TRANSLATIONS

On lunar calendar:
D. Sidersky (3)
Geminus (Manitius)
Karaite calendar at Yale
Michaelis
Danjon
von Littnow
Ginzel
Reinach?

On the crucifixion date:
Gerhardt (2)
Dittrich
Schoch

Sidersky

"REVIEW OF ASSYRIOLOGY AND

ORIENTAL ARCHEOLOGY"

"Excedent" = 2, 5
"29 or 30" = 5
"Last moon" = 6
Elongation and
radius of vision
complementary = 9
Elongation of
15° 44' = "invisibile" = 19

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Sidersky does not admit of Jewish origin to Maimonides' method p. 8, 9.

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The Chaldean Calculation of the New Moons

by

D. Sidersky

CHAPTER I

It was the custom of most of the ancient peoples, especially the Semitique~~s~~ peoples, to start their months by the appearance of the new moon on the western horizon soon after the setting of the sun; a custom observed by the Arabs until our days. Thus, the Babylonians always counted the days of the month as from the appearance of the crescent ~~of the~~ moon, which took place either the next day after the astronomical conjunction, or the second day after. Observations over centuries on this phenomenon carefully registered, made it possible for ~~to~~ the Chaldean priests of the three last centuries before our era, to calculate for one or several years in advance, together with the astronomical conjunctions, the dates the new light showed, which formed the beginning of the civil and religious month.

This fact is clearly evident from a great number of astronomical Assyro-Babylonian tables brought to light by Assyriology and studied especially by P.P. Epping, Strassmaier and Kugler. That is why tables covered with cuneiform writing, kept in the British Museum, containing Chaldean calendars of the years 188, 189 and 210 of the Séleucid era published by the two first of these scientists include precise indications for each month as to the date and the duration of the new light.[1] Autre tables mention even the interval of the time which passes between the astronomical conjunction and the official beginning of the

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[1] Note 1, p. 21: See Epping and Strassmaier. "Astronom, from Babylon", (Freiburg i. B. 1889). p. 18-20 and also the paper of Epping in the "Periodical for Assyriology", VI (1891). p. 95, containing the commentary of the table S + 1949, with regard to the new moons (néoménies) of the year 100 of the Séleucid era (212 B. C.)

month determined by the appearance of the lunar crescent, an interval varying between 18 and 56 hours. By the way, let us mention here that in these Assyro-Babylonian tables, the time measure is expressed in degrees of the arc measured on the equator, our 24 hours being divided first, into six even parts each at 4 hours, and each part is then divided into 60 degrees; each degree in its turn, is subdivided into 60 minutes a unit equaling 4 seconds. Albiruni, 68 Hastings, Jew. Cal. 150

The works of the above-mentioned scientists have acquainted us with the very interesting astronomical facts of the Chaldean priests as well as with the remarkable precision of their calculations. P. Kugler has succeeded in discovering the ingenious method used in the observations of Mesopotamia to figure out the lunar syzygies[1], a method combined by a Babylonian astronomer of the 3rd century B. C. named Kidinnu, whom the classical authors mention under the hellenized name de Kidenas or Cidenas[2]. The great table SH 272, containing the calculations of the néoménies of the years 208-210 of the era of the Séleucides, published and explained by P. Kugler[3], and arranged in a series of vertical columns, indicating for each neomenie the longitudes and latitudes of the moon, her angular movement in 24 hours, the éxcedent of the synodic month over 29 days, and the dates of the astronomical conjunctions.

However, this system of reckoning did not restrict itself to the sygygies only; it necessarily led to the new light, indicating the official beginning of the month. Unfortunately the fragmentary state of the deciphered tables until now prevented the completion of this part of the astronomical reckoning of the

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[1] Note 1, p. 22: See Kugler, "The Babylonian Lunar Reckoning", Freiburg, i.Br. 1900).

[2] Note 2, p. 22: See Franz Cumont. How the Greek knew the lunar tables of the Chaldees (Florilegium Melchior de Vogüe, Paris, 1909, p. 159/165.)

[3] Note 3, p. 22: See Kugler, Ibidem, p. 12-13.

Chaldees.[4] But the calculation tables published and partly explained by P. P. Epping and Strassmaier together with the ephemerides mentioned above include several columns of signs which remain unexplained, and which seem to be part of a complex calculation system ending in the dates of the visible new moons.

It seemed to be interesting to take up the study of these Babylonian documents in order to complete the pioneer work of the scientist-publishers, searching there for traces of the method followed by the astronomers of ancient times to determine in advance the Babylonian neomenies.

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[4] Note 4, p. 22: See Kugler, Ibidem, p. 10, the declaration of the author that he did not try to attain the last goal of the Chaldees, that of determining the date of the new light.

CHAPTER II

Let us remember briefly that the three tables of the British Museum published by P. P. Epping and Strassmaier, are not all of the same origin. The tables marked A and C belong to the Shemtob collection; table B is of the Spartoli collection.

Table A.--Table A, the most important part, has seven columns of figures on the new moons of 13 months, beginning with Arah-Samna. This table is part of the big table of syzygies SH 272, explained above, especially the lines 21 to 33, columns F (a), G (b), H (c), I (c_2), K (d), and L (e); this latter indicates the Babylonian dates of the astronomical conjunctions which took place between November 103 and October 102 B. C. This table of syzygies SH 272, deciphered by P. Kugler, is reproduced by us in the annex II of our "Studies on the Assyro-Babylonian Chronology".[1]

Table B.--The syzygies are also given in Table B of which P. Epping could explain only part. This table has several other columns which contain elements of calculation which probably before leading to the Babylonian new moon dates are on the appearance of the lunar crescent. (Phasis)

The information on Table B concerns the months of an unknown Babylonian year, beginning with Nisann and ending with the Nisann of the following year. We are here reproducing this table in the form given it by P. Epping with the small letters indicating the different columns, leaving also the auxiliary columns x, y, v, introduced by this scientist, which we are showing in differnt printed letter to make it easier for the eye. The first tow columns d and e, are of the same kind as K and L of the "Table of Syzygies SH 272"

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[1] Note 1, p. 23: Our "Studies" appeared in the "Memoirs presented by various Scientists to the Academy of Inscriptiones and Sciences". V. XIII (1917), p. 105-198.

indicating, in degrees of time, firstly (d), the time in excess over 29 days of each synodical month; then in column (e), the average conjunctions counted as from midnight. The third column (f) gives these same conjunctions adjusted to the setting or rising of the sun:

SU = before sunset, and

60 $\frac{16\frac{1}{3}}{60}$ $\frac{49}{60}$ 59 $\frac{11}{60}$

MI-DU = after sunset.

MAT = before sunrise, and

LAL-NUM = after sunrise.

Table A has a column (m) similar to this column f. but its defect condition hindered P. Epping to study it.

The fourth column (g) first gives the number of days (29 or 30) of the preceding month and then the time in degrees followed by the ideogram "gur," which P. Epping interprets as representing the interval included between the conjunction and the new light. (perhaps to first ss)

The fifth column (h) gives the degrees of the arc or the time, followed by the ideogram "bat". As these degrees are about twice as high as those of the preceding column, P. Epping at first believed they meant the elongation, i. e. the difference of the lunar longitude from the sun. However, in the course of the investigations of Epping, this scientist learned that the degrees "bat" express other measurements, which no doubt indirectly concern the elongations.

The sixth and last column (l) "Sa lu me" is followed by figures with the words "tab" or "lal" which are known to us from the "Table of Syzygies SH 272", where "tab" means "more" and "lal", "less". This column until now remains completely unexplained.

Table C.--The third part of the calculation tables, Table C, has columns marked "gur" and "bat"; one column giving the names of the 13 months (identical with those of Table A), then indicating the duration of the new moon and finally a column giving information with regard to the last moon of the preceding month. Certain indications, allowed P. Epping to make the statement that this Table C together with Table A make one whole body--Table C prolonging the horizontal ines of Table A. In this hypothesis, the four columns of Table C are included in the unpublished part of the big Table SH 272 explained above and which concerns the years 104-101 B. C.

In the present study we are dealing exclusively with Table B which belongs to a different epoch than that of the two other tables. First of all, we will find out the Babylonian year to which the information on this table refers. Then we shall examine the meaning of the columns with the words "bat" and "Sa lu me", which contain elements of calculation leading to the dates of the neomenes. However, before starting this research, a few words should be said about the astronomical method which allows to attain this goal. Probably this method was followed by the Chaldean priests of the Kidinnu school. In that case, we shall get inspiration from a Jewish document of the XIIth century A. D. made up on the Greco-Arabian basis of astronomy; we shall make use of Maimonides some valuable information from it.

CHAPTER III

We have learned above that the Babylonian system of reckoning the new moons was introduced in the 3rd century B. C. by the Chaldean astronomer Kid-innu. But most of the tables in cuneiform script dealing with this question do not go back farther than the 2nd century.

It was also in the 2nd century B. C. when an analogue system was adopted by the Jews of Jerusalem (i. e. by the Sanhedrin), according to the incontestable testimony of the Arabian-scientist Al-Biruni (Xth century A. D), who states in his work "On the Chronology of Ancient Peoples,"[1] that towards the year 200 of the Seleucid era (112/111 B. C.) the Jews had adopted the chronological reckoning of the conjunctions and the new moons thus displacing the direct observation used exclusively until then. This declaration of Al-Biruni is confirmed by the opinion of several Jewish authors, confirming that the Tribunal appointed by the Sanhedrin of Jerusalem, in hearing the witnesses who had seen the new moon on the evening of the 29th day of the month knew beforehand what position to take, thanks to these astronomical calculations, and that the testimony merely served as a means of control. Cf. p. 27.

Saadia - cf. Hastings, Jew. Cal. 119

Very detailed information on this subject is given by Maimonides, the famous Jewish philosopher of the XIIth century A. D. in his "Treatise on the Consecration of the New Moons" ( ), which is part of his religious codex known by the name of "The Strong Hand". In this treatise where chapters XII to XVII deal with the calculation rules on the visibility of the new moon[2], Maimonides

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[1] Note 1, p. 26: See E. Sachau, "The Chronol. of Ancient Nations," (English edition of Al-Biruni's book, London, 1879, chap. V. p. 68).

[2] Note 2, p. 26: See Karl von Littrow, On the Smalles Visible Phases of the Moon--Reports of the Academy of Scimces, VLXVI, Section II, 1872, who, thanks to M. A. Kurrein gives an excellent German translation of these chapters XII-XVII of Maimonides. We have given an outline in the Appendix B of our "Study on the Astronomical Origin of the Jewish Chronology," inserted in Vo. XII, 2ned part of the "Memoirs Presented by several Scientists to the Academy of Inscriptions and Sciences."

Maimonides states (chap. XI p. 1-3) that in order to establish these rules of calculation, he had at his disposal the traditional documents kept by the Jewish scientists, but he does not give their origin.

"Consecration of the New Moon," ch. 11.

Here are the characteristic passages from Maimonides: (chap. XI):

S1. As stated in the course of this treatise, the tribunal (commissioned to hear the witnesses) knew beforehand through exact calculations, whether the moon will be visible or not. . . .

S2. There are great difference of opinion on these methods of calculation among the scientists of ancient nations who had thoroughly investigated astronomy and mathematics. Great scientists had made erroneous conclusions; certain details had completely escaped them, other points remaimed doubtful to them. . .

S3. At the end of several centuries and thanks to the accumulation of a number of exact observations some of the scientists in the end learned these methods of claculation. On the other hand, we have on this subject traditions passed on by the scientists with demonstrations which have not been published in known works. Because of this, it seems to me of interest to ~~expose~~ set forth the principles of this calculation.

This method of calculation which leads to the dates of the appearance of the ~~lunar~~ moon Maimonides has described in the form of sentences ( ), in all points identical with those of the other parts of his "Codex", without explaining the reasons for the operations indicated and passing over in silence the sources from which he had drawn. The mathematical elements of which he makes use he has borrowed from Greek and Arab authors (Ptolemee, Albategnius, etc.); altogether, well reflects the picture of astronomy of the XIIth century A. D. It is rather difficult to see in these mathematical elements ancient traditions handed down by Jewish scientists and gathered by Maimonides for it concerns a science which has developed considerably in the course of centuries. The ancient principles it could have carefully kept for numerous generations are the rules for the interpretation of the two main results of the calculation: The elongation and the range of vision in order to determine the visibility of the new moon.

As a matter of fact, the elongation expresses the degrees of longitude the moon is away from the sun; the greater the elongation, the brighter the crescent will be, the easier it will be noticeable in the twilight of evening. A weaker elongation will produce an extremely fine crescent, which will not be noticeable before nightfall. The ~~radius~~ arc of vision indicates the negative ~~height~~ depth of the sun below the horizon at the moment the moon is setting, a measure which, for a given horizon, depends solely on the interval of time separating the setting of these two stars. Thus the elongation and the ~~radius~~ arc of vision mutually ~~complete~~ supplement each other. With a minimum elongation a sufficiently great ~~radius~~ arc of vision is necessary, in other words, an advanced twilight so that the first outlines of the new moon become visible to the naked eye; while a stronger elongation makes it possible to see the crescent at a minimum radius of vision. Maimonides made known these minima, as well as the mutual relationship of these two elements; these are the principles established by the astronomers of ancient times and handed down from one generation to the other.

Cf. next page.

When the moon is slow, and has not moved east of the sun very far, then the time between 9s and ms is long, if the moon is to be seen.

As to the origin of these Jewish traditions gathered by Maimonides, this author has omitted to state them; maybe he did not know them himself. However, in examining closely certain details contained in the presentation of this author, it will not be at all difficult to discover there the origin of these traditions.

As a matter of fac,t the elongation called by Maimonides "first length" (   ) is really the difference of the longitudes of the two stars, in conformity with the definition adopted by all schools of astronomy; but this is not the case with the ~~radius~~ arc of vision (   ), an expression of which Maimonides has changed the true meaning, (expressing the depression of the sun at the moment of the new moon's appearance), by attributing to it quite a different meaning: to designate an ~~radius~~ arc of the equator included between two unknown points (a and b), of which the former (a) will have passed the horizon at the same time as the sun, and the latter (b) will not get there in its turn until the moment of the setting of the moon. But the sun and the moon move in in an ecliptic and not in the equator; they do not pass it but twice during the year, at the equinoxes. The ~~radius~~ arc of the equator, improperly called "~~radius~~ arc of vision" by Maimonides, is longer than the perpendicular arc ~~on~~ to the Horizon representing the negative ~~height~~ depression of the sun, the true "arc of vision" of the astronomers. Maimonides' ~~radius~~ arc of vision represents the hypotenuse of a right angle triangle spherical ~~rectangle~~ of which the sun represents one of the sides while the other side blends with the circular line of the horizon. In any case, as the obliquitey of the equator on a given horizon remains constant being even at a right angle diminished by the height of the pole (or the geographical latitude) from the right side, there is a known relationship between Maimonides' arc of the equator and the true ~~radius~~ arc of vision of the astronomers; thus it is possible without inconvenience to substitute the first for the second taking into consideration their mutual relationship. But Maimonides' ~~radius~~ arc of vision measured on the equator between the two points defined above, simply represent the interval of time which elapses between sunset and the setting of the moon, time expressed in degrees of the ~~radius~~ arc with its sexagesimal subdivisions, a system generally used in the Babylonian inscriptions of an astronomical nature, as well as in the column marked "qur" of our Table B, reproduced above.

difference between sunset and moonset

Now Maimonides could have modernized his system, be it by extending his calculation until the ~~radius~~ arc of real vision, designating the depression of the sun under the horizon, or rather by expressing in hours and minutes the interval of time represented in degrees of the equator (1° = 4m; 1' = 4s). But this author has preferred to adhere to their ancient form of tradition which he gathered. These latter, however, bear in themselves the mark of their Chaldean origin, a fact which agrees also with all that is known at present of the essential elements of the Jewish reckoning, as for instance, the average phases of the

<u>the cyclical system of</u> <u>embolismical years.</u>

CHAPTER IV

If it is easy to figure out the elongation of a new moon by determining the longitudes of the sun and the moon, the problem on the contrary, of the ~~radius~~ arc of vision is more complex due to the changing elements of which it depends. There is first the obliquity of the ecliptic on the horizon which varies continually. For instance, in Babylon, when the geographical latitude is 32° (almost identical with the one in Jerusalem), the angle at which the ecliptic cust the horizon reaches 81° 30' at the vernal equinox; it goes down to 55° at the solstices and has but 32° 20' at the autumnal equinox. On the contrary, the obliquity of the equator at this same horizon remains almost unchanged = 58°. As to the angle (e) under which the ecliptic and the equator cross, actually being 22° 27', is not at all fixed, but its value does not alter but little in the course of centuries. In the period of the Chaldean astronomy, this angle was 23° 41'. On the other side the plane of the lunar orbit meets that of the ecliptic at an angle of 5°, so that the moon is not in the ecliptic but at the moment when she passes through one of the two nodes knots of her orbit; in getting farther away from these ~~knots~~ nodes, she deviates from the ecliptic and her latitude raises gradually until the maximum of 5°; this latitude is boreal (+) or australa (-) depending on whether the moon is above or below the ecliptic. The great table of syzygies SH 272 contains indications of this kind (col. e).

These two coordinatives of the ecliptic, longitude and latitude, refer to a plane which passes through the center of the earth. To an observer at a given determined point on the surface of the earth, the star will appear situated lower down towards the horizon due to the parallax and the error produced unnoticeably when it concerns the position of a very distant star, becomes sufficiently stron for the moon whose distance from the earht does not exceed 60 times the earth's radius. The corrections of the longitude and latitude, caused by the parallax, vary with the position of the moon in the ecliptic.

Suppose in the drawing given here VL represents an arc of the ecliptic, and VA an arc of the equator; V being the vernal point from where to start to count the longitudes (on the ecliptic) and the right ascensions (on the equator). Suppose: S = the sun; L = the moon in the ecliptic, or l = the moon in the boreal latitude. The parallax causes the moon to come down at L' (or at l'). The arc SL represents the real elongation (e), while the arc SL' will be the visible elongation (e') which Maimonides calls "second length". The arc Ll represents the real latitude of the moon β (B), which this author names "first width" while the arc L'l' will be the "visible latitude" β' (B') or the "second width".

Suppose, for instance, SE is the horizon at the time of sunset, and LA equals the same horizon at the time of the setting of the moon. The arc EA, on the equator, will give the measure of time which elapses between the setting of these two stars, these two points E and A passing over the horizon at the same time as these latter. This is the arc of vision of Maimonides, to be determined with the aid of spherical trigonometry. Point E is easy to determine by working out the right ascension ~~droite~~ VF and the declension SF of the sun (S), the angle SVF being known (equals 23° 41'); you then determine FE, one of the sides of the spheric triangle right~~rect~~angle SFE of which SF is known and the angle SEF (obliquity of the equator on the horizon) and then one has VE = VF + FE. In the same manner point a of the equator is to be determined which passes the horizon at the same time as L', the moon being in the ecliptic; in this case there is nothing to do but to figure out the right ascension VC and the declension L'C of the point L' on one side and the arc Ca on the other side which added to VC will come to give Va. Finally, you have Va - VE = Ea, the looked for arc ~~radius~~ of vision.

But when the moon is more or less far away from the ecliptic, suppose, for instance, in l', then it is point A which will pass the horizon at the moment of the setting of the moon, and Maimonides' arc of vision then will be EA instead of Ea. In order to find in the same way point A of the equator, it is necessary to know the right ascension and the declension of point 1', which is outside the ecliptic. For this purpose determine first on the ecliptic point G through which passes the circle of the declension of 1', this point G having with 1' (the moon) the common right ascension VD. To find this point G of the ecliptic Maimonides determines the small arc L'G, in fractions of the rectified latitude L'1' (B') β' which varies from the rectified longitude of the moon VL'. According to whether the latitude of the moon is boreal or austral, and also according to whether she is in the raising signs of the Zodiac (X - XII and I - III) or in the descending signs (IV - IX) deduct of or add to the longitude VL' the small arc L'G thus obtaining point G, the knowledge of which is indispensable in order to reach the final solution of the problem given. The arc SG is called "third length" by Maimonides; we are marking it "E").

Knowing point G, its right ascension VD, which is the one of the moon (1') as well as her declension GD, determine in the above indicated manner point B situated on the equator, which will pass the horizon at the same time as point G of the ecliptic. By cutting VE of VB (equals VD - DB) you get the arc EB (E'), which corresponds to the arc SG (E') of the ecliptic. Maimonides calls this arc Eb of the equator "fourth length" which he determines by a faster process having established beforehand, for each sign of the Zodiac where the elongation will come, what has to be added to the arc SG (third length) or what has to be deducted of it in order to get the arc EB (fourth length). Probably the Chaldean priests, inventors of the method of calculation gleaned by Maimonides (and restored by him to the level of the Arab astronomy of the XIIth century), also had determined in advance the coefficients to be applied to the rectified elongation (E') in order to get the corresponding arc (E') on the equator.

It remains now to determine the small arc AB, which is to be added to EB or deducted of it, according to the sign (plus or minus) of the lunar latitude in order to get the arc of vision EA = EB + Ba. Maimonides gives this arc an equal length to two thirds of the latitude, which comes very near to reality. Indeed, the arc AB is parallel and equal to the arc GI, which forms one of the two sides of the small rectangle triangle l'GI whose hypotenuse l'I blends with the line of the horizon l'A. Now, the calculation gives to GI a length noticeable equal to 2/3 of Gl'; and, as the latter often blends with the latitude L'l', the difference never exceeds $1/15^{\circ}$, the estimate of Maimonides in the more justified[1] as it concerns a very small arc, the maximum of the latitude being 5°.

According to the Babylonian manner, the arc EA of the equator expresses the time the moon remains above the horizon after sunset, on the evening marking the beginning of the month. This arc EA, incorectly called "arc of vision" is in direct connection with the true arc of vision EH, which indicates the negative ~~height~~ depression of the sun (S) under the horizon (l'IHA), at the moment of the setting of the new moon (l'). Of the length of this arc EH depends the degree of obscurity of the twilight.

According to Maimonides the new moon does not become visible but with an arc of vision exceeding 9° (equals more than 36 minutes after sunset), and on the condition that the total made up by the addition of this arc to that representing the elongation (EA plus SL) exceeds 22°. Likewise, the new moon will become invisible if the elongation does not exceed 9° in winter and spring, or 10° in summer and in fall. These principles of Babylonian origin make it possible to abridge the astronomical calculation which ends with the mere determination of the longitudes of the two stars in case the difference (the elongation of the moon) has not attained the indicated values no doubt derived from century-old observations. With a sufficient elongation it is also necessary that the arc of vision is sufficiently great so that the total of the two arcs exceeds the indicated minimum. On this point the longitude of the sun (the Zodiac sign) and

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[1]Note 1, p. 31: The trigonometrical formula evaluates the arc AB as follows, according to the degrees of the latitude of the moon (B):

For B equals 5°, AB equals $3^{\circ}\,9'$ ($3^{\circ}\,14'$);
B " 4°, Ab " $2^{\circ}34'$ ($2^{\circ}\,40'$);
B " 3°, AB " $1^{\circ}55'$ (2°);
B " 2°, AB " $1^{\circ}16\frac{1}{3}'$ ($1^{\circ}\,20'$) and
B " 1°, AB " $0^{\circ}38\frac{1}{3}'$ ($40'$).

French

Table

p 32 33

Columns 4-6 on p. 32:

"Hours reckoned from midnight."

Col. 3 & 4, p 33:

"Differences of longitude between the sun and the ~~circle~~ orbit of the lunar ~~declination~~ declination."

Col 6:

"Corrections in order to pass from ε" to ε'''."

moon is positive or negative). This arc supplies the measure of time, the interval between the setting of the sun and that of the moon. When $AV < 9°$, the new moon remains invisible, even with a very great elongation, as is seen in the case of $\overline{\text{VIII}}$ bis.

French

(p 33

In order to find on the equator the arc which corresponds to a given elongation, it is necessary to ~~bring~~ make to this latter the corrections here indicated, worked out for $\varphi = 32°31'$ (the height of the pole at Babylon), and $\varepsilon = 23°41'$ (the obliquity of the ecliptic in 133/122 B.C.). To the right of the modern values we are giving the Babylonian which result from columns "bat" and "Sa lu me". //

The arc of vision (Av) mesured at the equator is equal to $\varepsilon''' \pm 2/3\,\beta$ (according to whether the latitude of the

the latitude of the moon (making it possible to know the length and the sign of the small arc AB) furnish valuable preliminary indications which sometimes make every ulterior calculation superfluous.

CHAPTER V

In order to improve the mechanism of calculation contained in our Table B, following the method of Maimonides it is first of all necessary to fix the year in which the indicated new moons refer. Without knowing exactly the year in question one can, strictly speaking, find approximately the longitudes of the sun taking into consideration the fact that the new moon of Nisann closely follows the vernal equinox. But you will remain in complete ignorance of the coordinates of the moon which are independent of the tropical seasons. No doubt it is this ignorance of the year of Table B which has prevented P. Epping to pursue to the end his investigations with regard to the columns marked "bat" and "Sa lu me".

From our part, we have made numerous "tatonnements" to discover the year of Table B first of all making use of the valuable indication of a second Adaru (Adaru arku), which there characterises the date of the first new moon, i. e. that the year searched cannot be but the 1st, 4th, 7th, 9th, 12th or 15th of a ennea-decaeteride cycle, of which the system of intercalation of the 13th month is well known today. Considering, on the other hand, that Kidinnu, the Chaldean astronomer, to whom the method of calculating the syzygies is attributed, flourished in the 3rd century B. C. and that the astronomical Assyro-Babylonian tables become very rare since the beginning of our era, the research field narrows down greatly. Well, we are in possession of the complete list of the new moons of the last centuries B. C. calculated for the Greenwich Meridian with the hours reckoned from midnight according to the custom of modern astronomers. After having brought down to the same conditions the Babylonian new moons of our Table B figured out for the Babylonian meridian (or the one for Borsippa) with the hours counting as from midnight, we have compared them with the new moons of the different years preceded by a second Adaru, set aside in the tables of Ginzel (Handbook of Chronology, Vol. I, 1906, and Vol. II, 1911) in order to retain those which offer a concord followed through the whole list. Well, this concord does not exist but for the year 179 of the Seleucidean era (133/132 B. C.) as it is easy to realise from the columns making up the first part of the table on the opposite page. There can be no question of an absolute concord; but the differences there are sufficiently weak, inferior even to those found by P. Kugler for the syzygies of the great table SH 272. By adding to the Babylonian syzygies of our Table B the hours and minutes deducted from the column marked "gur", we got the hours of sunset on the dates of the appearance of the new moon; the lengths of the days are in perfect harmony with the longitudes of the sun (L).

To get as close as possible to the Chaldean astronomy, we have made use of the indications of Ptolemee for the calculation of the longitudes, the anomalies, the latitudes and the parallaxes (Almageste, III, 2, 3; IV, 3, 9; V, 7 and VI, 2). It is with the ancient prostaphereses and not with the modern astronomical elements that we established successively for the indicated new moons the degrees of the longitude of the sun (L), the elongation of the moon (E) her latitude (B), the same elements corrected by the parallaxes (E' and B'), the elongation of the point of the passage of the declination (E') and the same corrected by the evection (E' ev). These values of E' blend with those marked "bat" in Table B; but to us it seems difficult to deduct therefrom the knowledge of the evection with the Babylonians, the deviations between E'', E''ev and bat being very weak and not always in the same sense. What is sure is the fact that the expression "bat" refers to the arc SG of our figure, the arc which represents the "third length" of Maimonides and which we designate as the rectified elongation (e'').

Now we have to find on the equator the arc corresponding to EB of which the two extreme points pass the equator at the same time as the points S and G of the ecliptic. For this purpose it is necessary either to add to, or take from, the arc SG, the values indicated in column C of our table in order to find the values of the arc EB looked for (E'''), the "fourth length" of Maimonides.

Our corrections (C) are sometimes positive, sometimes negative, according to the sign of the Zodiak in which the arc corresponding to "bat" is found. Now, the Babylonian indications marked "Sa lu me" which also are positive (tab) or negative (lal) follow the same as our indications in (C). In restoring these latter Babylonian ciphers to the unity of the value "bat", the following coefficients are obtained by the side of which we place those arrived at by spherical trigonometry which have served us as basis for calculating the values of (C).

The differences between the Babylonian and modern values are not negligeable. Probably they are only seeming differences; that in reality the Babylonians have resolved their coefficients in two series, of which "Sa lu me" is the first, analogous to columns H and J of table SH 272. Unfortunately we are lacking the elements to support this hypothesis.

Knowing the values of E''', we have calculated those of the arc of vision (AV), which is the arc EA of our figure. In the last part of our picture, we have indicated the values of the Babylonian E''', those obtained by rectifying the values of "bat" by those of "Sa lu me". To this we have added the Babylonian values of AV, and, in the last column, the values (D) indicating the sinking of the sun below the horizon.

It will be noticed that the arc of vision (AB) everywhere exceeds 9°, and that the total of this arc and the elongation exceeds 22°, in conformity to the indications of Maimonides.

For the VIIIth series (new moon of the 6th November, 133 B. C.), Table B indicates an interval (gur) of about 56 hours between the conjunction and the appearance of the new moon on the evening of the 30th day of Tisritu, while the before (32 hours after the conjunction), the crescent was still invisible, in spite of her elongation of 15° 44'. Because then the arc of vision was insufficient: 7° 51', according to the modern calculation, or 8° 20', according to the modern calculation based on the coefficients deduced from "Sa lu me". The horizontal line placed at the bottom of our picture and marked "VIII bis (24 hours earlier)" will give the astronomical elements justifying the invisibility of the new moon. It clearly shows that the rules of Maimonides fixing the extreme limits of the visiblity of the crescent were perfectly known to the Chaldean astronomers who used this knowledge in their calculation of the new moons.

Summary and Conclusions

1. The Chaldean astronomers of the IIIrd and IInd centuries B. C. had established a method of calculating the new moons based on the lower limits of the elongation and of the arc of vision of the moon and on their mutual relationship, conditions of visibility derived from century-old observations. #

2. The appearance of the new moon, at the latitude of Babylon, was possible only with an elongation exceeding 9° in winter and spring, and 10° in summer and fall, provided that the degrees of this arc plus those of the arc of vision exceed 22°. Likewise it was necessary that the arc of vision exceeds 9°, and that it is supplemented beyond 22° by the elongation in order to assure the visibility of the crescent under favorable atmospheric conditions.

3. The method of calculation and the rules of the visibility of the crescent described by Maimonides in presenting them as traditions handed down by the Jewish scientist, are of Chaldean origin.

4. An astronomical table without date belonging to the Spartoli collection of the British Museum, published 1889 by P. Epping, contains the calculations of the syzygies and of the new moons which refer to the years 133/132 B. C. and from these calculations have emerged some elements of the Babylonian method with its fundamental rules determining the conditions of the visibility of the new moon.

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pp 98-100:

THE ORIGIN OF THE LUNAR CYCLE

and the Order of the Embolismic Years of the Jewish Calendar.

In the lunar cycle of 19 years which is the basis of the Jewish calendar, the embolismic are intercalary in the following order: 3, 6, 8, 11, 14, 17, 19, the order designated in Hebrew as follows: . Modern authors agree that the institution of this lunar cycle was inspired by an identical cycle of Meton (Vth century BC.), though the order of intercalation adopted by the astronomer of Athens is not the same. As a matter of fact in the Meton cycle the embolismic years are: 3, 5, 8, 11, 14, 16, 17, in Hebrew writing:

In his "Note on the Talmud" calendar (Bible of S. Cahen, III, Levite, p.170-193), Terquem states this difference without explaining it. Schwarz in his work "The Jewish Calendar" (Breslau, 1872, p.76) explains this difference as an improvement with the aim to realize (make real) towards the middle of the century the concord (harmony) of the solar and lunar years. The theory of this author amounts to this : The cycle of Meton is based on the fact that 235 synodic months make 19 tropic years; consequently, the lunar year is shorter than the solar year by 7/19th of a month and at the end of the 8th year the lateness reaches 18/19th of a month; Now, as the first Moled precedes the first Tekufa by several hours, the year is made embolismic while at the end of the 5th and the 16th year respectively, the difference attains (reaches) not more than 16/19 and 17/19 months; consequently, the intercalation of a third month did not take place.

To support his thesis Schwarz quotes a formula invented by Creizenach (Annales, 1840, p.131) making it possible to know whether the year of a cycle is embolismic or not. The year is embolismic when one of the numerical values included in $(7n + 1)$ and $(7n - 6)$ is divisible by 19 and the quotient simultaneously indicates the number of embolismic years as from the beginning of the cycle.

Slonimsky in his book "Yessode Haibour" (3rd edition, Warsaw, 1888, p.35) quotes the passage of Pirke d.R. Eliezer with regard to the lunar cycle stating that there is mentioned instead of the usual customary order . From this he concluded that the establishment of the Jewish calendar in its definite form is of a later date than this work.

Some more ancient authors constructed still less tenable theories with regard to the order and there is no space to reproduce them here. As for the rest, the origin of the order adopted is shown by Theodore Reinach in his article "On the Calendar of the Greek of Babylonia" (Revue, Vol. XVIII, p. 90-94) by means of several ancient inscriptions in accordance with the system .

This system does not agree with the order wriginally indicated by Meton which is precisely the one mentioned by "Pirke de R. Eliezer" making the years 5 and 16 embolismic instead of 6 and 17 of the cycle. Well, this is rather logical in as much as the difference with the solar years at the end of the 5th year attains (61 months) - 24 days, 21 hours, 227 ch. and the end of the 16th year, (197 months) - 26 days, 11 hours, 379 ch. or almost a whole month. If a thirteenth month is inserted, the month of Nissan of the 5th year will begin 4 days, 15 hours, 566 ch. and the one of the 16th year - 3 days, 1 hour, 414 ch. after the equinox of the spring, and Passah will be celebrated in the month of Abib in accordance with tradition.

We are of the opinion that the form came after the Jewish calendar was established and that in the beginning the order as indicated by Meton was in use which corresponds to the formula mentioned in "Pirke de R. Eliezer".

As a matter of fact, the date when the Athenian astronomer began his lunar cycle was June 28 (- 13 Scirrophorion) of the year 432 B.C. at noon, (exactly at the moment of) the summer solstice.

Now, the year 432 B.C. (4281 of the Julian period) corresponds the year 3328 since creation. It is the 3rd year of the 176 lunar cycle reckoned from creation. It was when establishing the era of creation long after the establishment of the calendar, that the primitive formula was modified by changing it into beginning the cycle with the 17th year of the one of Meton, i.e. by adding to Meton's cycle three years in order to get as the origin of the system the first year of creation. The dates of the Greek inscriptions mentioned by M. Th. Reinach (l.c.) agree just as well with the formula of as with the one of Pirke de R. Eliezer. Thus the origin of the formula is the era of creation taken as the starting point by applying Meton's system with his order of intercalation of embolismic years which agree with those of the calendar of the Greek of Babylonia.

Neither nor the era of creation are found in the Talmud literature; they are of more recent date.

D. Sidersky.

TRANSLATION

Oswald Gerhardt: "Das Datum der Kreuzigung Jesu Christi"
The Date of the Crucifixion of Jesus Christ 84 p

Berlin 1914, Verlag Wiegandt & Grieben (Erich Donati)

Library of Congress: BT 450. G4.

pp. 74-80: Conclusions

A. To begin with let us examine the dates of the month giving the day of the crucifixion partly according to ancient Christian tradition and partly according to scientific calculation.

a) Epiphanius has handed down to us the following dates of the Passion-week (see Merx p.378): On Tuesday March 17 the Lord took the Passover supper, "two days earlier than it should have been eaten"; Thursday, March 19, "it was proper" to eat the Passover for it was the 14th; Friday, March 20, He suffered the death on the cross. - Is there a week to be found in March in the years 27-36 when those dates coincided with the days of the week given? Once it actually happened, and that was in the year 33 (see above). This week, however, lay completely outside the Passover, even outside of Nisan which began only on Saturday, March 21. Hence the tradition of Epiphanius is of no value. In case it is of the same origin as the statement quoted above from the Syrian Didascalia, then in this respect the same judgment applies to the latter.

b) March 23 (Idatius, Annianus, Eusebius, Chronicon paschale) is supposed to have been the day of crucifixion in the year 34; in this year, however, March 23 was on a Tuesday, consequently those authors were mistaken. March 23 fell on a Friday in the years 31 and 36; but there it was 3-4 days, and here 8-9 days before the Passover. So this date is out.

c) March 25 in the consular year of Gemini, i.e. 28 or 29 (Acta Pilati, Tertullian, Lactanz, Hippolyt, Augustin and others), was in the year

e) 28 on a Thursday, in the year 29, however, on a Friday but completely outside the Passover. These two dates (March 23 and 25) have no chronological but merely symbolical significance. The first week of spring was considered the week of the creation of the world; the incarnation of the word of God, with which the new creation began was supposed to have taken place the same week - hence the birth of Christ on December 25. The closing of his humanity (crucifixion) and the beginning of the new life (resurrection) again was supposed to have come in the same week (March 25 and 27). The incarnation, i.e. the conception in the womb of the virgin Mary and the death were given the same date. The most ancient witness for this seems to be Clemens Al.; it is reprinted below. Augustin says (de Trinit. 1, IV, c.5) "octavo Calendas Aprilis (= March 25) conceptus creditur Christus quo et passus. Natus traditur octavo Calendas Januarias" (= Dec. 25). Compare Ideler II, 279 and on, 328 on, 420 and on.

d) April 3, 33; see above on the year 33.

e) April 6; it was a Friday in the year 31 and 36, but both times outside the Passover.

f) April 7; see above on the year 30 and also here below.

g) April 15; (Keim, Bunsen, Hitzig, Ideler); it was a Friday in the years 29 and 35; in the latter case it was the third or fourth day of the Passover, in the former it was before the Passover; so it is out.

h) April 23 (H. Sevin). It was a Friday in the years 28 and 34. In the latter only, one could think of a connection with the crucifixion, for this Friday (see the Calendarium above) actually was part of the Passover. But the year 34 cannot come into consideration because it is too late.

i) April 26 (Paulus) and April 27 (Anger). See above under year 31 and her at the end.

B. Those years of Pontius Pilate's administration when the days of the 14th and 15th Nisan do not come on a Thursday and Friday but on Monday, Tuesday, Wednesday, Saturday and Sunday, are completely out. Those are the years 29, 32, 36 and 3/ strictly speaking, also 35 (see above). Consequently there remain merely the years 27, 28, 30, 31, 33 and 34 for consideration.

Since the public ministry of Jesus began at the earliest in the winter of 27/28, at the latest in winter 28/29 and lasted $2\frac{1}{4}$ - $3\frac{1}{2}$ years, therefore the years 27 and 28 as well as 33 and 34 are out and we face the last decision: either the crucifixion was in the year 30 (Friday, April 7) or in the year 31 (Friday, April 27).

1. If the feast had fallen so that the Passover supper took place on the day of the full moon, then the year 31 would have to be eliminated, because here the day of the full moon was a Wednesday: according to one interpretation of the gospels it would mean Thursday, according to the other, Wednesday as the day of the death; yet both cannot be correct, for tradition agrees in that the crucifixion was on a Friday. On the contrary, in the year 30 the full moon was on a Thursday, hence on this day was the Passover supper of the Lord and the crucifixion on Friday.

2. Should the report of the gospels be so understood that the Lord held his Passah supper on the day b e f o r e the legal date, that he died on the day when all the people were offering their Passah lamb, that t h i s day, i.e. the 14. Nisan - was a Friday, then crucifixion could have been on none but Friday, April 7, 30. Because in 31 the 14. Nisan came either on Wednesday, April 25, or on Thursday, April 26, but n o t on a Friday. Yet it is shown above that in

harmony with all calendar rules of the Mischna the 14 Nisan could very well have been a Friday in the year 30.

3. Now the 14. Nisan did not necessarily coincide with the day of the full moon but depended exclusively on the sanctification of the first Nisan after sighting the new light;

if the Lord - what to my mind is proved for certain - held the Passah supper on the legal day, the 14. Nisan,

if this was a Thursday and the 15. Nisan a Friday, then there are according to the calendar two possibilities for the days of the passion: either Thursday, the 14. Nisan = April 6 and Friday, the 15 = April 7, 30, or Thursday, the 14. Nisan = April 26, and Friday, the 15. = April 27, 31.

Friday, April 7, 30 in every case is in harmony with the reports of the gospels, whether the legal Passah supper of the 14.Nisan came on the Thursday or on the Friday.

The general chronology of the life of Christ does not entirely solve these difficulties, for, as shown above (p.7), the year 31 as the year of the death is not altogether out. True, the most ancient date we have on this offers support not to be belittled for the year 30 as the year of the death. It comes from the gnostics of Egypt and is received through Clemens Alexandrinus. The place in question in the reads:

("Those who have made thorough investigation set his suffering in the year of the emperor Tiberius, e.i. some on 25. Phamenoth, others on 25. Pharmuthi; others say that the Saviour died the 19. Pharmuthi. Some among them say also he was conceived Pharmuthi 25.")

The 16. year of Tiberius ran from August 29, 29 until then in 30. E.Preuschen deserves credit for having rightly understood and calculated (Period. f. N.T. Science 1909, p. 1 and on) the three dates of the month given by Clemens. *)

[Note, p. 77: My calculations on this date are based on Ideler, Brandes, Mitteis and Wilcken.)

At the time when the Egyptian calendar was revised (reformed?) by Augustus, the 1. Thoth (New year's day) was set on August 29; the Phamenoth began Febr. 25, Pharmuthi, March 27 *)

[Note, p.78: Ideler I, 14 3; Mitteis and Wilcken, Vol.1.]

According to this Phamenoth 25 - indicated by some as the day of death - would be March 21; in the year 30 this was a Tuesday quite outside the Passah (see above). The two other dates would be: 19. Pharmuthi = April 14 (Friday), 25 Pharmuthi = April 20 (Thursday); this Friday, however, in the year 30 came one week after the Passah. Accordingly, all three dates would be valueless. Now by the side of the fixed solar year introduced by Augustus there still was the shifting (movable) year of the ancient Egyptian calendar. ~~Multiple~~ Numerous proofs for this are produced supplied by Ideler I, 124, based on Censorinus (de die natali) and on double inscriptions; H. Brandeis, too shows very clearly arranged the progressive shifting of the Egyptian wandering year as compared with the corresponding Julian year; **)

[Note 2, page 78: In his "Dissertations" (treatises?) p. 123 and on "On the Egyptian Apokatastases Years".];

his tables furthermore show how those two methods of reckoning corresponded to each other. - According to the fixed year of the Egyptian calendar in the year 30 the 1. Tjoth (= Aug. 29) coincided with the 14 Thoth of the wandering year; accordingly the 1. Thoth of the latter would be the 16. August. On that supposition the calculation of those three dates is made easy for us by Ideler (I p.97 and on) through (thanks to?) the calendarium. The order of the months was as follows: Thoth, Paophi, Athyr, Choiak, Tybi, Mechir, Phamenoth, Pharmuthi, Pachon, Payni, Epiphi, Mesori each at 30 days, besides there were 5 additional days. So it happens that 1. Pharmuthi was March 14; 19 Pharmuthi April 1 (Saturday); 25 Pharmuthi April 7 (Friday) 25 Phamenoth - March 8 (Wednesday).

Though it is to be greatly regretted that Clemens did not express himself ***)

[Note ***, p. 78: Preuschen pleads for the rather interesting assumption that that gnostic calendar had the double dates; if so, naturally the 19. Pharmuthi (April 1) must have been marked "Cal.-Apr.". "Due to some misunderstanding this date now seems to have been brought in connection also with the suffering of Christ." From inscriptions we learn that such double dates actually were being entered; see Ideler and Brandeis.]

on the three dates of which, after all, only one can be correct, still his tradition is of great significance: About the middle of the 2nd century among the Egyptian gnostics there were men who on the basis (based on?) of exact investigation (research) - - knew Friday, April 7,30 as the day of the crucifixion.

The Montanists adhered to (kept?) this day by celebrating on it the Passover regardless of the day of the week *)

[Note *), p. 79: see Preuschen in the "Real-Enzyklopädie Vol. 14, p.730.]

Whether they had borrowed this date from gnostic circles or came by it some other way, we do not know. So that date (dating?) was known elsewhere too; by comparing it with the second oldest date of the crucifixion it gains special value (becomes especially valuable?): it is supposed to have taken place under the consulate of the brothers Gemini in the 15th year of Tiberius. If the dating of the crucifixion did spread from Egypt then the year in question was reckoned according to (after?) the new year's day; that was Aug. 16, 29. The consuls in office at that time were R. and F. Gemini, and it was named the year of the Gemini brothers. By not heeding abroad the difference between the Egyptian and Roman calendars and overlooking that the consulate of the two brothers had expired January 1, the opinion (assumption?) originated that the Passah of the crucifixion, too, came in the consular year 15 of Tiberius. But t h o s e men, who searched carefully - the - learned correctly that it was the 16th year of Tiberius.

Whether these conjectures hit the mark remains uncertain. It has been proved for certain that, aside from April 7, 30, all dates which have come down to us from the chruch fathers according to the calendar of the years 27-36 are completely invalid. We are no more surprised at that because we have seen that they were led by aspects of dogma - probably also by viewpoints of cults - surrounding the days of Passion with noble symbols. As this dogmatic symbolism refers merely to the dates but not to the matter itself, nor to the person of Jesus Christ, we have earnestly pursued the historical interest being led as duty bound by reliable factors: Reliable are the moon as the basis of the Jewish month in those days; the law which fixed Passah to the 14. Nisan, and the gospel which names Friday of a Passover under the governorship of Pontius Pilate as the day of the Lor's death.
According to these inviolable facts we have, it is true, found two dates; but even so, it is clearly proved that all other are erroneous and that either Friday, April 7, 30, or Friday, April 27, 31 must prove correct.

Hebrew form of year corresponded to tribe = 17
Successive names of days of lunar month = "
Hazebriah = 19
Calculations in advance = 23
great anxiety to secure unity by observing
same date festivals = 23
Have all fought calendar = 24
Festivals on different days = 24

STUDY ON THE ASTRONOMICAL ORIGIN OF THE JEWISH CHRONOLOGY

Introduction

Among the first astronomical manifestations of ancient nations, an important place is occupied by the different systems of chronology, based on the periodical rotations of the stars, the first observations of which go back into the most ancient times.

The oldest form of a regular time period was, no doubt, the lunar month, beginning with the first appearance of the new moon after a short period of invisibility. The astral religions of ancient times, and above all, the worship of the moon which had her main focus (hearth-stone) in Chaldea, have especially contributed to the observation of the various phases of the moon. The lunar year was no doubt the result of the rudimentary observations of the return of the seasons at the end of twelve lunations. But, the precise form of the solar year was established later in Egypt by the heliacal rising of Sirius, and its coinciding with the rising of the Nile; a phenomenon of chief importance for the fertility of the Egyptian soil. The arithmetical division of the solar year in twelve months of 30 and 31 days substituted for the lunar months, is of a later period ~~since the particular denominations of the successive days of the lunar month are found in the hieroglyhical inscriptions~~[1].

The form of the luni-solar year, which regulates the months after the course of the moon and the whole of the year after the course of the sun, though of less ancient origin, was known in China as early as the 20th century B.C. It was used among the tribes of western Asia; by the Babylonians, the Greek, and the Hebrew. It is very likely that this system was formed only after it was found out that synodic rotation of the moon took place on an

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[1]Note 1, p. 596: See Ed. Mahler, Études sur le calendrier Égyptien (Annales du Musée Guimet, t. XXIV) Paris, 1907. p. 4-6.

average in 29½ days, and that the solar year was 364 or 365 days, or 10 or 11 days in excess of the period of the 12 lunations. At the end of 3 years, the difference amounted to one month, and the beginning of the solar year, marked by the return of a (cardinal) chief phase--equinox or solstice--coincided with the new moon.

For a very long time, the ancient peoples observed regularly on the evening of the 29th or 30th day of the month, the appearance of a very fine, luminous crescent in the sky which marked the beginning of a new month, and became, often, the object of religious ceremonies, the origin of which probably was worship of the stars. These observations were continued even long after the knowledge of astronomy made it possible to them to figure out in advance the date of the new moon. The methods of observation and the astronomical calculations were both improved until the latter were substituted entirely for the first. In the Babylonian astronomical ephemeris, dated the IV and III century B.D. deciphered by Strassmaier and published by Epping and Kugler[1], are found the results of the calculations for the visibility of the moon and the conjunctions. With the Jews, these calculations were in use since the II century B.C., until the end of the II century A.D., according to the testimony of several ancient authors. But it is possible, that these calculations go back much farther.

The computation of the Jews defined by Scaliger as being "the most ingenious and most elegant of all systems of chronology" (Joseph Scaliger, "De Emendatione Temporum", Lutetiae, MDLXXXIII, p. 194), in present form goes back to the IV century A.D. It comes more or less directly from the ancient system based on the direct observation of the new moon on the astronomical calculation of the visibility, combined with the observation (or the cyclic calculation) of the vernal equinox, of which traces are found in the Rabbini-

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[1]Note 1, p. 597: See Kugler, "Die Babylonische Mondrechnung", Freiberg, 1900.

cal literature. But, it is not easy to follow the successive transformations the ancient system had to undergo in order to put on finally the definitive form conserved until our days, and the numberous papers ex professo on the modern Jewish computation explaining its wheel-work in all details are reserved in information on the historical question. This question, however, is especially interesting because the formation and development of this system of chronology are the results of the progress of ancient astronomy. Thus the origin of the Jewish computation forms a very interesting chapter in the history of the first applications of astronomy.

It is from this point of view that we have undertaken this study, searching in the ancient texts[1], and in the concord of certain historical facts, the verification of some hypothesis which we have formulated[2].

In the literature of that period, we have found sufficient facts in order to reconstruct synthetically the ancient Jewish calendar during the 1st century of our era, and this restoration led us to the origin of the ennea-deca-eteride cycle which is the base of the modern computation. It was the same with the value of the synodic month, the origin of which, we shall discuss. But, the fact which seemed to us most interesting to know, the one the authors have left completely in the dark, is the physical instant which served as starting-point for the modern Jewish computation--an instant doubtless determined by an astronomical observation. This starting-point is the key stone of the whole system

[1]Note 1, p. 598: We have studied the original texts of the ancient texts; the published translations could not always be utilized.

[2]Note 2, p. 598: The confusion between the modern Jewish computation and the calendar system which preceded it, a confusion which you still meet sufficiently often in the professional literation, has recently led a Greek author to doubt the authenticity of the "Papyri araméens d'Elephantine", published by M,M. Sayce and Cowly (London, 1900). M. L. Belleli, after examining the double Semitic and Egyptian dates in these valuable documents and finding them not in agreement with the modern Jewish computation, drew from this, the very simple conclusion that these documents are not authentic--completely forgetting that in the V century B.C., the modern Jewish computation was not yet invented. We mention here the erroneous opinion of this author; the unsoundness of which, M. J.-B. Chabot (Journal asiatique, novembre-décembre, 1909, p. 315) has proven.

since its exact knowledge indicates, with the date of the observation, the meridian to which it is related.

In formulating the hypothesis that the starting-point of the computation should be an eclipse of the sun, visible in western Asia, say a true astronomical conjunction established for sure, we endeavored to determine with the aid of certain publications of an authority above reproach, the initial date of the system, and its concord with the historical facts of that period.

We have been led to study this question following another work of a more practical than scientific character to be published elsewhere. It is a special system of conversion tables of Jewish, Julian, and Gregorian dates for the use of chronologists and for rapid verification of historical dates, which we have worked out with the help of a method we shall expose further down. When writing the introduction for said work, we became aware of the complete absence of information with regard to the origin of the Jewish computation, the mechanism of which, however, is explained in a rather detailed way in works going back as far as the X century A.D. This strange fact caused us to engage in original research work, the result of which is this present memorial.

To facilitate the presentation of this somewhat arid paper, the results of our researches are preceded by a brief explanation on the functioning of the modern Jewish computation known only to the initiated. We shall make use of some conventional formulas easy to remember, and we shall appendix it with two small charts destined to facilitate all calculations. We shall then present our special researches in their natural order referring to the appendix for the proofs. The first annex is made up of excerpts of Rabbinical literature, the Hebrew, Aramean texts of which, followed by the french translation, have explanatory notes. In the second annex, we give a summary of the method described by Maimonides (XII century) for the astronomical calculation of the visibility of the moon. In the third annex, we reproduce a passage of Al-Biruni (X century) according to the English edition of Sachau. In the fourth annex, we present the principle of our methods for the conversion of Jewish, Julian and Gregorian dates, and the fifth annex represents a general bibliography of works in manuscript form, and printed dealing with the Jewish computation in order to facilitate research work for scholars to whom the question might be of interest.

600

Chapter I

Mechanism of the Modern Jewish Computation

1. The modern Jewish calendar includes a series of fixed regulations as well as a somewhat original method of computation which we shall briefly describe in order to facilitate the discussion before we start on our particular researches.

The Jewish year, being luni-solar, the months have 29 and 30 days, and the year which begins in autumn is made up of the twelve following months: Tishri (30 days), Marheschvan or Heschvan (29 or 30 days), Kislev (29 or 30 days), Tébeth (29 days), Schebath (30 days), Adar (29 days), Nissan (30 days), Iyar (29 days), Sivan (30 days), Tamuz (29 days), Ab (30 days), Elul (29 days). In the embolismic year, a thriteenth month was inserted between Adar and Nissan, and it received the name of Adar II or Veadar (29 days) while the one preceding it is named Adar I (30 days). Thus, 30 days are added, increasing by one day the preceding month, and giving the intercalary month a length of 29 days. It will be more exact to say that the thirteenth month has 30 days and that it is inserted between Schebat and Adar. This latter then becomes Adar II or Veadar. Thus, it will be avoided to vary its length unnecessarily. As the six summer months have 30 and 29 days alternately, there is nothing against starting the year with Nissan, putting new year's day 177 days ahead, the fixed interval between 1st Nissan and the 1st Tishri.

A cycle of 19 years or 235 months makes it possible to harmonize the respective courses of the sun and the moon, and the 7 embolismic years in the cycle come in the following order: 3, 6, 8, 11, 14, 17 and 19. While the ordinary years are: 1, 2, 4, 5, 7, 9, 10, 12, 13, 15, 16, and 18.

The civil day is counted as from the equinox sunset, thus preceding our civil day which is counted as from midnight by 6 hours, or by 18 hours the astronomical day which starts at midday. The hour is divided in 1, 080 scruples, the unit of which is equal to 31/3 seconds=1/18 of a minute. The years--common as well as leap years--are of variable length: 353, 354 and 355 days for the common year and 383, 384 and 385 days for the embolismic year. Thus every kind of year is of three different lengths signified in the following manner:

The regular common year has 354 days and its months alternate plain (30) and short (29). The regular leap year (R) has 30 days more, or 384 days. The ordinary abundant (p) has one day more than the common year, or 355 days, and the abundant leap year (P) has 385 days; in both, the extra day is added to the month Marheschvan which counts 30 days instead of 29 days. Finally, the deficient common year (m) is one day short, or 353 days, and the deficient leap year (M) is 383 days; the lacking day is taken off the month Kislev which counts but 29 instead of 30. We have adopted convenient signs, easy to remember, to designate the different lengths of the year: r and R for the regular years, p and P for the abundant years, having one day in excess, and m and M for the short years being one day short. The small letters stand for the common years, while the capital letters stand for the leap years.

In the following table, the distribution of the days in the different forms of the year is given:

Months	Common Years			Leap Years		
	m	r	p	M	R	P
Tischeri	30	30	30	30	30	30
Marheschvan.	29	29	30	29	29	30
Kislev	29	30	30	29	30	30
Tébeth	29	29	29	29	29	29
Schebath	30	30	30	30	30	30
Adar	29	29	29	30	30	30
Véadar (Adar II)				29	29	29
Nissan	30	30	30	30	30	30
Iyar	29	29	29	29	29	29
Sivan.	30	30	30	30	30	30
Tamouz	29	29	29	29	29	29
Ab	30	30	30	30	30	30
Eloul.	29	29	29	29	29	29
Total Days. .	353	354	355	383	384	385

2. 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. The calculation of the lunations is based on the average length of the synodic month, figured at 29 days, 12 hours, 793 scruples (29d. 12h. 44m. 3s. 1/3). The era mundi (era of creation) is taken as the starting point, the first mean conjunction of which is fixed at Sunday, October 6 of the proleptic year 3761 (or 953rd of the Julian period) at 11h. 11m. 20s. of the evening, or according to the Jewish computation to Monday, (Oct. 7), 5h. 204 scruples. The instant thus defined represents the "initial Moled"[1]. (i. e. the average conjunction of Tishri of the first year in the first cycle of the Jewish era since creation.) To find the Moled Tishri of a given year of this era, it is necessary first to divide this date by 19 in order to find through the quotient, the number of full cycles elapsed since the beginning of the era, and to know from the reaminder of the division, the rank of the given year in the started cycle, a division without a remainder giving the last year of the cycle. Knowing that each full cycle contains 235 lunations, that the years of the cycle in its course each represents 12 lunations plus one lunation for a leap year, it is easy for us to find the total number of lunations since the beginning of the era until the beginning of the given year. By multiplying the number of lunations by 29 days, 12 hours, 793 scruples, in transforming further the scruples into hours, the hours into days, and the days into weeks, and by adding to it the value of expressing the initial Moled, or Monday 5h. 204 scr., leaving then off, the figure representing complete weeks, you finally get to know the weekday (reckoned as from Sunday), hours and scruples defining the instant of the looked for Moled.

3. In order to simplify these calculations, and to render them more prac-

[1]Note 1, p. 603: The Hebrew word Moled meaning "birth" designates the mean conjunction and not the physical appearance of the new moon, as Ideler has stated erroneously.

tical, a special method has been adopted based on the principle of eliminating whole weeks. The length of one lunation being 29 days, 12 hours, 793 scruples, 28 days have been cut off, or 4 whole weeks, retaining only the remainder=1 day, 12 hours, 793 scruples, called the <u>monthly remainder</u>. Multiplying this by 12, you get, after eliminating whole weeks, the annual remainder of 4 days, 8 hours, 876 scruples, or multiplying it by 13--the remainder of a leap year. i. e. 5 days, 21h., 589 scruples. The multiplication of the monthly remainder by 235 leads to the cyclic remainder which amounts to 2 days, 15 hours, 595 scruples.

The practical advantage of this system of remainder will be easily understood. Let us say, for example, we have to determine the moment of the first lunation. i. e. the Moled Tishri of the Jewish year 5670 (1909-1910). Dividing 5670 by 19, we get the quotient 298, leaving 8; the given year will therefore be the 8th of 299th cycle of the creation era. Our mathematical operation at first includes the multiplication of the cyclic remainder (2d. 16h. 595 scr.) by 298 which leaves after eliminating whole (weeks) years, a remainder of 3d. 12h. 190 scr. Adding to it the value of the initial Moled, we get: (3d. 12h. 190 scr.) +(2d. 5h. 204 scr.)=5d. 17h. 394 scr., defining the first Moled of the current cycle (the 299th). The given year being the 8th of the cycle, 7 years have passed, 5 of which ordinary years (1, 2, 4, 5 and 7), and two leap years (3 and 6). Thus, we shall have 5×(4-8-876)=0-20-60 and 2×(5-21-589)=4-19-98, or altogether:

Moled of the 299th cycle	5d.	17h.	394 scr.
Remainder of the 5 common years	0	20	60
Remainder of the 2 leap years	4	19	98
Total (Moled Tishri of the given year)	4d.	8h.	552 scr.

which is to say, Wednesday, 8h. 552 scr. (2h. 30m. 40s. in the morning).

4. These calculations will be considerably cimplified by the help of the table on the opposite page, giving in three distinct parts, the multiples of the remainders for the month, year and cycle. In the case quoted, looking for the Moled Tishri of the year 5670, the way to proceed is as follows:

5670: 19=298, leaving 8; the given year thus is the 8th of the 299 cycle.

The initial Moled.	2d.	5h.	204 scr.
200 cycles	5	22	200
90 cycles	4	1	630
8 cycles	0	12	440
7 years of the current cycle	5	15	158
Total	16d.	55h.	1,632 scr.
Respectively.	4	8	552

TABLEAU DES RÉSIDUS

Résidus Mensuels — Résidus Annuels

Mois	Résidus Jours.	Heures.	Scr.**	Annés	Résidus Jours.	Heures.	Scr.
1.	1	12	793	1.	4	8	876
2.	3	1	506	2.	1	17	672
3.	4	14	219	3*	0	15	181
4.	6	2	1,012	4.	4	23	1,057
5.	0	15	725	5.	2	8	852
6.	2	4	438	6*	1	6	362
7.	3	17	151	7.	5	15	158
8.	5	5	944	8*	4	12	747
9.	6	18	657	9.	1	21	543
10	1	7	370	10	6	6	339
11	2	20	83	11*	5	3	928
12	4	8	876	12	2	12	724
13*	5	21	589	13	6	21	520
				14*	5	19	29
				15	3	3	905
				16	0	12	701
				17*	6	10	510
				18	3	19	6
				19*	2	16	595

*Les années marquées d'un asterisque sont embolismiques.

**Scr. means Scruples.

TABLEAU DES RÉSIDUS

Résidus Cycliques

Cycles	Années	Résidus Jours	Heures	Scr.	Cycles	Années	Résidus Jours	Heures	Scr.
1.	19	2	16	595	30. . . .	570	3	16	570
2.	38	5	9	110	40. . . .	760	2	14	40
3.	57	1	1	750	50. . . .	950	1	11	590
4.	76	3	18	220	60. . . .	1,114	7	9	60
5.	95	6	10	815	70. . . .	1,330	6	6	610
6.	114	2	3	330	80. . . .	1,520	5	4	80
7.	133	4	19	925	90. . . .	1,710	4	1	630
8.	152	0	12	440	100 . . .	1,900	2	23	100
9.	171	3	4	1,035	200 . . .	3,800	5	22	200
10	190	5	21	550	300 . . .	5,700	1	21	300
11	209	1	14	65	400 . . .	7,600	4	20	400
12	228	4	6	660	500 . . .	9,500	7	19	500
13	247	6	23	175	600 . .	11,400	3	18	600
14	266	2	15	770	700 . .	13,300	6	17	700
15	285	5	8	285	800 . .	15,200	2	16	800
16	304	1	0	880	900 . .	17,100	5	15	900
17	323	3	17	395	1000. .	19,000	1	14	1,000
18	342	6	9	990	2000. .	38,000	3	5	920
19	361	2	2	505	6000. .	114,000	2	17	600
20	380	4	19	20	10,000.	190,000	2	5	280

Sometimes, the desire is expressed to know the Moled of a certain month for a given year. This will be found without difficulty with the help of our table, simply by addition. Let us note, however, that the tables on the monthly and cyclic remainders do not include but the ordinary multiples of the units, leaving off the entire weeks. But the table of the 19 annual remainders follows the order of common and leap years of the cycle. For instance, the remainder of the 4th year is not exactly the same as of the 2nd year because in 4 years, there are 49 lunations instead of 2x24=48.

5. New moon of Tishri--The fixation of the first new moon[1] of a year, (the designation of the day with which the month Tishri begins, the day named in Hebrew Rosch haschanah or "head of the year") is subject to the following regulations:

[1] Note 1, p. 607: The new moon is the festival of the first day of the month, often coinciding with the next day of the physical appearance of the new moon.

1st. If the Moled in question comes before noon, the Tishri new moon is fixed on the very day of Moled, except in the case of a postponement to be discussed later. Moled is not the same as true conjunction

2nd. If the Moled comes in the afternoon, (or until 18 o'clock), or later, the new moon is fixed on the day after the Moled, or in the case of the postponement, the day after the next.

3rd. The new moon of Tishri must never coincide with a Sunday, a Wednesday or a Friday. If the Moled comes on one of these three days before noon or the eve of the afternoon, the new moon is postponed to the next day. Hence, the 1st Tishri can come on no other days but Monday, Tuesday, Thursday or Saturday. As the 1st Nisan precedes the 1st Tishri with an interval of exactly 177 days, there are again three days which exclude the new moon in Nisan: Monday, Wednesday, and Friday. 608

4th. If the Tishri Moled of an ordinary year comes on a Tuesday at 9h. 204 scr., or above that, the new moon is postponed to Thursday. This regulation like the one that follows it is motivated by the strict borderlines within which the length of the year oscillates. If the Tishri Moled of an ordinary year reaches the limit of 3d. 9h. 204 scr., the Moled of the following year will reach Saturday noon, because (3-9-204)+(4-8-876)=7d. 18h. 0scr. By fixing the new moon of the given year on Tuesday in accordance with regulation #1, and by postponing to Monday (according to regulations #2 and #3 combined), the corresponding new moon of the following year, an interval of 6 days is obtained, or an ordinary year of 356 days which is not admissible (See S1).

5th. If in a common year succeeding a leap year, the Moled of Tishri comes on a Monday at 15 h. 589 scr., the new moon is fixed on the next day, Tuesday. It is by taking off the given Moled the remainder of a leap year, you get (2-15-589)-(5-21-589)=(3-18-0) or Tuesday noon, as the Moled of Tishri of the preceding year, the new moon of which was postponed to Thursday (regulations 2 and 3 combined). By fixing the new moon of Tishri of the given year on Monday, the interval with the preceding will be but 4 scruples, or a length of 382 days for a leap year which length is not sufficient.

6th. Knowing the Moled Tishri of a given year, and thus the day by which the year begins, add to the given Moled the annual remainder (4-8-876) for 12 months or (5-21-579) for 13 months and you get in this way the Moled Tishri of the following year. This will make it possible to know the day when it will begin in its turn. The interval between these two days will give you the length of the given year. The ordinary regular year (r) of 354 days (50 full weeks+4 days), will leave an interval of 4 days between the two successive new moons of Tishri; the abundant year (p) of 355 days will form an interval of 5 days; the deficient year (m) of 353 days-3 days. Likewise, the regular leap year (R) counts 384 days (54 whole weeks+6 days), and will leave an interval of 6 days between the two new moons of Tishri; the deficient year (M) has but 383 days and will leave an interval of 5 days; but in the abundant year (P), which has 385 days or 55 whole weeks, the two successive new moons of Tishri will fall on the same day. As is seen, all the calculations concentrate on the day of 1st Tishri.

7th. Following the example of the authors of the middle ages, we shall designate by simple formulas the different forms of the year. For instance: 2p indicates an ordinary abundant year (of 355 days), beginning on a Monday, the figure designating the day and the letter--the length and space of the year; 3R, the regular leap year (384 days) beginning with a Tuesday; 5r, the ordinary regular year (354 days) beginning on a Thursday; 7m, the ordinary deficient year (353 days) starting on a Saturday.

The formula expressing the form of the year summarizes its whole calendar.

The four days of the new moon of Tishri and the six lengths of the Jewish year do not at all form 4x6=24 varieties of distinct years but merely 14; 7 for the ordinary years and the same for the leap years, setting out again in the following manner, in the order of the days:

Monday	2m,	2p,	2M,	2P
Tuesday	3r		3R	
Thursday	5r,	5p,	5M,	5P
Saturday	7m,	7p,	7M,	7P

The year beginning on a Monday cannot be regular, nor of 354 or of 384 days, because of regulation 3 given above. Likewise, the year which begins on a Thursday cannot be either an abundant or a deficient one for the same reasons, and so on.

8th. Thus, in order to know the form of the year, it is necessary to calculate its Tishri Moled and the one of the following year in order to establish the interval. To simplify the calculations, the ancient authors have divided the 19 years of the cycle in four distinct categories.

1. Ordinary years preceded by leap years (1, 4, 9, 12, 15).
2. Ordinary years followed by leap years (2, 5, 10, 13, 16).
3. Ordinary years preceded by and followed by leap years (4, 18).
4. Leap years (3, 6, 8, 11, 14, 17, 19).

For each of these four categories have been established the extreme limits within which the Tishri Moled can vary without causing a change in the form of the year. These limits are indicated in the following table named "Four Gates", invented in the course of the Gaonite period. It suffices to know the Tishri Moled of a given year and its rank of the year in the cycle to find in this table its form represented by its two elements: day (feria) and length. This chart, or rather the indications it contains have always served as base for the fixation of the Jewish calendar for each year.

TABLEAU DES QUATRE PORTES (ARBA SCHEARIM)

Indiquant La Forme de chaque année d'après son rang ordinal dans le cycle
Et so néomenie de tischeri, établie suivant le comput juif.

Classement des années			Lundi		Mardi.	Jeudi		Samedi	
Caté-Gories	Position des Années	Rang Ordinal dans Le Cycle	2 m 2 M	2 p 2 P	3 r 3 R	5 r 5 M	5 p 5 P	7 m 7 M	7 p 7 P
			j. h. sc.	j. h. sc.	j. h. sc.	j. h. sc.	j. h. sc.	j. h. sc.	j. h. sc.
I.	Années simples précédées d'années embolismiques.	1, 4, 9, 12 et 15.	7 18	1 9 204	2 15 589	3 9 204	5 9 204	5 18	6 0 408
II.	Années simples suivies d'années embolismiques.	2, 5, 10, 13 et 16.	7 18	1 9 204	2 18	3 9 204	5 9 204	5 18	6 9 204
III.	Années simples précédées et suivies d'années embolismiques.	7 et 18	7 18	1 9 204	2 15 589	3 9 204	5 9 204	5 18	6 9 204
IV.	Années embolismiques.	3, 6, 8, 11, 14, 17 et 19.	7 18	1 20 491	2 18	3 18	4 11 695	5 18	6 20 491

Nota. Les valeurs indiquées dans ce tableau représentent les limites extrêmes pour le maintien de la forme de l'année. Soit la forme d'une année simple du groupe I qui sera 2 m tant que la néomenie (conjonction moyenne) de Tischeri tomera entre 6 j. o h. 409 scr. la forme de l'année deviendra 3 r, etc.

612

In this table, the whole system proceeds from the new moon of Tishri considered as the head of the year, according to the designation of the religious festival of this day. But, as stated above, the six months preceding the one of Tishri are alternately full and hollow. Thus, its fixation, respectively, is dependent on the day with which the following 1st Tishri is to coincide, of what length the year is to be. These six months form 177 days or 25 whole weeks plus 2 days. Therefore, the day of the 1st Nisan will preceded the one of 1st Tishri by two days. So one can start the year just as well with the 1st Nisan, as it has been practiced earlier, before the captivity of the Jews in Babylon, and even a long time after, and it will be possible to fix the form of each year through the position of the Nisan Moled which precedes the one of Tishri by 2d. 4h. 438 scr.

It is interesting to know these details because back in the period of the establishment of the modern Jewish calendar and even a long time after, the Babylonian Jews counted the years beginning with 1st Tishri while their coreligionists of Palestine continued to start the years 1st Nisan in conformity with the direction of the Bible (Deut. 16:1).

612

Chapter II

Origin of the Hebrew Luni-Solar Year

9. Like all Semitic nations of old, with the ancient Hebrews, the time unit was the lunar month, beginning with the first physical appearance of the crescent and designated with the Hebrew word hodesch (   ), which means "renewing". 613 That is why this word signifies the new moon and--by extending it--the whole lunar month. The Hebrew form of the year had to be the one of the tribes in the midst of whom they lived. But we have no precise indication on this form of the year.

During the Hebrew sojourn in Egypt, under the rule of the Pharaohs, it could take there the form of the solar year, still retaining the lunar months in which the Egyptians, too, were interested for the numerous hieroglyphic inscriptions reproduced by H. Brugsch in his Thesaurus Inscriptionum Aegyptiacarum (the astronom. and astrolog. part of it. p. 49, and on), contain the successive names of the 30 days of the lunar month.

10. Several authors have stated that the ancient Hebrew had solar months and in support of their thesis, they point to the five months of the flood amounting to 150 days (Gen. 7:11, 24; 8: 3, 4), or months of 30 days. Without insisting on the frailty of this demonstration, we shall point out that L. Ideler (Handbuch der Chronologie, Vol. I., Berlin, 1825), has shown that there was nothing to this. Cf also Schwarz, p & Lyons, p. and Bede, p. 170

11. But, the form of the luni-solar year was adopted by the Hebrew immediately after the Exodus, following the institution of the Passah festival decreed by Moses, which feast was to be celebrated at evening of the fourteenth day of the lunar month, coinciding with spring, in memory of their departure from Egypt. This fact is clearly evident from the following Biblical texts: Exod. 12:2, 6, 14; 614 Lev. 23:5; Deut. 16:1[1].

[1]Note 1, p. 614: See Schiaparelli (Giovanni). "L'Astronomia nell Antico Testamento" (Milan, 1903), ch. VIII, S. 89, who explains there the Hebrew luni-solar year.

614

The words hodesch ha-abib usually are translated as "month of the new grain" or "month of the ears", because the Hebrew word abib is synonymous with "maturity of the corn", and, on the other hand, on the day following the Passah festival, (on the 16th of the month) the first fruits of the barley harvest had to be offered in the temple of Jerusalem. Lev. 23:10, 11). #

Some modern scholars[2] consider "the month of Abib" to mean the Egyptian solar month "epiphi", called Abib by the Arabs and the Copts. (See Biot. Resumé de Chronologie astronomique, Mémoires de l'Académie des Sciences, Vol. XX. p. 335). We do not have to discuss here this original interpretation of a Biblical text[3], which will in no wise influence our thesis.

