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566TH ORDINARY GENERAL MEETING,

HELD IN COMMITTEE ROOM B, THE CENTRAL HALL, WESTMINSTER, ON MONDAY, MARCH 15TH, 1915, AT 4.30 P.M.

LT.-COL. G. MACKINLAY, CHAIRMAN OF COUNCIL, PRESIDED.

The Minutes of the preceding Meeting were read and confirmed.

The SECRETARY announced the election of Lady Jane Taylor, and of the Rev. J. W. Fall, M.A., as Associates of the Institute.

The CHAIRMAN said that the Institute was most fortunate in having for their consideration that afternoon a paper by Dr. A. M. W. Downing, for many years a Fellow of the Royal Society, and Superintendent of the Nautical Almanac. He greatly regretted that Dr. Downing was not able to be personally present with them, and in his absence would call upon the Secretary to read his paper on "The Determination of Easter Day."

THE DETERMINATION OF EASTER DAY. By A. M. W. DOWNING, M.A., D.Sc., F.R.S.

IN order to understand clearly the principles underlying the determination of the date of Easter in any year it is desirable, in the first place, to make ourselves acquainted with the definition of Easter given in the English Prayer Book. This definition has been handed down to us from the time of the Council of Nicæa, A.D. 325, and is designed to preserve, as nearly as possible, the same relation between the times of celebration of Easter and of the Passover as obtained at the time of the Resurrection, and especially that the former should not be celebrated before, or on the same day as, the latter; hence the second clause of the definition: "Easter Day is always the first Sunday after the full moon which happens upon, or next after, the 21st day of March; and if the full moon happens upon a Sunday, Easter Day is the Sunday after." This definition (though copied from the Act of Parliament which regulates the matter for us) requires a further explanation to make it perfectly clear. The "moon" referred to is not the

real moon of the heavens, but the artificial moon of the calendar, which, as we shall see later on, is regulated by certain definite rules by means of which its phases are made to agree pretty accurately with those of the real moon. This artificial calendar moon is accounted to be "full" on the fourteenth day, *i.e.*, thirteen days after the new moon; an artifice suggested by the practice prevalent amongst the Jews in early times of counting the "new" moon from the time of first visibility of the crescent, and considering it to be "full" on the following fourteenth day. This artifice secures an approximate agreement between the times of "full" (but not between the times of "new") for the calendar moon and the real moon of the heavens.

The decision of the Council of Nicæa, with regard to the celebration of Easter, ended what is known as the Paschal controversy, which had disturbed the Church for a great many years previously. Certain Asiatic Christians kept their Paschal solemnities on Nisan 14, and do not appear to have paid any particular attention to the following Sunday, as a commemoration of our Lord's Resurrection, except on those occasions on which it happened to be the "third day." The Jews, it will be remembered, killed the Paschal lamb on the fourteenth day of the first month, or Nisan 14, "between the evenings." It was then eaten during the following night, which would be the commencement of the day Nisan 15, according to the Jewish method of reckoning days. On account of their practice in this respect, these Asiatic Christians were called "Quartodecimans," and it is stated that they claimed the sanction of St. John the Apostle as their authority for their mode of celebrating Easter. On the other hand the Western Churches, from very early times, made the Sunday following Nisan 14 to be the central and chief day of the Easter solemnities, which for them lasted an entire week.

The Council of Nicæa decreed, then, that Easter Day should be a Sunday having a certain position with regard to the vernal equinox (then assumed to fall on March 21) and a certain position with regard to a specified full moon. This involves a consideration of three incommensurable quantities, the tropical year, the week, and the lunar month, which necessarily entails a considerable amount of complication. We shall find, however, that once the requisite tables are constructed, the process of finding the date of Easter is a perfectly simple one.

