76FEB09L
 šú “to cover”: (6), -712APR19L, -685APR21L, -684OCT03L, -631MAY23L, -608SEP03L, -602OCT27L,
 -598FEB19L, -598FEB19L, -587JAN19L, -586JAN08L, -576DEC07L, -554OCT06L, -525SEP16L,
 -500NOV07L, -464NOV29L, -439FEB02L, -407OCT31L, -406OCT21L, -405APR15L, -396APR05L,
 -395SEP18L, -381DEC12L, -377APR06L, -370NOV11L, -370NOV11L, -363JUN29L, -362JUN18L,
 -352NOV22L, -330SEP20L, -326JAN13L, -316DEC13L, -283MAR17L, -247OCT03L, -225AUG01L,
 -189FEB28L
 šú “to set”: (14), -746FEB06L, -746AUG02L, -712APR19L, -701MAR20L, -694MAY01L, -667OCT25L,
 -666OCT15L, -658MAY22L, -649MAY13L, -590MAR22L, -587JAN19L, -586JAN08L, -576JUN14L,
 -572SEP25L, -562SEP05L, -536APR23L, -536OCT17L, -525MAR24L, -518OCT28L, -482NOV19L,
 -441MAR25L, -414MAR26L, -395MAR26L, -378APR17L, -363DEC23L, -356FEB14L, -352NOV22L,
 -345JAN13L, -334DEC03L, -330SEP20L, -326JAN13L, -321SEP26S, -321SEP26S, -304MAY08L,
 -291AUG25S, -286MAY19L, -283MAR17L, -279DEC24L, -278JUN19L, -266OCT17S, -253JAN31S,
 -248APR19L, -248APR19L, -247OCT03L, -239NOV03L, -225FEB06L, -225JUL18S, -214DEC25L,
 -211APR30L, -211MAY15S, -209SEP18S, -194JUN20L, -189FEB28L, -189AUG23L, -189SEP07S,
 -188FEB02S, -188FEB17L, -184MAY30L, -170AUG23L, -169FEB16L, -169JUL28S, -161FEB18L,
 -161AUG14L, -161AUG14L, -153MAR21L, -149JUL03L, -140JUL22L, -137MAY22L, -136OCT20S,
 -135OCT09S, -134MAR06S, -132FEB13S, -124SEP07S, -122AUG02L, -105AUG25L, -97MAR31L,
 -79APR11L, -79APR11L, -66JAN19L, -65JAN08L, -65JAN08L, -65DEC28L, -40FEB15S, -09JUN30S
 šú “west”: -72NOV16L
 šú-e “to set”: -356FEB29S
 šú-im “to cover”: (6), -609SEP15L, -368APR11S, -214DEC25L, -193NOV05L, -188FEB17L, -170AUG23L,
 -149JUL03L, -134MAR21L, -133MAR10L, -123AUG13L, -105AUG25L, -98OCT05L, -96AUG14L,
 -80APR21L
 šú-ma “to set”: -09JUN30S
 šú-meš “to set (pl.)”: -119JUN01L, -119JUN01L

- šú-ú “to set (pl.)”: -97MAR31L
 šú-u’ “to set (pl.)”: -123AUG13L
 šub-di ?: -238APR28L
 šudun “yoke”: -134MAR21L, -80APR21L
 šu-gi “Old Man”: -214DEC25L, -104AUG13L
 šur ?: -370NOV11L, -352NOV22L
 šu-šá-an “the town of Susa”: -441MAR25L
 šu-si “finger”: -611NOV05L, -611NOV05L
 šú-šú “overcast”: -238APR28L, -164OCT29S
 ta “from”: (9), -608SEP03L, -605JAN08L, -572APR01L, -554OCT06L, -528NOV17L, -525SEP16L,
 -500NOV07L, -464NOV29L, -377APR06L, -370NOV11L, -363JAN02L, -359APR17L, -326JAN13L,
 -326JAN13L, -326JUL09L, -304MAY08L, -283MAR17L, -272FEB16L, -253JAN31S, -241JUN15S,
 -238APR28L, -225AUG01L, -214DEC25L, -189MAR14S, -189AUG23L, -162MAR30L, -153MAR21L,
 -135APR01L, -135APR15S, -133SEP03L, -130JUL02L, -128NOV05L, -124AUG24L, -123AUG13L,
 -122AUG02L, -119JUN01L, -111JUN18S, -109NOV05L, -105FEB28L, -105AUG25L, -95AUG03L,
 -88SEP29S, -86FEB28L, -86FEB28L, -79APR11L, -75JAN28L, -66JAN19L, -65DEC28L, -09JUN30S,
 -09JUN30S