Whether the hodesch ha-abib indicated by Moses be the month of the ears or the solar month epiphi of the natural Egyptian year, which terminates with the maturity of the fruits, it is always the same month which coincides with the vernal equinox. Thus the aim of the Mosaic command was to regulate the months according to the course of the moon and the whole year in accordance with the 615 course of the sun--by assigning as a starting point, the lunar month coinciding with the beginning of a determined solar season, be that, if necessary by inserting a thirteenth month instead of following the Egyptian system of the epagomenes. (See Appendix A. I).

12. To determine the month of Abib, the more or less imminent maturity of the barley was being observed, the first fruits of which had to be offered in the temple the 16th day of the month; or rather, they made use of the solar year of 365.25 days which the Hebrew no doubt knew since their sojourn in Egypt. Due to lack of explanatory documents, we cannot affirm anything with regard to this. Whatever it may be, the form of the luni-solar year was established with the Hebrews by Moses, (In the course of the XIV century B.C.), and the year began

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[2]Note 2, p. 614: See Ed. Mahler, Study on the Egyptian Calendar (Annales du Musée Guimet, Vol. XXIV), Paris, 1907, p. 58.

[3]Note 3, p. 614: The article "ha" meaning "the" placed before the word abib (month of Abib) however, will be inexplicable if it concerns a proper name, and Moses should have written in this case, Hodesch-Abib without the article, like Hodesch Nissan (Nehemiah 11:1)

615

with the moon of the spring equinox.

13. This fact passed by until now almost unnoticed, however, is worth to be especially retained because it implies the suppostion that with the Hebrew, the institution of the luni-solar year was the starting point of astronomical observations and chronological calculations[1], which in the first half of the XI century B.C. led to a calendar system making it possible to know in advance the new moons 616 customary to celebrate with official meals, according to the Biblical text. (I Sam. 20:5).

A few years later, in the beginning of David's reign, they had official men for computations, charged to regulate the calendar, a fact clearly affirmed by the following Biblical text: I Chron. 12:32.

It is to be remarked that the children of Issacar are named in the midst of the enumeration of the chiefs of the army gathered at Hebron to proclaim David as king in place of Saul.

These children of Issacar, the Hebrew astronomers of the period, no doubt, had determined regulations to fix the luni-solar year which no exterior circumstance was allowed to influence. It was because of this that king Hezekiah in the course of special events decided (in 724 B.C.) to celebrate Passah in the second month of the year instead of decreeing the intercalation of a thirteenth month at the end of the preceding year and commencing the current year with the month in which Passah had to be celebrated. One century later, king Josias, after learning of the precepts in Deuteronomy, gathered his people to Jerusalem (in 621 B.C.) in order to celebrate Passah there in the first month, the one of Abib (Deut. XVI: 1). The Biblical chronicler relates these facts in following terms: II Chron. 30:2, 3; 24: 29, 30; 25: 1; II Kings 23: 21.

14. Designation of the months--During the whole duration of the dynasty of 617

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[1]Note 1, p. 615: According to the book "Sapience", king Solomon (1017-997 B.C.) had a conception of astronomy and astrology because he has said (Sapience, VII, 17, 18 and 19): "It was (God) himself who gave me the true knowledge of what there is, who taught me to know the disposition of the universe, the power of the elements, the beginning, the end, and the middle of time, the changes caused by the going away and returning of the sun, the vicissitudes of the seasons, the rotation of the years, the dispositions of the stars".

617

David's descendants and until the beginning of the Babylonian exil, the months of the year as well as the days of the week had no other names than the number.

There are found in the story of the construction of the temple of Solomon (I Kings VI, 1, 37, 38; VIII: 2), some significant names given to certain months: Ziv (blossoms) for the second; Etanim (river's growth) for the seventh; and Bul (rains) for the eighth; names which are analogous to some in our republican calendar. These are perhaps agricultural epithets rather than fixed names since there is no trace left of other names, in case they ever existed[1].

Some authors think that these names, like the one of Abib (ripeness of grain) of the first month, designate the solar months, and they conclude from this, the existence of the simple solar year with the ancient Hebrew. This opinion has been refuted by M. Dilmann in a remarkable memoire on the Hebrew calendar before the exil (Comptes rendu mensuels de l'Académie des Sciences de Berlin, seance du 27 octobre, 1881). The learned professor proves the cananean origin of these names which have been found in the Phenico-Cypriotic inscriptions[1], (Corpus Inscrip. Semit, I. 1, n 3, 18, 86 and 90; Schrader, Die Keilinschriften und das alte Testament, 3rd edition, Berlin, 1903, p. 329), and J. Derenbourg, (Revue des Etudes juives, 1881, Vol. II, p. 124), holds that these names were given by the Phenician workers employed at the construction of the temple of Solomon. 618

M. Dilmann states that the Hebrew word Jerah (month) which precedes the names mentioned, is of Aramaan origin, that it is used but in poetry in the Bible, and that the Phenicians used it to designate the month, reserving the word ḤODESCH for the new moon. Only the Jews extended the meaning of hodesch to the lunar month so as to differentiate the solar Jerah of the Phenicians with which it did not agree.

15. Analogous denominations are found in a strange Hebrew inscription in

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[1] Note 1, p. 617: This explains the article placed before the word étanim (I Kings 8:2): Ierah ha-etanim. . . which is the seventh Ḥodesch. See p. 614, note 3 regarding the article of the word abib.

[2] Note 1, p. 618: In these inscriptions, the five epagomenes days are discussed.

Phenician characters dating back at least to the VI century B. C. discovered recently (end of 1908) by M. Macalister in the archeological excavations made at Gezer (Palestine), and deciphered by M. M. Lidzbarski, Gray, Pilcher and H. Vincent[2]. This table contains the enumeration of the agricultural months: Jerah Assif (Harvest month), Jerah Zera (month of seed time), Jerah Lekesche (month of grass, herbs) . . . . Jerah Zomir (month of vintage), and so on. The inscription proves that 619
sometimes the months were designated according to the agricultural works, same as the seasons were designated (Gen. 8:22); nothing proves the existence of solar months or solar years independent of the lunar phases[1].

16. It is certain that prior to the Babylonian exil, the Jews did not yet have the names of the months in use since even Jeremiah does not designate them other than by their number. Only in texts dated from the period of the Babylonian captivity, the months are designated by their proper names[2], preceded by their respective number (Zacharia, Esther), or without number (Nehemiah). These names are of Babylonian origin and have been identified with those of the cuneiform inscriptions deciphered by Hinks; they are of mythological origin and represent Assyrian divinities about which M. Ginzel has given detailed information in his remarkable Manuel (Ginzel, Handbuch der Chronologie, Vol I. Leipzig, 1906, p. 117-118), which we cannot reproduce here.

17. Here are the names of the Jewish months, some of which are in the Old Testament. We give also those of the Assyrian inscriptions. The year begins with the first moon in spring:

1. Nisan. . . . .=Nisanu--(Nehemiah II, 1; Esther III:7)
2. Iyar . . . .=Airu
3. Sivan . . . .=Sivannu--(Esther 8:9)
4. Tamuz . . . .=Duuzu

[2]Note 2, p. 618: See Macalister, Quarterly Statement of the Palestine Exploration Fund, Jan. 1909. p. 26-34; Vincent, Revue Biblique, Apr. 1909. p. 243-269; Sidersky, Bulletin de la Société nationale d'Agriculture, June 1909. p. 515-517.

[1]Note 1, p. 619: This is also the opinion of G. Schiaparelli in his book: L'Astronomia nell'Antico Testamento (Milan, 1903) chap. VII S. 73-84.

[2]Note 2. p. 619: See Sidersky, Le Calendrier semitique des papyri arameens d'Assuan (Journal asiatique, Nov.-Dec. 1910. p. 587.

620

5. Ab . . . . = Abu
6. Elul . . . . = Ululu--(Nehemiah VI, 16, 1)
7. Tishri . . . . = Tashritu
8. Marheshvan . . . . = Arah-Samnah
9. Kislev . . . . = Kislivu--(Zach. VII, 1; Neh. I, 1; Macc I, 53; IV, 57)
10. Tebeth . . . . = Thebitu--(Esther II, 16)
11. Schebath . . . . = Sabatu--(Zach. I, 7)
12. Adar . . . . = Adaru--(Esther, III, 7; Macc. VII, 46; II ibid., Viv, 43)

The word "Tamuz" is found in the Old Testament (Ezek.VIII, 14) as the name of a Phenician divinity. It is also found in the calendar of the Syrian; the people of Palmyra replaced it by the name "Kinian".

The complete enumeration of the Jewish months in the order indicated above is found the first time in the "Meghilath Taanith" (Rouleau des Jeuves), the revised Aramaic calendar, enumerating the days when it is prohibited to fast because they are to remind happy events. According to M. Schwab (XI congres des Orientalistes, 1897), this document must have been written and introduced between the years 1 or 2 of Coponius, the procurator of Judea. (About 6 or 7 A.D.)

18. The name "Marheshvan" of the eight month is the only one the origin of which is not shown in the cuneiform inscriptions and some scientists explain as a transformation of the name "Arah-Samnah" of the Babylonians[1]". It is not found in the Old Testament but there is not any doubt that it is of the same origin as the other names. It is found in the "Armaic Papyrus of Assuan", referring to the destruction of a Jewish temple at Elephantine (an island in the Nile) by Egyptian priests, published by M. Eduard Sachau (Mémoires de l'Académie des Sciences de Berlin, section hist. phil., séance of the 25th July 1907). This papyrus is dated the 20th of the month Marheshvan of the 17th year of the king Darius (405/404 B.C.); consequently, it is contemporary with the events told in the books of Ezra and Nehemiah, with which it has several points of contact[1]. 621

[1]Note 1, p. 620: In the famous tribungual (three languages) inscription of Behistoun of the period of Darius I, the name Marheshvan is found in its Persian form Markhazana. See Rawlinson, Record of the Past, Vol. I. p. 125.

[1]Note 1, p. 621: This document like the fine collection published by M. M. Sayce and Cowley (Armaic Papyri discovered at Assuan, London, 1906), and the fragments published by M. C. Marquis de Vogue (Comptes rendus des séances de l'Académie des Inscriptions et Belle-Lettres, 1903. p. 269), come from a Jewish colony established at Elephantine, near the Nubian frontier under the protection of a Persian garrison. Merit is due to M. Clermont-Ganneau for having recognized as early as 1878 that the Aramaic papyrus coming from Egypt pertained to the Persian administration. The excavations carried out by the same scientist in Elephantine in 1907 and 1908 have produced a collection of "Ostraka" not yet published, in same language.

Fixation of the new moons and the leap years--With the return of the Jews to Jerusalem, under the reign of Cyrus, towards the end of the VI century B.C. and the reorganization of their religious units by Ezra and Nehemiah, the fixation of the calendar has undergone a series of improvements marked above all by the institution of special tribunal commissioned to listed to the persons having observed the appearance of the new moon and by itto control the depositions, as well as of a special commission to declare certain years as leap years by inserting a thirteenth month between Adar and Nisan[2]. Observations and calculations both improved until 622 astronomical knowledge allowed the Jews to relegate to the second plan, the direct visibility of the crescent which was calculated in advance with great precision. (See Appendix B)

At Jerusalem, the Sanhedrin, this great council having in hand the direction of all questions regulating the Jewish religious life, have printed in celebration of the new moons, a ceremony unknown before and organized fire signals on the mountain tops to announce the new moons to all Jewish communities of Palestine and Babylon (See Appendix A. IX). This system of optical telegraphy has functioned during a very long time, until the moment when the Samaritans (a schismatic sect hostile to the cult of Jerusalem), have imitated the signals in order to mislead the distant Jews[1]. The Sanhedrin as well as the authority exercised by the patriarch in matters of the calendar, the starting point was their great anxiety to assure the unity of the Jews by celebrating on the same days their religious 623 festivals, and this preoccupation is found again and again, as a leading thread, throughout all periods of Jewish history. The different schismatic sects which came up within Judaism, such as: Sadducees, Bethusees, and the Essenes in the 2nd century B.C. and the Caraites in the 8th century A.D. have all fought the

[2]Note 2, p. 621: The intercalary month of the Jewish calendar like the one of the Greek calendar, did not have a special name.

[1]Note 1, p. 622: The Samaritans of whom there still exists a small number living at Naplouse (in Syria) have separated from the Jews following the severe measures taken by Nehemiah against the mixed marriages and founded a concurrent cult on the mouth of Garizim, distancing themselves as much as possible from the religious cult and interpretations of the Jews, among which is the calendar question.

623

calendar regulations established by the Sanhedrin[1] without that their members could reconcile themselves to unify them. Thus until this day, the Karaites in the Orient and in the Crimea, are seen to have their religious festivals celebrated on different days by different communities.

21. With 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 observation and calculation of the equinox called "tekupha", a Hebrew word which means "revolution, or periodical time", and which then was adopted to designate each of the four cardinal phases of the solar year. 624

It was the year of Sothis (Egyptian) of 365 days, 6 hours, which has served for a long time as a basis for calculating the tekuphat-Nisan (the vernal equinox). But the special commission appointed for this purpose by the Sanhedrin, named by the latter Sod-haibour or "Secret Council of Intercalation" whose deliberations always took place behind closed doors, having pursued its investigations still further, found in the end, the Egyptian solar year too long, and that this latter rather should be equal to that of 12 7/12 average synodic months of 29 days, 12 hours, 44 minutes, 3 1/3 seconds each, or approximately equal to 364 days, 5 hours, 55 minutes, 12 seconds indicated by Hipparc (See Appendix. A, II and III). But the Council kept this measure secret, leaving to the commons, the measure

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[1]Note 1, p. 623: In the book of Henoch which is of Essenian origin, is an astronomical outline on the movements of the sun and the moon, respectively, preconising a solar year of 364 days composed of 8 months of 30 and 4 months of 31 days placed at the four cardinal phases. It criticizes the octaétéride cycle which no doubt was used in that period (end of the 2ned century B.C.) as not being susceptible to make the two kinds of years agree. The book of Jubilees which too seems to be of Essenian origin, also refers (chap. VI, 23), to the year of 364 days and its division in 12 solar months of 30 and 31 days which are engraved in the sky (the 12 Zodiacal signs), and he adds (chap. VI, 36: "And there will be people who will observe the moon, those who detract from the times and retrograde by 10 days all the years, and thus the festivals will no more be celebrated at the prescribed periods."

"The Ecclestisiastic" of Jesus, son of Sirah (XLIII, 6, 7), making himself the advocate of the lunar calendar, probably to answer to the attacks of the author of "Jubilees", expresses himself in the following terms: "Similarly, the moon shines at periodical times, to preside over time and as an eternal sign. Through this, the festivals and the legal dates determine itself and by its revolution, the desire of the creator." (See Israel Lévi, L'Ecclésiastique, Paris, 1898, p. 67-69, the original Hebrew text according to the papyri of M. Schecter, and the above French version.

624

of the Julian year.

Thus, the Jews earlier had two systems of the Tekufoth: one approximately known to all, the other, more exact, kept secret. This detail is told by Al-Birûni (100 A.D.) by Abraham Hanassi (1120 A.D.) and by Maimonides (1178 A.D.) The two Jewish authors probably did not know the work of Al-Birûni who got his information from other sources.

625

Chapter III

On the Transfer of the Jewish Calendar During the Ist Century of the Christian Era.

22. During the century preceding the destruction of Jerusalem, the Sod-haïbour or "Secret Council for Intercalation" appointed by the Sanhedrin, fixed each year of the Jewish calendar by means of astronomical calculations based on certain regulations kept secret for a long time, which in the end transpired to the outer world. The direct observation of the new moon on the evening of the 29th day of the month, and the statements of witnesses--observers to be received with the customary formalities by a tribunal designated by said Council--were used merely to confirm the astronomical calculations, and, above all, in order to surround with mystery, the deliberations of the Council behind closed doors[1].

The main question, naturally, was the intercalation of a thirteenth month, between Adar, and Nisan. In order to decide whether the year should be proclaimed embolismic or not, they began by figuring out the day of the Tekufa (the vernal equinox); in case this day did not come before the 16th of the month [Adar], the year was declared a leap year and the month in question became the 13th of the past year and named Adar II (or Véadar); but if the equinox preceded the 16th day of the month [Adar], there was no intercalation and the month in question became the first of the new year, under the name Nisan. (See Appendix A., passage of the Talmud VII). Thus the Jewish Passah always coincided with the first full moon following the equinox. (See "Fragments of Saint Anatole", given in Eusebius, Hist, eccl., VII, 32, 16-19; see also Philon, Vita Moysis, I, III, p. 686, and Josephus, Jewish Antiquitées, III, 15). Cf. also Scaliger, "De Emendatione Temporum," p. 105 Eusebius and others to be taken with precaution. 626 222

23. With regard to the proclamation of the new moons, first the true astronomical conjunction was figured out with the aid of a method identical with the one exposed by Maimonides in his "Treatise on the Sanctification of the New Moons",

[1]Note 1, p. 625: See Dr. B. Zückermann, "Materia for the Development of the Ancient Jewish Time Calculations in the Talmud" (Breslau, 1882) p. 21.

(See Appendix B); in case this came 20 or more hours before sunset of the 29th day of the month, this latter was declared "hollow" and the 30th day became the 1st day of the following month; if the interval between the true conjunction and sunset did not attain 20 hours, then the new moon could not be seen the evening of the 29th day, the month passed was declared full and the new month began with the 31st day. (See Appendix A., passage from Talmud V).

Cf Kokisoff's "22 hrs."

24. As the vernal equinox[1] in the 1st century took place on the 23rd of March Julian cal. (or on the 22nd of March in a leap year), it is easy to establish with the above given regulations, the Julian date limits of the 1st Nisan.

As a matter of fact, as 1st Nisan must come on March 23 at the earliest, the 1st Nisan is placed between March 8 and April 7, (7th March and April 6, respectively, in a leap year). Under these conditions, the limits of the true astronomical conjunction of Nisan was from March 5, 22h. to April 4, 22h., and the limits of the visibility of the new moon was March 7 and April 5 in an ordinary year.

Proceeding from these limits, we have made up the following calendar for the period of 80 years, starting with the year preceding our era until the year 80 giving for each year, the Julian date of the 1st Nisan. For this purpose, we have worked out with the aid of the "Tables de syzygies de Largeteau (Mémoires de l'Académie des Sciences, Vo. XXII, 1850, p. 491), the true astronomical conjunctions of Nisan for this period, the visibility of the new moon which follows the conjunction with an interval of at least 20 hours, and the next days of these new moons which make the 1st Nisan and the New Year's days. The difference between two successive 1st Nisans will give the length of the year (common or leap year). In this table the days (férias) are designated with Roman figures.

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[1]Note 1, p. 626: The tables of Largetean for the calculation of the equinoxes and solstices (Knowledge of the Times, 1847), give (for Jerusalem) the vernal equinox of the year 0 (leap year), on March 22, 18 hours, 35 minutes, 21 seconds, and the one of the year 80 (leap year), on March 22, 3 hours, 38 minutes, 16 seconds.

Let us state here that in the years 5, 6, 7, 14, 15, 24, 25, 32, 33, 34, 43, 51, 52, 53, 61, 70, 71, 72, 79 and 80, the conjunctions of Nisan were ecliptic, and Theodore Oppolzer has indicated these in his Canon des Eclipses (Mémoires de l'Académie des Sciences de Vienne", section mathem., Vol. LII, 1886); so we did not have to calculate these directly, and we have merely transferred the conjunctions calculated for Greenwich to the Meridian of Jerusalem.

We did not think we should prolong beyond the year 80, the table reconstructing the Jewish calendar because after the destruction of Jerusalem (70 A.D.), the seat of the Sanhedrin was transferred to Jamina (near Jaffa), and it is difficult to know to what Meridian the Secret Council of Intercalation related its calculations.

Our synthetical table representing the Jewish calendar during the first century A.D. offers an item of special interest. As a natural consequence of the regulations followed by the Sanhedrin in order to fix the limits for the falling fue of Passah, the énnéadécaétéride cycle will be noted especially which is the result and not their cause, for the regulations mentioned were imposed on the Jews by their rites, the origin of which is older than the cyclic system. This cyclic system of the Jews, however, is very old, perhaps taken over from the Babylonians who had it since long.[1] Perhaps, these latter had come by it through regulations analogous to those of the Sanhedrin, having their origin in the fixation of certain religious festivals attached from one side to the new moons or full moons and having to coincide on the other side with certain agricultural seasons regulated by the course of the sun.

26. In reality, the system in use during the 1st century A.D., the period for

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[1]Note 1, p. 631: The astronomical tables (with cuneiform inscriptions) of the palace of Assurbanipal, deciphered by Strassmaier (See Epping, Astronom. from Babylon, Freiberg, 1889), indicate the existence of an énnéadécaétéride cycle in the 3rd century B.C., while M. Eduard Mahler traces it back to the VIII century B.C. (in his memoire (On the Chronology of the Babylonians", published by the imperial Academy of Sciences in Vienna, section mathemat. Vol. LXII, 1895). See Henri Martin, The lunisolar Chaldeo-Macedonian Calendar (Revue archeologique Vol. X, 1 Paris, 1853, p. 193, 257 and 321).

ESSAI DE RECONSTITUTION DU CALENDRIER JUIF
PENDANT LE I SIÈCLE DE L'ÈRE CHRÉTIENNE.

Hours as from 14 to 34, beginning at midnight, Jerusalem time.

ANNÉES		NÉOMÉNIE DE NISSAN							
après J.-C.	de La Pé-Riode Julienne	Conjonction Vraie Féries	h.	m.	Visibilité du Croissant le soir du	Date Julienne du 1er Nissan	Longueur de L'Année Ecoulée Jours	Mois	Équinoxe Vernal	Date de Pâque
14	4727	II 19 mars	15	42	20 mars.	IV 21 mars	355	12	23 mars	4 avril
15	4728	VII 9 mars	5	11	10 mars.	II 11 mars	384	13	23 mars	25 mars
16	4729	VI 27 mars	1	49	28 mars.	I 29 mars	354	12	22 mars	12 avril
17	4730	III 16 mars	20	48	17 mars.	V 18 mars	383	13	23 mars	1 avril
18	4731	II 4 avril	21	18	5 avril.	IV 6 avril	355	12	23 mars	20 avril
19	4732	VII 25 mars	5	46	26 mars.	II 27 mars	353	12	23 mars	10 avril
20[b]	4733	III 12 mars	18	0	13 mars.	V 14 mars	384	13	22 mars	28 mars
21	4734	II 31 mars	19	10	1 avril.	IV 2 avril	355	12	23 mars	16 avril
22	4735	VII 21 mars	4	46	22 mars.	II 23 mars	354	12	23 mars	6 avril
23	4736	IV 10 mars	12	29	11 mars.	VI 12 mars	383	13	23 mars	26 mars
24[b]	4737	III 28 mars	13	34	29 mars.	V 30 mars	355	12	22 mars	13 avril
25	4738	I 18 mars	[illegible]	[illegible]	19 mars.	III 20 mars	354	12	23 mars	3 avril
26	4739	V 7 mars	21	29	8 mars.	VII 9 mars	384	13	23 mars	23 mars
27	4740	IV 26 mars	20	1	27 mars.	VI 28 mars	355	12	23 mars	11 avril
28[b]	4741	II 15 mars	2	32	16 mars.	IV 17 mars	384	13	22 mars	31 mars
29	4742	VII 2 avril	22	35	4 avril.	II 5 avril	353	12	23 mars	19 avril
30	4743	IV 23 mars	4	12	23 mars.	VI 24 mars	354	12	23 mars	7 avril
31	4744	I 11 mars	18	17	12 mars.	III 13 mars	385	13	23 mars	27 mars
32[b]	4745	VII 29 mars	22	36	31 mars.	II 1 avril	354	12	22 mars	15 avril
33	4746	V 19 mars	13	11	20 mars.	VII 21 mars	355	12	23 mars	4 avril
34	4747	III 9 mars	6	0	10 mars.	V 11 mars	384	13	23 mars	25 mars

which the Mishnah, etc., has given us valuable indications was then in use since long, and it was established about 200 of the Séleucides are (112-111 B.C.), according to the exact indication given by Al-Bîrûnî in his "Chronology of Oriental Nations", (See Sachau, Engl. transl., London, 1879. chap. V., p. 68), no doubt, according to certain authentic documents he had under his eyes. As this Arab author of the X century has proved himself one of the best informed in the various systems of chronology in use with the ancient nations, and had particularly good documents with regard to the Jews, we therefore, are authorized to depend on the date he indicated, the year 200 of Sél. era, or 112-111 B.C. At this period, the Jews had a new era established since about 30 years by the Maccabees, under the Sel. era (143-143 B.C.), the date of the recognition of the Jewish political independence by Démétrius, and beginning with said year, all public acts and official documents were marked: The first year under Simon, the high-priest, governor and prince of the Jews (I Macc. XIII, 42).

This era is found engraved on the coins dated the fifth year of Simon's reign, reproduced by Benzinger (Hebr. Archaologie, Leipzig, 1904, p. 196).

27. Proceeding from Nisan 143 B. C. which is the beginning of this era (the kingdoms always being counted as from Nisan), the year 10-11 A.D. becomes the first of the 9th cycle (innéa-déce-étéride). Referring to our synthetical table, we find there, the leap years 12-13, 15-16, 17-18, 20-21, 23-24, 26-27 and 28-29, following the order III, VI, VIII, XI, XIV, XVII and XIX indicated by Pétau (See Biot, Résumé de Chronologie Astronomique, Mémoires de l'Académie des Sciences, t. XXII, 1850, p. 422-423) which will explain its origin. Proceeding from the Jewish era of creation (established in a later period), a slight difference with the system of P. Pétau is found, according to which the XVI year is a common and the XVII an embolismic, while in our calendar, the XVI year of the cycle is a leap year and the XVII is not. This order of the leap years: III, VI, VIII, XI, XIV, XVI and XIX is precisely the one M. Mahler attributes to the Babylonians (in his tables published in the Mémoires de l'Académie des Sciences de Vienne, class of mathem., Vol. LXII).

28. On the other side, it will be noticed in our synthetic calendar, that the

ordinary year counts 354 or 355 days and the embolismic year counts 383 and 384 days, representing exactly--expressed in whole days--the average length of 12 and 13 synodical months:

12 ×29d. 12h. 44m. 3 1/3s. = 354d. 8h. 48m. 40s. and
13 ×29d. 12h. 44m. 3 1/3s. = 383d. 21h. 32m. 43 1/3s.

In the modern Jewish calendar, greater variations are found in the lengths of the ordinary and embolismic years respectively, especailly the ordinary short year of 353 days, and the abundant embolismic year of 385 days, issues of the system of adjournments inaugurated later by the Jewish doctors of Babylon, but which did not yet exist in the Ist century.

29. The objection could well be raised that our synthetical calendar, established according to the regulations of intercalation of the Sanhedrin, indicated by the Talmud for the period considered, supposes that the astronomical calculations of the secret council of Jerusalem--the details of which we shall find so much harder, having always been surrounded with the greatest mystery--necessarily must lead to the same results than those of our modern calculations, which is not true, because the ancient people ignored the secular perturbations and accelerations, respectively, in the movements of the stars to take them into consideration in the calculations of the conjunctions. But this natural objection would influence merely the length of the two successive years respectively by the possible displacing of one new moon of Nisan; or that in a determined year, the 1 Nisan could be fixed by the Sanhedrin on the next day of the one we have found for it, increasing thus, the year passed by one day, and diminishing that much the length of the year begun with this new moon. In any case, our ignorance of the ancient method of calculation and the necessity to make this up with modern calculations leave in tact, the system of intercalation and the whole of the calendar.

30. Verification of a historical date--Our synthetical calendar of the 1st century A.D., will allow us to verify a historical date which formerly was the object of numberous and ardent controversies. This is the date of the famous Jewish Passah mentioned in the New Testament in connection with the story of the

death of Christ, which took place on a Friday, the day of Parascève of the Jews, (the 14 Nisan, according to the gospel of St. John XIX, 41), or rather, the first day of Passah, (the 15 Nisan, according to the gospel of St. Matthew XXVI, 17). This apparent contradiction between the two texts of the gospels has been the object of numberous historical contradictions on the part of various scholars on which the eminent Russian academic D. Chwolson has written an authoritative study entitled, "The Last Passover Meal and the Death of Jesus Christ", (Mémoires de l'Académie des sciences of St. Petersburg, section of History, 1892), proving that the Friday, the supposed day of Christ's death, really was the 14 Nisan in conformity with the text of St. John, and that the scene of the evening before mentioned in the gospel of St. Matthew, took place the evening of 13 Nisan in accordance with a special interpretation of the Biblical text with regard to the Passah taught in certain school of the time of Jesus and his disciples--an interpretation which tends to separate by one day, the Passah from the feast of the Azymes.

Without entering into the details of a question, of which solely, the chronological question should concern us here, we merely recall that the church sets the death of Christ[1] in the year 33 for the following reason: Supposing by mistake that the modern Jewish calendar with its system of postponements (see chap. 1, Sec. 5), has functioned as early as the Ist century, they could find there easily an explanation for the contradiction referred to by saying that Friday, the day of Christ's death, really was the 15th day since the appearance of the new moon of Nisan but that the Pharisees applying their famous regulation excluding the Mondays, Wednesdays and Fridays as days of Passah, have postponed it to the next Saturday, making Friday the day of the Parascève, according to the gospel of St. John, while Christ and his disciples of the Pharisees disapproving, with their system of postponements, considered Friday as the 15 of Nisan and had their Passah the evening before to conform with the command of the Bible.

[1]Note 1, p. 635: The story of the gospels cannot be placed other than between 30 and 33 A.D. because of the presence of Pontius Pilate who was Roman governor in the province of Judah from 25 to 36 A.D. The year 33 is the only one in this short interval in which the first day of Passah coincided with a Saturday.

As a matter of fact, in the year 33, the mean conjunction of Nisan (the Moled of the modern Jewish calendar), comes on Thursday March 19, 13h. 5m. 16 2/3s. (or 5d. 19h. 95scr. according to the Jewish computation); the new moon of a Moled coming in the afternoon is set customarily the next day but this being a Thursday, it must be postponed to Saturday (Regulation 2 and 3, explained in chap. 1, sec. 5). (March 21) Thus, Friday, April 3, the supposed day of Christ's death, becomes the 14 Nisan of the Pharisees in accordance with the text of St. John, while it should have been the 15 Nisan for those who do not accept the regulation on the postponing.

31. This ensnaring explanation of the contradiction referred to, briefly exposed in ancient ecclesiastical literature[1] accepts the application of the regulation on the postponements of the modern calendar to the first century of the Christian era and some authors have drawn from this source, an hypothesis contradicted by the ensemble of facts mentioned in the Talmud[2]. But it will be easy for us to show irrefutably that in the year 33 A.D., the 15 Nisan did coincide with Saturday April 4, in accordance with our synthetical calendar and not with Friday, April 3, the supposed day of Christ's death. Indeed, we know, that the evening of the Jewish Passah must coincide with the full moon, (according to the texts quoted above from Josephus and from Philon), and in no case could it precede this physical phenomenon[3]. Now, Theodore Oppolzer's Canon of Eclipses quoted above teaches us that in the year 33 A.D., a partial eclipse of the moon (visible in the Orient) took place precisely Friday, April 3, at 15h. 6m. Greenwich meridian[4], or

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[1]Note 1, p. 636: See "The Art to Verify Dates", by a religious benedectin (Com d'Antin, 3rd edition, Paris, 1783), p. 82 and on.

[2]Note 2, p. 636: See Zuckermann, Materialien etc., Breslau, 1882, p. 60-61.

[3]Note 3, p. 636: Sometimes it can happen, that due to certain circumstances, the new moon is fixed on the day after the next day of the conjunction and that the Passover is celebrated 24 hours after the full moon, but the contrary is impossible.

[4]Note 4, p. 636: See F. K. Ginzel, Speical canon of Sun and Moon Eclipses (Spezieller Kanon der Sonnen--and Mondfinsternisse, Berlin, 1899) p. 201-202. According to this scientist, the lunar eclipse mentioned lasted since 14h. 44.4m until 18h. 37m. Jerusalem time.

17h. 26m. Jerusalem Meridian. The opposition having come about about a half an hour before sunset, the full moon should appear even on the evening of Friday, April 3, after sunset, and not the evening before, thus, the 15 Nisan began, according to Jewish custom, with sunset Thursday, April 3, which day really was the 14 Nisan, the Parasceve of St. John.

In this year 33, the true astronomical conjunction was in Jerusalem, according to our table, March 19, at 13h. 11m., or 6 minutes after the average conjunction of the modern computation (same day, 13h. 5m.), a coincidence that no doubt contributed to confound the ancient system based on the visibility of the crescent at the seat of the Sanhedrin. (The calculations based on the true astronomical conjunctions with the modern computation based on the calculation of the average conjunctions).

Our digression will prove to the historian that the calculation of a lunar syzygie sometimes can become the most sure means to verify a chronological date.

Chapter IV

Origin of the Constitutive Elements of the Jewish Computation

32. For a very long time, the fixing of the new moons in the ancient Jewish calendar remained subordinate to the visibility of the crescent on the evening of the 29th or 30th day of the month passed; a visibility determined materially or calculated in advance by astronomical methods, of which Maimonides has left us a peculiar specimen in his "Traite de Sanctification des néomenies". (See Appendix B) Due to special circumstances, those which we shall have to investigate, the astronomical calculations have been replaced by a more simple system of computation, based on the value (L) of the average synodic month:

$$L = 29d.\ 12h.\ 793scr. = 29d.\ 12h.\ 44m.\ 3\ 1/3scr. = 29d.\ 5305941358;$$[1]

which is identical with the one indicated by Ptolemé expressed in sexagesimal fractions:

$$L = 29d.\ 31^{1}\ 50^{11}\ 8^{111}\ 20^{1v} = 29d.\ 5305941358.$$

As a matter of fact, in chapter II of the book IV of Almageste (Edition Halma, Vol. I, Paris, 1813, p. 217), the famous Greek astronomer reports that Hipparc, after examining the intervals of time between two very distant exlipses of the moon has established that 4,267 synodic revolutions are made in a number of solar days equal to 126.007 1/24, from which fact he deduced the value of the average synodic month given above.

It is proper, however, to note that in dividing 126.007d. 1/24, by 4,267, you get slightly less for value L, or:

$$L = \frac{126997\ 1/24}{4267} = 29d.\ 31^{1}\ 50^{11}\ 8^{111}\ 9^{1v}\ 20^{v} = 29d.\ 5305933130,$$

differing from the one indicated by Ptolemée by 0d. 0000008228.

The last expression for L is the one reproduced in the various versions (arab and latin) of the Almageste which earlier were in the hands of the astronomers

[1] Note 1, p. 638: A value exceeding the actual value by about 1/2 scr. owing to the secular acceleration of the average movement.

before the abbot Halma had edited the original Greek together with a French version (Paris, 1813 and 1816), in which is found the fraction 20lv in agreement with most of the manuscripts preserved.

To the discrepancy of these two values attention was called as early as 1850 by Biot in his "Résumé de Chronologie astronomique (Mémoires de l'Académie des Sciences, XXII, p. 401), with the special remark that he did not know whether this fact should be attributed to an error committed by Ptolemée or to an intentional rectification, but that, in every case, it cannot be a question of a simple mistake of the copyist because Ptolemée uses the fraction 20lv as an element of his further calculations. M. Biot no doubt has ignored the value of L given in the arabic and latin versions of the Almageste, which agrees with the one expressed by Hipparc.

33. This little detail is of certain importance for the Jewish computation. As a matter of fact, the division of the hour in 1,080 scruples, which is very old, must have as its origin, the conversion of sexagesimal fractions of the average synodical month in ordinary fractions of which 1,080 was the common denominator, or:

$$\frac{31}{60}+\frac{50}{60^2}+\frac{8}{60^3}+\frac{20}{60^4} \text{ jour} = 12 \text{ heures } \frac{793}{1080},$$

in striking harmony with the value reported by Ptolemée as found in the original Greek of the Almageste.

Struck by this harmony, I hastened to affirm without looking any further, that the authors of the modern Jewish computation have borrowed the various astronomical facts from the Almageste making them substantial elements of their system, especially, the value of the synodic average month, and the énnea-déca-etéride cycle of Méton.

34. We have seen above with regard to the cyclic system of the intercalation that the authors of 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. The same is true of the value of the average synodic month indicated above, which was used already by the Sanhed-

drin of the Ist century A.D. at a time when the fixation of the new moons was yet subordinated to the true conjunctions, (See Appendix A., II and III), as one of the elements of the astronomical calculation. Indeed, the Talmud reports of a declaration made by Rabbi Gamaliel, (who was chief of the Sanhedrin about the middle of the Ist century A.D.), of having learned in the house of his grandfather that the synodical rotation of the moon represents 29 days, 12 hours, 2/3 of an hour and 73 scruples. (See Appendix A. II). Now, the Almageste of Ptolemée (written about the middle of the IInd century A.D.) is later by one century than Rab. Gamaliel, and as the value of average synodic month as indicated by this latter[1] does not agree completely with the one given by Hipparc, it must be admitted necessarily that this value has been drawn from another source, the investigation of which will be facilitated by the very declaration of R. Gamaliel. As a matter of fact, the grandfather of R. Gamaliel was Hillel the Babylonian (born about 75 B.D., died about 5 A.D.), a man of vast learning, founder of the famous Palestinian school bearing the name, "House of Hillel", to certain teachings of which reference is made in the New Testament (St. Paul, etc.). It is possible that this scholar had brought from his native country, Babylon, certain astronomical facts in which he was interested from the point of view of fixing the new moons, among others, the value of the average synodical month:

L = 29d. 12h. 44m. 3 1/3s. = 29d. 5305941358,

known there as from the IV century B.C. as proven by M. Kugler (Die Babylonische Mondrechnung, Freiberg, 1900, p. 24), by means of astronomical tables deciphered by the Assyriologist, I. N. Strassmaier.

It is even permitted to suppose that Ptolemée has rectified the value of the average synodical month resulting from the one spoken of by Hipparc in order to identify it found earlier by the Babylonian astronomers of which he doubtless had knowledge.

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[1]Note 1, p. 640:

640

35. In the foregoing chapter, we have indicated that the value of the average synodical month was used by the Sanhedrin as an element of astronomical calculation of the true conjunctions and the appearance of the crescent (See Appendix A. V), because the proclamation of the new moons has always been one of his prerogatives. Even after the destruction of Jerusalem (70 A.D.), the Sanhedrin, though stripped of its ancient prestige, remained as before, establishing its seat first at Jabné (Jamnia) near Jaffa, later in various localities of Gallilee and finally at Tiberiad; it was always presided by a patriarch, a dignity that fell to the descendants of Hillel I, the Babylonian. But following the rebellion of Bethar (135 A.D.) under the reign of Hadrian and its bloody suppression, where about six hundred thousand persons perished through iron and through fire, the deliberations of the Sanhedrin with regard to the calendar were distrubed many a time and it even happened that two consecutive years were declared embolismic, according to the council of a chief (R. Akibba) who was consulted in the dungeon where he was cast by the Romans.

36. During this time, the Jewish communities of Babylon where a certain number of doctors had found refuge, began to manifest some slight inclination of independence toward the Sanhedrin of Palestine in the matter of fixing the religious festivals. A young Palestine scholar by the name of Hananiah, nephew of an influential member of the Sanhedrin (R. Josué), who went to Babylon according to the counsel of his uncle, and founded a school there one day, decided to improvise a special college charged to fix the new moons and the religious festivals in order to emancipate the Babylonian communities. But this attempt was promptly reprimanded through the energetical intervention of the patriarch Simon-ben-Gamaliel who threatened his Babylonian coreligionists with excommunication if they persist in their tracks. Since, the fixing of the calendar cannot be done other than in Palestine. (See the details directly in Graetz, History of the Jews, transl. Wogue and Bloch, Bol. III, Paris, 1888, p. 117 and 118).

37. But, in the course of the III century, the glory of the Jewish schools of Palestine was waning, while those which had formed in Babylon gained by it, and

the efforts for independence in matters of the calendar were renewed in a more accentuated form. One of the more outstanding scholars, Samuel, the computer, famous through his vast knowledge in theology, medicine and astronomy, declared one day to be able to establish the calendar for all communities of the Jews in dipersion, (See Appendix A. V), and to prove it, he made up a calendar for a period of 60 years which he submitted to R. Johanan, one of the most learned members of the Sanhedrin of Palestine. He declared the calendar proposed by Samuel inacceptable, qualifying it as "general calculation", no doubt finding the year of 365 days, 6 hours too long; the Babylonian computer having used it for calculating the vernal equinox. (See chap. II)

38. From this moment on, the system of fixing the new moons in Babylon underwent a profound modification of astronomical nature. As a matter of fact, the system employed by the Sanhedrin of Palestine was based, as stated already, on the calculations 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 in relationship to a fixed Meridian, (The one of Jerusalem, same as the clocks of France are all regulated by the one of the observatory of Paris). As soon as the Babylonian Jews took the initiative to regulate the calendar, they found themselves compelled to substitute for the true conjunction, which is in relation to a determined geographical spot, the average fictitious conjunction, which--existing merely in the imagination--is kind of independent of a fixed Meridian. This substitution offering an analogous advantage over the one resulting from the use of the average Meridian, and theequinoxial hour, however, was not free of inconveniences. 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 unit of the Jews after the loss of their political unity. Well, there is no corelationship whatever between the average conjunction and the appearance of the new moon, and the interval sometimes can excede 48 hours; it is then that the system of postponements has been put into practice, excluding from the new moons, three special days: the details of

In the supposition that the physical instant looked for was a solar eclipse--total or partial--visible in the region inhabited by the Jews between the longitudes 30° to 50° to the east of Paris and the latitudes 28° to 38° (Palestine, Babylonia, etc.), we shall try to find it with the aid of modern astronomical works. For this purpose, we have made a list from the "Canon des eclipses" of Th. Oppolzer (Mémoires de l'Académie Imperiales des Sciences de Vienne, cl. de mathemat. Vol. LII, 1887), of all solar eclipses visible in eastern Asia having taken place during the long period of six centuries, beginning with the one of the proleptic year 10 (-- 9 astronomie), during the period when the Sanhedrin of Jerusalem was headed by Hillel I, the Babylonian, and continuing until the middle of the VI century, long after the publication and general adoption of the modern computation. These eclipses amount to 19 in number; we have gien them in the following table which contains in the first column, the indications of Th. Oppolzer in relation to the meridian 0 of Greenwich and which we have corrected according to the special indications by F. K. Ginzel in his "Canon special des éclipses historiques" (Berlin, 1899). With regard to these indications completed by us by the days marked in Roman figures, we have transcribed the same indications brought in relation to the meridian of Jerusalem and Babylon respectively; in the column next to it, we have placed the corresponding average conjunctions calculated according to the modern Jewish computation, and transcribed into the civil time reckoned as from midnight in order to make all facts of the table uniform; finally, the last two columns mark the differences between the true conjunctions and the average (Moleds) for the meridians of Jerusalem and Babylon respectively (See table on opposite page, 43).

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ECLIPSES OF THE SUN VISIBLE IN PALESTINE AND BABYLON
INDICATED BY M.TH. OPOLZER (KANON DER FINSTERNISSE) AND M. K. F. GINZEL (SPEZIELER KANON)
COMPARED WITH THE NEW MOONS (AVERAGE CONJUNCTIONS) CALCULATED ACCORDING TO THE JEWISH COMPUTATION

(Equinoxial Hours Reckoned From 0 to 24 Beginning at Midnight)
The Nature of the Eclipse is Indicated by T (total) and A (annular) According to M. Oppolzer

Numéros D'Ordre	Années	Nature De L'Eclipse	Dates		Milieux Des Éclipses calculés Pour Les Méridiens						Néoménies Juives (Conjonction Moyenne)			Différences avec Les Milieux des éclipses			
					de Greenwich		de Jérusalem		de Babylone					à Jerusalem		à Babylone	
			Féries		h.	m.	h.	m.	h.	m.	Féries	h.	Mois Juifs	h.	m.	h.	m.
1	— 9	T	VI	30 juin	10	30,7	12	53,2	13	27,4	VI	18 12,6	Tamouz	+ 5	19,4	+ 4	45,2
2	+ 45	T	I	1er août	9	26,6	11	49,4	12	24,3	I	17 25,8	Eloul	+ 5	36,4	+ 5	1,5
3	+ 59	T	II	30 avril	12	21,0	14	42,8	15	17,7	II	22 15,2	Iyar	+ 7	32,4	+ 6	57,5
4	+ 83	T	VII	27 dec.	11	56,8	14	18,6	14	53,5	VII	18 12,1	Schebath	+ 3	53,5	+ 3	18,6
5	+ 125	A-T	VI	21 avril	7	41,6	10	3,4	10	38,3	V	21 24,6	Iyar	— 12	39,7	— 13	13,7
6	+ 164	A	II	4 sept.	8	48,6	11	10,4	11	45,3	II	6 59,6	Tischeri	— 4	10,8	— 4	45,7
7	+ 186	T	II	4 Juil.	7	2,7	9	24,5	9	59,4	II	13 14,6	Ab	+ 3	50,1	+ 3	15,2
8	+ 197	A	VI	3 juin	11	41,9	14	3,7	14	38,6	VI	4 22,1	Tamouz	— 9	41,6	— 10	16,5
9	+ 218	A	IV	7 Oct.	7	49,9	10	11,7	10	46,6	IV	16 29,6	Kislev	+ 6	17,9	+ 5	43,0
10	+ 219	T	VI	2 avril	7	34,1	9	55,1	10	30,8	VI	10 37,1	Nissan	+ 0	42,0	+ 0	6,3
11	+ 240	T	IV	5 août	6	5,0	8	56,8	9	1,7	IV	12 27,8	Eloul	+ 4	1,0	+ 3	26,1
12	+ 266	T	I	16 sept.	6	46,3	9	8,1	9	43,0	I	21 37,7	Tischeri	+ 12	29,6	+ 11	54,7
13	+ 301	T	VI	25 avril	7	4,2	9	26,0	10	0,9	V	23 53,5	Iyar	— 9	32,5	— 10	7,4
14	+ 316	A	VI	6 juil.	4	36,6	6	58,4	6	33,3	VI	13 55,9	Ab	+ 6	57,5	+ 6	22,6
15	+ 334	A	IV	17 juil.	11	26,9	13	48,7	14	23,6	V	1 40,3	Ab	+ 11	51,6	+ 11	16,7
16	+ 349	A	III	4 avril	10	0,5	12	22,3	12	57,2	III	15 18,4	Iyar	+ 2	56,1	+ 2	21,2
17	+ 472	T	I	20 août	9	49,0	12	10,8	12	45,7	I	7 36,1	Eloul	— 4	34,7	— 5	9,4
18	+ 486	T	II	19 mai	10	31,2	12	53,0	13	27,9	II	12 36,7	Sivan	— 0	16,3	— 0	51,2
19	+ 550	T	V	24 nov.	9	13,8	11	35,6	10	10,5	V	22 33,0	Tebeth	+ 10	57,4	+ 10	22,5

Note: The Jewish new moons habitually are calculated in equinoxial hours counted as from sunset, and the fractions ofthe hour are expressed in scruples (at 1/18 of a minute). We have transformed them into hours and minutes ofthe civil day in order to compare with the eclipses.

41. One glance is sufficient to see that of the 19 solar eclipses mentioned, 17 show that the average conjunctions differ by several hours, sometimes in one, sometimes in another direction, one eclipse (of May 19, 486), is 16 minutes (at Jerusalem) behind the computation and the harmony cannot be established but for a more western meridian in the sea; only one--of April 2, 219--concords sufficiently with the computation, though not with the meridian of Jerusalem but at least with the more eastern of Babylon, being 6 minutes ahead of the computation. It deserves to be taken into consideration all the more so because it happens to be the only eclipse of Nisan among the 19 given in our table.

The average conjunction or the Moled Nisan calculated with the aid of the auxiliary table of the first chapter, is 6 days, 16 hours, 668 scruples, or according to civil time reckoning (April 2, 219), Friday, 10 hours, 37,1 minutes.

The total eclipse indicated by Th. Oppolzer had in the middle part at 7h. 31,6m. (Greenwich meridian, resp. at 7h. 34,1m. at the same meridian according to the correction of F. K. Ginzel, a difference of 2.5 minutes. It was visible in all western Asia. By accepting Ginzel's correction, it follows that the moment of the middle of the eclipse, establishes itself for Jerusalem (which is at 35013[1] 6[11] to the east of Greenwich); 7h. 34,1m. 2h. 20,95m = 9h. 55,05m. or 42 minutes before the Moled, and for Babylon (which is at 43° 11[1] 14[11] to the east of Greenwich): 7h. 34,1m. 2h. 52,75m. = 10h. 26,85m. or 10h. 25m. before the Moled.

42. However, the Jewish fireside was not in Babylon proper but in several places situated farther to the east, especially in a city named Soura[1] on the

[1]Note 1, p. 648: See the judicious observations made by de Goeje in his study (German: "Zur histor. Geographie Babyloniens" (Zeitschrift der Deutschen Morgenlandischen Gesellschaft, Vol. XXXIX, 1885, pl 10-13) according to which the city of Soura which became the seat of the famous Jewish Academy (not to be confounded with another smaller locality of the same name, farther to the north), was situated at the confluent of the canal Bedet and the canal Soura at a longitude of 44° 50 to the east of Greenwich and the boreale latitude 31° 45[1]. The two other Jewish centers--Pombedita and Nahardea where later two new academies were established--were more to the north.

Euphrates where during the period in question was great intellectual fermentation which led to the establishment of the first Jewish Academy, opened exactly in 219 A.D. with more than 1,200 students from the very start (See Graetz, Historie des Juifs, transl. Woogue and Bloch, Vol. III, Paris, 1888, p. 170). Now this city of Soura which is marked on the geographical map (edit. Stieler) of Mesopotamia is situated at 44° 50 longitude east of Greenwich. The middle of the eclipse given by Oppelzer-Ginzel for 7h. 34,1m. (Greenwich time) will come at Soura: 7h. 34,1m. 2h. 59,3m. = 10h. 33,4m., or 3.7m. before the Moled, this slight difference is easily explained if you note that the observation of the eclipse, made with the naked eye, could not begin but after a few moments after the start of the phenomenon. Perhaps only the end of the clipse could be seen coinciding with the moment of the return of the light.

43. This total eclipse of April 2, 219 A.D. was for the Jewish computers of Soura an excellent occasion to verify their astronomical calculations of a true conjunction which must have interested them all the more since it concerned the moon of Nisan of a year which began an enneadecasteride cycle (the 20th of the Maccab. era). There is nothing surprising in the fact that it was carefully observed and that it was then taken as a starting point for a computation which later was adopted by Judaism the world over. These scholars knew the two great scientific principles used by the Sanhedrin of Palestine: The average synodic month and the enneadecasteride cycle; having found materially a true conjunction, they took this as the starting point for their calculations in order to establish the religious festivals independently from the Palestinian Sanhedrin whose communications by messengers often were disturbed by Roman persecutions. It was not until later that the computation thus sketched and little by little improved (by the system of postponements, see chapter I), spread without giving much thought to its starting point.

44. As to the author of the system, everything leads to believe that it was R. Ada who a few years later became rector of the Academy of Soura, and to whom was attributed the principle of absolute equality, supposed at that time,

between the 19 solar years and 235 average synodic months of 29 days, 12 hours, 44 minutes, 3 seconds 1/3, or one solar year equal to 365d. 5h. 55m. 26s (14 seconds longer than the solar year of Ptolemee, 365d. 5h. 55m. 12s), a principle mentioned by the authors of the XII century under the name of Tekoufa of R. Ada, according to a memoire of this doctor found in the hands of Abraham bar Hiya Hanassi, author of a treatise on Jewish astronomy and chronology, written in Hebrew in 1120, the oldest known.

45. During more than one century, the Jews of Babylonia have followed the new computation based on the average conjunctions (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 established for the Catholic church, the well-known Pascha regulations based on the use of a luni-solar calendar[1], analogous to the Jewish, simultaneously deciding that the Jews under Roman denomination were to be prevented from celebrating their Passah the same time 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 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 calculation established by the Babylonians and accepted by the Palestinians which Hillel II by virtue of

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[1]Note 1, p. 650: The ennea-decateride cycle and the system described by Petau (See above) were adopted by a first Council in 284, the year the Church has tkaen as the beginning of the cycle (golden number). This explanation is given by S. Slonimsky in his book "Tessode Haibour, 3rd edition, Warwaw, 1888, p. 62. We do not know the source from which this author has taken it.

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 enneadecaeterid cycle of Maccabeau 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 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 year of the old cycle has become the XVI 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 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 XVI 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 polemic on the subject of the calendar which took place in the X century between the Jewish doctors of Palestine and their colleagues of Babylon (See Revue des Études juives, Bol. XLII, 1901). The principal object of the polemic was the pretension of a chief of the Palestine school, Ben-Méir, to modify the talbe of the four gates (reproduced above, p. 611) so as to add 642 scruples (35m. 40s.) 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 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. Maybe 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.

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 following the order "III, VI, VIII, XI, XIV, XVII and XIX" as indicated by P. Pétau.

3. The value of the average synodic month of 29 days, 12h. 44m, and 3 1/3 seconds, taken over from the Babylonian astronomers who have pointed this out as early as the IV 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 proclamation of the new moons depended exclusively.

4. The substitution of the average conjunction to the true conjunction or to the visibility of the crescent was at first adopted by the Jews of Babylon with the aim 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 10h. 33m. 4. By a retrograde computation, the Jewish calendar of the era of creation was started (fixed to Oct. 7, 3761 B.C. according to the Babylonians, or April 2, 3760 B.C. according to those of Palestine).

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 by means of celebrating their religious festivals on the same days.

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.)

Samuel said: "How is it known that the days are not counted in the Years? Because 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 it is said (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)

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 grandfather (Hillel I) to know that a lunation is never less than 29 days and a half, 2 thirds of an hour and 73 scruples."

III

Supplementary Passage (Erachin, 9b.)

This is the day formed at the end of 36 months by multiplying the thirds of the hour and the scruples 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, 95b.)

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 a member of the Sod-haibour or Secret Council of Intercalation and knew, evidently, all regulations 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 the solar year (E'rubin, 56a) as being 365d. 6h. while the length of the solar year according to R. Adda was 365d. 5h. 55m. 26s.

V

Passage on the Calculation of the New Moons
(Rosch-Haschanah, 20,b.)

Samuel said: "I can regulate (the calendar) for the whole Diaspora (Babylonia". Abba, father of R. Simlai, asked of Samuel: "Do you know what is taught in the Sod-haibour (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?): "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. Simlai wished to say; one must calculate the Moled; if it takes place before noon, one knows that the crescent will be visible after sunset; if it did not 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 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 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 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 (milieu-middle), 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 not immediately followed by the word (night) always means "noon" what need not be doubted. That is why S. Slonimsky's opinion was fought by his colleagues, and Ad. Schwarz in his remarkable and conscientious memoire "Der judische Kanender", (Breslau, 1872), declared that the Talmudic passage in question was one of the most obscure.

We believe, on the contrary, that this passage is as plain as interesting. It indicates that in order to calculate the first appearance of the crescent, one is to make use of the interval of 20 hours, 30 minutes which exists between the true astronomical conjunction and this 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 (perhaps 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 Maimonides in his "Treatise on the Sanctification of the New Moons", (See Appendix B), or by an analogous calculation, always long and complicated, they proceeded from the Moled, (the average conjunction), established in a few moments by a simple mathematical operation. Knowing, on the other hand, that the extreme difference between the Moled and the true astronomical conjunction was at most, 14 hours (as admitted by the astronomers), the Secret Council of Palestine had 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 unless the average conjunction comes before noon, because only then, and in the most favorable case when the true conjunction has preceded the Moled by 14 hours, there will be, by adding the 6 hours since noon until sunset in the equinox period, a total interval of 20h. 30m. between the true conjunction and the appearance of the new moon, half an hour after sunset; but when the Moled did not occur before noon, the new moon will not be visible in the evening, because the interval of 20h. 30m. 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

Passage on the Regulations of Intercalation

(Jeruschalmi, 18d top.)

(Tosefta, Sanhedrin, II, 2, edition Zuckermandel, p. 417, line 18.)

On three signs, the embolismic year is declared: The maturity of the 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
(Rosch-Haschanah, 21a.)

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

Note: The word Tekoufa, in the Old Testament, designates a rotation, a period of time. The talmudists designate by this word, a cardinal 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, (to the duration of the Tekoufoth), average values, representing a quarter of a tropical year.

VIII

From numberous passages of the Mischnah, the Babylonian and Jeruschalmi 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 Jeruschalmi (Rosch-Haschanah, II, 1), deals with the 1st Tishri, falling on a Friday. (For the details, see: Zuckermann, Materialieu, etc. Breslau, 1882, p. 49,50 and 60.)

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 the formalities of verification of their testimony--the institution of an optic telegraphy 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 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 Maimonides.

Though the astronomical new moon begins with the moment of the conjunction, the calculation of which was known in the course of the last centuries preceding the Christian era[1], 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 the scientists of the post-talmudic period have exerted themselves to establish it according to a~~ total of instructions that had come down to them, and the result of these efforts have been the curious method described by Maimonides in his "Constitutiones de Sancti-ficatione Novilunii" the Hebrew text of which accompanied with an excellent latin version (due to Ludovic Compiegne de Veil), has been published by Blais Ugolin in his "Thesaurus Antiquitatum Sacrarum," Vol. XVII (Venise, 1755). This method presents a good specimen of the scietific activity of the ancients. We shall summarize it in the following note retaining the expressions of the author which are in bearing with the system of Polemée's world.

Method Described by Maimonides (XIIth Century.)

1. To inquire after the visibility of the new moon at Jerusalem for a given evening, it is necessary, first, to calculate the respective positions of sun and

[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.

moon, then the movements, average and rectified, of these stars.

The Sun--The arc described by the sun in its average tropical movement in 24 hours is 0^{o} 59^{1} 8^{11}, or in 10 days 9^{o} 51^{1} 23^{11}, in 100 days, 98^{o} 33^{1} 53^{11}, in 1,000 days (after the defalcation of whole circumferences), 265^{o} 38^{1} 50^{11}, and in 10,000 days, 136^{o} 28^{1} 20^{11}. 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 28^{o} 35^{1} 1^{11} (29 days) and 358^{o} 55^{1} 15^{11} (354 days) respectively. On the other hand, there is a particular point in the ecliptic from where the sun sheds its most vivid light on the earth; a point which moves very slowly of about 1^{o} in 70 years. This point is called the height of the sun. Its displacement makes an arc of 1^{11} 30^{111}, in ten days, in 100 days--15^{11}, in 1,000 days--2^{1} 30^{11}, in 10,000 days--25^{1}, in 29 days--a little over 4^{11}, and in a regular year--53^{11}.

2. Maimonides has taken as the staring 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 701^{1} 32^{11} in the sign of the Aries, and its height was at 26^{o} 45^{1} 8^{11} 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--later or prior to the one chose 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 to them, 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 calculations of the average movement of the sun does not exactly coincide with the beginning of the night and that the difference is one hour too much or short; 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

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

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

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 $1^{\circ}\ 41^{1}$ for 60° and $1^{0}\ 51^{1}$ for 70°, or a difference of 10^{1}, hence, $1^{\circ}\ 45^{1}$ for 64°. In this manner, the true position of the sun for no matter what date, can be calculated taking it then as a staring point in the calculation, be that, for instance, the beginning of a century or any other appropriate period.

4. The Moon--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 average tropical movement of the moon. It describes in 24 hours, an arc of $13^{\circ}\ 10^{1}\ 35^{11}$, or in 10 days--$131^{\circ}\ 45^{1}\ 50^{11}$, in 100 days--$237^{\circ}\ 38^{1}\ 23^{11}$, in 1,000 days (after defalcation of whole circumferences)--$216^{\circ}\ 23^{1}\ 50^{11}$, in 10,000 days--$3^{\circ}\ 53^{1}\ 20^{11}$; in 29 days--$22^{\circ}\ 6^{1}\ 56^{11}$ and in 354 days--$344^{\circ}\ 26^{1}\ 43^{11}$. 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 (average anomalistic movement of the moon), represents for 24 hours, $13^{\circ}\ 3^{1}\ 54^{11}$, or in 10 days--$130^{\circ}\ 39^{1}\ 0^{11}$, in 100 days--$226^{\circ}\ 29^{1}\ 53^{11}$, in 1,000 days--$104^{\circ}\ 58^{1}\ 50^{11}$, in 10,000 days--$329^{\circ}\ 48^{1}\ 20^{11}$, in 29 days--$18^{\circ}\ 53^{1}\ 0^{11}$, and in 354 days--$305^{\circ}\ 0^{1}\ 13^{11}$.

5. At the beginning of the night of Thursday, the date taken as the starting point, the moon was in its average movement of $1^{\circ}\ 14^{1}\ 43^{11}$ in the sign of Taurus, and the average orbit was at $82^{\circ}\ 28^{1}\ 42^{11}$. 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, determine the Zodiak sign the sun is on the given date. If it is between the middle of the Fishes and the middle of the Aries, the average movement of the moon remains without correction; if the sun is between the middle of the Aries and the beginning of the Gemini, 15^{1} is added to the average movement of the moon (reduction at sunset); if the sun is between the beginning of the Gemini and the middle of the Leo, 30^{1} is added to the average movement of the moon; if the sun is between the beginning of Leo and the middle of Virgo, 15^{1} 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^{1} 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^{1} is cut off; finally, if the sun is between the beginning of Aquarius and the middle of the Fishes, 15^{1} 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 30m. 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 difference of the lengths).

These calculations are but an aid for the visibility, a phenomenon which is realized only when the double distance is between 5° and 62°; <u>below 5° and above</u>

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 double distance as from	6° to	11°
2°	12°	18°
3°	19°	24°
4°	25°	31°
5°	32°	38°
6°	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 you get the rectified orbit of the moon.[1]

7. According to the number of degrees of the rectified orbit, cut off from 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 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.

The deductions and additions (equation of the center 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

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

8. The circumference described by the tropical movement of the moon is not completely in the plane of the ecliptic, but meets it in two points named knots, 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^{1} 11^{11}, or in 10 days--31^{1} 47^{11}, in 100 days--5° 17^{1} 43^{11}, in 1,000 days--52° 57^{1} 10^{11}, in 10,000 days-- the overplus will be 169° 31^{1} 48^{11}, in 29 days, the average movement will be 1° 32^{1} 90^{11}, and in 354 days--18° 44^{1} 42^{11}. On the evening of Thursday, the initial date, the head was at 18° 57^{1} 28^{11}. To find the position of the head for a given evening, you calculate its average movement, 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 the head at the seventh sign of the Zodiac.

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, 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 boreale--northern width of the moon, is the more pronounced, the more it distances itself 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 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; it is boreal (northern) if it is in between 1° and 180°; and austral (southern) if it exceeds 180°, it is zero exactly at 180° and at 360°.

This width is increasing 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 Palestine; if the lenght 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 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 Zodiac 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 Zodiak	Deduct of the 1st Length
Aries	$0^{\circ}\ 59^{1}$	Libra	$0^{\circ}\ 34^{1}$
Taurus	$1^{\circ}\ 00^{1}$	Scorpion	$0^{\circ}\ 34^{1}$
Gemini	$0^{\circ}\ 58^{1}$	Sagittarius	$0^{\circ}\ 36^{1}$
Cancer	$0^{\circ}\ 43^{1}$	Capricorn	$0^{\circ}\ 44^{1}$
Leo	$0_{\circ}\ 43^{1}$	Aquarius	$0^{\circ}\ 53^{1}$
Virgo	$0_{\circ}\ 37^{1}$	Fishes	$0^{\circ}\ 58^{1}$

12. Parallaxis 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: Thus the second width is obtained.

Sign of Zodiak	Deduct of the 1st Length	Sign of Zodiak	Deduct of the 1st Length
Aries	9^{1}	Libra	46^{1}
Taurus	10^{1}	Scorpion	45^{1}
Gemini	16^{1}	Sagittarius	44^{1}
Cancer	27^{1}	Capricorn	36^{1}
Leo	38^{1}	Aquarius	24^{1}
Virgo	44^{1}	Fishes	12^{1}

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° Taurus or Scorpion
1/5	20°	End Taurus or Scorpion
1/6	Beginning	10° Gemini or Sagittarius
1/12	10°	20° Gemini or Sagittarius
1/24	20°	25° Gemini or Sagittarius
0	25° Gemini or Sagittarius	5° Cancer or Capricorn
1/24	5°	10° Cancer or Capricorn
1/12	10°	20° Cancer or Capricorn
1/6	20°	End Cancer or Capricorn
1/5	Beginning	10° Leo or Aquarius
1/4	10°	20° Leo or Aquarius
1/3	20° Leo or Aquarius	10° Virgo or Fishes
2/5	10°	End Virgo or Fishes

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:

1. 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.

2. 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, substraction or addition, you get the 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 to its value; If the moon is in Capricorn or Gemini, add 1/6 to its value; if the moon is in Sagittarius or Cancer, the third length remains as it is, without addition or subtraction; if the moon is on 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 hieght of the place (hauteur du lieu); add this to the fourth 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 ehight 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, $7^{\circ}\ 9^{1}$ in Taurus;
True position of the moon, $18^{\circ}\ 36^{1}$ in Taurus;
First southern width, $3^{\circ}\ 53^{1}$.

In looking for the position of the sun and the one of the moon, you find $11^{\circ}\ 27^{1}$ as the first length and since the moon is in the sign of Taurus, it is necessary to deduct 1° of the length, and you will have $10^{\circ}\ 27^{1}$ as the second length. The parallax of the width is 10^{1} which must be added to the width because it is southern, thus getting $4^{\circ}\ 3^{1}$ as second width. Sincethe moon is at 18° in Taurus, 1/4 of her width must be taken, or $1^{\circ}1$, 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 $11^{\circ}\ 28^{1}$ as the third length. Since it is in the Taurus, it will be necessary to add 1/5, or $2^{\circ}\ 18^{1}$, and then you will have $13^{\circ}\ 46^{1}$ as the value of the fourth length. Then 2/3 are taken of the first width, or $2^{\circ}\ 35^{1}$, representing the height of the place which must be deducted of the fourth length (the width being southern), and it will remain $11^{\circ}\ 11^{1}$ as the quantity of the arc of vision of the moon for the given night.

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 $10°$, and the first length $= 13°$;
2. The arc of vision $> 10°$ to $11°$, and the first length $= 12°$;
3. The arc of vision $> 11°$ to $12°$, and the first length $= 11°$;
4. The arc of vision $> 12°$ to $13°$, and the first length $= 10°$;
5. The arc of vision $> 13°$ to $14°$, and the first length $= 9°$.

In each of these five cases, the new moon will be visible in all of Palestine; 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 4838, we have found 11° 11' for the arc of vision which we shall compare with the first length 11° 27[1]. 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 explanations, it is evident that the astronomical calculation of the visibility according to the method described by Maimonides[1], is a rather long operation due to the numberous perturbations 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).

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[1] 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 the conservation of the principle of the physical appearance of the crescent (astronomically calculated) for the fixation of the new moons; the intercalation was made according to the enneadecaeteride cycle of the Jews.

Appendix C

Excerpt from Al Biruni: The Chronology of Ancient Nations[2].

Jewish Months--The mathematicians computed for them the cycles, and taught them how to find, by calculation, the conjunctions and the appearance of new moons, 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.

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

Appendix 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 of the 1st Tishri, proceeding from the era of creation, which began Oct. 7, 3761 B.C. at 5h. 204 scruples. 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 in the embolismic year, in the following manner:

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

Proceeding after this principle, 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 it in a big table, divided in 20 parts, its form and the Julian date of the 1st Tishri indicated for each year, and beginning with the year 1583, we have substituted the Gregorian dates to the Julian. We then found that the corresponding date of the first Tishri oscillates between August 25 and September 27, Julian or September 3 and October 5, Gregorian, that the 1st Tishri of an ordinary year oscillates between September 5 and October 5, and the one of 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 for 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 one of 1st Tishri, to know the Julian or Gregorian dates of all day 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), 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 form of the Jewish year, the Julian dates corresponding 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 form of the Jewish year indicates at the same time the day of the 1st Tishri, we have made a special table to find the day of no matter what Jewish date.

We must content ourselves for the moment to give on this question of mutual conversion of Jewish, Julian and Gregorian dates some general indications, reserving for us the privilege of the pulication of our "Tables of Conversion".

Who wrote this?

CALCULATION OF TIME BEFORE THE JULIAN PERIOD

= 248 cycles

The Julian Period (JP) begins with January 1 of the year −4712 of our time reckoning. This day is the zero day of the JP, the day preceding this, or December 31, −4713, would therefore be the −1 day of the JP, December 1 of −4713, the −31st day of that period, etc. To avoid using negative day figures the method similar to that used with fractions in logarithms was employed in these tables, 10 million days are added to the day number and instead of −1 we put down 9999 999, and instead of −31 we write 9999 969, etc; so that from such a day number as given in the tables theoretically 10 million days should be subtracted, but this is superfluous for the practical use of the tables. So one finds, for example, for the 1st Thoth of the year 1 of Panodorus, according to page 114, the day 9715 346, after the subtraction of the 10 million days; this would really be the −284654 day of the JP. This conversion is quite unnecessary--page 4 shows us without any conversion the number ~~0~~9715 346 corresponds to the 29th of August −5492 of our time reckoning. Historically there is no time before the JP and the figures have only been worked back that far, so that the beginnings of such eras which have been calculated back, as the one of Pandoras has, can be converted into each other.

ASCERTAINING THE WEEK DAYS

January 1 of −4712 or the 0 day of the JP was a Monday or a Ferie II. Therefore, the remainder of the Julian day number multiplied by 7 would give the Ferie. It is still more simple to note that the remainder 0 Corresponds to Monday; therefore, 1 to Tuesday, etc. For the time before the JP, as stated above, the numbers have been increased by 10 million, therefore the remainders increase by 3 and the remainder 3 corresponds to the Ferie II and the remainder 0 to Friday. Therefore the following relations are valid:

Remainder of the Julian day number divided by 7.							
After — 4712 (day-thousands from 0 upwards).	0	1	2	3	4	5	6
Before — 4712 (day-thousands 9000 to 9999).	3	4	5	6	0	1	2
Day of the week. .	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
Ferie.	II	III	IV	V	VI	VII	I

Therefore, January 14, 1908, is a Tuesday, because 2417 955 divided by 7 gives
345422-1
a remainder of 1; November 9, 1881, a Wednesday, because 2408 394 gives a remainder 2; the 18th Brumaire of the Republic is a Saturday, since 2378 444 gives the remainder 5, etc. Furthermore, the 31st of December — 4713 is a Sunday, because 9999 999 gives the remainder 2 (lower line); and December 1, — 4713 is a Friday, because of the remainder 0 from 9999 969. These definitions calculations of the week days are applicable to all time reckonings, and since it is only very seldom that one has dates before — 4712, so it is in general quite sufficient to remember that the remainder 0 corresponds to a Monday.

JULIAN AND GREGORIAN YEAR

Next, the Julian year has been tabulated from — 1600 to 2400 of our time reckoning, just as most of time reckoning in the tables has been worked out as far as 2400 A.D. But, since it is a known fact that the length of a Julian year contains 365 1/4 days, 4000 years contain 1,461,000 days; therefore the last three figures of the day number do not change after the expiration of 4000 years. Because of this the table could be stretched to double that time so as to include the 8000 years from — 5600 to 2400 by simply setting down the double of the day thousands. Therefore, according to page 23, the Julian day 1520 171 corresponds to January 1 of the year — 550; the Julian day 59 171 corresponds however to January 1 — 4550.

In the B.C. era it is known that the years are calculated back and that by two systems. The above-mentioned dates -550 and -4550 are set down according to the generally followed astronomical rules of calculation, whereas they would have to be set down as 551 B.C. and 4551 B.C. according to the reckoning of historians. Both ways of calculating have this in common that the year numbers decrease with time; therefore there are arguments for the Julian year at the right and left: at the left, those increasing with time $\underline{t}$; at the right, those decreasing with time (tau). The former serve for the time A.D. as well as all other time reckonings noted on the left margin; the latter serve exclusively for the astronomical as well as the historical manner of reckoning of time B.C. So, for example, on page 61 the Julian day 2223 277 corresponds to January 1, 1375 A.D. (1300 + 75); or to January 1, 6088 of the JP. (6013 + 75); or to January 1, 5556 of the Frankish world era (5481 + 75); or to January 1, 2128 a. u. c. (2053 + 75); etc. Also the Julian day 762277 corresponds to January 1, 2088 of the JP. (2013 + 75); or to January 1, 1324 of the Scaligers' world era (1249 + 75); against January 1, -2625 of our time reckoning [t-(2600 + 25)]; or to January 1, 2626 B.C. [2601 + 25], since (tau) and not $\underline{t}$ has to be put in.

About the years of the city, it is to be noted that they are given according to the customary Varronical reckoning. If they are desired in the Catonical or Capitolinical reckoning, one would have to write: $\underline{t} - 47$ instead of $\underline{t} - 48$ on pages 18 and 19; and on the following pages instead of $53 + \underline{t}$, $153 + \underline{t}$ and $52 + \underline{t}$, $153 + t$, etc.