And first, with regard to the tropical year. The old style or Julian year was introduced by Julius Cæsar, with the assistance of Sosigenes, an astronomer of Alexandria, and is perhaps one

of the most remarkable achievements of that most remarkable man. The Roman year had previously been a lunar year, which of course requires constant readjustment by intercalation, to keep it in practical harmony with the solar year. In B.C. 46, it was found that the months were occurring far from the seasons with which they were supposed to be connected. It was necessary to make this "year of confusion" to consist of 445 days to get things right again. Cæsar wisely abandoned the lunar year altogether, but so far deferred to usage (it is said) as to fix the commencement of his first reformed year on the day of the following new moon instead of on the day of the winter solstice. At all events a new moon actually occurred on January 1, B.C. 45. The mean Julian year consists of $365\frac{1}{4}$ mean solar days; and as a year suitable for everyday purposes cannot contain fractions of a day, the rule adopted was that three years in succession should consist of 365 days, and that every fourth year should consist of 366 days. Thus the average length of each of the four years is $365\frac{1}{4}$ days. The year of 366 days is called "bissextile" because the additional, or intercalated day, was inserted after February 24, and, in the Roman method of reckoning, this day is the sixth day before the Kalends of March. So that in every fourth year there were two "sixth days" before the Kalends of March, and hence the name "bissextile." "Leap year," the other and more familiar name for the year of intercalation, is so called because the day of the week corresponding to any particular day of the month, after the intercalary day, advances two places with reference to its position in the preceding year, instead of one place as in ordinary cases. Thus January 1, 1916, is a Saturday; but since 1916 is a leap year, January 1, 1917, is a Monday, instead of being a Sunday, as it would have been had 1916 been a common year.

The Julian calendar has thus the merit of great simplicity, but unfortunately, as time went on, it was found to be subject to considerable inaccuracy, and it was considered that reformation was desirable. In the middle of the 16th century it appeared that the spring equinox, which ought to have occurred on March 21 (the day on which it was assumed to have occurred at the time of the Council of Nicæa) actually occurred on March 11. Luigi Lilio, a native of Calabria, found the error of the mean Julian year to amount to about three days in 400 years. His scheme, submitted to Pope Gregory XIII, was that ten days should be dropped, so as to bring the equinox up to March 21 again, and that a more accurate length of the mean

year should be adopted. The Pope referred the matter to a commission, the principal member of which was a German Jesuit named Schlüssel, better known by his Latinised name of Clavius. It was decided, in order to bring up the spring equinox to what was considered to be the proper date, that the day after October 4, 1582, should be called October 15, and in order to correct for the assumed error in the length of the mean Julian year, of three days in 400 years, that the centennial years should be counted as leap years only when the number of centuries is divisible by four. Thus the years 1700, 1800, and 1900, which in the Julian calendar are leap years, are common years in the reformed calendar, whilst the year 2000 is a leap year in both calendars. The Gregorian calendar was immediately adopted in Roman Catholic countries, but the old style remained in force in England until 1752. The accumulation of error in the Julian reckoning having by that time amounted to eleven days, it was decided that the day after September 2 in that year should be called September 14. It will be noted that this change does not involve any change in the week-days, but only in their numeration as days of the month. Wednesday, September 2, was followed by Thursday, September 14. And in Russia and Greece, where the old style is still continued, the day of the week is the same as with us, only the day of the month is different. Thus Monday, March 15, new style, corresponds to Monday, March 2, old style, the difference of the styles now amounting to 13 days.

It will be found that the mean length of the Gregorian year is 365·2425 days. The actual length of the tropical year being 365·2422 days, the error of the mean Gregorian year amounts to 3 ten-thousanths of a day, or 26 seconds, *per annum*, or to one day in about 3,300 years. This is sufficiently accurate for practical purposes. It may, however, be pointed out that as the error of the mean Julian year amounts, with great exactness, to one day in 128 years, greater accuracy would have been attained by following the rule that one intercalary day should be dropped in every such period. But the practical inconvenience of this arrangement would be much greater than that of the Gregorian rule, for which the increased accuracy would scarcely be a sufficient compensation.

It must be understood that the difference of styles causes a great deal of trouble, and is always a possible source of confusion to those who have to take account of it. And many a time astronomers and chronologists are constrained to wish that Pope Gregory and his advisers had adopted the alternative

scheme of assigning the spring equinox to March 11, instead of dropping ten days of the year. But the idea that the spring equinox had been assigned to March 21 by a Church Council was too firmly rooted in men's minds to be disregarded, and the opportunity of effecting a simple and natural reformation of the calendar was lost for ever. That great astronomer, the late Professor Newcomb, boldly asserted that, in his opinion, the so-called reformation of the calendar was a mistake; that it would have been far better to have adhered to the Julian style rather than that people should be worried by the inconvenience caused by the break of continuity. His view was that the change of the seasons relatively to the civil date, consequent on adherence to the old style, would progress so slowly as not to cause any practical inconvenience to the general public.

