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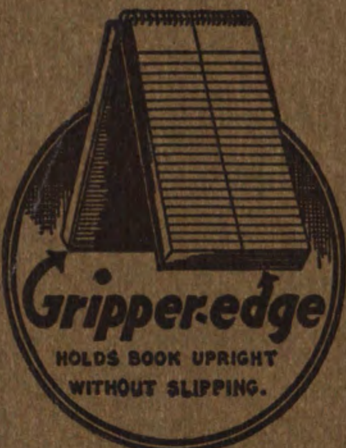

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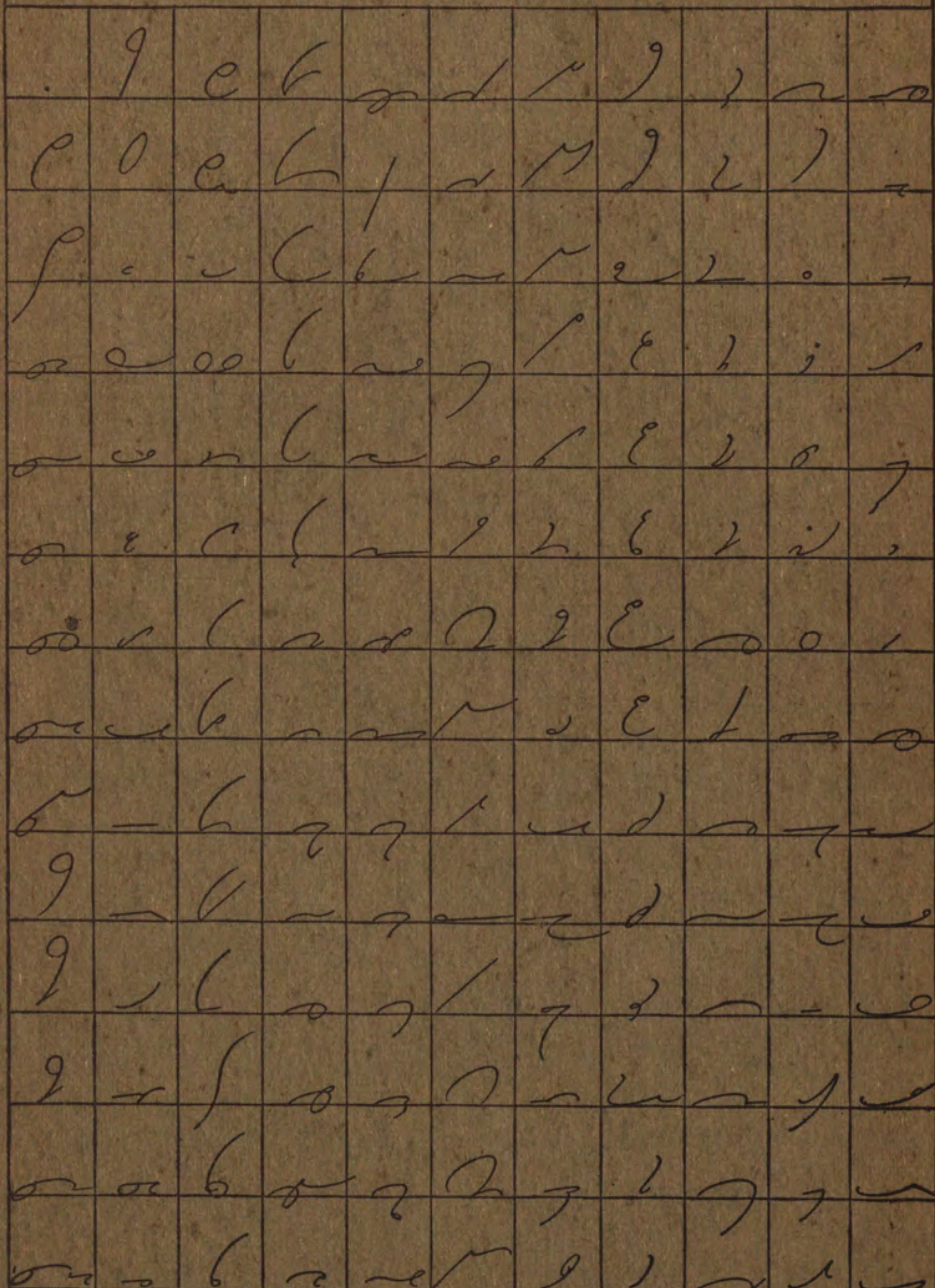

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J. Narrien, Historical Account of the
Origin and progress of Astronomy

Dr Louis Ginzberg,
Broadway and 123rd St.
Jewish Theological
Seminary of America

"Sitzungsberichte der kaiserlichen Akademie der Wissenschaften" Wien 1872.

LXVIth Vol. I – V Numbers, June – December.

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AS 142 | Karl von Littrow: (Mondphasen

V.311 | "Zur Kenntnis der kleinsten sichtbaren

Transl. fr. German:

K. v. Littrow: On the Smallest visible Phases of the Moon."

p. 459: Lately the question how soon after the new moon the crescent becomes visible to the naked eye has been ~~discussed~~ taken up in different quarters. I was surprised not to find any reference to a noteworthy preliminary work which has come to us through the great Jewish philosopher Maimonides. I therefore induced the Rabbi-Candidate Mr. A Kurrein to make an exact translation of the Hebrew original which I am passing on herewith. Mr. Kurrein has taken the trouble not only to translate the edition of "Maimonides Constitutiones de Sanctificatione Novilunii" in "Blasius Ugolinus, Thesaurus

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Antiquitatum Sacrarum, Vol. XVII." which I placed at his disposal, but he has compared it with other versions in circulation so that as regards exact reproduction of the original the following text hardly leaves anything to be desired. Of the 19 paragraphs into which the original is divided I am giving only chapters XII - XVII, for the remaining ¶§s contain all kind of tomfoolery which do not interest us. Of the first chapters left out might say briefly that several of them dial with the rules according to which the testimonies are to be examined.

On having seen the crescent

The ritual importance the appearance of the new moon had for the Jews because the beginning of their sacred months depended on it from the remotest time, motivated them since earliest times & until they finally

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(p. 460)

got confidence into the ~~actual~~ eigentliche astronomical calculations(1) [Note 1, p. 460]: See the excellent paper by Dr. A. Schwarz: "Der jüd. Kal., histor. & astronom. untersucht. Breslau 1872."] to investigate, how soon after the Newmoon it can be depended ~~on~~ with surety on the visibility of the crescent. The statement of the formula - evidently derived from many-century-long observations - (one of the oldest examples of inductive method) was the long strived after goal of the efforts of Jewish scholars. The results were compiled by Maimonides. ¶ To examine the rule set up & valid for Palestine as well as to transfer it into today's mode of expression(2) I leave to those who have made the visibility of the smallest phases of the moon a subject of their investigations. I ~~shall merely~~ am content to add occasionally such explanations which were self evident when revising the whole. These additions ~~are~~ stand out because they are given in italics.

Chapter XII

The average course of the sun (average tropical movement) during

[Note 2, p. 460: I take the liberty to call attention to a work which to my knowledge is far too little known: "J. Narrien, Historical account of the origin & progress of Astronomy. London 1833."

wise one can ~~figure~~ work out certain figures for the average way for 2, 3, 4 - 10 days, also for 20, 30, 40 - 100 days; it is open & clear, as soon as you know the average way for one day; then you must also know for sure & exactly the average way of the sun

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which were self evident when revising the whole. These additions ~~are~~ stand out because they are given in italics.

Chapter XII

The average course of the sun (average tropical movement) during one day - i.e. in 24 hours - amounts to: 59' 8", so the average way in 10 days is 9° 51' 23", in 100 days 98° 33' 53", in 1000 days (after eliminating ~~each time~~ as the case may be 360° — 265° 38' 50" & the surplus in 10000 days 136° 28' 20". In this ~~way~~ manner, the average way (course?) for no matter what number of days can be calculated. Likewise one can ~~figure~~ work out certain figures for the average way for 2, 3, 4 - 10 days, also for 20, 30, 40 - 100 days; it is open & clear, as soon as you know the average way for one day; then you must also know for sure & exactly the average way of the sun for 29 days + for 354 days which make up one lunar year if the months are regular, + which (p 461) year is called a regular. If you have the figures for the average way ready (to hand) then the calculation of the appearance of the new moon is easy; because from the night of the appearance of the new moon until the night of her next appearance 29 full days pass by; just as many in every month, no more + no less than 29 days — + here we want to learn nothing else than this appearance (occurrence?) Likewise, from the night of the appearance of the new-moon of this year until the night the same new moon appears next year one regular year passes by or 1 yr + 1 day + thus it is every year.

The average way of the sun

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for 29 days amounts to 28° 35' 1" + for one regular year 348° 55' 15".

There exists a certain point in the ~~course of the sun~~ ecliptic of the sun + also in the course ~~those~~ of the other planets; if the planet reaches it, ~~his~~ its whole light is high above the earth. This point of the ecliptic of the sun + of the planets - with the exception of the moon - circ~~ulates~~les ~~evenly~~ evenly ~~regularly~~ and its way amounts to almost 1° (Precession) in 70 years; this point is called the sun's altitude.

It's way in every 10 days is 1" + ½ = 30"',
or in 100 " 15"'
1000 " 2' 30"
10000 " 25'
29 " 4" + a little more
in a regular year 53".

The starting point - as stated above - where the beginning of this calculation originates, is the beginning of the night to Thursday the 3rd

Littrow-7

Nisan of the year 4938 of Creation (March 23, 1178 o.St. - Julian?), & the position of the sun in the average way was at this ~~exit~~ starting point 7°3'32" in the sign of Aries & the position of the sun's altitude at this ~~exit (?)~~ starting point amounted to 26°45'8" of the ~~Twins~~. Gemini

If you want to know the position of the sun in the average ~~way~~ (course?) ~~at~~ for any given or desired time, take the number of days passed by since the day of the ~~exit~~ starting point until the given day, calculate the average ~~way~~ course of these days according to the method stated,

(p. 462) add to the ~~exit~~ beginning the parts for it & the result is the position (average length) which the sun is ~~keeping in~~ holding in the average way for this day. Should you wish for inst. to figure out the position of the sun in the average ~~way~~ distance for the beginning of the night to Saturday the

14. Tam~~mug~~ of the starting year, the result ~~would be~~ the number of days from the starting day until the day on ~~on~~ (~~of~~) which it is desired to determine the position of the sun, would be 100; the average distance ~~way~~ for 100 days amounts to 98° 33' 53"; adding this to the ~~start?~~ beginning? ~~exit?~~, which is 7° 3' 32" of ~~the~~ Aries, the total is 105° 37' 25" & its position in the average distance ~~way~~ for the beginning of this night = 15° 37' in the sign of the Cancer. The average way resulting from this calculation sometimes coincides exactly with the beginning of the night, sometimes one hour before, sometimes just as long after sunset, ~~which~~ what, however, does not hurt the calculation of the appearance of the moon because we complete (supply) this approximate

figure in calculating the average ~~way~~ (course?) of the moon. The same is always done for any desired time, even for 1000 years; now if you add all surpluses to the start ~~beginning~~ you get the place of the average ~~way~~ course? So it is done with the average way (course) of the moon & with the average way of every planet: If you know the ~~size~~? length? of the way on one day, & the beginning ~~start~~ from where you begin to count & if you add (to the start?) the way for the years & days in question, then you get the position for the average way. Likewise one proceeds with the sun's altitude: Add the way in these days or years to the start & you get the sun's altitude for the day in question. It is optional to chose another way out than the one here accepted in order to take perhaps the beginning - ~~start~~ - of the first year of a known cycle or a century. Should it be desired to take the beginning a few years earlier or later than the one mentioned the method is clear. The ~~way~~ course of the sun for a regular year is known, likewise for 29 days + for one day; it is known that the year whose months are completed ~~counts~~ has one day more than the regular, + that the year whose months are smaller has one day less than the regular; that furthermore the intercalary year with regular months has 30 days, with additional (completed) months 31 days, with smaller months 29 days more than a regular ~~d~~ year. (p. 463) With these dates the average way of the sun is calculated for the desired number of years + days, adding them to the given start - beginning -

+ you get average way for the desired day of later years + can take this as the beginning - start; or you deduct the average way calculated from the given beginning-start - + gets an earlier start-beginning for the desired day + can make this the beginning.

Likewise one proceeds with the average way of the moon + the other planets. From the foregoing is evident that the average way of the sun can be calculated for ~~any~~ (every past or future day.

Chapter XIII.

1/ If you want to know the true position of the sun for any chosen day, you must first figure out the average distance ~~way~~ for this day according to the method stated, ## as well as the sun's altitude + deduct the position of the sun's altitude from the average way of the sun, the remainder is called true course of the sun (average Anomaly, with reference? to the Aphelium?)