With the Byzantine and Seleucidan era, years that begin with months of September or October, respectively, it must be noted that the months of ~~September, October, November and~~ ~~December, or Oct., Nov., + Dec., respectively, are to~~ ~~with the Byzantine era year (beginning with October) the months~~ September, October, November and Decebmer, and October, November, December, respectively must be combined with a different $\underline{t}$-line than the other months. For example:

September 10, Byzantine year 6630 (6609 + 21), according to page 56, corresponds to the day 2130 756; contrary to this, January 3 of the same year 6630 (6608 + 22) corresponds to the day 2130 871. In the same manner, the day 2151 270, according to page 57, corresponds to the 9th Dios of 1489 (1412 + 77) of the Seleucidan era, and the day 2151 400 to the 19th Dystros of the same year 1489 (1411 + 78) of the Seleucidan era. With these eras one must always remember to choose the right number corresponding to the month.

The Seleucidan era is not connected with the ordinary names of the months given in the headings of the tables; but with those mentioned at the bottom of the tables, also with the Greeks in the first-mentioned and with the Syrians with those given in second place.

last ¶ on p. XIV left out.

For regular years the "fast number " (? fixed?) is given in the column marked "Kalender-zahl" (calendar number), for leap years, to emphasize them, the "fastnumber" given has been ~~multiplied~~ enlarged by 50. Therefore the years whose calendar number are greater than 50, are leap years.

Under the heading I, N and S numbers are given which let one find the indication, the golden number and the sun circle, by subtracting the next smaller negative number from t or, if none of the negative numbers are smaller than t, by adding the first positive sum to t. With this the upper number stands for the upper, the lower one for the year belonging to the lower <u>daythousand</u>, this applies to the Julian as well as the Gregorian year. E.g. we find on page 80 the Indiction 6 (8-2), the golden number 9 (8 + 1), the sun circle 13 (8 + 5) for 1908; for 2621 of the Julian period (2613 + 8) the Indiction is 11 (8 + 3), the golden number 18 (8 + 10), the sun cirde 17 (8 + 9); these same figures would have been the result for the indentical year --2092 since also with the negative year numbers not τ but t, standing on the same line, is to be used. According to page 78 one would have had the Indiction 11 (83 - 72), golden number 3 (83 - 80), sun circle 16 (83 - 67) for the Julian as well as the Gregorian year of 1883.

The Sunday letter for the year belong to the upper daythousand is found by the formula $\left(\frac{Kal+3}{7}\right)R$ or $\left(\frac{Fst.+3}{7}\right)R$, but for the year belonging to the lower day-thousand it is found by the formula $\left(\frac{Kal+5}{7}\right)R$ or $\left(\frac{Fst.+5}{7}\right)R$. In figuring the upper as well as the lower year use the figure given directly in the column "Kal" (eventually Fst = Kal. — 50). For the Gregorian calendar naturally the number given in the Gregorian calendar naturally the number given in the Gregorian column "Kal." It being a fact that, in ordinary years: Kal = Fst, the identical result is obtained from both formulas for the Sunday-letter of the year; in leap years the first formula gives the first sunday-letter of the leap year; the second (formula), the second (Sunday-letter). For the Julian year 1883 the formulas accord to ps 78 are Kal. = Fst. = 27, therefore L = $\left(\frac{27+3}{7}\right)R = 2$ or B; for the corresponding year — 2117 it is L = $\left(\frac{27+5}{7}\right)R = 4$ or D; for the Gregorian 1883 it is Kal. = Fst. = 4, therefore L = $\left(\frac{4+3}{7}\right)R = 7$ or G. For 1908 page 80, it is Julian: Kal = 73, Fst = 23, therefore L = $\left(\frac{73+3}{7}\right)R = 6$ or F and L = $\left(\frac{23+3}{7}\right)R = 5$ or E, therefore L = FE. For the Gregorian year 1908 it is : Kal = 79, Fst = 29, therefore L = $\left(\frac{79+3}{7}\right)R = 5$ or E and L = $\left(\frac{23+3}{7}\right)R = 4$ or D, therefore L = ED. Finally the Julian as well as the Gregorian Epakte can be calculated by the golden number. Since the golden number for 1908 is 9, the Julian Epakte = $\left(\frac{9+10(\frac{9}{3}r)}{30}\right)r = 9$; the Gregorian = $\left(\frac{18+9+10+(\frac{9}{3})r}{30}\right)r = 27.$

Since 1873, the year in which the Japanese adopted the Gregorian calendar, their reckoning is given at the bottom of the Gregorian tables. Therefore the year 1908 (t = 8) is the Japanese year 2568 according to Jimum Tenus (2560 + 8), furthermore it is the Cyclusyear 45 (37 + 8) or wu-schen (p. 265) and finally the year 41 Meyi (33 + 8).

Finally the Julian tables also give the dimension "reduction to the Gregorian calendar" namely in two lines, one right above the other. The first line is to be used with the upper Daythsus and, the second with the years belonging to the lower day-thousand. This correction along with its sign is always to be added to the day-numbers given in the table. Upon the first glance this seems superfluous since there is a separate table for the time since the introduction of the Gregorian calendar and since it is not customary to reckon back the Gregorian calendar. But in exceptions there are times when one reckons back; e.g. the Japanese Government issues a reckoning table for the Japanese time reckoning and consistently the Japanese dates are all reckoned (501 A.D. to 1873 A.D.) into the Gregorian. And also Dabane's tables reckons the Turkish-Arabian dates from the most ancient times into the Gregorian calendar. But also and from such unused figures it may occasionally seem advisable to reckon a Gregorian date back. In contrast to the tropical year the Gregorian only moves over a day about once every 4000 years, therefore, one can use the Gregorian calendar to quickly calculate the approximate season of the year.

We know, e.g. that at the present time the spring equinox comes on March 21 and one would want to know when it was in the year — 4110, one finds according to page 31, March 21 for the —4110 Gregorian day of the Julian period 219993 (219939 + 33 + 21) and for this day 219993 according to that page we have the Julian date April 23 (219993 - 219970). Therefore in —4110 the spring equinox was approximately on April 23; and it is a fact that careful reckoning sets it for April 25. The reduction with its signs, can always be worked out from the numbers of the table. If the questions should arise to which day the "Tisri" the 4th day of the 7th month of the 22nd year of the 10th cycle of the Chinese corresponds, one finds for the 22nd year of the 10th cycle, according to page 240 the year — 2075 (—2097 + 22) and according to page 244 for this year — 2075 (— 2113 + 38) the 7th month, the 4th day, the Julian day 963418 (963402 + 12 + 4). According to page 80 this day is the Gregorian 25th of August (963418 - 963376 + 17) which according to page 265 corresponds to the Tisri "tschu-shu".

With the Seleucidian era it must also be mentioned that occassionally it begins with September in which case the legends should not read "Oct to Dec", "Jan to Sept", but "Setp to Dec," "Jan to Aug". There is also occasionally a beginning of a year later so that the figures must be decreased by a whole, so that instead of ending in 12 and 11 would end in 11 and 10. But these are exceptional beginnings which cannot be taken into consideration in the table anymore than the various beginnings of the Chr. year, which, as is known, began at many different times in the different localities, sometimes with Christman, sometimes with March 25, sometimes with Easter, etc. Before going into the table this year beginnings must be reduced to a January beginning, e.g., when it began at Christman during the days from the 25th to 31st of Dec. the year number must be decreased by one, with the Amunciation style according to the "calculus Feorentimus" the year number for the period of Jan. 1 to March 24 must be increased by one, or according to the "calculus Pisanus" during the time from March 25 to Ded. 31 it must be decreased by one. It would be lengthy to go into all the beginning of the year, one must refer to the chronological handbooks.

The "Kalenderzahl" calendar-numbers given with Julian as well as the Gregorian calendars serves the purpose of finding the corresponding calendar on pages 100-105 for any given year. Each calendar has 2 calendar-numbers written above it, one for ordinary years and one for leap years. One doesn't need to bother with this, however, one only has to chose the column which has the calendar-number as heading. The calendars show in 3 columns, one for the Catholics, one for the Protestants, and one for the Greeks, the Sundays and holidays as well as not worthy days, in smaller type, which are not holidays. Because of the local variations in the Saints names and holidays of the calendar they could not be given, but here are a few of the Saints names and holidays that most calendars had in commoh:
18/1 Peters thromf. in Rome: Prisca, 20/1 Fab. and Seb., 23/1 Mar. Marriage, 25/1 Paul's conversion, 14/2 Valent., 16/2 Juliane, 22/2 Peter's thronef. in Antioch, 24/2 Matthias, 12/3 Gregor, 19/3 Jos. Neihrv., 24/3 Gabriel, 24/4 Georg, 1/5 Phil u. Jac., 3/5 Crucifixion exp., 12/5 Pancrat., 13/5 Servat., 14/5 Bonif., 15/5 Sophie, 16/5 John of Nep., 8/6 Medardus, 13/6 Ant of Pad., 24/6 John the Bap.,

2/7 Mary's visitation, 5/7 Cyr. and Meth., 16/7 Apostl, 25/7 Jac. Ap., 26/7 Anna, 1/8 Peter's Chain festival, 2/8 Portiuncula, 4/8 Domin., 5/8 Mary's snow, 6/8 Transfiguration of Jesus, 20/8 Steph., 24/8 Barthol., 29/8 John's Ent., 24/9 Mary's Grace., 28/9 Wenz., 29/9 Mich., 4/10 Franz Ser., 15/10 Therese, 28/10 Simon and Jude., 11/11 Martin, 15/11 Leopold, 19/11 Elizab., 21/11 Mar, Sac., 25/11 Katharina, 30/11Andreas., 4/12 Barbara, 6/12 Nicolaus, 13/12 Lucia, 18/12 Mar. Erwart., 21/12 Thom., 27/12 John Er. 28/12 Innoc. Children, 31/12 Sylvester.

Dates which are emphasized by bold or italic letters are always accompanied by a note, or else the italics show that said date only rates as holiday in a confession. The date as well as the day of the week of each holiday is given, sometimes the day of the week is for the whole line and the date of each column or again the date is for the whole line and the day of the week for each separate column.

For the Gregorian year 1908 we find the "Festzahl" 79. According to column 12 on page 101 the year begins with a Wednesday and January 19 is the 2nd Sunday after Ephiphany and since it is printed in bold face note 1 points out that the Sunday is also Jesus' names day feast. In the Gregorian year 1835 the calendar-number is 29. According to column 11 on page 101 this year begins on a Thursday and January 18 is the 2nd Sunday after Epniphany and the Jesus' namb festival. March 1 of both years falls on a Sunday, that is the Sunday of Quinquaguimae or Estomihi and both years have the same calendar beginning with March because both have the "Festzahl" of 29, which was only purposely raised to 79 for the leap year. During the first 2 months of the year there is a day's difference between them, that is why January and Febtuary have different "calendar-numbers" for column headings. Naturally one can only (in the modern times) open up to a calendar-number, e.g. to the number 79 for 1908, for the feasts of the Catholics and Protestants, since one has to find the Julian calendar-number for 1908, that is 73, then you find, in column 6 on page 101, that the Julian year 1908 began with a Tuesday, that the Julian February 24 was the Sunday of Syropust etc.

Numbers are added to the Sundays which refer to the Gospels and Epistles mentioned on page 106 which are read on these Sundays. E.G. we find for January 19, 1908 under the calendar-number 79, the number 6 for Catholics as well as Protestants, that means that the Catholics read the Gospel of John 2:1-11, Acts 4:8-12, and the Protestants read John 2:1-11; and Romans 12:7-10. We also find on August 23, the 11th Sunday after Pentecost or the 10th Sunday after Truitatis, which is also, since it is in italics, according to note 4 at the same time the Maria Heart Feast, the number 43 for the Catholics and the number 41 for the Protestants. Therefore the catholics read Mark 7:31-37, 1 Cor. 15:1-10; the protestants Luke 19:41-48, 1 Cor 12:1-11.

The readings are fixed for the Greeks and Catholics, but it should be noted that the readings given here for the protestants are those that used to be commonly used and are now called the "older Pericopes," whereas, in modern times the Pericopes change in difference countries and are different for different years. E.G. the Weimarian and the Saxonian Pericope tables has numberous lines of Pericopes for a certain day to be used for the different years. Quite often the old Pericopes as they are given here are still in use; but should one want to construct a calendar with the "new Pericopes", one has to refer to Pericope tables which cannot all be listed here. We just want to mention a few of them here. In 1891 a newly edited Pericope book was published in Saxony; in 1899 one was published in Berlin by S. Mittler a "Verzerchur's der kirchlichen Perikopen," in 1902 Hermann Bohlaus Nachfolger in Weimar published "The Pericopes to be used by the Weimarchurches after the 1st Advent of 1901," etc. Some calendars give the gospels for the Catholic holiday, the mass book give the complete compilation of those of the Catholic Church; in the Russian calendars the Gospels to be read are given for each day, these are found in the tabulation issued by the Synod in Moscow and in detail, but according to the old Bible division in paragraphs, which have to be changed over into chapters and verses, thus is in the calendar tables of Chawski.

How to figure the days of the week, see page XIII. Anyway the day of the week can be checked by the calendar. On page XIII we found for January 14, 1908, as the day 2417 955 with a rest I, a Tuesday. We find the same from calendar column 79 on page 101, since January 12 is a Sunday there, therefore, the 14th is a Tuesday.

In the Julian calendar the calendar-number for the years corresponding to the upper day thousands are the only ones given, since they are quite meaningless for the time before the Christian era. If, however, one wanted to find the calendar number for such a year, remember that the Julian calendar repeats every 532 years; e.g. the calendar-number for the year — 4713 would be the same as for the year 607 (5320 — 4713), so, according to page 46, it would be 33. But such accurate reckoning for the Easter term has no meaning for that time, and if one only desires to check a week day it would suffice to find a calendar-number which would differ by a multiple of 7 from the real calendar number and therefore, indicates the same week days. One finds such a calendar-number for a year belonging to the lower daythousands by increasing the calendar-number of the year belonging to the upper day thousand by 2 or by diminishing it by 5. To find the calendary-number for — 4713 in this manner, one would increase the calendar-number 0 (p. 19) standing for — 713 by 2 and get 12, which differs in fact from the above found true calendar-number 33 by a multiple of 7, that is 21. In calendar column 12 on page 104 we really find that December 31 was a Sunday and December 1 a Friday, found according to page XIII.

Since one uses the Julian and Gregorian calendar to reckon time by and is also used in epochs that lie far back or way ahead, therefore, it might be found necessary to go beyond the bounds of the table in one direction or the other. This is done by multiplying or diminishing the Julian dates by multiples of 4000 years until they are within the limits of the tables, with the Gregorian dates one multiplies or divides, as the case may be, by multiples of 400. The multiples of the day numbers of 4000 Julian and of 400 Gregorian years are therefore given.

Julian Year		Gregorian Year	
Years	Days	Years	Days
4000	1461000	400	146097
8000	2922000	800	292194
12000	4383000	1200	438291
16000	5844000	1600	584388
20000	7305000	2000	730485
24000	8766000	2400	876582
28000	10227000	2800	1022679
32000	11688000	3200	1168776
36000	13149000	3600	1314873

E.G. If one wanted to be sure that in the 490th century the difference between the Julian and Gregorian calendars really was a whole year and one wanted to know what Gregorian date the Julian March 17, 48917 is, one would have the following calculations:

	40000 years	14610000
	8000 years	2922000
March 17	917 (page 52)	2056068
March 17	48917 Julian	19588068

Which date according to Gregorian ti e does the day 19588068 correspond. We have:

19588068		36000 years
13148730		
6439338		8000 years
2921940		
3517398		3200 years
1168776		
2348622 (p. 73)	March 17	1718 years
19588068	March 17	
		48918 Gregorian

ALEXANDRIAN YEAR

As with the Julian year one can affix the Alexandrian year the doubled daythousands for times lying 4000 years apart. Since these tables have also been continued up to 2400 A.D. they should have started with — 1600 and then they would have covered time from — 5600 to 2400 like the Julian tables. But since the Alexandrian year does not appear before the first century for the time from — 1600 to — 100 which does not come into consideration and this time, as well as the time from —5600 to —4100 which belongs to it, was taken into consideration differently. Since 1692 Alexandrian years are 618003 days a side table was attached to the time from 75 A.D. to 1574 A.D. in which the daythousands for the time lying back 1692 years are given, that is from —1617 to —118; or from — 5617 to —4118. These daythousands are to be united to the individual days of the main table and a correction of —3 days is to be applied to the latter. Therefore page 116 gives the 1st Thoth 5777 Panodorus the day 1825030 [1825029 + 1] the 1st Thoth 1777 Panodorus the day 364030 [364029 + 1] and the 1st Thoth 85 Panodorus the day 9746027 [9746029 - 3 + 1].

How to find the days of the week see page XIII. But the days of the week can be checked here by the feast table of the following table: (Table given on Page XXI).

For the upper figure of the main table the feast number is directly given, for the upper number of the side table it has to be increased by one; for the bottom number of the main table, by 2; and for the bottom number of the side table by 3. So, e.g. page 121, the 17th Tybi 251 Diocletians or the day 1916478 [1916461 + 17] because of the remainder 4, a Friday and in fact figured by the feast number 18 of the above table the 17th Tybi is a Friday. The 12th Payni 4335 [4284 + 51] Panodorus or the day 1298620 [1298611- 3 + 12] with a remainder of 1 is a Tuesday which the feast-number 19 [18 + 1] shows. The 9th Mechir 2027 [1976 + 51] Panodorus or the day 45550 [455491 + 9] is with a remainder of 3 and a feast-number 20 [18 + 2] a Thursday, and finally the 4th Erganzungstag (supplement day) 335 [284 + 51] Panodorus according to page XIII a Friday, it is also that according to the feast-number 21 [18 + 3].

At the head of the table are given the Egyptian, and Arabian names of the months, at bottom of the table the Coptic and Abessinian.

THE JEWISH YEAR

The Jewish year is tabulated from 185 A.D. to 2389 A.D., that is ~~of~~ from a time which lies before the introduction of the newer Jewish calendar up to the time limit ~~which is taken as the general~~ in ~~all~~ these tables in general. For ordinary purposes of ~~rerocking~~ translation this period ~~of~~ from about 4000 to 6000 of the Jewish era would suffice. But since the Jewish year has a perfected complicated calendarsystem, it is ~~often~~ sometimes of value for calendariographic investigations ~~and~~ also to be able to figure out dates of earlier time. Besides these dates that have been worked out backward ~~reckoned~~, even if the modern Jewish calendar did not yet exist then, can serve as valuable approaches for the old Jewish calendar which generally cannot be ~~reduced~~ worked out exactly. Therefore, it seemed desirable, to be able to reckon the dates for the time up to 4000 of the Jewish era, which was accomplished by adding the side table.

The Jewish year has an average length of 365.2468 days; therefore, 2204 years have, pretty accurately, 805004 days and 4408 years have 1610008 days. The main table has been extended over a period of 2204 years and into the side table the daythousands for the 2204 and 4408 years lying back of against the dates of the main table have been entered above each other. These daythousands are to be combined with the single days from the main table and really a correction of —4, respectively— 8 days ought to be applied. In reality, however, ~~But it is a fact that~~ this correction is not a constant one, but it changes because of the various transpositions ~~changes~~ of the beginning of the year from year to year; then too, since the lengths of the months Marcheschwan and Kislev vary according to the classification (kind) of the year, the correction would be different for the first 2 months, a different one for the month Kislev and still another for the last 9 (or 10) months. These corrections are set down in 2 columns of the side table. So we have on page 225, e.g., the 1st Thamus 5668 equal to the day 2418123 [2418122 + 1], the 1st Thamus 3464 [3396 + 68] equals the day 1613119 [1613122-4 + 1], the 24th Thischri 1260 [1192 + 68] equals the day 807842 [807827 - 9 + 24]. The 13th Kislev 1260 equals the day 807891 [807886 - 8 + 13], finally the 1st Thamus 1260 equals the day 808116 [808122 - 7 + 1]. Then, too, the calendar columns show that the year 5668 has the calendar ~~21~~ 2D, the year 3464 the calendar ~~51~~ 5D, finally the year 1260 has the calendar 7A.

These calendarnumbers serve as arguments for the calendar on pages 235 - 238. These calendars give the holidays, Sabbaths and also in small print the note worthy days which are no holidays. Besides the German names of the holidays the Hebrew names are given in quotation and in such a transcription that they can be transcribed directly back into the Hebrew Script with the help of the Transcription key given on page 234, by leaving out the vowels without accents ~~are left out~~, and the accented vowels and consonants are put down in the signs given there. So the 17th Tha~~r~~mus "Schebah asar bethamus" is written back as Hebrew . . . . (p. XXIV). For the Saturday's their names, ~~them,~~ are given, i.e their corresponding paragraphs of the Pentateuch e.g. 27th Thischri, Bereschith. These names have not only calendaric value, but often also chronological meaning. Quite often there are so-called Sabbatical dates, that is the day of the week with the notation before which reading it falls, is given as date. The days of the week are denoted by the number Sunday 1, monday 2, Tuesday 3 etc. or really by the corresponding 7 first letters of the Hebrew alphabet: Sunday, Monday , Tuesday Wednesday , Thursday , Friday , Saturday . That is why, e.g., Tuesday of the week on whose Sabbath Wajescheb is read is called : 3 Wajescheb or ג Wajescheb, therefore the Tuesday before Wajescheb [p XXV], therefore in a year whose calendar is 2 D (p 235) the Tuesday before the 24th Kislev is the 20th Kislev. ~~T~~Here it should be noted, that between some readings, because of holidays, there is more than a week. E.g. in a year 5 r there are 3 weeks between Zaw and Schemini, these 3 weeks therefore belong to the reading Schemini and are differentiated by I II III. In the calendar 5 r, e.g., since Schemini falls on the 29th Nisan; 4 Schemini I is Wendnesday before Nisan 15, or 12th Nisan 5 Schemini II is the Thursday before the 22nd Nisan, therfore the 20th Nisan; and finally 7 Schemini III the 29th Nisan itself.

In the calendars only the words that are not in parenthesis apply to all dates in the line, those in ( ) belong only to those printed in ordinary type, those that are [] apply only to those printed in bold type and those in ⟨⟩ to those printed in italics. So, for example, the 19th Nisan is the 3rd day Chol hamoed in all calendars and has in all calendars the letter a, but only in the calendars 5r, 5a, 7d, 2A, 3R, 5D does it also have the letter l; whereas in the calendars 2a, 3~~s~~T, 2D, 7A it has instead of that the letter h and in the calendars 2d, 7a, 5A, 7D a Sabbath ~~is~~ Chol hamodd is 60K. The number attached to the Saturdays and holidays point out the Haphtoren or readings from the prophets which are always given in the Jewish calendars especially for the Saturdays; the Latin letters point ot the first, the Greek letters, to the second Parasche or readings from the Pentatench on holiday, which are also quoted in many calendars, e.g. the "Normalkalender fur das ~~Komjerich~~ Königreich Sachsen. (For Saturdays there is no need of a letter to point this out, as the reading of the Pentateuch indicates the name of the Saturday (p 190).

"GEMINI ELEMENTA ASTRONOMIAE"

ad codicum fidem recensuit germanica interpretatione et commentariis instruxit

CAROLUS MANITIUS

Days named after phases – cf. Aratos
Daily Movement of moon p. 14
Minutes, Seconds, etc. p. 13
Moon's constants p. 17
13th p. 10
Zodiac movement p. 12

Translation from German
by
Erna Borm

Should add these items
to "Time in first Century"

Lipsiae
In aedibus B. G. Teubneri
1898

Chapter VIII

About the Months

A month is the time from one conjunction to the next or from one full moon to the other. A conjunction takes place when sun and moon are in the same degree. This happens on the 30th of the month. It is full moon when the moon stands diametrically opposite the sun. This happens about the middle of the month. The time of a month amounts to $29\frac{1}{2} + 1/33$ days.[4] In the course of a month the moon passes not only through the Zodiac but also that part of the sun is covering (passing through) in the course of a month in the direction of the signs; this is approximately one sign. Thus the moon is passing through about 13 signs in the course of a month.

The exact time of the month, as stated, amounts to $29\frac{1}{2} + 1/33$ days, but for the civil compution the month is rounded off to $29\frac{1}{2}$ days, so that a double month is equal to 59 days. For this reason, the civil months are counted alternately full (at 30 days) and hollow (at 29 days) for the double month has 59 days. From this, the lunar year of 354 days results: by multiplying $29\frac{1}{2}$ days by 12, the result will be 354 days of the lunar year. A distinction must be made between the lunar and the solar year. The solar year covers the course of the sun through the 12 signs, or 365 1/4 days, while the lunar year covers a period of 12 lunar months, or 354 days.

Since neither the month nor the solar year consists of whole days, the astronomers searched for a period covering whole days, whole months and whole years. To reckon the month according to the moon and the years according to the sun was done with a purpose by the ancient peoples. The demand made by the law and the oracles to present the sacrifices "after the manner of the fathers" all the Greeks understood to mean, that they were to keep the years in agreement

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4

with the sun, the days and the months in agreement with the moon. But to reckon the years after the sun means, to present the same sacrifices in the same seasons of the year (the spring sacrifice must always be presented in the spring). (the summer sacrifice always in the summer, likewise in the remaining seasons of the year, the same sacrifices had to be brought.) For they thought this to be pleasing and agreeable to the Gods. This is possible only in case the solstices and the equinoxes always come in the same months. To reckon the days according to the moon means , to keep the names of the days in agreement with the phases of the moon.

The names of the days are taken from the phases of the moon. The day, on which the new moon becomes visible was called because of this, "new moon"; the day the second appearance takes place was named the "second"; the appearance of the moon taking place about the middle of the moon was called after this "middle moon". So all days were named according to the phases of the moon. Therefore, the last day of the month, (the 30th), after the coinciding was named Trikade. In conformity here, Aratos expresses himself with regard to the names of the days as follows:

"Don't you see her? When she appears again as a tiny horn,
Luna on the western sky, of the new and growing month!
She teaches, as soon as the first glimmer of her is pouring out;
When she throws a shadow, she then goes to the fourth of the days;
Half on the eight, towards the middle of the month round as full moon,
Always from another place a different face, showing to us,
She announces to you what day of the month soon will be gone."

Thus, he plainly states that the names of the day were derived from the phases of the moon. As proof that the days are reckoned exactly after the moon serves the fact that the solar eclipses take place on the 30th--then the sun enters in conjunction with the moon and is in the same longitude--while the lunar eclipses occur in the night leading to the middle of the month--then the moon stands in opposition to the sun and enters into the shadow of the earth.

If, therefore, on one side, the years are reckoned exactly according to the sun, on the other side the months and the days according to the moon, then the Greek believed to bring their offerings "in the manner of the fathers" (the same sacrifices were offered at the same seasons of the year.)

The Egyptians had exactly the opposite understanding and intention than the Greek. For they neither reckon the years after the sun nor the months and days after the moon, but followed quite a peculiar principle. Because they did not that the sacrifices were brought at the same time of the year, but they should go through all seasons of the year,(the summer festival, at one time, is to become a winter festival, and the autumnal festival one day a spring festival). For they reckoned the year at 365 days, having 12 months at 30 days and 5 additional days. For the above given reason they do not count the 1/4 day so that their festivals would go backwards. In 4 years, they are one day behind as compared with the sun, in 40 years, they will be 10 days behind in relation to the solar year. Thus their festivals too, would keep behind in conformity with the purpose; not to have them in the same season of the year. In 120 years, the difference with the solar year, and with the seasons of the year too, will amount to a whole month.

This quite gradual increase can be considered as the reason why a common error, sanctioned by a tradition of many years standing, has been accepted in good faith with the Grecians. For the majority of the Greek are of the opinion that the winter solstice takes place simultaneously with the Isis festival according to the reckoning of the Egyptians as well as according to the calendar of Eudoxos. That is quite wrong; because the Isis festival differs with the winter solstice by a whole month.[16] The error crept in for the above stated reason. Once, (120 years ago) the Isis festival actually was celebrated exactly at the winter solstice; but only four years later the difference amounted to one day. That difference, it is true, was not noticeable in the season of the year. After 40 years, the difference amounted to 10 days. But this, too, would not be so conspicuous. However, at present, when after 120 years, the difference amounts to a whole month, the supposition, that the festival of Isis came on winter solstice according to the reckoning of the Egyptians as well as after Eudoxos, does not lack in ignorance. A difference of one day or at most two can pass, but a difference of a whole month cannot remain unnoticed. For the length of the days can serve as a clue which show a big difference compared with the winter solstice. Besides, the sun-dials showed plainly the true entry into the solstice, especially with the Egyptians who were such good observers. Thus, once upon a time, the Isis festival coincided with the winter solstice and still earlier with the summer solstice--as mentioned also by Eratosthenes in his treatise about the eight-year period--and in future it will be celebrated in the fall, at the summer solstice, in spring and again at the winter solstice. Because in the course of the 1460 years,[17] each festival must pass through all seasons of the year and again return to the same point of time.

Thus the Egyptians undertook to solve according to this peculiar principle the problem we are now dealing with thile the Greek, pursuing the opposite view reckoned the years according to the sun, the months and the days, however, after the moon. As to the ancients, their months had 30 days, and the intercalary months they inserted one year after the other. But because the correctness of this procedure in view of the phenomenon in the heavens soon was questioned since the days and months did not remain in harmony with the moon, and the years did not hold pace with the sun, they were looking for a period which with regard to the years would remain in harmong with the sun, with regard to the months and days in harmony with the moon, and yet consist of whole months, whole days and whole years. The first period they set up was the eight-year period; it covers 99 months including 3 intercalary months, or 2922 days, (eight years). They arrived at it thus. As the solar year has 365 1/4 days but the lunar year only 354 days, they took the excess of the solar year over the lunar year. It amounts

17

to 11 1/4 days. It we figure the months in the year according to the moon, we shall be behind as compared with the solar year, 11 1/4 days. Now, they searched for the number to multiply these days by in order to get whole days and whole months. You get this by multiplying by eight: 90 days or three months. Since we are behind 11 1/4 days in a solar year, it is clear that in eight years, compared with the sun, we shall be behind 90 days, or three months. Therefore, in each eight-year periods, three intercalary months are inserted, to make up for the annual shortage as compared with the sun, and the the festivals again come in the same season of the year. When this is done, the sacrifices are always presented in the same season of the year.

Now, the intercalary months had to be inserted as regularly as possible. One must neither wait until the difference, as compared with the phenomenon in the sky, amounts to one month, nor should a whole month be taken in advance, as compared with the course of the sun. For this reason, the instruction was given to insert the intercalary months in the third, fifth and eighth year, or two months after an interval of two years, one with but one year interval. It does not make any difference, however, should the corresponding order of the intercalary months be made in other years.

(The lunar year has 354 days. Therefore, the month according to the moon was reckoned at 29 1/2 days, the double month at 59 days. Thus, the months are full and hollow, alternately, because the double month has 59 days according to the moon. So the year has six full and six hollow months; the total of days amounts to 354.)

Were it merely the solar years we have to be in agreement with, we would remain in sufficient harmony with the phenomenon of the sky by applying to the phenomenon of the sky, the just described period. But inasmuch as not only the years are reckoned after the sun, but also the months and days after the moon, a method was searched in order to satisfy this demand, too. As the month, strictly speaking, amounts to 29½ + 1/33 days, while the eight-year period including the intercalary months has 99 months, the total of the days of the months was multiplied by 99, the number of months, ($29\frac{1}{2}$ + 1/33 99). The result is $2923\frac{1}{2}$ days, which means that in eight solar years, there are $2923\frac{1}{2}$ days according to the moon. But the solar year has 365 1/4 days; eight years according to the sun, thus, cover 2922 days which result you get by multiplying the days of the years by eight. As the days according to the moon in eight years amounted to $2923\frac{1}{2}$, we shall be $1\frac{1}{2}$ days behind in relation to the moon in the course of eight year. Consequently, in 16 years, we shall be three days behind as compared with the moon. For this reason in each 16-year period in consideration of the course of the moon, three days are added so as to reckon the years according to the sun but the months and days according to the moon.

$365\frac{1}{4}$ = Julian time

Making this correction has another mistake in its train. The three days added in 16 years in consideration of the moon cause in 160 years in relation to the sun to be 30 days or a month ahead. For this reason every 160 years an intercalary month is taken from the eight year periods (instead of the three months which should be inserted in the eight years, only two are inserted in the eight years, only two are inserted.) Thus after dropping this month again there is harmony as regards the months and days with the moon and with regard to the years with the sun.

After making this correction, still there is no harmony obtained with the phenomenon in the sky. For the whole eight-year period is wholly incorrect as regards the months, days and intercalary months. (For the time of the month is not counted exactly.[18] To be exact, the time of the month is 29 d. 31 m. 50 s. 8 t. 20 q. Therefore, in the course of 16 years, instead of three intercalary days, four will have to be added. Hence in none of the periods the same number of hollow months must be given as full months, the number of the full months must rather outweigh the hollow months. For if the month had only $29\frac{1}{2}$ days, an equal number of full and deficient months would have to be taken. Now, there is

18

in the monthly period a small noticeable fraction which grows to the length of one day. For this reason, the number of the full months must out number those of the hollow months.) There are not three intercalary months in eight years. For if the lunar year had 354 days, the difference with the solar year would be 11 1/4 days and this multipled by eight would certainly make three full intercalary months. But the lunar year has exactly 354 and 1/3 days. If we deduct 354 1/3 from 365 1/4 there remains 10 11/12 days. This multipled by eight amounts to 87 1/3 days (not three ful months). For this reason in eight years there must not be added three intercalary months. The same result you get with the help of the 19-year cycle. In 19 years seven intercalary months are inserted by which the 19-year cycle as regards the months will remain in harmony for a longer period. In eight 19-year cycles, there will be 56 intercalary months. In the eight-year period are three intercalary months, in 19 eight-year periods, (in 152 years), there will be 57 intercalary months. During that same time according to the 19-year cycle, which is in harmony with the phenomena in the heavens, there will be but 56 intercalary months. Thus, the eight-year period (in 152 years) has one intercalary month too many. Consequently, the eight-year period does not have three intercalary months, but is also quite faulty in this respect.

Because it has turned out that the eight-year period is incorrect in every respect, the astronomers of the school of Euktemon, Philippos and Kallippos[19] set up a new period in the 19-year cycle. For they had found through their observations that in 19 years, there are 6940 days or 235 months including the intercalary months. There are seven intercalary months in the 19 years. (Thus the year according to its reckoning has 365 5/19 days.) Of the 235 months, 110 were reckoned as deficient and 125 as full so that the full and hollow do not always alternate, but sometimes two full follow each other. This measure, not followed in the eight-year period results from the natural course of the

19

phenomena of the heavens in view of the behavior of the moon. Of the 235 months 110 were counted as hollow months for the following reason. Since there are in 19 years, 235 months, these at first were reckoned at 30 days each, or in total, 7050 days. But in the 19-year cycle, there were 6940 days according to the moon. Now if you take all months at 30 days, it amounts to 7050 days as against 6940, and this plus amounts to 110 days. Consequently, they take 110 deficient months in order to make full the 6940 days of the 235 months in the 19-year cycle. In order to distribute these days as evenly as possible, they divided the 6940 days by 110; thus you get 63 days.[20] Hence, in the course of every 63 days in this cycle, one day is to be pointed to as to be eliminated. So, in no wise always the 30th of the month is left out but always the day following the 63-day interval.

In this cycle to all appearances, the months are given correctly and the intercalary months are arranged in conformity with the celestial phenomena. But the time of the year is not in harmony with the celestial phenomena. If the time of the year from within a longer period of years is determined by observation, the concurring result is 365 1/4 days while the value derived from the 19-year cycle amounts to 365 5/19. This latter value is by 1/76 days bigger than the first. Therefore, the astronomers of the school of Kallippos have doen away with this excess by a correction and set up the 76-year cycle; it consists of four 19-year cycles with 940 months including 28 intercalary months, or 27759 days. The arrangement of the intercalary months was handled in exactly the same way. Experience has shown that this cycle agrees best with the celestial phenomena.

20

Chapter IX

On the Phases of the Moon

The moon gets its light from the sun, for her illuminated part is always turned toward the sun. If she rises before the sun, her illuminated part is toward the east, and if she rises after the sun, her illuminated part is toward the west. Whether she sets before or after the sun, her illuminated part is turned toward the sun. On some days, an observation has been made which presents itself but seldom, namely, that the moon sets after the sun and her illuminated part is directed toward the west. But after having passed by the sun during the night and now having arisen before the sun, her illuminated part is seen directed toward the east.[21] From this, it is evident that the moon gets her light from the sun.

Then the following observation has been made. When the sun rises during the winter solstice, exactly the center of the illuminated part of the moon is directed toward the sun, so that the line which connects the horns of the moon is cut in half by a point to point line under a right angle. If then, the sun rises at the time of the summer solstice, again the center of the illuminated part is directed towards the sun, so that likewise the above named line is cut in half and under a right angle. The same thing happens at the settings of the sun. Thus, this sign, too, proves that the moon gets her light from the sun.

However, at all times an equally great part of her is illuminated, (a half-sphere), only this equally great illuminated part is not always visible to our field of vision on account of the different elongations from the sun. For when on the 30th of the month, the sun and the moon enter the same degree, then the hemisphere directed towards the sun, is illuminated which is turned

21

from our field of vision; for the course of the moon is below the sun. But, if the moon--about the first of the moon--has passed by the sun, then she is seen in the form of a sickle; for of the illuminated hemisphere only a small part reaches our field of vision because of her moving sideways. But as the moon is distancing herself from the sun in the following days, the illuminated part is seen by us to an ever-increasing extent. If the distance amounts to a quarter of the Zodiac, the moon is seen half-full. For then exactly half of the hemisphere illuminated by the sun is turned toward us. If the distance of the moon from the sun becomes greater, then the illuminated part is becoming visible in greater measure. If it comes to stand diametrically opposite the sun, the illuminated hemisphere comes to our field of vision exactly opposite. The visibility of the size of the phases is always in relationship to the elongation. Finally, when the moon goes underneath the sun, she seems to us unilluminated. For her illuminated hemisphere is then turned upward to the sun wherefore the illuminated part of the moon naturally becomes invisible for us. From this is evident that the moon receives her light from the sun.

The moon passes through all her phases--four in number--in a period of one months, passing twice through each. The phases are as follows: crescent, half full, curved both sides, full. She has the form of a crescent at the beginning of the month, half full about the eighth of the month, both sides curved about the twelfth, full, the middle of the month; then again both sides curved, after the middle of the month, half full, about the twenty-third, the form of a sickle towards the end of the month.

However, the moon does not always take on the same form on the days named the same, but due to the irregularity of her movement, on different days.

The moon appears:

as a sickle at the earliest on 1st, latest on 3rd. 1 to 3
remains in form of sickle until 5th, or to 7th.
becomes half-full earliest on 6th, latest on 8th.
both sides curved earliest on 10th, latest on 13th.
X full earliest on 13th, latest on 17th.
2nd time both sides curved earliest on 18th, latest on 22th.
2nd time half-full earliest on 21st, latest on 23rd.
2nd time sickle form earliest on 25th, latest on 26th.

(The whole period of the month amounts to 29 1/2 + 1/33 days. The month is the time from one conjunction to the next or from one full moon to the other. Conjunction is the time when sun and moon enter the same degree which is the case on the 30th of the month.)

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Chapter XVIII

On the Great Period of the Moon

The great period of the moon is the shortest interval which covers whole (synodic) months, whole days and whole (anomalistic) courses of the moon. For, after having found by observation the time of the synodic months, the value of approximately 29½ plus 1/33 days for the anomalistic course of the moon, the value of about 27½ plus 1/18 days, the shortest interval was looked for which covers whole days, whole synodic months and whole anomalistic courses of the moon. With these it is as follows:

The moon passes through the Zodiac seemingly in an irregular velocity. For instance, if she has passed through the small part of the ecliptic in her course, her movement on the next day is greater than this, and is still greater in the following days until the greatest part of the arc has been covered; then again always a smaller part than the preceding until she returns to the smallest part of the arc from which she started, thus covering one course. The time from the smallest movement back to the smallest again is called anomalistic.

It is found by observation that the great period of the moon covers 669 whole synodic months or 19756 days. In this time the moon makes 717 anomalistic courses in longitude (that is, with regard to the Apsides and 726 anomalistic courses in latitude; that is, with regard to the nodes,[32]) while in the time mentioned she passes 723 times the Zodiac and, in addition, 32°. Knowing these facts through observation of the sky since ancient times and as it was necessary to determine the daily anomali in longidtue, the question was raised:

1. How much is the smallest, the greates and the mean movement of the moon?

2. How much is the daily increase or decrease of her movement?

From the observation of the sky (for the solution) as a help served furthermore the fact that when passing through this smallest part of the arc in her course, she covers more than 11° but less than 12°, and when passing

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through this greatest part of the ecliptic, she covers more than 15° but less than 16°.

Since now it has been determined through observation that the moon passes in 19756 days 725 times the Zodiac and, in addition, 32° and as each circle has 360°, I have reduced the number of circles into degrees adding 32° to it. The total amounts to 260312°. So the moon passes through this number of degrees in 19756 days. By dividing the number of degrees by the number of days we shall find the average daily movement of the moon, for if you simply divide the number of degrees by the number of days, without consideration of the increase or decrease of the movement, you get as a result the so-called mean movement. It amounts to $13^\circ\ 10^m\ 35^s$. (The 60th part of a degree is called minute; the sixtieth part of a minute is called second. Likewise the second is divided into sixty parts and each sixtieth part is called tertie.)

With the help of the mathematical example here given, the Chaldeans have found the mean movement of the moon to be $13^\circ\ 10^m\ 35^s$. As the moon in 19756 days makes 717 anomalistic rounds, in order to know in how many days the moon is making one round we must divide the number of days by the number of courses. Then to one course come $27^d\ 33^m\ 20^s$. ($= 27^d\ 33^h\ 20^m$). In so many days the moon gets from the smallest movement back again to the smallest.

As now in the whole course there are four even periods, I have taken the fourth part of $27^d\ 33^m\ 20^s$ which is 6 d. 53 m. 20 s.; thus the moon gets in so many days from the smallest movement to the mean and from the mean to the greatest; then again, likewise from the greatest to the mean and from the mean to the smallest. These four periods are equal.

Then we apply the theorem: In an arithmetical trinomial progression, the total of the first and third term is double that in the middle. In the movement of the moon there are three figures which form an arithmetical progression; the smallest, the mean and the greatest movement. If we now add the greatest and the smallest, their sum total will amount to double that of the mean movement. The mean movement amounted to 13° 10 m. 35 s.; I have doubled this value and get 26° 21 m. 10 s. Consequently the greates and the smallest movement of the moon totals 26° 21m. 10s. But the greatest and the smallest movement as found by observation in the rough totals but 26°. Thus there remains a plus of 21 m. 10 s. which had slipped the observation made with the aid of instruments. This plus must be added to the smallest and the greatest movement so that the total of the two movements amounts to 26° 21m. 10s. One must, however, be careful in adding the excess that on one had the smallest movement will not become greater than 12° and on the other hand, the greatest not greater than 16°.

The exact division will have to be made in the following manner: As the moon gets from the smallest movement to the mean and from the mean to the greatest in 6d. 53m. 20s. and as the increase as well as decrease is a stationery quantity, a figure must be found which multiplied by the fourth part of the time of the course will result in a figure which added to the mean movement amounts to a value which lies between 15° and 16° but deducted from the mean movement leaves a value which lies between 11° and 12°, while the values to be added to 15° or 11° total 21 m. 10 s.

The figure with the looked for quality is found in the value 0° 18 m. For, if you multiply this value by the fourth part of the time of the course, that is, 6 d. 53 m. 20 s. the result is 2° 4 m. Now you get from the mean movement found above by addition or subtraction of this quantity:

13 d. 10 m. 35 s. + 2 d. 4 m. = 14 d. 14 m. 35 s.
13 d. 10 m. 35 s. - 2 d. 4 m. = 11 d. 6 m. 35 s.

Consequently, it is found the smallest daily movement of the moon equals 11 °. 6 m. 35 s.
the mean movement of the moon equals 13 °.10 m. 35 s.
the greatest movement of the moon equals 15 °.14 m. 35 s.
and the daily increase of the moon equals 0 °. 18 m.

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p. 237

Appendix I

On Geminos' Era, Fatherland and Writings

The starting point of the controversy on Geminos' Era and Fatherland forms the suppositions laid down by Petau, partly in the introduction and treatises on the Uranologium and partly in the comments on the Isagoge. In the first place (p. 8) he states briefly and plainly Geminos has lived at the times of Sullas and Cicero; that his fatherland was the Island of Rhodos is generally agreed but that he is supposed to have stayed in Rome and Italy and there written the Isagoge is based on a conclusion not to be easily dismissed, supported also by thename Geminus which indicates a man standing in the midst of Roman traffic, maybe the freed slave or client of a family by this name as, for instance, the servilian. The supposition for which the reason is given in detail in the treatises, p. 150, et seq. The supposition that Geminos has written the work preserved for us in Rome is based on something which cannot be considered authoritative to us due to fragmentary tradition. (See Note 10.) Thanks to a keen combination for his era, the year 77 B. C. is determined. The suppositions of later scholars, as Voss, Weidler, Hamberger, Ideler, Delambre, Grasse, et al, based more or less on Petaus' conclusions. Mas C. P. Schmidt (1884, p. 88) has carefully compiled. To this list Paul Tannery (1885 p. 285, et Seq.) should be added, who comes to the year 30 B. C. by a rather forced interpretation (See Note 16), thus making Geminos a cotemporary of Strabon.

Of the differing suppositions which give the era of Geminos considerably later or earlier (see Schmidt 1884, p. 85, et seq.), only one deserves to be mentioned because it has found adherence because of the detailed reasons given. It is a supposition of Brandes that Geminos had written his Isagoge about 140 B. C. Scaliger already in 1598 had understood the statement in Chapter VIII, pp. 2-24 concerning the time to mean that Geminos was 120 years later than the astronomer Eudoxos of Knidos (about 380 B. C.), which is about 260 B. C., thus to be sure Geminos would be older than Hipparchos to whom he referred, which also caused Scalinger's well founded doubts. Proceeding from the same understanding of the difference in time, Brandes (1847 p. 219) tried to remove all doubts by distinguishing a younger Eudoxos of Rhodos from the older Eudoxos of Knidos whose paper Ges Periodus, written about 260 B. C., was taken by him as Geminos' source on the Egyptian Isis festival.

(Summary, p. 251)

Our final conclusion is that the Stoic philosopher Geminos, presumably a Greek from the Isle of Rhodos, the author of a voluminous work on the systematical division of mathematics, wrote about 73-67 B. C. a commentary not less voluminous to the meterological elementary text book of his teacher, Poseidonios of Rhodos. From an epitome of this commentary edited by himself and existing until the sixth century A. D., an unnamed author of the fourth to fifth century A. D., writing at latitude 41° (Canstantinople ?) under the original title, "---------greek--------------(page 252)" made excerpts set off with all kinds of additions which have come down to our time as Geminos' Introduction to Astronomy.

Appendix II

(P. 13, 101, 201) The tropical month discovered by Hipparchos, that is, the time when the moon proceeding from the vernal equinox again returns to same, amounts to 27 days, 7 hours, 43 minutes, 4.7 seconds = 27.321582 days around 27-1/3 days. As the vernal equinox because of the precession of the equinox moves toward the moon, therefore the tropical month is by a few seconds shorter than the sideric month, by which term is understood the time when the moon proceeding from any fixed point again returns to the same point. This time amounts to 27 days, 7 hours, 43 minutes, 11.5 seconds = 27.321661 days.

Furthermore, two additional courses of the moon are to be considered.

(a) p. 101--The synodic month, that is, the time between the two nearest conjunctions of the moon with the sun, amounts to 29 days, 12 hours, 44 minutes, 2.9 seconds = 29.530589 days, or around 29½ days plus 3/100 - 29½ days plus 1/33.

(b) p. 201--The anomalistic month, that is, the time in which the moon from the perigee again returns to the same, amounts to 27 days, 13 hours, 18 minutes 37 seconds, or 27.554600 days, around 27½ days plus 55/1000 = 27½ days plus 1/18th.

Translation of Karaite Calendar from Yale.

The photostats reproduce material from a 5594 (the present year, according to the Jewish calendar is 5700, so that the year of the photostats is 106 years ago) edition of Elijah Bashyazi's Addereth Eliyahu (The Mantle of Elijah), a classic Karaite treatise. Although the photostat copies present no complete calendar for any particular year, they nevertheless furnish relevant data. Tables I and II give cyclical excesses which facilitate the computation of the calendars for 5594 (1833-34) and 5595 (1834-35).

As is readily seen from the detailed description of the calendar in the Addereth Eliyahu, the Metonic 19-year cycle of 235 lunations is adopted by the Karaites. On page 136, col. 2 (Addereth Eliyahu, Odessa, 1870), Bashyazi sanctions the system by tradition traceable back to the Anshe Keneseth Hagedolah (the Men of the Great Synagogue, perhaps in or shortly after the time of Ezra. These Men of the Great Synagogue are mentioned in the first chapter of the Pirke Aboth, or Ethics of the Fathers). The year 5594, corresponding to 1833-34, is equivalent to 294 cycles and 8 years. As the eighth year of the 295th cycle, 5594 is, of course, embolismic. The year 5595 corresponds to 1834-35, and is to be regarded as common.

The basic difference between the Rabbanite and Karaite methods of calculating the Molad consists in the fact that the Karaites take into account the meridian of each locality, whereas the Rabbanites fix the Molad relative to the meridian of Jerusalem. For example, Molad Tohu or Behard is fixed at 2 days, 5 hours and 204 chalakim (2 days, 5 hours 11 minutes and 20 seconds). Since solar time at Jerusalem is 2 hours, 21 minutes in advance of Greenwich, the Karaites would modify Molad Tohu for Greenwich by deducting this excess. Thus 2 days , five hours, 11 minutes and 20 seconds minus 2 hours 21 minutes equals 2 days 2 hours 50 minutes and 20 seconds, which equals Sunday, 8 hours, 50 minutes , 20 seconds P.M.

Again, in Table III we find the Molads of the various months of the first year of creation. Molad Behard was computed for the meridian of Tet Resh
(Tarshkav)
Shin Kuf Vav (ibidem, 14a, col. 1).

The Karaites reject the Rabbinical rule (BaDU) enjoining theoccurrence of the fifteenth of Nisan (i.e. the Passover) on Monday, Wednesday ~~and~~ or Friday. (Shinedling's note: the B in Badu stands for the second day of the week, i.e. Monday, since the letter Beth in Hebrew means 2; the Daled in Badu (the D) stands for the fourth day of the week, since Daled is the fourth letter of the Hebrew alphabet; and the U in the word-abbreviation BaDU stands for the letter V, the sixth day of the week, or Friday, since the letter Vav in Hebrew stands for the number six; thus the abbreviation BaDU means that the 15th of Nisan, the first Hebrew month, or the holiday of Passover, may occur on either the second , fourth or sixth days of the week, i.e. Monday, Wednesday or Friday, but not on the other days). Consequently, since Tishri (the seventh Hebrew month) the first (the first day of Tishri, the Jewish New Year's Day) is invariably the 163rd day after Nisan ~~in~~ 15th of the preceding year, and since the number ~~tx~~ 163 is of the form 7n plus 2, it would follow that if Passover should commence on Monday, Wednesday or Friday, the next Tishri 1st would then necessarily occur on Wednesday, Friday or Sunday, respectively. The Rabbanites exclude Wednesday, Friday or Sunday for Tishri 1st with the memorial word ADU (A equals Alef, the first letter or day of the week; D equals Daled, the fourth letter or day of the week, i.e. Wednesday; U equals Vav, the sixth letter or day of the week, i.e. Sunday; therefore on Adu, or the first, fourth and sixth days of the week, Tishri 1st can not fall), but the Karaites admit these days of the week for Rosh Hashanah (the New Year's Day, on the first day of Tishri). The rabbinical postponement of Tishri 1st because of Yach (when the Molad exceeds 18 hours of a particular Jewish feria; the letters Yod Heth, or Yach by abbreviation in Hebrew, are the numerical equivalent of 18)is not recognized by the Kataites. The name apparently applies to Gatrad and Batu Thakpat - corollaries of ADU and Yach.

Let us now compute the Molad of 5594 (1833 -34).

5594 = 294 cycles and 8 years

Molad Behard ... 2 days 5 hours 204 chalakim

Excess of 200 cycles ... 5 days 22 hours 200 chalakim

Excess of 90 cycles ... 4 days 1 hour 630 chalakim

Excess of 4 cycles ... 3 days 18 hours 220 chalakim

Excess for eighth year ... 5 days 15 hours 158 chalakim.

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19 days, 61 hours and 1412 chalakim, which is reducible to 7 days 14 hours 332 chalakim corresponding to Saturday, September 14th (Gregorian) or September 2 (Julian) 8 hours 332 chalakim A.M.

For the Molad of 5595 (1834-35), we obtain

Molad 5594 ... 7 days 14 hours 332 chalakim.

Excess of embolismic year ... 5 days 21 hours 589 chalakim.

Molad 5594 ... 7 days 14 hours 332 chalakim.

Molad 5595 .... 6 days 11 hours 921 chalakim, and because of ADU, Tishri 1st is postponed to Saturday, September 22 (Julian) or October 4th (Gregorian). The embolismic year 5594 is of the form 7 n = 385 or abundant. According to the Karaites who would allow 5595 to commence on Friday, the preceding year is regular and embolismic. We can conclude that the divergence between the Rabbanites and Karaite calendars for 5594 is relatively slight.

Next:

Molad of 5596 ... 6 days 11 hours 921 chalakim

Excess of common year ... 4 days 8 hours 876 chalakim

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10 days 19 hours 1797 chalakim,

which is reducible to 3 days 20 hours 717 chalakim.

The Molad of Tishri 5595 equals 6 days 11 hours 921 chalakim, and ADU defers Tishri 1st to Saturday, September 22, 1834 (Julian) or October 4 (Gregorian). Again, Yach and ADU postpone the commencement of 5596 from Tuesday to Thursday. Hence 5595 commences on Saturday and ends on Wednesday, September 11th, 1835 (Julian) or September 23 (Gregorian). Consequently, the number of days in 5595 is of the form 7n plus 5, and the year consists of 355 days which renders it abundant in the Rabbanite system.

Let us now consider the situation from the Karaite viewpoint. The Karaites allow 5595 to begin on Friday, October 3, 1834 (Gregorian) and terminate with Monday, September 21, 1835 (Gregorian). Accordingly, 5595 comprises 354 days of the form 7n plus 4. The year is common and regular.

On this basis, we can attempt to reconstruct the complete Rabbanite and Karaite calendar of 5595:

(see next page)

Molad 5595 .... 6 days 11 hours 921 chalakim

Tishri 1st	RABBANITE Saturday, October 4, 1834	KARAITE Friday, October 3, 1834
Tishri	30 days	30 days
Marheshvan	30 days	29 days
Kislev	30 days	30 days
Tebeth	29 days	29 days
Shebat	30 days	30 days
Adar	29 days	29 days
Adar	~~ii~~ 29 days	29 days
Nisan	30 days	30 days
Iyar	29 days	29 days
Sivan	30 days	30 days
Tammuz	29 days	29 days
Ab	30 days	30 days
Elul	29 days	29 days
	355 days	354 days

It is obvious that the Rabbanites would celebrate Yom Kippur (the Day of Atonement) on October 13th and inaugurate Sukkoth (the Feast of Tabernacles) on October 18th, whereas the corresponding Karaite dates are October 12th and 17th. Next we observe that the Rabbanites would count 178 days between Tishri 1st inclusive and Nisan 1st exclusive, while the Karaites would include 177 days in this period. Hence, Nisan 1st, according to the ~~gx~~ former, occurred on March 31, 1835, and according to the latter, on March 29 (Gregorian).

CONCERNING THE MONTHS OF THE HEBREWS
Read
On the 21st day of July, 1764
Before the Royal Society of Scientists
By Joanne Davide Michaelis
Bremen

P. 16

I

The laws of Moses do not seem applicable to those months, which the Jews now enumerate, beginning the year from March.

Desiring that your work and that of other learned men become more certain, allow me to set forth to you colleague the suggestion that the truth[1] concerning the months of the Israelites has not been explored. The first month of the Jews who now are, falls almost in our March, except that which commonly occupies a part of April, on account of the ~~uncertainties~~ variations of the lunar year. For since the year of the Hebrews beginning from the new moon, is lunar, and the months lunar, the Jews commence their Nisan from the new moon that falls in March, which will embrace some days of April, or even very many, if the new moon falls, not upon the first, but upon the middle and last days of March.

P. 17 Hence it may be that some lexicographers interpret Nisan as March, others compare it partly to March, partly to April. Certainly, if the new moon should arise on the Kalends of March, or the day after, or the third day from the Kalends, the whole of the month of Nisan will ~~be~~ run even to the end of March, unless it should be intercalated: but if later, as many days of our April are referred to Nisan, as are taken from March. Whence, it may happen that if the new moon falls upon tha last days of March, almost the whole of April was being transferred to Nisan.

From this month the Jews number the rest; therefore, if we refer Nisan, the first month of the Jewish year to March, it follows that the second corresponds to April, the third to May, and, not to number all, the seventh to September, such as can happen in lunar months.

Thus the Jews of our time compute their months, and they likewise think that

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[1] So it seemed to me in the beginning, but after he consented to the testimony of Josephus, in this year, at length, I observed that which I may present at the end of the dissertation--the truth does not now seem to be a suggestion and conjecture, but just as sure as in a philological or historical question.

the same plan of the months had been recounted by Moses. The Christians follow them, and interpreters of the sacred literature, and lexicographers, no one, of whom indeed I may remember, differing from among those more recent.

But even so, the fact that Moses had numbered their months, began to look very different to me after I beheld that the first lines of the economical calendar of Palestine, which I owe specially to Shawius and Beer, oppose the laws of Moses, as understood from the Jewish calendar. For those feasts, which Moses ordered to be celebrated in the first, and third and seventh month, cannot agree with March, May and September, in the climate of Palestine.

Nor indeed am I ignorant that the temperature of heat and cold is much more
P. 18 changed on account of the neighborhood of Lebanon than is wont to be otherwise in so small an interval of about two degrees. The fields that lie under Lebanon, or are near by, turn yellow much later than in the south; and Jericho is reported to be more premature than all the rest, on account of the most intense heat of the sun in that plain: even which pretext Jeroboam perhaps used, in desiring to turn away his ten tribes from the public sacrifices at Jerusalem, he ordered the festivals to be celebrated one month later,[2] because, in his part of the kingdom, which was lying under Lebanon, the maturity, harvests and vintage were later. But concerning this northern Palestine, I do not now dispute: yet, in the south, the tract of Jericho not excepted, I do not think that in March, April. May and September, those things could be carried out which Moses commanded in the first, second, third, and seventh month.

II

A little handful of first fruits could not be offered in the month of March.

On the sixteenth day of the first month, later writers call Nisan, Moses, the month of corn, a little handful of ripe corn had to be offered to God, which Moses by law had consecrated as the first fruits of the field, and when these had been offered, at length he was allowing them to eat the corn, the green herbs, and the parched grain, and to send the sickle to the fields. Lev. XXIII: 9-14. From which law, who

[2] 1 Reg. XII:33.

P. 19 does not conclude that surely in certain parts of Palestine the fields begin to ripen on the 16th day of the month Nisan? But Shawius, who himself went to Palestine, reported accordingly concerning the time of the ripened fields:[3]

"At the beginning of April (but that is, since Shawius used the English, or old-style calendar, about that day of April which is our 12th) the barley had protruded its ears, indeed growing yellow in the southern tracts in the middle of that month (in our calendar toward the end of the month). Certainly I had seen in a precipitate March around Jericho, such as was almost after the half month about Acre. But wheat in that time was more rare than the barley ears, and around Jerusalem and Bethlehem was about a foot high. Therefore, in such a year, as was 1722, when I wandered through the Holy Land, with difficulty do the first fruits seem possible to be offered in their own time and day, except by intercalation of the month Veadar, and even by delaying the paschal days through the whole month."

And concerning intercalation indeed, as Maimonides believes, below we consider: but this is plain, that if, either in southern Palestine, and around that of Jericho itself, whose premature suburban estates are praised, the barley corn was beginning to turn yellow at length in the middle of April, in the year that Shawius traversed Palestine, it could not at all happen that a little bundle of ripe corn would be offered on the 16th day of March, and that the beginning of harvest would be on that day. For suppose that the new moon fall upon the 16th day of our March, and that the 16th day from that day be counted at the last of March, yet, it could
P. 20 not be that either the sacrifices commanded by Moses be carried out on this day, and then that the beginning of harvest be decreed. Yet it will be sufficient that that year was unusually late in which Shawius saw Palestine (although the rest of the things which he narrates nearly agree with those things which some have reported who have travelled into Palestine) if in common years, this should be the face of the fields of Palestine at the beginning of April, as he saw in the middle of that month. Besides, all who relate the time of harvest in their itineraries, report that the corn turns yellow in the months of April and May, and is reaped.[4]

Since these things are so, a little bundle of ripe first fruits could not be

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[3] Shawius, "Travels and Observations in Several Parts of the Levant," p. 364, first edition; p. 335, second edition. Oxford, 1757.

[4] Cf. that which will soon appear--Buschingius, "Geography of Asia," p. 299.

P. 20 offered on the 16th day of March, nor indeed in the whole month of March in Palestine, yet Moses commanded this sacrifice to be made on the 16th day of the first month, and Josephus, who lived even when the second temple was standing in Palestine, and performed the office of priest, described the sacrifice of that day, such as was the religious rite in his time. Neither am I willing that he be heard as an interpreter of the Mosaic laws, in which part he could err, but as a witness of those things which he had seen daily, and as a priest reporting concerning the sacrifices of his own time.[5] [Michaelis here gives the Greek and Latin of the reference in Josephus.]

P. 21 Reading these things, who will suggest that they plainly did not agree, by the command of Moses, with the atmosphere and climate of Palestine, and that in the accomplishment of the sacrifice there had been difficulties on account of the failure of the ripe corn, that the priests had resorted to intercalation as often as it would happen, in order that the office and observance might be true to the precept offered unawares? Who will not rather think that there had been abundance of ripe corn on the 16th day of that month which Josephus calls the first, and that the beginning of harvest had been made from that day? If which things are true, that first month cannot be of our March, nor can at all proceed from the new moon [day] which falls upon the first part of our March from the Calends even to the 16th or 20th.

III

Neither could the harvest be finished before the feast of Pentecost.

Seven weeks having elapsed since this 16th day of the first month, even upon the fifth or sixth day of the third month the pentecostal festivals were approaching.
P. 22 Then, the harvest of thanks to God having been finished, the first fruits of new bread were observed and offered, even whence was the name for the feast.[5] And not otherwise has Josephus reported concerning the thing in his own time as wont to be done.[6] But these accomplished days of harvest would have been disturbed in the mid-

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[5] Exod. XXIII:16. Levit. XXIII:16, 17, 18.
[6] Josephus, Ant. l. III. c. X. par. 6.

P. 22 dle of harvest, if they were celebrated at the beginning of May: and this was necessary to be done, if you should begin the year of the Hebrews from our March, as often as the new moon [day] was falling upon the first part of March. But if the new moon were on the very Calends of March, it was necessary that the pentecostal sacrifice follow on the fifth or sixth day of May: and a little later, according as the new moon had appeared on the second, or third, fourth, and the remaining days of March. At length let it be that she appear on the 16th day of March, and the pentecostal sacrifices would have been on the 21st or 22nd of May.

Now let us see how this agrees with the harvests of Palestine. Korte reports that they turn yellow in the month of April and May; and at the same time, even on the 20th day of May in mount Sion he saw that the barley was not yet reaped. Schmidius, in the great plain near Carmel, on the 23rd day of this month, saw the wheat even in the fields, awaiting the reapers: and Schweiggerus in Galilee, no doubt far from the lake of Galilee, on the 30th day of the same month. Hasselquisto, the wheat harvest in Galilee was during the month of May.

If therefore in May the harvest through the most parts of Palestine was remaining, lest indeed in a precipitate month it should everywhere be brought to the end, of what legislator, I ask, would it belong to so appoint the eucharistic sacrifice of the completed harvest so that then upon the fifth day of May, or the rest, it should fall, in place of the lunar months? It would seem foolish if anyone should
P. 23 call the people from the fields in that very time in which the return of the land had to be gathered, and compel them into one city by reason of celebrating the the sacrifices through

IV

And the feast of Tabernacles does not fit September.

Moses appointed the feast of Tabernacles at the going out of the year, after the completed collection of all the fruits (these are the very words of the lawgiver)[7] the thanksgiving of which feast was bound to embrace also the vintage, especial-

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[7] Exod. XXIII:16. Levit. XXIII:39.

P. 23 ly in that land whose peculiar riches are contained in the vintage--there is no doubt. But if the seventh month, on whose 15th day the feast of Tabernacles was beginning, was September, was calling Israel from the vintage, and was compelling the ripe grapes to remain on the vines, the feast was appointed without forethought. Certainly, on the 15th day of September, Polschnitzius, and on the 19th, Neidschitzius, around Jerusalem, that is in the southern and premature part of Palestine, ate fresh grapes from the very vines which had produced them,[8] so that if there were any vintage (which in this time is hardly any in the Palestine subjected by the Mohammedans) it would seem to fall upon those very days which Moses said should give up to the feast of Tabernacles. If this plan of the vintage is around Jerusalem, in Galilee in the beginning of October, it follows that the vintage could not yet have been finished.

I confess, these disagreements of the law and climate were less if the new moon should appear after the Calends of September: but yet even thus in the month of September the feast would have to be celebrated in the midst of the vintage, unless

P. 24 the new moon be later than the 16th day of our September.

Now, what greater stupidity of the legislator can be thought of, let me not say by divine bequest, or that not wholly unworthy of a foolish man, than to call the people in that very time from the vines, in which the vintage was first beginning at least throughout all Palestine, and to gather them together into one city for eight whole days for thanks to be offered by the divine will for the vintage which had to be lost through their neglect?

Indeed Josephus reported too little concerning this feast, not even relating the cause on account of which it was instituted: yet his testimony maintains this that it was celebrated in the time now verging toward winter[9] . . . and that therefore even Moses ordered the huts to be built over the houses because the cold had to be avoided in that time of the year. But how this agrees according to September, at the 31st de-

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8 Beer, "Abhandlungen zur Erläuterung der Zeitrechnung," P. II. p. 27.
9 Antiq. l. III. c. X. par. 4.

P. 24 gree of latitude of the city, when, among us, at the 51st degree, we find that
month so mild, no one easily disproves: and even more will it be seen to shrink
back from the climate of Palestine, from those selections which Beer chose for Pal-
estine with reference to September. Hence Relandus labors to explain these words
of Josephus: and altho they all pertain to the history of the elements and of the
climate, he does not undertake to illustrate, as was right, from the itineraries,
but from ancient Jewry, and from the Talmudic writings, not even having surmised
P. 25 from this that those very months, concerning which the oral tradition of the Jews
was held authentic by the literature in the Talmud, could be others than those
which are now so called. But, in our October, those things are most applicable,
which Josephus considers at the beginning of winter: for in that month, even the
rains begin sometimes, and it is necessary that some days now be cold, especially
around evening.

The Intercalations of the Jews do not solve the uncertainty.

Indeed I know what the Jews devise by which the Mosaic institutions could be
preserved by the very months themselves. Namely, they intercalate, as often as nec-
essary, the month Veadar, after Adar, or February. But, as I readily would grant, that
P. 26 the lunar months have the work, in order to be reduced in some way to the solar year,
yet I think that these intercalations are to be made according to the course of the
stars, and the precepts of astronomy, so that they are not ~~aided~~ prompted by unsuitable laws,
and by discordant things from ~~heaven.~~ the climate. Indeed a wise legislator, imbued even with
a moderate conception of the year and months, which no one will take away from Mo-
ses, octogenarian and philosopher, would not have offered those laws, the plan of
which is unable to agree with the atmosphere and climate of the land into which he
leads the people, unless perpetual intercalations had been called to aid.

VI

The Jewish calendar of our time, different from the Syrian. To the Syrians Nisan is April: according to which method the Mosaic laws also are to be understood.

But between the climate of Paledtine and the laws of Moses harmony will agree, only let us concede to the Hebrew names of the months that meaning which obtains

P. 26 with the Syrians. For to these Nisan ( ) is the first month of the year, not March, as by the new Jewish calendar, or by Hebrew lexicographers, nor the middle between March and April, but altogether it is April.

[Complete list of the Syrian months, their etymology, and comparison with the Jewish names]

P. 34 Thus far I will praise one of extraodinary merit in reference to Syrian chronology--Theophilus Sigfrid Bayerus. In reference To him, discoursing, indeed not concerning the months, but about the year of the Syrians, and its beginning from October, and in passing, indicating also the months--cf. page 17 of the Osrhoena history--

Tisri prior takes its beginning from	1st October
Tisri posterior	November
Conum prior	December
Conum posterior	January
Schvot	February
Odor	March
Nison	April
Jor	May
Chsiron	June
Tomus	July
Ou (Ab)	Augustus
Ilul	September

VII

P. 35 The plan of the Syrians of naming the months is ancient and Mosaic: of the Jews, recent and erroneous.

For now since no one can doubt but that to the Syrians and Chaldeans, who are Aramaeans, changed in name alone, not in tongue, and using a dialect known to the Hebrews, the common names of the months would, once upon a time, mean the same: it is manifest that in one of the two calendars, either Syrian or Jewish, in progress of time, error crept in. But of which people do we believe it to be? of that one, which, for so many ages, dwelt among other nations, using another calendar, without country, and having no fatherland? or of the Syrians, even up to this time, inhabiting their Syria? Or, if this does not suffice as to the opinion to be offered, in such a battle of the laws of Moses with the Jewish calendar, and in such with Syrian agreement, who can cover up that the error is of the Jews, and that the months recounted by Moses, and other ancient Hebrew writers, are to be taken from the fasti

P. 35 of the Syrians, not from the Jews? especially since the month Adar, said to be from Aries, is March to the Syrians, in which the sun goes forth in Aries, but February to the Jews, in which he goes forth in Pisces?

But in what time the Jews first revolted from the ancient and true plan of the months, perhaps by defect of intercalation, or having imitated the Romans, for whom March was the first month of the year, the seventh, September, whether before or after the written pandects of the Talmud, or the school of Tiberias should command the error, or some other, concerning this not yet is there anything of certainty fixed for me. Indeed we shall next see this a little that <u>to Josephus the ancient description of the year up to that time had been alone recognized</u>, in making Nisan to be April, and Tisri, October. In what time the Hebrew Bible was translated into

P. 36 Syriac, the Jews were having the same months with the Syrians: for the Syrian interpreter, to whom the Jewish Bible could not be unknown, when he turned from the Hebrew language, and many Jews were inhabiting Syria, Mesopotamia, Babylonia, and had there academies the most celebrated of the lands, therefore this Syrian interpreter restores the same names of the months for the Hebrew [names], plainly not having surmised that the Hebrew months anticipate the Syrian by a whole 30 days. Let there be for examples: <u>Nisan</u>, Neh. 2:1; Est. 3:7; <u>Elul</u>, Neh. 6:15; <u>Shebat</u>, Zach. 7:1; <u>Adar</u>, Ezr. 6:15; Est. 3:7, 13; 8:12, etc.

VIII

Josephus agrees with the Syrian calendar, ignores the Jewish.

It is necessary, if anyone continue to defend the calendar of the Jews, or to even doubt in a thing so manifest, he would pledge faith in the Rabbins: and yet in such a case, let me even dare to take away the doubt, or surely to shake the opinion accepted from the Jews, by a loud very credible witness, who lived in Palestine at the time the temple was then standing, who saw the feasts, celebrated them, and, himself a priest, offered the sacrifices. I speak of Josephus, whom I wonder as not having been heard in this thing, but even I confess that scarcely now is it questioned by me, although I set these things forth that were written four years ago. Certainly he could not be ignorant in what month, and as to what feast would be celebrated up to his own time in Palestine.

In the first month, which Moses calls even the month of corn, others, Nisan, Moses left the writing that the Israelites departed out of Egypt, and in memory of that thing that the paschal sacrifice was instituted in the middle of that month.
P. 37 This, the rest think to be March, but I teach is April. Now let us listen to Josephus.[10] [Original Greek text of Josephus is quoted]: that is, "God commanded Moses to inform the people that they should have ready at hand the sacrifice, preparing it from the tenth day of the month Xanthicus to the fourteenth: which month is indeed called Pharmuthi, among the Egyptians, and by the Hebrews, Nisan, but the Macedonians call it Xanthicus." Therefore in the month Xanthicus, that is, April, Josephus had been accustomed to celebrate the passover, it is testified, and that this month is called Nisan by the Hebrews, and that on the fourteenth day of this month, the Israelites left Egypt. The same is given in Liber III, chap. X, sec. 5. [Original Greek text is quoted, followed by the Latin]: "But in the month Xanthicus, which is called by us Nisan, and is the beginning of the year, on the fourteenth day after the new moon, when the sun is disposed in Aries, He ordered the sacrifice, which I said above that those then departing from Egypt performed, namely the Passover, to be carried out every year. But this we do in companies, etc." What could be said more clearly and distinctly than this? He names the month Xanthicus; he adds that the sun was then stationed in Aries, which was in truth on the 14th day of April, but falsely, on the 14th day of March, in which time, indeed, it was established in Pisces, but at length on the 21st day of March, entered Aries. And truly Josephus has not been understood by the learned interpreters. For, Bernardus, who has commented plentifully on this part, has much etymology on the names of the months,
P. 38 but he did not give warning that Josephus is contrary to the common error of our time. Indeed the accepted opinion was of so great value, and the authority of the Jewish calendar, that they feign that Josephus speaks not concerning the months of

O.K. for 70 A.D. (Ginzel)

[10] Josephus, Ant. II. c. XIV. sec. 6.