It is worth noting that our calendar does not rigidly fix the actual spring equinox to March 21; there is an oscillation backwards and forwards extending over two days. At the present time the equinox frequently occurs on March 20.

The next point to engage our attention is the determination of the day of the week corresponding to a given day of the civil month in a given year. To find Easter Day we must know what days of the year are Sundays. This is accomplished by means of the Dominical Letters, the use of which, as adopted in the Prayer Book calendar, we must now consider.

The Dominical, or Sunday, Letters are the first seven letters of the alphabet attached to the several days of the year: A to January 1, B to January 2, C to January 3, and so on, over and over again, throughout the year. No letter is attached to February 29, the intercalary day in the English Ecclesiastical and Civil Calendar. To find the Sundays throughout the year (for a common year) it is then only necessary to note what letter is attached to the first Sunday in the year, and every day throughout the year to which that letter is attached is a Sunday, and the letter is called the Dominical, or Sunday, Letter for the year. Thus January 3, 1915, was a Sunday, therefore C is the Sunday Letter for 1915, and every day in the year to which the letter C is attached in the calendar is a Sunday. In leap years the same letter (D) applies to February 29 and to March 1, so that after February 29 the Sunday Letter for the year retrogrades one place. There are thus two Sunday Letters in a leap year: one from the beginning of the year up to February 29, and the other for the remainder of the year. For example, in 1916 the Sunday Letters are B A. As a common year consists of 52 weeks plus one day, and a leap year of 52 weeks plus two

days, it is evident that from one common year to the next, the Sunday Letter retrogrades one place, whilst after a leap year the Sunday Letter retrogrades two places. It appears, then, that knowing the Sunday Letter for any year—knowing for instance (as all chronologists ought to know) that January 1, A.D. 1, was a Saturday, with corresponding Sunday Letter B—it is easy to write down a formula from which the Sunday Letter for any other year may be found. A number, occurring in this formula, has to be modified from time to time so as to adapt it to cases of the occurrence, or non-occurrence, of leap years in centennial years of the Gregorian calendar. This formula, translated into ordinary language, with the necessary modifications during successive periods, and the corresponding scale, is given in the Prayer Book calendar. It is not necessary, therefore, to dwell further on this point, except to note that in leap years the Sunday Letter so found will be the second letter for the year, the first being the preceding one in the Prayer Book scale referred to above.

We now come to the most complicated of the problems connected with the determination of Easter Day. To carry into effect the decree of the Council of Nicæa it was necessary to determine the fourteenth day of the moon. But the Council did not say how this fourteenth day was to be found, the duty of determining it being assigned to the Bishop of Alexandria. This arrangement naturally caused a good deal of dissatisfaction to the ecclesiastical authorities at Rome. It was considered derogatory to the Papal See, and efforts were made to render the Western Church independent of Alexandria. This eventuated, in A.D. 437, in the decision arrived at by Hilarius (afterwards Pope), that the moon which governed the date of Easter should not be the real moon of the heavens, but should be an artificial moon supposed to move regularly, and that the full moon should be accounted as occurring on the fourteenth day. The phases of this artificial moon were to be computed by means of the Golden Numbers of the Metonic Cycle, on the assumption that 235 lunations are equivalent to 19 solar years. This artificial moon, and the corresponding Golden Numbers, are still used in the reformed ecclesiastical calendar in the way that must now be explained.