2/ Then you must see how many degrees has the true course of the sun. If ~~she~~ it has less than 180° the part of the course is to be deducted from the average way of the sun; but if it is more than 180-360°, than the part of course is to be added to the average course of the sun & the result after addition or subtraction is the true (so to speak elliptic) position.

3/ If the course is exactly 180° or exactly 360°, then its part = 0 & the position of the average way ~~& the~~ coincides with the true way.

4/ The part of the course amounts to so much (equation of center of the sun)

Littrow 13

If the course has 10°, its parts amounts to 20'

20°	40'
30°	58'
40°	1° 15'
50°	1° 29'
60°	1° 41'
70°	1° 51'
80°	1° 57'
90°	1° 59'
100°	1° 58'
110°	1° 53'
120°	1° 45'
130°	1° 33'
140°	1° 19'
150°	1° 1'
160°	42
170°	21
180° exactly	0° 0' *

* the average & true position coincide.

5, If the course exceeds 180°, you have but to deduct it from 360° in order to know its part; if the course for inst. is 200°, it is 160° after deduction from 360°; & for 160° the part is 42', consequently, for 200° the part is also 42'.

6. If the course is 300°, it is to be deducted from 360° which leaves 60° & for 60° the part is 1°41' & the same for 300° & so on.

7. If the course ~~were~~ had? 65°, then the part for 60° is known as 1°41' & for 70° the part amounts to 1°51', thus the difference for 10° is but 10' & to each degree comes 1', consequently the part of the course for 65° = 1°46'.

8. If the course were 67°, then its ~~the~~ part is 1°48'. Thus ~~it~~ the unit is calculated with each course, ~~in~~ for sun as well as the moon, the unit which is connected with a ten.

9. If for inst. it is desired to learn the true position of the sun for the beginning of the night of the 14th Tammuz of the year given, first the average

Littrow 15

way of the sun for this time must be calculated & that amounts to 105° 37' 25", figure out the sun's altitude for this time, which is 86° 45' 23", deduct the sun's altitude from the average way & you get the course 18° 52' 2". If there are less than 30 minutes, it is not necessary to take them into consideration, but if they are 30 or
(p. 465) more, you take for it 1° adding it to the degrees of the course; therefore, this course amounts to 19° & its part according to the method stated 38'.

10 But because this course is smaller than 180°, the part which amounts to 38', ~~is being~~ must be deducted from the average way of the sun & then remains 104° 59' 25" & the true position of the sun at the beginning of this night is in the constellation sign of the Cancer 15° less 35", which can

be neglected (dispensed with?) when calculating the position of the sun or also the moon + the remaining phenomena?; only the minutes must be taken into consideration + if the seconds amount to about 30", then you can add 1' to the minutes.

11/ Thanks to the knowledge of the position of the sun for ~~any desired~~ time desired (given?), any day of earlier or later years can be taken as basis ~~or~~ instead of the given start.

Chapter XIV

1/ The moon has two average ~~way~~-courses. For the moon is circling in a small sphere which does not encircle ~~to~~ the whole world, + its average ~~course~~ way in this small sphere is called the average course. The small sphere itself again circles (turns) in a big sphere,

Littrow 17

which encircles the world & the average way of this small sphere in the big world encircling sphere is called the average way of the moon (average tropical movement) & amounts in one day to 13° 10' 35".

2/ Thus the way in 10 days amounts to 131° 45' 50"

The surplus of the way in 100 days	"	237° 38' 23"
1000 "	"	216° 23' 50"
10000 "	"	3° 53' 20"
29 "	"	22° 6' 56"
in the regular year	..	344° 26' 43"

So any number of days or years can be calculated.

3/ The way of the average course (average anomalistic movement of the moon) is in

1 day	13° 3' 54"
10 days	130° 39' 0"
(p. 466) The surplus in 100 "	226° 29' 53"
1000	104° 58' 50"
10 000	329° 48' 20"
29	18° 53' 4"

4/ For a regular year there is 305° 0' 13".

The position of the average way of

Littrow 18

the moon in the beginning of the night to Thursday of the start was in the sign of the Taurus. 1° 14' 43" & the average start was at this start ? 84° 28' 42". Now, knowing the average way of the moon & the one which counts as start, add the two & you the position of the average way of the moon for any day, same as was done with the average way of the sun. After calculating the average way of the moon for the beginning of this night, ~~look~~ try to find ~~for~~ out the sign of the Zodiac, in which the sun is.

5/ If the sun is between half of the sign of the fishes & the half of the Taurus, the average way of the moon remains unchanged; if it is between half of the Taurus & the beginning of the Twins, add to the average way of the moon 15' (Reduction

(ran)
to sunset); if it is between the beginning of the Twins + the beginning of the Leon, add to the average way of the moon 15' (rectius 30'?); if it is between the beginning of the Leon + the half of Virgo, add 15'; if it is between half of Virgo + half of Libra + the beginning of Sagittary, deduct of the average way of the moon 15'; if it is between the beginning of Sagittary + the beginning of the Aquarius deduct 30'; if it is between the beginning of Aquarius + half of the Fishes, deduct 15'.

6/ The result, after addition or deduction or if no change is made, is for the time calculated the average way of the moon after the elapse of almost 1/3 hours after sunset + is called: average way of the moon for the time of the appearance (?)

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(p. 467.) Chapter XV

1/ Thus if it is desired to know the true place of the moon for any day desired, first figure out the average way of the moon for the time of the appearance (?) in the given night, then the average course of the moon & the average course of the sun for this time, deduct the average way of the sun from the average way of the moon, double the remainder & this is called: The double distance (Double difference of length (latitude?)

2/ As stated earlier, these calculations serve merely to learn the appearance of the moon & there this double distance, in the night of the appearance when the moon becomes visible, can amount nothing but between 5° & 62°, not less than the first & no more than the latter.

3/ Consequently, the following must

is to be heeded: If the double distance is 5° or somewhat ~~more~~ above that, ~~the surplus~~ then what is more is not considered & is not added to it. (Quantity χ with Delambre, Hist. de l'Astron. ancienne, Vol. II, p. 204)

Is the double distance between		Add to the average course:
6° &	11°	1°
12°	18°	2°
19°	24°	3°
25°	31°	4°
32°	38°	5°
39°	45°	6°
46°	51°	7°
52°	59°	8°
60°	63°	9°

After these degrees have been added the average course is called the rectified course.

4, Upon look at the number of degrees of the rectified course. If it is less than 180°, deduct the part of the rectified course from the average course of the

moon for the time of appearance.
Is the rectified course greater than 180° - 360°, add this part of the rectified course to the average course of the moon for the time of appearance.
The result of the average course of the moon, after addition or subtraction, is the true position of the moon for the time of the appearance.

5) If the rectified course is exactly 180° or exactly 360°, the part is 0 + for the time of appearanse the place of the average course of the moon is also the true place (position?)

6) The parts of the course attain the following quantities (Equation of the center for the moon).

If the rectified course is	10° its part is	50'
	20°	1° 38'
	30°	2° 24'
	40°	3° 6'
	50°	3° 44'

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If the rectified course is	60° its part is	4° 16′
	70°	4° 41′
	80°	5° –
	90°	5° 5′
	100°	5° 8′
	110°	4° 59′
	120°	4° 40′
	130°	4° 11′
	140°	3° 33′
	150°	2° 48′
	160°	1° 56′
	170°	– 59′
	180°	0° 0′

i.e. the place of the average course of the moon + the true place coincide.

7. If the rectified course is greater than 180°, it is deducted from 360° + it gets the same part as in the course of the sun; if with the tens there are units, these are ~~calculated~~ figured out from the difference of the two parts according to the procedure given for the course of the sun.

8. Should we want to know, for inst., the true place of the moon for the beginning of the night to Friday, the 2nd of Ijar of the ~~starting~~ year of the start, the number of days passed by since the night we start with until the desired night is 29; figuring out the average movement of the sun for the beginning of this night, ~~you~~ we get 35° 38' 33"; if you then the average movement of the moon for this time (of appearance (?), ~~you~~ we get 53° 36' 39" & the average course for this time ~~amounts~~ makes to 103° 21' 46". In deducting the average ~~course~~ movement of the sun from the average ~~movement~~ way of the moon, there remain 17° 58' 6". If you double this distance, you get as double distance 35° 56' 12". accordingly, as is known, you must add 5° to the average course & get the rectified course 108° 21';

p. 469

29^d =

15° = 1 hr.
1° = 4'

in which case the minutes can be neglected, as ~~discussed~~ explained in the case of the sun.

9, If you want to ~~calculate~~ figure out the part of this rectified course which amounts to 108°, ~~it is~~ the part is 5°1' and ~~as~~ since the rectified course is less than 180°, 5°1' is to be deducted from the average course of the moon, leaving 48° 35' 39"; counting the seconds as one minute + adding it to the minutes, you get the true place of the moon for this time equal 18° 36' of the 19° in the sign of Taurus. ~~Thus~~ So the true place (position?) (<u>so to speak:</u> <u>elliptic length</u> (longitude?) of the moon for any time from the <u>year of the beginning</u> to the end of the world.

Chapter XVI

1, The circle in which the moon is moving continuously differs

Littrow - 26

from the circle in which the sun is ~~constantly~~ always moving, that is, one half towards north the other half towards south; the two circles meet, however, on two opposite points so that the moon, when she is in one of these points, is circling in the circle of the sun exactly opposite the sun; but if she leaves one of these points, her way is to the north or to the south of the sun. The point from where the moon begins to ~~deviate~~ digress to the north, is called head (ascending knode?) & the one, whence the moon swerves to the south is called tail (descending knode?) The head has a regular gait where there is neither in- nor decrease, it always circles ~~in~~ backwards in the signs of the Zodiac from Taurus to Fishes & from the Fishes to the Aquarius & so on.

Littrow 27

2/ The average ~~way~~ course of the head (movement of the knodes of the moon)

for 1 day is	3' 11"
10 days .	31' 47"
100 " .	5° 17' 43"
1000 " .	52° 57' 10"
the surplus 10000 " .	169° 31' 40"
the average way for 29 " .	1° 32' 9"
for one regular year .	18° 44' 42"

The average ~~way~~ movement of the head at the beginning of the night to Thursday of the start 180° 57' 28".

3./ If it is desired to figure out the position of the head for any given time, calculate its average ~~way~~ distance for this time like you calculated the average ~~way~~ distance of the sun + the average ~~way~~ distance of the moon; deduct the average ~~way~~ distance from 360°; the rest is the position of the head for this time; opposite the position of the tail.

4/ If you want to know the position of the head for the beginning of Night to Friday, 2nd Ijar of the starting year, the number of days from this time to the night desired, is 29.

5. Furthermore, if you calculate the average ~~way~~ [movement] of the head for this time in the ~~way~~ known by adding the ~~way~~ [distance] for 29 days to the start, you get the average ~~way~~ [distance] of the head 182° 29' 37", deduct it from 360°, [there] remain~~s~~ 177° 30' 23" & you have the position of the head neglecting the seconds in the sign of Virgo 27°30'; opposite the position of the tail 27°30' in the sign of the Fishes.

6. Between the head & tail there is always exactly half a circle; therefore the tail is always in the seventh sign, counting from the sign of the head, exactly in degrees & minutes, so that [if] the tail, + were the head in any sign 10°, - in the seventh sign ~~from~~

it would be 10° from it.

7. If you know the position of the head & the tail & the true place of the moon, consider (look at) these three figures. If the moon has the same degree & the same minute with the head & the tail then the moon deviates (swerves) neither to the north nor to the south; if, however, the moon is seen before the head & as though she is moving towards the tail, then the moon swerves from the sun towards the sun; but if she is in front of the tail & as though moving towards the head, she deviates to the south.

p. 471

8. The northern or southern deviation of the moon is called latitude of the moon, namely the northern deviation is called north latitude & the southern, south latitude; if the moon is in one of the

two points, the latitude = 0.

9/ The latitude of the moon never exceeds 5°, neither in the north nor in the south. It describes its way in the following manner: starting out at the head, it gradually ~~distances itself~~ moves away, the distance increases until 5°, then it ~~approaches~~ gets gradually nearer, so that when it comes to the tail its latitude is 0°, then it again moves away & the distance increases to 5° & comes nearer again until the latitude ~~to~~ becomes = 0°.

10/ If you wish to calculate the latitude of the moon for any time & ~~know out~~ find out whether it is north or south latitude, ~~calculate~~ figure out the position of the head & the true place of the moon for this time, deduct the ~~position~~ place of the head from the true place of the moon, the remainder is called the wide course (Argument of the latitude);

Littrow 31

If the wide course amounts to 1-180°, the latitude of the moon is northern, if it is more than 180°, then the latitude is southern; if it is exactly 180° or exactly 360° the latitude is = 0. Furthermore you must see, how great the part of the wide course is, for just as much is ~~its~~ her deviation to the north or south or ~~its~~ her northern or southern latitude.