P. 38 the Macedonians, but concerning the months of the Syro-Macedonians.[11] But this, as is said gratis, would be especially opposed to our position, whereby the celestial sign is called to mind, in which the sun was stationed on the 14th day of the first month.

The same one had the seventh month, on whose Calends the new moon usually fell, and on the 10th day, the feast of propitiation, and on the 15th day, the sacred days of tabernacles--not September, but October. For thus he begins the description of these feasts,[12] "but in the seventh month, which the Macedonians call Hyperberetaeus (that is indeed, October)." Since this meaning, which he had written so plainly, was one of preliminary judgment, it would not be of one who is ignorant that Hyperberetaeus is October, as Havercampius even wrote under this very place: "indeed the new moon of the month Tisri, which happens upon September of the Romans, and upon Hyperberetaeus of the Macedonians."[13] Again, in reference to the dedication of the temple, making mention of the same month and feast, he wrote thus: "in the seventh month they assembled, indeed called by the natives Tisri, but by the Macedonians, Hyperberetaeus. But the feast of tabernacles falls upon the same time, etc." Liber VIII. c. IV. sec. 1. (Antiquities)

The same one compares the rest of the months, where mention of them is to be
P. 39 made, in the same way to the Macedonian, as when he narrates that the building of the temple was begun "in the second month, which the Macedonians call Artemisius, the Hebrews Jar." Artemisius, without any doubt, is May: in the time of Josephus, therefore, the Hebrews were calling May, Jjar, and were numbering it the second, not as the Jewish calendar wishes--April.

Many things could be brought forward in regard to this idea, and perhaps the Macedonian names of all the Hebrew months could be collected from Josephus. But these are sufficient.

IX
Consectaria

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[11] Vid. Havercampius on Ant. I. c. III. sec. 3. [12] Ant. 1. III. c. X. sec. 2.
[13] Same as reference 11.

P. 39 Therefore all the Hebrew vocabulary with reference to the names of the months, must be corrected, and the Jewish commentators, and the Christians who lived after the tenth century, to be examined whenever the Hebrew codex concerning the months is mentioned: and furthermore, the whole Hebrew chronology, in reference to the months must be changed, and reformed according to this manner.

Before Moses commanded the month to be the first, in which the Israelites departed out of Egypt, they were making the beginning of the year from the seventh month, as is known to all. Then, therefore, the numbers were the same of the Israelitic and of the Syrians, and as now with the Syrians, so before Moses, the first month of the year with the Israelites was October,

Second	November
Third	December
Fourth	January
Fifth	February
Sixth	March
Seventh	April
Eighth	May
Ninth	June
Tenth	July
P. 40 Eleventh . . .	August
Twelfth . . .	September

And concerning these months Moses must be considered to speak, where, in the history of the flood, he makes mention of the first month, second, seventh, and tenth. He He begins the flood in November, (not as they think, in October), when the waters decrease in April (not in March), he stops the boat that has beat against the mountains, in July (not in June), the tops of the mountains stand out, in October (not in September), the land begins to be dried, in a word, in November they were dried, and Noah departed from the boat.

Afterward Moses paid honor to the month in which he had left Egypt, that it should be the first month of the year; the Hebrew months are thus to be rendered according to ours:

1. The first month, is called by Moses the month of corn, by others, Nisan, takes its beginning from the first new moon of April, must be compared with our April, as can be done in a lunar month, so that part of it sometimes would fall upon the fol-

lowing May.

7. The seventh, in which the feast of tabernacles was celebrated, called in the Hebrew bible the month of perennial rivers,[14] by the Chaldeans, Tisri, proceeded from the first new moon of October, responding to our October, and if the new moon were later, to part of November. [Long comment on "month of rivers"]

Those things which I have discussed above in reference to my description of the Hebrew fasti according to the laws of Moses, the Syrian names of the months, and Josephus, a most credible witness, at last I report that the etymology of the names is easily confirmed. Not that I am he who shows a large degree of etymologic attention: I am wont to remind listeners of plants, trees, buds, animals, and of artificial things, that, for the most part, in reference to the explanation of names, etymology is not sufficient, which indeed may often be obscure, and not contain definitions and descriptions. But if anyone hears of the month of corn, the month of rivers, the month of overflowing, he will not doubt but that that month would be called by its beginning, to which nature gives corn, perennial rivers, and floods. So, if anyone should read the name of the single month Weinmonath (month of wine) in our language, at one time dead and obliterated, immediately he discovers from the climate of Germany what month it is, and does not believe the dictionaries and commentators, however much agreement there may be with those claiming this name for September or August.

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[14] 1 Kings 8:2

BULLETIN

DE LA

SOCIÉTÉ ASTRONOMIQUE DE FRANCE

ET

REVUE MENSUELLE

D'ASTRONOMIE, DE MÉTÉOROLOGIE ET DE PHYSIQUE DU GLOBE

Illustré de 250 figures et de 10 planches hors-texte

QUARANTE-SIXIÈME ANNÉE : 1932

PARIS

AU SIÈGE DE LA SOCIÉTÉ

HOTEL DES SOCIÉTÉS SAVANTES

28, RUE SERPENTE, 28

—

1932

4″,5. — ξ Bouvier 2,7—5,1 ; 4″,2. — Σγ Lion 2,0—3,5 ; 3″,7. — ε Hydre 4—6,8 ; 3″,4. — σ Orion 4,2—8—7 ; 12″—42″. — θ¹ Orion 5—6—7—8 ; 9″ à 21″. — λ Bélier 5,3 —8 ; 38″. — δ Gémeaux 3,5—8 ; 6″,7. — δ Bouvier 3,4—8,5 ; 1′50″. — η Persée 3,9—8,7 ; 28″. — Polaire 2,1—8,8 ; 17″,6.

Fig. 26 et 27. — Aspect du ciel (en haut côté du Nord, en bas côté du Sud), le 1er mars à 21h, le 15 à 20h, le 1er avril à 19h pour les pays de latitude + 15° : Indochine ; Iles Philippines ; Siam ; Hindoustan ; Basse-Arabie ; Djibouti ; Erythrée ; Abyssinie ; Soudan égyptien ; Soudan français (Tombouctou) ; Sénégal (Dakar, Saint-Louis) ; Martinique ; Guadeloupe ; Jamaïque ; Haïti ; Cuba ; Guatemala ; Honduras ; Nicaragua ; Costa-Rica ; Bas-Mexique.

Amas d'étoiles et nébuleuses. — M. 31 et H. IV. 18 Andromède. — H. VI. 33 et 34 Persée. — M. 45 Taureau (Pléiades) et M. 1 Taureau (Crab Nebula). — M. 37 et 38 Cocher. — M. 42 Orion. — M. 35 Gémeaux. — H. VII. 2 et M. 50 Licorne. — M. 44 (Crèche) et M. 67 Cancer. — H. IV. 27 Hydre — M. 97 Grande Ourse. — M. 3 et 51 Chiens de Chasse. — H. IV. 37 Dragon. — M. 52 Céphée. — H. VI. 30 Cassiopée.

Le Secrétaire Général : Mme CAMILLE FLAMMARION,
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JEUNES ET VIEILLES LUNES

Le 13 août 1931, à Cavalaire (Var), dans l'aurore, le ciel étant très pur, j'ai observé le croissant lunaire peu de temps après son lever. L'horizon était limité à l'Est par une ligne de collines éloignées (distance zénithale 88°). Après quelques minutes de recherches à l'aide d'une jumelle grossissant trois fois, le croissant a été vu, à moins de un degré au-dessus des collines. Il a disparu à 4^h15^m (distance zénithale 85°), mais il a été retrouvé aussitôt

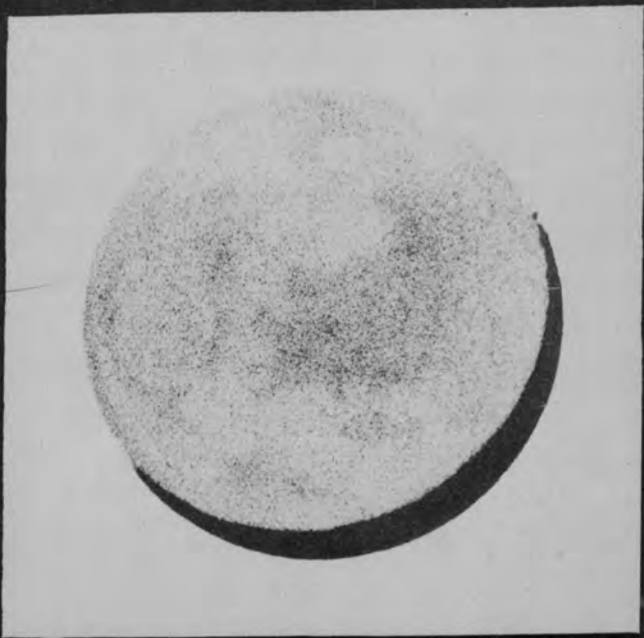

Fig. 28. — Le croissant lunaire et la lumière cendrée, le 13 mars 1899, à 7^h5^m soir (T. M. Paris)

D'après un cliché obtenu par M. Em. Touchet, en collaboration avec M. F. Quénisset, à l'équatorial de $0^m,108$ de l'Observatoire de la Société. La Nouvelle Lune ayant eu lieu le 11 mars 1899, à 8^h2^m du soir, ce cliché a donc été obtenu 47 heures après la nouvelle Lune. Si on joint les cornes de la Lune par une ligne droite, on constate que celle-ci passe au-dessous du centre du disque. Le croissant embrasse seulement 168° du tour de la Lune au lieu de 180°.

à l'aide d'une lunette de 75^{mm}, grossissant 25 fois, et suivi de nouveau pendant sept ou huit minutes ; à aucun moment, il n'a été perceptible à l'œil nu ; la lumière cendrée est restée invisible dans l'un et l'autre instrument. A quelques degrés de la Lune, Vénus brillait encore dans le ciel déjà lumineux.

A la jumelle, le croissant apparaissait comme un arc extrêmement ténu et légèrement ondulant, à peine coloré tant l'atmosphère était pure. La lunette révélait la complexité de sa structure. La corne australe était discontinue, formée d'un chapelet de grains allongés, la corne boréale, plus unie et plus régulière. L'arc central se composait d'une courte partie sombre, correspondant à *Mare Orientale*, encadrée de deux parties plus brillantes.

La distance angulaire des cornes était de 75° à 80° seulement. Le croissant s'étendait donc sur moins d'un quadrant. Sa largeur, rapportée par estimation au diamètre apparent de Vénus, n'atteignait nulle part 4", sauf peut-être dans la partie relativement brillante qui touchait *Mare Orientale* à l'Est.

A 4^h15^m, la distance angulaire de la Lune au Soleil, pour un observateur placé au centre de la Terre, atteignait 8°55' ; la parallaxe la réduisait à 8°0' au lieu d'observation, le grand cercle qui joignait les centres des deux astres faisant un angle de 75° avec l'horizon.

***

D'assez nombreuses publications ont été consacrées au fin croissant lunaire au voisinage immédiat de la Nouvelle Lune, mais, à peu d'exceptions près, elles traitent uniquement de sa visibilité. Celle-ci intéresse d'une part les israélites et les musulmans, pour des motifs d'ordre religieux, et d'autre part les chronologistes. Fotheringham a donné (*Monthly Notices*, 70, 1910, page 527) une règle empirique permettant de prévoir les cas où, sous un ciel très pur, le croissant sera visible à l'œil nu : pour cela, au lever ou au coucher du Soleil, la différence de leurs hauteurs géocentriques devra dépasser une certaine limite ΔH, variable avec la différence ΔA de leurs azimuts et donnée par la table suivante :

ΔA	ΔH
°	°
0	12,0
5	11,9
10	11,4
15	11,0
20	10,0
23	7,7

Cette règle est justifiée dans le mémoire cité par la discussion de 76 observations effectuées en majeure partie par Schmidt, en Grèce, mais elle souffre quelques exceptions, de l'aveu même de son auteur (*loc. cit.* et *The Observatory*, 44, 1921, page 308). Le 2 mai 1916, notamment, la Lune a été vue à l'œil nu en Angleterre, à 8°,3 du Soleil, cette distance étant calculée sans tenir compte de la parallaxe, qui la réduirait à 7°,4. Le 13 août 1931, la distance de la Lune au Soleil était un peu plus grande, et cependant la Lune n'a pas été visible à l'œil nu. Les diverses parties du limbe lunaire sont loin d'avoir le même albedo, et celles qui paraissent le matin sont moins brillantes que celles du soir.

Nous discuterons un peu plus loin trois autres observations qui mettent aussi en défaut la règle de Fotheringham.

***

Lorsque la Lune, proche du Soleil, est observable dans le crépuscule ou l'aurore, elle peut s'effacer pendant le jour. J'ai cherché la limite de sa visibilité en plein Soleil, au voisinage du méridien, par de belles journées, en Provence. Je me plaçais à l'ombre d'un arbre ou d'un mur, et je limitais le champ de mes recherches en pointant un théodolite sur la position calculée de la Lune. J'ai noté plusieurs cas de visibilité de la Lune à 38° du Soleil, un autre à 37°, un enfin à 32° seulement, le 11 août dernier ; tandis que la recherche est restée infructueuse à 27°, 24° et 20°. La limite paraît donc être au voisinage de 30°. Ces observations ont été faites à l'occasion d'un travail photométrique en cours.

***

Le croissant du 13 août s'étendait sur moins de 80°. A la lunette, on voyait ses cornes nettement limitées, et l'on ne peut invoquer l'éclat du ciel pour expliquer l'invisibilité de leurs prolongements, bien qu'il fût suffisant pour effacer la lumière cendrée. Mais la veille, 12 août, la lumière cendrée étant fort bien visible, le croissant était manifestement incomplet, son étendue atteignant seulement 160°. La Lune était alors à 22° du Soleil. L'observation a été répétée le 10 septembre, à 28° du Soleil, le croissant couvrant environ 165°.

Cet accourcissement ne paraît pas avoir été l'objet d'une étude systématique, et on l'a rarement signalé bien qu'il se produise à chaque Nouvelle Lune. Son explication est fort simple, si sa théorie mathématique menace d'être fort complexe. Quand la Lune est très proche du Soleil, les montagnes lunaires tournent vers nous leur face obscure : leurs ombres propres contribuent donc à nous les rendre invisibles. En second lieu, elles projettent les unes sur les autres des ombres portées qui concourent au même effet. Enfin, elles se profilent les unes sur les autres, de sorte qu'une montagne éclairée peut nous être cachée par une autre qui ne l'est pas. Ces trois causes agissent d'autant plus que le Soleil et la Terre se trouvent plus bas sur l'horizon de la Lune ; c'est donc aux cornes que les parties du sol lunaire qui seraient visibles sur une sphère lisse, ont le plus de chances de disparaître à notre vue.

Représentons la Lune, comme on le fait habituellement pour expliquer ses phases, en projection sur un plan passant par son centre et par ceux de la Terre et du Soleil (fig. 29). La lumière venant de la direction SO, illumine la moitié gauche du globe, limitée au terminateur BD. La Terre étant dans la direction OT, l'hémisphère qui nous regarde est limité au grand cercle qui se projette suivant AC. Sur une sphère lisse, le fuseau AOB serait vu éclairé, sous la forme d'un croissant s'étendant sur 180 degrés. L'une de ses cornes serait le point O, l'autre le point diamétralement opposé de la sphère.

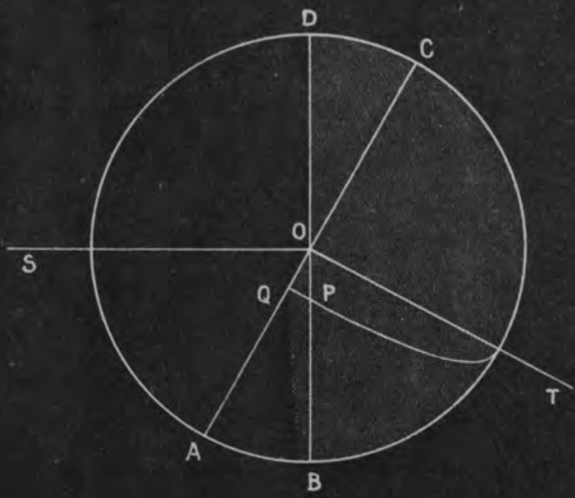

Fig. 29. — Détermination de *l'arc déficient* PQ.

Mais la Lune n'est pas lisse, et le mécanisme complexe qui vient d'être décrit déplace la corne de O en Q. Le sol lunaire compris dans le petit triangle OPQ reste invisible. Évaluons son côté PQ, que nous appellerons l'*arc déficient*. Si a est la distance angulaire de la Lune au Soleil, compte tenu de la parallaxe lunaire, 2ω la longueur du croissant (qui serait égale à 180° sur un globe lisse), l'arc déficient α est donné par l'expression :

$$\sin \alpha = \sin a \, . \cos \omega.$$

On trouve les valeurs suivantes de α à l'aide des trois observations rapportées ci-dessus :

	a	ω	α
	°	°	°
12 août 1931	23	80	3,9
13 — —	8	39	6,2
10 septembre 1931	28	82,5	3,5

L'arc déficient décroît quand la Lune s'écarte du Soleil, ce qu'on pouvait prévoir *a priori*, puisque nous cessons de voir son relief à contre-jour. Avant que la quadrature ne soit atteinte, l'arc déficient s'annule, et, au lieu d'un accourcissement du croissant, c'est un allongement que l'on observe. En effet, on voit apparaître au delà des cornes des sommets de montagnes, dont le pied reste dans l'ombre, et qui apparaissent comme de petites plages lumineuses isolées. Ces montagnes se trouvent au delà du terminateur géométrique, c'est-à-dire du terminateur tel qu'on l'observerait sur une sphère lisse. Il en résulte un allongement du croissant. En outre, la source de lumière qui éclaire la Lune n'est pas un point, mais un disque de 15′ de rayon apparent. Le Soleil éclairerait donc plus d'un hémisphère même si le relief lunaire était négligeable.

Nous montrerons plus loin que l'arc déficient devient nul aux cornes lorsque la Lune se trouve à 45° du Soleil. Par continuité, nous dirons que, plus loin du Soleil, l'arc déficient devient négatif.

***

Le triangle OPQ n'est pas la seule région qui, visible sur un globe lisse, cesse de l'être sur un globe rugueux. Toute une bande, située le long du terminateur, subit le même sort. La preuve en est dans l'amincissement du croissant. Sur un globe lisse de rayon angulaire apparent r, situé à la distance angulaire a du Soleil, la largeur du croissant atteindrait, en son milieu, la valeur :

$$e = r(1 - \cos a).$$

Ainsi, le 13 août, cette largeur eût été de 10″ si la Lune n'avait possédé aucun relief. L'observation a donné seulement 4″. On en déduit sans peine qu'à égale distance des cornes, l'arc déficient mesurait 3°,0, soit environ la moitié de sa valeur aux cornes. En O, la Terre se trouve dans l'horizon lunaire ; si l'on se déplace le long du terminateur, de O vers B, elle monte progressivement dans le ciel. Il est bien naturel que la visibilité augmente pour un observateur terrestre, à mesure qu'il s'élève au-dessus des sites lunaires, la troisième des causes invoquées intervenant de moins en moins.

***

Les astronomes qui ont signalé la visibilité du croissant lunaire à peu de distance du Soleil, ont omis le plus souvent de rapporter son aspect. J'ai limité mes recherches à la collection de *L'Astronomie* : il y est fait mention de l'accourcissement du croissant trois fois seulement, dans les termes suivants :

Première observation. (*L'Astronomie* 1886, page 110) :

« M. le docteur Léon Decroupet, à Soumagne (Belgique), a observé la Lune sous l'aspect d'un très mince croissant le 7 décembre 1885 à 4^h26^m du soir (temps moyen de Paris). Comme la Nouvelle Lune était arrivée le 6 décembre à 1^h26^m du soir, il ne s'est donc écoulé que 26^h47^m entre la conjonction de notre satellite avec le Soleil et cette rare et curieuse observation. Le ciel était pur et le crépuscule assez avancé pour qu'on pût distinguer aisément les étoiles de deuxième grandeur. Aucune trace de lumière cendrée n'a été observée. Le croissant apparaissait comme un fil lumineux s'étendant sur le tiers environ de la circonférence lunaire ; notre correspondant ayant dirigé vers la Lune une lunette de $0^m,075$ estime que la largeur de croissant était égale à la distance qui sépare Mizar de son compagnon télescopique, soit $14'',5$ ou environ la 120e partie du diamètre lunaire. »

Cette excellente relation, claire, précise, complète, fournit tous les éléments nécessaires au calcul de l'arc déficient. On trouve ainsi :

$a = 12°46'$;
$\omega = 60°$; $e = 24''$;
$\alpha = 6°,3$ à la corne ;
$\alpha = 2°,8$ au milieu du croissant.

Seconde observation (*Bulletin de la Société Astronomique de France*, 1908, page 306) :

« Mlle C. Bac, à Millau (Aveyron), a pu voir la Lune le 1er mai dernier (1908), de 19^h20^m à 19^h35^m, moins de 28 heures après la Nouvelle Lune, sous forme d'une ligne jaune très pâle, s'étendant sur environ un tiers de circonférence. Cornes invisibles à la jumelle. »

Le calcul donne pour cette observation,

$a = 14°4'$;
$\omega = 60°$;
$\alpha = 6°,9$ à la corne.

Troisième observation (*L'Astronomie* 1920, page 527) :

« M. Abel Triou, à Cannes (Alpes-Maritimes), a observé la Lune à l'œil nu le 19 avril 1920 à 19^h55^m, soit 22^h15^m seulement après la Nouvelle Lune. Croissant excessivement mince, rougeâtre, bien visible à l'œil nu. Le croissant ne paraissait pas s'étendre sur plus de 150 degrés. »

On vérifiera sans peine que la Lune était couchée à Cannes, à 19^h55^m (t. m. G.), le 19 avril 1920. L'heure d'été ayant été adoptée le 15 mars, il faut probablement lire 18^h55^m. Pour cet instant, on trouve :

$a = 11°8'$;
$\omega = 75°$;
$\alpha = 4°,7$ à la corne.

Toutes les valeurs de *a* ont été calculées en tenant compte de la parallaxe lunaire.

Voici, pour les trois observations, les différences d'azimut et de hauteur de la Lune et du Soleil :

ΔA	ΔH
°	°
8,0	11,0
10,1	10,7
5,0	11,0

Comme on avait en vue ici le contrôle de la règle de Fotheringham, on n'a pas tenu compte de la parallaxe, et les différences de hauteur sont géocentriques. On voit que la règle est en défaut dans les trois cas, les différences de hauteur étant respectivement trop faibles de 0°,6, 0°,7 et 0°,9. Elle faisait prévoir l'invisibilité de la Lune.

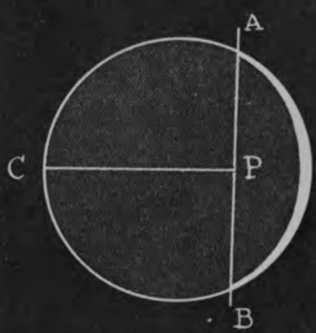

Fig. 30. — Mesure de l'arc limitant la lumière cendrée.

Pour compléter cette étude, j'ai cherché à tirer parti des photographies de la Lumière Cendrée obtenues par divers auteurs. Sur certains de ces documents, que j'ai dû rejeter, la diffusion photographique masque le phénomène à étudier, les cornes étant artificiellement allongées. Ce défaut n'affecte pas la très belle suite de négatifs que M. Em. Touchet a bien voulu me confier. Elle a été obtenue en 1899, à l'Observatoire de la Société Astronomique de France, au foyer de l'équatorial de $0^{m},108$, en collaboration par MM. Touchet et Quénisset. Le temps d'exposition ayant été judicieusement choisi, la Lumière Cendrée a impressionné la plaque, sans que la diffusion ait déformé les contours du croissant.

Sur chacun des clichés, qui sont au nombre de un pour la journée du 13 mars 1899 et de deux pour les autres dates, on a mesuré la flèche CP de l'arc de circonférence limitant la Lumière Cendrée, d'une corne à l'autre, puis le diamètre $2r$ de la Lune parallèle à la ligne des cornes (fig. 30). On a :

$$\cos \omega = \frac{CP - r}{r}.$$

Voici le résultat des mesures :

Date	a	α
	°	°
13 mars 1899	26	+ 2,5
14 — —	39	+ 0,5
15 — —	52	— 0,8
16 — —	64	— 0,5
17 — —	75	— 1,4

Le 13 mars, le croissant s'étendait sur 168° seulement (fig. 28). Le 14, il mesurait 178°. Ensuite, sa longueur dépassa 180°, des sommets montagneux ayant fait apparition au delà du terminateur géométrique (voir plus haut).

Les retouches du graveur et les défauts de l'impression rendent inutilisables le plus grand nombre des photographies de la Lumière Cendrée parues dans *L'Astronomie* ou dans d'autres publications. Après examen, je n'en ai retenu que trois, qui ont été mesurées chacune quatre fois de manière indépendante, à des jours différents. Elles ont fourni les données suivantes :

Dates	a	α	Auteurs
—	—	—	—
	°	°	
26 février 1895	26	2,1	(BARNARD, *Publ. Lick. Obs.*, XI).
17 août 1895	32	2,1	— — —
22 septembre 1908..	39	1,0	(QUÉNISSET, *Bulletin S. A. F.* 1909).

***

Nous disposons maintenant de 14 déterminations de l'arc déficient à la corne et de deux déterminations de l'arc au milieu du croissant. Portons les

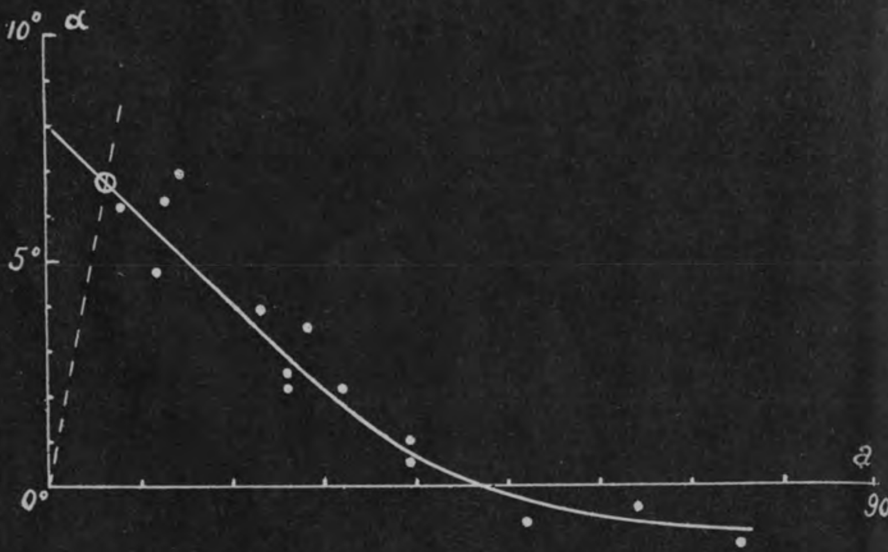

Fig. 31. — Variation de l'*arc déficient* α, avec la distance a de la Lune au Soleil.

premières en ordonnées sur un graphique (fig. 31) dont les abscisses représentent la distance angulaire de la Lune au Soleil. Les points se groupent assez bien autour d'une courbe qui va de l'ordonnée $\alpha = 8°,0$ pour $a = 0°$, à $\alpha = 0°$ pour $a = 46°$. Au delà, l'arc déficient est négatif.

Première conséquence, le croissant lunaire se réduit à rien bien avant que ne s'annule la distance angulaire de la Lune au Soleil. La disparition complète de la Lune a lieu évidemment lorsque $\alpha = a$, et le graphique montre que cette circonstance se présente pour $a = 6°,7$. Comme la latitude de la Lune reste toujours en deçà de cette limite, on peut affirmer que la Lune disparaît entièrement à chaque conjonction avec le Soleil. Si nous pouvions sortir de notre atmosphère et jouir d'un ciel obscur, nous y verrions la Nouvelle Lune grâce à la lumière cendrée, mais sans le moindre filet brillant dû à l'éclairage direct du Soleil. Ce qu'on appelle communément *la phase croissante* ne commencerait qu'à six degrés trois quarts du Soleil. A ma connaissance, cette particularité du plus vulgaire des phénomènes astronomiques n'avait pas été signalée.

Les conjonctions inférieures de Vénus et du Soleil offrent un effet opposé, la longueur du croissant s'étendant à mesure que la planète s'approche du Soleil. Lorsque leur distance est très petite, peu de temps avant ou après un passage, par exemple, les cornes arrivent même à se rejoindre, et le croissant se ferme en un anneau continu. On explique ce phénomène par la réfraction de la lumière solaire dans l'atmosphère de Vénus.

Loin de soupçonner l'accourcissement, dans les mêmes conditions, du croissant de la Lune, Lœwy et Puiseux écrivent ce qui suit, à propos d'une planche de leur Atlas : « La corne est limitée à la partie fortement éclairée ; dans cette région, une pose plus longue serait indispensable pour décider s'il y a ou non prolongement crépusculaire que l'on doive attribuer à la présence d'une atmosphère. » (*Atlas de la Lune*, Fascicule III, Texte, page C 17.)

On vient de voir ce qu'il en est. Mais, que des astronomes habitant une grande ville n'aient pas une connaissance approfondie de l'aspect du fin croissant, observable seulement dans les fumées de l'horizon, on ne doit pas s'en étonner outre mesure. Les amateurs sont souvent les mieux placés pour se livrer à de telles recherches, et je fais appel à leur coopération pour compléter et préciser le graphique encore bien insuffisant de la figure 4. L'élément à mesurer, dans les deux ou trois jours qui précèdent ou suivent la Nouvelle Lune, est l'*amplitude totale* 2α du croissant, prise d'une corne à l'autre. Il faut connaître aussi l'*heure* et le *lieu* de l'observation.

La mesure angulaire précise du croissant se fait avec un micromètre à fils adapté sur une lunette équatoriale entraînée : on détermine l'angle de position de chacune des cornes, la différence donnant l'amplitude demandée. Mais il n'est nullement indispensable d'avoir des valeurs précises, les irrégularités locales du bord lunaire en rendraient l'interprétation rigoureuse illusoire. Il est certain, en effet, que, d'une lunaison à l'autre, la valeur de l'arc déficient doit changer un peu, puisque les régions éclairées de la Lune ne sont pas les mêmes. On ne peut avoir qu'une connaissance moyenne du phénomène, dont la théorie elle-même est d'ordre statistique.

On pourra donc se contenter du mode suivant d'estimation, que j'ai employé. On trace un cercle d'une dizaine de centimètres de diamètre, puis on marque au crayon, sur sa circonférence, l'emplacement des deux cornes tel qu'on le voit dans une petite lunette grossissant quinze ou vingt fois, et montrant bien la lumière cendrée. On mesure ensuite avec un rapporteur l'angle qui sépare ces deux points. Si le limbe lunaire tout entier est bien visible, éclairé en partie par le Soleil, en partie par la lumière cendrée, l'erreur ne dépasse pas un ou deux degrés. On peut encore mesurer sur le dessin la distance CP et le diamètre du cercle (fig. 2). Lorsque le crépuscule empêche de voir la lumière cendrée, la précision est un peu moindre, mais alors le croissant sous-tend un angle notablement inférieur à 180 degrés, et une erreur de quelques degrés n'altère pas sensiblement la valeur calculée de l'arc déficient.

J'effectuerai bien volontiers la réduction des observations qui me seraient communiquées. Le calcul est assez simple, mais tous les observateurs n'ont pas à leur disposition la *Connaissance des Temps*. Il convient de leur rappeler ici que l'âge de la Lune fournit une évaluation insuffisamment précise de la distance angulaire qui sépare la Lune du Soleil ; il ne fournit même pas la différence des longitudes de ces astres, puisque leur mouvement n'est pas uniforme, celui de la Lune moins encore que celui du Soleil. La différence de longitude fût-elle exactement connue, elle ne suffirait pas ; il faudrait aussi tenir compte de la latitude de la Lune. A l'instant de la conjonction, par exemple, l'âge de la Lune est nul, mais sa distance du Soleil ne l'est pas, sauf s'il y a éclipse centrale. Elle est égale à la latitude de la Lune qui peut atteindre près de 6°. Enfin, l'observateur n'est pas placé au centre de la Terre, et l'on doit déterminer l'effet de la parallaxe, au moins pour les valeurs de a inférieures à 20°.

Le phénomène qui nous occupe, négligé des astronomes, est un de ceux qui compliquent étrangement le problème théorique de la photométrie lunaire. Celui-ci aura fait un progrès appréciable vers sa solution, lorsque la valeur de l'arc déficient sera exactement établie.

A. DANJON,
Directeur de l'Observatoire de Strasbourg.

LETTRE OUVERTE A CAMILLE FLAMMARION
Fondateur de la Société Astronomique de France

Mon cher Maitre et Ami,

Au moment où notre Société arrive au seuil de sa quarante-sixième année, je ne puis m'empêcher de penser à la réunion du 28 janvier 1887, tenue dans votre salon de la rue Cassini où quelques amis et fervents admirateurs d'Uranie décidèrent, sur votre proposition, la création de la Société Astronomique de France.

L'idée féconde qui a présidé à cette création a fait son chemin et la petite étoile qui prit naissance dans cette réunion a, d'année en année et malgré bien des difficultés, brillé d'un éclat de plus en plus vif dans le temple de la Science.

Les initiateurs sont devenus légion et leur nombre s'achemine progressivement vers le chiffre de cinq mille qui, vraisemblablement, sera atteint pour le cinquantenaire de la fondation de la Société.

Vous n'ignorez pas quelle somme d'efforts le groupement d'un aussi grand nombre de personnes représente et combien il faut de persévérance pour arriver à maintenir et à faire progresser un effectif aussi important.

Cette importance n'est d'ailleurs qu'apparente, car ce nombre de cinq mille ne représente qu'une portion infime de la population de notre planète et même du monde intellectuel.

Comme vous l'avez constaté et écrit vous-même, l'espèce humaine persiste à rester ignorante et à continuer à vivre sans savoir où elle est. Ce ne sont pas les moyens de s'instruire qui lui manquent, mais l'indifférence à l'égard de la science du Ciel est encore presque générale et il n'y a pas plus de deux personnes sur 100 000 qui désirent savoir où elles sont et se rendre compte de la situation de la Terre dans l'Espace. Les autres vivent à l'état d'ignorants volontaires sans se douter que leur existence se déroule au milieu d'un univers merveilleux dont la contemplation décuplerait pour eux le plaisir de vivre.

Depuis le 28 janvier 1887, le Temps a fait son œuvre et les créateurs de la Société sont tous disparus.

C'est le 3 juin 1925 que, brisant les liens matériels qui vous attachaient à la Terre, vous vous êtes élancé vers ce Ciel dont vous n'aviez jamais cessé de proclamer la grandeur et la beauté.

Votre première visite aura été pour notre voisine et fidèle compagne la Lune dont les détails de la surface vous étaient si familiers ; vous vous serez ensuite dirigé vers le Soleil, petite étoile, mais pour nous majestueux flambeau et source de vie. Vous aurez contemplé de près son bouillonnement

Les 45 premières années du *Bulletin de la Société astronomique de France* (1887 à 1930) qui ont publié successivement des articles et des études de MM. **Camille Flammarion, Paul** et **Prosper Henry, Trouvelot, Maurice Fouché, Faye, Laussedat,** général **Parmentier, Bouquet de la Grye, Gaudibert, Tisserand, Caspari, Janssen, Cornu, H. Poincaré,** général **Bassot, Deslandres, Ch.-Ed. Guillaume, Callandreau, Lœwy, Puiseux, Lippmann, d'Arsonval, Lallemand, H. Becquerel, Baillaud, Painlevé, Laisant, de la Baume Pluvinel, Eiffel, Stan. Meunier, Angot, E. Belot, Bosler, Salet, Esclangon, Schiaparelli, Newcomb, Pickering, Huggins, Lockyer, Crookes, Barnard, Lowell, de Glasenapp, Arrhénius, Birkeland, See, Frost, Hale, Shapley, Charles Fabry,** général **G. Perrier,** général **Ferrié, G.-W. Ritchey, A.-S. Eddington, etc.,** peuvent être acquises par les *Sociétaires* aux conditions suivantes : 1887 à 1930 (à l'exception des années 1889 à 1894, 1897, 1898, 1902, 1903, 1907, 1920 et 1922 épuisées).

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et Revue Mensuelle d'astronomie, de
meteorologie et de physique de globe.

46th year, 1932, Paris

A. Danjon, Young and Old Moons

Page 57

On August 13, 1931 at dawn I observed the lunar crescent soon after its rise at Cavalaire (Var), the sky being very clear. The horizon was limited at the east by distant hills (zenith distance 88°). After several minutes of searching with the help of field glasses which magnify three times, the crescent was seen at least one degree above the hills. It disappeared at 4 h. 15 m. (zenith-distance 85°) but it was at once found again with the aid of a glass (telescope?) of 75 mm. magnifying 25 times and again followed for seven or eight minutes; not for one moment had it been perceptible to the naked eye; the pale gray light remained invisible in both instruments. Several degrees away from the moon, Venus still shone in the sky which was already luminous.

Through the field glasses the crescent seemed like an extremely thin arc and slightly undulating, barely colored as long as the atmosphere was pure. The little moon revealed the complexity of her structure. The southern horn was discontinued formed by a string of elongated beads, the northern horn more *

Page 58

united and more regular. The central arc consisted of a short dark part corresponding to the "Mare Orientale" framed with two more lustrous (shining?) parts.

The angular distance of the horns was merely 75° to 80°. Thus the crescent spread over less than one quadrant. Its width, estimated with relation to the obvious (apparent) diameter of the Venus nowhere came up to 4", except, perhaps, in the relatively bright part touching the"Mare Orientale"in the east.

At 4 h. 15m. the angular distance of the moon to the sun, for an observer placed in the center of the earth, came up to 8°55'; the parallaxis reduced it to 8°0' at the place of observation, the great circle which joined the centers of the two stars making an angle of 75° with the horizon.

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* Fig. 28--The lunar crescent and the pale grey light on March 13, 1899, at 7 h 5m in the evening (T. M. Paris) After a stereotype plate obtained by Mr. Em. Touchet in cooperation with Mr. F. Quenisset at the equatorial of 0m, 108 of the Observatory of the Society. The new moon having taken place on March 11, 1899 at 8h 2m in the e vening, this plate consequently was obtained 47 hours after the new moon. If one joins the horns of the moon with a straight line he finds that it passes below the center of the disk. The crescent spans merely 168° of the revolution (turn?) of the moon instead of 180°.

Rather numerous publications have been devoted to the thin lunar crescent in the immediate vicinity of the new moon [conjunction], but, with very few exceptions, they deal solely with its visibility. This was of interest on the one side to the Israelites and the Musulmmans [Mohammedans] for reasons of religious orders and on the other side the chronologists. Fotheringham (Monthly Notices, 70, 1910, p. 527) has given an empiric rule permitting to foresee the case when, under a very clear sky, the crescent will be visible to the naked eye: for this, at sunrise or sunset the difference of their geocentric heights is to exceed a certain limit H which varies with the difference A of their azimuth, and is given in the following table:

A	H
o	o
5	12,0
10	11,9
15	11,4
20	11,0
23	10,0
	7,7

This rule is justified in the memorandum quoted in the discussion of the 76 observations, the greater part of which were made by Schmidt in Greece, yet it is subject to several exceptions as acknowledged even by its author (loc. cit. and The Observatory, 44, 1921, p. 308). On May 2, 1916, particularly the moon was seen in England by the naked eye at $8^{\circ},3$ from the sun, which distance was calculated without considering the parallaxis which reduced it to $7^{\circ},4$. On Aug. 13, 1931 the distance of the moon from the sun was somewhat greater and yet the moon was not visible to the naked eye. The various parts of the lunar body are far from having the same

Page 59

albedo and those which appear in the morning are less bright (shining) than those in the evening.

When the moon, near to the sun, can be observed in the twilight or at dawn, she can efface (blot out) herself during the day. I have searched for the limit of her visibility in the full sun, in the vicinity of the meridian on clear days in the Provence. I have placed myself in the shadow of a tree or a wall and have limited the field of my research by pointing (levelling?) a theodolite at the calculated position of the moon. I have noted on August 11, last, several cases of visibility of the moon at 38° (of) from the sun another at 37° and finally at 32° merely; however, the research remained without results at 27°, 24°, and 20°. Thus the limit seems to be in the vicinity of 30°. These observations were made on the occasion of some photometric work.

The crescent of Aug. 13 extended over less than 80°. Through glasses one could see its horns clearly limited and one cannot invoke the brightness of the sky in order to explain the invisibility of its prolongations although it sufficed to blot out the pale gray light. But on the eve of Aug. 12, the pale gray light being visible very plainly, the crescent was evidently incomplete, its length (expanse?) reached only 160°. The moon then was at 22° from the sun. The observation was repeated on Sept. 10, at 28° from (of?) the sun, the crescent covering about 165°.

This shortening (getting shorter) did not seem to have been the object of a systematic study and it has rarely been [reported] although it is produced every new moon. Its explanation is very simple even if its mathematical theory threatens to be very complex. When the moon is very near to the sun, the lunar mountains turn their dark (obscure) face towards us: their own shadows thus serve to make them invisible to us. In the second place they jut the shadow of one on top of the other which contributes to the same effect. Finally, the profile of one is over the other so that an illuminated mountain can be hidden for us by one which is not (illuminated). These three causes operate all the more the lower the sun and the earth are on the moon's horizon. It is therefore at the horns that the sections of the lunar surface that would be visible on a smooth surface are most likely to disappear from our view.

Page 60

Let us, as is customarily done to explain its phases, represent the moon in projection upon a plane passing through its center and through the center of the earth and of the sun. (Figure 29.) [Determination of the deficient arc PQ] The light falling in the direction S O illuminates the left half of the globe limited by the line BD. If the earth is located in the direction OT, then the hemisphere that faces us is limited by the great circle which is projected in AC. On a smooth sphere the spindle AOB would be seen light in the shape of a crescent extending over 180°. One of its horns would be at the point O and the other at the point of the sphere diametrically opposite (to O).

But the moon is not smooth and the complex mechanism which has just been described displaces the horn from O to Q. The lunar surface included in the small triangle OPQ remains invisible. Let us compute its side PQ which we shall call the deficient arc. If $\bar{a}$ is the angular distance between the moon and the sun reckoned from the lunar parallax, the length of the crescent (which would be equal to 180° on a smooth globe) then the deficient arc is given by the expression:

$$\sin \qquad = \sin a \cdot \cos w$$

The following values for are found at hand of the following three observations.

		a	w	
August 12	1931	23°	80°	3.9°
" 13	"	8°	39°	6.2°
Sept. 10	"	28°	82.5°	3.5°

The deficient arc decreases when the moon deviates from the sun, which we might expect apriori since we no longer see its relief (outlines?) in the counter-light. Before the quadrature is reached the deficient arc vanishes and in place of an abbreviation of the crescent there is observed an elongation. In fact, beyond the horns the summits of mountains are seen to appear, the bases of which remain in the shadow, and which appear (seem) like small illuminated, isolated surfaces.

Page 61.

These mountains lie beyond the geometric limit, which is to say the limit for what would be visible on a smooth sphere. There results an elongation of the crescent. Furthermore, the source of light which illumines the moon is not a point but a disc of 15' apparent radius. Consequently even though the surface-form (outline or relief) of the moon were negligible the sun illumines more than one hemisphere.

We shall further on proceed to demonstrate that the deficient arc becomes zero for the horns when the moon is at a 45° angle with the sun. In continuance, we state that still farther from the sun the deficient arc becomes negative.

The triangle OPQ is not the only region which, visible on a smooth globe, ceases to be so on a rough globe. A complete ring located along the limit shares the same fate (produces the same effect.) Its test lies in the attenuation of the crescent. On a smooth globe of the apparent angle of illumination r, located at an angular distance from the sun a, the size of the crescent would at its center attain the value:

= 4 (-- cos a)

Thus on the 13. August, this size would have been 10" if the moon had not had any unevenness. The observation gave a value of only 4". It is readily deduced that the deficient arc at equal distance from the horns would amount to 3°, approximately half its value at the horns. In O, the earth is in the lunar horizon; if we move along the terminator from O to B, it rises progressively (higher and higher) in the sky. It is quite natural that the visibility increases for a terrestrial observer, to the extent that he is raised above the lunar sites, the third cause of those referred to, intervening (having) less and less (effect).

The astronomers who have described the visibility of the lunar crescent at a small distance (angular distance) from the sun have most frequently omitted to describe its phase (aspect). [phasis] I have limited my research to the collection of L'Astronomie: There is mentioned only three times the abbreviation of the crescent in the following terms:

First observation. (L'Astronomie 1886, page 110): Dr. Leon Decroupet, in Soumague (Belgium) has observed the moon in a phase of a very minute crescent on Dec. 7, 1885 at 4.26 P. M. (Paris mean (standard) time.)

Page 62

Since the new moon had come on Dec. 6 at 1.26 P. M. only

26h 47' had alapsed between the conjunction of our satellite with the sun and this rare and singular observation. The sky was clear and the twilight sufficiently advanced that one might readily distinguish the stars of second magnitude. Not the slightest trace ofearth shine (pale gray light) was observed. The crescent appeared like a luminous thread extending approximately one-third of the circumference of the moon; the writer having trained a telescope of Om, 0 75 at the moon estimates that the size of the crescent was equal to the distance which separates Mizar from its telescopic companion, 14" 5 or just about $\frac{1}{120}$ of the lunar diameter.

This excellent description, clear, precise, complete, furnishes all the elements needed for the computation of the deficient arc. Thus we find:

$a = 12^\circ 46'$

$w = 60^0$

$e = 24''$

$= 6^\circ.3$ at the horn

$= 2^\circ.8$ at the center of the crescent.

Second Observation (Bulletin de la Societie Astronomique de France, 1908, page 306):

Miss C. Bac in Millau, Aveyron was able to see the moon on May 1 (1908) from 7.20 to 7.35 P. M. less than 28 hours after the new moon, in the shape of a very pale yellow line that extended about 1/3 of the circumference. Horns invisible in the field glasses.

The computation gives for this observation:

$a = 14^\circ 4'$

$w = 60^0$

$= 6^\circ$ at the hour

Third observation (L'Astronomie, 1920, page 527): "Mr. Able Triou, at Cannes (Maritime-Alps) observed the moon with the naked eye on April 19,1920 at 7.55 P. M., which was but 22 hrs. 15' after new moon. Crescent extremely minute, reddish, easily seen with the naked eye. The crescent did not seem to extend further than 150°.

It is easily verified that the moon had set in Cannes at 7.55 P. M. (t. m. g.) on April 19, 1920. Summer daylight saving time having been adopted on March 15, it should probably read 6.55 P. M. In that case we find:

$a = 11^\circ 8'$
$w = 75^\circ$
$= 4^\circ 7$ at the horn

All values for a have been calculated keeping in mind the lunar parallax.

As we have seen here, the verification of Fotheringham's rule, the parallax has not been kept in mind, and the differences of elevation are geocentric. It is seen that the rule is wrong in the three cases, the difference of elevation being small: 0.6°, 0.7° and 0.9° respectively. It would have to provide against the invisibility of the moon.

In order to finish this test, I have sought to ~~makes~~ make the best of photos of the grey light obtained by (or from) various authors. In some of these documents which I have had to reject, the photographic diffusion hides the phenomenon to be studied, the horns having artificially been elongated. This defect is not present in the very fine series of negatives which Mr. Em. Touchet has been kind enough to entrust to me. It was obtained in 1899 at the observatory of the Societe Astronomique de France in the room of the 108 millimeter telescope in collaboration with Mr. Touchet and Mr. Quenisset. The time of exposure having been chosen judiciously the grey light made a mark on the plate without the diffusion disformed the contours of the crescent.

On every negative, there being one for March 13, 1899 and two for the other dates, the abciss (here perhaps the verse sine) C P of the drc of circumference limiting the grey light from one horn to the other, and also the diameter 2r of the moon parallel to the line of the horns (Fig. 30) [Fig. 30--Measures of the arc limiting the earthshine] We have:

$$\cos = \frac{CP - r}{r}$$

Here are the results of the measurements:

Date	a	
March 13, 1899	26°	+ 25°
March 14 "	39°	+ 0.5°
" 15 "	52°	- 0.8°
" 16 "	64°	- 0.5°
" 17 "	75°	- 1.4°

Page 64

On the B. March the crescent extended only 168° (Fig. 28). On March 14 it measured 178°. After that its length exceeded 180°, mountain summits having become visible beyond the geometric limit (see above).

The retouching of the prints and the faulty exposure render useless most of these photos of earth shine that have appeared in L'Astronomie or in other publications. After examination I only kept three of them, each of which has been measured four times in independent manner on different days. They gave the following results:

Dates	a	
Feb. 26, 1895	26°	2.1°
Aug. 17, 1895	32°	2.1° x
Sept. 22, 1908	39°	1.0° xx

*Authors: x Barnard, Publ. Lick. Obs. XI
xx Quenusset, Bulletin S. A. F., 1909.

We now have available 14 determinations of the deficient arc at the horns and also two determinations of the arc at the center of the crescent. Let us plot the first ones on the order on the graph (Fig. 31) the abciss of which represents the angular distance of the moon from the sun. [Fig 31- Variation of the deficient arc with the distance a between the moon and the sun]. The points are quite well located along a curve which goes through = 8° at a = 0° and = 0° at a = 46°. Beyond that point the deficient arc becomes negative.

The first inference is that the lunar crescent vanishes long before the angular distance between moon and sun becomes zero. The complete disappearance of the moon evidently takes place when d = a, and the graph shows that this condition is present when a = 6.7°. Since the latitude of the moon always remains on this side of this limit, we can affirm that the moon vanishes completely at every conjunction with the sun. If we could get out of our atmosphere and have a dark sky, then we would be able to see there the new moon thanks to the earth shine, but without the least shining threat due to the direct illumination by the sun. That which commonly is called the crescent phase does not begin until six three-quarters (6.3/4°) degrees away from the sun. To my knowledge this most elementary peculiarity of astronomic phenomena has heretofore not been pointed out.

The inferior (less important) conjunctions of Venus and the sun present an opposite effect in that the length of the crescent grows as the planet approaches the sun. When their distance is very small just before or just after a passage for instance, the horns actually touch each other and the crescent closes in a continuous ring. This phenomenon is explained by refraction of the sun's light in the atmosphere of Venus.

For from surmising (suspecting) the abbreviation in (under) the same conditions, Loewy and Puiseaux write as follows regarding the crescent of the moon: "The horn is limited to the strongly illuminated part; in that region a longer exposure would be indispensable in order to determine whether or not there are twilight prolongations which would have to be attributed to the presence of an atmosphere" (Atlas de la Lune, Foscicule III, Texte page C 17).

It has just been observed that there is some
But it should not surprise beyond measure that the astronomers living in a large city do not have a thorough knowledge of the aspects of the small crescent which only can be observed through the mists of the horizon. The amateurs are frequently those most favorably located to devote themselves to this study, and I appeal to their cooperation in order to complete and correct the graph of figure 4 which still is very insufficient. The object of measurement, during the 2 or
3 days preceding or following the new moon is the total amplitude
2 of the crescent, measured from one horn to the other. Also the hour and place of observation must be known.

The precise angular measure of the crescent is done with a micrometer fitted to a portable bifocal telescope: The angle of the position of each horn is determined, the difference gives the required amplitude. But it is in no wise indispensable to have the accurate values, the local irregularities along the edge of the moon render the rigorous interpretation thereof illusory. It is actually certain that from one lumination to the next the value of the deficient arc should change some, since the regions of the moon which are illuminated are not the same.

Page 66

We can only have an average knowledge of the phenomenon, the theory of which is of a statistical nature.

We might thus be content with the following method of estimation which I have used. Trace a circle with a diameter of 10 centimeters, then with pencil mark on the circumference the site of the two horns as one sees it in a small telescope enlarging from 15 to 20 times and showing the earth shine clearly. Then with a protractor the angle which separates these two points is measured. If the entire border of the moon is clearly visible,partly lit by the sun and partly by earth shine. The error does not exceed one or two degrees. We can further measure the distance CP on the drawing and the diameter of the circle (Fig. 2) When the twilight hinders the view of earth shine, the precision is somewhat smaller, but then crescent subtends an angle notably smaller than 180° and an error of a few degrees does not noticeably alter the calculated value for the deficient arc.

I shall gladly carry out the reduction (or computation) of any observations submitted to me. The computation is quite simple but not all observers have the Connaissance des Temps at their disposal. It is expedient here to remind them that the age of the moon does not furnish a sufficiently accurate evaluation of the angular distance which separates the moon from the sun; it does not even furnish the longitudinal difference between those stars, since their motions are not uniform, that of the moon still less than that of the sun. Though the longitudinal differences were accurately known, it would not be sufficient; it would also be necessary to take into consideration the latitude of the moon.in For instance, at the moment of the conjunction the age of the moon is zero (age may here be :phase), but its distance from the sun is not zero except when there is a total eclipse. It is equal to the latitude which can reach 6°. Finally, the observer is not located at the center of the earth and it is necessary to determine the effect of the parallax at least for the values of a smaller than 20°.

The phenomenon which occupies us, neglected by astronomers, is one of those which strangely complicate the theoretical problem of lunar photometry. This will have made an appreciable progress toward the solution when the value of the deficient arc shall have been accurately established.

A. Danjon
President of the Strasbourg Observatory

ZUR KENNTNIS DER KLEINSTEN SICHTBAREN MONDPHASEN
(On the Smallest Visible Phases of the Moon)

Karl von Littrow

"Sitzungsberichte der kaiserlichen Akademie der Wissenschaften." Wien, 1872.
Vol. LXVl, Nos. l-V, June to December.

Translated from the German by
Erna Borm

459 The question how soon after the new moon the crescent becomes visible to the naked eye has lately been considered 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 Antiquitatum Sacrarum," Vol. XVll, 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 Xll-XVll, for the remaining paragraphs contain all kinds of "matter," which does not interest us. Of the first chapters left out, I might say briefly that several of them deal with the rules, according to which the testimonies of those who have seen the crescent are to be examined.

The ritual importance that the appearance of the new moon had for the Jews, because the beginning of their sacred months depended on it from the remotest time,
460 influenced them since earliest times, and until they finally obtained confidence in astronomical calculations,[1] to investigate how soon after the new moon can with surety the visibility of the crescent be depended upon. The statement of the formula, evidently derived from many century-long observations--one of the oldest examples of the inductive method--was the long-strived-after goal of the efforts of Jewish schol-

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[1] Schwartz, A., "Der judische Kalendar, historische and astronomische Untersucht." Breslau, 1872.

ars. The results were compiled by Maimonides.

To examine the rule set up and 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 am content to add occasionally such explanations which were self evident when revising the whole. These additions stand out because they are given in italics.

Chapter X11

The average course of the sun (average tropical movement) during one day--that is, in 24 hours--amounts to $59' \ 8''$. So the average course in 10 days is $9^{\circ} \ 51' \ 23''$; in 100 days, $98^{\circ} \ 33' \ 53''$; in 1000 days (after eliminating as the case may be 360°), $265^{\circ} \ 38' \ 50''$; and the surplus in 10,000 days, $136^{\circ} \ 28' \ 20''$. In this manner any number of days can be calculated. Likewise one can work out certain figures for 2, 3, 4-10 days; also for 20, 30, 40-100 days; it is open and clear, as soon as you know the average course for one day. Then you must also know for sure and exactly the average course of the sun for 29 days, and for 354 days, which make up one lu-
461 nar year, if the months are regular, which year is called a regular year. If you have the figures for the average course (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 and no less than 29 days--and here we want to learn nothing else than this appearance. 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 one year and one day, and thus it is every year.

The average course of the sun amounts to $28^{\circ} \ 35' \ 1''$ for 29 days, and for one regular year, $348^{\circ} \ 55' \ 15''$. There exists a certain point in the ecliptic of the sun, and also in the courses of the other planets, where, if the planet reaches it, its whole light is high above the earth. This point of the ecliptic of the sun, and of the planets--with the exception of the moon--circles evenly, and its precession amounts to almost 1° in 70 years. This point is called the sun's altitude.

[2] Narrien, J., "Historical Account of the Origin and Progress of Astronomy." London, 1833.

The course of this point (Precession) is in

10 days = 1' and 1/2 = 30'
100 " = 15'
1000 " = 2' 30'
10,000 " = 25'
29 " = 4' and a little more.
354 " = 53'

The starting point, as stated above, where the beginning of this calculation originates, is the beginning of the night of Thursday, Nisan 3, year 4938 of crea- t ion (March 23, 1178, old style), and the position of the sun in the average course at this starting-point was 7° 3' 32', in the sign of Aries. The sun's altitude at this starting-point amounted to 26° 45' 8' of the Gemini.

27
29
30
14

If you want to know the position of the sun in the average course for any given time, take the number of days passed by since the day of the starting-point until the given day, calculate the average course of these days according to the method
462 stated, add to the beginning the parts for it, and the result is the position, or average length, which the sun is holding in the average course for this day. Should you wish, for instance, to figure out the position of the sun in the average course for the beginning of the night to Saturday, Tammuz 14, of the starting year, the result, or the number of days from the starting day until the day on which it is desired to determine the position of the sun, would be 100; the average distance for 100 days amounts to 98° 33' 53' ; adding this to the beginning, which is 7° 3' 32' of Aries, the total is 105° 37' 25', and its position in the average course for the beginning of this night = 15° 37' in the sign of cancer. The average course resulting from from this calculation sometimes coincides exactly with the beginning of the night, sometimes one hour before, sometimes just as long after sunset. This, however, does not hurt the calculation of the appearance of the moon, because we complete this approximate figure in calculating the average course of the moon. The same is always done for any desired time, even for a 1000 years. Now if you add

to the start the course for the years and days in question, then you get the position for the average course. Likewise, one proceeds with the sun's altitude. Add the course in these days or years to the start, and you get the sun's altitude for the day in question. It is optional to choose another method than the one here accepted, to take perhaps the beginning of the first year of a known cycle or century. Should it be desired to take the beginning a few years earlier or later than the one mentioned, the method is clear. The course of the sun for a regular year is known, likewise for 29 days, and for one day. It is known that the year whose months are complete has one day more than the regular; that furthermore, the intercalary year with regular months has 30 days additional, and for complete [months], 31 days;
463 and for smaller months, 29 days, more than a regular year. With these dates the average course of the sun is calculated for the desired number of years and days. Add them to the given starting-point, you get the average course for the desired day of later years, and can take this as the beginning; or you deduct the mean course calculated from the given beginning, and get an earlier start for the desired day, and can make this the beginning.

Likewise one proceeds with the average (mean) course of the moon and other planets. From the foregoing it is evident that the mean course of the sun can be calculated for any 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 for this day according to the method stated, as well as the sun's altitude, from the mean course of the sun, and the remainder is called the true course of the sun (mean anomaly with reference to aphelion).

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

3. If the course is exactly 180°, or exactly 360°, then its part = 0, and the position of the mean course coincides with the true course.

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

If the course has		10°	its part		=	$20'$
"	"	20°	"	"	=	$40'$
"	"	30°	"	"	=	$58'$
"	"	40°	"	"	=	$1^\circ\ 15'$
"	"	50°	"	"	=	$1^\circ\ 29'$
"	"	60°	"	"	=	$1^\circ\ 41'$
"	"	70°	"	"	=	$1^\circ\ 51'$
"	"	80°	"	"	=	$1^\circ\ 57'$
"	"	90°	"	"	=	$1^\circ\ 59'$
"	"	100°	"	"	=	$1^\circ\ 58'$
"	"	110°	"	"	=	$1^\circ\ 53'$
"	"	120°	"	"	=	$1^\circ\ 45'$
"	"	130°	"	"	=	$1^\circ\ 33'$
"	"	140°	"	"	=	$1^\circ\ 19'$
"	"	150°	"	"	=	$1^\circ\ 1'$
"	"	160°	"	"	=	$42'$
"	"	170°	"	"	=	$21'$
"	"	180°	"	"	=	$0'$

and the mean and 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 instance, is 200°, it is 160° after deduction from 360°; and for 160° the part is $42'$, and consequently for 200° the part is also $42'$.

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

7. If the course had 65°, then the part for 60° is known as $1^\circ\ 41'$, and for 70° the part amounts to $1^\circ\ 51'$, and thus the difference for 10° is but $10'$, and to each degree comes $1'$. Consequently the part for the course of $65^\circ = 1^\circ\ 46'$.

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

9. If, for instance, 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 mean course of the sun for this time must be calculated, and that amounts to $105^\circ\ 37'\ 25''$.

9 Continued
Figure out the sun's altitude for this time, which is $86^\circ 45' 23''$; deduct the sun's altitude from the average course, and you get the course $18^\circ 52' 2''$. If there are less than 30 minutes, it is not necessary to take them into consideration, but if
465 they are 30 or more, you take for it 1°, adding it to the degrees of the course. Therefore this course amounts to 19°, and it part according to the method stated is $38'$.

10. But because this course is smaller than 180°, the part which amounts to $38'$, must be deducted from the mean course of the sun, and there remains $104^\circ 59' 25''$, and the true position of the sun at the beginning of this night is in the sign of Cancer 15° less $35''$, which can be neglected when calulating the position of the sun, or also the moon and the remaining phenomena. Only the minutes must be taken into consideration, and 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, any day of earlier or later years can be taken as basis instead of the given start.

Chapter XIV

1. The moon has two mean courses. For the moon is circling in a small sphere, which does not encircle the whole world, and its mean course in this small circle is called the average course. The small sphere itself again turns in a big orbit which encircles the world, and the mean course of this small sphere in the big world-encircling sphere is called the mean course of the moon (mean tropical movement). It amounts in one day to $13^\circ 10' 35''$.

2. Thus the course in	10	days	=	$131^\circ 45' 50''$
" surplus "	100	"	=	$237^\circ 38' 23''$
" " "	1000	"	=	$216^\circ 23' 50''$
" " "	10000	"	=	$3^\circ 53' 20''$
" course "	29	"	=	$22^\circ 6' 56''$
" " "	354	"	=	$344^\circ 26' 43''$

So any number of days or years can be calculated.

3. The course of the mean anomalistic movement of the moon is—

3 Continued -- Anomalistic course of the moon in

	1	day	=	13° 3' 54"
	10	"	=	130° 39' 0"
Surplus in	100	"	=	226° 29' 53"
466 "	1000	"	=	104° 58' 50"
"	10000	"	=	329° 48' 20"
	29	"	=	18° 53' 4"
	354	"	=	305° 0' 13"

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

5. If the sun is between half of the sign of the fishes and the half of Taurus, the mean course of the moon remains unchanged; if it is between half of the Taurus and the beginning of the Gemini, add to the average course of the moon --

Sun between half of Pisces and half of Taurus	=	no change in moon's mean course
Between half of Taurus and beginning of Gemini	=	add 15' to " "
Between beginning of Gemini and beginning of Leo	=	" 15' to " "
Between beginning of Leo and the half of Virgo	=	" 15' to " "
Between half of Virgo and half of Libra and beginning of Sagittary	=	deduct 15' from Moon's mean course
Between beginning of Sagittary and beginning of Aquarius	=	" 30' " " "
Between beginning of Aquarius and the half of Pisces	=	" 15' " " "

6. The result, after addition or deduction, or if no change is made, is for the time calculated the mean course of the moon after the lapse of almost 1/3 hour after sunset, and is called "Mean course of the moon for the time of appearance."

Chapter XV

1. Thus, if it is desired to know the true place of the moon for any day desired, first figure out the mean course of the moon for the time of appearance in the given night, then the mean course of the moon and the mean course of the sun for this

and deduct the mean course of the sun from the mean course of the moon, double the remainder, and this is called "the Double Distance" (double difference of length).

2. As stated earlier, these calculations serve merely to learn the appearance of the moon, and this double distance in the night of the appearance, when the moon becomes visible, can amount to nothing but between 5° and 62°, no less than the first and no more than the latter.

3. Consequently, the following is to be heeded: If the double distance is 5° or somewhat more, then what is above is not considered, and is not added to it.[3]

Is the Double Distance between	Add to the mean course
6° and 11°	1°
12° " 18°	2°
19° " 24°	3°
25° " 31°	4°
32° " 36°	5°
39° " 45°	6°
46° " 51°	7°
52° " 59°	8°
60° " 63°	9°

After these degrees have been added the mean course is called the Rectified Course.

4. Upon observing the number of degrees of the "rectified course," if it is less than 180°, deduct the part of the rectified course from the mean 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 mean course of the moon for the time of appearance. The result of the mean course of the moon, after addition or subtraction, is the true position of the moon for the time of appearance.

5. If the rectified course is exactly 180° or exactly 360°, the part is 0, and for the time of appearance the place of the mean course of the moon is also the true position.

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

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[3] Delambre, "Hist. de l' Astron. ancienne," Vol. II, p. 204. "Quantity X."

6 Continued--

IS the rectified course	Its part is
10°	$50'$
20°	$1^\circ\ 38'$
30°	$2^\circ\ 24'$
40°	$3^\circ\ 6'$
50°	$3^\circ\ 44'$
60°	$4^\circ\ 16'$
70°	$4^\circ\ 41'$
80°	5°
90°	$5^\circ\ 5'$
100°	$5^\circ\ 8'$
110°	$4^\circ\ 59'$
120°	$4^\circ\ 40'$
130°	$4^\circ\ 11'$
140°	$3^\circ\ 33'$
150°	$2^\circ\ 48'$
160°	$1^\circ\ 56'$
170°	$59'$
180°	$0'$

that is, the place of the mean course of the moon and the true place coincide.

7. If the rectified course is greater than 180°, it is deducted from 360° and it gets the same part as in the course of the sun; if with the tens there are units, these are 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 instance, the true place of the moon for the beginning of the night to Friday, the 2nd of Iyar of the 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 mean course of the sun for the beginning of this night, we get $35^\circ\ 38'\ 33''$; if you then get the average course of the moon for this time, we get $53^\circ\ 36'\ 39''$, and the average course for this time amounts to $103^\circ\ 21'\ 46''$. In deducting the mean course of the sun from the mean course of the moon, there remains $17^\circ\ 58'\ 6''$. If you double this distance, you get as double distance $35^\circ\ 56'\ 12''$. Accordingly, as is known, you must add 5° to the average course and get the rectified course $108^\circ\ 21'$, in which case the minutes can be neglected, as explained in the case of the sun.

9. If you want to figure out the part of this rectified course which amounts to 108°, the part is $5^\circ\ 1'$. Since the rectified course is less than 180°, $5^\circ\ 1'$ is to

be deducted from the mean course of the moon, leaving 48° 35' 39"; counting the seconds as one minute, and adding it to the minutes, you get the true place of the moon for this time to equal 18° 36', or 19° in the sign of Taurus. So the true place (so to speak, ecliptic length) of the moon for any time from the year of the beginning to the end of the world.

Chapter XVI

1. The circle in which the moon is moving continuously differs from the circle in which the sun is always moving, that is, one half is toward the north, and the other half half is towards the south. The two circles meet, however, on two opposite points, so that the moon, when she is one of these points, is circling in the orbit of the sun, exactly opposite the sun. But if she leaves one of these points, her her way is to the north or to the south of the sun. The point from where the moon begins to diverge to the north is called the head (ascending node), and the one whence the moon swerves to the south, is called the tail (descending node). The head has a regular gait where there is neither increase or decrease; it always circles backwards in the signs of the Zodiac from Taurus to Pisces, and from Pisces to Aquarius, and so on.

2. The mean course of the head (movement of the moon's node) for

	1	day	=	3' 11"
	10	"	=	31' 47"
	100	"	=	5° 17' 43"
	1000	"	=	52° 57' 10"
Surplus for	10000	"	=	169° 31' 40"
Mean for	29	"	=	1° 32' 9"
" "	354	"	=	18° 44' 42"

The mean 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 mean course for this time as you calculated the mean distance of the sun, and the mean distance of the moon. Deduct the mean distance from 360°; the remainder is the position of the head for this time; the opposite, the position of the tail.

4. If you want to know the position of the head for the beginning of night to

omission

Chapter XVII

473 1. What has been 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, and the true position of the moon, and the position of the head for the time of the appearance, and deduct the true place of the sun from the true place of the moon. The remainder is the "first length." How?

2. If the position of the head is known, and the true place of the moon, then you also know the latitude of the moon, and whether she is north or south, and that is called the "first latitude." This first longitude and first latitude must be well taken note of.

3. Thereupon consider this first longitude and 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°, then in all of Palestine the moon surely appeared, and there is no need of another calculation. But if the moon was between 9° and 15°, you must investigate carefully for this appearance, and calculate in order to know whether she appeared or not.

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

5. The calculations of the visibility are as follows: First observe in what sign of the Zodiac the moon is. If she is in the sign of the ram, deduct of the first length 59'; if in the sign of Taurus, deduct 1°; in the sign of Gemini, deduct 58'; in the sign of Capricorn, 43'; in Virgo, 37'; in Libra, 34'; in the sign of Scorpio, 34'; in Sagittary, 36'; in 44'; in Aquarius, 53'; in Pisces, 58'; and what is left after deducting from the first length, is called the "second length."

6. These minutes must be deducted because the true position of the moon is not where she is seen, but there is a digression in her longitude and latitude, and that is called the "digression in vision." The quantity of this distance at the time of appearance is always deducted.

7. If the digression of vision (Parallax) of the latitude is northern, the minutes of the digression of vision are to be deducted from the first latitude; is the latitude a southern, the minutes of the digression of the vision are to be added to the first latitude. What you get after addition or deduction of these minutes is called "second latitude."

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

If the moon is in		Aries	it amounts to		9'
"	"	Taurus	"	"	10'
"	"	Gemini	"	"	16'
"	"	Capricorn	"	"	27'
"	"	Leo	"	"	38'
"	"	Virgo	"	"	44'
"	"	Libra	"	"	46'
"	"	Scorpio	"	"	45'
"	"	Sagittary	"	"	44'
"	"	Cancer	"	"	36'
"	"	Aquarius	"	"	24'
"	"	Pisces	"	"	12'

9. If these minutes are known, deduct them from the first latitude, or add them to it, and you get the "second latitude." It is also known whether it is a northern or southern latitude. The degree and minutes of the second latitude must be well taken note of.

10. Upon this you take but of a fraction of the second latitude, because the moon moon slightly diverts in her course. These fractions are to be calculated:

one latitude

If the moon is between the beginning of Aries and 20° of it, or between the beginning of Libra and 20° of it	then 2/5 are taken off the second latitude
If between 20° of Aries and 10° of Taurus, or between 20° of Libra and 10° of Scorpio	" 1/3 taken off
If between 10° of Taurus to 20° of it, or between 10-20° of Scorpio	" 1/4 taken off
If between 20-30° of Taurus, or between 20-30° of Scorpio	" 1/5 taken off
If between 1-10° of Gemini	" 1/6 taken off

10 Continued--

If between 10-20° of Gemini or between 10-20° of Sagittary	then 1/12 taken off
If between 20-25° of Gemini, or between 20-25° of Sagittary	" 1/24 taken off
If between 25° of Gemini and 5° of Cancer, or between 25° of Sagittary and 5° of Capricorn	then nothing is taken off, for the deviation is zero.
If between 5° of Cancer and 10° of it, or between 5-10° of Capricorn,	then 1/24 taken off
476 If between 10-20° of Cancer, or 10-20° of Capricorn,	" 1/12 taken off
If between 20-30° of Cancer, or between 20-30° of Capricorn,	" 1/6 taken off
If between 1-10° of Leo, or between 1-10° of Aquarius,	" 1/5 taken off
If between 10-20° of Leo, or 10-20° of Aquarius,	" 1/4 taken off
If between 20° of Leo and 10° of Virgo, or between 20° of Aquarius and 10° of Pisces,	" 1/3 taken off
If between 10-30° of Virgo, or between 10-30° of Pisces,	" 2/5 taken off

These fractions to be taken off the second 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 longitude; if southern, add it. This, however, is done only in case the moon in between the beginning of Capricorn and the end of Gemini; in case she is between the beginning of Cancer and the end of Sagittary, then it is the other way around--at the northern latitude, the moon curvity is added to the second longitude, and at the southern latitude, deducted. What is received after addition or deduction is called the "third longitude." If there is no deviation in the course of the moon, and if the calculation leaves nothing which would have to be deducted from the second latutude, then the second and third longitude are equal in size.

12. Then it must be observed in what sign of the Zodiac is the third length, which gives merely the number of degrees between the sun and moon. If it is in the sign of Pisces or Aries, add 1/6 of the third longitude to it. If in Aquarius or Taurus, add 1/5 of the third longitude to it; if in Capricorn or Gemini, add 1/6; if in Sagittary or Cancer, the third longitude remains unchanged. If in Scorpio

or Leo, deduct 1/5 of the third longitude; if in the sign of Libra or Virgo, deduct 1/3 of the third longitude.

That which results from the third longitude, after addition or deduction, or without change, is called the fourth length. After this always 2/3 of the first latitude of the moon is taken, and that is called the height of the place of the moon. In case of northern latitude, the height is added to the fourth length, in case of southern latitude, it is deducted. What is left of this fourth length, after the addition or deduction, is called the "arc of vision."