 tab “to begin”: (4), -701MAR20L, -685APR21L, -665APR10L, -649NOV05L, -536OCT17L, -525SEP16L,
 -525SEP16L, -482NOV19L, -423SEP28L, -420FEB02L, -409DEC21L, -407OCT31L, -406OCT21L,
 -405APR15L, -405OCT10L, -396APR05L, -378APR17L, -377APR06L, -377APR06L, -370NOV11L,
 -352NOV22L, -316DEC13L, -88SEP29S, -09JUN30S
 tab-tab “to begin”: -528NOV17L
 tab-ú “to begin”: (4), -370NOV11L, -366AUG30L, -345JAN13L, -333MAY29L, -326JAN13L, -322OCT07S,
 -283MAR17L, -283MAR17L, -272FEB16L, -253JAN31S, -253JAN31S, -250DEC04L, -241JUN15S,
 -239NOV03L, -238APR28L, -238APR28L, -225AUG01L, -225AUG01L, -214DEC25L, -214DEC25L,
 -211APR30L, -211OCT24L, -202MAY06S, -194JUN06S, -194JUN06S, -193NOV05L, -193NOV05L,
 -189FEB28L, -189FEB28L, -189MAR14S, -189MAR14S, -189MAR14S, -188FEB17L, -184NOV24L,
 -182OCT04L, -179AUG17S, -170AUG23L, -169JUL28S, -162MAR30L, -159JAN26L, -156NOV14L,
 -153MAR21L, -153MAR21L, -149JUL03L, -142FEB17L, -135APR01L, -135APR01L, -135APR15S,
 -135APR15S, -134MAR21L, -133MAR10L, -133SEP03L, -132FEB13S, -132FEB13S, -131JAN17L,
 -128NOV05L, -128NOV05L, -124AUG24L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L,
 -119JUN01L, -111JUN18S, -109NOV05L, -108MAY01L, -105AUG25L, -105AUG25L, -98OCT05L,
 -97MAR31L, -95AUG03L, -93JUL13L, -88SEP29S, -86FEB28L, -86FEB28L, -80APR21L, -79APR11L,
 -79APR11L, -75JAN28L, -72NOV16L, -66JAN19L, -65DEC28L, -40MAR02L
 tag₄ “to remain”: (6,14), -745JAN26L, -609SEP15L, -482NOV19L, -423SEP28L, -409DEC21L, -370NOV11L,
 -366AUG30L, -363DEC23L, -322OCT07S, -304MAY08L, -211OCT24L, -189AUG23L, -119JUN01L,
 -79APR11L
 tak-šat “triplets”: -119JUN01L
 tar-ša “opposite”: -123AUG13L
 til “complete”: (6), -745JAN26L, -745JUL22L, -744JUL10L, -694MAY01L, -536OCT17L, -536OCT17L,
 -522JUL16L, -521JAN10L, -423SEP28L, -409DEC21L, -211OCT24L, -189MAR14S, -179AUG17S,
 -170AUG23L, -153MAR21L, -135APR15S, -98APR11L
 til-ma “complete”: -593MAY23L, -135APR15S
 til-tim “complete”: (6), -362DEC12L, -135APR15S, -119JUN01L
 tin “life”: -133MAR10L, -93JUL13L
 tu (=ku₄) “to enter”: -611NOV05L, -611NOV05L
 tu-šú “its ?”: -09JUN30S
 túg “garment”: (11), -464JUN05L, -439FEB02L, -423SEP28L, -396APR05L, -247OCT03L, -238APR28L,
 -162MAR30L, -162MAR30L, -124AUG24L, -122AUG02L, -95AUG03L, -86FEB28L, -79APR11L,
 -72NOV16L, -66JAN19L, -65DEC28L
 tuk “to exist”: -246SEP22L, -88SEP15L
 tuk-ú “to exist”: -326JAN13L
 tur “small”: -122AUG02L
 tür “halo”: -238APR28L, -128NOV05L, -80APR21L, -65DEC28L
 u “the god Adad”: (11), -370NOV11L
 u “and”: -746FEB06L, -701MAR20L, -685APR21L, -665APR10L, -649NOV05L, -631MAY23L,
 -631MAY23L, -611NOV05L, -611NOV05L, -605JAN08L, -605JAN08L, -602OCT27L, -602OCT27L,
 -600APR10L, -598FEB19L, -594NOV27L, -593MAY23L, -591APR01L, -576JUN14L, -576DEC07L,