11 The ~~quantity~~ size of the parts of the wide course is as follows:

If the wide course is: (Argument of latitude)	(latitude) [2] its part is: [1]
10°	52'
20°	1° 43'
30°	2° 30'
40°	3° 13'
50°	3° 50'
60°	4° 20'
70°	4° 42'
80°	4° 55'
90°	5°

Littrow 32 (p. 472)

12/ In case the tens have units, ~~it~~ they are calculated proportionately from the difference of the two parts, between which they ~~lie~~ come, as it is done in the case of the course of the sun or the moon. If the wide course for-inst. were 53°, then the part for 50° according to the above amounts to 3° 50', for 60° the part amounts to 4° 20'. the difference between the two is 30' thus ~~for~~ to each 1° come 3' & ~~for~~ to 53° it amounts to 3° 59'. The same applies to all figures.

13/ If the part of the wide course is known accord. to above indications ~~is~~ until 90°, you can calculate parts of any size for if the course is above 90° but smaller than 180°, you deduct the quantity from 180° & thus have the part.

14/ If the course is greater than 180° then the ~~width~~ latitude of the moon at the beginning of this night is southern; if it is greater than

Littrow 33

180°, but smaller than 270°, deduct of it 180° & the remaindir represents the part.

15 Is the course greater than 270°, but smaller than 360°, you deduct it from 360°, the balance gives the part.

16 Were the course 150° for inst., deduct it from 180°, getting 30°; to 30° however, comes the part of 2°30' & just as much to 150°.

17. Were the course 200°, deduct of it 180°, leaves 20°, thus you get a part of 1°43'; the same comes (falls?) to 200°.

18 If the course were 300°, deduct it from 360°, leaves 60°; for 60° you get the part of 4°20', the same for 300°.

19 If for inst. the latitude of the moon is to be calculated & whether it was northern or southern at the beginning of the night to Friday the 2nd Ijar of the starting

year, then according to the foregoing the true place of the moon in that night is 18° 36' in the sign of the Taurus, the position of the head at that time was 27° 30' in the sign of Virgo; if you deduct the position of the head from the true place of the moon, you get the wide course 231° 6'. Since here the minutes can be neglected (omitted?) you get, as is known, the part of the course 3° 53' + that is the latitude of the moon in this night + that to the south, because the course exceeds 180°.

(p. 473). Chapter XVII

1. What was given so far serves as a means to calculate the appearance of the moon. If you want to know this, first figure out the true position of the sun + the true position of the moon, the position of the head for the

time of the appearance, deduct the true ~~position~~ place of the sun from the true ~~place~~ position of the moon, the remainder is the first length (longitude?)

2/ If the position of the head (ascending node) is known & the true place of the moon, then you also know the latitude of the moon & whether she is north or south & that is called the first latitude. This first longitude & first latitude must be well taken notice of.

1

3/ ~~After~~ Thereupon consider this first longitude & first latitude. If the former was exactly 9° or less, then it was impossible for the moon to appear in this night anywhere in Palestine — no other calculation is necessary for this —; but if the first longitude was greater than 15°, than in all

2 of Palestine the moon surely appeared, without any need of another calculation; but if the

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3 moon was between 9° & 15°, you must infestigate carefully after the appearance (phenomenon?) & calculate in order to know, whether she appeared or not.

4) This, however, is valid only in case the true place of the moon was between the beginning of the Capricorn & the end of the Twins; but if ~~however~~ it was between the beginning of the Cancer & the end of the Sagittary & the first
4 longitude (length) amounted to 10° or less, then the moon was not seen in ~~the whole of~~ anywhere in Palestine; but if the first length exceeded 24°, she was seen in all Palestine; but if it was between
5 10° & 24°, it must be carefully calculated whether she could be seen or not.

5) The calculations of the appearance
(1) (phenomenon) are as follows: First observe in what sign of the

Littrow 37

Zodiac the moon is. If she is in the sign of the ram, deduct of
(2) the first length 59'; if she is in the sign of the Taurus, deduct of the first length 1°, in the sign of the Twins deduct 58', in the sign of the Capricorn 43'; in Leon 43'; in Virgo 37'; in Libra, 34'; in the sign of Scorpio, 34', in Sagittary 36', in Capricorn, 44';

Second length

p. 474 in Aquarius, 53'; in Fishes, 58'; & what is left after deducting the first length, is called the 2nd length (latitude?)

6/ These minutes must be deducted because the true position of the moon is not where she is seen, but there is a distance (digression) in longitude & latitude (length & width) & that is called digression (distance) of vision? & the ~~size~~ quantity of the distance of vision of the latitude (Parallaxe in longitude?) at the time of the appearance (~~phenomenon?~~) is always

Littrow 38

deducted from the latitude (length?)

7. If the ~~distance~~ digression of vision (Parallaxe) of the latitude is northern, the minutes of the digression of vision of the latitude are to be deducted from the first latitude; (3) is the latitude a southern, the minutes of the digression of vision of the latitude are added to the first length (latitude?). What ~~comes out~~ you get from the first latitude after addition or deduction of these minutes, is called second latitude.

Latitude

8. These are the minutes to be added or deducted:

(475) If the moon is in Aries it amounts to 9'

If the moon is in	Aries it amounts to	9'
	Taurus	10'
	Twins	16'
	Capricorn	27'
	Lion	38'
	Virgo	44'
	Libra	46'
	Scorpio	45'

Littrow - 39

If the moon in the Sagittarius, it is 44'
Capricorn' 36'
Aquarius 24'
Pisces 12'

9./ If these minutes are known, deduct them from the first latitude (~~width~~) or add them to it + you get the 2nd latitude; it is also known whether it is a northern or southern latitude The degree + minutes of the 2nd latitude must be well taken notice of.

10/ Upon this you take, but of the 2nd latitude ~~only~~ a fraction, because the moon ~~does not~~ slightly diverts in her course.

(4)

(p. 475) These fractions are to be calculated:

If the moon is between the beginning of the Aries + 20° of it or between the beginning of Libra + 20° of it, then of the 2nd latitude 2/5 th ar taken off.

If the moon is between 20° of

Littrow 40

the Aries & 10° of the Taurus or between 20° of Libra & 10° of Scorpio, 1/3rd of the 2nd latitude are taken off.
If the moon is between 10° of Taurus to 20° of it or between 10° of Scorpio to 20° of it, then one fourth of the 2nd latitude is deducted.
If the moon is between 20° of Taurus & the end of it or between 20° of Scorpio & the end of it, then one fifth of the 2nd latitude are taken off.
If the moon is between the beginning of the Gemini & 10° of ~~a~~ them, then 1/6 of the 2nd latitude are taken off.
If the moon is between 10° of the Gemini & 20° of them or between 10° of Sagittarius & 20° of it, then one twelfth of the 2nd latitude is deducted.
If the moon is between ~~the~~ 20° of the Gemini & 25° of them or between 20° of Sagittarius & 25° of it, then 1/24 th of 2nd latit. is deducted.

Littrow 41

If the moon is between 25° of the Gemini + 5° of Cancer or between 25° of Sagittarius + 5° of Capricorn nothing is deducted for the deviation equals 0.

If the moon is between 5° of Cancer + 10° of it or between 5° of the Capricorn + 10° of it, then 1/24 th of the 2nd latitude is taken off.

(p 476) If the moon is between 10° of Cancer + 20° of it or betw. 10° of Capricorn + 20° of it, then 1/12 th of the 2nd latitude is deducted.

If the moon is betw. 20° of Cancer + the end of it or between 20° of Capricorn + the end of it, then 1/6 of the 2nd latitude is taken.

If the moon is between the beginning of Lion + 10° of it, or betw. the begining of Aquarius + 10° of it, then 1/5 th of 2nd latitude is deducted.

Littrow 42

If the moon is betw. 10° of Lion & 20° of it or betw. 10° of Aquarius & 20° of it, then 1/4th of the 2nd latitude is deducted.

If the moon is betw. 20° of Lion & 10° of the Virgo or between 20° of Aquatarius & 10° of Pisces, then 1/3 rd of the 2nd latitude is deducted.

If the moon is betw. 10° of Virgo & the end of it or betw. 10° of Pisces & the end of them, then 2/5th of the 2nd latitude is taken off.

These fractions to be taken off the 2nd latitude are called moon curvity.

11. After this one must look whether the latitude is northern or southern. If northern, then deduct this moon curvity off the second ~~latitude~~ longitude; if southern, add it. This, however, is done only in case (if) the moon is between the beginning of Capricorn & the end

of Gemini, in case she is between the beginning of Cancer & the end of Sagittarius, ~~that~~ then it is the other way around, then at northern ~~att~~ latitude the moon curvity is added to the 2nd ~~latitude~~ longitude (length) and at southern latitude deducted. What is received (after addition or deduction) from the 2nd ~~latitude~~ longitude (length) is called the third ~~latitude~~ longitude (length?) If there is no deviation of the course &
p.477 does the calculation leave nothing which would have to be deducted from the second latitude then the second & third longitude are equal in size.

12/ Then it must be observed, in what sign of the Zodiac is the third length (longitude) - which gives merely the number of degrees between Sun & Moon.

If it is in the sign of Pisces

Littrow 44

or of the Aries add 1/6 of the third longitude to it.
If it is in the sign of Aquarius or the Taurus, add 1/5 of the third longitude to it.
If it is in the sign of the Capricorn or the Gemini, add 1/6 of the third longitude to it.
If it is in the sign of the Saggittarius or the Cancer, the third longitude remains unchanged.
If it is in the sign of the Scorpio or the Leo, deduct 1/5 of the third longitude.
If it is in the sign of Libra or Virgo, deduct 1/3 of the third longitude.
What results from the third longitude after addition or deduction or without change, is called the fourth length (longitude?) After this always 2/3 of the first latitude of the moon is taken & that is called

Littrow 45

height of the position or place (Ortshöhe). In case of northern latitude the height of the position is added to the fourth latitude; in case of southern latitude deducted & what is left (or the result) from this fourth longitude after this addition or deduction is called arc of vision.

13) If it is for inst. desired to ~~calculate~~ figure out whether the moon was seen in the night to Friday 2nd Ijar of the starting year, calculate the true position of the sun, the true place of the moon & the latitude of the moon for this year in the manner stated. Then the true position of the sun is found an 7°9' in the sign of Taurus, the true place of the moon 18° 36' in the sign of the Taurus, the latitude southern 3° 53' as the first latitude (width?) Now deduct the position of the

Littrow 46

sun from the place of the moon & there remain 11° 27' as the first longitude (length?) & as the moon is in the sign of the Taurus, the distance of vision of the longitude is 1°, which must be deducted from the first of longitude & you get the second longitude 10° 27'; likewise the distance (deviation?) of vision of the latitude
(p478) is 10', & because it is southern latitude, the deviation of vision of the latitude, which is 10', must be added & you get as the second latitude 4° 3'; but as the moon was in the sign of Taurus 18°, of the 2nd latitude 1/4th must be deducted, which is the curvity of the moon & you get as curvity of the moon 1° 1', neglecting the seconds.

14 As the latitude of the moon is southern & the true place of the moon between the beginning of

Littrow 47

~~of~~ the Capricorn & the beginning of Cancer, you must add the curvity of the moon to the second longitude & get the 3rd longitude 11° 28'. This longitude is in the sign of Taurus, wherefore 1/5 is added to the third longitude, i.e. 2° 18' & you get the fourth length (longitude) 13° 46'; now take 2/3 of the first latitude & you have ~~get~~ the height of the place? position? 2° 35', which, ~~as~~ since the latitude is southern, is to be deducted from the fourth longitude, & there remain 11° 11' & that is the arc of vision for this night. In this manner you can calculate the arc of vision in degrees & minutes for every night of the appearance (phenomenon?).

15/ After the arc of vision is worked out observe the degrees of the arc. In case they amount

Littrow 48

to 9° or less, then the moon could not be seen in all of Palestine. If the arc of vision is more than 14°, then she must have been seen in all Palestine.

16 Is the arc of vision between the beginning of the 10° & the end of the 14°, compare the arc of vision with the first longitude & learn from the ends, whether it was seen or not. These are called end of vision.

17 With the ends of vision it is as follows: Is the arc of vision greater than 9° to 10° or somewhat greater than 10° & is the first longitude 13° or more, the moon surely was seen. If, however, either the arc of the size stated & the longitude smaller or vice versa, then she was not seen.

18 Is the arc of vision more than 10° until the end of 11° or somewhat greater than 11° & the first

longitude amounts to 12° or more, the moon was seen; is the arc of the size stated & the longitude smaller or vice versa, she was not seen.