13. If, for instance, it is desired to figure out whether the moon was seen in the night to Friday, 2nd Iyar of the starting year, calculate the true position of the sun, the true place of the moon, and the latitude of the moon for this year in the manner stated. Then the true position of the sun is found at 7° 9' in the sign of Taurus, and the true place of the moon 18° 36' in the sign of Taurus, and the latitude as 3° 53' southern--the first latitude. Now deduct the position of the sun from the place of the moon, and there remain 11° 27' as the first length. As the moon is in the sign of Taurus, the distance of vision (parallax) is 1°, which must be deducted from the first length, and you get 10° 27' as second length. In like manner the distance of vision for the latitude is 10', and because it is southern latitude, the deviation of vision, which is 10', must be added, and you get as the second latitude 4° 3'; but as the moon is in the sign Taurus 18°, of the second latitude 1/4 must be deducted, which is the curvity of the moon, and you get as curvity of the moon 1° 1', neglecting the seconds.

14. As the latitude of the moon is southern, and the true place of the moon between the beginning of Capricorn and the beginning of Cancer, you must add the curvity of the moon to the second longitude, and get the third longitude 11° 28'. This longitude is in the sign of Taurus, wherefore 1/5 is added to the third length, viz. 2° 18', and you get the fourth length, or 13° 46'. Now take 2/3 of the first latitude, and you have the height of the place, or 2° 35'. Since the latitude is south-

ern, it (height) is to be deducted from the fourth length, and there remains $11^\circ\ 11'$, and this is the <u>arc of vision</u> for this night. In this manner you can calculate the arc of vision in degrees and minutes for every night of visibility.

15. After the arc of vision is worked out, observe the degrees of the arc. In case they amount 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° and the end of the 14°, compare the arc of vision with the first length, and learn from the limits whether it was seen or not. These are called "ends of vision."

17. With the ends of vision, it is as follows:

	If arc of vision is greater than 9° to 10° or somewhat greater than 10°, and first length 13° or more,	the moon surely was seen
	If, however, if the arc be of the size given, and the first length be smaller, or vice versa,	the moon was not seen
18.	If arc of vision be more than 10°, or somewhat greater than 11°, and the first length is 12° or more,	the moon was seen
	If the arc be of this size, and the first length smaller, or vice versa,	the moon was not seen
19.	If the arc of vision is greater than 11° and somewhat more than 12°, and the first length is 11° or more,	the moon surely was seen
	If the arc be of this size, and the first length smaller, or vice versa,	the moon was not seen
20.	If the arc of vision is greater than 12°, and more than 13°, and the first length is 10° or more	the moon was surely seen
	If the arc be as stated, and the first length smaller, or vice versa,	the moon was not seen
21.	If the arc is more than 13°, up to 14° and over, and the first length be 9° or more,	the moon surely was seen
	If, however, the arc be of this size, and the first length smaller, or vice versa,	the moon was not seen

And this is the whole procedure.

22. If we wish, for instance, to observe the arc of vision of the night to Friday, the 2nd of Iyar, of the starting year, we would get by calculation the arc of vision as $11^\circ\ 11'$, as is known. Since the arc of vision was between 10° and 14°, we compare it with the first length, which amounted to $11^\circ\ 27'$. As the arc of vision is more than 11°, and the first length more than 11°, the moon surely was seen, as is evident from the rules for the ends of vision. In this way, every arc is to be compared with its first length.

23. From this procedure it is evident how many calculations there are--how many additions and 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 meets her course, but not so the moon."

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

480 24. The reason why in these calculations this has to be added, and the other subtracted, as also the manner of all calculations, the proofs are given in the science of the calendar calculation and in Geometry, about which the Greeks have written many books not yet in possession of many of our scholars. For the books written by the wise men of Israel at the time of the prophet in the tribe of Issachar have not come down to our time. However, these statements are confirmed by very exact proofs, nor is there any mistake, and nobody can contest them. Therefore it makes no difference whether they were written by prophets or heathen; for in every matter, the basis of which is open, and its truth assured by proofs, so that no mistake is found in it, we depend upon the man who has said or taught the matter, however, merely on the strength of the proof which is public, and on the strength of the reason which is known.

April 18, 1844 – Jerusalem

Sun's Long. = 28° 32' 7"
Moon's Long. = 39 47 47

(1) <u>First Length</u> = 11° 15' 40"

Moon's Latitude = 2° 53' 43" = First Latitude = $\varphi 1$

(1) 11° 15' 40" – 1° = 10° 15' 40" = <u>Second Length</u> (2)

$\varphi 1 = 2° 53' 43'' - \frac{1}{3}$ of it or 54' 31" = 1° 59' 12"

(2) = 10° 15' 40" – 54' 31" = 9° 21' 9" = <u>Third Length</u> (3)

(3) = $9° 21' 9'' + \frac{1}{6}$ or 1° 33' 31" = 10° 54' 40" = <u>Fourth Length</u> (4)

$\frac{2}{3}$ of 2° 53' 43" = 1° 52' 22" = <u>Height of moon</u>

(4) = 10° 54' 40" + 1° 52' 22" = 12° 47' 2" = <u>Arc of Vision</u>

Compare

First Length = 11° 15' 40"
and
Arc of Vision = 12° 47' 2"

SHORT TRANSLATIONS OF THE MOON

"An Early Observation of the New Moon. The Cape Times of December 2 reports that the new moon of November 28 was seen with the naked eye in South Africa by Mr. A.W. Long and Capt. D. Cameron Swan 35 minutes after sunset, when its age was $17^h\ 31^m$. This is almost a record for South Africa; it was just beaten one Metonic cycle earlier on November 28, 1913; the age of the moon was then $16^h\ 39^m$. Observations of this kind have chronological importance, as many nations began their months with the first observation of the lunar crescent, and it is important to determine the shortest interval after new moon that they would be likely to see it. The position of the moon's node is of importance in this connection, and it will be noted that the Metonic cycle nearly reproduces this position, since the node completes its circuit of the ecliptic in 78 years 7 months" (Nature, January 21, 1933, p. 100).

TRANSLATION
EB-Jan.1941

GINZEL, Chronologie I.

[p.160] Paragraph 34. The Division and Beginning of the Day

So far as is evident from single monuments the day (horw) was divided into 24 parts or 12 day-hours and 12 night-hours. Hence, obviously, horae temporales, hours of uneven length are meant. The hours of the day appear represented by goddesses which carry the sundisc above their head, the hours of the night as goddesses with the *. The hours usually are given with the ordinal number as the first, second, etc., of the day or night. But the hours have other special names besides which differ in older or later texts. The knowledge of these names is of importance since without the knowledge of the goddesses of the hours some texts remain unintelligible. (Comp. the name list of BRUGSCH, Thesaur, Inscript. Aegypt. 1883, II, p. 843 and with regard to later names the information of DÜMICHEN, Zeitschr. f. Ägypt. Spr., III,
[p.161] 1865, p. 1-4). Not much that is certain is known about the manner of subdividing the hours and the naming of these parts. On one pylone of Karnak in one inscription the hours are called unut, the smaller periods attached to it are named at, hat, aut. It would be too hasty to see in these designations minutes, seconds, or even tertias, for probably by adding customary expressions merely the endeavour is to be expressed to extend the enumeration of times while the author does not have in view an exactly demarcated conception of time. We find something quite similar in the period cited in paragraph 38b as to the extension of this row upward.

With regard to the question in what time of the day the Egyptians set the beginning of the day, the majority of testimonies point to the morning. The following text from an inscription on the cover in the temple Ramses II at Thebes which is cited by BRUGSCH,[1] is, however, less decisive:

1) BRUGSCH, Thesaur. Inscr. I, p. 89.

"He is letting you (the king) radiate like Isis-Sothis in the sky on the morning of the new year." BRUGSCH believes he had to define the "morning" here as the "eleventh night-hour" in view of THEON (Schol. ad Arati Phaen. v. 152): "The rise of the dog star takes place about the eleventh (night)-hour, and they (the Egyptians) begin the year with it and believe that the dog star and its rise is dedicated to the goddess Isis."[2] We want to disregard a more exact definition of time in the two texts cited and merely assume that new year's day was begun in the morning with the visibility of Sirius in the dawn. If we set the time of Rameses II to which above inscription belongs at about 1300 B.C.[3] and the beginning of the Sothis year on July 20 (although for Thebes the heliacal rise of Sirius takes place 4 days earlier, see paragr. 39), and ascertaining for July 20, 1300 B.C. the sunrise and sunset and the rise of Sirius[4], then we get for the sunrise about $5^h\ 8^m$ mean time in the morning for Thebes; for Sirius, $3^h\ 48^m$; the sun set the day before about $6^h\ 47^m$ in the evening, hence, the eleventh night-hour, reckoned from sunset, ran from $3^h\ 25^m$ until $4^h\ 17^m$ in the morning and the rise of Sirius comes indeed in the eleventh night hour. Simultaneously it is evident that New Year's day was not
[p.162] begun exactly with the moment of sunrise but rather with the general morning dawn (here probably one hour before sunrise), and in like manner the remaining days of the year will have been reckoned as from the morning dawn. From the

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2)

3) Rameses II at present is placed in the time of about the second half of the 13th century to the first quarter of the 14th century.

4) Position of Sirius 1300 B.C. AR = $4^h\ 20^m$ D = $-17°\ 45'$ (see table I at close of volume) of the sun (with the help of Neugebauer's sun tables, see Introduction p. 54) a = $7^h\ 3.4^m$, d = + $23°\ 3.2'$. Half the diurnal arc of Sirius $5^h\ 24^m$ for the latitude of Thebes (25° 45' n. l.) half the diurnal arc of the sun $6^h\ 50^m$; equation of time -1.9^m.

little known up to this time from the monuments of the beginning of the day LEPSIUS has justly concluded that the day began in the morning (Chronol. d. Ægyptol., 1849, I 130), and IDELER (I 100) had come to the same conclusion much earlier through the statements of PTOLEMY in the Almagest.

The latter texts of PTOLEMY which here are very weighty were critically appraised especially by A. BÖCKH[1]. With the observations made during the night and especially with those made after midnight PTOLEMY Gives a double day date but contrariwise never with the day observations. This addition was necessary if with the observations made in the morning dawn there was to be no doubt left as to what day (date?) they applied, for the time of morning dawn could be counted with the end of the day just expired as well as with the beginning of the starting day; thus doubts could arise if not plainly designated on which day the observations were made. For instance, a Mercury observation made in the morning dawn of Jan. 1 in the corresponding Alexandrinic date could come on the 5th or 6th Tybi according to whether the dawn was set at the end of the 5th or the beginning of the 6th Tybi and could lead to the misunderstanding whether the 5th or 6th was the day of observation if some counted the dawn with the end of the day, others with the beginning of the day; but the double date 5/6 Tybi, i.e. from 5th to 6th Tybi eliminated the doubt. There are three such decisive double dates found in the Almagest: a) In determining the summer solstice in the year 463 prior to Alexander's death, it reads,[2] it fell "on the 11th Mesori nearly 2 hours after the midnight to the 12th Mesori", 11/12 Mesori, i.e. the definition still belongs with the 11th Mesori; b) HIPPARCH'S fixation of the spring equinox in the 43rd year of the 3rd Kallipic period[3] comes "on the 29th Mechir, after midnight to the 30th;" c) similarly

1) Ub. die vierjähr. Sonnenkreise der Alten, Berlin 1863, p. 303 & on.
2) Almag. III 2(1).
3) Almag. III 2(1):
4) Almag. III 2(1):

the autumn equinox of the 32nd year of the 3rd Kallipic period[4] "on the 3rd Epagomen-day at that midnight which leads to the 4th." Two other statements -
[p.163] although but one day is mentioned - reveal that the date did not change at midnight; that day is named which would have to be the first of a double date if such were used; a) The lunar eclipse observed by HIPPARCH in the 55th year of the 2nd Kallipic period[1] is set on the 9th Mechir, although the beginning of the eclipse took place half an hour before midnight and extended until the morning of the 10th Mechir; b) The other lunar eclipse, too, which took place in the same year as the one observed by HIPPARCH, of the 5th Mesori[2] is being figured as coming on the 5th Mesori although its center came 2 1/3 hours after midnight, hence into the morning dawn to the 6th Mesori. Likewise PTOLEMY expresses the time of two star-covering observations made in the morning hours by TIMOCHARIS by giving double dates (Almag. VII 3).

Thus HIPPARCH, and after him PTOLEMY, when dates of observations are concerned, begin the day with the morning. The reckoning of the day as from noon, also found with PTOLEMY (Almag, III 6) has purely astronomical and not chronological reasons and that is just why it was taken over by the astronomers. The closer definition as to what is to be understood by PTOLEMY as "morning" BÖCKH derives from three texts of the Almagest (IX 7, 8, 10) where mention is made of two Mercury observations, and of the second of DIONYS' observations. The former were made on the 18th Epiphi or 18th Phamenoth (19th) (morning dawn) and are later cited under 19th Epiphi or 19th Phamenoth. From this double date it is evident that , the dawn, the time of daybreak is already counted reckoned with the second day of the double date, being moved over with the day beginning with the next sunrise.

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1) Almag. IV 10. Begin after 5 1/2 hours of the night = $23^h\ 28^m$ mean Alexan. time.

2) Almag. IV 10. "And at that, as he (HIPPARCH) says, the center of the eclipse was at about 8 1/3 h," i.e. $2^h\ 11^m$ mean Alexandr. time (after midnight.)

Hence, it can be accepted in general that the Egyptians began the day with daybreak, about the 9th night hour (2h morn.) at the latest with the 11th (4-5h morn.) which agrees with the statements made earlier. Thus they reckoned from dawn to dawn. So when mention is made of the morning of the 1st Thoth, the morning dawn introducing the day of 1st Thoth is meant, not the dawn which comes again at the close of this day forming the transition to the 2nd Thoth. - Moreover, [p.164] it seems that passages of CENSORIN and HEPHAESTION also seem to indicate[1] that the time about sunrise formed the boundary line of the day.

The remark of PLINIUS (hist. nat. II 79) that the Egyptians began the day at m i d n i g h t thus in no way is confirmed from the Almagest. There are, however, still some writers who set the beginning of the day of the Egyptians at evening, so ISIDOR (de natura rer. 1, etym. V 30): dies secundum Aegyptios inchoat ab occasu solis, similarly SERVIUS (ad Aeneis V 738) and LYDUS (de mensibus II 1, comp. also BEDA, de die, and de temp. ratione); but these authors already belong to the later in literature and have no weight. Support of them was supposed to have been found in the hour tables at Thebes. These tables give the night hours for the beginning and the middle of each month (1 - 12) when a definite position (culmination ?[2]) of certain stars takes place. For each first day of the month they write: "Thoth, Beginning of night, beginning of the year," "Phaophi, Beginning of night," etc.; thus they seem to begin the day with sunset and figure the first hour of the night as from the latter. However, this is no argument for the day itself having been started with the evening, since the night hours as well as the day hours run as something independent of each other -- those from sunset, these from sunrise. Moreover, with the days - in the middle of each month - this significant writing occurs: "Thoth 16-15",

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1) BOCKH, a.a.O., p. 308-310.

2) see SCHACK-SCHACKENBURG (Agyptol. Studien, I. No.2, Leipzig 1902) he sees in the hour tables certain star culminations which were used with the help of an apparatus to fix the time.

"Phaophi 16-15" etc. Between the figures 16, 15 is the sign BRUGSCH (Materiaux p. 106) saw in this sign the expression "corresponding" or "equal" and accepted an equation between two different forms of dating (a "holy" "sacred" and a civil year). The meaning of the sign at present, however, is in no way clear. This form of dating speaks for the morning as the beginning of the day and it seems it should be understood in the same manner as the double dates of PTOLEMY. For the tables intend to state that in the first half of the month, from 1st to 15th and at that inclusive of the whole night of the 15th or until the morning of the end of this day such and such positions of stars take place in the single hours of the night but that from then on, i.e. as from the beginning of the 16th (end of 15th) from daybreak until the end of
[p.165] the month a changed position of the stars takes place, so that (in case culminations are meant) new stars enter in place of the earlier (due to the shifting of the star-day as against the sun-day which has become noticeable).

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"THE CALENDAR OF THE GREEK OF BABYLONIA

and the Origin of the Jewish Calendar"

The propagation of the metonian calendar - the most perfect of the luni-solar calendars - met with the ancient Grecians with obstacles of the same kind as were those of the Gregorian calendar met with the modern nations. The scholars opposed it with rival systems, as the one of Eudox, the ignorant with their inertness of routine or indolence, the pious with superstitious prejudices. In course of time, however, the Meton calendar imposed itself on the most civilized Greek states of the world but the chronologers do not agree as to the exact extent of these conquests. The ancient witnesses themselves are rather contradictory with regard to this subject. "The majority of the Greek, writes Diodore of Sicily in the 1st century B.C., until my time used the ennea-decasteride (i.e. the Meton cycle) and were well satisfied with it." (1) (Diodore de Sicile XII, 36). 250 years later, the christian chronicler Sextus Julius Africanus declares with the same assurance that "the Greek and the Jews have the custom of inserting three intercalary months in eight years, (2)". (Note 2, p.90:

Africanus by Georges Syncelle, p. 611

It is extraordinary that this text was not quoted by the Hebrew historians of the calendar, nor the ch.74 of the "Book of Enoc" which testifies ~~but~~ very vaguely of the ancient knowledge of the octaeteride by the Jews. This latter text was pointed out to me by M. Joseph Halevy.)

in other words, they were using the "octaeteride". All the conclusions that can be drawn from these two assertions is that the eight-year cycle and the

19 year cycle continued to share until a very advanced period, probably until the general adoption of the solar calendar, the favour of the Greco-Oriental world. But in what proportions did this division take place? Where is the exact demarcation line for these two domains? That is difficult to determine a priori. The problem should be examined for each nation, for each city in particular, and here the inscriptions, and medals offer more help than the historical texts or literature. With these aids it was possible to make sure that beginning with the middle of the 4th century B.C. Athens adopted the Metonian reform while in most of the cities of Syria and Palestine the octaeteride prevailed until the Roman era when it gave way to the solar calendar. (Note 1, p.91: On this point see Unger, "Time-computation of the Greek"; also Ivan Muller "Handbook of Science of Classical Antiquity" I,1601).

What was, with regard to this, the sustem followed in the Arsacide monarchy, or, to be more exact, in the Greek colonies of Babylon from where the Parthian kings took over the language and the calendar on their moneys and their official records?

To solve this little problem, we first point to two theorems the demonstration of which is almost useless for it merely means to translate into the language of mathematics the fundamental principles of the whole luni-solar calendar be it ever so little scientific.

<u>Theorem I:</u> In every luni-solar calendar based on a cycle of N years, in case the year E. is embolismic (2) it is the same with every year the date of which differs being over or short from that of E by an exact multiple of N.

(Note 1, p.91: On this point see Unger, "Time-computation with the Greek"; Ivan Muller, "Handbook of Science on Classical Antiquity" I,601.)

(Note 2, p.91: Years of thirteen lunar months are called embolismic and "common" those with but twelve months.)

If, for instance, in an octaetenque calendar, the year 1870 is embolismic, it will be the same with the years 1862, 1854 .... 1878, 1886, 1894 .... In the ennea-decateric calendar, in the contrary, the embolismic years are 1870, 1851, 1832, ... 1889, 1908 etc. This theorem proves that the embolismic years are reproduced at periodic intervals: as known the same rule serves to determine the leap-years in the Julian calendar.

Theorem II: In no luni-solar calendar there can be two consecutive embolismic years nor two three consecutive common years.

This theorem is formulated expressly by the astronomer Geminus (3) and is easy to verify with all known calendars.

(Note 3, p.91: Geminus, intorduction to Phenomena, ch. VI.) It signifies that the aim in inserting the intercalary month is solely to prevent that the New Year's day of the lunar year ever is put off delayed by a complete lunation from the astronomical point - equinox or solstice - chosen as the beginning of the solar year. The year of 12 lunar months (of 29 days and a half on the average) is 11-$\frac{1}{4}$ days shorter than the solar year; in admitting therefore, that in the beginning of the cycles, the initial new moon comes precisely at the astronomical point, the delay will be 22$\frac{1}{2}$ days at the end of 2 years, 33$\frac{3}{4}$ days at the end of 3 years, i.e. more than one lunation: thus at least one intercalary year in three is needed. Similarly, the succession of two embolismic years is not only unnecessary and asymetrical but it would also almost always advance new year's day of the lunar year over new Year's day of the solar year by more than one lunation, which is just as irritating as a delay of the same length of time. For better reasons the succession of three embolismic years is absolutely impossible.

This being granted, we come to our Greco-Babylonian calendar. On a great number of tetradrachmas coined by the kings Arsacides, not only the year (reckoned according to the Seleucides era, Sept. 312 B.C.) but also the month is given. Contrary to the Pontic and Athenian series where the month (or the prytanie) is expressed by a numeral letter, the Arsacides months are indicated by their first letters: the names of the months are those of the Macedonian calendar, introduced in Babylon by Alexander the Great; the intercalary month is simply called EMB or EM for Embolimos "intercalary". All coins dated with this month reveal to us an embolismic year of the Greco-Babylonian calendar, the date of which is supplied by the corresponding Seleucides date. So far to my knowledge three pieces of this kind have been found. They are: (1) A tetradrachma of the year 287 Sel. (British Museum); (2) A tetradrachma of the year 317 Sel. (Berlin Cabinet-Percy Gardner, Parthian Coinage, p.46); (3) A tetradrachma of the year 390 Sel. (Legoy, Review Numismatic 1855 -- Percy Gardner, op. cit. p.62). Thanks to our two theorems it will be seen that these three coins - though spaced over a period of more than a century - make it possible to determine the nature of the Arsacide calendar with certitude.

Let us first see whether the indications of our tetradrachmas are compatible with the hypothesis of an octaeteric calendar.

The year 287 being embolismic, it will be the same (Theorem I) with the years 287 ∤ 32 (the exact multiple of 8) i.e. 319.

Similarly, 390 being embolismic, it will be the same with 390 - 72 (exact multiple of 8), i.e. 318.

On the other hand, the tetradrachma of Berlin teaches us that the year 317 was embolismic. We have therefore the years 317, 318, 319, as embolismic i.e. not only two but three embolismic years in succession which is absolutely impossible according to theorem II.

Hence, one can affirm that the Greco-Babylonian calendar during the period of the Arsacides, was not based on the octaeteride.

Let us see now whether the system ennea-deca-eteric can be applied to our tetradrachmas.

In this system, if you add 19 to the embolismic 287, you arrive at the embolismic 306.

Likewise, if you deduct of the embolismic year 390 76 (= 19 x 4) you arrive at the embolismic 314.

Thus, in the period of 19 years beginning, for instance, in 301 Sel., there are three embolismic years which are sure: 306, 314, 317. Now, this succession is not only not at all absurd but it also coincides exactly with the results received by that from the christian Pascha cycle, or the tupe of the Metonian cycle customary with the Jews. Indeed in these two calendars, the seven embolismic years of each cycle have the numbers 3, 6, 8, 11, 14, 17, 19. (1) (Note 1, p.93: It is easy to see that this distribution of embolismic years is the most natural and most symmetrical of all when, at the beginning og the cycle, the days of the lunar and solar year coincide exactly or almost so. In the Pascha cycle this is the necessary consequence of the principle of the celebration of Pascha (Sunday after the full moon which follows immediately the spring equinox) and the year arbitrarily chosen as the start (285 A.D.).) You see how the years 6, 14, 17 correspond precisely to the three embolismic years attested by the tetradrachmas arsacides.

It probably will not be audacious to draw the following conclusions from this reasoning.

(1) The arsacide calendar or properly speaking, the calendar of the Greek of Babylon was based on the Meton cycle.

(2) Taking as the beginning (arbitrary) of the cycles, the year 301 Sel., the embolismic years very likely came in the following order in each cycle: 3, 6, 8, 11, 14, 17, 19.

(3) When the Jews in the IVth century A.D. adopted the Metonian calendar, they arranged it after the Greco-Babylonian model. So this calendar, in all probability came to them not from Palestine where the octaeteride had held its own, but from Babylon:

This hypothesis is confirmed by the fact that the astronomical studies, according to the testimony of the Talmud flourished more in the schools of Babylonia than in those of Tiberiad. If asked to designate the true inventor of the present Jewish calendar, I would choose the famous Babylonian Rabbi Samuel, known by his astronomical researches (1). (Note 1, p.94: Talmud of Babylon, Rosch ha Schanah, 20b; Hulin, 95b (according to Graetz "History of the Jews" IV, 289 and note 21).) The patriarch Hillel II, to whom tradition attributes the manufacturing of the calendar (2). (Note 2, p.94: R Hai Gaon, with Abraham ben Hiyya, Ibbour, p.97) no doubt did nothing else than to give legal consecration and publicity to a private work, spread since long among the Rabbis of Babylon who endeavoured to free themselves from the tutelage of the Tiberiade patriarchat in what concerns the intercalation.

Theodore Reinach.

The 14th Nisan, the Day of the Crucifixion and the Synoptikers

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Part I

P. Joh. Schaumberger

The old question of controversy as to the synoptic chronology of the passion of the Lord is to be discussed here as much as it is necessary for the modern astronomical calculations.

It is known that the synoptikers seem to put the crucifixion on the Easter holiday, the last supper on the evening of the day before, but according to John everything seems to be a day sooner.

According to the law (Ex. 12: 6, 8) the passover lamb had to be killed on the 14th Nisan toward evening and eaten that same night. According to Jewish calculations, the 15th Nisan began already on the evening of the 14th with the setting of the sun, this 15th was the first great holiday. According to our calculations as well as the old Roman those evening meals would still be on the 14th Nisan. This calculation of ours was not unknown to John since he includes the appearance of the Resurrected in the evening to the Easter holiday, even though it was late at night from Easter Sunday to Easter Monday: "cum sero esset die illo, una sabbatorum" (John 20:19). In this same manner John's time given for the Lord's supper could be "ante diem festum paschae" (John 13:1) referring to the evening of the 14th to the 15th Nisan. When John designates (19:14) the death Friday as . . . . this would not mean under this supposition the "day of preparation for the passover" but the day of preparation for the Sabbath which falls into the first Easter holiday of that year that is the "Friday of the Easter week". If the Jews did not want to go into the court house of Pilate on the morning of Good Friday, "ut non contaminarentur, sed ut manducarent pascha" (John 18:28) that the word pascha does not refer to the Easter lamb but to the feast offering (Chagiga) of the 15th Nisan. In harmony with this conception the crucifixion of Christ would fall on the 15th Nisan according to John as well as according to the synoptikers, which is the first Easter feastday. I would like to call that the simple harmonizing.

Lots of things happened on the death day of Christ that was forbidden for holidays. The Mischna teaches that "there is no difference between a holiday and a Sabbath only in the preparation of food" (Besa 5:2) which was prohibited on Sabbath but permitted on a holiday. Court procedure was not permitted on Sabbath or a holiday, but it also could not be started on the day of preparation to either of these days since in that case the conviction and execution would have had to take place on a Sabbath or a holiday since conviction could only be made of the second day of the court procedure. (Sanhedrin 4:1).

But it is certain that on the other hand, the court order of the Mischna was not adhered to in the condemnation of Christ. This specified that the action had to begin by day and that the condemnation could not take place until the next day. The suit could not have been brought against Jesus in the night the way it was. The enemies of Christ probably were of the same opinion as R. Simeon Lakis 200 years later: "Sometimes the suspension of the Tora is its strengthening". (Bab, Talmud Menachoth 99a). In all events, they knew they were protected by the rule that the actions which were forbidden on the holiday i.e. condemnation, when they were "done", were"done", that isvalid (1). That they were able to buty linen on a holiday cannot be proved rabbinically (Mark 15:46) by Strack-Billerbeck 1.c.832. But it was permitted to prepare food on a holiday so one was able to but it, if one dispensed with certain formalities of the purchase. Perhaps this could be done with acquiring the necessary things for a funeral since the Mischan ordains (Sabbath 23, 5) "One is allowed to do everything that is necessary for a dead person, one can anoint him and wash him, only one must not dislocate any joint."

From this law of rest for the holiday there seems to be no forcible difficulties against accepting the fact that Christ died on the 15th Nisan and celebrated the Pascha on the 14th. But to many these difficulties mentioned above seem so great that they rather accept the theory that Jesus ate the passover a day earlier than the other Jews, be it that they had shoved it up or that the Lord anticipated the meal.

The synoptikers designate the day of the Lord's supper as . . . . (Math. 26:17; Mac. 14:12). According to the theory of anticipation these would have to be understood as :. . . . .(2)

But was it even possible to have the passover lamb killed in the temple on the 13th Nisan? Perhaps the Lord had it killed in the house of the Lord's supper? That is the way it was done at the first passover in Egypt. Then one surmises that because of the great number of passover lambs all of them could not be killed in the temple. Then there was only this difference between the killing of the Easter lamb and the peace offering, from the latter the priest received the should and the breast. So perhaps one could have taken a peace offering lamb for the passover supper? According to Joseph Schneid (2) Rabbi Jusua (3) is to have pronounced a pascha a valid that had been offered under some other title (that is a peace offering) say on the morning of the 14th Nisan or even on the evening of the 13th. But this quotation is clearly to be understood differently just like the parallel quotation Mischna Zebachim 1, 3 (4): If someone has offered and killed a passover lamb on the morning of the 14th Nisan not for its purpose (as passover lamb) then R. Josua declared it as suitable (clearly as peace offering) as if it had been killed on the 13th. Ben Bathyra declares it to be avoided if it has been killed (on the 14th) "between the two evenings". So if a lamb that had been originally designated as a passover offering was killed on the 14th Nisan "between the two evenings", that is the lawful time for the passover to be killed, but not for this purpose then it could not be considered any kind of a sacrifice, not even a peace offering, since it was forbidden to bring the daily freewill offer at this time because the daily Tamid-offering had already been brought. (5) According to Ben Bathyra a lamb that has originally been selected for a passover and is killed on the morning of the 14th Nisan for some other purpose then it does not count as anything. But R. Josua wants to let it count as a peace offering that had been killed on the 13th.

Therefore, to keep to the anticipation theory one would have to take it for granted, that Christ as Lord of feast as well as of the Sabbath had set His own time for celebrating the passover, deviating from the custom of the Jews, because He knew that He would be the real passover lamb at the lawful time. (1 Cor. 5:7)

We would have complete harmony between the synoptik reports and John's if we accepted the theory of shifting. The present calendar of the Jews is arranged so that the 15th Nisan never can fall on a Friday. One takes it for granted that the first Easter holiday that should have been on Friday in the death year of Christ was shifted to Saturday, whereas Jesus (and others with Him) celebrated it on the right date. The terminoly of the synoptikers as well as of John would be easily understood in a case like that. If such a shift was customary at the time of Christ will be discussed further on.

The astronomical calculations are not favorable to this shifting hypothesis. It shows that during the years of 28 to 33 A.D., that is in the period into which one usually sets the death year of Christ, the 15th Nisan never happened on a Friday, but the 14th twice, that is in the year 30 (14th Nisan was on Friday the 7th of April) and in the year 33 (14th Nisan was on Friday the 3rd of April), compare this with the table in the preceding article by Karl Schoch, Christ's Crucifixion on the 14th Nisan. Schoch's singular computation rests on the fact that he has been observing new moons very carefully for 30 years and upon the result of these hundreds of observations and the reports of old observations on moons he has calculated (1). If the Jews observed the new moon carefully at the time of Christ and regulated their calendars by this then Christ's crucifixion took place on Friday the 14th Nisan, April 7, 30 or April 3, 33.

Frederick Westberg (2) wants to exclude the first date since the "7th of April was a DIES NEFASTUS on which no court sessions were allowed". It is correct that the 7th of April belonged to the dies nefasti on which the Roman officials were not permitted to perform certain actions of the court. But "this did not include all the actions of the authorities and individuals . . for the purpose of coercitio questio, animadversio against unyielding ones and evildoers, who therefore, were often condemned on dies nefsti." (1)

The death date of April 7, 30 fits in the best with the generally accepted ideas of the whole span of the life of Christ. At the beginning of His public life Christ was about 30 years old (Luke 2:23). His public life is usually calculated as not having lasted more than three years. It is known that Christ was born before the death of Herod the Great, that is before Easter of the year 4 before the beginning of our time reckoning (according to astronomical calculations this year is designated as the year -3). How long before the death of Herod Christ was born is not definitely known. On the strenght of Mathew 2 one usually figures it to be about 2 years. We substitute x for this unknown figure! At Easter time of 33, Christ was 33 + x, that is about 35 years old. If we would take East of the year 33, we would have 3 more years and that would make Him too old, about 38.

The following year of 34 would make Him still older, but Friday April 23 of that year was the 15th Nisan which date would fit with the synoptik reports as well. Christ would have been about 29 years old or almost as old as Iremaeus gives Him: "A 40, autem et 50, anno declinat iam in aetatem seniorem, quam habens Dominus Noster docebat, sicut Evangelium et omnes seniores testantur, qui in Asia apud Iohannem discipulum Domini convenerunt." Haer, II 22, 5. It is a known fact that no one has agreed with Iremaeus. Perhaps one should understand his reference to the apostle students only that Jesus worked in His riper years, whereas Iremaeus came to the setting of the number of the years themselves through misunderstanding of John 8:57 (Quinquaginta annos nondum habes).

The calculation for the year 27 results in quite a peculiar case in every respect, a "bordercase". Schoch calculates (according to private communication), the new moon (black moon) for the afternoon of March 26, 27 at 8 hours and 10 minutes Jerusalem time. At sunset of the following day, the moon was 21, 8 hours old and if the sky was very clear it would be visible for a few minutes perhaps. In that case, March 28 was the first Nisan, April 10 a Thursday the 14th Nisan; April 11 a Friday the 15th. But it is just as possible that the moon was not visible on the night from the 27 to the 28th of March then the 29th of March would be the first Nisan; April 11, Friday the 14th Nisan; and April 12 the 15th Nisan.

On March 23 of the year 30, the moon was just as old as it was on the 27th of the year 27. And yet in that case, it was not visible whereas in this case it might have been. That is because the anomaly of the moon which plays such a great role with spring new moons, often is quite different. On March 23, 30 was 158°, therefore the moon was near the Apogaeum (180°). Therefore it was slowly moving away from the sun and did not become visible until late. On March 27, 27 was 288°, the moon was nearer the pergeäum than to the apogeaum. It was moving away from the sun faster and could be seen sooner.

The Nisan new moon of the year 27 is a border case in which astronomy cannot decide whether the new moon was visible on the 27th of March or the 28th. But that year is also a border case for the chronology of the life of Christ as death year, i.e. it lies hard on the border, possible already outside of the border of the possible time period.

According to Luke 3:1 we have to put all of the public life of Christ as well as the public work of the preceding John the Baptist has to be brought into the reign of Pilate. Pilate did not begin his office before 26 at the earliest. It is questionable if he had started before Easter of 26. Now John the Baptist would have to have appeared some time before Easter of 26 if Christ is to have died by Easter of 27. In such a case the public life of Christ can only be one year and such a supposition, it is well known, leads into all kinds of difficulties. Then too, in this case, the 15th year of the Kaiser Tiberius

(Luke 3:1) must be calculated according to the much disputed "crown prince-aera" i.e. we have to add to the years of sole ruling of the caesar since the death of Augustus (died August 19, 14 A.D.) the years of his coregency with Augustus which began about two years earlier. (1)

All these difficulties rest upon the equision: Good Friday equals the 14th or 15th Nisan equals April 11, 27. Therefore, this equasion moves to the border of probability.

Schoch calculates April 12 as the first Nisan for the year of 31. In the evening from the 11th to the 12th of April the moon was already 28 hours old, so that there are no astronomical objections to its being seen in Jerusalem. The possibility that because of metereological conditions (clouds of the evening sky) the visibility might have been impossible Schoch denies. It is a fact that this time of the year so many clouds in the vening sky would be extraordinary. But should this nevertheless have been the case, this would have brought the first Nisan on the 13th of April and the 15th Nisan on a Friday, the 27th of April. The year 31 would fit quite well into the chronology of the life of Christ. But we would have to figure, as has been stated, with an extraordinary happening, to reach this result.

It is striking that the year 29, the consulat year of the Gemini (1) into which so many of the fathers put the death of Jesus, is completely out of the picture according to astronomical calculations. The 14th Nisan of that year was Monday, April ,8 and its 15th Nisan a Tuesday, April 19, days which are quite impossible for the days of the passion of Christ. (Matter are about the same for the year 32, Monday April 14 is the 14th Nisan). One supposes therefore according to E. Preuschen (2) that those fathers had named the 16th year of the sole regency of Tiberius (Aug. 19, 29 to Aug. 19, 30) after the counsuls, (this is the year into which they put the crucifixion of the Lord), into what year of office the beginning of this ceasar year fell. The Gemini were the Consules ordinarii of the year 29, and that is why the whole year was named after them, even though they already had made room for the Consules suffecti Vinuncius and Cassius Longinus ona July 7, 29. (1). This would bring us again to the year 30 as the death year of Christ. However, this way is so unsure that I would rather not go that way.

Surveying all this, we find not a single Friday in the period from the 28 to 33 A.D. as the 15th Nisan. Only an uncalculable and improbable meteriological circumstance could have brought the 15th Nisan of the year 31 onto a Firday (perhaps also the year 28). The year 34 with its sure 15th Nisan-- Friday April 23 surely is too late and the year 27 with its "bordercase" Friday April 11--the 14th or 15th Nisan is too early.

The astronomical calculation speaks continually for the equasion: Good Friday--14th Nisan--April 3, 33 or probably--April 7, 30, i.e. for the fact that Christ died on the day before the first Easter holiday (Nisan 15), just as the sensus obvius of John gives. The equalisation with the synoptikers can then only be brought about by way of the above propounded anticipation hypothosy.

PART II

So far, we assumed that the Jews at the time of Christ figured their calendar accurately according to the moon by accurate observations of the new moon. We must now examine if this assumption really is a fact.

The modern Jews set their New Year, i.e. that first Tischri by calculation of the Moled (-"birth") of the moon, i. e. by calculating the new moon (black moon) not by observing the new moon. On the day of the Moled, the first month of the new year begins. (But there are certain definite delays. When e.g. Moled is not until in the afternoon then the month does begin until the next day. The beginning of the month which is calculated from the black moon rather than the new moon is naturally earlier (2), but by the delays which arise, this equals things out again. The beginning of all following months is regulated by the fact that the 1st, 5th, 7th, 9th, and 11th months always have 30 days and the 4th, 6th, 8th, 19th, 12th, always 29 days. The second month, Marcheschvan, has in regular years 29 days and in over years 30 days. The third month, Kislev, usually has 30 days, but in under years, only 29 days. To even out the moon year with the sun year, they have 7 leap years in every 19 years which have an Adar (sixth month) with 30 days and then a second Adar of 29 days.

New Year is never allowed to come on a Wednesday or Friday since then the day of Atonement which comes nine days later (the 10th Tischri) would fall on a Friday or a Sunday, i.e. just preceding of after Sabbath. That would lead to too great difficulties since the day of Atonement is a strict day of rest upon which the preparations which are permitted on a holiday are just as forbidden as on a Sabbath. Furthermore, the first Tischri cannot be a Sunday or the 21st Tischri, the 7th day of the feast of tabernacles would fall on Sabbath which would make the customary ceremonies with willow branches impossible.

If therefore, New Year, according to the Moled calculations, would fall on a Sunday, Wednesday or Friday, it is moved by a day. This is called Dechijja (-Exception or prorogation case) Moled Adu. They name is derived from the figure letter of the exempted days: Sunday 1, Weekday- Wednesday, 4 Weekday- ; Friday 6 Weekday-).

From the first Easter holiday (15th Nisan) to the following New Year's day there are always 163 days according to the reformed Jewish calendar, that is 23 weeks and 2 days. Easter always falls two weekdays earlier than the following New Year, therefore, never on a Monday, Wednesday or Friday. The number letters of these days give the name of the Dechijjah: Badu.

Now the question arises if this shifting of the Easter holidays was already customary during the time of Christ, as the above discussed shifting hypothesis takes for granted.

In the Mischna several cases are mentioned which do not fit into the present holiday regulation of the Jewish calendar.

Pesachim 7, 10, the Mischna gives rules ab ut the passover lamb: "The bones and the sinews and the leftovers are burned on the 16th Nisan. If this happens to be on a Sabbath, then they are burned on the 17th because they do not take precedence over a Sabbath or a holiday." Here it is taken for granted that the 16th Nisan could happen on a Sabbath and therefore, the 15th, contrary to the Badurule on a Friday.

In the controversy between the Pharasees with the Boë-thosäer about the Pentecost time which are going to discuss later, the fact that the 16th Nisan came on a Sabbath, therefore, the 15th on a Friday played an important role.

In the pamphlet Megilla 1, 2, 5, the Mischna gives the regulations governing that case when the 14th Adar (Purimfeast) comes on Monday or Saturday. R. Jose makes the remark in the Jerusalem Gemara which belongs to it, that neither case is possible since in that case the day of atonement would come on Sunday or Friday as the case might be. R. Jose therefore takes it for granted at his time (fourth century A.D.) that the calendar rules of his time were already used during the time of the Mischna, whereas it is evident that the latter does not know these rules (1).

In the Jerusalem Gemara on the pamphlet Sukka 4, 1 (2) R. Simon (3) (3rd Century A.D.) orders the calendar makers to see to it that the ceremony of the willow twigs (7th day of the feast of tabernacles) does not come on a Sabbath. Before that, it had been insisted that the willow twigs took precedence over the Sabbath i. e. the ceremony could be performed on Sabbath, but the Boëthosäens contradicted this (4). The Adu regulation ended this controversy.

The Babylonian Gemara (Sukka 54b) says: "If the first day of the feast of the tabernacles coincides with the day of preparation for the Sabbath, the Day of Atonement would have to come on a Sunday; that is why it is shifted." (By lengthening the preceding month Elul to 30 days). In another place, the Talmud reports (Rosch Haschana 20a): "When Ulla came he told that in Palestine one had made the month of Elul to a full month (of 30 days). Then he said: the associates in Babylonia recognize the service that has been rendered them by this." Therefore, at the time of Ulla (300 A.D.), the calendar rules had not definitely been laid down.

On the other side, it is of little value when later on R. Judas (Jer. Gemara Aboda Zara 1, 1) takes it for granted that the 23rd Tischri (Neh. 9,1) in the time of Nehemiah could not have been a Sabbath because in that case the Day of Atonement would have come on a Sunday.

Nevertheless, there is a Jewish tradition according to which the calendar rules for the feasts dates (Adu, Badn, etc.) had been introduced by divine command right after the erection of the second temple.

According to Christoph Langhausen (1) "Gerardus (i.e. the old Lutheran theologian Joh. Gerhard, who dies in 1637) in Harmonia evangelica (not accessible to me) chap. 166" refers himself for these traditions to a "testimonium es Seder Olam a Paulo Burgensi in Matth. citatum."

In my edition of Paul of Burgos (in the Venecian edition of the Biblia ordinaria 1603f. V. 44lff), the reference to the Seder Olam is lacking. Should by any chance, this be a reference to the haggadian world chronic Seder Olam Rabba which was written in the Mischna period, then this quotation would prove to be a latter insertion, as there are several in the book, because of its contradiction with the Mischna. I really think something else is meant, however. Lud. Compiegne de Veil (2) can only give one prayer in the lturgy of the "great Sabbath" right before Easter (according to the Jewish prayerbook) Machzor of Bologna as the quotation for this tradition. The Bolognese Machzor (publ. 1541) is one of the original documents of the Munich State's Library. It contains (Vol. 19,3) in a rhymed prayer for that Sabbath that tradition. In the first 7 lines, I count 6 half verses which rhyme with Olam. Since many Jewish prayers are designated as Sedar, I believe this is the prayer the Burgensis and Gerardus mean by Seder Olam. This would then be the only and very unreliable source for the news that the Jewish calendar rules had been intorduced by divine command in the Christian era.

According to all of this, we cannot presuppose the Badu rule of shifting of the Easter feast at the time of Christ.

Shortly before the time of Christ, according to the Jerusalem Gemara in Pesachim, people were in doubt whether the pascha could be killed on Sabbath until R. Hillel, the ancestor of the Gamaliel family eliminated the doubt. From this, which contains much which does not rhyme, it is not clear whether this doubt was solved by shifting the Easter feast or by postponing the killing until the Sabbath evening or if one anticipated it before the beginning of the Sabbath. But anyway for the death year of Christ, there is no need of a consideration of a collision of the 14th Nisan with the Sabbath.

When a fast day came on Sabbath, it was shifted to the next day without changing the calendar. Various quotations in the Babylonian Talmud (Taanith 12a., Erubin 41a) and in the Jerusalem Schekalim 4, 1, prove that this was already customary in 70 A.D.

Therefore, we have not proof that at the time of Christ, certain Easter dates were fundamentally sidestepped by calendar regulations. But we do have definite grounds to believe and know that it happened occasionally, purposely or unintentionally, the calendar was deviated from the cycle of the moon.

In older times, the Jewish calendar was regulated by observing the new moon, not as it is done now by calculation of the conjunction (new moon, black moon). If the new moon appeared on the evening from the 29th to the 30th day of the month, then the new moon began with the evening. Otherwise the month would not begin until the next evening. If the calendar council had convinced itself by the hearing ot witnesses of this appearance, then "it sanctified the new moon" and let it be known throughout Palestine even into Babylon, but later on when the Samarian caused confusion by setting false signals they sent out messengers.

Efforts were made to deceive the calendar by false witnesses. The Boëthosäens, a group of Sadducees, named after Boëthos, a priest who had been called from Alexandria by Herod, from whose family several high priests were called right before the time of Christ and also after, deviated from the practice of setting the day of Pentecost as the Pharisees did. They counted 50 days down from Easter to Pentecost from the Sabbath in the Easter week, so that Pentecost always came on Sunday; the Pharisees, however, reckoned from the 15th Nisan, no matter what day of the week it happened to be on. The Pharisees loved to emphasize their deviation from the practice of the Boethosaens. If e.g. the 15th Nisan was a Friday, then they performed on Sabbath, the 16th Nisan, with great pomp and ceremony, the ceremony of cutting the first sheaf, which according to the Boethoseans should not be done until the day after Sabbath. The Boethoseans wanted to have the 15th Nisan to coincide with Sabbath, because then the Pharisees had to celebrate the right date for Pentecost according to their ideas, so that it might appear that the Pharisees had given in to the ideas of their oponents.

The Jerusalem Talmud writes that the Boethoseans had bribed two new moon witnesses so as to bring the 15th Nisan on a Sabbath by beginning the months sooner. This trick was discovered because one of the witnesses betrayed himself. After that, they were more careful with their examination of witnesses.

The Mischan tells about Rabban Gamaliel II, the grandson of the Gamaliel of Acts, that he accepted two witnesses against the contradiction of R. Johann ben Nuri, they said, they had seen the old moon in the east in the morning and the new moon in the west in the evening. Naturally this is impossible. The Jerusalem Gemara comments on this: Gamaliel possessed a tradition of his fathers on the difference of the cycle of the moon. In other words, he rejected the first part of the testimony of the witnesses but accppted the latter part, because according to his reckoning, he figured that it was time for the new moon. The absolutely accurate calculation of the new moon was still considered impossible as late as by the famous astronomer Johann Kepler. We will have to say that R. Johanan was right when he mistrusted Gamaliel.

Furthermore, the Mischna reports that Gamaliel accepted two witnesses who said that they had seen the new moon at its time (in the night from the 2 39th to the 30th) when in reality it had even been invisible in the night of the 30th. Tp break the hard opposition of several rabbis Gamaliel commanded one of the contradictors, Rabbi Josua, to appear on the day which according to Josua's calculation should have been the day of Atonement with staff and money before Gamaliel, i.e. he was not allowed to celebrate this day as day of rest. To begin with, Josua was going to fight this but finally he let himself be persuaded by R. Akiba when this one explained to him: "What Gamaliel has done is done." i.e. the regulation of the president, even though erroneous is valid. When Josua came to Gamaliel he greeted him saying: My master and my student! My master in wisdom and my student because you have accepted my words." In other words, Gamaliel himself was convinced in the meantime that Josua had been "his master in wisdom, i.e. had been right. In spite of this, he did not take back the decision about the calendar. Maimonides reamrks on this: "that when the new moon had been witnessed in the night from the 29th to the 30th and still was not seen in the following night one held to the witnesses nevertheless: "because we are only bound to the observation during the night to the 30th day."

Similarly one s ould judge the case which P. Lagrange mentions in his Marcuscommentator 339f, and in his report on his trip to Sinai in the spring of 1896 which he describes in detail. In the evening of the 14th of March, 1896, the Beduins of the caravan held lookout for the new moon which would have ended the month of fast of Ramadan. When they neared Gaza on the 15th of March, one met "des gen, qui on vu la lune (some people who had seen the moon", who therefore, were not observing the fast any more and were already celebrating the feast of Beiram which began with the new moon. Right away the Beduins celebrated with them.

The Berlin "Astronomical Yearbook" gives as the time of the conjunction (new moon): March 13, 1896, $23^h\ 41^m\ 3^s$ i.e. according to our civil reckoning a few minutes before the noon on the 14th of March. By sundown in the evening, of the 14th of March, the moon in our localities was about 6 hours old. In Gaza about 5. Therefore, it is absolutely excluded, that anyone could have seen the new moon anywhere in Palestine on the evening of March 14, 1896.

The exact time of the conjunction is given today in every calendar in advance. One look into such a calendar would prove that it was quite useless to try to look for a new moon in the evening of March 14, 1896. But the Turkish Rusname (everlasting calendar) gives only a cycle calculation of the new moon which is inaccurate up to two days. Therefore, the Mohammedans do not rely upon the calendar for the setting of their feasts but upon the observation of the new moon. This would explain now at a time when we have exact astronomical calculation, there still could be mistakes, like the one of March 14, 1896. Naturally, they could happen in Gamaliel's time and to a much greater extent.

From personal experience, Schoch gives the following explanation (by letter): "In the spring because of the steep ecliptic, the crescent stand level with the horizon. With very yong new moons, he looks like a fine bright thread from left to right. Now there are reddish, yellowish horizontal lines 'never vertical) on the evening sky, they are often quite short (twilight stripes of the atmosphere). It often happened to me that in the spring when I was looking for the young new moon, which is as fine as a thread, would believe for a moment that such a colored horizon could stripe was the crescent and have excalimed 'I have it,' only to see a minute later, that I had been mistaken, because the thread disappeared or divided itself."

An observer who is educated in astronomy who is only persuing scientific purposes can usually correct such an error easily, as one sees in Schoch's example. But it is a different matter, who have a special interest in it, to observe the new moon early, e.g. a Mohammedan who is tired of fasting or with a Jew, who desires to set a certain date for a feast or to avoid it. That there were such people at the time of Christ, we have already seen. Now the Easter day for the year 30 and 33 gave rise to let such interests come into play.

On both of these years, according to astronomy, the 15th Nisan fell on Sabbath. That was what the Boethoseans greatly desired. On other occasions they tired to set this date by false witnesses of the new moon. As we know, the Pharisees at the time of Christ we can easily attirube them of havingshifted the 25th (I think this is a printer's error and should be 15th. Mrs. Lockwood) away from the Sabbath. But we do not need to surmise this. This could be accomplished in good faith by an error as in Gamaliel's time or of those Mohammedans of Gaza.

It could be possible, therefore, that on the 23rd of March of 30 or on the 19th of March of 33, there were people who testified that they had seen the new moon, whereas in reality it had not been visible until the following evening. The Pharisees welcomed such a testimony, because this shifted the 15th Nisan from Saturday to Friday. So it was that a majority could be found in the calendar council who would accept the testimon setting the first Nisan a day too soon. The High Priest did not always have the decisive word in the calendar council. The Boethoseans might really have news that the new moon was not visible until later, that the 15th Nisan would not come until Sabbath, as they desired. They could, therefore, hold to this date with their friends the Sadducees, among them the High Priest.

R. Gamaliel in his time had to bring all his authority into play to prevent R. Josua from celebrating the Day of Atonement on a different day that he did. Josua submitted only unwillingly. And yet the authority of Gamaliel was uncontested as the head of the Jews in those purely pharisee circles, so that his orders were binding even if they were founded on error. One or two generations before the Pharisees and Sadducess as well as Gamaliel existed side by side. The Sadducees even had their own book of criminal laws. From the time that the Pharisees finally succeeded in putting this out of power, they celebrated the day of victory (the 14ht Tammuz) as a feast day. Particularly about the date of Pentecost Gamaliel's predecessor in office Johanan ben Zakkai had to fight with the Bethoseans. Under Johana, shortly before the destruction of the temple, they succeeded in breaking the influence of the Boethoseans in every respect. This was so important to the Pharisees that they appointed the days from the 8th to the 21st of Nisan as days of joy. Before that it often happened that the Boethosians tried to put through their opinions in practice, even though they usually had to take the people into consideration and let the Pharisees have their way.

So it may be that in the year of Christ's death, many Jews celebrated according to the calendar council, the 15th Nisan on a Friday, whereas the Boethosians and theirfriends the Sadducees, and so perhaps even the High Priests, celebrated their favorite date the 15th Nisan--Sabbath, which corresponded with the true moon phase. For the High Priest who played a role in the condemnation of Christ, Good Friday, was a work day which made no difficulties to their actions. The

Pharisees went along and perhaps welcomed the views of the High Priest as a pretext to calm their own misgivings which would arise out of their views.

The Lord, who knew that He would not live to see the evening of Firday, could hold to the official regulation of the calendar council for His passover meal, without sharing its error, just as much as people later on in countries that used the Julian calendar kept to this, even though one recognized the advantages of the Gregorian and the disadvantages of the Julian. In this sense, the synoptiker could designate the day of the Lord's Supper as the "first day of the unleavened bread", the "day on which the Pascha should be offered" etc. John . . . . (John 18: 16) may have used the exact calendar of the High Priest and dated everything in his report a day earlier.

The Mischna rules (Sanhedrin 5,3) that if the testimony of two witnesses if it differs in one day of the same month still is valid, because it might be that they mean the same day only figure the beginning of the month differently. This we can apply to the Chronology of the Passion since the writers of the Gospels agree as to the days of the week and at the most disagree in the reckoning of the day of the month by one day with each other.

This theory and hypothesis has the advantage over the old anticipation and shifting theory that it is founded on fadts which can be substantiated by old Jewish witnesses (Boethosian Pentecost controversy, Gamaliel's setting of the calendar) and upon modern experiences in primitive (Gaza) and scientific (Schoch) new moon observers. The hypothesis that is grounded upon this offers these advantages; it gives a smooth understanding to all gospel reports on the date of the passion of our Lord.

And this also lets the dates of April 7, 30 or April 3, 33 stand as the probable date of the crucifixion of Christ. But it is possible that some of the Jews because of early setting of the beginning of the month celebrated this day as the 14th Nisan whereas others figured it to be the 14th Nisan according to the cycle of the moon.

TRANSLATION

Oswald Gerhardt: "Das Datum der Kreuzigung Jesu Christi"
The Date of the Crucifixion of Jesus Christ p. 84

Berlin, 1914, Verlag Wiegandt & Grieben (Erich Donati)

pp. 74-80: C O N C L U S I O N S

A. To begin with let us examine the dates of the month giving the day of the crucifixion partly according to ancient Christian tradition and partly according to scientific calculation.

a. Epiphanius has handed down to us the following dates of the Passion-week (see Merx p. 378): On Tuesday March 17 the Lord took the Passover supper. "Two days earlier than it should have been eaten"; Thursday, March 19, "it was proper" to eat the Passover for it was the 14th; Friday, March 20, He suffered the death on the cross. Is there a week to be found in March in the years 27-37 when those dates coincided with the days of the week given? Once it actually happened and that was in the year 33 (see above). This week, however, lay completely outside the Passover even outside of Nisan which began only on Saturday, March 21. Hence the tradition of Epiphanius is of no value. In case it is of the same origin as the statemtn quoted above from the Syrian Didascalia, then in this respect the same judgment applies to the latter.

b. March 23 (Idatius, Annianusm Eusebius, Chronicon paschale) is supposed to have been the day of crucifixion in the year 34; in this year, however, March 23 was on a Tuesday consequently those authors were mistaken. March 23 fell on a Friday in the years 31 and 36; but there it was 3-4 days, and here 8-9 days b e f o r e the Passover. So this date is out.

c. March 25 in the consular year of Gemini, i.e. 28 or 29 (Acta Pilati, Tertullian, Lactanz, Hippolyt, Augustin and others), was in the year 28 on a Thursday, in the year 29, however, on a Friday but completely outside the Passover.

These two dates (March 23 and 25) have no chronological but merely symbolical significance. The first week of spring was considered the week of the creation of the world; the incarnation of the word of God with which the new creation began was supposed to have taken place the same week--hence the birth of Christ on December 25. The closing of his humanity (crucifixion) and the beginning of the new life (resurrection) again was supposed to have come in the same week (march 25 and 27). The incarnation, i.e. the conception in the womb of the virgin Mary and the death were given the same date. The most ancient witness for this seems to be Clemens Al.; it is reprinted below. Augustin says (de Trinit. 1, IV, c.5) "octavo Calendas Aprilis (= March 25) conceptus creditur Christus quo et passus. Natus traditur octavo Calendas Januarias" (= Dec. 25). Compare Ideler II, 270 and on, 328 on, 420 and on.

d. April 3, 33; see above on the year 33.

e. April 6; it was a Friday in the year 31 and 36, but both times outside the Passover.

f. April 7; see above on the year 30 and also here below.

g. April 15; (Keim, Bunsen, Hitzig, Ideler); it was a Friday in the years 29 and 35; in the latter case it was the third or fourth day of the Passover, in the former it was before the Passover; so it is out.

h. April 23 (H. Sevin). It was a Friday in the years 28 and 34. In the latter only, one could think of a connection with the crucifixion, for this Friday (see the Calendarium above) actually was part of the Passover. But the year 34 cannot come into consideration because it is too late.

i. April 26 (Paulus) and April 27 (Anger). See above under year 31 and her at the end.

B. Those years of Pontius Pilates's administration when the days of the 14th and 15th Nisan do not come on a Thursday and Friday but on Mondy, Tuesday, Wednesday, Saturday, and Sunday, are completely out. Those are the years 29, 32, 36 and, strictly speaking, also 35 (see above). Consequently there remain merely the years 27, 28, 30, 31, 33 and 34 for consideration.

Since the public ministry of Jesus began at the earliest in the winter of 27/28, at the latest in winter 28/29 and laster $2\frac{1}{4}$ - $3\frac{1}{2}$ years, therefore the years 27 and 28 as well as 33 and 34 are out and we face the last decision: either the crucifixion was in the year 30 (Friday, April 7) or in the year 31 (Friday, April 27).

1. If the feast had fallen so that the Passover supper took place on the day of the full moon, then the year 31 would have to be eliminated, because here the day of th full moon was a Wednesday: according to one interpretation of the gospels it would mean Thursday according to the other, Wednesday as the day of the death; yet both cannot be correct, for tradition agrees in that the crucifixion was on a Friday. On the contrary, in the year 30 the full moon was on a Thursday, hence on this day was the Passover supper of the Lord and the crucifixion on Friday.

2. Should the report of the gospels be so understood that the Lord held his Passah supper on the day b e f o r e the legal date, that he died on the day when all the people were offering their Passah lamb, that t h i s day, i.e. the 14 Nisan--was a Friday, then crucifixion could have been on none but Friday, April 7, 30. Because in 31 the 14 Nisan came either on Wednesday, April 25, or on Thursday, April 26, but not on a Friday. Yet it is shown above that in harmony with all calendar rules of the Mischna the 14 Nisan could very well have been a friday in the year 30.

3. Now the 14 Nisan did not necessarily coincide with the day of the full moon but depended exclusively on the sanctification of the first Nisan after sighting the new light; if the Lord--what to my mind is proved for certain--held the Passah supper on the legal day, the 14 Nisan, if this was Thursday and the 15 Nisan a Friday, then there are according to the calendar two possibilities for the days of the passion: either Thursday, the 14 Nisan = April 6 and Friday, the 15 = April 7, 30, or Thursday, the 14 Nisan = April 26, and Friday, the 15 = April

27, 31.

Friday, April 7, 30 in every case is in harmony with the reports of the gospels, whether the legal Passah supper of the 14 Nisan came on the Thursday or on the Friday.

The general chronology of the life of Christ does not entirely solve these difficulties, for, as shown above (p. 7), the year 31 as the year of the death is not altogether out. True, the most ancient date we have on this offers support not to be belittled for the year 30 as the year of the death. It comes from the gnostics of Egypt and is received through Clemens Alexandrinus. The place in question in the reads:

("Those who have made thorough investigation set his suffering the year of the emperor Tiberius, e. i. some on 25 Pamenoth, others on 25 Pharmuthi; others say that the Saviour died the 19 Pharmuthi. Some among them say also he was conceived Pharmuthi 25.")

The 16 year of Tiberius ran from August 29, 29 until then in 30. E. Preuschen deserves credit for having rightly understood and calculated (Period f. N.T. Science 1909, p. 1 and on) the three dates of the month given by Clemens.)

(Note, p. 77: My calculations on this date are based on Ideler, Brandse, Mitteis and Wilcken.)

At the time when the Egyptian calendar was revised (reformed) by Augustus the 1 Thoth (New Year's day) was set on August 29; the Phamenoth began Febr. 25, Pharmuthi, March 27*)

(Note, p. 78: Ideler I, 14 3; Mitteis and Wilcken, Vol. 1.)

According to this Phamenoth 25--indicated by some as the day of death--would be March 21; in the year 30 this was a Tuesday quite outside the Passah (see above). The two other dates would be: 19 Pharmuthi = April 14 (Friday), 25 Pharmuthi = April 20 (Thursday); this Friday, however, in the year 30 came one week after the Passah. Accordingly, all three dates would be valueless. Now by the side of the fixed solar year introduced by Augustus there still was the shifting (movable) year of the ancient egyptian calendar. Numerous proofs for this are produced by Ideler I. 124, based on Censorinus (de die natali) and on double inscriptions; H. Brandeis, too shows very clearly arranged the progessive shifting of the Egyptian wandering year as compared with the corresponding Julian year:--)

(Note 2, page 78: In his "Dissertations" p. 1234 and on "On the Egyptian Apokatastases Years".)

His tables furthermore show how those two methods of reckoning corresponded to each other. According to the fixed year of the Egyptian calendar in the year 30 the 1 Tjoth (= Aug. 29) coincided with the 14 Thoth of the wandering year; accordingly the 1 Thoth of the latter would be the 16 August. On that supposition the calculation of those three dates is made easy for us by Ideler (I p. 97 and on) through (thanks to) the calendarium. The order of the months was as follows: Thoth, Paophi, Athyr, Choiak, Tybi, Mechir, Phamenoth, Pharmuthi, Pachon, Payni, Epiphi, Mesori each at 30 days, besides there were 5 additional days. So it happens that 1 Pharmuthi was March 14; 19 Pharmuthi April 1 (Saturday); 25 Pharmuthi April 7 (Friday) 25 Phamenoth--March 8 (Wednesday).

Though it is to be greatly regretted that Clemens did not express himself***

(Note---, p. 78: Preuschen pleads for the rather interesting assumption that gnostic calendar had the double dates; if so, naturally the 19 Pharmuthi (April 1) must have been marked "Cal.-Apr.". "Due to some misunderstanding this date now seems to have bee brought in connection also with the suffering of Christ." From inscriptions we learn that such double dates actually were being entered; see Ideler and Brandeis.)

on the three dates of which, after all, only one can be correct, still his tradition is of great significance: About the middle of the 2nd century among the Egyptian gnostics there were men who on the basis (based on) of exact investigation--. . . . .--knew Friday, April 7, 30 as the day of the crucifixion.

The Montanists adhered to this day by celebrating on it the Passover regardless of the day of the week*

(Note * p. 79: See Preuschen in the "Real-Enzyklopadie Vol. 14, p. 730)

Whether they had borrowed this date from gnostic circles or came by it some other way, we do not know. So that date was known elsewhere too;; by comparing it with the second oldest date of the crucifixion it gains special value: it is supposed to have taken place under the consulate of the brothers Gemini in the 15th year of Tiberius. If the dating of the crucifixion did spread from Egypt then the year in question was reckoned according to the new year's day; that was Aug. 16, 29. The consuls in office at that time were R. and F. Gemini and it was named the year of the Gemini brothers. By not heeding abroad the difference between the Egyptian and Roman calendars and overlook that the consulate of the two brothers had expried January 1, the opinion originated that the Passah of the crucifixion, too, came in the consular year 15 of Tiberius. But those men, who searched carefully the learned correctly that it was the 16th year of Tiberius.

Whether these conjuctures hit the mark remains uncertain. It has been proved for certain that, aside from April 7, 30, all dates which have come down to us from the church fathers according to the calendar of the years 27-36 are completely invalid. We are no more surprised at that because we have seen that they were led by aspects of dogman--probably also by viewpoints of cults--surrounding the days of Passion with noble symbols. As this dogmatic symbolism refers merely to the dates but not to the matter itself, nor to the person of Jesus Christ, we have earnestly pursued the historical interest being led as duty bound by reliable factors: Reliable are the moon as the basis of the Jewish month in those days; the Law which fixed Passah to the 14 Nisan, and the gospel which names Friday of a Passover under the governorship of Pontius Pilate as the day of the Lord's death.

According to these inviolable facts we have, it is true, found two dates: but even so, it is clearly proved that all other are erroneous and that either Friday, April 7, 30, or Friday, April 27, 31 must prove correct.

But see his later conclusion in Astronomische Nachrichten Bd. 240 ...

ASTRONOMISCHE NACHRICHTEN.

Band 240. Nr. 5745-46. 9-10.

Das Datum der Kreuzigung Jesu Christi. Von *O. Gerhardt.*

Christus starb unter *Pontius Pilatus.* Alle Versuche, aus der Amtszeit dieses Prokurators das Jahr der Kreuzigung auf rein historischem Wege zu finden, nach den in den Evangelien auftretenden Jahreszahlen, haben nur ein Annäherungsresultat ergeben. Der Todestag war ein Freitag am Anfang des Passah. Da dieser Termin ganz von der Erneuerung des Mondes abhing, so wird die Frage nach dem Jahr und Datum der Kreuzigung durch die Astronomie entschieden. In dieser Hinsicht beruht meine Darlegung auf den Berechnungen der Neu- und Vollmonde durch *F. K. Ginzel*[1]). Welchen wertvollen Beitrag mir *P. V. Neugebauer* geliefert hat, tritt an den betreffenden Stellen zu Tage. Ich bin bestrebt, das Tatsachen-Material so vorzutragen, daß sich der Leser sein Urteil, evtl. abweichend von dem meinen, leicht bilden kann.

1. Die Amtszeit des Prokurators *Pontius Pilatus* ist aus *Josephus*' Altertümer 18.4, 2 und 3 ermittelt worden. Als *Pilatus* in Rom anlangte, wo er sich vor dem Kaiser *Tiberius* verantworten sollte, war dieser gerade gestorben, 16. März 37 n. Chr. Vor dem Passah des vorangegangenen Jahres — also 36 n. Chr. — hatte ihn *Tiberius* abberufen, nachdem er Palästina 10 Jahre lang verwaltet hatte. Seine Amtszeit lief also vom Frühjahr 26 bis dahin 36.

2. Wann begann die öffentliche Wirksamkeit *Jesu*? *Lukas* datiert 3.1 zunächst den Anfang der Bußpredigt *Johannes des Täufers*: »im 15. Jahre der Herrschaft des Kaisers *Tiberius*, da *Pontius Pilatus* Landpfleger in Judäa war ... da geschah der Befehl Gottes zu *Johannes*«. *Tiberius* war dem *Augustus* am 19. August 14 n. Chr. gefolgt. Die Datierung »im 15. Jahre des Kaisers *Tiberius*« kann in dreifach verschiedener Weise verstanden werden: es kann das vom 19. Aug. 28 bis dahin 29 laufende Jahr gemeint sein, oder das Jahr 28, wenn nämlich das Anfangsjahr 14 voll gerechnet wurde, wofür *E. Schürer* Beispiele fand; drittens kann auch 29 gemeint sein, falls erst vom Januar 15 ab gezählt wurde. Ein vierter Modus, die *Tiberius*-Jahre zu zählen, konnte sich aus der Tatsache ergeben, daß dieser Kaiser durch ein Gesetz dem *Augustus*, als er noch lebte, in der Verwaltung der Provinzen und auch im Heereskommando gleichgestellt worden war. Die Quellen hierfür sind *Velleius Paterculus* II.121 und *Sueton.* Nach letzterem scheint es, als ob dieses Gesetz im Jahre 13 n. Chr. beschlossen worden sei; aber *V. Paterculus*, der ein langjähriger Begleiter des *Tiberius* auf dessen Kriegszügen gewesen war, datiert es genau: es wurde vor dem Triumphzuge vom 16. Januar 12 erlassen, vielleicht also Ende 11 n. Chr. Daß man in Rom offiziell die Regierung des *Tiberius* vom August 14 ab zählte, bedarf keiner Erläuterung. Aber durch das Gesetz, das den *Tiberius* in der Verwaltung »aller Provinzen« und im Oberbefehl »über alle Heere« dem *Augustus* gleichgestellt hatte, so daß ihn *Tacitus* den collega imperii nannte, war ein Rechtszustand geschaffen, auf Grund dessen man in der Provinz eine Zeitlang seine Regierungsjahre zählte. a) *Lukas* 3.1 heißt es »*ἐν ἔτει δὲ πεντεκαιδεκάτῳ τῆς ἡγεμονίας Τιβερίου Καίσαρος, ἡγεμονεύοντος Ποντίου Πειλάτου* ...«. Die Amtsstellung des Kaisers ist hier mit dem entsprechenden Worte bezeichnet wie die des Prokurators, noch dazu in unmittelbarer Folge. Das ist bei einem Autor wie *Lukas* kein Zufall. Die einfachen Worte »im 15. Jahre des Kaisers *Tiberius*« würden völlig genügt haben. Aber *Lukas* wählte das Wort *ἡγεμονία*, um die Mitregentschaft und die Alleinherrschaft zusammenzufassen. Dem steht nicht entgegen, daß man mit diesem Worte auch gelegentlich die Autokratie bezeichnete. Die übliche Bedeutung war »Oberbefehl«, und den hatte *Tiberius* inne. — b) Einen urkundlichen Beweis liefert die Münzkunde. Es sind *Tiberius*-Münzen erhalten, die der Statthalter *Silanus* in der syrischen Hauptstadt Antiochien, der Heimat des *Lukas*, prägen ließ. Eine von ihnen hat die Zahlenangabe *Α* und *ΓΜ* d. i. 1 und 43. Die letzte Zahl geht von der Ära von Aktium (31 v. Chr.) aus, während *Α* das erste[2]) Jahr des *Tiberius* angibt; dies entsprach also dem Jahre 12 n. Chr. — c) Die Alleinherrschaft des *Tiberius* hatte 22 Jahre, 6 Monate, 27 Tage gedauert. Das wurde von Autoren des ersten Jahrhunderts wie *Philo* und *Josephus* auf 22 bzw. 23 Jahr abgerundet. Aber der Alexandriner *Clemens* (um 200), der selber 22 Regierungsjahre angab, kannte andere Autoren, die dem *Tiberius* eine Regierung von 26 Jahren, 6 Monaten, 19 Tagen zuschrieben (s. »Teppiche« I.144). Demnach war, da der Kaiser am 16. März 37 starb, von 11 n. Chr. ab gezählt. — *Hippolyt* von Rom, um 230, gibt im Danielkommentar an, daß *Christus* »im 18. Jahre des *Tiberius* litt«, und fügt die Namen der Konsuln — *Fufius Geminus* und *Rubellius Geminus* — hinzu. Da deren Amtsjahr 29 n. Chr. war, so war in dieser Datierung das erste *Tiberius*jahr 12 n. Chr. — d) *Lukas* schreibt 3.23: »*Jesus* war, als er anfing, ungefähr 30 Jahre alt«. Welchen Wert hat diese Altersschätzung? Von dem Evangelisten rührt sie nicht her, da er den Herrn nie gesehen hatte. Er erhielt sie offenbar aus dem Kreise derer, bei denen er »allen Dingen vom Anbeginn an mit Fleiß nachgegangen« war, damit sein vornehmer Freund *Theophilus* »gewissen Grund erfahre der Lehre, in welcher er unterrichtet war«, *Lukas* 1.2–4. Demnach darf jene Alterschätzung nicht als wertlos übergangen werden. Aber auf welches Jahr kann sie hinweisen? *Herodes* war im Frühjahr 4 v. Chr. gestorben, sodaß 5 v. Chr. als spätestes Geburtsjahr zu gelten hat. Dann wäre *Jesus* 26 n. Chr. gerade 30 Jahre alt gewesen, und jenes

[1]) Das Verzeichnis der von mir benutzten Schriften s. Anhang.

[2]) Vgl. *Zahn*, Kommentar z. *Lukas*-Evgl., und seinen »Grundriß der Geschichte des Lebens *Jesu*«, 1928, S. 40; ferner *Hartl*, S. 67 f. *Hartl* hat zwei gut erhaltene Exemplare jener Münze im Kabinett zu St. Florian geprüft.