 -562SEP05L, -525SEP16L, -521JAN10L, -464JUN05L, -464NOV29L, -441MAR25L, -439FEB02L,
 -423SEP28L, -423SEP28L, -409DEC21L, -409DEC21L, -408JUN16L, -407OCT31L, -407OCT31L,

- 407OCT31L, -407OCT31L, -406OCT21L, -405APR15L, -405OCT10L, -396APR05L, -377APR06L,
 -370NOV11L, -370NOV11L, -370NOV11L, -366AUG30L, -356FEB29S, -352NOV22L, -345JAN13L,
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 -326JAN13L, -326JAN13L, -325JAN03L, -322OCT07S, -321SEP26S, -316DEC13L,
 -316DEC13L, -316DEC13L, -304MAY08L, -304MAY08L, -286MAY19L, -283MAR17L, -283MAR17L,
 -283MAR17L, -280JAN30S, -272FEB16L, -272FEB16L, -255SEP16S, -253JAN31S, -248MAY04S,
 -247OCT03L, -240NOV28S, -238APR28L, -238APR28L, -225AUG01L, -214DEC25L, -214DEC25L,
 -211APR30L, -211OCT24L, -193NOV05L, -189FEB28L, -189FEB28L, -189MAR14S, -189MAR14S,
 -189MAR14S, -189MAR14S, -184NOV24L, -182OCT04L, -182OCT04L, -179AUG17S, -169JUL28S,
 -169JUL28S, -162MAR30L, -156NOV14L, -153MAR21L, -153MAR21L, -153MAR21L, -153MAR21L,
 -153MAR21L, -149JUL03L, -149JUL03L, -142FEB17L, -135APR01L, -135APR01L, -135APR15S,
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 -135SEP24L, -134MAR21L, -134MAR21L, -133MAR10L, -132FEB13S, -131JAN17L, -130JUL02L,
 -128NOV05L, -128NOV05L, -128NOV05L, -128NOV05L, -128NOV05L, -125SEP19S, -124AUG24L,
 -124AUG24L, -123AUG13L, -123AUG13L, -122AUG02L, -122AUG02L, -122AUG02L, -119JUN01L,
 -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L, -119JUN01L,
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 -98APR11L, -98OCT05L, -97MAR31L, -97MAR31L, -96AUG14L, -95AUG03L, -90NOV05L,
 -90NOV05L, -88SEP15L, -88SEP29S, -88SEP29S, -86FEB28L, -86FEB28L, -80APR21L, -79APR11L,
 -79APR11L, -79APR11L, -79APR11L, -75JAN28L, -72NOV16L, -66JAN19L, -66JAN19L,
 -66JAN19L, -66JAN19L, -66JAN19L, -66JAN19L, -65JAN08L, -65DEC28L, -65DEC28L,
 -65DEC28L, -65DEC28L, -09JUN30S, -09JUN30S, -09JUN30S, -09JUN30S, -09JUN30S
 ù “and”: -238APR28L, -79OCT05L
 u₄ “day”: -611NOV05L, -609SEP15L
 u₄-ka-du₈-a “panther”: -187AUG01L
 u₄-zal “morning watch”: (14), -746FEB06L
^dudu-idim-me “the planets”: (12), -605JAN08L, -482NOV19L, -352NOV22L, -326JAN13L, -238APR28L,
 -214DEC25L
^dudu-idim-meš “the planets”: (12), -307JUL09L, -286MAY19L, -225AUG01L, -189MAR14S, -170AUG23L,
 -153MAR21L, -149JUL03L, -135APR01L, -128NOV05L, -122AUG02L, -119JUN01L, -119JUN01L,
 -105AUG25L, -93JUL13L, -86FEB28L, -79APR11L, -66JAN19L, -65JAN08L, -65DEC28L
 udu-idim-meš “the planets”: (12), -189FEB28L, -189MAR14S, -184NOV24L, -109NOV05L
 ugu “above”: -528NOV17L, -525SEP16L
 ulù “south”: (4,11), -746AUG02L, -701MAR20L, -684OCT03L, -665APR10L, -649NOV05L, -609SEP15L,
 -609SEP15L, -572APR01L, -528NOV17L, -528NOV17L, -521JAN10L, -500NOV07L, -482NOV19L,
 -439FEB02L, -407OCT31L, -405APR15L, -396APR05L, -396APR05L, -377APR06L, -377APR06L,