(p. 479). 19. Is the arc of vision greater than 11° up until the end of 12° or somewhat greater than 12° & the first longitude amounts to 11° or more, the moon surely was seen; is the arc as stated above & the longitude smaller or vice versa, she was not seen.

20. Is the arc of vision greater than 12° up to the end of 13° or somewhat over 13° & the 1st longitude is 10° or more, the moon surely was seen; is the arc, however, as stated above & the longitude smaller or vice versa, she was not seen.

21 Is the arc of vision greater than 13° up to the end of 14° or somewhat over 14° & amounts the

Littrow 50

first longitude to 9° or more, the moon surely was seen; is, however, the arc of the size stated & the longitude smaller or vice versa, then she was not seen. And this is the whole procedure.

40-23-10
29
11-28

43-18-24
37-23-10
5 55 14

22. If we ~~want~~ wish for instance to observe the arc of vision of the night to Friday the 2nd of Ijar of the starting year, we would get by calculation the arc of vision 11° 11', as is known; since the arc of vision was between 10° & 14° we compare it with the first longitude & this amounted then to 11° 27'; since the arc of vision is more than 11° & the first longitude amounted to more than 11°, the moon surely was seen, as is evident from the regulation of the ends of vision. ~~H~~ In this way every arc is to be compared with its first longitude (length?)

Littrow 51

23 — From this procedure it is evident how many calculations there are, how many additions & deductions, since we have taken the trouble to find known procedures the calculation of which does not cause great difficulty; for the moon makes many curves in her courses, wherefore the wise men said: "The sun finds (meets - trifft -) her course, but not so the moon."

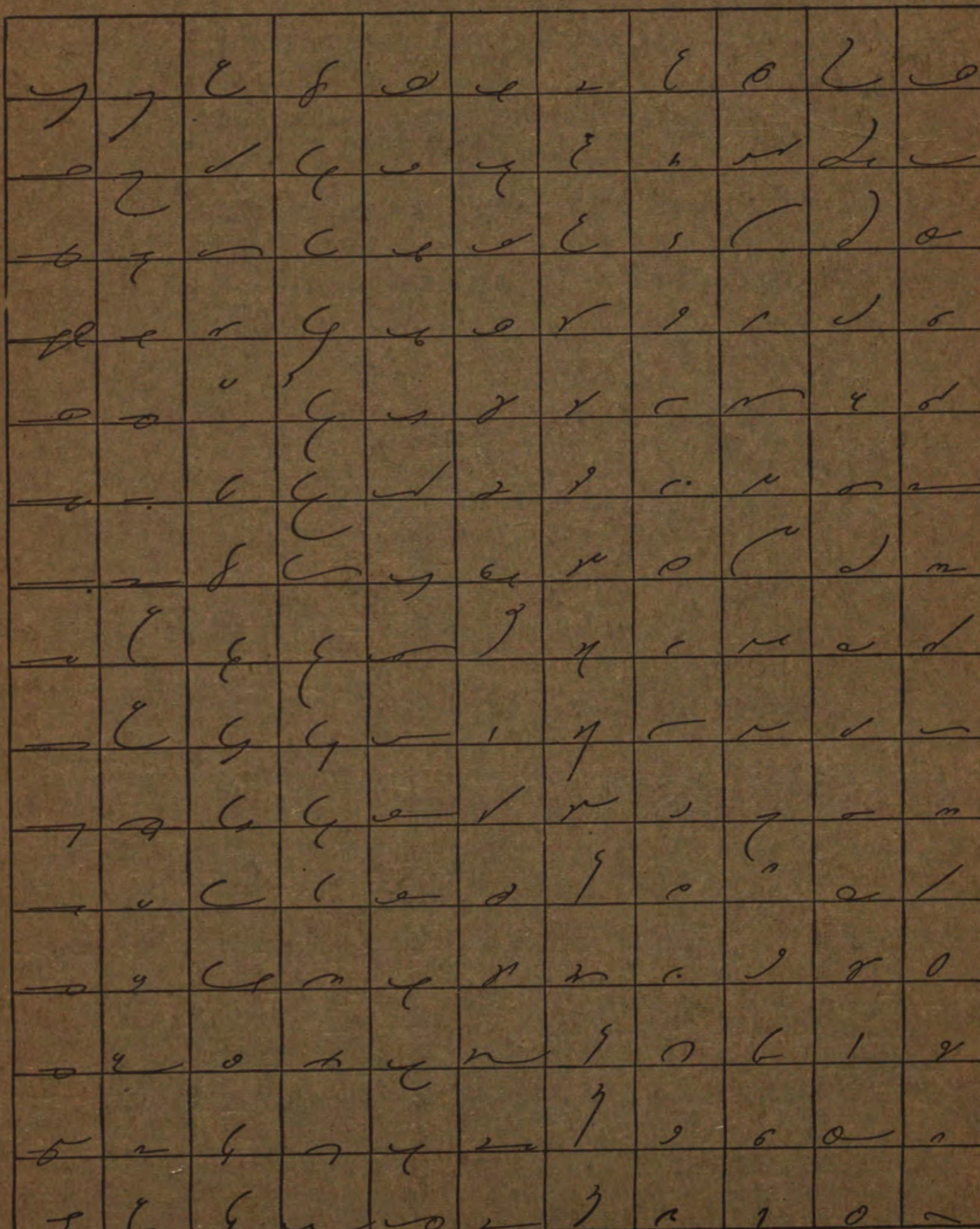
24. — The wise men also said: sometimes sie covers a long, sometimes a short course, as is seen from the calculation one has to add sometimes & sometimes to subtract in order to get the arc of vision which is sometimes greater, sometimes smaller.

p. 480 25. — The reason why in these calculations this has to be added & the other deducted, as well

Littrow 52

as the manner of all calculations & the proofs are given in the science of the calender calculation & Geometry, about which the Greeks have written many books not yet in possession of many of our scholars. ~~That~~ For ~~is~~ ~~namely~~, the books written by the wise men of Israel at the time of the prophet in the tribe of Isachar have not come (down) to our time.

However, these statements are confirmed by very exact proofs, nor is there any mistake & ~~they cannot be contested (object to) by anybody.~~ nobody can contest them (object to them); therefore it makes no difference whether they were written by prophets or heathen; for in every matter the basis of which is open & ~~the~~ its truth assured by proofs, so that no mistake is found in it, we depend on the man who has said or taught the matter; - however ~~ex~~ merely on the strength of the proof which is public & on the strength of the reason which is known.



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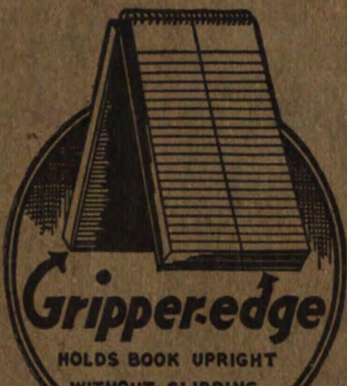

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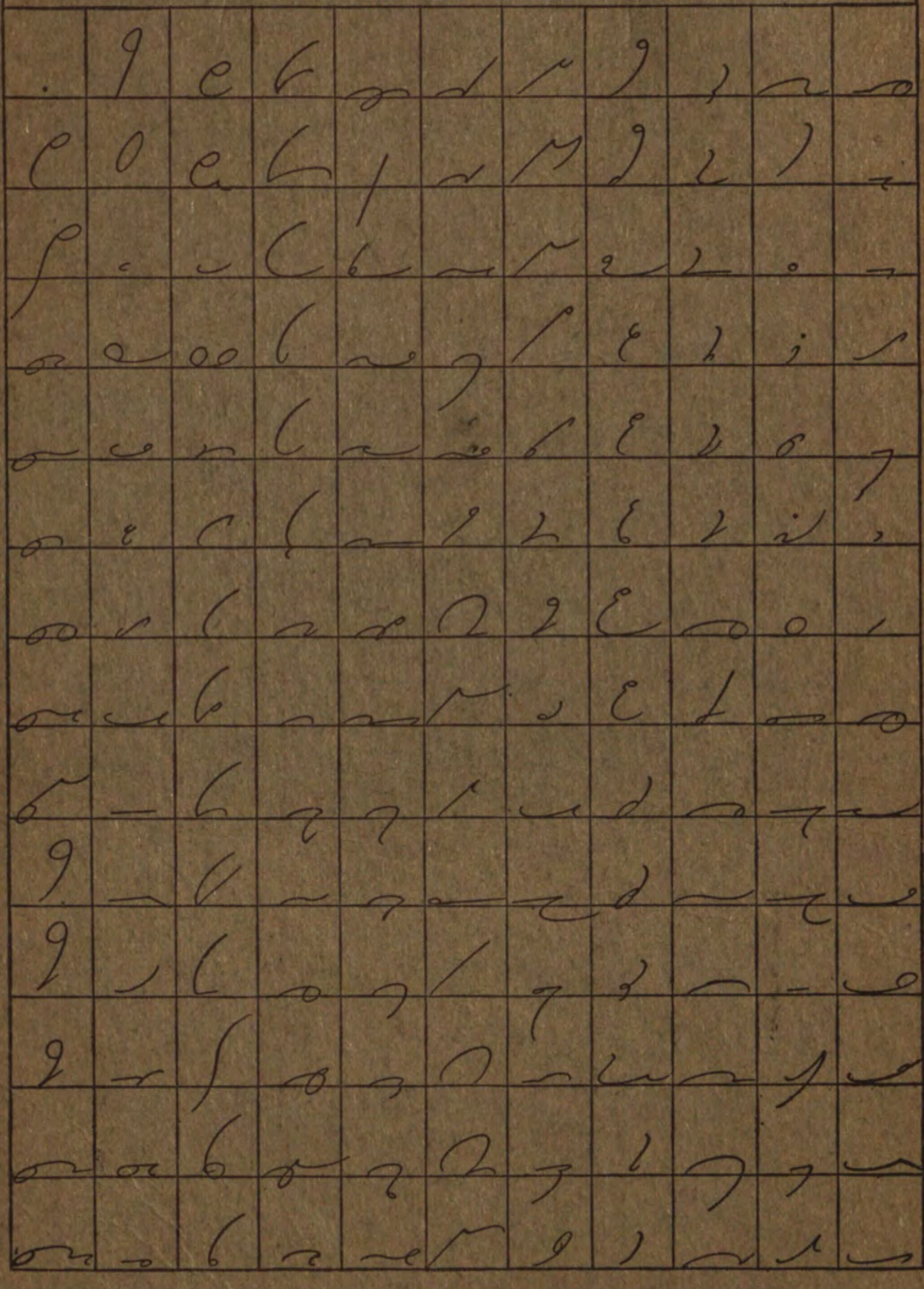

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Aramaic Papyri
A. Cowley

Oxford, 1923

80 (p 650 cont'd)

45.) During more than one century the Jews of Babylonia have followed the new computation based on the average conjunctions, i.e. the calculation of the moled, while the Palestine Jews had kept their astronomical calculations of the true conjunction and of the visibility of the crescent coming from it, surrounding their work with great mystery. But in 325 the council of Nicea ~~has~~ established for the Catholic church the well known Pascha regulations based on the use of a luni-solar calendar (1) [Note 1, p650: The enneadecacteride cycle and the system described by Pétau (see above) were adopted by a first Council, in 284, the year ~~which~~ the Church has taken as the beginning of the cycle (golden number) | This explanation is given by S. Slonimsky in his book "Iessodé Haïbour, 3rd edition, Warsaw, 1888, p. 62. We do not know the source from which this author has taken it.] analogous to the Jewish, simultaneously deciding that the Jews ~~which are~~ under Roman

midnight by, Oct. 11, 1844. p. 119, col. 1.