»ungefähr 30« würde auf 27 oder 28 gut passen. (Vor 26 dürfen wir nicht zurückgehen wegen des Amtsantritts des *P. Pilatus*.) Wir müssen aber ein früheres Geburtsjahr annehmen. Die Weihnachtsgeschichte (*Lukas* 2) beginnt bekanntlich mit dem Schätzungsbefehl des Kaisers *Augustus*. Nach allem, was jetzt über die Schätzung sicher ermittelt ist, besteht einstimmig die Überzeugung, daß *Jesus* zwischen 8 und 6 v. Chr. geboren wurde.[1]) Demnach läßt die Altersschätzung »ungefähr 30 Jahre« nicht zu, daß der Anfang auf ein späteres Jahr als 28 anzusetzen ist; denn 29 oder 30 war *Jesus* schon 34–37 Jahre alt, und das nannte man nicht »ungefähr 30«. Man muß den Charakter eines Autors wie *Lukas*, der »allen Dingen von Anbeginn an mit Fleiß nachgegangen war und es sorgfältig der Reihe nach niedergeschrieben hatte«, gebührend würdigen. Er hatte die drei wichtigen Zeitbestimmungen: die Geburt *Jesu* z. Z. der Schätzung des Kaisers *Augustus* — das Auftreten des *Täufers* im 15. Jahre des K. *Tiberius* — die Altersangabe »ungefähr 30 Jahr« — bei seinen sorgfältigen Nachforschungen erfahren. Es wäre ein Unding, *Lukas* mit sich selbst in Widerspruch zu bringen. Hat er in dieser indirekten Form den Anfang *Jesu* auf 27 oder 28 fixiert, so hat er selbst entschieden, daß er vom Beginn der Mitregentschaft an gezählt hat. Dies konnte er nach dem in Syrien bestehenden Rechtszustand.

Das Anfangsjahr *Jesu* nach dem *Johannes*-Evangelium. Als *Jesus* nach der Taufe, der Versuchung und der Wahl der Jünger zum ersten Male in Jerusalem weilte, an einem Passah, fiel ihm gegenüber das Wort der Juden: »Dieser Tempel ist in 46 Jahren erbaut worden, und du willst ihn in 3 Tagen wieder aufrichten«, Kap. 2.20. Auf welches Jahr passen diese Worte? Nach wiederholter Prüfung der Quellen (*Fl. Josephus* und *Dio Cassius*) haben *Zahn* und *Schürer* festgestellt, daß der Tempelbau im Winter 20-19 v. Chr. begonnen wurde und daß am 1. Januar 28 n. Chr. die 46 Jahre abgelaufen waren. Da nun offenbar die Juden dort im Tempel *Jesu* gegenüber das laufende Jahr als ein volles rechneten, so fand jene Debatte über den Tempelabbruch und -aufbau am Passah 27 statt[2]) (schwerlich am Passah 28). Mithin war 3–4 Monate vorher, im Januar 27, die Taufe gewesen und der Anfang des *Täufers* i. J. 26. Die Auffassung, daß »in dem 15. Jahre der Herrschaft des Kaisers *Tiberius*« seine Mitregentschaft einbegriffen ist, hat also fünf Bestätigungen erhalten: einige Münzen, die dem *Clemens* bekannten Autoren, ferner *Hippolyt*, sodann *Lukas* selbst durch seine Angabe »ungefähr 30 Jahre« und indirekt *Johannes* in der soeben besprochenen Notiz 2.20.

3. In welchem Jahre begann demnach *Jesus* seine Tätigkeit? Daß er mehrere Monate nach dem *Täufer* auftrat, folgt aus den Angaben der vier Evangelien: *Matthäus* 3.1–13; *Markus* 1.4–9; *Lukas* 3.1–21; *Johannes* 1.19ff. Wir lassen wiederum alle Möglichkeiten gelten: *Johannes d. T.* begann »im 15. Jahre der Herrschaft des Kaisers *Tiberius*«, das kann bezeichnen a) das Jahr vom Aug. 28 bis Aug. 29, oder b) das Jahr 28, oder c) das Jahr 29, oder d) das Jahr 26. Demnach trat *Jesus* auf im Januar entweder nach a) und b) des Jahres 29 oder nach c) des Jahres 30 oder nach d) des Jahres 27, hinzu kommt 4. nach *Joh.* 2.20 des Jahres 27 (oder 28).

4. Wie lange dauerte die öffentliche Wirksamkeit *Jesu*? Nach der Taufe und den 40 Tagen der Versuchung predigte *Jesus* erstmalig in Nazareth; von hier siedelte er nach Kapernaum über, wo er sich die ersten Jünger wählte, nahm an der Hochzeit zu Kana teil und zog zum Passah nach Jerusalem (*Joh.* 2). Diese Vorgänge mögen 3 bis 4 Monate umfassen, das sei abgerundet auf $^1/_4$ Jahr.

Wiewohl die Synoptiker nur das eine Passah erwähnen, an welchem *Jesus* gekreuzigt wurde, zeigen sie doch deutlich Spuren von der mehrjährigen Wirksamkeit; vgl. namentlich *Luk.* 13.6–9 und Vers 34. Ein genaues Schema gewährt uns das *Johannes*-Evgl.: Kp. 2 das Passah, welches *Jesus* in Jerusalem verlebte, Kp. 6 das Passah, welches *Jesus* in Galiläa verlebte, Kp. 12 das Todespassah. Zwischen je zwei Passahfesten lag ein Jahr; es kommt indessen im Kp. 5.1 ein Fest hinzu, das noch näher zu bestimmen ist. *Jesus* verlebte es in Jerusalem und heilte u. a. den 38-jährigen Kranken, 5.5ff. Der Verlauf aller vorangegangenen und nachfolgenden Ereignisse stellt sich völlig klar aus folgenden Stellen heraus: *Johannes* 2.13, 23f.; 3.22; 4.1–5, 35, 40–46; 5.1; 6.1–4. *Jesus* verblieb nach dem ersten Passah etliche Wochen in Jerusalem, also April evtl. Anfang Mai, verweilte dann längere Zeit »im judäischen Lande«, kehrte auf der Rückreise nach Galiläa in der Stadt Sichar ein, und zwar im Januar (4.35) des nächsten Jahres; danach war er einige Zeit in Galiläa, 4.43–54, also im Monat Februar. »Danach war ein (das) Fest der Juden, und *Jesus* zog hinauf gen Jerusalem« 5.1. Hieran schließt sich 6.1–4 das Passah, welches er in Galiläa verlebte. Man hat früher oft angenommen, jenes Fest, 5.1, sei Purim gewesen; es lag nur vier Wochen vor Passah, dann wäre *Jesus* von Galiläa im März nach Jerusalem gezogen und im April — vielleicht gar Ende März — zum Passah schon wieder nach Galiläa. Demnach hätte die Zwischenzeit zwischen Kp. 5 und 6 nur ein paar Wochen betragen. Das ist jedoch völlig ausgeschlossen. Denn die Ereignisse im Kp. 6 zeigen uns *Jesum* auf der Höhe seiner galiläischen Wirksamkeit: durch seine Heilungstaten angezogen, begleiten ihn Tausende und wollen ihn zum König machen; die Apostel sind längst gewählt, und schon beginnt sich eine rückläufige Bewegung bemerklich zu machen, 6.60ff. Das alles kann nur die Folge von monatelanger Predigt- und Heiltätigkeit gewesen sein. Das Fest war also nicht Purim. Das geht aber auch aus der Textüberlieferung hervor. In zahlreichen Handschriften steht 5.1 »es war das Fest der Juden« — dieser Sprachgebrauch, der auch im Alten Testament und bei *Josephus* begegnet, bezog sich nur auf Laubhütten; vgl. auch *Joh.* 7.2. — Die Kirchenväter, die von dem Inhalt jenes Kp. 5 handeln, nennen das Fest das Passah; dem entspricht eine besonders

[1]) Als Geburtsjahr ergibt sich 7 v. Chr. aus der Geschichte vom Stern der Weisen. Die Lösung dieses Problems, die ich in meinem Buch »Der Stern des Messias«, Lpz. 1922, gegeben, beruht auf Tatsachen unter gänzlichem Ausschluß von Hypothesen, nachdem es mir gelungen war, aus reichem Quellenmaterial, das sich über 2000 Jahre erstreckt, nachzuweisen, daß der Stern, von dem im Evangelium die Rede ist, existiert hat. Meine astronomischen Rechnungen hat *Ginzel* kontrolliert.

[2]) Die jüngste Untersuchung von *E. Power* S. J., dem Herausgeber der Zeitschrift »Biblica«, 1928, kam nach einigem Schwanken zu dem Ergebnis, daß diejenige Auslegung der griechischen Texte – *Johannes* und *Josephus* – welche als die »giltige« – current – anzusehen ist, auf das Jahr 27 bezüglich der 46 Jahre des Tempelbaus und auf 30 für die Kreuzigung führt.

hoch geschätzte Handschrift, in welcher es heißt »es war das Fest der ungesäuerten Brote«. — (Zum Purimfeste reiste man nicht nach Jerusalem.)

Wir gewinnen demnach folgende Übersicht:

5. Die Dauer der öffentlichen Wirksamkeit *Jesu*: 3–4 Monate von der Taufe bis zur ersten Reise nach Jerusalem,

erstes Passah: *Jesus* in Jerusalem, *Joh.* 2,
zweites » oder wahrscheinlicher Laubhütten: *Jesus* in Jerusalem, *Joh.* 5,
drittes » : *Jesus* in Galiläa, *Joh.* 6,
viertes » : das der Kreuzigung,
im ganzen rund $3^1/_4$ Jahr.

Fügen wir sie an die als Anfangstermin ermittelten Jahre 27, 28, 29, 30 an, so ergibt sich das klare Resultat, daß

das Jahr der Kreuzigung

eines von den vieren gewesen sein muß: 30, 31, 32 oder 33. Jedes frühere oder spätere ist ausgeschlossen.

6. Das Jahr der Bekehrung des Apostels *Paulus* habe ich früher, nach dem Vorgang anderer, benutzt, um für das Jahr der Kreuzigung einen terminus ad quem zu besitzen. Wenn es beispielsweise fest stünde, daß sich jener Vorgang auf der Straße nach Damaskus i. J. 32 ereignet hätte, dann könnten für die Kreuzigung nur noch 30 und 31 in Betracht kommen. Aber nach dem jetzigen Stand der Forschung — z. B. *Th. v. Zahn*, *A. v. Harnack*, *Deißmann*, *Wohlenberg* — kann die Bekehrung des *Paulus* in einem der 6 Jahre 31–35 stattgefunden haben. *Harnack* hält an 31 bzw. 32 fest, mit der Hinzufügung »33 muß auch offen bleiben« — *Zahn* dagegen an 35. Diese beiden Koryphäen haben aber als Jahr der Kreuzigung 30 berechnet.

7. Der Todestag war ein Freitag, s. *Mtth.* 27.62; *Mark.* 15.42; *Luk.* 23.54; *Joh.* 19.14, 31, 42. Der technische Ausdruck für diesen Wochentag war *παρασκευή*, das in einigen modernen Sprachen als paraskeve, parascève weiter lebt. Er bedeutet »Vorbereitung, Zurüstung«, daher in unserer Bibel »Rüsttag«. Näher erläutert dies *Mark.* 14.52 »der Rüsttag, welches ist der Vorsabbath«.

8. Passah, Fest der ungesäuerten Brote, Azyma. Über die Entstehung, Bedeutung und Gebräuche des Festes s. II. *Moses* 12; 34.18; III. *Moses* 23; IV. *Moses* 9 und 28; V. *Moses* 16. — Die Namen *πασχα*, Passah gehen auf das hebr. Pesach (= Vorübergang) zurück und verewigen den Vorübergang des Herrn an den israelitischen Häusern, die mit dem Blute des Lamms bestrichen waren. II. *Moses* 12.2–14: Am 14. Tage des ersten Monats wurde das Lamm geschlachtet und zugerichtet und »zwischen den beiden Abenden gegessen«. Hiermit ist entweder die Zeit zwischen Niedergang und Untergang der Sonne gemeint, oder die Zeit vom Sonnenuntergang bis zur Dunkelheit. Der Abend bildete in seinem Beginn das Ende des einen, in seinem Ausgang den Anfang des anderen Tages. Das Passahmahl erstreckte sich vom 14. in den 15. Nisan hinein. Hieran schlossen sich »die sieben Tage der ungesäuerten Brote«, »mazzoth, *ἄζυμα*«. Aber schon am 14. Nisan durfte nur ungesäuertes Brot in den Häusern vorhanden sein, sodaß dieser als der erste Tag der ungesäuerten Brote galt, s. *Matth.* 26.17; *Markus* 14.12. — Die zwei Festbenennungen wurden schon in vorchristlicher Zeit nicht mehr streng auseinander gehalten; man nannte das ganze Fest oft nur Passah oder nur Fest der ungesäuerten Brote. Dieser schwankende Sprachgebrauch ist im Alten und Neuen Testament reichlich bezeugt, auch bei *Josephus* kommt er vor.

9a. Der Tag, an welchem *Jesus* das Passahmahl hielt, ist von *Lukas* und von *Markus* in der denkbar genauesten Weise bestimmt. *Lukas* 22.7: »es kam der Tag der ungesäuerten Brote, an welchem Passah geopfert werden mußte« — ganz unzweideutig der 14. Nisan. *Markus* 14.12: »am ersten Tage der ungesäuerten Brote, da man Passah zu opfern pflegte« — das ist im Urtext durch das Imperfekt ausgedrückt, aber leider in der Übersetzung übergangen. Somit hat *Markus* den 14. Nisan in diesem Satze zweimal bezeichnet: 1. »am ersten Tage der ungesäuerten Brote«, 2. »da man Passah zu opfern pflegte«. Dies letztere findet sich auch in der alt lateinischen Version quando immolabant. Die Peschittha und eine nordägyptische Übersetzung haben je das Präsens »da man Passah opfert«; deutlicher, als diese fünf Texte es tun, kann man jenen Tag nicht bezeichnen. Es ist unverkennbar, daß *Markus* und *Lukas* jede Unklarheit vermeiden wollten; ihre Worte sind gleichbedeutend mit dem Datum »am 14. Nisan« (weniger scharf ist *Matthäus* 26.17f.). Somit haben wir ein klares Kalendarium gewonnen:

14. Nisan, Donnerstag: am Abend das Passahmahl,
14.-15. » in der Nacht: Gethsemane, Gefangennahme,
15. » Freitag: Verhöre, Verurteilung, Kreuzigung, Bestattung.

Die Zuverlässigkeit dieser synoptischen Berichterstattung ist nach einer Richtung bisweilen angefochten worden: die beiden Gerichtsverhandlungen vor *Hannas* und *Kajaphas* hätten, nach dem in der Mischna enthaltenen Verbote, am Freitag, der doch Festtag war, nicht stattfinden dürfen. Dieser Einwand konnte aber leicht zurückgewiesen werden. Man vergegenwärtige sich zunächst den Lauf der Ereignisse: die Hohenpriesterpartei war längst fest entschlossen, den verhaßten Gegner zu beseitigen; unerwartet schnell lieferte ihn der Verräter in ihre Hände in der Nacht vom Donnerstag zum Freitag — was sollte sie nun machen? Ihre Verhöre waren ja auch beendigt, als der Tag anbrach; alles übrige hatte der Prokurator zu erledigen. — Außerdem ist es mehr als zweifelhaft, ob jenes Verbot aus vorchristlicher Zeit stammt, denn die im Neuen Testament mehrfach berichteten Tatsachen stehen direkt dagegen: zur Zeit Christi fanden polizeiliche Maßnahmen, Gerichtsverhandlungen, sogar Vollzug der Todesstrafe, selbst am Sabbath statt (s. *Matth.* 12.14; *Luk.* 4.29; *Joh.* 7.30, 32, 44–52; *Joh.* 8.59; *Joh.* 9.13–34; *Joh.* 10.31, 39).

Es bleibt also bei der synoptischen Datierung.

9b. Hat *Johannes* den 14. oder den 15. Nisan als Tag der Kreuzigung angegeben? Daß es bei ihm wie bei den Synoptikern ein Freitag war, ist oben gezeigt worden, s. Nr. 7. Nun nennt er ihn 19.14 »Rüsttag des Passah«. Das hat man irrigerweise als Rüsttag zum Passah gedeutet, wonach dann dieser Freitag der 14. Nisan gewesen wäre. Aber das dort stehende paraskeué war der allein übliche technische Ausdruck für Freitag, der sich überall im N. T. wie im griechischen A. T. findet, auch zweimal in demselben

Kapitel 19, Vers 31, 42. In dem siebentägigen Feste kam immer ein Freitag vor, und der war dort gemeint.

An diesem Tage sprach *Pilatus* zu den Juden »es ist euch eine Gewohnheit, daß ich euch im Passah einen frei gebe; wollt ihr nun, daß ich euch den König der Juden frei gebe?« 18.39. Er sagte nicht »um das Passah«, auch nicht »zum Passah«, vielmehr »im Passah«, d. i. innerhalb, während des Passah. Wenn das am Morgen des 14. Nisan gewesen wäre, an dessen Nachmittag erst das Passahmahl zugerüstet wurde, würde *Pilatus* schwerlich gesagt haben »im Passah«. Seine Worte charakterisieren den Freitag als den 15. Nisan, der im Feste lag.

Die Meinung, daß nach dem vierten Evangelium die Kreuzigung am 14. Nisan stattgefunden habe und daß dies der Freitag gewesen sei, gründet sich hauptsächlich auf zwei Stellen. Im Kapitel 13 wird das letzte Mahl erwähnt, das *Jesus* vor der Gefangennahme mit den Zwölfen hielt; hierbei wird des Passah-Ritus nicht Erwähnung getan. Und dann heißt es nach den letzten Reden in den Kapiteln 14–17 und nach der Gefangennahme in Gethsemane und nach den ersten Verhören 18.28 »da führten sie *Jesum* von *Kajaphas* vor das Prätorium; und es war frühe. Und sie gingen nicht in das Prätorium, damit sie nicht unrein würden, sondern Passah essen möchten«. Wenn hier das Essen des Passahlammes gemeint war, dann war es am Morgen des 14. Nisan, dann war jenes Mahl Kapitel 13 nicht das rituelle Passahmahl, und die Kreuzigung am 14. Nisan. Die Gegengründe sind durchschlagend: a) die Nichterwähnung des Passah-Ritus im Kapitel 13 steht auf gleicher Stufe mit zahlreichen ähnlichen Fällen: *Johannes* erwähnt nicht die Stiftung des heiligen Abendmahls (wie auch nicht die der Taufe), ferner nicht den Gebetskampf in Gethsemane, das Einschlafen der Jünger, den Judaskuß, das Verhör vor *Kajaphas*, den Schwur *Jesu*, daß er Christus, der Sohn Gottes war. Es ist der bekannte charakteristische Zug in der Passionsgeschichte des vierten Evangeliums: das Übergehen verschiedener Vorgänge bedeutet die Zustimmung zu den synoptischen Berichten. Auch *Johannes* berichtet es nicht anders als die Synoptiker, daß der Todestag ein Freitag war und daß am Abend vorher der *Herr* das Mahl hielt, bei welchem er den Verräter bezeichnete. b) Die Verunreinigung, welche die Juden vermeiden wollten, trägt zur Klärung des Datums bei. Wäre jene Szene vor dem Prätorium am 14. Nisan gewesen, so konnte eine Verunreinigung, am frühen Morgen begangen, bis zum Nachmittag sehr wohl entsühnt werden. Das war indessen unmöglich am 15. Nisan, der hoher Festtag war, mit einer Mahlzeit, die den Charakter des Dankopfers hatte. c) Die Juden wollten sich nicht verunreinigen, »damit sie Passah essen möchten«. Was bedeutete Passah in der jüdischen Kultsprache? »Passah fand statt — es war Passah — man bereitete Passah vor — man hielt Passah — man veranstaltete Passah«, das sind die üblichen Ausdrücke in der Bibel, auch bei *Philo* und *Josephus*; d. h. man nannte das Fest bzw. das Mahl, aber nicht das Tier. Durch Metonymie erweiterte sich die Bedeutung des Wortes Passah, wie die Redeweisen »sie kochten das Passah — sie brieten das Passah mit Feuer« erkennen lassen, in denen das Tier gemeint war. Aber in den anderen Ausdrücken »sie schlachteten bzw. opferten das Passah« war wiederum nur vom Feste die Rede was deutlich aus dem Ausdruck »sie schlachteten — opferten — das Fest« hervorgeht; letzterer findet sich bei *Josephus*. Eine andere Erweiterung der Bedeutung von »Passah« liegt V. Moses 16.2 vor, wo es heißt »und du sollst Passah schlachten dem Herrn, deinem Gott, Schafe und Rinder«. Das konnte sich nicht auf das Mahl des 14. Nisan beziehen, bei welchem nur ein Lamm genossen wurde, es bezog sich vielmehr auf die Dankopfermahlzeit; diese wurde von den meisten am 15. Nisan genossen, man konnte sie aber auch an den übrigen Tagen im Fest genießen. Nicht anders verhält es sich mit dem Wort »Passah essen«. In der Mischna heißt es einmal »das Passah Ägyptens wurde gegessen in Eile in einer Nacht und das Passah der Generationen (d. i. die in der Folgezeit wiederkehrende Feier) war Brauch sieben Tage«. Dem entspricht genau II. Chronika 30.22 »und sie aßen das Fest (scil. Passah) sieben Tage lang«. Ebenso bei *Josephus*, in den Targumen und bei *Hieronymus*. Hier ist immer die Festmahlzeit gemeint, die an jedem der sieben Tage genossen werden konnte; niemand sollte sich ihr entziehen, sie sollte »in Freuden« gegessen werden, und nach der Überlieferung fand sie gewöhnlich am 15. Nisan statt[1]). So begreift man die Scheu der Juden vor dem Betreten des Prätoriums am Freitagmorgen, dem 15. Nisan. In Summa: daß der *Herr* mit seinen Jüngern das Passahmahl rituell am Abend des 14. Nisan hielt, ist bei *Lukas* und dem vierfachen *Markus*-text in schärfster und klarster Form ausgedrückt. Die Angabe im *Johannes*-Evangelium ist allerdings nicht eindeutig; aber ihr Sinn ließ sich aus den kultischen Redeweisen aufzeigen, und es ergab sich die Übereinstimmung der Datierung bei den vier Evangelien. Somit bleibt das Kalendarium bestehen: der 14. Nisan ein Donnerstag, der 15. Nisan, Freitag, Tag der Kreuzigung.

Die letzte Einwendung gegen diese Datierung. Man behauptet, daß der Freitag der Kreuzigung von den Synoptikern als der 14., aber von *Johannes* als der 15. Nisan bezeichnet sei, und behauptet ferner, daß beide Datierungen richtig seien; denn es konnte damals vorkommen, daß ein Wochentag zwei Monatsdaten hatte. Dies ist die Hypothese von *Jechiel Lichtenstein* 1913, D. *Billerbeck* im Kommentar zum N. T.; eine starke Hinneigung zu dieser Hypothese bekundet Pater *J. Schaumberger* in »Biblica«, 1928. Wie *Johannes Lundius* in seinem prächtigen Werke »Die alten jüdischen Heiligtümer«, Hamburg 1701, gezeigt hat, wurde sie schon vom Reformationszeitalter an stark diskutiert. Ihr Urheber soll der Bischof *Paulus von Burgos*, ein Konvertit aus dem Judentum † 1435, gewesen sein. Unter den Stützpunkten dieser Hypothese ist ein einziger geeignet, sie glaubhaft zu machen. Ich zitiere nach *Schaumberger* aus dem Mischnatraktat Sanhedrin 5.3 »wenn zwei Zeugen in der Datierung eines Ereignisses um einen Monatstag auseinandergehen, so ist ihr Zeugnis doch giltig; denn es kann sein, daß sie den gleichen Tag meinen und nur den Monatsbeginn verschieden rechnen«. Eine Erklärung für solches Kalenderkuriosum gibt *Schaumberger* nicht.

10. Die zwiefache Datierung ein und desselben Tages war die natürliche Folge der damaligen

[1]) Vgl. *E. Baneth* zur Mischna Pesachim VI.3, Note 24.

Kalenderpraxis; sie ist durch viele in der Mischna diskutierte Tatsachen erhärtet und sehr leicht zu erklären. Ich wähle zunächst folgenden Fall: »wenn der Gerichtshof und das ganze Volk in Jerusalem die neue Mondsichel am 29. des Monats bald nach Sonnenuntergang gesehen haben, durch irgend ein Hindernis aber auch der 30. Tag abgelaufen, d. h. die volle Nacht zum 31. Tage eingetreten ist, ohne daß der Gerichtshof die Heiligung ausgesprochen hat, so wird der verflossene Monat als ein vollzähliger von 30 Tagen eingesetzt, obwohl er nach dem beobachteten Neulicht nur 29 Tage haben müßte«. (Rosch haschana 3b u. 25b; s. auch *E. Baneth* 401f.) Diese offizielle Datierung wurde in Jerusalem und in den Gegenden, die von den Neumonds-Boten erreicht wurden, befolgt; aber anderwärts, wo die Boten nicht hinkamen, datierte man nach dem gesehenen Neulicht, und so erhielt ein und derselbe Tag ein doppeltes Monatsdatum. — Das Umgekehrte trat ebenfalls ein: in Jerusalem wurde nach der am 29. Abend erfolgten Sichtung der Sichel der 30. Tag zum ersten gemacht: aber anderwärts wo man weder am 29. noch am 30. Abend die Sichel sah, gab man nach altem Brauch dem Monat 30 Tage, sodaß der 31. zum 1. wurde. Auch in diesem Falle hatte ein Tag zwei Daten.

Die seltsamsten Fälle der »Rückdatierung« traten aber ein, wenn man wegen ausgebliebenen Neulichts den 31. Tag zum 1. gemacht hatte und am 4. oder 5. Tage Zeugen ankamen, die den Mond am 29. Abend gesehen hatten. Konnten sie ihr Zeugnis auch beim strengsten Verhör vor dem Gerichtshof aufrecht erhalten, dann sah sich dieser gezwungen, um 4 bzw. 5 Tage zurückzudatieren. Wer davon Kenntnis erhielt, datierte den Monat hindurch korrekt, wer nichts erfuhr, wich um einen Tag ab. Diese Dinge waren offenkundig; jederman wußte, daß infolge der Sichtung des Neulichts hier und der Nicht-Sichtbarkeit dort die Datumsdifferenz um einen Tag sich ergeben mußte. Und jener gerichtliche Grundsatz Sanhedrin 5.3 war ganz selbstverständlich. Auf Dokumenten pflegte man deshalb, um Irrtümer zu verhüten, neben dem Datum den Wochentag zu nennen. — In der Diaspora pflegte man, aus ebendemselben Anlaß, sowohl den 30. als auch den 31. als Rosch Chodesch (= Monats-Ersten) zu halten. Wie streng man aber darauf bedacht war, die zwiefache Datierung zu verhindern, zeigt zunächst folgender Fall. Der Neujahrstag war der 1. Tischri, der vorangegangene Monat hieß Elul. Wurde am 29. Elul des Abends die Sichel nicht erblickt, so wartete der Gerichtshof den ganzen 30. Tag, ob nicht Neulicht-Zeugen von auswärts kommen würden; aber dieser 30. Tag wurde als Neujahrstag gefeiert. Trafen keine Zeugen ein, dann galt der 31. Tag als 1. Tischri, und man feierte in Jerusalem einen zweiten Neujahrstag. Die offizielle Zählung der Tischri-Tage, also vom letztgenannten Tage an, wurde durch Boten weithin verbreitet; die einheitliche Datierung dieses Festmonats bestand also in Jerusalem und in den von den Boten erreichten Gegenden.

Alle diese unvermeidlichen Vorkommnisse hatten veranlaßt, daß sich schon in früher Zeit in den Provinzen und noch mehr in der Diaspora der Brauch herausbildete, die großen Feste an 2 aufeinanderfolgenden Tagen zu feiern (den Versöhnungstag ausgenommen wegen des strengen Fastens). Denn nur auf diese Weise konnte das Prinzip durchgeführt werden, daß ganz Israel einen Festtag gemeinsam hatte. Dieser Grundsatz wurde auf den heiligen Ursprung der Feste zurückgeführt. »Alles ist verpflichtet«, so stellt es *Maimonides* II.10 dar, »die Fest- und Feiertage nach dem Tage anzuordnen, an welchem sie den Neumond geheiligt haben . . . und jeder, dem das Beobachten der Feste anbefohlen ist, ist verpflichtet, sich auf den Gerichtshof zu stützen, denn es heißt in der Schrift: Dies sind die Feste des Ewigen, die ihr ausrufen sollt mit ihnen, um sie zu dieser Zeit feiern zu können« (ähnlich an vielen anderen Stellen). Die Boten, welche den Nisan-Anfang überall hin melden sollten, durften das Sitzungslokal des Gerichtshofes nicht eher verlassen, als bis der Vorsitzende das »Geheiligt« gesprochen hatte (Rosch haschana 21b; *Maimonides* III.10), damit in allen Gegenden die Tage des Passah und der ungesäuerten Brote einheitlich lagen. Was man auf diese Weise auswärts erreichte, war im Zentrum des Judentums erst recht heilige Pflicht: Feier des Passahmahls an ein und demselben Abend. Eine zwiefache Zählung der Nisan-Tage, ein doppelter Passah-Tag in Jerusalem ist ganz ausgeschlossen gewesen.

Unsere Aufgabe bleibt also dieselbe: es ist astronomisch festzustellen, in welchem Jahre der 14. Nisan auf einen Donnerstag, der 15. auf Freitag fiel, und welche Daten es nach unserem Kalender waren.

11. Passah und Vollmond. Von der Tatsache ausgehend, daß in altchristlicher Zeit der erste Vollmond nach dem Frühlingsäquinoktium als der 14. Nisan galt, haben Theologen — z. B. *Achelis* — bisweilen die Astronomen gebeten, die Frühlingsvollmonde jener zehn Jahre zu berechnen. Das Ergebnis war folgendes:

i. J. 27 am Mittwoch den 9. April,
28 » Montag den 29. März und Dienstag den 27. April,
29 » Sonntag den 17. April,
30 » Donnerstag den 6. April,
31 » Dienstag den 27. März und Mittwoch den 25. April,
32 » Montag den 14. April,
33 » Freitag den 3. April,
34 » Dienstag den 23. März und Donnerstag den 22. April,
35 » Montag den 11. April,
36 » Freitag den 30. März und Sonntag den 29. April.

Die letzten drei Jahre kommen für die Chronologie *Jesu* nicht mehr in Betracht.

Das Resultat ist überraschend: wer die angeblich *Johann*eische Datierung für die richtige hält, könnte hiernach nur das Jahr 33 als das der Kreuzigung erklären, weil da durch den Vollmond der 14. Nisan auf einen Freitag fixiert ist. Wer aber an der anderen Datierung festhält — der 14. Nisan am Donnerstag, der 15. am Freitag — der kann nach dem Vollmond nur das Jahr 30 als das der Kreuzigung halten. Alle übrigen Jahre scheiden dann aus.

Aber nach der damaligen Kalenderpraxis kann die Ermittelung der Vollmonde unser Problem nicht lösen.

Z. B. am Abend des 3. April 33 trat Vollmond ein um $17^h 14^m$; da können wir zunächst gar nicht wissen, ob das der 14. oder schon der 15. Tag war! Die Passahfeier begann am Nachmittag des 14. Tages, und der hing vom Neumond bzw. Neulicht ab. Der Abstand vom Neumond zum Vollmond ist sehr ungleich: für die Jahre 28, 29, 30 n. Chr. und die Monate Januar bis April einschl. findet man leicht aus den *Ginzel*schen Tabellen, daß jener Abstand im Minimum 13.94, im Maximum aber 15.57 Tage betrug (entsprechend ist es in allen Jahren). Demnach trat der Vollmond manchmal 14, manchmal $14\frac{1}{2}$, auch 15 und sogar $15\frac{1}{2}$ Tage nach dem Neumonde ein. Der jüdische Monat begann aber durchschnittlich einen Tag nach Neumond, bisweilen auch anderthalb Tag, wie bald gezeigt wird. Daraus erhellt, daß der für die Passahfeier verordnete 14. Tag manchmal 15, vielleicht auch 16 Tage nach Neumond lag und daß er nur gelegentlich mit dem Vollmonde im astronomischen Sinne zusammenfiel.

12. Es ist in neuerer Zeit zuweilen behauptet worden — zuletzt von *F. Westberg*, Riga 1910 — die Juden hätten z. Z. Christi bereits den konstanten Kalender besessen. Das haben *E. Schürer*, *F. K. Ginzel* u. v. a. als Irrtum zurückgewiesen. Die Bemühungen der Rabbinen *Juda Hanasi* um 170 n. Chr., *Rab*, *Jochanan*, *Mar Samuel Jarchinai* 160–250, *Adda bar Ahaba*, *Hillel II*, der noch später lebte, schufen die Grundlagen des konstanten Kalenders. Eingeführt wurde er um 300 n. Chr.

13. Die Vertagungen. Nach dem konstanten Kalender darf der Neujahrstag nicht auf Sonntag, Mittwoch, Freitag fallen, der erste Passahtag nicht auf Montag, Mittwoch, Freitag. Wenn nun nach dem Mondlauf der 1. Tischri auf einen verbotenen Tag fallen würde, dann wird Neujahr um einen Tag vertagt. Daß diese Vertagungen erst nach der Zeit Christi durchgeführt wurden, ist aus den Mischnatraktaten (Sabbath XIX.5; Menachot XI.7; Rosch haschana II.1), auch aus der Tosefta und Gemara erwiesen. Näheres bei *Zuckermann*, *Sidersky* S. 660 und *Schaumberger* in der Zeitschrift Biblica 1928.

14. Die Schaltung und die Lage des Nisan. Das kürzeste jüdische Jahr umfaßte 352 Tage (8 Mon. zu je 29; 4 Mon. zu je 30 Tagen); das längste 356 Tage (umgekehrt 4 zu 29, 8 zu 30). Demnach betrug die Durchschnittslänge 354 Tage, d. h. das Jahr blieb um 11 Tage hinter dem Sonnenlauf zurück. Das machte in 3 Jahren schon mehr als einen Monat aus. Wenn nun beispielsweise in einem Jahr der Nisan mit unserem April zusammenfiel, dann würde er drei Jahre später schon im Febr. begonnen haben und Passah schon vor Mitte März eingetreten sein. Das war aus kultischen Gründen unmöglich: die Opfertiere mußten zum Fest vorschriftsmäßig entwickelt sein, am 16. Nisan mußte das Gersten-Erstlingsopfer und 50 Tage danach das Opfer an Baumfrüchten dargebracht werden. Deshalb mußte sich im letzten Monat der Hohe Rat von der Beschaffenheit des Jungviehs, vom Stande der Saaten und der Baumfrüchte überzeugen. Nach dem negativen Ausfall dieser Prüfung wurde ein ganzer Monat eingeschaltet, er folgte auf den zwölften Monat Adar und hieß Veadar. Der Grundsatz über die Schaltung lautete (Sanhedrin II.2): »auf drei Zeichen hin erklärt man das Jahr für interkaliert: die Reife des Getreides, die Baumfrüchte und die Tekupha (Äquinoktium); auf zwei von diesen Zeichen hin kann man den Kalender fixieren, aber nicht auf ein einziges«. Diese astronomische Bedingung besagt: Der Festmonat Nisan mußte so liegen, daß das Frühlingsäquinoktium vor dem Passah eingetreten war. Und bei *Aristobul*, *Philo* und *Josephus* hat *Ginzel* mehrfach die Bestätigung gefunden, daß Passah gefeiert wurde, »wenn die Sonne im Widder stand«. Aber für die Schaltung, und somit auch für die Lage des Nisan, war das astronomische Moment nicht ausschlaggebend, vielmehr mußte eine von den landwirtschaftlichen Bedingungen — Reife der Gerste und der Baumfrüchte — hinzukommen. (Es war daher ein Irrtum, daß *Sidersky* den Anfang des Nisan und die Lage des Passah ausschließlich nach dem Äquinoktium fixierte.)

Wann reift in Palästina die Gerste? Die klimatischen Verhältnisse sind so ungleich, daß in den günstig gelegenen Gebieten um Jericho die Ernte fast 4 Wochen früher beginnt als auf den Bergen Judas. »Die Gegend am unteren Jordan um Jericho hat fast tropisches Klima und zum Teil tropische Vegetation; dort beginnt die Gerstenernte oft Ende März« (*Vogelstein* S. 58; *Benzinger* in d. P. R. E. I.137; *Baedeker*, *G. Ebers* und *Guthe* I.144 u. a.). Wenn wir auf Grund der Neumonde den damaligen Kalender rekonstruieren, so muß der Nisan so liegen, daß die Festtage des 14. und 15. frühestens Ende März fallen[1]). Aber ein Neumond Anfang März kann nur den Adar oder Veadar einleiten.

15. Der jüdische Monat und der Mondlauf. Gott hat »den Mond gemacht, die Zeit zu bestimmen« (Ps. 104.19, wo unsere Übersetzung freier lautet: Gott hat »den Mond gemacht, das Jahr danach zu teilen«). Wie eng sich der Kalender an den Mondumlauf anschloß, erkennen wir aus folgenden Tatsachen: a) von Neumond zu Neumond vergehen $29\frac{1}{2}$ Tag, die Monate hatten 29 oder 30 Tage, nie mehr und nie weniger; b) die in der Mischna oft wiederkehrende Formel »wenn der Mond zur Zeit gesehen wird« bezeichnet jedesmal die Sichtung am Ende des 29. Tages; c) es gab Jahre mit 8 Monaten zu je 29 und 4 Monaten zu je 30 Tagen — solches Jahr von 352 Tagen blieb hinter dem 12-maligen Mondwechsel um 2 Tage zurück; d) es folgten bisweilen 2 Monate von je 29 Tagen unmittelbar aufeinander; sie waren zusammen um einen Tag kürzer als der zweimalige Mondumlauf.

16. Das Neulicht. Wenn am Abend nach der Konjunktion die Sichel wieder erschien, so galt es als das von Gott eingerichtete Zeichen, nach welchem der neue Monat »geheiligt« werden mußte; es wurde das Neumondsfest gefeiert, das in der Bibel oft erwähnt ist. Das Neulicht erscheint in der Abenddämmerung am westlichen Himmel in der Nähe des Sonnenuntergangs, meist tief am Horizont. Seine Sichtbarkeit hängt von verschiedenen Umständen ab: a) was den Horizont betrifft, ob er frei oder bewölkt, ob die Atmosphäre rein oder dunstig, ob die Dämmerung lang oder kurz ist; b) was den Beobachtungsort betrifft, ob er auf einem hohen Berge oder in der Ebene, und in welcher geographischen Breite er liegt; c) was die Mondbahn betrifft, ob er sich in Erdnähe oder in Erdferne befindet (im ersten Falle bewegt

[1]) Nach dem Traktat Menachot X.2 war man manchmal in Verlegenheit, die reife Gerste für das Opfer am 16. Nisan zu bekommen.

er sich sehr rasch, im zweiten sehr langsam), ferner wieviel Grade er über oder unter der Ekliptik steht (d. i. die geozentrische Breite des Mondes), und endlich wie breit seine Sichel ist. »Im Frühjahr«, so führt es *F. X. Kugler* aus, »ist die Ekliptik steil aufgerichtet, im Herbst dagegen bildet sie mit dem Horizont einen bedeutend spitzeren Winkel. Die Folge davon ist, daß der Mond nach der Konjunktion — bei gleicher Mondbreite und gleicher Elongation — im Herbst bedeutend schneller untergeht als im Frühjahr ... und daß die Zeit zwischen Neumond und Neulicht im Herbst größer, ja unter Umständen viel größer ist als im Frühjahr.«

Die Bedingungen unter b) und c) können mathematisch berechnet werden, dagegen sind wir völlig hilflos gegenüber den unter a) genannten Faktoren. Bedeckter Himmel kann den Mond ganz verbergen; zweitens kann die schmale Sichel, die am ersten Abend wie ein feiner leuchtender Faden erscheint, durch eine leichte Trübung der Atmosphäre unsichtbar werden. Daher kommt es, daß in Gegenden gleicher geographischer Breite der eine Beobachter das Neulicht sieht, der andere aber nicht. Endlich drittens zeigen sich im Abendrot auch zuweilen feine rötliche Streifen, die dem leuchtenden, gleichfalls feinen Faden der Sichel ähneln und den Beobachter, selbst den geübten, täuschen. Die Mischna berichtet genug Fälle falscher Neulichtbeobachtungen und gibt die erforderlichen Winke, wie man die Zeugen prüfen muß, um den wahren Tatbestand festzustellen.

Das Ausbleiben des Neulichts bildet die erste unsichere Größe in der Aufgabe, den jüdischen Kalender jener Jahre zu rekonstruieren. Wenn auch die klimatischen Verhältnisse Palästinas einen reineren Horizont, als der unsrige ist, verbürgen, wenn auch durchschnittlich im Jahre nur 50—52 Regentage nebst etlichen Schneetagen vorkommen, so genügt doch die Tatsache, daß sich die Regentage gerade in den Monaten Oktober bis Anfang Mai einstellen, um uns zu beweisen, wie oft das Neulicht ausbleiben kann. (Einer meiner Gewährsmänner, ein Lehrer in Jerusalem, sah Anfang 1928 das Neulicht 4-mal hintereinander nicht, wegen bedeckten Himmels.) *Maimonides* macht darauf aufmerksam, daß nicht in allen Monaten die Sichel sichtbar werden kann, diese Möglichkeit werde nicht oft eintreten, »aber man glaube nicht, daß ein solcher Fall unmöglich ist«.

Wenn die monatliche Beobachtung durch die Witterung vereitelt wurde, dann pflegte man auf einen 30-tägigen Monat einen 29-tägigen folgen zu lassen. Das ergibt sich aus den Traktaten Rosch haschana und Erachin.

Von der Zeit ab, wo die Kalendergelehrten die Dauer des Mondumlaufs genauer kannten, begann man, das Ende und den Anfang der Monate durch Berechnung zu normieren. Auch hierfür liefern die genannten Traktate, dazu Sanhedrin, viel Anhaltspunkte. *Gamaliel*, der Lehrer des Ap. *Paulus*, besaß eine Tradition aus dem Lehrhause seines Großvaters, daß der Mondumlauf $29\frac{1}{2}$ Tag $\frac{2}{3}$ Stunde (und 73 Teile) dauerte und daß sich der Mond zu Zeiten schneller, zu Zeiten langsamer bewege, so daß die Zwischenzeit zwischen Neumond und Neulicht von ungleicher Dauer ist. Diese astronomischen Kenntnisse ermöglichten es dem Gerichtshofe, die Aussagen der Zeugen, welche die Sichel zuerst gesehen, zu prüfen und evtl. als irrig zurückzuweisen (*Maim.* II.4).

Um die Wende der Zeiten standen beim Kalenderrat »Beobachtung und Berechnung in Wechselwirkung«. »Es ist ein Gebot der Thorah, daß der Gerichtshof ergründe und erfahre, ob der Neumond werde gesehen werden oder nicht« — so *Maimonides* I.7; vgl. ferner I.6, 8; II.4; XI.1 u. öft.

Die Neumonde jener Zeit hat der treffliche *Ginzel* aufs genaueste berechnet (s. Handbuch d. math. u. techn. Chronologie, 2. Bd.). Aber wieviel Stunden nach der Konjunktion erscheint das Neulicht?

17. Wie bestimmen wir den Eintritt des Neulichts? Aus den beiden Tatsachen, daß bisweilen zwei Monate von je 29 Tagen aufeinander folgten, die also um einen ganzen Tag kürzer waren als der zweimalige Mondumlauf, und daß zweitens ein Jahr von 352 Tagen vorkam, das um zwei Tage kürzer war als der zwölfmalige Mondumlauf, folgt von selbst, daß vom Neumond zum Neulicht oft beträchtlich weniger als 24 Stunden verflossen. *A. Schwarz* hat aus der Mischna nachgewiesen (S. 31, 1), daß die Rabbinen, welche die Grundlagen zum konstanten Kalender lieferten, mit einer Zwischenzeit von mindestens 18 Stunden rechneten; daß sie aber auch erheblich länger sein konnte, war natürlich bekannt.

Die in Assuan gefundenen Papyri aus dem 5. Jhdt. v. Chr. enthalten jüdische Monatsdaten, die *Ginzel* nachgeprüft hat: in 2 Fällen war das Neulicht nach 24 Stunden, in 2 anderen Fällen nach weniger Zeit erschienen. Eine ähnliche Feststellung gelang *Ginzel* aus drei Datumsgleichungen im Almagest des *Ptolemäus*: das Neulicht war nach 22 Stunden erschienen. — *Epping* fand in Keilschrifttexten eine Zwischenzeit von 19 und 18.8 Stunden. — In den Monaten Februar, März, April und Mai 1918 habe ich von meinen ältesten Söhnen und ihren Kriegskameraden in Nordpalästina, Syrien und Nordarabien zahlreiche Beobachtungen anstellen lassen; es ergab sich, daß in 23 erfolgreichen Fällen die Sichel nach $29\frac{1}{2}$, 27, 26 und am 13. März schon 20 Stunden nach der Konjunktion gesehen wurde. Dies letztere Resultat meldeten mir drei Beobachter aus Aleppo und Umgegend. — Am 22. März 1928 wurde im Gebiet des Karmel und bei Kubebe-Emmaus von sechs Beobachtern das Neulicht bei einem Mondalter von 19.1 Std. gesehen (Biblica 1928). — *J. K. Fotheringham* veröffentlichte (in Observatory, Okt. 1921) die Resultate von 14 Beobachtungsorten: 14.5—26.1 Std. Zwischenzeit, die erstere ($14\frac{1}{2}$) aus Äquatorialgegenden. — Sir *G. B. Airy* berechnete für Jerusalem als Minimum 18 Stunden (s. Observatory 1911); das wurde von Dr. *Downing* bestätigt. Als Maximum haben *Ideler*, *Wurm*, *Wieseler*, *Caspari*, *Ginzel* 36 Stunden angenommen.

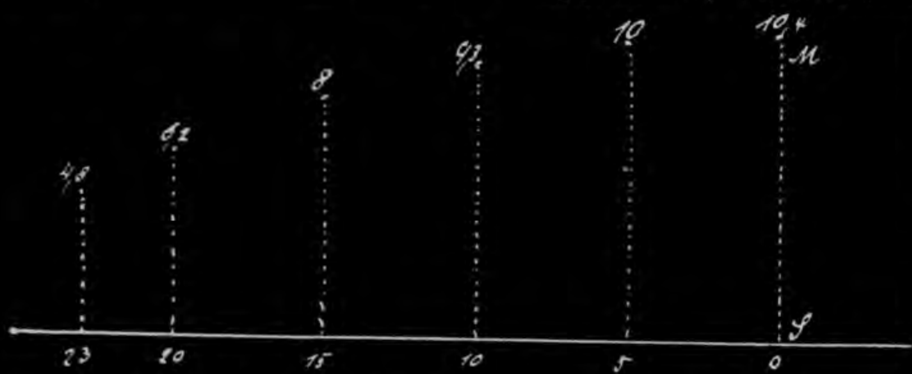
Wenden wir diese Ergebnisse zunächst einmal auf den April 33 n. Chr. an. Es war Neumond für Jerusalem am Donnerstag den 19. März 1^h23^m mittags. Wenn am nächsten Abend, also am 20. März, nach 29 Stunden der Mond gesichtet wurde, was sehr wohl denkbar ist, dann wurde der an jenem Abend beginnende Tag als »Erster« des neuen Monats geheiligt. Wir nehmen an, daß es der Nisan war. Also der 1. Nisan entsprach unserem 21. März, Sonnabend; und der 14. Nisan, Passahanfang, fiel auf Freitag den 3. April.

Das wäre eine Stütze nur für die angebliche *Johanne*ische Datierung. Wie aber, wenn am 20. März bedeckter Himmel war? Dann verschob sich alles um einen Tag: 1. Nisan = Sonntag den 22. März, 14. Nisan = Sonnabend den 4. April, und somit fällt jede Beziehung des Jahres 33 auf die Passion weg. Mit dieser Möglichkeit muß man rechnen.

Die schwankende Zwischenzeit von der Konjunktion zum Neulicht — 18 bis 36 Stunden — bildet in unserem Vorhaben die zweite unsichere Größe.

Dieses Verfahren, die Monatsanfänge in jener Zeit nach den Zwischenzeiten festzusetzen, wird heute nur noch angewandt, wenn man mit einem Näherungsresultat auskommt.

18. Seit etwa 20 Jahren wird eine andere Methode zur Bestimmung des Neulichts befolgt. Ihr Urheber ist *J. K. Fotheringham*, an ihrer Vervollkommnung haben *Maunder*, *C. Schoch* und *P. V. Neugebauer* gearbeitet. Der Grundgedanke ist gewissermaßen selbstverständlich: bei Sonnenuntergang muß der Mond, der sein Licht von der Sonne empfängt, einen bestimmten Abstand von ihr haben und in bestimmter Höhe über dem Horizont stehen, um sichtbar zu werden. Zur leichteren Veranschaulichung diene meine Skizze, die *Neugebauer* freundlichst nachgeprüft hat.



Die Wagerechte deutet den Horizont an. *S* ist die Stelle, an welcher der Mittelpunkt der Sonne stehen würde, wenn die Strahlenbrechung nicht berücksichtigt wird. Die oberen Zahlen 4.8 bis 10.4 bezeichnen die Höhe des Mondes *M* über dem Horizont in Graden. Die punktierten Linien markieren den Vertikalkreis, auf dem der Mond steht, und veranschaulichen die jedesmaligen Abstände zwischen Sonne und Mond (die Azimutdifferenzen). Diese Abstände sind auf der Horizontlinie in Graden 0–23 angegeben. Im ersten Falle steht der Mond auf dem gleichen Vertikalkreis wie die untergehende Sonne, daher sein Abstand 0°; an diesem Abend ist die Mindesthöhe, die zur Sichtbarkeit der Mondsichel erforderlich ist, 10°4. Je größer der Abstand zwischen den beiden Himmelskörpern, desto geringere Mondhöhe ist zum Neulicht erforderlich. Sie beträgt nur 4°8 beim Abstand von 23°.

a: Azimutdifferenz Sonne – Mond
b: Mindesthöhe des Mondes zur Sichtbarkeit

a	b	a	b	a	b
0°	10°4	8°	9°5	16°	7°7
2	10.3	10	9.3	18	7.0
4	10.1	12	8.9	20	6.2
6	9.8	14	8.3	22	5.2
				23	4.8

Diese Tabelle zeigt die Zusammenhänge zwisch[en] den beiden Faktoren, welche die Sichtung des Neulich[ts] gewährleisten (nach *Neugebauer*, Astron. Chronologie **2**, 192[9]).

Eine »unsichere Größe« ist auch in diesem Verfahr[en] enthalten. Man veranschauliche sich, wie klein ein Gradbog[en] am Himmel ist, und wie minimal ein Zehntelgrad. »Die B[e]rechnung der Sichtbarkeitsmöglichkeit«, so legt es *Neugebau[er]* dar, nach der Voraussetzung, daß zu einer bestimmten Azimu[t]differenz eine bestimmte Mindesthöhe des Mondes gehö[rt] (was aus Neulichtbeobachtungen erschlossen ist), »ist natürli[ch] nicht absolut zuverlässig. Insbesondere wird die Entsche[i]dung dann unsicher ausfallen, wenn die wirklich stattfinden[de] Mondhöhe in der Nähe der Grenze liegt, welche aus de[n] Beobachtungen als Mindesthöhe des Mondes gefolger[t] worden ist. In diesem Falle ist die Möglichkeit der Sich[t]barkeit nicht ausgeschlossen. Ein überzeugendes Beispi[el] hierfür erlebte *Schoch* durch das oben erwähnte Neulich[t] vom 22. März 1928; es bewies ihm, daß seine für die Mond[]höhe berechnete Formel um 0.3 Grad erniedrigt werde[n] mußte«.

19. Unsere Aufgabe, den jüdischen Kalender z[u] rekonstruieren, enthält also vier »unsichere Größen«: die meteorologischen Bedingungen — di[e] gelegentlich verhinderte Heiligung des 30[.] Tages — die schwankende Zwischenzei[t] vom Neumond zum Neulicht — die theo[]retisch ermittelten Werte für Mondhöh[e] und -abstand.

Trotzdem ist die Lösung der Aufgab[e] möglich. Denn unveränderlich fes[t] steht a) der Mondumlauf von 29½ Tage[n] und b) die hierdurch bedingte Länge de[r] Monate von 29 oder 30 Tagen. Bei de[r] Festsetzung des Monats-Ersten ist mi[t] einem Schwanken um einen Tag zu rech[]nen, aber nicht um mehr.

Die hier und da vorgekommene zwiefache Datierung eines und desselben Tages hat für unsere Ermittelungen keinerlei Bedeutung. — Die Schaltung bereitet uns gleichfalls keine Schwierigkeiten: Passah muß nach der Frühlings-Tag- und -Nachtgleiche liegen; die Eventualitäten sind zu be[]rücksichtigen.

Das hier folgende Kalendarium enthält in der ersten Spalte die von *Ginzel* für Jerusalemer Zeit berechneten Neumonde, die Stunden von Mitternacht an gezählt; in der 2. Spalte die Monatsanfänge julianisch und jüdisch, nach der Zwischenzeit vom Neumond zum Neulicht.

28.

15. Jan.	15^h	9^m	17. (18.) Jan.	= 1. Schebat
14. Febr.	9	33	16. Febr.	= 1. Adar
15. März	2	35	17. März	= 1. Nisan[1]
13. April	16	31	15. (16.) April	= 1. Ijar
13. Mai	4	2	15. Mai	= 1. Siwan
11. Juni	12	55	13. Juni	= 1. Tamnuz
10. Juli	20	50	12. (13.) Juli	= 1. Ab
9. Aug.	4	31	11. Aug.	= 1. Elul

[1]) In diesem Jahre 28 ist die Schaltung ausgeschlossen.

7. Sept.	12^h	40^m	9. Sept.	= 1. Tischri
6. Okt.	22	31	8. (9.) Okt.	= 1. Marcheschwan
5. Nov.	10	31	7. Nov.	= 1. Kislew
5. Dez.	0	26	7. Dez.	= 1. Tebet

29.

3. Jan.	16^h	16^m	5. (6.) Jan.	= 1. Schebat
2. Febr.	9	33	4. Febr.	= 1. Adar
4. März	3	4	6. März	= 1. Veadar
2. April	19	52	4. (5.) April	= 1. Nisan
2. Mai	10	45	4. Mai	= 1. Ijar
31. Mai	23	57	3. Juni	= 1. Siwan
30. Juni	10	45	2. Juli	= 1. Tamnuz
29. Juli	20	35	1. Aug.	= 1. Ab
28. Aug.	5	14	30. (31.) Aug.	= 1. Elul
26. Sept.	14	35	29. Sept.	= 1. Tischri
26. Okt.	0	26	28. Okt.	= 1. Marcheschwan
24. Nov.	11	28	26. Nov.	= 1. Kislew
23. Dez.	23	57	25. Dez.	= 1. Tebet

30.

22. Jan.	13^h	38^m	24. (25.) Jan.	= 1. Schebat
21. Febr.	4	45	23. Febr.	= 1. Adar
22. März	20	21	24. März	= 1. Nisan
21. April	12	26	23. (24.) April	= 1. Ijar
21. Mai	3	47	23. Mai	= 1. Siwan
19. Juni	18	11	22. Juni	= 1. Tamnuz
19. Juli	7	9	21. (22.) Juli	= 1. Ab
17. Aug.	18	55	20. Aug.	= 1. Elul
16. Sept.	5	43	18. Sept.	= 1. Tischri
15. Okt.	16	16	18. Okt.	= 1. Marcheschwan
14. Nov.	3	4	16. Nov.	= 1. Kislew
13. Dez.	14	7	16. Dez.	= 1. Tebet

31.

12. Jan.	1^h	23^m	14. (15.) Jan.	= 1. Schebat	
10. Febr.	12	55	12. (13.) Febr.	= 1. Adar	
12. März	1	9	14. März	= 1. Nisan	od. 1. Veadar
10. April	14	7	12. (13.) April	= 1. Ijar	» 1. Nisan
10. Mai	4	31	12. Mai	= 1. Siwan	» 1. Ijar
8. Juni	19	38	10. (11.) Juni	= 1. Tamnuz	» 1. Siwan
8. Juli	10	55	10. (11.) Juli	= 1. Ab	» 1. Tamnuz
7. Aug.	2	21	9. Aug.	= 1. Elul	» 1. Ab
5. Sept.	16	31	7. (8.) Sept.	= 1. Tischri	» 1. Elul
5. Okt.	5	43	7. Okt.	= 1. March.	» 1. Tischri
3. Nov.	18	11	6. Nov.	= 1. Kislew	» 1. March.
3. Dez.	5	57	5. Dez.	= 1. Tebet	» 1. Kislew

32.

1. Jan.	16^h	45^m	4. Jan.	= 1. Schebat	od. 1. Tebet
31. Jan.	3	4	2. Febr.	= 1. Adar	» 1. Schebat
29. Febr.	12	55	2. (3.) März	= 1. Veadar	» 1. Adar
29. März	22	59	1. April	= 1. Nisan	
28. April	9	33	29. (30) April	= 1. Ijar	
27. Mai	21	47	30. Mai	= 1. Siwan	
26. Juni	11	57	28. (29.) Juni	= 1. Tamnuz	
26. Juli	3	19	28. Juli	= 1. Ab	
24. Aug.	19	38	27. Aug.	= 1. Elul	
23. Sept.	12	26	25. (26.) Sept.	= 1. Tischri	
23. Okt.	4	2	25. (26.) Okt.	= 1. Marcheschwan	
21. Nov.	18	40	24. Nov.	= 1. Kislew	
21. Dez.	7	52	23. (24.) Dez.	= 1. Tebet	

33.

19. Jan.	18^h	55^m	22. Jan.	= 1. Schebat
18. Febr.	4	45	20. Febr.	= 1. Adar
19. März	13	23	21. (22.) März	= 1. Nisan
17. April	21	47		

20. Im Jahre 29 war in Jerusalem am 4. März 3^h4^m morgens Neumond; 39 Stunden später, am Abend des 5. März, konnte das Neulicht gesehen werden; die Mondhöhe betrug 16°, die Azimutdifferenz 7° — beides sehr günstig. Dann fiel der 1. Tag des neuen Monats mit dem 6. März, Sonntag, zusammen. Der Nisan kann es nicht gewesen sein, weil dann der 14. und der 15. auf den 19. und 20. März (Sonnabend und Sonntag) fielen, was für das Passah zu früh war. Am 6. März begann also der Schaltmonat Veadar. — Nächster Neumond am Sonnabend d. 2. April 7^h52^m abends. Mondhöhe und -abstand brauchen nicht in Rechnung gesetzt zu werden, weil die beiden Möglichkeiten klar sind: Neulicht entweder am Abend des 3. oder des 4. April; demnach entweder 1. Nisan = 4. April, Montag; 14. Nisan = 17. April, Sonntag; oder 1. Nisan = 5. April, Dienstag; 14. Nisan = 18. April, Montag. Konnte infolge bedeckten Himmels die Sichel an jenen Abenden nicht gesehen werden, dann bekam der ablaufende Monat 30 Tage und endigte am 4. April, und der 14. Nisan war am Montag d. 18. April. Nach diesen klaren Ergebnissen scheidet das Jahr 29 ganz aus.

21. Das Jahr 30. Vom 1. Nisan 29 ab zählen wir 12 Monate und setzen den Adar i. J. 30 fest nach dem Neumond vom 21. Februar morgens 4^h45^m. Am 22. betrug abends das Mondalter 36–37 Stunden, mithin 1. Adar = 23. Febr. (so auch *Schoch* nach seinen Formeln) und 29. Adar = 23. März. Nächster Neumond am 22. März abends 8^h21^m (*Ginzel*). Wann war der 1. Nisan 30? Um diese Feststellung geht eine jahrzehntelange Debatte:

1. Am 23. März war das Mondalter 22 – 23 Stunden, Sonnenuntergang 6^h15^m. Da die junge Sichel dort im März schon bei viel geringerer Zwischenzeit gesehen wird, so kann das Neulicht auf den 23. März angesetzt werden. Also 1. Nisan = 24. März; 14. Nisan = 6. April, Donnerstag; 15. Nisan = 7. April, Freitag. Das sind die Tage der Passion. So hatten sich *Wurm*, *Richter*, *Hontheim*, der holländische Astronom *Oudemans*, ich selber u. a. entschieden. *C. Schoch* hatte diese Datierung für die richtige erklärt (Biblica 1926), und zwar nicht mit Anwendung der Zwischenzeit, sondern nach seinen Formeln für Mondhöhe und -abstand.

2. *J. K. Fotheringham* fand, daß am 23. März die Mondhöhe nur 9°.3 betrug, während sie 11°.9 betragen müßte. Daher behauptete er, daß der 1. Nisan = 25. März, und der 14. Nisan = 7. April Freitag gewesen sei; folglich müsse »das synoptische Datum der Kreuzigung aufgegeben werden«. *Fotheringham* machte *Schoch* auf einen Rechenfehler (von $1^1/_2$ Std.) aufmerksam, sodaß letzterer seine Berechnungen nachprüfte und fand, daß am 23. März die Mondhöhe 9°.3 betrug, aber 10°.2 betragen müßte, um die Sichtbarkeit zu gewährleisten (Biblica 1928,9). Nunmehr stimmte *Schoch* dem Datum *Fotheringhams* zu und behauptete, »daß diejenigen recht haben, die auf Grund des *Johannes*-Evgl. den Tod des *Herrn* auf den 14. Nisan ansetzen«. Die *Johann*eische Datierung und ihre Übereinstimmung mit der synoptischen s. ob. Nr. 9b. Die Möglichkeit, daß am 23. März wegen be-

deckten Himmels der Mond nicht gesehen werden konnte, ist unten Nr. **21**, 6, erwogen.

3. Bisher ist von niemandem geprüft worden, wie i. J. 30 der Nisan lag, wenn mehrmals bei jedem Mondwechsel bedeckter Himmel war. Ich gehe vom September 29 aus: Am 26. September Neumond nachmittags 2^h35^m; Neulicht am 27. oder 28. September; 1. Tischri am 28. oder 29. September. Wenn von da ab das Neulicht ausblieb, dann müssen wir 30- und 29-tägige Monate abwechselnd folgen lassen. Zunächst vom 28. September 29 ab ausgehend:

1 Tischri = 28. Sept. | 1. Marcheschw. = 28. Okt.
30. » = 27. Okt. | 29. » = 25. Nov.

1. Kislew = 26. Nov.
30. » = 25. Dez.

1. Tebet = 26. Dez. | 1. Schebat = 24. Jan.
29. » = 23. Jan. 30 | 30. » = 22. Febr.

1. Adar = 23. Febr.
29. » = 23. März

1. Nisan = 24. März
14. » = 6. April }
15. » = 7. » } unsere gesuchten Tage.

Ging indessen der Wechsel der 30- und 29-tägigen Monate vom 29. Sept. aus, dann verschieben sich diese Daten um einen Tag, und das letzte Resultat ist: 14. Nisan = 7. April, Freitag. In genau derselben Weise habe ich das Kalendarium angelegt nach den obigen Neumonden vom 26. Okt. an u. s. f. Dabei ergab sich das gleiche Resultat: bisweilen fiel der 14. Nisan auf Donnerstag d. 6., bisweilen auf Freitag d. 7. April.

4. Da *Schoch* anfänglich nach eigener mathematischer Berechnung meinem Resultat zugestimmt und es mir in mehreren Zuschriften bestätigt hatte, danach aber fand, daß nach seiner Formel am 23. März 30 an der Mondhöhe 0°9 gefehlt haben, und da ferner seine neue Formel sich durch das Neulicht vom 22. März 1928 als ungenau — um 0°3 — herausgestellt hatte, so wandte ich mich an *Neugebauer* mit der Bitte um die Berechnung der astronomischen Faktoren und Beurteilung der Sachlage. Seine Darlegung gebe ich als einen höchst wertvollen Beitrag wörtlich wieder.

»Die astronomischen Daten für das Neulicht am 23. März 30 in Jerusalem (Breite 31°8) sind folgende:

Sonne (Mittelpunkt) im wahren Horizont (ohne Refraktion) 23. März 6^h8^m abends mittl. Zeit Jerusalem,

Länge des Mondes	$\lambda =$	10°80
Breite des Mondes	$\beta =$	−3.96
Länge der Sonne	$\odot =$	0.73
Rektaszension d. Mondes	$\alpha =$	11.49
Deklination d. Mondes	$\delta =$	+0.63
Rektaszension d. Sonne	$A =$	0.67
Deklination der Sonne	$D =$	+0.29
Halber Tagbogen d. Sonne	$T =$	90.18 (ohne Refraktion).

Damit wird der Stundenwinkel des Mondes =

$$A + T - \alpha = 79^\circ\!.36$$

und nach den bekannten Formeln zur Verwandlung der Rektaszension und Deklination in Azimut und Höhe:

Höhe des Mondes	$h =$	9°37
Azimut d. Mondes	=	84.89
Azimut d. Sonne	=	90.35
Azimutdifferenz	$\Delta =$	5.46.

Nach der von *C. Schoch* aufgestellten Bedingung (vgl. *Neugebauer*, Astron. Chronologie 1929, 2. Bd., S. 23) ist das Neulicht sichtbar, wenn bei Azimutdifferenz 5°5 der Mond eine Mindesthöhe von 9°9 hat. Da sie hier aber nur 9°4 beträgt, so ist t h e o r e t i s c h das Neulicht am 23. März nicht sichtbar.

Es ist zu sehen, daß die Entscheidung der Frage ganz von der Zuverlässigkeit der angenommenen Grenze der Mondhöhe abhängt. Die hier benutzten Werte sind die neuesten, die Herr *Schoch* auf Grund des »Karmel-Neulichts« (Biblica 1928) abgeleitet hat. Nach der älteren Tafel von *Schoch* (in seinen »Planetentafeln für jedermann«) war die Mindesthöhe 10°2 erforderlich. Nach der neuen Tafel kommt der Mond nun bis auf 0°5 an die theoretisch geforderte Grenze heran. Diese Differenz von einem Mondhalbmesser ist so gering, daß man wohl sagen darf, daß unter günstigen Umständen die Sichel doch bemerkt werden konnte; die theoretische Grenze von 9°9 ist nicht unbedingt zuverlässig; das beweist schon die Tatsache, daß Herr *Schoch* auf Grund eines günstigen Neulichts die Grenze von 10°2 auf 9°9 herabsetzen konnte.«

Soweit *Neugebauer*. Ich setze daher abermals wie oben:

1. Nisan = 24. März
14. » = 6. April, Donnerstag }
15. » = 7. April, Freitag } die Tage d. Passion.

5. Eine weitere Beihilfe gewährte mir *Neugebauer* in der Berechnung der »mittleren Konjunktion«. Der technische Ausdruck für diese Mondphase war im jüdischen Kalenderverfahren »moled«. Man besaß, auf empirischer Grundlage, einen einfachen Modus, mit Hilfe des Moled den Eintritt des Neulichts zu berechnen. Die Mischna Rosch haschana, 20b, sagt: »man muß den Moled berechnen; wenn er vor 12^h mittags stattfindet, dann weiß man, daß der Neumond sichtbar sein wird nach Sonnenuntergang. Wenn er nicht vor 12^h mittags stattfindet, ist man sicher, daß er (der Neumond) nicht nach Sonnenuntergang sichtbar sein wird«. Ähnlich *Maimonides* VII. 2: »findet der Moled vor Mittag, wenn auch nur einen Chelek (d. i. einige Sekunden) statt, so bestimmt man den Rosch Chodesch (d. i. der Monats-Erste) für denselbigen Tag des Moled«. Mit anderen Worten: wenn die mittlere Konjunktion vor 12 Uhr mittags eintritt, so fängt am Abend dieses Tages der neue Monat an.

Diese Regel hatten die jüdischen Kalendergelehrten durch die jahrhundertelange Praxis gewonnen. Ihre Anwendung ist einfach: die mittlere Konjunktion — der Moled — fand, wie *Neugebauer* berechnete[1]), am 22. März abends 9.4 Uhr statt, folglich konnte am nächsten Abend das Neulicht gesehen werden. Also 1. Nisan = 24. März; 14. und 15. Nisan = 6. und 7. April, wie oben, die Tage der Passion.

[1]) *Neugebauer* fügt hinzu: »Wenn es der Zufall wollte, daß der mittlere Neumond um 6 Uhr früh war und die Störungen +14 Stunden betrugen, dann fiel der Neumond auf 8 Uhr abends, und das Neulicht war an diesem Abend sicher nicht zu sehen. Allerdings sind solche Fälle seltene Ausnahmen. Aber als Behelf konnte die Regel gelten, weil das Neulicht im schlimmsten Falle einen Tag später fiel und so ein großer Fehler im Kalender nicht entstehen konnte.«

6. Eine letzte, auf der Mischna beruhende Fixierung des 1. Nisan 30 ist abzuleiten aus dem Grundsatz, der für die Verlängerung eines Monats galt: »Hat ihn (den Neumond) der Gerichtshof, ja selbst ganz Israel gesehen, oder es waren die Zeugen schon verhört, es ist jedoch nicht erreicht worden, vor Eintritt der Nacht das Wort der Weihe auszusprechen, so ist der Monat verlängert«, d. h. er erhält 30 Tage. Daraus folgt, daß er nicht verlängert, daß vielmehr der 30. Tag der Erste des neuen Monats wurde, wenn noch vor Anbruch der Nacht das »geheiligt« erfolgte. Dies konnte geschehen, »bevor der erste Stern erscheint« (so die Mischna und entsprechend *Maimonides* II. 9). Dieser Fall kann am 24. März 30 eingetreten sein, wenn am vorangegangenen Abend der Mond verdeckt war. Es bestand folgende Situation: die Mondhöhe — von *Neugebauer* berechnet — 20°, d. h. 10° über der theoretischen Grenze; der Mond ging 1 Std. 34 Min. nach der Sonne unter, er stand hoch am Himmel, war 46–47 Std. alt, hatte an Breite erheblich gewonnen, und so wurde er, klaren Himmel vorausgesetzt, lange vor Sonnenuntergang (am 24. März) gesehen. Man wußte, daß von dem neuen Mondumlauf schon 2 Tage verflossen waren, man hatte noch hinreichend Tageszeit (der Tag endigte erst beim Erscheinen von einem größeren oder zwei mittleren Sternen), um das »geheiligt« auszusprechen (das durfte nur bei Tage geschehen), und so wurde der Adar nicht verlängert, sondern dieser ablaufende Tag wurde als 1. Nisan geheiligt. Es ergab sich also dasselbe Kalendarium wie vorhin: 1. Nisan = 24. März; 14. Nisan = 6. April.

Über diesen Fall: »Wurde am 30. Tage, wenn abends die Mondsichel gesehen und alles für richtig befunden war, in der Dämmerung vor Eintritt der Nacht das ‚geheiligt' für den 30. Tag ausgesprochen?« haben *Slonimsky* und *Pineles* in der Zeitschrift Hamagid (Lyck 1868) eine Kontroverse geführt. *Slonimsky* lieferte den Beweis im obigen bejahenden Sinne; *Pineles* hielt diese Heiligung für undenkbar, weil nach seiner Ansicht die Sichel vor Ausgang des Tages nicht gesehen werden könne. Diese Meinung ist irrig. Ich darf mich für meine Darlegung noch auf zwei jüdische Autoritäten berufen: *E. Baneth* und *B. Schwarz*, ersterer begründet sie durch Rosch haschana III. 1. — Im April und Mai 1918 wurde in Nazareth, Damaskus und Aleppo der Neumond von fünf Beobachtern bei Sonnenuntergang, d. h. bei Tage, gesehen. Die nämliche Beobachtung hat Prof. *Alt* in Palästina wiederholt gemacht (nach seiner Mitteilung Mai 1923). *Schoch* schreibt Biblica 1928 »im Frühjahr — Februar bis April — ist jedes Neulicht, das mindestens 34 Stunden alt ist, in Jerusalem schon vor Sonnenuntergang sichtbar«. — *Kugler* II. 546 fand in Keilschrifttexten zwei Fälle, wo »in Babylon die Dauer der Sichtbarkeit des Neulichts 84 bzw. 86 Minuten betrug... Die Sichel hatte eine erhebliche Breite und somit eine bedeutende Helligkeit erlangt.«

Das Endergebnis ist klar: i. J. 30 begann der Nisan am Vorabend zum 24. März; Passah-Anfang, der 14. Nisan, war demnach am Donnerstag dem 6. April; Freitag den 7. April war der 15. Nisan, der Tag der Kreuzigung. Am Donnerstag, dem Tag des Passahmahls, war Vollmond.

Das Jahr 31. Vom Nisan 30 ab gezählt, begann der zwölfte Monat, Adar, nach dem Neumond vom 10. Febr. 12^h55^m mittags. Folglich 1. Adar = 12. (oder 13.) Februar, 30. Adar = 13. (oder 14.) März. Nächster Neumond am 12. März 1^h9^m nachts; Mondalter am Abend des 12. März 17 Std., am 13. März 41 Std. Wir erwägen alle Möglichkeiten: die Sichtbarkeit am 13. März, aber auch die Nichtsichtbarkeit infolge bedeckten Himmels, und erhalten:

a)	1. Nisan	= 14.	März,	Mittwoch;
	14. »	= 27.	»	Dienstag;
	15. »	= 28.	»	Mittwoch;
b)	1. »	= 15.	»	Donnerstag;
	14. »	= 28.	»	Mittwoch;
	15. »	= 29.	»	Donnerstag.