The Golden Numbers are the numbers attached to each year of a cycle of nineteen years, after which the calendar new moons fall on the same days of the Julian year. Thus, if a new moon falls on January 1 in any year, it will again fall on January 1 after a lapse of nineteen Julian years, and to each

of these years the same Golden Number would be attached. This cycle is said to have been discovered by Meton, a celebrated Athenian astronomer, about the year B.C. 433, and was called from him the Metonic Cycle; and the successive years of the cycle, with the dates of the new moons corresponding to each year, were inscribed in characters of gold upon the walls of the temple of Minerva. Hence the origin of the name "Golden Numbers." In the distribution of the Golden Numbers over the successive years of the Metonic Cycle, it was assumed (as indeed was an actual fact at the date of the Council of Nicæa) that a new moon fell on January 1 in the third year of the cycle. The year 0 (or B.C. 1) of our era is reckoned the first year of the cycle; therefore, to find the Golden Number for any year, "add one to the year of our Lord, and then divide by 19; the remainder, if any, is the Golden Number; but if nothing remaineth, then 19 is the Golden Number," to quote the words of the Prayer Book rule.

The determination of Easter by this system made it recur, under the Julian calendar, after each period of 28×19, or 532 years. This period was called the Paschal Cycle. It was used as a practical means of finding the date of Easter, for a long time before the introduction of the Gregorian calendar.

Before the change of style was introduced into the ecclesiastical calendar it was the practice to attach their proper Golden Number to each of the 235 days of the year which were the computed first days of lunations. Twelve of the Numbers appeared twelve times, and seven appeared thirteen times. This left 130 days in a common year, and 131 in a leap year, without any Golden Number. There are, therefore, this number of days in the year upon which the first day of an artificial lunation does not occur. But in the reformed calendar, as now given in the Prayer Book, a different plan is adopted. It was considered more convenient to indicate the fourteenth day of the calendar moon (being the day of "full" moon) rather than the first day, and it was considered unnecessary to indicate other fourteenth days except those, nineteen in number, which fall in the respective years between March 21 and April 18, both inclusive. It was found that the fourteenth day of the Easter moon must fall between these limits—hence called the "Paschal Limits"—and that Easter Day must consequently fall on one of the thirty-five days, March 22 to April 25, both inclusive. There are thus only thirty-five possible forms of the ecclesiastical almanac. With regard to the accuracy of the Metonic Cycle as a practical means of

representing the dates of phases of the moon, it is assumed that 235 calendar lunations (of thirty or twenty-nine days' duration, combined in a certain proportion) are equal to 6,939¾ days, which, again, are equal to nineteen mean Julian years; whence a mean calendar lunation equals 29 days 12 hours 44 minutes 25·5 seconds; being 22·7 seconds in excess of the mean astronomical lunation. But in adapting the cycle to the Gregorian style we have to take account of the assumed error of the mean Julian year, viz., three days in 400 years; and so (allowing for the centennial years not made bissextile in the new style) we find that the time of calendar full moon will advance (*i.e.*, fall later) three days in 400 years. Also it must be noted that 6,939¾ days are 1½ hour longer than 235 mean astronomical lunations, and therefore (on account of this error in the adopted length of the mean calendar lunations), the calendar full moons occur 1½ hour too late at the end of each cycle of nineteen years, or 1 day too late in 308 years. In the calendar it is assumed that the error from this cause amounts to 8 days in 2,500 years. And the correction necessary to keep the calendar full moons in fair agreement with the actual full moons is applied by subtracting 1 day from the date of calendar full moon whenever the error amounts to this quantity.

If we now examine the Prayer Book tables (which were drawn up by Bradley, and extend to the year 8500 of our era), we shall see that the Golden Numbers are affixed to different days at different periods of time, *e.g.*, the first Prayer Book table holds good until the year 2199, and after that a readjustment is required. This readjustment is really the application to the cycle of Golden Numbers of the two corrections referred to above. The first, *i.e.*, that depending on the difference between the Gregorian and the Julian style, consists in *adding* one day to the date of full moon, or shifting the Golden Numbers to a position one day later in each of the years 1700, 1800, 1900, 2100, etc., which are leap years in the Julian calendar, but are common years in the Gregorian style. The second correction referred to, *i.e.*, that depending on the error in the assumed length of the calendar lunation, consists in *subtracting* one day from the dates of full moon, or shifting the Golden Numbers to a position one day earlier in each of the years 1800, 2100, etc. So that the same system of Golden Numbers holds good from 1700 to 1899, another system holds good from 1900 to 2199, whilst yet another holds good from 2200 to 2299. An examination of the distribution of the nineteen Golden Numbers,