Visibility of Crescent

81/ domination were to be prevented ~~to~~ from celebrating their Passah the same time ~~as~~ the Christians (did)

The painful trials the Jews had to pass through induced the patriarch Hillel II (the Tiberiad) to cause the adoption of a measure which shows that he placed the public interest well above his own. Since it was no more possible under Constantine to apply the old calendar, he made known certain regulations of the Sanhedrin to make the Jewish calendar public (in 359). Thus he cut the bonds which bound (p 651) the Jewish communities of Persia to those of Palestine. (Graetz, Histoire des Juifs, Vol. III, Paris, 1888, p. 207.) //

It was the modern computation with the elements of calculations established by the Babylonians and accepted by the Palestinians which Hillel II, by virtue of his power as chief of the Sanhedrin of Palestine officially passed on to universal Judaism thus assuring their religious unity until our days. //

46. However, this computation has again undergone a slight modification, probably in the course of the VI century. Following the precession of the equinoxes, the year of the enneadecacterid cycle of Maccabean era, until then embolismic, became a simple year, the 16th day of the intercalary month going beyond the equinox (see chap. II) and the month thus becoming the first of the new year. Without changing the order of the embolismic years in the cycle, simply the starting point of the latter was modified, beginning with the XII th year of the old cycle, probably because they than had seen that the Moled of the following Nisan coincided with the day of the equinox which fell on March 18 Julian; the VIII th year of the old cycle has become the XVI th of the new cycle. This one later was attached to a new era, say, the era of creation, established by retrograde computation proceeding from a lunar conjunction brought in relation to the

meridian of a Babylonian locality (as ~~we~~ indicated by us) and not to the one of Jerusalem as still allowed by some scholars. This particular detail mentioned in form of an hypothesis by an Italian scholar of the XVIth century, Azaria de Rossi (of Mantua) in his Hebrew work "Matzref-la-Kessef" (see Appendix D, bibliography) is confirmed since several years by the publication of a curious (p. 652) polemic on the subject of the calendar which ~~broke~~ took place in the Xth century between the Jewish doctors of Palestine and their colleagues of Babylon (see Revue des Etudes juives, Vol. XLII, 1901). The principal object of the polemic was the pretension of a chief of the Palestine school, Ben-Méir, to modify the table of the four gates (reproduced above, p. 611) so as to add 642 scrupules (35 m. 40 s.) to each limit of the moled, very likely with the aim to bring the starting point of the computation to a Palestine meridian situated more to the east (the one of Jerusalem ?). His contradictor, Saadia-Gaon, rector of the Jewish Academy of Bagdad and well known philosopher, who defended the system in use since several centuries, finished by carrying the cause and by assuring for ever the religious unity of the Jews, menaced for a moment by Ben-Méir. //

§ 47. Without offering an absolute proof, the different publications of manuscripts with regard to this polemic are in accord to recognize that the modern Jewish computation was established in Babylon and brought in relation ~~of~~ to the meridian of a locality in this country - a fact which well agrees with our thesis attaching the starting point of the computation to the solar eclipse of the year 219. May be one day some old manuscripts will be discovered, some rolls which were carefully hidden by its author, the contents of which will make it possible to the scientists to take up the question under another form. //

Summary and Conclusions.

1. The luni-solar year of the Jews has its origin in the mosaic prescriptions with regard to the celebration of the Passah festival, which had to coincide with the first full moon of spring. ?

(p.653)

2. By doubling the month Adar each time the vernal equinox came after the day of the full moon, they finished no doubt by discovering the periodical return of the embolismic year in a cycle of 19 years in ~~the~~ following the order "III, VI, VIII, XI, XIV, XVII and XIX" as indicated by P. Petau.

3. The value of the average synodic month of 29 days 12 h. 44 m. and 3 seconds 1/3, taken (~~borrowed~~) over from the Babylonian astronomers who have pointed this out as early as the IVth century B.C., has served a long time to the Sanhedrin as an element of calculation (in order) to establish the true conjunction and the visibility of the crescent at Jerusalem, of which the

86/ proclamation of the new moons depended exclusively. //

4/ The substitution of the average conjunction (moled) to the true conjunction or to the visibility of the crescent was at first adopted by the Jews of Babylon with the aim (in mind - for the purpose?) to render the fixation of the calendar independent of the Palestine authorities, whose communications by signs or by messengers were often disturbed. //

5/ As the starting point for the modern computation, based on the calculation of the average conjunctions, the physical moment of a true conjunction of Nisan was taken, marked by a total solar eclipse observed at Soura on the Euphrates (seat of the famous Jewish Academy) April 2, 219 A.D. at 10 h. 33 m. 4. By a retrograd computation the Jewish calendar of the era of creation was started (fixed to Oct. 7, 3761 B.C. according to the Babylonians, or Apr. 2, 3760 B.C. according to those of Palestinians). //

87
6. The Jewish authorities of Palestine finished by accepting the new computation proposed by their Babylonian correligionists following material difficulties they experienced in order to communicate the new moons proclaimed in Palestine to the communities of the dispersion. The principal aim of the publication of the regulations of the calendar made by Hillel II in 359 A.D., was to assure for ever the unity of Judaism ~~through~~ by means of celebrating their religious festivals on the same day. //

p.654

p.655

Appendix A.

Extracts from Passages of the Talmud With regard to Regulations of the Jewish Calendar.

I

Passage regarding the days and hours. (Meguilah, 5a.)

Hebrew . . . . .

Samuel said: How (from where) is it known that the days are not counted in the years? Because (he has) it is said (Exodus XII, 2): for the months of the year; the year is counted in months but not in days.... How is it known that the hours of the month are not counted? Because (he has) it is said

88/ (Numbers XI, 20): during one month in days; the days are counted in the month but not the hours (after the manner of the Samaritans). //

II

Passage on the length of the Synodic month.
(Rosch-Haschanah, 25a)

Hebrew.....

[Note 1, p.655: Text corrected according to the manuscripts of the Talmud kept in Munich and at Parma, published by N. Rabinowitz (Munich, 1871); in the printed editions one reads הדושה, with "waf", what evidently is erroneous.]

(p. 656) Teaching in a Boraita (ancient document): Once the sky was covered with clouds and the image of the crescent appeared the 27th day of the month. The people believed it was new moon and the tribunal wanted to proclaim the new moon. But R. Gamaliel said to the rabbis: "I have a tradition from the house of my grand father (Hillel 1st) to know that a lunation is never less than 29 days and a half, 2 thirds of an hour and 73 scrupels." //

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III

Supplementary Passage.
(Erachin, 9 b.)

Hebrew. . . .

This is the day formed at the end of 36 months by multiplying the thirds of the hour and the scrupels make a year at the end of about 30 years (exactly in 365 months).

IV

Passage on the attempts of the doctors of Babylon to establish the calendar independently of the Palestinian. (Houlin 95 b.)

Hebrew. . . .

Samuel sent (to R. Johanan, to prove to him his knowledge) a calendar (the intercalations) for sixty years. R. Johanan answered: "This is a general calculation which he knows."

R. Johanan was member of the Sod-haïbour or Secret Council of Intercalation and knew, evidently, all regulations ~~which~~ were used there to fix the calendar. If he did not find the calendar for 60 years submitted by Samuel, exact, it was probably because of the too great value placed by Samuel to

90 the solar year (E'rubin, 56a) as being
365 d. 6 h. while the length of the solar year
according to R. Adda was 365 d. 5 h. 55 m. 26. s. //

~~VI~~
V

Passage on the calculation of the new moons.
(Rosch-Haschanah, 20, b.)

Hebrew....

Samuel said (once): "I can regulate (the calendar) for the whole Diaspora (Babylonia)". Abba, father of R. Simlaï, asked of Samuel: "Do you know what is taught in the Sod-haïbour (Secret Council for Intercalation): If the new moon took place before noon or in the afternoon (that is to say, what was the difference between these two cases)?" Samuel answered: "No". Abba again: "If you do not know this, there are other things which you do not know either." – When R Zeira arrived (from Palestine to Babylonia) he said to the rabbis: "There must be one night and one day of the new moon (or about 24 hours) and that is what Abba, father of R Simlaï, wished to say: one must calculate the ~~the~~ molad (average conjunction); if it takes place before noon, one (you) knows that

91/ that the crescent will be visible after sunset; if it did not (take place) occur before noon, it is certain that it will not be visible after & sunset. — What does it matter to us? — That is, says Rab. Aschi, in order to contradict the witnesses."//

Note: The majority of the authors who have occupied themselves with the question have tried to explain this strange (curious) passage of the Talmud in a more or less acceptable manner pointing to one of the general regulations of which the Secret Council of Palestine made use in order to calculate in advance the appearance of the new moon after sunset, a physical phenomenon (p.658) ~~(sign)~~ having served in ancient times (with all Semitic nations) as starting point to count the days of the month. — Confounding the true and average conjunctions, the ancient and modern calendar, some authors, believing in the possibility of the appearance of the new moon merely a few hours after the conjunction, under the pretext that the ancients were very familiar with the sky, saw in this passage one of the regulations

92/ on postponements of the modern Jewish calendar: the one of the noon. But the more prudent, knowing that the interval between conjunction and visibility of the new moon is much greater, even for the latitude and altitude of Jerusalem have tried inacceptable round-about explanations, and S. Slonimsky (of Warsaw) has given to the word חצות (milieu - middle? midst) the meaning of "midnight", in order to have an interval of 18 hours between the conjunction and the visibility of the crescent. But the term חצות not immediately followed by the word הלילה (night) always means "noon" what need not be doubted. That is why S Slonimsky's oppinion was fought by his colleagues, and Ad. Schwarz in his remarkable and conscientious memoire "Der jüdische Kalender" (Breslau, 1872) declared that the Talmudic passage in question was one of the most obscure.

We believe, in the contrary, ~~that~~ this passage is as plain (clear) as interesting. It indicates that in order to calculate the first appearance of the crescent one is to make

As a matter of fact, the system employed by the Sanhedrin of Palestine was based, as stated already, 'on the calculation of the true conjunction' and the interval of time elapsing between this instant and the appearance of the first outlines of the crescent. But these material facts had to be brought into relationship to a fixed meridian, i.e. the one of Jerusalem... Indeed, above everything it was most important to make the festivals coincide with those of Palestine, on the same days, so as not to destroy the religious unity of the Jews after the loss of their political unity. Well, there is no co-relationship whatever between the average conjunction and the appearance of the new moon, and the interval sometimes can exceed 48 hours; it is there that the system of postponements has been put into practice excluding from the new moons three special days, the details on this we have explained in the first chapter, a system the purpose of which is to retard by one or two days the official new moons in such a way as to make them coincide as often as possible with the evenings of the appearance of the crescent in Palestine (explanation given by Maimonides in his "Traite de la, etc.

93 use of the interval of 20 hours 30 minutes which exists between the true astronomical conjunction and this ~~interval~~ phenomenon, an interval indicated by Schmidt for Jerusalem (see Schmidt, "On the visibility of the new moon," in 'Astronomical News, Vol. 71, 1868, p 202-207). The regulation with which the Talmud passage deals refers to the equinoxial months of Nisan and Tishri (~~probably~~ perhaps

5 only to the first) as being the only ones that enter into consideration for the fixation of the calendar. Now, in order to calculate the true conjunction, probably by the method given by Maïmonides in his Treatise on the Sanctification of the New Moons (see Appendix B), or by an analogous calculation, always long and complicated, they (one) proceeded from the Moled, i.e. the average conjunction, (p. 659) established in a few moments by a simple mathematical operation (procedure?). Knowing, on the other hand that the extreme difference (in one sense (direction?) or another) between the Moled and the true astronomical conjunction was at most 14 hours (as admitted by the astronomers), the Secret Council of Palestine had

642

The fixing of the calendar cannot be done other than in Palestine (Graetz, trans. Wogue and Bloch, Vol. III, Paris, 1888, pp. 117 and 118)

640

The modern Jewish computation have but utilized an ancient system in use with them since several centuries and the origin of which is found in the ritual conditions of the luni-solar year.

Page 602

"The fixation of the calendar every year depends on a series of regulations, some of which are of astronomical nature, and the others are motivated by ritual propriety. This being lunar months, the whole computation as far as possible tends to make the beginning of the month coincide with the first physical appearance of the new moon."

94/ 659

adopted a very practical regulation in order to simplify the fastidious operations of the astronomical calculations, to know that the visibility of the crescent for a given evening, is not possible ~~but in the case when~~ unless the average conjunction (Moled) comes before noon, because only then and in the most favorable case, when the ~~th~~ true conjunction has preceded the moled by 14 hours there will be, by adding the 6 hours since noon until sunset ~~a~~ in the equinox period, a total interval of 20 h. 30 m. between the true conjunction and the appearance of the new moon, half an hour after sunset; but when (if) the moled did not occur before noon, the new moon will not be visible in the evening, because the interval of 20 h. 30 m. will not be reached even under the most favorable conditions. In this case the rapid operation of the moled is sufficient to dispense with the long calculation of the true conjunction, which has become useless.//

VI

VI

Passage on the Regulations of Intercalation
(Jeruschalmi, 18d top.)
(Tosefta, Sanhedrin, II, 2, edition Zuckermandel, p416, line 18.)

~~Hebrew~~....

On three signs the embolismic year is declared: the maturity of the cereales (corn?) the fruits of the trees and the tekoufa (equinox); on two of these signs the calendar can be fixed but not on a single sign. //

VII

Passage indicating the main regulation of Intercalation. (Rosh-Haschanah, 21, a.)

Hebrew.....