Passah kann sehr wohl so früh gelegen haben: die astronomische Bedingung (Sonne im Widder) war erfüllt, und reife Gerste konnte vorhanden sein. Falls jedoch die landwirtschaftlichen Bedingungen — der Stand des Getreides und der Baumfrüchte — im Februar ungünstig waren, dann wurde geschaltet, dann war der soeben besprochene Monat der Veadar, und der Nisan begann erst nach dem Neumond vom 10. April mittags 2^h7^m. Am 11. April beim Sonnenuntergang 6^h25^m war der Mond $28\frac{1}{4}$ Std. alt, sein Abstand betrug 4°, seine Höhe 12°, sie brauchte nur 10°1 zu betragen. Folglich, klaren Himmel vorausgesetzt:

c)	1. Nisan	= 12.	April,	Donnerstag;
	14. »	= 25.	»	Mittwoch.

War aber durch Gewölk die Sichtung des Neulichts verhindert, dann:

d)	1. Nisan	= 13.	April;	
	14. »	= 26.	»	Donnerstag;
	15. »	= 27.	»	Freitag.

Dies wären dann die Tage der Passion.

Sämtliche kalendarische Möglichkeiten für den Nisan 31 sind erschöpft. Nach den ersten drei Fällen kam der 14. Nisan auf Dienstag bzw. Mittwoch, sodaß das Jahr 31 ausscheiden muß. Nach dem letzten Fall, der, wie erkenntlich, nur geringe Wahrscheinlichkeit für sich hat, könnte der 15. Nisan am Freitag d. 27. April 31 gewesen sein.

Das Jahr 32. Der Neumond am 29. Februar mittags 12^h55^m war vom 14. März 31 ab gezählt der dreizehnte, vom 12. April ab der zwölfte. Den Nisan leitete er nicht ein, weil dann Passah-Anfang zu früh — Mitte März — fallen würde. Nächster Neumond 29. März 10^h59^m nachts; zwei Möglichkeiten kommen in Rechnung:

a) Neulicht am 30. März beim Mondalter von 19 Stunden,

1. Nisan	= 31.	März,	Montag;
14. »	= 13.	April,	Sonntag;
15. »	= 14.	»	Montag.

b) Neulicht am 31. März, Mondalter 43 Stunden,

1. Nisan	= 1.	April;	
14. »	= 14.	»	Montag;
15. »	= 15.	»	Dienstag.

Auch die Annahme bedeckten Himmels bringt die Festtage des 14. und 15. nicht auf Donnerstag bzw. Freitag.

Das Jahr 32 scheidet ganz aus.

Das Jahr 33. Vom 29. März 32 ab war der Neumond am 19. März 33 mittags 1^h23^m der dreizehnte, also begann der Nisan. Es sind theoretisch vier Möglichkeiten zu berücksichtigen:

a) Neulicht am 20. März (Mondalter 29 Stunden), dann war 1. Nisan = 21. März, Sonnabend; 14. Nisan = 3. April, Freitag. Nach den Formeln für Mondhöhe und -abstand fand *C. Schoch* die gleichen Daten, ebenso *Neugebauer* mit Anwendung von zwei Methoden (s. Hilfstafel III, S. XXIX).

Diesen 3. April 33 hat man öfter als den Freitag der Kreuzigung erklärt unter Berufung auf die *Johann*eische Datierung. Daß diese Berufung aber nicht stichhaltig ist, weil die *Johann*eische mit der synoptischen Datierung übereinstimmt, wurde oben, Nr. 9b, dargelegt.

b) War am 20. und 21. März die Sichel durch Gewölk verdeckt, dann gab man dem Adar 30 Tage, sodaß

1. Nisan = 22. März; 14. Nisan = 4. April, Sonnabend.

Die Möglichkeit, daß am 21. bzw. 22. März der Schaltmonat Veadar anfing, liegt ganz fern; sie sei trotzdem berücksichtigt. Nächster Neumond am 17. April, abends $\frac{3}{4}$10 Uhr, folglich entweder:

c) 1. Nisan = 19. April;
14. » = 2. Mai, Sonnabend;
oder: d) 1. » = 20. April;
14. » = 3. Mai, Sonntag.

Nach diesen astronomischen Möglichkeiten scheidet das Jahr 33 gleichfalls aus.

Der Leser wird gebeten, mit mir das Fazit der Untersuchungen zu ziehen. Er wird sich erinnern, daß ich in dem rein historischen Teil allen Möglichkeiten Raum gegeben habe, sodaß das Endergebnis absolut sicher formuliert werden konnte: die Kreuzigung hat in einem der Jahre 30 – 33 stattgefunden. Das richtige von diesen vier Jahren muß eine unerläßliche Bedingung erfüllen: der Freitag der Kreuzigung muß auf den 15. Nisan fallen. Bei der Rekonstruktion des damaligen Kalenders habe ich gleichfalls allen Möglichkeiten Raum gewährt, um Resultate zu bringen, die innerhalb eines unvermeidlichen Schwankens absolut sicher feststehen. Nach der Lage des 15. Nisan ergab sich folgendes:

a) Die Jahre 29 und 32 scheiden gänzlich aus, weil in ihnen dieser Passahtag auf Montag oder Dienstag fiel.

b) Im Jahre 31 lag nach der größten Wahrscheinlichkeit der 15. Nisan auf einem Mittwoch oder Donnerstag (dem 28. oder 29. März); mit sehr geringer Wahrscheinlichkeit kann er für Freitag den 27. April angenommen werden.

c) Im Jahre 33 bringt von den vier kalendarischen Möglichkeiten die eine den 14. Nisan auf einen Freitag (3. April), aber nicht eine den 15. Mithin scheidet auch 33 aus.

d) Bleibt das Jahr 30 übrig. Ich verweise auf die mehrfache Art, die Passahtage dieses Jahres festzulegen: der 14. Nisan = 6. April, Donnerstag; der 15. Nisan = 7. April, Freitag; das sind unsere gesuchten Tage.

Zusatz a) Wer die Ansicht vertritt, daß im Neuen Testament zwei Daten für den Freitag der Kreuzigung genannt seien — der 15. Nisan bei den Synoptikern, aber der 14. Nisan bei *Johannes* — der findet dieses doppelte Datum nur in dem Jahre 30 verwirklicht.

Zusatz b) Der eingangs geführte Nachweis über die Anrechnung der Mitregentschaft seitens des *Lukas* in den Worten »im 15. Jahre der Herrschaft des Kaisers *Tiberius*« hat nun seine letzte Bestätigung erhalten.

Für das Jahr 30 als Jahr der Kreuzigung seien am Schluß noch zwei außerbiblische Zeugen angeführt. Zunächst der Talmud. In Jerusal. Talmud, Joma fol. 43c, und ganz ähnlich im Babyl. Talmud, fol. 39b, wird erzählt, daß Rabbi *Jochanan ben Sakkai* eines Morgens im Tempel gewisse Dinge sah, die ihn sehr erschreckten, weil er sie als Vorzeichen vom Ende des Heiligtums erkannte. »Die westliche Lampe erlosch, und das karmesinrote Wollenband blieb rot, und das Los Gottes kam zur linken Seite hervor, und man verschloß die Tür des Tempels am Abend, und als man morgens aufstand, fand man sie geöffnet. Da sagte R. *Jochanan*: »Tempel, warum erschrickst du uns? Wir wissen, daß dein Ende Zerstörung ist, wie geschrieben steht: öffne, Libanon, deine Tore, und Feuer wird deine Zedern verzehren«, Sach. 11. 1. (Mit »Libanon« ist hier das Zedernholz gemeint, aus dem der Tempel gebaut war; wenn er sein Tor öffnete, werde es das Vorzeichen von der Vernichtung durch Feuer sein[1]).

Von »den sichtbaren Zeichen und Andeutungen« der kommenden »Zerstörung des Tempels« schreibt *Josephus* im Jüd. Krieg VI. 5, 2 – 4. Er beruft sich auf den schriftlichen Bericht eines Augenzeugen und sagt, was die Tür des Tempels betrifft, »das östliche Tor des inneren Vorhofs, das doch von Erz und von ungeheurem Gewicht war und des Abends von 20 Männern mit Mühe geschlossen und mit eisenbeschlagenem Querbalken verrammelt wurde, dessen Riegel tief in die steinerne Schwelle fielen, sah man um Mitternacht von selbst sich öffnen«. *Josephus* fügt hinzu, daß sich dies »beim Fest der ungesäuerten Brote ereignete«. (Seine Datierung für sämtliche Vorzeichen durch die bloßen Worte »vor dem Aufstande« ist bisweilen irrtümlich so aufgefaßt worden, als ob er geschrieben hätte »kurz vor dem Aufstande«; er meinte vielmehr »in der Periode vor dem Aufstande«; vgl. *Laible* s. u. Anm.)

Das Hebräer-Evangelium hatte die Überlieferung aufbewahrt, daß beim Tode *Jesu* die Oberschwelle im Tempel, die von ungeheurer Größe war, zerbrach und einstürzte. Die Kenntnis von dieser Überlieferung verdanken wir dem *Hieronymus*, der in den Jahren 374 – 79 jenes Evangelium abgeschrieben und übersetzt hatte. Von dem Entzweibrechen der Oberschwelle schreibt er an vier verschiedenen Stellen (im Kom. zu *Mtth.* 27.51 und zu *Jesaja*, in einem Brief an *Hedebia* und einem an den römischen Bischof *Damasus*). Dabei erwähnt er Leute, »welche verkünden, daß zu jener Zeit, als der Vorhang des Tempels zerriß, die Oberschwelle vernichtet wurde und das ganze Haus Israel von einer Wolke des Irrtums überschattet wurde«. Von dem Zerreißen des Vorhangs beim Tode *Jesu* berichten *Matth.* 27.51; *Mark.* 15.38 u. *Luk.* 23.45. Daß zwischen dem Zerreißen des Vorhangs, dem Zerbrechen der Oberschwelle und

[1]) Das ununterbrochene Brennen der westlichen Lampe, das Weißwerden des roten Wollenbandes und das Herauskommen des Loses Jahwes in der Rechten waren drei »Gnadenzeichen« gewesen; siehe *Laible*: Eine noch nicht bekannte Jesus-Stelle im Talmud, in der Allg. Evg. Luth. Kirch.-Zeitg. 1926.

dem gewaltsamen Öffnen der ungeheuer schweren Tür ein natürlicher Zusammenhang bestand, leuchtet sofort ein: »wenn die Oberschwelle dieser schweren Tür einen Riß bekam, der schließlich ihren Einsturz zur Folge hatte, so war das Zerreißen des an der Oberschwelle befestigten Vorhangs die nächste Folge, und das Aufspringen der Torflügel in der Nacht eine spätere« (*Th. Zahn*). Und das alles hatte eine natürliche Ursache, nämlich das Erdbeben, von dem *Matth.* 27.52 berichtet. Die christliche Überlieferung bewahrte die Erinnerung nur an die beiden Vorgänge, die sich am Nachmittag beim Tode *Jesu* ereigneten (Erdbeben, Zerreißen des Vorhangs), die jüdische erhielt die Erinnerung an die kultischen Dinge und an die unheimlichen Vorzeichen des Tempelbrandes. Im Talmud wird an beiden Stellen vermerkt, daß dies geschah »vierzig Jahre bevor das Haus zerstört wurde«, also im Jahre 30[1]). Und *Josephus* wußte von den Augenzeugen, daß es sich am Passah zugetragen hatte. Somit ist durch den Talmud indirekt die Kreuzigung am Passah 30 datiert und damit zugleich auch das Monatsdatum bestimmt, denn der Freitag am Anfang des Passah war der 7. April.

Die älteste Datierung der Kreuzigung verdanken wir dem Alexandriner *Clemens* (um 200). In den »Teppichen«, I.21, 146, schreibt er »seine Passion verlegen die, welche genau nachgeforscht haben, in das 16. Jahr des Kaisers *Tiberius*, und zwar die einen auf den 25. Phamenoth, die anderen auf den 25. Pharmuthi, andere sagen, daß der *Heiland* am 19. Pharmuthi starb«. Diese genauen Nachforschungen waren, wie aus dem Zusammenhang hervorgeht, von ägyptischen Gnostikern, etwa um 150, veranstaltet worden. Daß sich damals in den christlichen Kreisen Palästinas oder Nordägyptens noch eine feste Überlieferung vom Jahr und Monatsdatum der Kreuzigung erhalten hatte, dürfte nicht zu bezweifeln sein. Das 16. Jahr des *Tiberius* lief vom August 29 bis dahin 30. Nach dieser Überlieferung war also *Christus* am Passah 30 gekreuzigt. Die Frage nach dem Monatsdatum ist damit zugleich entschieden: der Freitag der Kreuzigung am Anfang des Passah kann im Jahre 30 nur der 7. April gewesen sein; die angebliche Differenz zwischen *Johannes* und den Synoptikern hat in diesem Falle nichts mehr auf sich.

Wie ist es nun mit jenen drei ägyptischen Monatsdaten? Dort bestanden damals zwei Kalender nebeneinander: der von altersher überlieferte, volkstümliche, bewegliche, daneben der durch *Augustus* reformierte mit festem Sonnenjahr. Hierüber sind wir durch zahlreiche Inschriften und erhaltene Doppeldatierungen genau unterrichtet. Die Umrechnung jener drei ergibt folgende Daten:

	Nach dem alten Kalender:	Nach dem reform. Kalender:
25. Phamenoth	= 8. März, Mittwoch	= 21. März, Dienstag
19. Pharmuthi	= 1. April, Sonnabend	= 14. April, Freitag
25. »	= 7. April, Freitag	= 20. April, Donnerstg.

Da haben wir abermals Freitag, den 7. April 30. Warum aber sind drei Daten genannt worden? In dieses Dunkel hat *E. Preuschen*, dem wir diese Entdeckung verdanken, Licht gebracht. In dem alten Kalender, aus dem jene Überlieferung entnommen war, waren, wie allgemein üblich, Doppeldatierungen eingetragen; das ist durch zahlreiche Beispiele belegt und auch leicht verständlich. Dann hatte man beim 19. Pharmuthi »Kal. Apr.« vermerkt (1. April), um den Parallelismus mit dem offiziellen Datum festzulegen; das dritte Datum, der 25. Phamenoth, entsprach dem 21. März des reformierten Kalenders; das war der Tag des Äquinoktiums nach alexandrinischer Astronomie, der vielfach den Anfang des Jahres bildete. Durch Mißverständnis wurden diese zwei Daten gleichfalls auf *Christi* Leiden bezogen, sodaß *Clemens* sie mit anführte. Diese Erklärung betreffs d. 25. Phamenoth und 19. Pharmuthi wird sehr wohl zutreffen. Von größtem Werte ist es, daß die sorgfältigen Nachforschungen der ägyptischen Gnostiker auch den 7. April 30 als Tag der Kreuzigung ergeben hatten. Daß er in der Folgezeit nicht mehr beachtet wurde, darf uns nicht wundernehmen. Denn zur Zeit des *Clemens* blühte schon die symbolische Chronologie, welche das Werk der Schöpfung und der Erlösung in engsten Parallelismus setzte und beides nach dem Frühlingsanfang datierte. An dieser symbolischen Chronologie haben alle Kirchenväter ein halbes Jahrtausend festgehalten.

Nach objektiver Prüfung der geschichtlichen Angaben der Evangelien und nach der astronomischen Festsetzung der Passahtage hat sich klar ergeben, daß der Tag von Golgatha

Freitag der 7. April 30 war.

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[1]) In meiner ersten Arbeit über »Das Datum der Kreuzigung« (Berlin 1912) hatte ich einen leisen Zweifel an der runden Zahl »vierzig Jahre« ausgesprochen: den nehme ich zurück. Die sichtlichen inneren Zusammenhänge aller jener Vorgänge am Tempel und die richtige Datierung auf das Jahr 30 können nicht auf Zufall beruhen.

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O. Gerhardt.

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THE DATE OF THE CRUCIFIXION OF JESUS CHRIST

Christ died under Pontius Pilate. All attempts to find the year of the crucifixion in a purely historical way from this procurator's period in office according to the years mentioned in the gospels have yielded merely approximate results. The day of death was a Friday in the beginning of the Passah. Since this date depended entirely on the renewal of the moon, the question after the year, and the date of the crucifixion is decided by astronomy. In this respect, my presentation is based on the calculation of the new and full moons by F. K. Ginzel[1]. How valuable the contribution of P. V. Neugebauer is will be evident in the respective places. I am endeavoring to present the facts in such a way that the reader can easily form his opinion, probably at variance with mine.

1. The time of office of the procurator Pontius Pilate is ascertained from Josephus' Antiquities 18, 4, 2 and 3. When Pilate reached Rome where he was to defend himself before the emperor Tiberius, the latter had just died, March 16, 37 A.D. Tiberius had recalled him before the Passover of the preceding year--i.e. 36 A.D.--after he had administered Palestine 10 years. Thus his time of office lasted from spring 26 until then in 36.

2. When began the public ministry of Christ? Luke 3:1 first of all dates the beginning of John the Baptist's sermon on repentance: "in the fifteenth year of the reign of Tiberius Caesar, Pontius Pilate being governor in Judea . . . . the word of God came unto John". Tiberius had succeeded Augustus August 19, 14 A.D. The dating "in the fifteenth year of the reign of Tiberius Caesar" can be understood in three ways: it can mean the year as from August 19, 28 until then of 29, or the year 28, that is if 14 as the starting year was counted in full, for which E. Schurer found precedents, or in the thrid place, it can also mean the year 29, in case the

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[1]See Appendix for list of papers used by me.

reckoning begins only January 15. A fourth mode to reckon the years of Tiberius would result from the fact that this emperor by a decree (law) was put on a par with Augustus while he yet lived as to the administration of the provinces and also in the command of the army. Sources for this are Velleius Paterculus II. 121 and Sueton. According to the latter, it seems as though this decree was decided upon in the year 13 A.D.; but V. Paterculus, who had accompanied Tiberius on his war expeditions for many years, gives the exact date: it was issued prior to the triumphal march on January 16, 12, or probably at the end of the year 11 A.D. It requires no explanation that in Rome officially the reign of Tiberius was reckoned from August 14. But through the decree which put Tiberius in the administration of "all provinces" and in the chief command "over all armies" on a par with Augustus so that Tacitus called him Collega imperii, a legal situation was created on the strength (basis) of which in the province for a time his years of reign were counted.

a. Luke 3:1 reads:

The emperor's rank in office is here designated by the same word as the one of the governor and at that in immediate succession. With an author like Luke, this is no chance. The simple words, "in the fifteenth year of Caesar Tiberius" would have been quite sufficient. But Luke chose the word in order to combine the coregency and the autocracy. The fact that by this word occasionally also autocracy is designated is not against this. The customary (usual) meaning was "chief command" and Tiberius held that.

b. A documentary proof furnishes numismatics. Tiberius coins have been found which the governor Silanus had coined in the Syrian capital Antioch, the native place of Luke. One of them has the numbers A and that is 1 and 43. The last number proceeds from the era of Aktium (31 B.C.) while A gives the first[2] year of

[2]Note 2, p. 138: Compare Zahn, Commentary to Luke's Gospel and his "Compendium on the Story of the Life of Christ", 1928, p. 40; further, Hartl, p. 67. Hartl has examined two (well preserved) specimens of that coins in good condition in the cabinet at St. Florian.

Tiberius: so this corresponded to the year 12 A.D.

c. The autocracy of Tiberius had lasted 22 years, 6 months, 27 days. By authors of the first century like Philo and Josephus, this was rounded off to 22 and 23 years respectively. But the Alexandrian Clemens (about 200)--who himself gave 22 years of reign--knew other authors, who ascribed to Tiberius a reign of 26 years, 6 months, 19 days, (c. "Teppiche" (rugs), I., 144). Accordingly, since the emperor died March 16, 37, it was reckoned as from 11 A.D.--Hippolyt of Rome about 230, writes in the Daniel Commentary, that Christ "suffered in the 18th year of Tiberius", adding the names of the consuls--Fufius Geminus and Rubellius Geminus. As their year of office was in 29 A.D., in this date, the first year of Tiberius was 12 A.D.

d. Luke writes (3:23): "Jesus himself began to be about thirty years of age". Of what value is this estimation of age? It did not originate with the evangelist, for he had never seen the Lord. Evidently he received it from those of whom he got, "from the beginning . . . . perfect understanding," in order that his most excellent friend Theophilus might "know the certainty of those things, wherein he was instructed". (Luke 1:2-4) Consequently this estimation of the age should not be passed by as meaningless. But to what year could it point? Herod had died in the spring 4 B.C. so that 5 B.C. would have to figure as the latest year of birth. Then 26 A.D., Christ would have been exactly 30 years old, and "about thirty" would well fit to 27 or 28. (We dare not go back farther than 26 on account of P. Pilate's entering upon office.) We must, however, accept an earlier year of birth. The history of Christmas (Luke 2) as is known, begins with the decree of emperor Augustus that all the world should be taxed. According to everything now ascertained about this, the unanimous conviction prevails that Jesus was born between 8 and 6 B.C.[1] Accordingly, the estimate "about

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[1]Note 1, p. 139: From the story of the star of the wise men, follows 7 B. C. as the year of birth. The solution of this problem given by men in my book, "Messiah's Star", Leipzig, 1922, is based on facts completely eliminating Hypothesis after I had succeeded to prove from the abundant source of material covering a period of over 2,000 years, that the star spoken of in the Gospel has existed. My astronomical calculations are verified by Ginzel.

30 years " does not allow to set the beginning later than 28; for in 29 or 30, Jesus was already 34-37 years old, and that was not called "about 30". The character of an author like Luke who "having fully followed all accurately from the very first to write to you consecutively" should receive due appreciation. After careful investigations, he had learned of the three important dates: The birth of Christ at the time of the registration of emperor Augustus--the appearance of the Baptist in the 15th year of Tiberius--the statement about the age "about 30 years". It would be an absurdity to bring Luke in contradiction to himself. Having fixed the beginning of Jesus in this indirect form to 27 or 28, he thus decided that he had reckoned as from the beginning of the coregency. This he could do according to the legal status in Syria.

The first year of Jesus, according to the Gospel of John--After the baptism, the temptation, and the election of the disciples, when Jesus was in Jerusalem, on a Passah, with regard to him the Jews said: "46 years was this temple in building, and wilt thou rear it up in three days?" (Chap. 2:20) What year do these words fit? After repeated examinations of the sources, (St. Josephus and Dio Cassius), Zahn and Schurer have found that the building of the temple was begun in winter of 20-19 B.C., and that on January 28 A.D., the 46 years had elapsed. Since the Jews there in the temple before Jesus obviously counted the current year for full, that debate on the demolition and construction of the temple took place on Passah 27[2]. Consequently, 3-4 months earlier in January 27, the baptism had taken place, and the beginning of the Baptist in the year 26. The opinion that "in the 15th year of the reign of emperor Tiberius" includes his coregency, thus has received five confirmations: a few coins, the authors known to Clemens, furthermore, Hippolyt, then Luke himself by his statement "about 30 years" and indirect, John in the note 2:20 just discussed.

3. In what year, therefore, did Jesus begin his ministry? From the statements

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[2]Note 2, p. 139: The latest investigation by E. Power S. J., editor of the periodical "Biblica", 1938, after some wavering, came to the result, that the interpretation of the Greek texts--John and Josephus--which is to be considered the "valid" leads to the year 27 regarding the 46 yrs. of the temple building.

of the four evangelists follows that he began a few months after the Baptist: Matt. 3:1-13; Mark 1:4-9; Luke 3:1-21; John 1:19. Again we allow all possibilities to stand: John the Baptist began "in the 15th year of the reign of emperor Tiberius". That can mean (a) the year from August 28 until August 29, or (b) the year 28, or (c) the year 29, or (d) the year 26. Accordingly, Jesus began in January either according to (a) and (b) of the year 29 or according to (c) of the year 39 or according to (d) of the year 27. Besides there is (4) according to John 2:20 of the year 27 (or 28).

4. How long did Jesus' public ministry last? After the baptism and the 40 days of temptation, Jesus preached for the first time in Nazareth; from here he moved to Capernaum where he chose the first disciples, took part in the wedding festival in Cana, and went to Jerusalem for the Passover (John 2). These events may cover 3 to 4 months, or rounded off to ¼ year.

Although the synoptics mention but the one Passah when Jesus was crucified, still they show distinct traces of an activity of several years; compare especially Luke 13:6-9 and verse 34. An exact outline offers us the Gospel of John: Chapter 2, the Passover which Jesus passed in Jerusalem, chapter 6, the Passah Jesus passed in Galilee, chapter 12, the Passah of the death. Between each two Passah festivals was one year. In chapter 5:1, there is yet one more festival to be determined. Jesus was in Jerusalem at the time, and among others, healed the paralytic of 38 years illness. The course of all preceding and following events is quite clear from the following texts: John 2:13-23; 3:22; 4:1-5; 4:35; 4:40-46; 5:1; 6:1-4. After the first Passah, Jesus remained a few weeks in Jerusalem, probably beginning in May, then stayed for considerable time "in the land Judah". On his return journey to Galilee, he stopped in the City of Sichar, and that was in January (4:35) of the following year. After that, he was in Galilee for some time (4:43-54) in the month of February. "After these things, there was a festival of the Jews and Jesus went up into Jerusalem". (5:1) This follows by the Passah (6:1-4) which he passed in Galilee. Earlier it was assumed often that that festival was the Purium. It was but four weeks prior to the Passover. If so, Jesus would have gone in March from Galilee to Jerusalem, and in April--probably even the end of March--again to Galilee for the Passah. Accordingly, the interval between chapter 5 and 6 would have amounted to but a few weeks. That, however, is quite out of the question. For the events in chapter 6 show us Jesus at the height of his ministry in Galilee. Drawn by his deeds of healing, thousands accompanied him, wishing to make him king. The apostles have long been chosen, and a recurrent movement is beginning to make itself felt. (6:6 and on) All this can be but the result of a preaching and healing activity over a period of months. So the festival was not Purium. This follows too, from the tradition of the text. In a great number of manuscripts, 5:1 reads: "it was the festival of the Jews". This usage which we find also in the old Testament and with Josephus, referred exclusively to the Feast of Tabernacles. Compare also John 7:2. The church fathers, in dealing with the contents of chapter 5, call it the festival of the Passover. This is compatible with an especially valued manuscript which reads, "it was the feast of the unleavened bread" (It was not customary to go to Jerusalem for the Purium.:

Accordingly, we have obtained the following brief outline:

5. The duration of Christ's public ministry--3-4 months as from the baptism until the first journey to Jerusalem.

First Passah: Jesus in Jerusalem, John 2.

Second Passah: More likely Feast of Tabernacles. Jesus in Jerusalem, John 5.

Third Passah: Jesus in Galilee, John 6.

Fourth Passah: Crucifixion

Altogether in round figures, three and one quarter years.

By adding these to the years 27, 28, 29, and 30 ascertained as the starting point, the clear result is that the year of the crucifixion must have been one of the four: 30, 31, 32 or 33. Every other, earlier or later, is out of consideration.

6. Following the example of others, I have earlier made use of the year of the conversion of the apostle Paul in order to find a terminus ad quem for the crucifixion. In case, for instance, it were certain, that the event on the street to Damascus had taken place in the year 32. Then only the years 30 and 31 could come

into consideration for the crucifixion. But according to the present status of research --for instance, Th. v. Zahn, A. v. Harnack, Deissmann, Wohlenberg--the conversion of Paul can have taken place in one of 6 years, 31-35. Harnack holds to 31 or 34 adding: "33 also must be left open". Zahn, on the contrary, holds to 35. But these two leaders have figured out that 30 was the year of the crucifixion.

7. The day of death was a Friday. (See Matt. 27:62; Mark 15:42; Luke 23:54; John 19:14, 31, 42. The technical expression for this week day was which in some modern languages still lives as paraskeve, parascéve. It means "preparation, getting ready", hence in our Bible, "Preparation Day". Mark 14:52 elucidates this to "the day . . . .".

8. <u>Passah, Feast of the unleavened bread, Azyma. About the origin, significance and customs of the festival</u>. (See Exodus 12;34:18; Lev. 23; Num. 9, 28; Duet. 16. The name Passah, came from the Hebrew Pesach (passing over), and immortalise (perpetuate) passing over the Israelite houses which were marked with the blood of the lamb. (Exodus 12:2-14) On the 14th day of the first month, the lamb was slaughtered and prepared and "eaten between the two evenings". This means either the time between the sun's going down and sunset or the time as from sunset until darkness. The beginning of the evening formed the end, and its closing the beginning of the other day. The Passah meal lasted from the 14th into the 15th Nisan. This was followed by "the seven days of unleavened bread", "mazzoth, But as early as the 14 Nisan, no other than unleavened bread was allowed to have in the houses, so that this was considered as the first day of unleavened bread. (See Matt. 26:17; Mark 14:12. The two names of the festivals as early as in the time B.C. were no more strictly discriminated. The whole festival often was called Passah or merely feast of the unleavened bread. This varying usage of the names is amply proved in the Old and New Testament. Also with Josephus it is found.

9a. The day on which Jesus held the Passah Feast (Last Supper) is determined by Luke and Mark in a most precise way. "Then came the day of unleavened bread, when the passover must be killed." Luke 22:7. --quite unequivocal the 14. Nisan.

"On the first day of the unleavened bread, when it was customary to sacrifice the Passah." Mark 14:12 In the original this is expressed by the imperfect tense, but unfortunately in the German translation it is not. Thus Mark refers twice to the 14. Nisan in this text: (1) "on the first day of the unleavened bread", (2) "when it was customary to sacrifice the Passah." The latter is found also in the old Latin version quando immolabant. The Peschittha and a north Egyptian translation each have the present tense: "When Passah is sacrificed." It is impossible to designate that day still more plain than these five texts have done it. There is no mistaking it that Mark and Luke wished to avoid every obscurity. Their words are synonymous with the date "on 14. Nisan". (Less clear is Matt. 26:17.) Thus we have gained a distinct calendar:

14. Nisan, Thursday, on the eve of the Passah feast

14-15 Nisan, in the night: Gethsemane, arrest

15 Nisan, Friday: Trials, Verdict, Crucifixation, Burial

The reliability of this synoptic report has been challenged sometimes in one direction. According to the prohibition given in the Mischna, the two trials before Hanna's and Caiphas' were not allowed to have taken place on Friday, for it was on a festival. First of all, picture to yourself the course of events: The party of the high priest long since had firmly decided to make away with the hated adversary; unexpectedly soon, the traitor delivered him into their hands in the night from Thursday to Friday. What were they to do now? Their trials were finished when the day broke. All the rest was for the governor to settle. Besides, it is more than questionable whether that prohibition is from the time before Christ, for the facts repeatedly reported in the New Testament directly contradict it. In Christ's time, measures or interventions by the police, judicial proceedings, even the execution of capital punishment took place on the Sabbath itself. (See Matt. 12:14; Luke 4:29; John 7:30, 32, 44, 52; John 8:59; 9:13-34; 10:31, 39.)

So the synoptic dating stands.

9b. Has John given the 14 or 15 Nisan as the day of the crucifixion? Above is shown that with him as well as with the synoptics it was Friday. (See Numbers 7.)

Now he calls it, "Preparation day of the Passah". Numbers 19:14. This erroneously has been interpreted as the preparation day <u>for</u> the Passah, thus making this Friday the 14 Nisan. But the <u>paraskeue</u> used there was the only customary expression for Friday, found everywhere in the New Testament as well as in the Greek Old Testament. Also twice in the same chapter 19, verses 31, 42. There was always a Friday in the seven day festival and that one was meant there.

On this day, Pilate spoke to the Jews, "it is your usage that I should be releasing one to you in the Passover. Do you wish that I release to you the kind of the Jews?" 18:39. He did not say "<u>about</u> the Passover", nor "<u>for</u> the Passover", but rather "<u>in</u> the Passover". i.e. within, during the Passover. Had that been on the morning of the 14 Nisan on the afternoon of which day the Passover feast was to be prepared, Pilate hardly would have said "<u>in</u> the Passover". His words characterise Friday as the 15. Nisan, which was in the festival.

The opinion that according to the fourth gospel, the crucifixion is to have taken place on the 14 Nisan and that this was the Friday is based mainly on two texts. In chapter 13, the last supper is mentioned which Jesus had with the twelve before his arrest. In this connection, no mention is made of the Passah rites. And then, after the last discourses in chapters 14-17, and after the arrest in Gethsemane, and after the first trial," then they led Jesus from Caiaphas into the Pretorium lest they may be defiled, but may be eating the Passover." If here the eating of the Passover lamb was meant, then it was on the morning of the 14 Nisan, then the meal of chapter 13 was not the ritual Passah feast, and the crucifixion was on 14 Nisan. The counter- arguments are telling.

(a) The fact that the Passah rites are not mentioned is on a level with a number of similar cases. John does not mention the establishment of the holy communion (nor of baptism), nor further, the prayerful struggle in Gethsemane, the falling asleep of the disciples, Judas' kiss, the trial before Caiphas, Christ's oath that he was Christ, the son of God. It is the known characteristic trend in the passion stroy of the fourth gospel. The passing over of various events means agreement with the synoptic reports. Nor does John's report differ from that of the synoptics, (John too, does not report differently from the synoptics.), that the day of death was a Friday, and that on the evening before the Lord had the supper when he designated the traitor.

(b) The defilement the Jews tried to avoid helps to make the date clear. If the scene before the pretorium had taken place on 14 Nisan, a defilement committed early in the morning, could very well be atoned until the afternoon. That, however, was impossible on the 15 Nisan, which was a high day of the festival with a meal having the character of a thank offering.

(c) The Jews did not wish to become defiled "in order that they could eat the Passover". What did Passah mean in the language of Jewish worship? "Passah took place"--"Passah was prepared"--It was the Passah--"Passah was arranged"--these are the customary expressions in the Bible, and also with Philo and Josephus. i.e. the feast or rather the meal was mentioned, but not the animal. By metonymy, the meaning of the word Passah was widened, as is evident from the expressions, "they cooked the Passah"--"They roasted the Passah on fire"--where it refers to the animal. But in other expressions, "they slaughtered or sacrificed the Passah", again reference is made to the festival which is clear from the expression "they slaughtered--sacrificed--the festival"; the latter expression is used by Josephus. Another widening of the meaning "Passah" is found in Deuteronomy 16:2, where it reads "and thou shalt therefore sacrifice the passover unto the Lord thy God, of the flock and the herd, in the place which the Lord shall choose to place his name there." This could not refer to the meal of the 14 Nisan, where merely a lamb was eaten, it rather referred to the thank offering meal. The majority partook of this on the 15 Nisan, yet one could partake of it also on the other days of the festival. It is no different with the word "to eat the Passah". In one place the Mischna reads: "The Passah of Egypt was eaten in haste and at night and the Passah of the generations (i.e. the repeated celebration in after-times) was customary for seven days".. This corresponds exactly with II Chronicles 30:22: "and they did eat throughtou the feast seven days, offering peace offerings, and making confession to the Lord God of their fathers." The same by Josephus, in the Targumen and by Hieronymus.

Here it means always the meal of the festival, which could be eaten on each of the seven days; nobody was to avoid it, it was to be eaten "with joy", and according to tradition it usually took place on 15 Nisan[1]. Thus the dread of the Jews to enter the pretorium on Friday morning, 15 Nisan, is understandable. To sum it up, Luke and the fourfold text in Mark express in the most distinct and clearest form that the Lord with his disciples held the ritual Passah meal at eve of the 14 Nisan. The statement in John's gospel, it must be admitted, is not quite clear; but the meaning of it could be shown from the expressions used in worship, and it proved the harmony in the dating in the four gospels. Hence the calendar remains in tact: the 14 Nisan a Thursday, the 15 Nisan, Friday, the day of the crucifixion.

The last objection against this date.--It is asserted that Friday of the crucifixion is given by the synoptics as the 14. While by John as the 15 Nisan, and furthermore, that both dates are correct; for in those times it could happen that one weekday had two dates of the month. This is an hypothesis by Jechiel Hichtenstein 1913, D. Billerbeck in the Commentary to the N.T. Father J. Schaumberger manifests a strong tendency towards this hypothesis in "Biblica", 1928. As shown by Johannes Hundius in his excellent work, "The Old Jewish Sanctuaries", Hamburg, 1701, it was strongly discussed beginning as early as in the time of the reformation. Its originator is supposed to have been the bishop Paulus von Burgos, a convert from Jewry, 1435. Among the points supporting this hypothesis, a single one is fit to make it credible. I quote according to Schaumberger from the Mischna tract Sanhedrin 5.3: "if two witnesses in dating an event differ by one day of the month, still their witnessing is valid, for it is possible that both mean the same day and only reckon the beginning of the month differently." Schaumberger does not offer an explanation for such a calendar curiosity.

10. The twofold dating of the same day was the natural result of the calendar system of the time. It is supported by many facts discussed in the Mischna and very easily explained. To begin with, I choose a case as follows: "if the court of

[1]Note 1, p. 144: Compare E. Baueth to Mischna Pesachim VI. 3, Note 24.

justice and all the people of Jerusalem have seen the new crescent of the moon on the 29th of the month soon after sunset, but due to some hindrance the 30th day too, has elapsed, i.e. the full night to the 31st has begun without the tribunals, but pronounced the sanctification, the past month then is inserted as a full month of 30 days, though according to the new light observed, it should have but 29 days." (See Rosch Haschana, also E. Baneth). This official dating was followed in Jerusalem and in regions which could be reached by messengers; but in other places where messengers did not get the dating was done according to the new light--thus the same day received a double monthly date.

The reverse also happened. After sighting the crescent on the 29th at eve in Jerusalem, the 30th day was made the first. Yet in other places where neither on the 29th nor on the eve of the 30th the crescent was seen, according to old custom, the month was given 30 days so that the 31st became the first. In this case, too, one day had two dates.

But the most odd or strange cases of "dating back" occurred when due to failing new light the 31st day had been made into the first and on the 4th or 5th day, witnesses appeared who had seen on the eve of the 29th. If they were able to maintain their testimony through the most severe trial of the tribunal, the latter was compelled to date back 4 and 5 days respectively. All who learned of it, dated the days through the month correctly, who did not hear of it, differed by one day. These matters were public. Everybody knew that because the new light had been seen here, there, it had been invisible, the result was the difference in the date by one day. So the judicial principle referred to. It was therefore customary in order to avoid errors, to state on documents by the side of the date also the day of the week. In the Diaspora for the same reason it was customary to hold the 30th as well as the 31st as Rosch Chodesch (First of the month). The following case shows how intent the effort was to prevent the double dating. New year's day was the 1 Tishri, the month prior to this was named Elul. If on the 29th Elul at eve the crescent was not sighted, the tribunal waited all day of the 30th for witnesses for the new light from outside. Yet this 30th day was celebrated as new year's day. Did no witnesses arrire, this 31st day was reckoned as 1st Tishri, and a second new year's day was celebrated in Jerusalem. The official reckoning of the Tishri days, i.e. beginning with the last named day, was spread far and wide by messenger; so the uniform dating of this festival month existed in the regions reached by messengers.

All these unavoidable happenings had brought about in very early times in the provinces and still more in the diaspora the custom to celebrate the great festivals on two succeeding days (except the day of atonement because of the strict fast). For only in this way was it possible to carry out the principle that the whole of Israel had one common festival day. This principle was traced back to the holy origin of the feasts. Maimonides II, 10 presents it as follows: "Everything is under the obligation to arrange the feast and festival days according to the day sanctified as the new moon . . . . and everybody who was told to observe the feasts, is obliged to rely on the judicial court, for it is written in the Scriptures: "These are the feasts of the Eternal which you are to call out in order to be able to celebrate time in this time". The messengers who were to announce everywhere the beginning of Nisan, were not allowed to leave the meeting place of the court of justice until the chairman had spoken the word "sanctified" (Rosch Haschana 21b; Maimonides II, 10), in order to have the days of the Passah and the unleavened bread uniform in all regions. What in this way was accomplished outside, still more was on holy duty in the center of Jewry; celebration of the Passover supper on the same evening. A double reckoning of the Nisan days, a double Passah day in Jerusalem was completely out of the question.

So our task remains as before: To find out from astronomy, in what year the 14 Nisan fell on a Thursday, the 15 on Friday, and which dates these were according to our calendar.

II. Passah and Full Moon. On the strength of the fact that in ancient Christian times the first full moon after the spring equinoktium was counted as the 14 Nisan. Theologians--for instance Achelis--have sometimes requested of astronomers, to figure out the spring full moons of those ten years. The result was the following:

In the year 27 on Wednesday, April 9

In the year 28 on Monday, March 29 and Tuesday April 27

In the year 29 A.D., on Sunday, April 17

In the year 30 A.D., on Thursday, April 6

In the year 31 A.D., on Tuesday, March 27 and Wednesday, April 25

In the year 32 A.D., on Monday, April 14

In the year 33 A.D., on Friday, April 3

In the year 34 A.D., on Tuesday, March 23 and Thursday, April 22

In the year 35 A.D., on Monday, April 11

In the year 36 A.D., on Friday, March 30 and Sunday, April 29

The last three years do no more come into consideration for the chronology of Jesus.

The result is surprising. According to this, whoever accepts the dating as stated by John as the correct one, accordingly could explain but the year 33 as the one of the crucifixion because there the 14 Nisan by the full moon is fixed to a Friday. But whoever holds to the other dating--the 14 Nisan on a Thursday and the 15th on a Friday--if he goes by the full moon, cannot but take 30 as the year of the crucifixion. All the other years are out.

But according to the calendar system, the ascertainment of the full moons cannot solve our problem. For instance, on the eve of April 3, 33, the full moon began at $17^h\ 14^m$. There, first of all, we cannot know that was the 14 or already the 15th day! The Passah festival began in the afternoon of the 14 day, which was dependent on the new moon, or rather new light. The interval from new moon to full moon is very variable. For the years 28, 29, 30 A.D. and the months January to April inclusive, it is easy to find from Ginzel's tables that each interval in the minimum was 13.94, but in the maximum 15.57 days. (Accordingly, it is in all years.) So the full moon appeared sometimes 14, sometimes 14½ or 15, and even 15½ days after the new moon. On the average, however, the Jewish month began one day after new moon; occasionally also 1½ days, as will be shown shortly. From this, it is evident that the 14 day decreed for the Passah observance, sometimes came 15, may be even 16 days after new moon, and that only occasionally it coincided in an astronomical sense with yes!

with the full moon. Never!

12. In more recent times, occasionally, it has been asserted--lately by F. Westberg, Riga, 1910--the Jews were in possession of the constant calendar as early as in the times of Christ. E. Schurer, F. K. Ginzel and many others have rejected this. The endeavors of Rabbis Juda Hanasi of about 170 A.D., Rab, Jochanan, Mar Samuel Jarchinai 160-250, Adda bar Ahaba, Hillel II, who lived still later, created the basis of the constant calendar. It was introduced about 300 A.D. Fixed Calendar

13. The Postponements--According to the constant calendar, New Year's day must not come on a Sunday, Wednesday, or Friday. The first day of Passah must not come on a Monday, Wednesday, or Friday. If now, according to the course of the moon, the 1 Tishri would fall on a prohibited day, then New Year's day is postponed by one day. It is proved from the Mischna-tracts (Sabbath XIX, 5; Menachot XI, 7; Rosch haschana II, 1), also from the Tosefta and Gemara that these postponements were carried out only after Christ's time. More about this by Zuckermann, Sidersky, p. 660, and Schaumberger in the magazine Biblica, 1928.

14. The Intercalation and the position of Nisan--The shortest Jewish year consisted of 352 days (8 months at 29 each; 4 months at 30 days each). The longest year consisted of 356 days (reversed, 4 months at 29 days; 8 months at 30 days). Accordingly, the average length amounted to 354 days. i.e. The year was short by 11 days of the course of the sun. In three years, it amounted to more than a month. If, for instance, in one year, Nisan coincided with our April, three years later, it would have begun in February, and Passah would have come before the middle of March. For cultic reasons, this was impossible. The animals to be immolated had to be developed according to set rules. On the 16th Nisan, the barley--first fruit offering--had to be presented, and 50 days later, the offering of the fruits of the trees had to be presented. Therefore, the Sanhedrin in the last month, had to convince itself of the status of the harvest and the fruits of the trees. After a negative result of this investigation, a whole month was inserted. It followed the twelfth month Adar, and was called

Veadar. The principle for the intercalation read (Sanhedrin II, 2): "Upon three signs the year is declared as intercalary: the ripeness of the grain, the fruit of the trees, and the Tekupha (Equinoctium);on the strength of two, the calendar can be fixed, but not on a single one." This astronomical condition means: The festival month Nisan must be so placed, thetthe vernal equinox had taken place before the Passah. And Ginzel repeatedly found the confirmation with Aristobul, Philo and Hosephus, that Passah was observed "when the sun was in the Aries". But for the intercalation, as thus also for the position of the Nisan, the astronomical momentum was not decisive, but rather, one of the agricultural conditions--ripeness of the barley, and the fruit of the trees--had to be added. (It therefore was an error when Sidersky fixed the beginning of Nisan and the position of the Passah exclusively after the equinox.) Read for Intercalation

When does barley ripen in Palestine?--The climatic conditions are so variable, that in the favorably situated territories round about Jericho, the harvest begins almost 4 weeks earlier than in the mountains of Judah. "The territory at the lower Jordan around Jericho has almost tropical climate, and partly a tropical vegetation. There, the barley harvest often begins the end of March." (Vogelstein, p. 58; Benzinger in the P. R. E. I. 137; Baedecker, G. Ebers and Guthe I. 144 and others.) If we reconstruct the then calender on the basis of the new moons, Nisan must come in such a position, that the feast days of the 14 and 15 at the earliest, fall the end of March[1]. But a new moon the beginning of March can only introduce Adar or Veadar.

15. The Jewish month and the course of the moon--God has "made the moon to determine the time". (Ps. 104:19, where our (Luther's) translation (free translation) reads: "God has made the moon, to divide the year by it".) How closely

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[1]Note 1, p. 148: According to the tract Menachot X, 2. Sometimes they were at a loss to get ripe barley for the offering on the 16 Nisan.

the calendar followed the course of the moon, we recognize from the following facts:

(a) From New moon to new moon, 29½ days elapse. The months had 29 or 30 days, never more and never less.

(b) The form of expression so often repeated in the Mischna, "if the moon is seen at the time", designates each time the sighting of the moon at the end of the 29th day.

(c) There were years with 8 months at 29 days, and 4 months at 30 days each-- such a year of 352 days was behind by 2 days of the 12 times--change of the moon.

(d) Sometimes two months of 29 days each followed immediately one upon the other. Together they were shorter by one day than two-times change of the moon.

16. <u>The Newlight</u>--If on the evening after the conjunction, the crescent again appeared, this was considered as the sign established by God, according to which, the new moon had to "sanctified". The new moon feast was celebrated, which is mentioned often in the Bible. The new light appears in the evening twilight on the western sky near sunset, mostly low on the horizon. Its visibility depends on different factors.

(a) <u>As to the horizon</u>--Whether it is clear or cloudy; whether the atmosphere is pure or vaporous; whether the twilight is long or short.

(b) <u>As to the place of observation</u>--Whether it is on a high mountain or in the plains, and in what geographical latitude.

(c) <u>As to the lunar orbit</u>--Whether it is in the perigee or apogee (in the former case it moves very fast; in the latter, very slowly). Furthermore, how many degrees above or below the ecliptic (i. e. the geocentric latitude of the moon). Finally, how wide its crescent is. "In the spring", says F. X. Kugler, "the ecliptic rises in a steep line, while in the fall, it forms a considerable pointed ~~corner~~ angle with the horizon. The result of it is that after the conjunction, the moon--given the same width of the moon and the same elongation--<u>goes down much quicker in the fall than in the spring</u> . . . . and that <u>the time between new moon and new light</u> is greater in the fall, in some circumstances much greater than in the spring."

The conditions under (b) and (c) can be figured out mathematically. Contrariwise, we are completely helpless before the factors named under (a). A cloudy sky can hide the moon completely. The narrow crescent which appears the first evening like a fine luminous thread can become invisible through a light dimness of the atmosphere. That is why in some territories of the same geographical latitude, one observer sees the new light, but the other does not. Finally, at times in the evening glow, there are seen fine reddish stripes similar to the bright and fine thread of the crescent, which deludes the observer, even the experienced one. The Mischna reports sufficient cases of wrong new light observations, and gives the necessary hints how to examine the witnesses in order to arrive at the true facts.

But the Jews did not start with narrow crescent.

The absence of the new light forms the first unknown quantity in the problem to reconstruct the Jewish calendar of those years. Though the climatic conditions of Palestine guarantee a clearer horizon than ours, though on an average, there are only about 50-52 rainy days besides several snowy days. Yet the fact that the rainy days are just in the months October until the beginning of May suffices to prove how often the new light can be wanting. (One of my informants, a teacher in Jerusalem, did not see in 1928 the new light four times in succession, due to a cloudy sky.) Maimonides calls attention to the fact that the crescent cannot become visible in all months. This possibility is not often to happen, "But do not believe, that such a case is impossible."

When the monthly observation was frustrated on account of the weather, it was customary to have a 29-day month follow a 30-day month. This is evident from the tracts Rosch haschana and Erachin.

Beginning with the time when the calendar scientists knew the duration of the lunar ecliptic, they began to standardize by calculation, the end and beginning of the months. For this, too, the tracts named, as well as the Sanhedrin, provide many clues. Gamaliel, teacher of the apostle Paul, was in possession of a tradition from the house of instruction of his grandfather according to which the course of the moon took $29\frac{1}{2}$ days, 2/3 hours (and 73 parts), and that the moon at times was moving faster, and at times slower, so that the interval between new moon and new light is of unequal duration. This astronomical knowledge enabled the judicial court to examine and eventually reject as erroneous, the statements of the witnesses who had first seen the crescent. (Maim. II, 4)

At the turning point of the time, the calendar council was making use of observation and calculation alternately. "It is a law of the Thorah, that the court find out and know whether the new moon will be seen or not."--See Maimonides I, 7; compare further I, 6, 8; II, 4; XI, 1 and more often.

The new moons of those days are worked out most exactly by the excellent Ginzel. 'See Handbook of mathematics and technical chronology, Volume 2). But how many hours after the conjunction does the new light appear?

17. How do we determine the appearance of the new light?--From the two facts that at times two months of 29 days each followed in succession which therefore were shorter than twice the course of the moon by a whole day, and that further a year could (and did) have 352 days, which is two days shorter than the 12-times course of the moon; it follows that from the new moon to the new light; often considerable less than 24 hours elapsed. A. Schwarz has proven from the Mischna (p. 31, 1) that the Rabbis, who supplied the basis for the constant calendar, reckoned with an interval of at least 18 hours. It was, of course, known that it could be considerably longer.

III The parchments of the 5th century B.C., found in Assuan, contain Jewish dates of months, which Ginzel has examined. In two cases, the new light had appeared after 24 hours. In two other cases, after less time. Ginzel succeeded in making a similar find from three equations of dates in Ptolemaus' Almagest. The new light had appeared after 22 hours.--Epping found in texts in cuneiform characters an interval of 19 and 18.8 hours.--In the months of February, March, April and May, 1918, I had my oldest sons and their fellow-soldiers carry out a number of observations in Northern Palestine, Syria and Northern Arabia. The result was that in 23 successful cases, the crescent was seen $29\frac{1}{2}$, 27, 26 and on

March 13, as early as 20 hours after the conjunction. This latter result was reported to me by three observers of Aleppo and vicinity. On March 22, 1938 in the territory of the Carmel and near Kubebe-Emmaus, the six observers saw the new light when the moon was 19.1 hours old. (Biblica, 1928). J. K. Fotheringham published (in Observatory, Oct. 1921), the results of 14 places of observation--14.5--26.1 hours interval. The first (14.5) from Equatorial territories--Sir G. B. Airy figured out the minimum for Jerusalem 18 hours (See Observatory, 1911). This was confirmed by Dr. Downing. Ideler, Wurm, Wieseler, Caspan, and Ginzel take 36 hours as the maximum. Gerhardt, Oswald, "Astronomische Nachrichten," Band 240, pp 150, 151.

Let us first apply these results to April 33 A.D. New moon was for Jerusalem on Thursday, March 19, $1^h\ 23^m$ noon. If on the next evening, (i. e. on March 20, after 29 hourse the moon was seen, which is very well conceivable), then the day beginning that evening was sanctified as the "first" of the new moon. We take it that it was the Nisan. So the 1 Nisan corresponded to our March 21, Saturday, and the 14 Nisan, beginning of Passah, fell on Friday, April 3. That would merely be a support to the so-called date after John. But what, if on March 20, the sky was cloudy? Then everything was shifted by one day: 1 Nisan--Sunday, March 22; 14 Nisan--Saturday, April 4. Thus every relation of the year 33 to the Passion with this possibility must be reckoned.

The fluctuating interval as from the conjunction to the new light--18 to 36 hours--presents the second uncertain quantity in our project.

This procedure, to fix the beginnings of the months in that time according to the intervals, is applied to day only in cases when an approximate result suffices.

18. Since about 20 years, another method is used in determining the new light. Its author is J. K. Fotheringham. To improve it, Maunder, C. Schoch, and P. V. Neugebauer have worked. The basic thought is so to speak self-evident. At sunset the moon, which receives her light from the sun, must beat a certain distance from the latter and stand at a certain height above the horizon in order to be visible. My sketch which Neugebauer kindly verified may serve as an

illustration.

The horizontal line indicates the horizon. S is the place where the center of the sun would be if the refraction is not taken into consideration. The upper figure indicates the height of the moon (M) above the horizon in degrees. The dotted lines mark the vertical circle where the moon stands, illustrating each distance between sun and moon (the azimuth differences). These distances are given in degrees, 0-23 on the horizontal line. In the first case, the moon is on the same vertical circle as the setting sun. Hence the distance 0°. On this evening, the minimum height necessary for the visibility of the lunar crescent is 10°.4. The greater the distance between the two celestial bodies for the new light, the lower need be the height of the moon. It amounts to but 4°.8 at a distance of 23°.

(a)--Azimuth difference sun--moon

(b)--Minimum height of the moon for visibility

(a)	(b)	(a)	(b)	(a)	(b)
0°. . .	10°.4	8° . . .	9°.5	16° . . .	7°.7
2 . . .	10 .3	10 . . .	9 .3	18 . . .	7 .0
4 . . .	10 .1	12 . . .	8 .9	20 . . .	6 .2
6 . . .	9 .8	14 . . .	8 .3	22 . . .	5 .2
				23 . . .	4 .8

This table shows the connections between the two factors guaranteeing the visibility of the new light. (According to Neugebauer, Astron. Chronology, II, 1929)

This procedure, too, contains an uncertain quantity. Picture to yourself how small a degree curve on the sky is, and how minimal a tenth of a degree. According

31

12. Jan.	1^h	23^m	2	14. (15.) Jan.	--I. Schebat		29
10. Febr.	12	55	2	12. (13.) Febr.	--I. Adar		30
12. Marz.	1	9	2	14. Marz.	--I. Nisan	od. I. Veadar	29
10. April	14	7	2	12. (13.) April	--I. Ijar	od. I. Nisan	30
10. Mai	4	31	2	12. Mai	--I. Siwan	od. I. Ijar	29
8. Juni	19	38	2	10. (11.) Juni	--I. Tammuz	od. I. Siwan	30
8. Juli	10	55	2	10. (11.) Juli	--I. Ab	od. I. Tammuz	29
7. Aug.	2	21	2	9. Aug.	--I. Elul	od. I. Ab	30
5. Sept.	16	31	2	7. (8.) Sept.	--I. Tischri	od. I. Elul	29
5. Okt.	5	43	2	7. Okt.	--I. Marcheschwan	od. I. Tischri	30
3. Nov.	18	11	3	6. Nov.	--I. Kislew	od. I. March.	29
3. Dez.	5	57	2	5. Dez.	--I. Tebet	od. I. Kislew	30
							29
							388

32

1. Jan.	16^h	45^m	3	4. Jan.	--I. Schebat	od. I. Tebet
31. Jan.	3	4	2	2. Febr.	--I. Adar	od. I. Schebat
29. Febr.	12	55	2	2. (3.) Marz	--I. Veadar	od. I. Adar
29. Marz	22	59	3	1. April	--I. Nisan	
28. April	9	33	1	29. (30.) April	--I. Ijar	
27. Mai	21	47	3	30. Mai	--I. Siwan	
26. Juni	11	57	2	28. (29.) Juni	--I. Tammuz	
26. Juli	3	19	2	28. Juli	--I. Ab	
24. Aug.	19	38	3	27. Aug.	--I. Elul	
23. Sept.	12	26	2	25. (26.) Sept.	--I. Tischri	
23. Okt.	4	2	2	25. (26.) Okt.	--I. Marcheschwan	
21. Nov.	18	40	3	24. Nov.	--I. Kislew	
21. Dez.	7	52	2	23. (24.) Dez.	--I. Tebet	

33

19. Jan.	18^h	55^m	3	22. Jan.	--I. Schebat
18. Febr.	4	45	2	20. Febr.	--I. Adar
19. Marz	13	23	2	21. (22.) Marz	--I. Nisan
17. April	21	47			

20. In the year 29, in Jerusalem was new moon on March 4, 3^h 4^m in the morning. 39 hours later, on the evening of March 5, the new light could be seen. The height of the moon was 16°. The azimuth difference 7°; both very favorable. Then the first day of the new month conincided with March 6, Sunday. It could not have been Nisan, because then the 14th and the 15th fell on the 19th and 20th of March (Saturday and Sunday) which was too early for the Passah. So on March 6, the intercalary month Veadar began.--Next new moon on Saturday, April 2, 7^h 52^m at evening. Height and

distance of the moon need not be reckoned with, because the two possibilities are clear: New light either on the evening of the third or the fourth of April. Accordingly, either 1 Nisan=April 4, Monday; 14 Nisan=April 17, Sunday; or 1 Nisan= April 5, Tuesday; 14 Nisan=April 18, Monday. If due to cloudy sky, the crescent could not be seen on those evenings. Then the ending month was given 30 days, and ended on April 4, and the 14 Nisan was on Monday, April 18. In view of these clear results, the year 29 is quite out.

21. <u>The Year 30</u>. We count 12 months from the 1 Nisan 29, and determine the Adar in the year 30 after the new moon of Feb. 21, $4^h\ 45^m$ in the morning. On the 22nd at eve, the moon was 36-37 hours old, so 1 Adar=Feb. 23 (same after Schoch according to his formulas), and the 29 Adar=March. 23. Next new moon, March 22, $8^h\ 21^m$ at eve (Ginzel). When was the 1 Nisan 30? A debate of decades has been waged around this determination.

(1) On March 23, the moon was 22-23 hours old, sunset $6^h\ 15^m$. Since the young crescent there is seen in March already at a much smaller interval, the new light can be fixed on March 23. So 1 Nisan=March 24; 14 Nisan=April 6, Thursday; 15 Nisan=April 7, Friday. These are the days of the Passion week. Thus had decided Wurm, Richter, Hontheim, the Holland Astronomer Oudemaus, myself and others. C. Schoch had pronounced this date as the correct one (Biblica, 1926), and that, not by applying the interval, but from his formulas for height and distance of the moon.

(2) J. K. Fotheringham found that on March 23, the height of the moon was but $9^\circ.3$ while it should be $11^\circ.9$. Therefore, he asserted that the 1 Nisan=March 25, and the 14 Nisan=April 7, Friday. Consequently, "the synoptic date of the crucifixion must be abandoned". Fotheringham called Schoch's attention to a mistake in reckoning $1\frac{1}{2}$hours, causing the latter to verify his calculation, and he found that on March 23, the height of the moon amounted to $9^\circ.3$, but should have been $10^\circ.2$ in order to guarantee the visibility. (Biblica, 1928, 9). Now, Schoch agreed with Totheringham's date, and stated, "that those are right who set the date of the Lord's death on the strength of the gospel of John on 14 Nisan". About the

date according to John's gospel and its agreement with the synoptic, see above No. 96. The possibility that on March 23, the moon could not be seen due to cloudy sky is weighed below under No. 21, 6.

(3) So far, it has not been examined by anybody how Nisan came in the year 30, if several times at each lunation, the sky were cloudy. I proceed from Sept. 29. On Sept. 26, new moon in the afternoon $2^h\ 35^m$; new light on Sept. 27 or 28; 1 Tishri on Sept. 28 or 29. If from then on, the new light failed to come, we must have 30- and 29-day months follow alternately. To begin with as from Sept. 28, 29:

1 Tishri--28. Sept. 1. Marcheschwan--28. Okt.
30 Tishri--27. Okt. 29. Marcheschwan--25. Nov.
1. Kislew--26. Nov.
30. Kislew--25. Dez.
1.Tebet--26. Dez. 1. Schebat--24. Jan.
29.Tebet--23. Jan. 30 30. Schebat--22. Febr.
1. Adar--23. Febr.
29. Adar--23. Marz
1.Nisan=24. Marz
14.Nisan= 6. April <u>Our looked for days</u>
15.Nisan= 7. April

If, however, the alternation of 30 and 29 day months proceeded with Sept. 29, then these dates shift by one day, and the last result is: 14 Nisan=April 7, Friday. In exactly the same way, I have made up a calendar according to above new moons beginning Oct. 26 and so on. The result was the same. Sometimes the 14 Nisan fell on Thursday, April 6; sometimes on Friday, April 7.

(4) Inasmuch as Schoch, according to his own mathematical calculations, at first agreed with my result, confirming it to me in several written statements, but finding later that according to his formula, on March 23, $0^\circ.9$ was lacking of the height of the moon, and since further, his new formula, the new light of March 23, 30 has proved to be inexact by $0^\circ.3$. I approached Neugebauer requesting him to figure out the astronomical factors and to criticize the situation. I am passing on his statement verbatim as a most valuable contribution.

"The astronomical data for the new light on March 23, 30 in Jerusalem (latitude $31^\circ.8$) are as follows: Sun (center) in the real horizon (without refraction). March 23, $6^h\ 8^m$ at eve. Jerusalem, meantime.

Moon length	$= 10^\circ.80$
Moon width	$= 3\ .96$
Sun length	$= 0\ .73$
Right ascension of moon	$= 11\ .49$
Declension of moon	$= 0\ .63$
Right ascension of sun	$A = 0\ .67$
Declension of sun	$D = 0\ .29$
1/2 diurnal arc of sun	$T = 90\ .18$ (without refraction)

Thus the hour angle of the moon = A T - a = $79^\circ.36$, and according to the known formulas for transforming the right ascension and declension in Azimuth and height:

Height of moon	$h = 9^\circ.37$
Azimuth of moon	$= 84\ .89$
Azimuth of sun	$= 90\ .35$
Azimuth difference	$= 5\ .46$

According to the condition stipulated by C. Schoch (compare Neugebauer, Astron. Chronology, 1929, 2, p. 23), the new light is visible when (if) at a Azimuth difference of $5^\circ.5$. The last light of the moon is $9^\circ.9$. Since here it is but $9^\circ.4$, theoretically the new light is not visible on March 23.

It is evident that the decision of the question is wholly dependable on the reliability of the accepted limit of the height of the moon. The values there used are the newest arrived at by Mr. Schoch on the basis of the "Carmel new light" (Biblica 1928). According to the older table of Schoch (in his "Planet tables for Everybody") the least height required was $10^\circ.2$. According to the new table, the moon now comes as near as $0^\circ.5$ to the theoretically required limit. This difference of a moon's semi-diameter is so small that one can well say that under favorable conditions, the crescent yet could be seen. The theoretical limit of $9^\circ.9$ is not absolutely dependable. This is also proved by the fact that Mr. Schoch was able to reduce the limit from $10^\circ.2$ to $9^\circ.9$ because of a favorable new light."

Thus for Neugebauer. Therefore, again I set as above: 1 Nisan=March 24; 14 Nisan=April 6, Thursday; 15 Nisan=April 7, Friday (the days of the Passion).

(5) Neugebauer rendered further support to me in the calculation of the "mean conjunction". The technical expression for this phase of the moon in the Jewish calendar was "moled". They had a simple mode on an empirical basis to figure out the appearance of the new light with the aid of the Moled. Mischna Rosch haschana, 20b, says: "One must figure out the moled. If it takes place before 12^h noon, then he knows that the new moon shall be visible after sunset. If it does not take place before 12^h noon, he can be sure that she (the new moon) shall not be visible after sunset". Similarly, Maimonides VII, 2: "If the Moled takes place before noon, though merely for one Chelek (i. e. a few seconds) then the Rosch Chodesch (i. e. the first of the month) is fixed for the same day of the Moled". In other words, if the mean conjunction begins before 12 o'clock noon, on the eve of this day, the new month begins.

The Jewish calendar scientists had gained this rule through a practice over centuries. Its application is simple: The mean conjunction--the Moled--took place, as Neugebauer has figured out[1], on March 22, 9.4 in the evening. Consequently, the new light could be seen the next evening.

Therefore, the 1 Nisan=March 24; 14 and 15 Nisan=April 6 and 7.

(6) A last fixation of the 1 Nisan 30, based on the Mischna, can be derived from the principle that was valid for the prolongation of a month: "Has the court, yes, even all Israel seen her (the new moon), or the witnesses had already been heard, but it had not been possible before nightfall to pronounce the word of sanctification, then the month is prolonged". (i. e. it gets 30 days). From this, follows that it does not prolong but rather that the 30th day became the first of the new month if the "sanctified" ensued before nightfall. This could happen "before the first star appears". (See the Mischna and accordingly Maimonides II,9)

This could have been the case on March 24, 30, if on the previous evening, the moon was covered. The situation was as follows: The height of the moon--figured out by Neugebauer--20° (10° above the theoretical limit). The moon went down 1 hour, 34 minutes after the sun; she stood high on the sky; was 46-47 hours old; had gained considerably in width, and so, provided the sky was clear, she was seen long before sunset (on March 24). It was known, that of the new revolution of the moon, two days had already elapsed. There was yet sufficient daytime (the day ended only at the appearance of one greater or two medium sized stars), in order to pronounce the "sanctified", (this could be done only in daytime), and so Adar was not prolonged, but this just closing day was sanctified as the 1 Nisan. So the result is the same calendar as before: 1 Nisan=March 24; 14 Nisan=April 6. Slonimsky and Pineles in the magazine Hamagid (Lyck, 1868) have had a controversy. Slonimsky furnished the proof in the following positive sense: "Was it on the

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[1]Note 1, p. 156: Neugebauer adds: "If by chance the mean new moon was at 6 o' clock early, and the disturbances amounted to 14 hours, then the new moon came at 8 o' clock, and the new light surely was not seen on this evening. Such cases, of course, are rare exceptions. But this rule could serve as a make-shift, because at the worst, the new light would fall one day later, and so could not cause a great error in the calendar."

30th day--when at eve the crescent was seen and everything found in order--the word "sanctified" was pronounced in the twilight before nightfall for the 30th day?" Slonimsky furnished the proof in the above positive sense. Pineles considered this sanctification unthinkable because in his opinion, the crescent could not be seen before the end of the day. This assumption is erroneous. For my statement, I am able to quote two more Jewish authorities, E. Baneth and B. Schwarz. The former bases his opinion on Rosch haschana III, 1. In April and May, 1918 in Nazareth, Damascus, and Aleppo, the new moon was seen by five observers at sunset. (i. e. in daytime). The same observation has been made by Prof. Alt in Palestine (according to his information, May, 1923). Schoch writes in <u>Biblica</u> 1928, "in the spring--February to April--every new light which is at least 34 hours old is visible in Jerusalem before sunset". Kugler II, 546, found in cuneiform texts, two cases, where "in Babylon, the duration of the visibility of the new light amounted to 84 to 86 minutes . . . . The crescent had become rather wide and so was considerably bright".

The final result is clear. In the year 20, the Nisan began on the eve of March 24. The beginning of Passah, the 14 Nisan, accordingly was on Thursday, April 6. Friday, April 7 was the 15 Nisan, the day of the crucifixion. On Thursday, the day of the Passah meal, was full moon.

<u>The Year 31</u>. Starting to count with Nisan 30, the twelfth month, Adar, began after the new moon of February 10, $12^h\ 55^m$ noon. Consequently, 1 Adar=12th or 13th of February; 30 Adar=13th or 14th of February. The next new moon on March 12, $1^h\ 9^m$ at night. The age of the moon on the evening of March 12, 17 hours; on March 13, 41 hours. We are weighing all possibilities; not only the visibility oh March 13, but also the invisibility due to cloudy sky, and get:

a) 1. Nisan--14. Marz, Wednesday
14. Nisan--27. Marz, Tuesday
15. Nisan--28. Marz, Wednesday
b) 1. Nisan--15. Marz, Thursday
14. Nisan--28. Marz, Wednesday
15. Nisan--29. Marz, Thursday

Passah could very well have been as early as that. The astronomical condition (sun in the Aries) was fulfilled, and ripe barley could be present. In case, however, the agricultural conditions--status of the grain and the fruits of the trees--were unfavorable in February, then the month was inserted. Then the month just mentioned was Veadar, and the Nisan began but after the new moon of April 10, $2^h\ 7^m$. On April 11 at sunset $6^h\ 25^m$, the moon was 281/4 hours old. Her distance amounted to 40; her height 12°, while it needed to be but $10^\circ.1$. Therefore, provided the sky was clear:

c) 1. Nisan--12. April, Thursday
14. Nisan--25. April, Wednesday

If, however, the visibility of the new light was prevented by clouds, then:

d) 1. Nisan--13. April
14. Nisan--26. April, Thursday
15. Nisan--27. April, Friday

These would then be the days of the Passion.

All calendar possibilities for Nisan 31 are exhausted. According to the first three cases, the 14 Nisan came on Tuesday, or Wednesday respectively, so that the year 31 must be eliminated. According to the last case--for which, as can be noticed, the probability is small--the 15 Nisan could have come on Friday, April 27, 31.

The Year 32. The new moon on February 29 noon, $12^h\ 55^m$, reckoned as from March 14, 31, was the thirteenth; from April 12 it was the twelfth. It did not introduce the Nisan because then the beginning of Passah would have come too early--the middle of March. The next new moon, March 29, $10^h\ 59^m$ at night. Two possibilities are to be reckoned with:

a) New light on March 30; moon 19 hours old.
1. Nisan--March 31, Monday
14. Nisan--April 13, Sunday
15. Nisan--April 14, Monday

b) New light on March 31; moon 43 hours old.
1. Nisan--April 1
14. Nisan--April 14, Monday
15. Nisan--April 15, Tuesday

Nor does the assumption of a cloudy sky bring the days of the festival of the 14 and 15 on a Thursday or Friday.

The year 32 is completely out.

The year 33. Beginning with March 29, 32, the new moon on March 19, 33, at noon 1 23 was the thirteenth, thus the Nisan began. Theoretically, there are to be considered four possibilities:

(a) New light on March 20 (age of moon 29 hours), then the 1 Nisan=March 21, Saturday; 14 Nisan=April 3, Friday. According to the formulas for height and distance of the moon, C. Schoch found the same dates, also Neugebauer by using two methods. (See Help Table III, p. XXIX).

This April 3, 33, referring to the dates of John, has frequently been said to have been the Friday of the crucifixion. That this reference does not stand the test because the dating according to John agrees with the dating of the synoptics, has been shown above under No. 9b.

(b) If on March 20 and 21, the crescent was covered by clouds, then Adar was given 30 days, so that the 1 Nisan=March 22; 14 Nisan=April 4, Saturday. The possibility that on March 21 and 22 respectively, the intercalary month Veadar began is quite remote; still, it can be considered. The next new moon on April 17, 93/4 o' clock (the evening). Consequently either:

c) 1. Nisan--April 19
14. Nisan--May 2, Saturday
or
d) 1. Nisan--April 20
14. Nisan--May 3, Saturday

According to these astronomical possibilities, the year 33, too, must be eliminated.

The reader is asked to draw with me the conclusion of the investigation. He will remember that in the purely historical part, I have given space to all possibilities so that the final result could be formulated with absolute certainty. The crucifixion took place in one of the years 30-33. The correct one of these four years must meet an indispensable condition. The Friday of the crucifixion must fall on the 15 Nisan. In reconstructing the then calendar, I have again given space to all possibilities in order to bring results which are--within unavoidable fluctuations--absolutely sure. According to the position of the 15 Nisan, the result was as follows:

(a) The years 29 and 32 are to be eliminated completely, because in these Passah fell on Monday or Tuesday.

(b) In the year 31, most likely the 15 Nisan came on a Wednesday or Thursday (March 28 or 29). There is very little likelihood for accepting it on Friday, April 27.

(c) In the year 33 of the four calendar possibilities, one is for the 14 Nisan on Friday, April 3, but not one for the 15. Thus 33, too, is out.

(d) There remains the year 30. I refer to the multiple way to fix the Passah days of this year: the 14 Nisan=April 6, Thursday; the 15 Nisan=April 7, Friday. These are our looked for days.

Supplement (a) Supporters of the opinion that in the New Testament, two dates are given for the Friday of the crucifixion--the 15 Nisan with the synoptics, but the 14 Nisan by John--find this double date realized exclusively in the year 30.

Supplement (b) The proof given in the beginning of taking into account the coregency by Luke in the words "in the 15 year of the reign of emperor Tiberius", now has received its final acknowledgment.