 -377APR06L, -370NOV11L, -370NOV11L, -368APR11S, -366AUG30L, -356FEB29S, -352NOV22L,
 -352NOV22L, -338SEP04S, -326JAN13L, -316DEC13L, -283MAR17L, -280JAN30S, -272FEB16L,
 -272FEB16L, -253JAN31S, -238APR28L, -238APR28L, -225AUG01L, -211APR30L, -194JUN06S,
 -194JUN06S, -189FEB28L, -179AUG17S, -162MAR30L, -162MAR30L, -153MAR21L, -153MAR21L,
 -153MAR21L, -142FEB17L, -135APR01L, -135APR01L, -135APR15S, -135APR15S, -135APR15S,
 -131JAN17L, -128NOV05L, -124AUG24L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L,
 -111JUN18S, -108MAY01L, -105FEB28L, -98APR11L, -95AUG03L, -93JUL13L, -86FEB28L,
 -86FEB28L, -86FEB28L, -79APR11L, -79APR11L, -79APR11L, -66JAN19L, -65JAN08L,
 -65DEC28L, -65DEC28L, -40MAR02L, -09JUN30S
^lú-ma-kuš “Umakuš”: -422MAR25L
 un-meš “people”: -09JUN30S
 ur-a “Leo”: -345JAN13L, -326JAN13L
 ur-gu-la “Leo”: -605JAN08L
 uru “town”: -441MAR25L
^lú-ru-da-a “Orodes”: -79APR11L, -79OCT05L
 uš “degree (4 minutes of time)": (2,14), -609SEP15L, -609SEP15L, -605JAN08L, -602OCT27L, -600APR10L,
 -593MAY23L, -591APR01L, -591APR01L, -590MAR22L, -586JAN08L, -575JUN03L, -562SEP05L,
 -528NOV17L, -528NOV17L, -525SEP16L, -482NOV19L, -439FEB02L, -408JUN16L, -378APR17L,
 -374FEB03L, -370NOV11L, -368APR11S, -363JAN02L, -333MAY29L, -330SEP20L, -322OCT07S,
 -321SEP26S, -316JUN18L, -307JUL09L, -304MAY08L, -239NOV03L, -238APR28L, -230MAY15S,
 -226MAR03S, -225AUG01L, -193NOV05L, -169AUG13L, -168JAN07L, -162MAR30L, -162MAR30L,
 -162MAR30L, -153MAR21L, -149JUL03L, -142FEB17L, -142FEB17L, -133MAR10L, -133MAR10L,
 -133SEP03L, -130JUL02L, -124SEP07S, -122AUG02L, -119JUN01L, -108MAY01L, -95AUG03L,
 -80APR21L, -79APR11L, -79SEP20S, -65DEC28L, -62MAY03L, -09JUN30S, -09JUN30S

- uš “degree (angle)": (13), -684OCT03L, -536OCT17L, -441MAR25L, -409DEC21L
 uš-ú “to stand still": -370NOV11L
 usan “evening watch": (14), -578FEB08L
 utah “shower": -156NOV14L
^dutu “the sun god": -280JAN30S, -226MAR03S, -202MAY06S
^dXV-AMA-šú “his mother goddess": -65DEC28L
 za (short for *sa-bit?*) “captured": -248MAY04S, -193NOV19S, -162MAR15S, -162MAR30L, -162MAR30L, -159JAN26L, -132FEB13S
 zal “morning watch": (14), -685APR21L, -587JAN19L, -586JAN08L
 zalág “to be or become bright": (7,9,10,14), -745JAN26L, -701MAR20L, -694MAY01L, -666OCT15L, -631MAY23L, -631MAY23L, -608SEP03L, -602OCT27L, -602OCT27L, -600APR10L, -598FEB19L, -594NOV27L, -591APR01L, -576DEC07L, -576DEC07L, -575JUN03L, -572APR01L, -562SEP05L, -561MAR02L, -554OCT06L, -554OCT06L, -554OCT06L, -536APR23L, -536OCT17L, -528NOV17L, -525SEP16L, -525SEP16L, -525SEP16L, -521JAN10L, -500NOV07L, -500NOV07L, -482NOV19L, -464JUN05L, -464NOV29L, -439FEB02L, -423SEP28L, -423SEP28L, -413MAR16L, -409DEC21L, -409DEC21L, -408JUN16L, -407OCT31L, -407OCT31L, -407OCT31L, -406OCT21L, -405APR15L, -405OCT10L, -396APR05L, -396APR05L, -396SEP29L, -377APR06L, -377APR06L, -377APR06L, -374FEB03L, -370NOV11L, -370NOV11L, -370NOV11L, -363JAN02L, -363JUN29L, -363DEC23L, -362JUN18L, -356FEB29S, -352NOV22L, -352NOV22L, -345JAN13L, -345JAN13L, -338SEP04S, -338SEP04S, -330SEP20L, -326JAN13L, -326JAN13L, -326JAN13L, -322OCT07S, -322OCT07S, -316DEC13L, -316DEC13L, -316DEC13L, -307JUL09L, -304MAY08L, -304MAY08L, -286MAY19L, -283MAR17L, -280JAN30S, -277MAY10L, -272FEB16L, -272FEB16L, -255SEP16S, -253JAN31S, -248MAY04S, -241JUN15S, -241JUN15S, -240NOV28S, -240NOV28S, -238APR28L, -238APR28L, -238APR28L, -238APR28L, -225AUG01L, -225AUG01L, -225AUG01L, -225AUG01L, -211APR30L, -200APR13S, -193NOV05L, -193NOV05L, -189FEB28L, -189FEB28L, -189MAR14S, -189MAR14S, -189MAR14S, -189MAR14S, -189AUG23L, -188FEB17L, -184NOV24L, -169AUG13L, -162MAR30L, -162MAR30L, -162MAR30L, -162SEP08S, -162SEP08S, -143SEP08S, -140DEC31S, -136OCT04L, -135APR01L, -134MAR21L, -133MAR10L, -133SEP03L, -132JAN29L, -130JUL02L, -128NOV05L, -125SEP19S, -118MAY07S, -106MAR27S, -105AUG25L, -97MAR31L, -93JUL13L, -90NOV05L, -88SEP29S, -86FEB13S, -79APR11L, -79APR11L, -72NOV16L, -65DEC28L, -46JUL04L, -40MAR02L, -09JUN30S
 zalág-ir “to be or become bright": (9), -326JUL09L, -283MAR17L, -253JAN31S, -214DEC25L, -162MAR30L, -153MAR21L, -135APR01L, -134MAR21L, -128NOV05L, -125SEP19S, -124AUG24L, -123AUG13L, -122AUG02L, -119JUN01L, -119JUN01L, -111JUN18S, -105FEB28L, -95AUG03L, -88SEP29S, -66JAN19L, -09JUN30S
 zalág-meš “to be or become bright (pl)": -09JUN30S
 zalág-ru “to be or become bright": (7,10), -562SEP05L, -283MAR17L, -283MAR17L, -253JAN31S, -250DEC04L, -214DEC25L, -214DEC25L, -189FEB28L, -189FEB28L, -189MAR14S, -189MAR14S, -182OCT04L, -179AUG17S, -170AUG23L, -156NOV14L, -153MAR21L, -153MAR21L, -135APR01L, -135APR15S, -134MAR21L, -132FEB13S, -130JUL02L, -128NOV05L, -128NOV05L, -124AUG24L, -124AUG24L, -123AUG13L, -123AUG13L, -122AUG02L, -122AUG02L, -122AUG02L, -119JUN01L, -119JUN01L, -119JUN01L, -111JUN18S, -109NOV05L, -108MAY01L, -105FEB28L, -105AUG25L, -95AUG03L, -88SEP29S, -86FEB28L, -80APR21L, -79APR11L, -79APR11L, -66JAN19L, -66JAN19L, -65JAN08L, -65DEC28L, -65DEC28L
 zib-me “Fishes": -105AUG25L
 ziq-pi “culmination": (3), -225AUG01L, -214DEC25L, -193NOV05L, -193NOV05L, -189FEB28L, -187AUG01L, -184NOV24L, -182OCT04L, -162MAR30L, -162MAR30L, -159JAN26L, -149JUL03L, -142FEB17L, -135APR01L, -134MAR21L, -133MAR10L, -128NOV05L, -122AUG02L, -119JUN01L, -95AUG03L, -93JUL13L, -90NOV05L, -86FEB28L, -86FEB28L, -80APR21L, -79APR11L
 zíz “month XI": (1), -745JAN26L, -744JAN15L, -598FEB19L, -588FEB29L, -578FEB08L, -577JAN28L, -421FEB13L, -420FEB02L, -188FEB17L, -162SEP23L, -161MAR05S, -160FEB07L, -142FEB17L, -142MAR05S, -40FEB15S