(p 660) Rab Hounah-bar-Abin has asked of Raba: "When you see that the Tekoufa de Tebeth (the periode as from the winter solstice to the vernal equinox) is prolonged until 16 th Nisan, pronounce this year without hesitation as embolismic because it is said (Deuteron. XVI, 1): "Observe the month Abib", which that means observe whether (that) the Abib of the Tekoufa ~~comes~~ falls in the month Nisan. /

Note: The word Tekoufa in the Old

96 Testament ~~meanst~~ designates a rotation, a period of time. The talmudists designate by this word a cardinal ~~word~~ phase of the solar year, and the solstice ~~of~~ winter is called Tekoufa de Tebeth because it begins in the month of Tebeth; generally they give to the intervals between the solstices and the equinoxes, i.e. to the lengths (duration?) of the Tekoufoth, average values representing a quarter of a tropical year. //

VIII

From numerous passages of the Mischnah, the Babylonian ~~Talmud~~ and Jerus~~alem~~chalmi Talmud, it is evident that prior to the destruction of Jerusalem in 70 A.D., no day of the week was excluded from the calendar for the fixation of the 1st Tishri. The Mischnah (Sabbath, XIX, 5) speaks of the 1st Tishri falling on a Sunday, and another Mischnah (Menahot, XI, 7) deals with the Great-Pardon falling on a Friday (or the 1st Tishri falling on a Wednesday). The Jerusschalmi (Rosch-Haschanah, II, 1) deals with the 1st Tishri falling on a Friday.

/ See for the details: Zuckermann, Materialien etc. (Breslau, 1882) p. 49, 50 and 60. /

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IX

The general conditions for the fixation of the new moons in Jerusalem, of the deposition before a tribunal ad hoc of witnesses-observers of the new moon, and of 56 the formalities of verification of their testimony, (p.661) the institution of an optic telegraphy ~~with~~ by means of lighted torches brandished on the summits of the mountains in order to announce the new moons far off, and the sending of messengers to the Diaspora for the same purpose, are set forth in detail in the Mischnah (Rosch-Haschanah, I and II). In the Babylonian Talmud, the chapters ~~conser~~ devoted to these questions include long explanations, controversies and discussions difficult to summarize.//

Appendix B.

Calculation ~~of the~~ Visibility of the New Moon according to Maïmonides.

Though the astronomical new moon begins with the instant of the conjunction the calculation of which was known in the course of the last centuries preceding the Christian era [1] [Note 1, p 661: See Epping and Strassmaier, "Astronomisches aus Babylon (Freiberg, 1889) where are found the ephemerides of the IVth and IIIrd centuries B.C. indicating separately the true conjunctions and the visibilities of the new moons.] the Hebrew like the Babylonians did not start their new month but with the first physical appearance of the crescent after sunset no doubt because of the ritual importance of the new moon, either by continuing the direct observation of the new moon according to ancient custom, or by calculating this visibility in advance by means of inductive methods established by the ancients in consequence of observations over centuries.//

The formula used by the Secret Council of the Sanhedrin for the calculation of the visibility of the new moon has not been found again; but

99/ the scientists of the post-talmudic period have exerted themselves to establish it according to a total (collection?) of instructions that had come down to them, and the result of these efforts has been the curious method described by Maimonides in his "Constitutiones de Sanctificatione Novilunii" the Hebrew text of which accompanied with (together with) p.662 an excellent latin version (due to Ludovic Compiègne de Veil) has been published by Blaise Ugolin in his "Thesaurus Antiquitatum Sacrarum, Vol. XVII (Venise, 1755). This method presents a good specimen of the scientific activity of the ancients; we shall summarize it in the following note retaining ~~therein~~ the expressions of the author which (relate to) are in bearing with the system of Polemei's world. //

Method described by Maimonides (XII th century)

1/ To inquire after (look for) the visibility of the new moon at Jerusalem for a given evening, it is necessary first to calculate the respective positions of sun and ~~moon~~ st, then the ~~average~~ movements, average and rectified, of these stars. //

The sun. – The arc described by the sun in its average tropical movement in 24 hours is ~~from~~ 0° 59' 8", or in 10 days 9° 51' 23", in 100 days,

98° 33' 53", in 1000 days (after the defalcation of whole circumferences) 265° 38' 50" and in 10 000 days 136° 28' 20". With these indications it will be easy to establish a detailed table by days, months and years, but it matters above all to retain the arcs corresponding to 29 days (one month) and to 354 days (an ordinary regular year), which are (respectively. 28° 35' 1" (29 days) and 348° 55' 15" (354 days) ⅄.
On the other hand, there is a particular point in the ecliptic from where the sun repand sheds its most vivid light on the earth, a point which moves very slowly of about 1° in 70 years (precession); this point is called the height of the sun. Its displacement makes an arc of 1" 30"', in ten days, in 100 days - 15", in 1000 days - 2' 30", in 10 000 days - 25', in 29 days - a little over 4", and in a regular year - 53".// 70) 1900 / 100

2/ Maimonides has taken as the starting point for his calculations which he brought in relation to the meridian of Jerusalem, the beginning of the night of the 3 Nisan 4938 of the era of the creation (or 22/23 March 1178 A.D.). The sun was then, in its average movement at 7° 1' 32" in the sign of the Aries, 101 (p. 663)

and its height was at 26°45'8" in the sign of the Gemini. With these indications one can calculate the average movement of the sun and its height for no matter what date - (~~in advance or back~~) later or prior to the one chosen as starting point by first calculating the values corresponding to the years, months and days which form the interval of the time elapsed; and by adding them (to) (or in taking off from) the indications given for the initial date (according to whether the given date has succeeded or preceded it). It sometimes happens that the result of the calculation of the average movement of the sun does not exactly coincide with the beginning of the night and that the difference is on hour too much or short (more or less?); this is of no importance for the purpose pursued, the difference having to be corrected at the moment of the calculation of the average movement of the moon. //

3. To know the true position of the sun, first the average movement and ~~5~~ 9 the height of the sun for the given date is calculated, the height is cut off (~~retrenched~~ deducted) from the

average movement and the remainder is the rectified movement (the average anomaly, at the apogee). Then the number of the degrees contained therein are taken observed; if it's less than 180°, the values indicated below are deducted (cut off), or added in case they are found between 180° and 360°, and the result obtained after this correction is called the true (ecliptic) position of the sun. The correction becomes zero for exactly 180° and 360°. This correction (equation of the center of the sun) represents:

0° 20' for	10° or	350°	1° 58' for	100° or	260°
0° 40'	20°	340°	1° 53'	110°	250°
0° 58'	30°	330°	1° 45'	120°	240°
1° 15'	40°	320°	1° 33'	130°	230°
1° 29'	50°	310°	1° 19'	140°	220°
1° 41'	60°	300°	1° 1'	150°	210°
1° 51'	70°	290°	0° 42'	160°	200°
1° 57'	80°	280°	0° 21'	170°	190°
1° 59'	90°	270°	0° 0'	180°	180°

p. 664

The degrees above 180° are deducted of 360 and the difference is taken as indicated in above small table. The corresponding correction for the units is determined by interpolation. So, for instance, for 64°; you have 1°41' for 60° and 1°51' for 70°, or a difference of 10' for 10°, hence, 1°45' for 64°. In this manner the true position of the sun for no matter what date can be calculated, taking it then as a starting point in the calculation, be that for instance the beginning of a century or any other appropriate period.//

4. <u>The moon.</u> – The moon has two circular movements: one, called the average orbit, describes a small circumference which is involved in her movement around the world called the <u>average tropical movement of the moon</u>. It describes in 24 hours an arc of 13° 10' 35", or in 10 days – 131° 45' 50", in 100 days – 237° 38' 23", in 1000 days (after defalcation of whole circumferences) – 216° 23' 50", in 10000 days – 3° 53' 20"; in 29 days – 22° 6' 56" and in 354 days 344° 26' 43". With these facts one can calculate the average movement of the moon for no matter what number of years, months and days.//

The average orbit (<u>average anomalistic movement of the moon</u>) represents, for 24 hours, 13° 3' 54", or in 10 days – 130° 39' 0", in 100 days – 226° 29' 53" 60, in 1000 days – 104° 58' 50" in 10,000 days – 329° 48' 20", in 29 days – 18° 53' 0", and in 354 days – 305° 0' 13".//

5 At ~~In~~ the beginning of the night of Thursday, the date taken as the starting point, the moon was in its average movement of 1° 14' 43" in the sign of Taurus, and the average orbit was at 82° 28' 42". By calculating the average movement for the interval elapsed since the initial date until a determined date, and by adding to this one the initial date, you get the average movement of the moon for the given date, same as was done for the sun. Having done this calculation (~~look for~~) determine the Zodiak sign the sun is ~~on~~ (p. 665) on the given date. If it is between the middle of the Fishes and ~~the~~ the middle of the Aries, the average mouvement of the moon remains without correction; if the sun is between the middle of the Aries and the beginning of the Gemini 15' is added to the average movement of the moon (reduction at sunset); if the sun is between the beginning of the Twins Gemini and the middle of the Leo, 30' is added to the average movement of the moon; if the sun is between the beginning of

105 Leo and the middle of Virgo, 15' is added; if the sun is between the middle of Virgo and the middle of Libra, the correction is zero; if the sun is between the middle of Libra and the beginning of Sagittarius, 15' is cut off the average movement of the moon; if the sun is between the beginning of the Sagittarius and the one of Aquarius, 30' is cut off; finally, if the sun is between the beginning of Aquarius and the middle of the Fishes, 15' is cut off the movement of the moon. The result of this correction represents the average movement of the moon at the moment of its first appearance in the sky, or about 30^m after sunset. //

6. Now about establishing the true position of the moon for the given period. For this, note: I. The average movement of the moon, II, Her average orbit, and III, the movement of the sun; deduct III of I and multiply the remainder by 2, which represents the double distance (double differences of the lengths). //

106 These calculations are ~~only~~ but an aid for the visibility, a phenomenon which is realized only when the double distance is 6 between 5° and 62°; below 5° and above 62° the new moon will not be visible in Palestine.

Knowing the double distance, value II is rectified (the average orbit of the moon) by adding to it:

1°	for the the double distance as from	6° to 11°
2°		12° - 18°
3°		19° - 24°
4°		25° - 31°
5°		32° - 38°
6° (p.666.)		39° - 45°
7°		46° - 51°
8°		52° - 59°
9°		60° - 63°

and when the double distance is 5° or a little more, there is no correction. Thus ~~so~~ you get the rectified orbit of the moon.(1)

[Note 1, p.666: V. Delambre, Histoire de l'Astronomie ancienne (Vol. II, p. 204).]

7. According to the number of degrees of the rectified orbit, cut off (deduct?) from ~~it~~ the average movement of the moon (I) the values indicated hereafter, in order to establish the true position of the moon (elliptical length) for the given evening. These

deductions take place if the degrees of the rectified orbit are included (compris) between 0° and 180°; between 180° and 360°, the values given hereafter are added to the average movement of the moon, and these additions correspond with the degrees resulting from the difference between 360° and the rectified orbit. The correction is zero for 180° and 360° exactly. By interpolation are found the corrections corresponding to the units of the average orbit, same as explained for the sun.

These deductions and additions (equation of the centre of the moon) are for the rectified orbit, from:

0° 50'	for	10° and	350°	5° 8'	for	100° and	260°
1° 38'		20°	340°	4° 59'		110°	250°
2° 24'		30°	330°	4° 40'		120°	240°
3° 6'		40°	320°	4° 11'		130°	230°
3° 44'		50°	310°	3° 33'		140°	220°
4° 16'		60°	300°	2° 48'		150°	210°
4° 41'		70°	290°	1° 56'		160°	200°
5°		80°	280°	0° 59'		170°	190°
5° 5'		90°	270°	0° 0'		180°	180°

8) The circumference described by the tropical movement of the moon is not completely in the plane of the ecliptic but p. 667 meets it in two points named knots (nodes) (3), of which one, the one where the

moon passes from south to north is called the head (ascending knot) and the other in the other sense, is called tail (descending knot); they are exactly 180° distant from one another. The movement described by the head is exactly regular from west to east, and represents for 24 hours 3' 11" or in 10 days – 31' 47"; in 100 days – 5° 17' 43"; in 1000 days – 52° 57' 10"; in 10000 days the surplus will be 169° 31' 48"; in 29 days the average movement will be 1° 32' 9" and in 354 days – 18° 44' 42". On the evening of Thursday, the initial date, the head was at 18° 57' 28". To find the position of the head for a given day, you calculate its average movement, as same as for those of the sun and the moon, adding this to the value indicated for the initial date and deduct the avg. movement from 360°; the remainder will give the position of the head on the zodiac.

The tail is exactly at 180° from the head at the seventh sign of the zodiac.