For the year 30, as the year of the crucifixion, I refer to two more witnesses outside the Bible in closing. First, the Talmud. In Jerusal. Talmud, Joma fol. 39b, and very similar in the Babyl. Talmud, fol. 39 b, it is stated that Rabbi Jochanan ben Sakkai saw one morning, certain things which terrified him greatly because he recognized them as omens of the end of the sanctuary. "The western lamp went out, and the carmesin red woolen ribbon remained red, and the lot of God came out at the left side, and the door of the temple was locked on the evening, and after arising in the morning, it was found open." Then R. Jochanan said, "Temple, why do you terrify us? We know that your end is destruction, as it is written, 'open, Lebanon, thy gates, and fire will devour your cedars'". (Lebanon here means the cedar wood of which the temple was built; when it opened its door, this would be the omen of the destruction by fire[1].)

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[1]Note 1, p. 160: The burning of the western lamp, the becoming white of the wollen ribbon, and the appearing of the lot Jehovah's at the right were three "omens of mercy". See Laible: A not yet known Jesus reference in the Talmud in the "Allg. Ev. Luth. Kirch.-Zeitg.", 1926.

Of "the visible signs and intimations" of the coming "destruction of the temple", Josephus writes in Jud Krieg VI, 5, 2-4. He refers to a written report of an eye witness and says with regard to the door of the temple, "the eastern gate of the inner fore-court which was of brass and of enormous weigh, and was closed in the evening with difficulty by 20 men, and barricaded with an iron-clad cross-beam, the bars of which fell deep into the threshold, was seen at mid-night to open itself". Josephus adds that this "happened at the feast of the unleavened bread". (His dating of all omens merely saying "before the revolt" sometimes has been so erroneously understood as though he had written "shortly before the revolt". He meant, however, in the period before the revolt.)

The Hebrew-gospel had preserved the tradition that at Jesus' death, the upper cross-bar in the temple, which was of enormous size, broke and fell down. The knowledge of this tradition we owe to Hieronymus, who has copied and translated that gospel in the years 274-79. Of the breaking of the top cross-bar he writes on four different places. (In the commentary to Matt. 27:51 and to Isaiah, in a letter to Hedebia and in one to the Roman bishop Damacus). In this connection, he mentions people "who proclaim that in that time when the veil in the temple rent, the top cross-bar was destroyed and the whole house of Israel was overshadowed by a cloud of terror". Of the tearing of the veil at the death of Jesus read Matt. 27:51; Mark 15;38 and Luke 23:45. It is at once clear that there was a natural connection between the rending of the veil, the breaking of the top cross-bar and the opening by force of the huge heavy door. "If the top cross-beam of this heavy door had a split, then rending of the veil fastened to the top cross-beam was the next result, and the opening of the door wings during the night a later one". (Th. Zahn). And all that was due to a natural cause. (i. e. the earthquake of which Matthew reports in 27:52. The Christian tradition has preserved merely the memory of the two events which happened on the afternoon at the death of Jesus. (The earthquake, and rending of the veil.) The Jewish preserved the memory of matters of cult and of the weird omens of the temple fire. In the Talmud in both places it is stated that this happened "forty years before the house was destroyed". Hence, in the year 30[1].

And Josephus knew from the eye witnesses that it had happened at the Passah. Thus through the Talmud indirectly, the crucifixion is dated Passah 30, and hence simultaneously, the date of the month, too, is determined, for Friday at the beginning of the Passah was April 7.

For the oldest date of the crucifixion, we have to thank the Alexandrian Clemens (about 200). In the "Rugs" 1. 21, 146, he writes, "Those who have investigated carefully, set his Passion in the 16 year of the emperor Tiberius--some on the 25 Pharmenoth; others on the 25 Pharmuthi; others say the Savious died on 19 Pharmuthi." These exact investigations were made, as is seen from the sequence, by Egyptian gnostics at about 150. It cannot be doubted that at that time in Christian circles of Palestine or Northern Egypt, a firm tradition of the date of the year and the month of the crucifixion had been kept alive. The 16 year of Tiberius ran from August 29 until then in 30. Thsu according to this tradition, Christ was crucified at Passah 30. With this, also, goes the question as to the date of the month, and this also is decided. Friday of the crucifixion at the beginning of the Passah in the year 30 cannot be but April 7. The would-be difference between John and the synoptics in this case is insignificant.

Now, what about those three Egyptian dates of the month? There then existed two calendars. The one came down from ancient times and was popular and movable. The one reformed by Augustus had a fixed solar year. On this, we have precise information through numerous inscriptions and double dates. By commutation of the three, we arrive at the following dates:

According to the old According to the new

Calendar

25. Phamenoth--8. Marz, Mittwoch--21. Marz, Dienstag
19. Pharmuthi--1. April, Sonnabend--14. April, Freitag
25. Pharmuthi--7. April, Freitag--20. April, Donnerstg.

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1 Note 1, p. 161: In my first work on "the date of the crucifixion" (Berlin, 1912), I expressed a faint doubt about the round figure "forty years". This I am taking back. The evident inner connections of all those events in the temple and the right dating to the year 30 cannot be based on chance.

There again, we have Friday, April 7, 30. But why were these three dates mentioned? E. Preuschen, to whom we owe this discovery, has brought light into this darkness. In the old calendar, from which the tradition was taken, as usual, double dates were entered. This is confirmed by many examples, and is easy to understand. In order to express the parallelism with the official date at the 19 Pharmuthi, the note was added "Cal. April" (April 1). The third date, 25 Pharmenoth, corresponded to March 21 of the reformed calendar. That was the day of the equinox according to Alexandrian astronomy, which (day) often formed the beginning of the year. Through misunderstanding, these two dates, too, were brought in connection with Christ's suffering, so Clemens included them in his reference. This explanation regarding the 25 Phamenoth and 19 Pharmuthi very likely will be correct. It is of the greatest value that the careful investigations of the Egyptian gnostics also resulted in giving April 7, 30 as the day of the crucifixion. We must not be surprised that in later times, no more attention was paid to it. For in Clemens' time, the symbolic chronology was already in bloom, which was placing creation and salvation in the closest parallelism, dating both after the beginning of spring. For 500 years, all the church fathers have adhered to this symbolic chronology.

After an objective examination of the historic statements of the gospels, and after the astronomical determination of the days of Passah, it clearly results that the day of Golgotha was

FRIDAY, APRIL 7, 30.

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O. Gerhardt

$360^\circ = 24hr$

False new and
full-moon
reckonings

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401 402

ASTRONOMISCHE NACHRICHTEN.

Band 241. May 1931 Nr. 5784. Kiel 1931 24.

Zum Todesdatum *Jesu* von Nazareth. Von *E. Dittrich.*

O. Gerhardt veröffentlichte eine inhaltsreiche Studie über die Hauptfrage der christlichen Chronologie in AN **240**, Nr. 5745-46[1]). Diese Frage ist neuerdings wichtig geworden wegen der geplanten Kalenderreform. Besonders für die beabsichtigte Festlegung des Osterfestes ist das Kreuzigungsdatum von Bedeutung. Deshalb möchte ich rechtzeitig einige Notizen zur Sache publizieren. Es wäre sehr unangenehm, wenn man z. B. nachträglich die Begründung des fixierten Osterfestes erschüttern müßte.

Jede chronologische Arbeit beruht auf einer Synthese von historischem und astronomischem Wissen. Das astronomische in jeder chronologischen Arbeit ist sicher. Aber Sorgen macht, was und wie man rechnen soll, resp. darf.

Gerhardt entscheidet sich für das Jahr 30 n. Chr. und setzt Freitag den 7. April = dem 15. Nisan, dem Passahfeiertag.

Diese Datumgleichung ist das Resultat der Jahrzehnte langen Bemühungen um die Rekonstruktion des jüdischen Kalenders mit Hilfe der Neulichtberechnung. Diese gehört zu den schwierigsten Aufgaben der Astronomie. Ihre erste Lösung stammt von den Babyloniern[2]). Sie geriet mit samt ihrer eigenartigen Rechentechnik in Vergessenheit, so daß später noch *Kepler* die genaue Berechnung für fast unmöglich erklärte (Astronomia optika, p. 357). Sie hängt nämlich ab von einer empirischen Relation zwischen der Azimutdifferenz von Mond und Sonne bei deren Untergang und der Mondhöhe. Diese scheint heute durch *Schoch*s Bemühungen, der Hunderte alte Berichte durchrechnete und viele Neulichter selbst beobachtete, genügend bekannt. Wir können jetzt den jüdischen Kalender rekonstruieren, allerdings als idealen, genau nach dem Neulicht regulierten Mondkalender. Frage bleibt, ob der wirkliche Kalender diesem Ideale entsprach.

Das Jahr 30. *Schaumberger*, welcher es für möglich hält, beunruhigt sich, daß so viele Kirchenväter das Jahr 29, das Konsularjahr der *Gemini*, nennen[3]).

Dieses römische Konsularjahr war unvergeßlich, weil zufällig beide consules das Familien-cognomen *Geminus* führten. *Ideler* und *Beyschlag*[4]) äußerten sich, daß die Quelle der Nachricht möglicherweise auf das Archiv des *Pilatus* zurückgeht. Nun tritt dieses Datum wirklich in den »Acta *Pilati*« auf[5]). Diese fromme Fälschung stammt aus den Jahren 326–376 n. Chr. Sie ist uns als erster Teil des *Nicodemus*-Evangeliums erhalten und bildet einen Bericht über den Prozeß *Jesu* vor *Pilatus*, über Kreuzigung und Auferstehung, eine erweiterte Zusammenarbeitung unserer vier Evangelien. Es hat aber doch wohl echte *Pilatus*-Akten gegeben, deren Inhalt den Christen unangenehm war. Der oströmische Cäsar *Maximinus Daja* (305–313), welcher die Christen verfolgte, ließ des *Pilatus* Protokolle und Relationen über den Prozeß *Jesu* verbreiten und in den Schulen vorlesen. Es war sein Gegenzug wider die christliche Tradition über *Jesu* Tod und Auferstehung. *Eusebios* erklärte diese Acta für gefälscht, aber wohl nur, weil sie sich mit der christlichen Tradition nicht vertrugen. Schon die älteren christlichen Autoren berufen sich seit dem 2. Jahrhundert n. Chr. auf die *Pilatus*-Akten, verweisen auf sie die Ungläubigen, d. h. glauben an ihre Existenz.

Die Zählung der Tiberiusjahre. In der Regel wird das Jahr der *Gemini* als 15. des *Tiberius* genommen. *Hippolytos*[6]) nimmt es als 18. *Eusebios* nennt sogar das 19. Jahr des *Tiberius* als Todesjahr. Und doch meint er das Jahr 29 n. Chr. Er bestimmt ja das Todesjahr durch die Sonnenfinsternis des *Flegon* vom 24. Nov. 29[7]). Über die vier möglichen Äquivalente des 15. *Tiberius*-Jahres siehe AN 5745, p. 139–140. Die verschiedene Ausdeutung dieses 15. Jahres scheint die Quelle der Meinung von der ein- resp. dreijährigen öffentlichen Wirksamkeit *Jesu* zu sein. Das *Johannes*-Evangelium kann uns darüber nichts mitteilen, da es als historische Quelle ausscheidet. Die Synoptiker deuten auf ein Jahr. Aber auch das ist wohl noch zu viel. *Maurenbrecher*[8]) gibt gewichtige Gründe an, daß *Jesu* Tätigkeit kurz war. Wenige Wochen. Vom Auftreten *des Täufers* bis zum Tode *Jesu* ein halbes Jahr, *Lukas* III.1, ein Frühling in Galiläa, dann der Zug nach Jerusalem und das tragische Ende.

Der 7. April ist zweifelhaft aus einem recht merkwürdigen Grunde. *F. Westberg*, Die bibl. Chronologie nach Flav. Jos. und das Todesjahr *Jesu*, p. 169 (1910), sagt, daß der 7. April ein dies nefastus war, an dem keine Gerichtssitzungen stattfinden durften. *Schaumberger* bemerkt dazu, daß sich das nicht auf coercitio, quaestio, animadversio[9]) bezieht. — Darf man die Fällung eines Todesurteils so gering einschätzen?

Der Freitag am 14. Nisan. Die Synoptiker geben den 15. Nisan, *Johannes* den 14. In diesem Falle kann man nicht mechanisch den Synoptikern folgen, weil sie im allgemeinen verläßlicher sind. Es sind nämlich in den Synoptikern selbst

[1]) *O. Gerhardt*, Das Datum der Kreuzigung *Jesu Christi*.
[2]) *C. Bezold*, Astronomie, Himmelsschau und Astrallehre bei den Babyloniern, p. 9–13 (1911). Es ist nach p. 30 ein Beitrag *Kuglers*, des Autors der Babylonischen Mondrechnung, von 1900.
[3]) *J. Schaumberger*, Der 14. Nisan als Kreuzigungstag der Synoptiker, Biblica 1928 p. 64.
[4]) *O. Gerhardt*, Das Datum der Kreuzigung *Jesu Christi*, p. 12 (1914).
[5]) *O. Gerhardt*, Cit. 4, p. 75. [6]) AN 5745, p. 138.
[7]) *F. K. Ginzel*, Spezieller Kanon der Sonnen- und Mondfinsternisse, p. 198 (1899).
[8]) *Maurenbrecher*, Von Nazareth nach Golgatha, p. 215–217 (1909). *J. Leipoldt* bringt *Maurenbrecher*s Auffassung kurz in »Vom Jesusbilde der Gegenwart«, p. 95 (1913). *Maurenbrechers* Bearbeitung entspricht streng dem Laienstandpunkte.
[9]) *Schaumberger*, Cit. 3, p. 61–62.

Stellen, welche ihrer Zahlenangabe widerstreiten. So *Markus* XIV.2, wo die jüdischen Behörden *Jesu* Tod beschließen, aber einschränken: nicht am Fest, auf daß es keine Unruhe gibt im Volk[10]). — Das wurde bestimmt, als noch zwei Tage bis zum Passah waren, *Markus* XIV.1, also am Mittwoch abends, da das Todespassah am Freitag abends begann. Ein weiterer Beleg ist in der Notiz bei *Markus* XV.21 über *Simon* von Kyrene[11]), der vom Felde kam und gezwungen wurde, den Kreuzpfahl zu tragen, also zur Arbeit. Es ist eben Wochentag, nicht Feiertag. *Markus* erwähnt, daß *Simon* von Kyrene der Vater des *Alexander* und *Rufus* ist, als ob diese beiden seinem Leserkreise wohlbekannt wären. Also Erinnerung, nicht Phantasie; Geschichte, nicht Poesie. — Wer in *Simon* einen ankommenden Festpilger sehen will, bedenke, daß er am 15. nicht mehr am Wege sein konnte. Und wenn er sich verspätet haben sollte, so wäre doch das Kreuztragen, die Arbeit, eine Versündigung.

Älter als die Synoptiker sind die *Paulus*briefe. *Paulus* I. Korinther V.7 sagt: denn als unser Passah ist geschlachtet der Christus. Diese Aussage fordert doch, daß *Jesus* starb um die Zeit, wo man das Passahlamm zu schlachten pflegte, also am 14. Nachmittag. Auch eine talmudische *Baraita* bringt, daß *Jesus* von Nazareth am Vorabend des Pessachfestes starb, also am 14. Die jüdischen Autoren mußten doch besser als die Christen wissen, was nach jüdischem Recht und Brauch möglich ist oder nicht[12]). Dieses Datum stützt auch das unkanonische *Petrus*-Evangelium.

Wäre das Todesjahr wirklich das 30., so müßten wir eine Verschiebung des Kalenders um einen Tag zulassen. Damit der 14. Nisan auf den 7. April, Freitag fällt, muß der 1. Nisan auf den 25. März fallen und abends am 24. beginnen. Nach der Bestimmung von *Neugebauer* war damals die Mondhöhe 20°, sein Alter 46–47 Stunden und der Mond ging 1^h34^m nach der Sonne unter. Hier hätte man sich darüber hinwegzusetzen, daß das Volk am Monde merkt, daß der Kalender nicht stimmt.

Im Jahre 29. Nach AN 5745 fiel der theoretische 1. Nisan auf den 4. April, der 14. Nisan auf Sonntag den 17. April. Um den 14. auf Freitag zu bringen, ist eine zweitägige Verschiebung gegen den Mondlauf nötig. Man mußte vorgehen, als ob das Neulicht abends am 1. April gesehen worden wäre, so daß der 1. Nisan auf den 2. April, der 14. auf den 15. April käme. Nun war Neumond erst am 2. April um 7^h52^m abends. Das Jahr 29 ist nicht möglich ohne falsche Neulichtbestimmung.

Wie unbeabsichtigte Neulichttäuschungen entstehen. *Schoch*, welcher persönlich über 100 Neulichte beobachtet hat[13]), schreibt über irrige Beobachtungen an *Schaumberger*[14]): »Im Frühling steht bei der steilen Lage der Ekliptik die Sichel waagerecht zum Horizont. Bei sehr jungen Neulichten sieht es aus wie ein feiner heller Faden von links nach rechts. Nun sind am Abendhimmel öfter rötliche, gelbe horizontale (niemals vertikale) Streifen am Horizont, die manchmal ganz kurz sind (Dämmerungsstreifen in der Atmosphäre). Es ist mir oft so gegangen, daß ich im Frühjahr beim Suchen nach jungen Neulichten, die so fein sind wie ein Faden, einen Moment geglaubt habe, solch heller, feiner, gefärbter Horizontwolkenstreifen wäre die Sichel, . . . «.

Diese Täuschung erklärt wohl auch die hie und da notierte Behauptung, daß an demselben Tage der Alte Mond und das Neulicht gesichtet worden ist[15]).

Neulichtfälschungen. Die Pharisäer einerseits, die Sadduzäer und Boethusianer andererseits waren in dauernder Meinungsverschiedenheit wegen des Kalenders. Auch über die »Heiligung des Neumondes« gab es Differenzen, weshalb die Sadduzäer und Boethusianer das Synedrion auch durch falsche Neulichtzeugen in die Irre zu führen suchten[16]). Hauptstreitpunkt war die Berechnung des Pfingstfestes. Nur, wenn der 15. Nisan auf den Sabbat fiel, deckte sich der Pfingsttermin der Pharisäer mit dem der Boethusianer. Dann entstand im Volke der Eindruck, daß die Pharisäer nachgegeben haben. Deshalb ließ sich die hochkirchliche Partei keine Gelegenheit entgehen, den 15. Nisan auf den Sabbat zu bringen, resp. zu schieben. Dabei scheute man von der Verwendung bestochener Zeugen nicht zurück, nur um das Neulicht verfrüht ansetzen zu können. Einen Fall, wo die falschen Zeugen entlarvt wurden, aus dem Jerus. Talmud bringt *Schaumberger*[17]). Die Juden haben eine ganze Theorie über die erlogenen Neulichter entwickelt, ja sogar eine Art kasuistische Rückendeckung geschaffen für den Fall, wenn auch nach dem Tage der Bezeugung das Neulicht noch unsichtbar war, wenn also der Mond selbst den Betrug enthüllte[18]).

Auch als später die Pharisäer die Oberhand gewannen, wurde der Kalender weiter gefälscht. Noch Anfang des dritten Jahrhunderts nach Chr. stritten sich die Rabbiner, ob man durch falsche Zeugen das Neulicht gegen die Wirklichkeit vor oder zurück schieben darf. Auch kam es vor, daß am 29. der Altmond noch sichtbar war[19]).

Nun war aber gerade beim Tode *Jesu* der 15. Nisan am Sabbat, also an dem Tage, welcher den Sadduzäern und Boethusianern besonders erwünscht war. Deshalb können wir uns gerade wegen dieser Besonderheit in diesem Falle nicht auf die theoretische Genauigkeit des jüdischen Mondkalenders verlassen.

Das Passahmahl. Einerseits soll *Jesus* nach *Paulus* zu der Zeit gestorben sein, wo man das Passahlamm schlachtete, andererseits soll er noch selbst mit den Jüngern das Passahlamm gegessen haben. Das ist eine ernsthafte Schwierigkeit. Manche entscheiden sich, daß die Nachricht vom Passahmahl eben ein Irrtum der Synoptiker ist[20]). Aber selbst wenn wir dies gelten lassen, so muß man doch nach der Quelle der Irrung fragen.

Sie liegt wieder in dem Zusammentreffen des Sabbats mit dem 15. Nisan. Am 14., Freitag abends, wurde das Lamm geschlachtet; die Zubereitung geriet schon in die Dunkelheit, also in den Sabbat hinein. Am Sabbat durfte man nicht kochen.

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10) Zitiert ist immer *Weizsäckers* Übersetzung des Neuen Testaments von 1906, 9. Aufl. 11) *Maurenbrecher*, Cit. 8, p. 254.
12) *J. Klausner*, Jesus von Nazareth, p. 29, 472 (1930).
13) *C. Schoch*, Christi Kreuzigung am 14. Nisan, Biblica 1928 p. 52. 14) *Schaumberger*, Cit. 3, p. 73.
15) Cit. 3, p. 71. — *Amerigo Vespucci* soll jenseits des Äquators so eine Beobachtung gemacht haben. Siehe *C. Manitius*, Geminos, p. 271 (1898).
16) *Klausner*, Cit. 12, p. 296. 17) Cit. 3, p. 71. 18) Siehe des *Maimonides* Bemerkung, Cit. 3, p. 72. 19) Cit. 3, p. 74, Fußnote 2.
20) *M. Maurenbrecher*, Cit. 8, p. 250 und »Von Jerusalem nach Rom«, p. 71 (1910).

Aber das Passah mußte man feiern. Nach der Halacha, die zur Zeit *Hilels*, also vor Chr. Geb., durch die Pharisäer neu gestaltet wurde, hielt man sich an die Regel: »das Pessachopfer verdrängt die Sabbatvorschriften«. — Nach der alten Halacha, an der die Priester bis zur Zerstörung Jerusalems festhielten, ging der Sabbat vor. Fiel der 14. Nisan auf den Vortag des Sabbat, schlachtete man das Lamm am 13., also Donnerstag abends, um es in der folgenden Nacht zu verzehren[21]). Galiläa folgte dieser strengeren Regel, und so konnte *Jesus* mit den Jüngern das Passahmahl am 13. Donnerstag abends halten. Später, als man sich nach Jahren zur schriftlichen Festlegung der Ereignisse erinnerte, legte *Markus* das Passahmahl mechanisch auf das gewöhnliche Datum, den 14. Nisan, und den Karfreitag auf den folgenden 15. Nisan.

Dr. *J. Klausner*, dem ich das Neue in der vorstehenden Darstellung entnehme, ist Ordinarius für Geschichte an der Universität in Jerusalem, also in der Frage besonders berufen. Auf die Möglichkeit, daß das Passah in Jerusalem sowohl am 13. als am 14. gegessen werden konnte, wies schon im Jahre 1892 *Chwolson*[22]) hin.

Ich besitze das Handexemplar *Schochs* mit seinem und *Schaumbergers* Aufsatz. Das *Chwolson*-Zitat ist von *Schochs* Hand rot angestrichen, 9 Zeilen sind unterstrichen und am Rande steht *Schochs* eigenhändige Bemerkung: »sehr einleuchtend — dadurch wird die Kreuzigung am 14. Nisan erklärt«.

Noch eine Bemerkung *Schochs* über den Todestag *Jesu*:

Die Finsternis des *Flegon*. Sie war für Nicäa total am 24. Nov. 29 n. Chr. *Eusebios*, welcher 314:–340 Bischof von Cäsarea in Palästina war, entnimmt die Beziehung der Finsternis auf *Jesu* Tod *Flegons* »Olympiaden«, was auch *Julius Afrikanus* tut[23]). *Schoch* sagt sehr richtig, daß dies ein Irrtum der alten Chronologen ist[24]). Denn eine November-Finsternis hat mit einem April-Ereignis nichts zu tun. »Jedenfalls, denke ich mir, muß aber diesen Chronologen überliefert sein, daß sie zeitlich nicht weit vom Todesjahr vorfiel.« — *Schoch* benutzt diesen Gedanken, um zwischen den Jahren 30 und 33 zu entscheiden.

Flegon war ein Freigelassener des Kaisers *Hadrian* (117–138). Dieser verfolgte das Christentum, nahm aber doch schon die Apologien des *Quadratus* und *Aristides* an. Die Apologie des *Quadratus* ist verloren, die des *Aristides* erhalten[25]). Solche Schriften in der Bibliothek des Kaisers können *Flegons* Quelle gewesen sein.

In den wenigen letzten Jahren seines Lebens, welche der zum schweren Schaden der Chronologie im Jahre 1929 verstorbene *C. Schoch*[26]) dieser Wissenschaft widmete, hat er die Berechnung der Finsternisse wesentlich verbessert. *Schochs* Veränderungen beeinflussen jedoch die Lage des Schattenstreifens durch Kleinasien bei der Finsternis des *Flegon* nur sehr wenig. Zum Vergleiche gebe ich die Elemente nach *Ginzel* und meine Nachrechnung (unten zweite Zeile) mit Hilfe der *Neugebauer*schen Chronologie von 1929. Die oberen Zahlen sind von *Ginzel*.

Finsternis des *Flegon* vom 24. Nov. 29 n. Chr.

Jul. Tag	W.-Z.	P	L	μ	γ	u
1731978	$9^h20^m.4$	$171^\circ.327$	$240^\circ.860$	$324^\circ.52$	0.7468	0.5440
1731978	9 44	171.5	240.9	326	0.735	0.542

Schoch selbst hat für die Finsternis von +29 Nov. 24 (Nicäa) den Nord- und Südrand des Schattens berechnet[27]). Trägt man seine Werte in die *Ginzel*sche Karte ein, so verschiebt sich der Schatten um etwa $^2/_3$ seiner Breite nach Süden. Die Finsternis wird dadurch für Jerusalem und Galiläa um ein geringes bedeutender. Total ist sie nicht für die genannten Orte. Wohl aber sagt *Schoch* an der zitierten Stelle: »Die Finsternis wird für Nicäa total; der Ort liegt $0^\circ.23$ südlich der Nordgrenze. Nach *Ginzel*, Kanon, Karte X, liegt Nicäa dicht südlich der südlichen Grenzkurve.«

Mit *Neugebauers* Tafeln findet man für Jerusalem die größte Phase 11.5 Zoll südlich der Zentralkurve um 11^h48^m, also 12^m vor Mittag wahrer Jerusalemer Zeit. Für den See Genezareth ($\lambda = 35^\circ.6$, $\phi = +32^\circ.8$) finde ich die Phase 11.8 Zoll, 10^m vor dem wahren dortigen Mittag. Für Jerusalem begann die Finsternis um 10^h24^m wahrer Jerusalemer Zeit und endete um 13^h32^m. Sie dauerte also 3^h8^m. *Markus* hat die Erinnerung an die dreistündige Dauer bewahrt, aber das Maximum zu Mittag mit dem Beginn verwechselt. Das ist nicht verwunderlich, denn die Sonne muß ja merklich verfinstert sein, bevor man es bei hohem Sonnenstande merkt.

Die *Flegon*-Finsternis war nach *Jesu* Tod. Wäre sie in die Zeit seiner Wirksamkeit gefallen, wie *Schoch* meinte, so hätte sich ihrer gewiß die Legendenbildung bemächtigt. Ist doch nach *Markus* VIII.12 einmal ein Himmelszeichen von *Jesu* verlangt worden. — Übrigens verraten die evangelischen Texte doch noch an einer Stelle, daß die Finsternis, selbst für das Bewußtsein des Evangelisten, nach *Jesu* Tod eintrat. *Markus* XV.33 erwähnt die Finsternis von der sechsten Stunde (Mittag) bis zur neunten (3 nachm.). *Lukas* XXIII.44 reproduziert dies und fügt bei, daß die Sonne ihren Schein verlor. *Matthäus* bringt an Stelle dieser Nachricht XXVII.53, daß nach *Jesu* Auferstehung die Leiber der entschlafenen Heiligen in Jerusalem erschienen. — Das ist gewiß eine Übertreibung der scheinbaren Schrecken einer Sonnenfinsternis. In ihrem fahlen Zwielicht nimmt die Natur ein gespenstiges, unwirkliches Aussehen an, die Menschen sind leichenhaft fahl usw. Eine beachtenswerte Parallele zu der *Mathäus*-Stelle bringt *Homers* Odyssee XX, 351–357. Der Seher *Theoklymenos* sagt: »Die Sonne ist am Himmel verloren gegangen«. Nacht deckt die Köpfe und Gesichter, voll Geister ist Vorsaal und Halle, die zum Erebos wandeln.

Schon *Plutarch* schloß auf eine Sonnenfinsternis. Neuerdings hatte *C. Schoch* das Problem in diesem Sinne auf-

[21]) *Klausner*, Cit. 12, p. 449. [22]) *Schaumberger*, Cit. 3, p. 69, Note 2. [23]) *Ginzel*, Cit. 7, p. 198. [24]) *Schoch*, Cit. 13, p. 56.
[25]) Die Religion in Geschichte und Gegenwart. Apologetik, III, p. 575 (1909).
[26]) Sein Hauptwerk sind die »Planetentafeln für jedermann« (1928). Seine kostbaren, meist im Telegrammstil geschriebenen Aufsätze, sammelte *P. V. Neugebauer* in Astron. Abhandl. der A.N., Band 8, Nr. 2 (1930).
[27]) *P. V. Neugebauer*, Neudruck der im Selbstverlag von *C. Schoch* erschienenen Schriften. Die Verbesserungen der Syzygientafeln von *C. Schoch*, p. 27 (1930) in Astron. Abhandl. Bd. 8, Nr. 2.

genommen[28]). Er deutet auf die Finsternis vom 16. April 1178 v. Chr. — Günstig ist der Deutung, wie schon *Plutarch* bemerkt, daß nach *Homer* XIV.161 und XIX.306 Neumond war. *Schoch* schließt aus XVIII.366, daß Winter war[29]).

Ich möchte die Stelle ein wenig anders deuten. In der Sage vom Freiermord war wohl ursprünglich das leichenhafte Aussehen der Freier bei der Finsternis als Vorzeichen ihres Todes verwendet. So deutet ihnen der Seher, welcher dafür verhöhnt wird. Der Dichter hat den Stoff wohl aufgenommen, aber nicht mehr ganz verstanden. Eben darum nähert er sich der obigen *Matthäus*-Stelle.

Verschiebung einer Finsternis zugunsten eines historischen Ereignisses kommt vor. In der Schlacht bei Stiklestad am 29. Juli 1030 fiel König *Olaf* der Heilige. Auf diesen Tag wurde auch die Sonnenfinsternis vom 31. August verlegt, sogar unter Vergleich mit den Vorgängen bei *Jesu* Tod. Ebenso wurde der Tod von Päpsten mit Sonnenfinsternissen in Beziehung gebracht[30]).

Eine Sonnenfinsternis, mag sie noch so schlecht aufgezeichnet sein, ist immer eine kostbare Angabe für chronologische Studien. Man sollte systematisch alle Notizen über die evangelische Finsternis sammeln. Eine war im Anti-Evangelium des *Celsus*[31]). *Celsus* glaubt nicht an die Gleichzeitigkeit von Tod, Erdbeben und Finsternis, wie die Polemik des *Origines* verrät.

Zwei bisher nicht beachtete chronologische Angaben. *Matthäus* XVII.24, 27 erzählt, wie *Jesus* beim letzten Aufenthalt in Kapernaum den halben Schekel für die Tempelkasse bezahlte. Am 1. Adar wurde zur Bezahlung aufgefordert, am 15. kamen die Geldwechsler in die Provinzen und am 25. Adar ließen sie sich am Tempel nieder. *Klausner*[32]) bemerkt: »Es war also Mitte Adar, die schönste Zeit in Palästina, wenn der Regen vorüber ist und alles zu blühen beginnt«.

Markus II.23 bringt das Ährenraufen am Sabbat. *Baumgarten*[33]) sagt, daß die Erzählung die Nähe des Passah voraussetzt. Chronologisch bedeutsam ist die Stelle, wenn *Jesu* Wirksamkeit kurz war. Dann fällt dieser Sabbat kurz vor das Todespassah. Da der Veadar so eingeschaltet wurde, daß zum Passah wirklich schon reifes Getreide vorhanden ist[34]), weist der Ähren-Sabbat auf ein gegen das Äquinoktium spät liegendes Passah.

Jesus zog über Jericho nach Jerusalem. Beide Städte sind 5 Wegstunden voneinander. Zwischen Jericho und dem Toten Meer liegt eine sehr warme Niederung, wohl der Schauplatz des Ereignisses. Dort fällt durchschnittlich die Ernte auf den 1. April Greg. = 3. April Julian. Das Schwankungsintervall der Ernte ist geringer als in Mitteleuropa[35]).

Zusammenfassung. Der Todestag *Jesu* ist durch die erhaltenen Mitteilungen nicht eindeutig festgelegt. Die Jahrhunderte lange Diskussion ist nicht ohne Resultat geblieben. Früher suchte man das Todesjahr in einem ganzen Jahrzehnt, heute nur noch im Jahr 29 oder 30. Der 7. April 30 wäre der geplanten Kalenderreform willkommen. Nach Beschluß des Völkerbund-Ausschusses von 1925 soll Ostern etwa auf den 8. April fixiert werden[36]). Es wäre sehr unangenehm, wenn sich nachträglich zeigen sollte, daß der Karfreitag am 15. April 29 war.

Stará Ďala, Tschechoslowakei. *E. Dittrich.*

28) *C. Schoch*, The Eclipse of Odysseus, The Observatory **49**, No. 620 (1926). — *C. Schoch*, Die sechs griechischen Dichterfinsternisse. Astron. Abhandl. Bd. 8, Nr. 2, p. 16 (1930).

29) *Dörpfeld*, Die Sterne, 1926, p. 186, bringt ausführlich die übliche Visionshypothese der Altphilologen.

30) *E. Zinner*, Geschichte der Sternkunde, p. 357 (1931).

31) *A. Dide*, Das Anti-Evangelium des *Celsus*. Autor. Übers. von *A. Saager*, p. 53 (1907).

32) Cit. 12, p. 416.

33) Cit. 25, Jesus Christus II, 2. b, p. 368.

34) AN Nr. 5745, p. 148.

35) *F. X. Kugler*, Von Moses bis Paulus, p. 30 (1922) und *Schoch*, Cit. 13, p. 54, Note 1. An der Stelle ist im Datum irrtümlich eine Null angehängt. Gesichert durch *Schoch*: »Planetentafeln«, Spalte XLIII.

36) International fixed calendar League, Broschüre B, p. 3.

Il periodo di Eros. Di *S. Taffara*.

Pare che una reale differenza esista nel periodo fra due minimi consecutivi, fatto questo che ha dato luogo a una netta distinzione fra minimi pari e dispari. I minimi che qui sotto elenco mi hanno permesso di ricavare, dopo molti tentativi, il periodo di $0^d\!.109796$, che quasi esattamente si accorda con quello ricavato da *Jacchia* (AN **241**, Nr. 5764).

L'epoca 0 l'ho fissata con riferimento al minimo 2426282.636, quale ho ottenuto da osservazioni visuali mie e da immagini fotografiche prese da *L. Taffara* e da me ridotte.

Sono pure ottenuti fotograficamente i minimi che nella tabella ho contrassegnato con *Tf**.

I dati osservati sono corretti dell'aberrazione planetaria; quelli calcolati sono riferiti, come sopra ho detto, a

$$m = 2426282.636 + 0^d\!.109796 \cdot E.$$

I valori O–C, rappresentati graficamente qui sopra, mostrano la effettiva differenza nel periodo considerando separatamente i minimi pari e quelli dispari: mentre dall'ottobre 1930 il periodo fra due minimi pari sembra in aumento per poi oscillare per valori di O–C fra $\pm 0^d\!.010$ (con un periodo di circa più di un mese), il periodo fra due minimi dispari sembra in un primo tempo diminuire per poi mantenersi costante con un O–C di circa $-0^d\!.010$, fino a che per ambedue le specie di minimo pare avvenga una piccola oscillazione.

Mancanza di dati posteriori non mi hanno permesso di accertarmi della realtà della perturbazione, che, essendo avvenuta verso la metà di gennaio 1931, molto probabilmente può mettersi in relazione all'avvicinarsi di Eros al perielio.

Minimi dispari.

E	2426...	O–C		*E*	2426...	O–C	
−93	272.446	+21	*Jc*	281	313.476	−13	*Ls*
− 9	281.661	+13	*Tf*	281	.481	− 8	*Mü*
− 3	282.307	0	*Zw*	291	314.581	− 7	*Pg*
− 1	.528	+ 2	*Tf*	291	.577	−11	*Bn*
81	291.521	− 8	»	363	322.485	− 7	*Jc*
99	293.504	− 2	*Jc*	373	323.576	−14	*Gf*
107	294.375	− 9	*Ls*	499	337.417	− 7	»
143	298.327	−10	*Zw*	527	340.488	− 9	»
145	.548	− 9	*Bd*	627	351.467	−12	*Jc*
145	.551	− 6	*Tf*	627	.472	− 7	*By*
191	303.604	− 3	»	673	356.523	+14	»
227	307.554	− 6	*Sk*	673	.532	+23	*Lt*
253	310.408	− 6	*Zw*	683	357.634	+ 7	*Lc*
255	.625	− 9	»	709	360.472	− 9	*Bü*
271	312.385	− 6	»	737	363.540	−16	*My*

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I

About the Death of Jesus of Nazareth

By. E. Dittrich

Favors 14 Nisan = Friday p. 6.

O. Gerhardt published a study rich in content over the Christian chronology in Astronomical News 240, No. 5745-46[1]). Lately this question has taken on importance because of the planned calendar reform. The date of the crucifixion is of meaning because of the fixing of the Easter date. That is why I would like to publish a few timely items on the subject. It would be quite embarassing if e.g. after the Easter date has been permanently fixed, one would have to overthrow it.

Every chronological work is founded on a synthesis of historical and astronomical knowledge. The astronomical in every work is certain. But it gives one worries, what and how one shall figure, or dares.

Gerhardt chose for himself the year 30 A.D., and sets Friday, April 7 -- the 15th Nisan, as the Passover.

This date equation is the result of decades of work for the reconstruction of the Jewish calendar with the help of the "new moon reckoning." This is one of the most difficult tasks of astronomy. Its first solution comes from the Babylonians[2]). It was forgotten along with its peculiar technique of calculation so that later on Kepler declared that the exact solution was nigh onto impossible (Astronomia optika, p. 357). It really depends on an impirical relation between the Azimuth difference of moon and sun at the time of its setting and the heights of the moon. This seems well enough known today because of Schoch's efforts, who calculated through hundreds of old reports and observed many new moons himself. We can now reconstruct the Jewish calendar, however the ideal one, the moon calendar, accurately regulated by the new moon. The question remains, did the real calendar correspond to the ideal?

The year 30 - Schaumberger, who considers it possible, is uneasy that so many church fathers mention the year 29, the consular year of the Gemini[3]).

A.D. 29

This Roman consular year was unforgettable because accidently both consuls had the same family cognomen, Geminus. Ideler and Beyschlay[4]) made the statement that the source of the news possibly might go back to the archives of Pilatus. Now this date really turns up in the "Acta Pilati"[5]). This saintly forgery originates from the years 326-376 A.D. It has been preserved as the first part of the gospel of Nicodemus and gives a report of the prosecution of Jesus before Pilate, of the crucifixion and resurrection, an enlarged work of forming the four gospels. But there must have existed genuine Pilatus documents, whose content was embarassing to the Christians. The East Roman Caesar Maximinus Daja (305-313), who persecuted the Christians, who had the minutes and relations of Pilate about the persecution of Jesus distributed and read out loud in the schools. It was his counter defense against the christian tradition about the death and resurrection of Jesus. Eusebios declared that these documents were forgeries, but more than likely only because they did not agree with christian tradition. The oldest christian authors already refer the unbelievers to the Pilate documents since the second century A.D. that shows, they believed in its existence.

A.D. 29

The reckoning of the years of Tiberius. As a rule the year of Gemini is taken as the 15th of Tiberius. Hyppolytos[6]) takes it to be the 18th, Eusebios, even calls ~~it~~ the 19th year of Tiberius, the death year. And at that, he means, the 29 year A. D. He calculates the death year by the darkness of the sun, the Flegon of the 24th, November 29[7]). About the four possible equivalents of the 15th Tiberius year see AN 5745, p. 139-140.

The various explanations of this 15th year seem to be the source of the opinion of the one or three years of public ministrations of Christ. The gospel of John cannot tell us anything about that, since it is not an historical source book. The synoptikers explain it as a year.[a] But even that seems too much. Maurenbrecher[8]) cites weighty arguments, that Christ's activities were short. A few weeks. From the appearance of John the Baptist to the death of Jesus, a half[3] of a year, Luke 3, 1; a spring in Galiläa, then the march to Jerusalem and the tragic end.

The 7th of April is doubtful for a noteworthy reason. F. Westberg, "Die bibl. Chronologie nach Flav. Jos. und das Todesjahr Jesu" (Biblical chronology acc. Flav. Jos. and the death year of Jesu) p. 169 (1910) says that April 7 was a dies nefastus on which no court session could take place. Schaumberger remarks to this that this does not refer to coercitio, quaestio, animadversio[9]). -- Can one value the handing down of a death sentence as so unimportant?

The Friday on the 14th Nisan. The synoptikers give the 15th Nisan, John the 14th. In this case one cannot follow the synoptikers mechanically, in that ~~because~~ they are usually more reliable. For there are places in these synoptikers which contradict their date assertions. So Mark XIV: 2 where the Jewish authorities decide for the death of Jesus, but they include: "not on the feast, so that there be no unrest among the people."[10]). -- This was decided when there were still 2 days to the Passover, Marc XIV: 1, that is, Wednesday evening, since the death passah began on Friday evening. There is further proof in the remark of Marc 15:21 about Simon of Cyrene[11]) who came from the field and was forced to carry the cross, that is to do work. It was a weekday, not a holiday. Marc mentions that Simon of Cyrene is the father of Alexander and Rufus as if these two men were well known to his readers. Therefore, reminiscence not imagination; history not Poetry. --

Whosoever wants to make an arriving pilgrim for the feast out of Simon, let him remember, that he could not be on the road anymore on the 15th. And if he should have been belated, the carrying of the cross, or the work would have been a transgression.

Older than the Synoptikers are the letters of Paul. 1 Cor. 5:7. Paul says: "Christ was offered as our Passover." The passage demands that Christ die at the time it was customary to kill the Passover Lamb, that is on the afternoon of the 14th. A Talmud Baraita says, that Jesus of Nazareth died on the eve of the Passah feast, that is the 14th. Jewish authors certainly ought to know better than Christians, what is possible according to Jewish law and custom and what not[12]). This date is founded also on the uncanonical Petrus gospel.

22.84 23 24 60 60 120

1.92 24 368 184 2208 94m

If the death year really were the 30th, then we would have to permit the shifting of the calendar by a day. To have the 14th Nisan fall on the 7th of April, a Friday, the first Nisan must fall on March 25 or begin in the evening of the 24th. According to the reckoning of Neugebauer, the new moon height was 20° at that time, it would have been 46-47 hours old and the moon went down 1^h34^m after the sun. Here one would have to get over the difficulty that the people notice by the moon, that the calendar is not correct [does not agree?].

In the year 29 according to AN 5745 the theoretical first Nisan fell on the 4th of April, the 14th Nisan fell on Sunday, April 17. To bring the 14th to a Friday there would have to be a two day shift toward the moon cycle. One would have to proceed as if the new moon had been seen on the evening of April 1, so that the first Nisan would come on April 2, the 14th on April 15. But new moon wasn't until April 2 at 7^h52^m in the evening. The year 29 is not possible without false new moon determining.

How unintentional new moon deceptions happen. Schoch, who personally observed over 100 new moons[13]), writes about erroneous observations to Schaumberger[14]): "In the spring the crescent moon stands horizontal to the horizon because of the steep position of the ekliptik. With very young new moons it looks like a very fine light thread from left to right. Now there are often reddish, yellow horizontal (never vertical) stripes on the horizon, which are often quite short (twilight strips in the atmosphere). This often happened to me, that in the spring when looking for young new moons, which are as fine as a thread, that for a moment I have believed that such a bright, fine, colored horizontal cloud stripe was the crescent moon, . . ."

This deception explains more than likely the notated assertion here and there that the old moon and the new moon had been sighted on the same day[15]).

New moon forgeries. The Pharisees on one side, the Sadducees and Boethusians on the other hand were continually of different opinion about the calendar. Also, in regard to the "Sanctifying the new moon" there were differences, that is why the Sadducees and Boethusians tried to mislead the Sanhedrin by false new moon witnesses[16]). The main point of controversy was the reckoning of Pentecost. Only when the 15th Nisan fell on a Sabbath as at crucifixion did the Pentecost season of the Pharisees coincide with that of the Boethusians. Then the people had the impression that the Pharisees had given in. Because of this the high church Party let no opportunity go by to bring the 15th Nisan on a Sabbath, or even to shift. To do this they did not hesitate to use bribed witnesses only to be able to set the new moon earlier. There is one case cited where the false witnesses were exposed. in Jerusalem. Talmud bring Schaumberger[17]). The Jews developed a whole theory about the false new moons; yes even a sort of casuitic back discovery, created for the case, when even on the day after the witnessing the new moon was still invisible, that is when the moon itself revealed the deception.[18]).

And later on when the Pharisees won the upper hand the calendar was still forged. Even at the beginning of the 3rd century A.D. the rabbis were still fighting as to whether to shift the new moon forward or backward toward the reality with false witnesses. Then, too, it happened that the old moon was still visible on the 29th[19]).

But at the death of Christ it happened that the 15th Nisan fell on a Sabbath, that is the day which was so much desired by the Sadducees and Boethusians. Because of this extraordinary circumstance, that is the great reason why we cannot depend on the theoretical exactness of the Jewish calendar in this case.

The Passover feast. On one side Jesus according to Paul is supposed to have died at the time the Passover lamb was slain. On the other hand He is supposed to have eaten the Passover lamb with His disciples. That is a serious difficulty. Some simply decide that the news about the Passover feast was simply an error on part of the synoptics.[20]). But even if we would accept this explanation, we would have to ask about the source of the error.

It lies again in the coincidence of the Sabbath with the 15th Nisan. On the 14th, Friday evening, the lamb was slain; the preparation would happen into the darkness, that is into the Sabbath. One was not permitted to cook on Sabbath. But the Passover had to be celebrated. According to the "Halacha", which was revised by the Pharisees at the time of Hilels, that is B. C. one held to the rule: "The Passover sacrifice sets aside the Sabbath law." According to the old "Halacha," to which the priests held until the destruction of Jerusalem, the Sabbath had the preference. If the 14th Nisan came on the day before the Sabbath, the lamb was killed on the 13th, that is Thursday evening, so as to eat it the following evening[21]). Galiläa adhered to this strict rule, so it was possible for Christ to eat the Passover feast with His disciples on the 13th, Thursday evening. Later on when one thought of putting down in writing what had happened, Marc mechanically set the Passover feast on the usual date, the 14th Nisan, and the Holy Friday on the following 15th Nisan.

Dr. J. Klausner, from whom I am taking these new ideas in this exposition is Ordinarius of History at the University in Jerusalem, that is he is especially versed and capable in this matter. Chwolson[22]) already pointed out in 1892 the possibility that the Passover could be eaten in Jerusalem on the 13th as well as on the 14th.

I own the "hand copy" of Schoch with his and Schaumberger's essay. The quotation of Chwolson is underlined in red by Schoch's himself, 9 lines are underscored and on the margin is written in Schoch's own hand this remark: "very enlightening--this explains the crucifixion on the 14th Nisan."

Here is another remark of Schoch's on the death day of Jesus:

The darkness of Flegon. It was complete for Nicäa on the 24th Nov. A.D. Eusebios, who was Bishop of Caesarea in Palestine 314-340 takes the connection of the darkness to the death of Jesus from Flegon's "Olympiades;" Julius Afrikanus does this also. Schoch is more correct when he says that this is an error of the old chronologers[24]). Because an eclipse in November certainly had nothing to do with an event taking place in April. "In any case, I believe, however, it must have been handed down to these chronologists, that it (darkness) happened timely not far from the death year." -- Schoch uses this thought to decide between the year 30 and 33.

Flegon was a liberated one of the Caesar Hadrian (117-138). He persecuted the Christians, but accepted the apologies of Quadratus and Aristides. The apology of Quadratus has been lost, but that of Aristides is preserved[25]). Such writings in the library of the Caesar's may have been Flegon source.

The few remaining years of his life C. Schoch[26]), whose death in 1929 was a great loss to chronology, dedicated to this science and he made great corrections in the reckoning of eclipses. But Schoch's changes hardly affect the position of the shadow strip through Asia-Minor for the eclipse of Flegon. For comparison I quote the elements according to Ginzel as well as my own calculations (the second line below) with the help of the Neugebauersch chronology of 1929. The upper figures are those of Ginzel.

Eclipse of Flegon of Nov. 24, 29 A.D.

	Jul. Day	W.-Z.	P	L	μ	Y	U
Ginzel	1731978	9^h20^m4	171°327	240°860	324°52	0.7468	0.5440
Dittrich	1731978	9 44	171.5	240.9	326	0.735	0.542

Schoch himself calculated the north and south border of the shadow for the eclipse of +29 Nov. 24 (Nicea)[27]). If you enter his figures into the Ginzel map the shadow is shifted about 2/3 of its width to the south. The eclipse is a little big greater, therefore, for Jerusalem and Galilee. It is not a total one in the localities mentioned. However, Schoch says in the passage quoted: "The eclipse becomes total for Nicea; the place lies 0°23 south of the northern boundary. According to Ginzel, Canon, Map X, Nicea lies close to the southern boundary line."

With Neugebauer's tables we find the greatest phase for Jerusalem is 11.5 digits south of the central curve at 11^h48^m, that is 12^m before noon real Jerusalem time. For the Sea of Genezareth ($\lambda = 35°6$, $\phi = + 32°8$) I find the phase 11.8 digits, 11^m before the real noon there. For Jerusalem the eclipse began by true Jerusalem time at 10^h24^m and ended 13^h32^m. Therefore it lasted 3^h8^m. Marc preserved the fact of three hours duration but confused the maximum at noon with its beginning. That is not strange since the sun must be fairly well eclipsed before it would be noticed at that time of the day.

The Flegon eclipse was after the death of Jesus. If this eclipse had taken place during His activities, as Schoch thought, surely the legends would have taken hold of it. Once a sign in heaven was demanded of Jesus according to Marc 8:12. Then also, the gospel writer betrayed in another text that the eclipse even to the knowledge of the gospel writer was after the death of Jesus Marc 15:32 mentions the darkness from the 6th hour (noon) to the ninth (3 P.M.). Luke 23:44 reproduces this and adds, that the sun lost its luster. Matthew brings the news at this place, 27:53, that after Christ's resurrection the bodies of the departed saints appeared in Jerusalem. This certainly is an exaggeration of the apparent horrors of an eclipse. In its gray twilight nature takes on a spooky unreal look, people are gray like corpses, etc. A notable parallel to the text in Matthew can be found in Homer's Odyssee XX, 351-357. The seer Theoclymenos says: "The sun is lost from heaven." Night covers the heads and faces, full of spectres is entrance-hall and great room, they are wandering to Erebos.

Already Plutarch decided upon an eclipse. Lately Schoch had tackled the problem in this light.[28]). He pointed out the eclipse of April 16, 1178 B.C. -- Favorable to this explanation is the fact that, as Plutarch remarks, according to Homer XIV.161 and XIX.306 is was new moon. Schoch draws from XVIII.366 that it was winter[29]).

I would like to interpret this quotation a little different. In the legend of the murder of the monks, originally the corpse-like appearance of the friars at the eclipse was used as a sign of their coming death. That is the way the seer explains it to them who is ridiculed for this explanation. The poet took this material over but did not quite understand it. That is why it resembles the above mentioned Matthew text.

Shifting of an eclipse in favor of an historical event happens. In the battle of Stiklestad on July 29, 1030 the holy king Olaf fell. To this day also was the eclipse of August 31 shifted even with a comparison of the happenings at the death of Christ. In this same manner eclipses of the sun were brought into connection with the death of popes[30]).

9/ An eclipse, no matter how poorly it has been noted down, is always a valuable notation for students of chronology. One should systematically gather all notations about the gospel eclipse. One was in the anti-gospel of Celsus[31]). Celsus does not believe in the coincidence of death, earthquake and eclipse, as the Ptolemik of Origines betrays.

Two chronological notations which have not been noticed up till now. Matthew 17:24, 27 tells how Jesus during His last stay in Capernaum paid half a sheckle for the temple treasury. On the 1st Adar the call for the payment was made, on the 15th the money changers came to the provinces and on the 25th Adar they settled at the temple. Klausner[32]). says: "Therefore, it was the middle of Adar, the most beautiful time in Palestine, when the rains are over and everything begins to bloom."

Mark 2:23 sets the pulling of the wheat head on Sabbath. Baumgarten[33]) says, that this narrative takes it for granted that the Passover is near. Chronologically important is this text if the activities of Christ were only very short. Then this Sabbath would be only a short time before the death Sabbath. Since the Veadar" was so intercalated that there really is ripe grain at the Passover[34]), the "ears-of-corn"-Sabbath points, against an equinox, for a late Passover.

Jesus travelled over Jericho to Jerusalem. Both cities lie 5 hours apart. Between Jericho and the Dead Sea lies a very warm valley, probably the scene of the happening. On an average the harvest falls there on April 1, Greg.= April 3, Julian. The variation interval of the harvest is less than in Central Europe[35]).

Summary. The death day of Jesus has not been uniformly fixed by the various statements. The discussion which has lasted centuries has not been without results. Formerly the death year was hunted in a whole decade, today only in the year 29 or 30. April 7 of 30 would be a welcome date for the planned calendar reform. According to the decision of 1925 of the League of Nations, Easter is to be fixed perhaps on April 8[36]). It would be rather embarrassing if Holy Friday would later on turn out to have been April 15, 29.

Stara Dala, Czechoslovakia E. Dittrich.

1st day of Passover = 15 Nisan = pp 10, 11.
See Draper's suggestions on back of last page

THE CRUCIFIXION OF CHRIST on 14 of NISAN

Karl Schoch

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Summary. ...

In BIBLICA, July, 1926, p. 296, in the article, "Messiah's Star," regarding the Jewish day of the month of the crucifixion, in case it took place in the year 30 A.D., I had expressed my agreement with the opinion presented by Oswald Gerhardt. (1) For Gerhardt in his book is trying to prove that the new light of the new moon - which started March 22 at eve 8:22 according to Jerusalem time - was visible for Jerusalem by the next evening, March 23, or after about 21.6 hours, which would make the first Nisan March 24 by starting both days, the Jewish and the Julian at midnight, although the Jewish begins six hours earlier or here on March 23 at sundown. Therefore, the fifteenth Nisan = April 7, which day was a Friday for it is absolutely certain that the day of the crucifixion was a Friday. Thus the main thing in this inquiry is to prove that in the years 28 to 34 in April, a Friday fell on the fourteenth or fifteenth Nisan.

Now, I am hereby expressly retracting my agreement with Gerhardt's opinion as stated in BIBLICA, July, 1926. I wish to prove, on the contrary, that in the year 30 A.D., Friday, April 7, fell on the fourteenth of Nisan and not on the fifteenth Nisan. For as soon as, in 1926, Dr. J. K. Fotheringham of Oxford had read my article in BIBLICA, he wrote to me at once stating that I must have made a mistake. According to his reckoning, the moon was not visible on the eve of March 23. In checking I now find that in my simple reckoning I made a gross, unpardonable mistake in the addition, making a difference of one and one-half hours. My new light tables are made up in such a way that the addition of several items gives the number of hours which necessarily must elapse from the moment of the new moon (black moon) until 6:00 P.M. the following day. If now the number of hours which have actually passed is equal or greater than the number of hours necessary, then the new light is visible the next evening; but in case it is smaller, the new light falls one evening later, that is, on the second day after a new moon. (2) In our case the number of hours necessary is 23.3 hours. (The "necessary" age of the crescent next evening at 6:00 P.M. Jerusalem time.) The number of hours actually passed by (the "real" age of the crescent) was only 21.6 hours, as already stated above. Consequently, not on March 23 but only on the eve of March 24, the crescent was visible in Jerusalem and the first Nisan = March 25, fourteenth Nisan = April 7, a Friday. Again I regret profoundly that due to my mistake in addition, I have expressed an erroneous opinion in such an important question.

Unfortunately now, I cannot avoid to bring up here astronomical matters but without such it is impossible to disprove the statements of Gerhardt.

II

The visibility of the new light, that is, the necessary age of the crescent, depends:

On the geographical latitude of the observer on the earth; also longitude

On the season of the year; also on the sun length (distance of the sun from the vernal point of the ecliptic); = Signs of Zodiac.

On the geocentric latitude of the moon;

On the average irregularity (g) of the moon in its course. [apogee or perigee]

Therefore the determination of the new light was one of the most complicated things in ancient astronomy because all four quantities always work together so the ~~four~~ new light is a function of the four variable quantities. Fortunately we can eliminate here two quantities, that is, the geographical latitude which is not variable but the constant in Jerusalem = 31.8°; also the sun length is constant - since it concerns merely the new lights of March and April - the sun length = 350° until about 15°.

Thus the visibility depends only on two factors:

1. On the geocentric latitude of the moon which determines how many degrees she stands above (+) or below (-) the ecliptic.

2. On the average irregularity (g) of the moon which determines at which point of the ellipse formed course of the moon around the earth she stands. If "g" is at about 0°, then she is in the perigee and moves very quicly to the left or east away from the sun; if "g" is at about 180°, then she is in the apogee and moves very slowly.

Now we two simple astronomical rules:

perigee

1. If, as here, in the spring the latitude of the moon ( ) = + 5°, = "g" at 0°, then the crescent can be visible in Jerusalem after 17 hours. Example: The new light on March 13, 1918, mentioned by Gerhardt on page 121, which was visible in Syria after 20 hours. There it would have been visible as early as after 17 hours. In Germany I have observed it, latitude 51°, after 22 hours. Here most favorable conditions prevail. Latitude = + 5° "g" equals 0°. (3)

2. If, as here, in the spring the latitude equals - 5, "g" at 180°, then the crescent is visible after 23.4 hours at the earliest. Example: The new light of the year 30 A.D. became visible not on March 23 but only March 24, because only 21.6 hours had actually passed.

In the spring perigee and apogee count more than latitude

It is especially worthy of note that in the spring the necessary age depends much more on the average irregularity of the moon, "g", than on her geocentric latitude; that is, it is much more important that the moon is distancing itself as quickly as possible from the sun so as to reach a

Unexplainable discrepances

certain elongation. The latter she reaches at the perigee in $17\frac{1}{2}$ hours; at the apogee, however, only in 23 hours. Contrary to this, in the spring a great positive latitude is less important, for then the ecliptic is already so suddenly arising in the evening against the horizon that the positive latitude only slightly increases the heighth of the moon above the horizon. (In the fall, August-September), on the contrary, the latitude is so important that a negative latitude of -5° raises the necessary age of the new light to about 41 hours.)

Not being an astronomer, Gerhardt, in determining the new light, has not given sufficient attention to these complicated conditions. Therefore he treats the new light of March 23, 30 A.D. in exactly the same way as that of March 13, 1918, although both stand in greatest contraposition to each other, the first under the most unfavorable, the latter under the most favorable conditions you can imagine. So the visibility on March 23, 30 is completely out of question and if Neugebauer thinks it possible he evidently quite overlooked the accompanying circumstances: The geocentric latitude of the moon very negative and the moon in her apogee. Personally, I have observed with my own eyes more than 100 new lights and figured out more than 400 of the new lights observed by the Babylonians, so that all my figures rest on a practical basis.

I shall now deal with the other error of Gerhardt - his theory of dating back which he develops on pages 124 and 130. Strictly speaking, it is not necessary to prove its impossibility for this theory takes for granted that when a new light which, for instance, was not visible at eve of 29th Adar, i.e., after the 30th, Adar had begun, in spite of this the Jews considered it as visible for the purpose of dating, provided it was seen the next evening before sundown, i.e. on the evening which closed the 30th Adar. According to Gerhardt, the Jews who observed the new light just as carefully as the Babylonians are supposed to have dated back a new light sighed at the eve of the 30th Adar (before sundown), giving Adar but 29 days instead of the proper 30 days. This dating back runs counter to all regulations and laws of the Babylonians and Jews on the new light and must be refused energetically. All theologians and historians must be warned not to accept this theory on dating back. For otherwise we could no more figure with certainty any new light of the Jews. For in Spring (February-April) every new light with an age of at least 34 hours is visible in Jerusalem before sundown, but no one would ever think of having the first of the month start one day earlier on that account. Even in Berlin (latitude 52.5°) in spring every new light of 36 hours standing is visible before sundown. This theory, which contradicts every ancient new light observation, Gerhardt, due to a complete misunderstanding, has erroneously taken from Maimonides. The quotations from Maimonides refer to the following case: Assuming that on the eve of the 29th Adar in Jerusalem a new light otherwise visible was not visible due to clouds, but it was seen at a place (say) 30 km away from Jerusalem where the sky was clear. From this place now in the course of 30 Adar witnesses came to Jerusalem whose statements were examined. In case they were worthy of credence, in the course of 30 Adar this day was subsequently sanctified, i.e. it became the first Nisan because the crescent actually had been in Palestine on 29th Adar at eve. On the contrary, a new light not having been sighted anywhere in Palestine on 29th Adar was never used for dating back because it appeared on the 30th Adar <u>before</u> sundown; in this case naturally Adar had 30 days. Now the latter does not apply to Adar of the year 30.ᵃ It had 30 days. 1 Nisan was March 25 and 14 Nisan was Friday, April 7. Thus the question of this important year is settled and every possibility to bring the 15 Nisan in that year on April 7 is disproved.

I have been asked to give for the important year 30 the exact astronomical reckoning with regard to the visibility of the new light at the eve of March 23 in Jerusalem. For the proper understanding of this example I refer historians and theologians to my "Planet Chart for Everybody" (published by Linser Verlag, Berlin-Pankow, 1927) Column XXXVIII and XLIII where the same example is given with detailed explanation for Babylon. As the name indicates, any one without knowledge of higher mathematics and astronomy can work with these tables or charts because with the aid of more than one hundred easy-to-understand examples from all spheres of astronomy, every phenomenon is worked out in elementary manner. There are no logarithms nor trigonometric formulas.

As to this example, I can give here but briefly the following explanation. On page 14 of my chart on the small table K, I have shown the value of "h" (heighth above the horizon) of the moon necessary in view of a certain Azimuth difference between the sun just setting and the moon standing at height "h" over the horizon to the left of the sun, - derived by more than 300 new lights observed by the Babylonians and in excess of 100 sighted by myself. As is evident in the example, the equals 5.4°, and the necessary height "h" of the moon must then be 10.2°. The reckoning for the moon on March 23 at 6.1 o'clock Jerusalem time (setting of sun without refraction) reveals, however, but a height "h" = 9.3° above the horizon of Jerusalem. Consequently the crescent stood 1° too low and could not be sighted after sundown in the evening twilight. Thus the new light appeared only March 24.

With the new light of March 13, 1918 easily observed in Syria (3) 21 hours after new moon, and just as easily observed by me under the high northern latitude of 51°, for Jerusalem the Azimuth difference of = 3.1°, the calculated heigth of the moon above the horizon amounted to fully 12.5° or 3.2° more than in the year 30. Furthermore, in the first case the crescent was two times brighter than in the latter, so that it is difficult to understand how Gerhardt could call these two so fundamentally different new lights identical.

Year 30, March 23, new moon March 22, 8:22, Jerusalem. Was the new light visible after 22½ hours at the evening of March 23 ?

S u n		M o o n (figured at 6.1 hours n. March 23)			
L	N	L	I	N	Θ
18.8°	35°	280.7°	51°	9.1°	176.3°
0.4	359	69.5	314	115.9	116.0
316.2	34	57.4	308	30.6	3.1
22.7	L + N	303.1	260	0.9	1.2
0.7		10.0	8	156.5	296.6
L 358.8	t 358.6	0.4	221	L 1.4	10.7
L′ + 1.9	t′ 92.2	0.3	g 158	158.	u 307
⊙ 0.7	t 90.8	L 1.4	II 19		II 19
	a 11.4	8.5			u − II 288
	s 79.4	0.8		− 4.3	
Setting of sun		10.7		0.3	Moon
6:08 n Jerusalem		a′ + 1.6		− 4.0	Az₀ 70.5
= 6:01 n. March 23		a″ − &0.9		+ 4.6	Az 14.4
		a 11.4		+ 0.6	Az 84.9
					Sun Az 90.3
					5.4°

Heighth h of the moon at setting of sun equal 9.3°.

But at an Azimuth difference of = 5.4° for the visibility a height h = 10.2° is necessary. Crescent is invisible and the new light only on March 24 at eve. 1 Nisan = March 25.

I now come to the year 31 A.D. when the new moon for the Nisan new light came on April 10, 2:10 in the afternoon, Jerusalem. After 28 hours, on the eve of April 11, at this time of the year, every new light is quite easily seen in Jerusalem, even when the latitude of the moon is negative and she is in her apogee. 1 Nisan = April 12; 14 Nisan = April 25, Wednesday; 15 Nisan = April 26, Thursday. Here the objection could be raised that due to unfavorable weather the new light could not be seen April 11 but only on April 12 at evening. We then would have: 1 Nisan = April 13; 14 Nisan = April 26, Thursday; 15 - Nisan = April 27, Friday, so that the year 31 could be the year of the death. This objection, however, can be easily disproved for, as stated above, in April, in Jerusalem, it is very easy to see every new light after 28 hours. Besides, the cloudiness on April 11 could not have been very great, for an average of several years reveals the following amount of precipitation in millimeters. In the months omitted the precipitation cannot even be measured. April has but 38 mm (about as much as in Germany on the average), falling mostly during the first part of April and that in short heavy showers. Thus it is quite impossible that on the eve of April 11 of the year 31 in Jerusalem and surroundings, the sky could have had such a dense cloud-cover as to prevent the visibility of the new light. Since in Aleppo and Babylon similar amounts of precipitation have been measured, I have given in my tables, Column XLII, the time when the sky is but slightly cloudy in Babylon as from April 15 to November 10, Gregorian reckoning.

Mo.	mm
Oct.	10
Nov.	59
Dec.	146
Jan.	165
Feb.	127
Mar.	104
Apr.	38
May	6

In the year 33, 1 Nisan could come only on March 21 (new light after 29 hours!). Since for the other years everything is quite clear, we can now determine the 14 and 15 Nisan in the corresponding Julian days of the month and the day of the week for the years 28 to 34 A.D. The crucifixion can have taken place only on a 14 or 15 Nisan which fell on a Friday. I differ from Gerhardt in the following: As to the year 30 in principle; as to the year 28 on the intercalation (which for our purposes is of no significance); as to the year 31 in my unequivocal interpretation of 1 Nisan. According to my assumption, a Veadar (the Jewish intercalary month) fell in the years 28, 31, 34 (see my "Planetary Charts for Everybody", column XLIII). (5) In the following table I now give in the first column, the year; in the second, the day, hour and minute when the new moon (black moon) enters in local Jerusalem time, the day beginning at midnight and v standing for forenoon, n for afternoon. In the third column, the Julian day of the month of the first Nisan is given, both days here beginning at midnight, although the Jewish begins six hours earlier, i.e., at sundown of the previous Julian day of the month. After that follows the Julian day of the month and the week day of the 14 and 15 Nisan.

1 Nisan	New Moon	1 Nisan	14 Nisan	15 Nisan
28	13 April 4:34 n	15 April	28 April, Wednesday	29 Thursday *
29	2 April 7:55 n	5 April	18 April, Monday	19 Tuesday
30	22 March 8:24 n	25 March	7 April, Friday	8 Saturday
31	10 April 2:10 n	12 April	25 April, Wednesday	26 Thursday
32	29 March 11:2 n	1 April	14 April, Monday	15 Tuesday
33	19 March 1:26 n	21 March	3 April, Friday	4 Saturday
34	7 April 2:10 n	9 April	22 April, Thursday	23 Friday

* Only in this year the accepted Veadar is questionable. In case no intercalation was made, the 14 Nisan was March 30, Tuesday, 15 Nisan, March 31, Wednesday.

For the day of crucifixion only the year 30, April 7, and the year 33, April 3, come into consideration because both fell on a Friday. Both correspond to the 14 Nisan. It is true that in the year 34 April 23 also comes on a Friday, corresponding to 15 Nisan. But is it at all possible to set the death of Christ as late as that ? In that case he would have reached an age of about 40 years at his death! Inasmuch as these dates depend on the new light and the calculation of the new light is a purely astronomical matter, astronomy is deciding that Christ could die only on one of the two days referred to. Consequently those are in the right who set the death of the Lord on the 14 Nisan on the basis of the gospel according to John. (6) However, Which of the two years is the correct one, only the historians and theologians can decide. If I, as an astronomer, should venture an opinion, I should like to agree with Gerhardt's view which is pointing to the year 30 as the correct one while in more recent times many defend the year 33.

My reasons for this again are of a purely astronomical nature. The known solar eclipse of the year 29, November 24, of which Phlegon reports, and which was a total eclipse in Nicäa is mentioned by Eusebius and others in connection with the death of Christ, but this is obviously an error of these chronologists, for an eclipse in November has nothing to do with events in April. In any case I imagine these chronologists must have assumed from tradition that as to time, the eclipse did not occur long before the year of Christ's death. Now, it is only four and one-half months earlier than the day of His death in the year 30 but almost three and one-half years earlier than the eclipse that occurred in the year 33.

All this research naturally has been made on the assumption that the Jews at the time of the death of Christ were observing their festivals in a strictly ritualistic fashion. By this I mean that the first Nisan was determined exactly according to the new light and that the first day of the passover festival fell on the 15 Nisan, irrespective of whether this was a Friday or a Sabbath. Furthermore, I consider it an impossible assumption that the Jews, for instance in the year 30, where the first and fifteenth Nisan (Passah) fell on Saturday (Sabbath), somehow moved the first Nisan, contrary to the new light observations. (6)

Karl Schoch

Berlin-Steglitz, August 20, 1927

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1. O. Gerhardt, "Messiah's Star," Leipzig 1922, Deichert'scher Verlag.

2. These new light tables, issued at Oxford in 1928, enable the historian, by simply adding the number of hours (with one fraction), to figure out quickly the new light for places between the 31° and 34° northern latitude (Jerusalem, Babylon, Ur).

3. The next similar favorable new light will take place on March 13, 1937. It is advisable to make observations on this evening under all geographical latitudes. The age of the new light varies between 16 and 23 hours after new moon, according to the geographical longitude of the place.

4. O. Gerhardt, "Messiah's Star," p. 121.

5. There I assumed that in the very warm lowland between Jericho and the Dead Sea the harvest of the winter barley begins about April 10, Gregor. (Leonhard Bauer, on the strength of personal observations, in VOLKSLEBEN IM LANDE DER BIBEL 2, 1903 edition, p. 141, also gives this day as the average date of the beginning of the harvest in the Jordan valley.) Now from my experiences as an agriculturist, I know that before a whole field is ripe to be cut, there are several smaller places with ripe ears. (Some agriculturists exaggerating even call barley "double timer" ?) These first ripe ears could easily have been brought in gleans to Jerusalem as early as March 31 (as the earliest 15 Nisan) and there presented as an offering April 1 (as the earliest 16 Nisan). Thus it is easy to show the intercalation with the ancient Jews.

6. Quae in Evangeliis Synopticis huic conclusioni adversari videntur proxima elucubratione discutiuntur (Nota Redactoris).

comment on Theophilus.

Page 24

Due to atmospheric refraction both sun and moon are each fully visible after they have geometrically set – so that a total eclipse of the moon may be visible to an observer while the sun is still fully above the horizon. Hence this follows (Anatolius).

The authority (Vol. I, page 4) should be substantiated by some ancient record. If chronology has to base its conclusions upon scribal errors or an emended text, ~~then~~ anybody's guess ~~good~~. We have Newcombe for authority ~~that we~~ that anybody's guess is good where ignorance is complete. It should be admitted by all that considerable confusion exists relative to ancient Jewish chronology. I ~~have~~ merely claim to have taken the records and have shown how they agree with ~~my~~ single premise. This premise is consistent with other dates (Anglican Review) my reckoning Parker's dates do not synchronize with the ancient historical dates, and therefore it remains for Dr Parker to show some historical date not in harmony with

It also remains for Dr. Parker to show foundation for his assumption in his tables.

7. In conclusion, I would mention that in my Planet Tables, page 15, tables P and Q can be made useful, especially for the Jewish calendar, as from 8 B.C. to 200 A.D. by eliminating in the Cycle table P, the cyclus + 9. By inserting instead the cycles

−	7	0
+	69	0
+	145	0

such a conformity to the Jewish calendar is reached that for this important time (the time of Christ and His disciples) of 200 years, probably only eight years cannot be worked out exactly. Then you can easily read off every Jewish date as the Julian date (within the nearest proximity).

The small table inserted in this Planet Chart (BIBLICA VIII, 482-4) has a printer's error at N. 2 (Hammurabi 39 = -.028). It should read: Tisri 30 = Oct. 26 Jul. = Oct. 11 Gregor. The end of the date harvest (i.e., the time when ripe dates could be had in big quantities) for central Babylon I have there set on Oct. 9. For Larsa which is more to the south it can be set on about October 8.

S/ Karl Schoch