109/ moon passes from south to north, is called the head (ascending knot) and the other, in the other sense, is called tail (descending knot); they are exactly 180° distant from one another. The movement described by the head is exactly regular, from west to east, and represents for 24 hours 3' 11", or in 10 days - 31'47", in 100 days - 5° 17' 43"', in 1000 days - 52° 57' 10"; in 10 000 days the overplus will be 169° 31' 48"; in 29 days the average movement will be 1° 32' 90" and in 354 days - 18° 44' 42". On the evening of Thursday, the initial date, the head was at 18° 57' 28". To find the position of the head for a given evening, you calculate its average movement, as same as for those of the sun and the moon, adding this to the value indicated for the initial date and deduct this average movement from 360°; the remainder will give the position of the head on the given evening. //

The tail is exactly at 180° (from) of the head at the seventh sign of the Zodiac.

110/

9./ Knowing the true position of the moon, the head and the tail, consider these three values. If the moon coincides with the head or with the tail, ~~it~~ she is then in the plane of the ecliptic. When the moon is between the two knots, in the direction going from the head to the tail then she is inclined towards the north and this inclination, called largeur boréale - northern width of the moon, is the more pronounced, the more its distances itself (widens) from the head. When the position of the moon is in the direction going from the tail to the head, the inclination is directed towards the south and is called "largeur australe", southern width of the moon. These inclinations towards the north or towards the south, never exceed 5°./

To know the width of the moon and ~~her~~ its direction for a given day, you deduct the position of the head from the true position of the moon and the remainder is the width of the moon (argument of the width); it is boreal (northern) if it is in between 1° and 180°, and austral

111/ (southern) if it exceeds 180°, it is zero (exactly at 180° and at 360°.//

p668 (63) This width is increasing ~~while~~ in distancing itself from the knots, and its value is:

0°52'	for the arguments	10° and	170°
1°43'		20°	160°
2°30'		30°	150°
3°13'		40°	140°
3°50'		50°	130°
4°20'		60°	120°
4°42'		70°	110°
4°55'		80°	100°
5°		90°	90°

and by interpolation you will find the values corresponding to the units of the argument. For the arguments in between 181° and 360° you first deduct of it 180 and the remainder represents the argument of the southern width.//

10. Conditions of the visibility. —

Knowing the positions of the sun, the moon, and the head, respectively, you have all necessary elements to establish by calculation whether the new moon will be visible or not, in Palestine, at the beginning of the given evening to which the three values mentioned are reported. You deduct the true position of the sun of that of the moon, and the difference is called first length of the moon. Knowing, on the other side, the width of the moon (resulting from her true position and the one of the head) consider these two values; if the first length is 9° or below, every other calculation becomes superfluous, the new moon will not at all be visible, in Palestine; likewise, if the length exceeds 15°, it is not necessary to look much farther because the new moon will certainly be visible throughout Palestine. But if the first length is in between 9° and 15°, it is necessary to resort to a special calculation to know whether the visibility of the moon is possible or not.

This remark is of value only in the case when the true position of the moon is in between the beginning of the Capricorn and the end of the Gemini. But if the moon is between the beginning of Cancer and the end of the Sagittarius and the first length is 10° or below, the new moon will not be visible at all in

p669

113/ in Palestine; if the length exceeds 24°, she will be visible in all of Palestine; if the length is in between 10° and 24°, only through a supplementary calculation can ~~it be decided~~ the visibility of the new moon be decided.

This special calculation will be carried out in the following manner:

The true length and the true width of the moon are not those obtained in the first rank, because of the parallaxis; and, to take this into consideration, the following corrections have to be made:

11/ Parallaxis of the Length. – According to the Zodiacal sign where the moon is found, deduct of the first length one of the values given here, and you then have the second length.

Sign of Zodiak	Deduct of the 1st length	Sign of Zodiac	Deduct of the 1st Length
Aries	0° 59'	Libra	0° 34'
Taurus	1° 00'	Scorpion	0° 34'
Gemini	0° 58'	Sagittarius	0° 36'
Cancer	0° 43'	Capricorn	0° 44'
Leo	0° 43'	Aquarius	0° 53'
Virgo	0° 37'	Fishes	0° 58'

12. Parallax of the Width. –

According to the sign of the Zodiac where the moon is found, you deduct of the first width in case it is boreal (northern) or add if it is austral (southern), the corresponding value (in minutes) (given here) as follows; ~~you~~ thus the second width is obtained.

Sign of Zodiac	to deduct of the 1st width	Sign of Zodiac	To deduct of the 1st width
Aries	9'	Libra	46'
Taurus	10'	Scorpion	45'
Gemini	16'	Sagittarius	44'
Cancer	27'	Capricorn	36'
Leo	38'	Aquarius	24'
Virgo	44'	Fishes	12'

p 670

13. The value indicating the second length of the moon must undergo a new correction because of the perturbations the moon experiences in her movement. This correction is expressed in fractions of the second width indicated hereafter, which have to be deducted from, or added to, the second length:

Fractions of the 2nd Width	When the Position of the Moon is in: Between	And
2/5	Beginning	20° Aries or Libra
1/3	20° Aries or Libra	10° Taurus or Scorpion
1/4	10°	20° " " "
1/5	20°	End - " " "
1/6	Beginning	10° Gemini " Sagittarius
1/12	10°	20° " " "
1/24	20°	25° " " "
0	25° Gemini or Sagittarius	5° Cancer " Capricorn
1/24	5°	10° " " "
1/12	10°	20° " " "
1/6	20°	End - " " "
1/5	Beginning	10° Leo or Aquarius
1/4	10°	20° " " "
1/3	20° Leo or Aquarius	10° Virgo " Fishes
2/5	10°	End - " " "

14. These fractions represent the greatness of the perturbations, they are deducted from the second length or added to it according to the series of the Zodiacal signs where the moon is found and whether its width is boreal or austral (northern or southern) in conformity to the following indications:

1st The moon is found between the Capricorn and the Gemini:

The fractions of the northern width are to be deducted from the second length, and the fractions of the southern width are to be added to same;

2nd The moon is between the Cancer and the Sagittarius:

The fractions of the northern width are to be added, and those of the southern width are to be deducted of the second length.

After this correction, subtraction or addition, you get the (p 671) third length of the moon; it indicates the degrees between the sun and the moon, for the given evening.

15. Arc of Vision. - Now about the calculation of the arc of vision of the moon. For this, correct the third length in the following manner:

If the moon is in the fishes or in the Aries, add to the third length 1/6 of its value;

If the moon is in the Aquarius or Taurus, add 1/5 of its value;

117/ If the moon is in Capricorn or Gemini, add 1/6 of its value;

If the moon is in Sagittarius or Cancer, the third length remains as it is, without addition or ~~1/6~~ subtraction;

If the moon is in the Scorpion or Leo, deduct 1/5 of its length;

If the moon is in the Libra or Virgo, deduct 1/3 of its value.

What remains of the third length after these additions or deductions is called the fourth length.//

Take then 2/3 of the first width of the moon, and this value is called the height of the place (hauteur du lieu); add this to the forth length in case the width is boreal, or deduct this value in case the width is austral, and what remains of the fourth length, after adding or deducting of the height of the place, represents the arc of vision of the moon.

If, for instance, you want to know whether the new moon was visible in Jerusalem, at the beginning of the night of Friday 2 Iyar of the year taken

as a starting point (20/21 of April 1178 A.D.).
Begin by calculating the true position of the sun, the one of the moon and her width, for the given night. Then the following values are found:

True position of the sun, 7°9' in Taurus;
" " " " moon, 18°36' " "
First southern width, 3°53'.

p. 672

In looking for the position of the sun and the one of the moon, you (get) find 11°27' as the first length and since the moon is in the sign of Taurus, it is necessary to deduct 1° of the length (parallax) and you will have 10°27' as the second length. The parallax of the width is 10' which must be added to the width because it is southern, thus getting 4°3' as second width. Since the moon is ~~in~~ at 18° in Taurus, 1/4 of ~~the~~ her width must be taken, or 1°1, to correct the perturbations. Since the width is southern and the true position of the moon is found between Capricorn and cancer, it is necessary to add this fraction of the width to the second length, thus getting 11°28' as the third length. Since it is in the Taurus, it will be necessary to (you must) add 1/5, or 2°18', and then you will have 13°46' as the ~~fourth~~ value of the fourth length. Then 2/3 are taken of the first width, or 2°35', representing the height of the place which must be deducted of the fourth length (the width being ~~austral~~ southern), and it will remain 11°11' as the quantity (magnitude?) of the arc of vision of the moon for the given night.

(67) 16. Consider the arc of vision; if it has but 9° or less, the new moon will not be visible in Palestine; if it exceeds 14°, the new moon is visible.

If the arc of vision is within the beginning of 10° and the end of 14°, it is compared with the first length, in order to recognize by the limits indicated hereafter whether the new moon is visible or not.

The limits of the visibility are as follows:

1. The arc of vision > 9° to 10°; & the first length = 13°;
2. — " — > 10° to 11° — " — = 12°;
3. — " — > 11° to 12° — " — = 11°;
4. — " — > 12° to 13° — " — = 10°;
5. — " — > 13° to 14° — " — = 9°.

In each of these five cases, the new moon will be visible in all of Palestine; (p. 673) but the visibility becomes impossible if in one case, one of the two limits is not reached."

In the instance quoted of the night of 2 Iyar 4938, we have found 11° 11' for the arc of vision which we shall compare with the first length 11° 27'. The limits of the third case: Arc of vision = > 11°, and first length = 11°, being attained, or exceeded in the given night, the new moon certainly was visible in all of Palestine."

17. From the foregoing explanation it is evident that the astronomical calculation of the visibility according to the method described by Maïmonides,(1) is a rather long operation due to the numerous perturbations

121. the moon is experiencing in her movement in the planetary system.

To shorten the work, the Astronomical Council of the Sanhedrin used certain preparatory formulas, like the one which one of its members one day made known to Mar-Samuel, called the computer (see Appendix A, V).

[Note 1, p.673: An identical method is still used by the Karaite scholars for making up their calendar, as described by Kokizoff in his interesting memoire Halichoth Olam, Astronomical Tables, Odessa, 1880). The Karaite chronology differs from that of the modern Jews by (in?) the conservation of the principel of the physical (visible?) appearance of the crescent (astronomically calculated) for the fixation of the new moons; the intercalation was mad according to the enneadecaeteride cycle of the Jews.]

April 21/32

Appendix C.

Excerpt from Al Biruni:
The Chronology of Ancient Nations. (2)

[Note 2, p. 673: English edition published by Edouard Sachau, London, 1879, chap. V, p. 68.]

Jewish Months. – The mathematicians computed for them the cycles, and taught them how to find, by calculation, the conjunctions (p. 674) and the appearance of new moon, viz. that between new moon and the conjunction the time of 24 hours must elapse. And this comes near the truth. For if it was the connected conjunction, not the mean one, the moon would be about 13 degrees, and her elongation from the sun would be about 12 degrees.

This reform was brought about nearly 200 years after Alexander.

123 69

Appendix C D.

Conversion of Jewish dates into Julian and Gregorian dates, and vice versa.

In the first chapter we have explained the manner to establish for each Jewish year, its form and the day (feria) of the 1st Tishri, proceeding from the era of creation, which began Oct. 7, 3761 B.C. at 5 h. 204 scrupel. It is then easy to calculate the Julian date of the 1st Tishri of a given year because for this it suffices to calculate the number of days elapsed since the beginning of the era of creation, to divide this number by 1491 (4 × 365 + 1) and the remainder by 365 in order to have the number of Julian years elapsed; the remainder will give the number of days passed since Oct. 7. If this calculation is done year after year, it can be abreviated in the following manner:

Knowing the Julian date of the 1st Tishri of a given Jewish year the form of which is known, the 1st Tishri of the following Jewish year will have to be advanced in the ordinary year and retarded (~~put back~~) in the embolismic year, in the following manner: 20

		or in case the Julian year is a leap-year:
m =	−12 days	−13 days
r =	−11 "	−12 "
p =	−10 "	−11 "
M =	+18 "	+17 "
R =	+19 "	+18 "
P =	+20 "	+19 "

p. 675 Proceeding after this priciple, we have calculated the Julian dates for all Jewish years within 3761 and 5761 of the era of creation or between 0/1 and 1999/2000 A.D., and we have made ~~of~~ it in a big table, divided in 20 parts, by centuries, indicating for each year, its form and the Julian date of the 1st Tishri, and beginning with the year 1583 we have substituted the Gregorian dates to the Julian. We then found that the corresponding date

125/ of the first Tishri ~~ocs~~ oscillates between ~~the~~ August 25 and September 27, Julian or Sept. 3 and Oct. 5, Gregorian, that the 1st Tishri of an ordinary year oscillates between September 5 and October 5, and the one of ~~the~~ an embolismic year oscillates between August 25 and September 16.

As the variations of the length caused by the different forms of the Jewish year do not change, except the months from Marheshvan to Adar, while as from 1st Nisan to 29 Marheshvan there never is a variation of dates, it suffices to know one of them, for instance the <u>one of 1st Tishri</u>, to know the Julian or Gregorian dates of all days in~~cluded~~ covered in this long interval. It is only for the interval between the 30 Marheshvan (p or P), 1st Kislev, respectively (m, r, M. R), and the 29th Adar (or Veadar in M, R and P) that the dates are displaced with the form of the Jewish year; and it suffices, therefore, to make up for it a small table, indicating for each

126 form of the Jewish year the corresponding (Julian dates) to the first of the Jewish months, and another small table to find the intermediary Julian dates. We have calculated a series of auxiliary tables to facilitate all operations and to convert instantaneously the Jewish dates into Christian dates, and the Julian and Gregorian dates into Jewish dates. As the forme of the Jewish year indicates at the same time the day (feria) of the 1st Tishri, we have made a special table to find the day (feria) of no matter what Jewish date.

We must content ourselves for the moment to give for on this question of mutual conversion of Jewish, Julian and Gregorian dates some general indications (explanations), reserving for us the privilege to return to it soon at the time of the publication of our "Tables of Conversion".

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Append. E. - Bibliography.

Lev. 23:10, 11 shows that the barley sheaf was to be offered "when they should come into the land." 614.

1st Nisan precedes Tisri by 2d 4h 438 ser. 612.

Tisri moled ~~can oscillate~~ without causing a change in form of year. 610

Table of Common and Leap years. 602

Starting point = Eclipse of sun - 598

Present Jewish Cal. goes back to 4th cen. A.D. 597.

Not easy to follow the successive transformations of the ancient system which have led to the definitive form conserved within our day. 597.

Observations were continued even long after the knowledge of astronomy made it possible to figure out in advance the date of the new moon. 597.

Babylonian astronomical ephemeris (3rd & 4th cen. B.C.) deciphered by Strassmaier and published by Epping and Kugler (Die Babylonische Mondrechnung, Freiburg. 1900) 597.

Church sets the death of Christ in the year 33 - reason for because Jewish Calendar so marks out 635.

Friday = 15 day of moon.

Evening of Jewish Passah must coincide with Full Moon and in no case could precede. 636

Tekupha prolonged to 16th Nisan

3 signs of embolism 660

No postponements in first century (Talmud references) 660

Mishnah (Rosh Hashanah I and II) give full details of the Court in Jerusalem and the signals 661

M Universities of Jews 648

Positions of the sun, the moon, and the head, respectively, you have all necessary elements to establish by calculation whether or no new moon will be seen in Palestine. 668

Table of Signs and amount of correction 669

$\frac{31}{60} + \frac{50}{\ }$

$81' + 50'' + 8''' + 20^{iv} =$

The system of postponements was introduced by the doctors of Babylon, which did not exist in the first century. 633.

Ancient Jews ignored the secular perturbations and accelerations of the stars 634

Synthetic = 633–598. Synthetic calendar.

143 B.C. All public Jewish acts dated. 632. I Mac. XIII, 42.

Sun and Moon 76= Scaliger Jerusalem era.

Vernal equinox in 1st century was March 23. 626.

Jewish Passah always coincided with the first full moon after V. E.

14 hrs. difference between Jewish molad 626. and true conjunction 659

Maimonides followed in 1st century according to Talmud. 626. See Appendix 7.

In regard to the system of intercalating a thirteenth month, the Sanhedrin did not content itself to observe the maturity of the barley, but added to it the calculation of the equinox. 624 i.e. after destruction of temple.

Unity of scattered Jews depended upon having festivals on same days. 623

Dropped barley sheaf 624.
Jews calculated in advance the ~~visibility of the crescent~~ 622.

Issachar. 616

Form of luni-solar year established by law of Moses.

Hebrews knew solar year from Egypt – 615 no documents on this

Followed intercalation instead of epagomenae of Egyptians 615

Trys to show that April 4, 33 = Nisan 15 636

Passover sometimes 24 hours after full moon. 636
Before impossible.

Almagest 638

Hipparch computed length of synodic month from eclipses id.

Origin of 1080 scruples 639

Sanhedrin in 1st century knew value of synodic month — Indeed Talmud reports Rabbi Gamaliel (middle of 1st cen A.D.) as having learned value from his grandfather 640

Rites older than cyclic system 631

Equinox in 1st century 626

Talmud on Intercalation 626

Secrets transferred to world 625

Jewish year always commenced with the first full moon following the Equinox 626

To make beginning of the month coincide with the phases as near as possible 602

Moled = mean conjunction 604

Tractiar - 616

Jews used Hodesh for lunar months to distinguish it from the solar jerah of the Phoenicians with which it did not agree. 618

Complete names of months for first time 619

Special tribunal for hearing reports of witnesses 621

Sadducees, Essenes and Bethusas who arose in the second cent. B.C. and Karaites in 8th cent. A.D. have all fought the calendar 623

Jews had two systems of Tekufahs — one known like Julian and one secret 624

Mystery of Secret Council behind closed doors 627
Zuckerman ref

If the V. E. did not come ~~before the 16th of the~~ month, the Jews intercalated 623

Origin of 1080 scruples
taken from common denominator in ~~Ptolemy's Almagest~~ Chaldean cycle 639

Modern Jewish Computation have used an ancient system the origin of which is based on the natural conditions of the luni-solar years 640

Synodic month known to Sanhedrim in 1st century, Rabban Gamaliel = 29½ days 640

Almagest = middle of 2nd cent A.D. ″

Proclamation of New Moons has always been one of Sanhedrim's prerogative Hillel I, the Babylonian House of Hillel, same as Paul 641

2 Consecutive embolismic years due to persecution 642

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Mar-Samuel's Calendar = 643

System employed by Sanhedrim of Palestine was based on the interval between conjunction and the phasis, 643
dependent upon fixed meridian

Present Jewish system based on the ancient direct observation of the new moon, p. 4

Jewish computation is an interesting chapter of first application of ancient astronomy, p 5

Confusion between modern Jewish computation and calendar which preceded it, p 5

Fifth century B.C. modern Jewish computation not invented p 6

Intercalary month = 29 days. p. 10

If you make Veadar 30 days, insert it between Shebat and Adar. then Adar is 29 days. p 10

177 days between Nisan 1 and Tisri 1 p. 10.

3, 6, 8, 11, 14, 17, 19 = p. 11

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First of creation p 13.

Hebrew "molad" = mean conjunction and not phasis p. 14

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Different formulae p. 22

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Jewish Passah always first full moon after equinox. p. 44

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Evening of Jewish Passover must coincide with Full Moon and can't precede it. 636

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To determine abib, the maturity of the barley was observed. p 28

~~Knew in advance the new moons. p 29.~~

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To celebrate on same day p 39

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Karaites have different days p 40

Equinox replaced barley p 40

Book of Enoch criticizes octaeteride cycle which was used doubtless in second century B.C. p 40, 41

Early Jews had two systems of Tekuphoth - one approximate known to all and one secret

p 42

Paschal month of Christians often runs in Jewish Adar. Scaliger, 105
Sun and moon control = Scaliger, 76.
Used pure Jewish year, others fixed their passover first after equinox. 106.

Palestine the only place where the beginning of the month was permissible. Mar-Samuel, p 19.
Great censure upon one who determined new months and intercalation. Mar-Samuel, page 19.

Patriarch had to be very well experienced in the reckoning of every new moon. {conjunction / visibility
Mar-Samuel 20

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First year begins with equinoctial moon ? — 645

[So modern system is computed on an equinoctial moon while first century was based on a barley-harvest moon !]

Bedersky's 19 eclipses from time of Christ to 600 A.D. — 647

Jerusalem = 35° 13' 6" east — 647

219 A.D. Jewish Academy of 1200 students in Babylon at Sora — 648
(Graetz, vol III,)

Pombedita and Naphardea as centers of learning — do

219 A.D. = 1st year of 20th cycle from 143 B.C. — 649

2 great ~~principles~~ of Sanhedrin of Palestine = 19-yr cycle and 29½ synodic mo. — 649

Nov 5

Mar 21
20
19
18
17
16
15
14
13
12
11

Nov. 15

$1 \frac{1}{2}$

2.08
300

24) 600
2

Abraham Hanasi = 1120 A.D.
Oldest known

Palestinian Jews kept their calculations based on true conjunction and phases in contrast to the Babylonian Jews who computed on the mean conjunction or moon 650

Catholic - Church cycle taken from 284 650
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p. 28 = Abib by maturity of barley
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54 = Chwolson = Friday = 14 Nisan
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69 = Maimonides on Adu and Badu.
95 = Tekupha and 16th Nisan.
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111 = Knowing position of sun, moon and head - can tell whether moon can be seen or not, Maimuni.
80 = Church 19-yr. cycle started with 284.
80 = Palestinian Jews kept their astronomical calculation of true conjunctions.
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656
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Extreme difference between
Molad and true
conjunction at most 659
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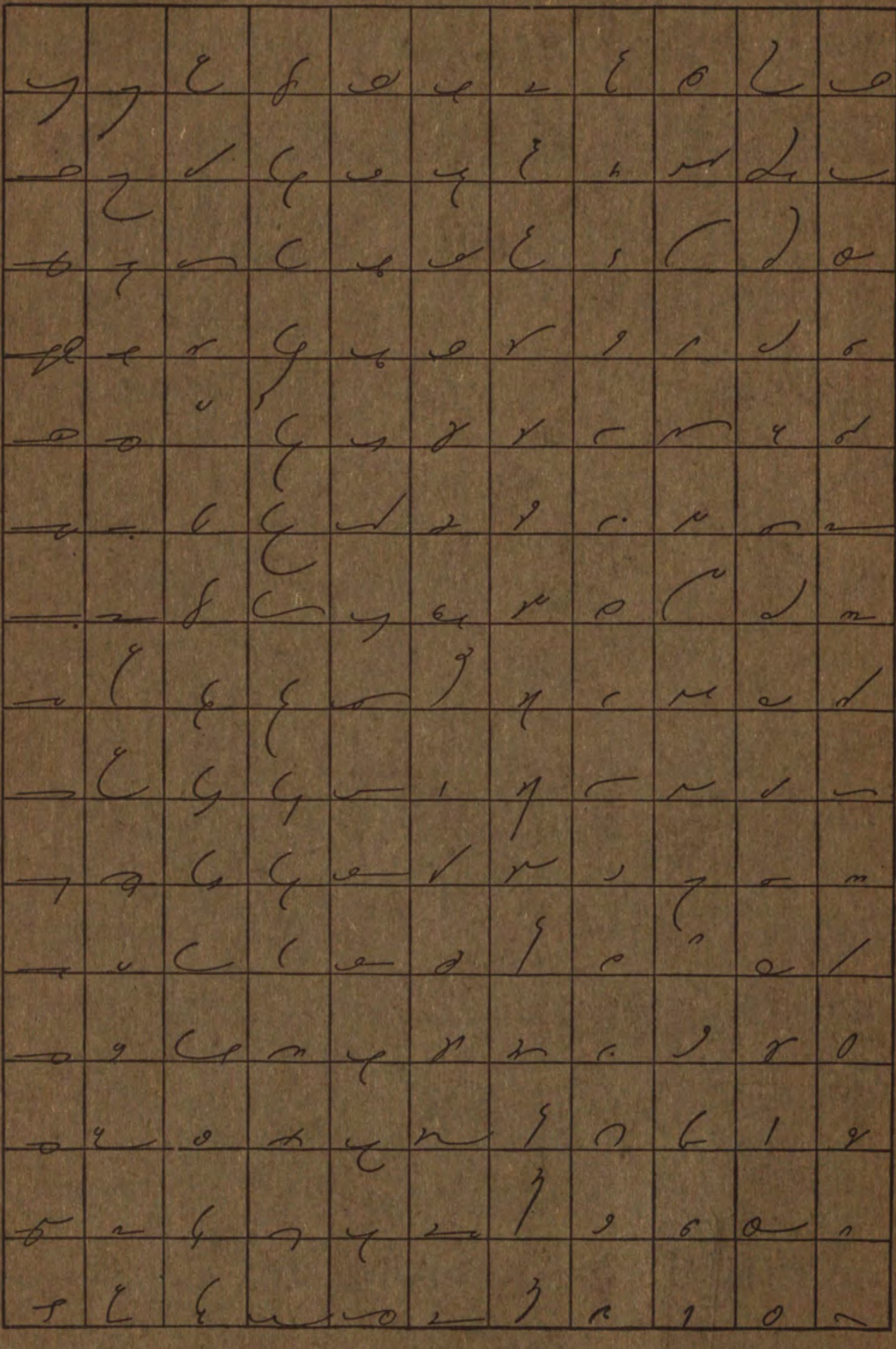
4$\overset{3}{7}$1 119

Apr. 2
28
31
30
31
31
~~~~
151
14
~~~~



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