in the three successive periods mentioned above, will show clearly the manner in which the Numbers are shifted relatively to the different days comprised within the Paschal Limits. It will be noticed, for instance, that no Golden Number appears opposite to March 21 during the period 1900 to 2199. This means that no calendar full moon occurs on that day, and, therefore, that Easter Day cannot fall as early as March 22 during this period. A consideration of the Numbers affixed to April 17 and 18, during the successive periods, is very instructive, as exemplifying one of the peculiar artifices of which the framers of the calendar appear to be so fond. It will be observed that the Golden Numbers xvii and vi have not been shifted in passing from 1899 to 1900, although all the preceding Numbers have been brought down one day later in the series. Now the calendar lunations consist generally of thirty or twenty-nine days alternately, with certain modifications. In general, if a lunation terminates in January or March it is made to consist of thirty days, but if in February or April it is to consist of twenty-nine days. But a special rule is made for the particular case where a calendar full moon falls on either March 19 or 20. It is assumed that if a full moon falls on March 19, or earlier in March, then the April full moon will fall thirty days later. But if the March full moon is on the 20th, the April full moon will happen twenty-nine days later. Thus the calendar full moon of April will fall on the same day (April 18) whether the March full moon happens on the 19th or 20th of that month. To apply this to the particular case before us, it will be seen that during the period 1700 to 1899, the Golden Number vi is affixed to April 18, and that in the preceding lunation it would be affixed to March 19 (being two days earlier than the date to which xiv is affixed), thus giving an interval of thirty days in length. But during the period 1900 to 2199, the Golden Number vi is still affixed to April 18, although in the preceding lunation it would now be affixed to March 20. The interval, therefore, is, in this case, only twenty-nine days in length, in accordance with the artifice to which reference has been made. The framers of the calendar further determined that two full moons must not occur on the same date twice in a single nineteen-year period. And to avoid such a contingency, the device was adopted of putting back the date of a calendar full moon one day, when otherwise two full moons would fall on the same date; Golden Number xvii, which would otherwise have been affixed to April 18 during the period 1900 to 2199, is, therefore, put back to April 17, thus

avoiding collision with vi. An inspection of the "General Tables" in the Prayer Book, especially of "Table III," with its two horizontal lines allotted to each of the dates April 17 and April 18, will show how these artifices are carried through the calendar in the successive periods to which the tables apply.

These regulations confine the dates of the Easter full moons within the Paschal Limits, and ensure that Easter Day shall not fall later than April 25.

In the "Table of the Moveable Feasts for forty-six years" of the Prayer Book will be found the values of the epacts for the different years included in the table. No explanation of the use of these epacts, as a means of determining the date of Easter, is given in the Prayer Book, and in fact, no use is made of them. A few words of explanation may, therefore, be desirable, especially as it is recorded that Pope Gregory's advisers arranged the lunar cycle by the epact. But when the reformed calendar was adopted in England, Bradley preferred to use the Golden Numbers as arranged in the Prayer Book, and with which English-speaking people are, therefore, more familiar.

The epact, as now used in chronology, is simply the age of the calendar moon on January 1 in each year of the nineteen-year cycle. As twelve calendar lunations fall short by eleven days in general of a mean solar year, the epacts for successive years are formed as a rule by the addition of eleven to the value for the preceding year. Just as the Golden Numbers have to be shifted in position, so as to be affixed to different days in different periods, so the epacts have to be adjusted to the nineteen-year cycle, and to the Gregorian style, generally by the addition of a unit at appropriate intervals. By this means the calendar epacts are kept in harmony with the phases of the real moon. During the period 1900 to 2199, the cycle of epacts is that given in the Prayer Book table, referred to above, for the years 1900 to 1918 inclusive. When the addition of eleven to the epact for any year produces a number greater than thirty, this amount must be subtracted from the sum. Thus twenty-nine is the epact for 1900, and this is followed by ten as the value for 1901. It will be noticed that seventeen is the epact for 1918, the last year of the cycle, whilst that for the first year of the cycle is twenty-nine, a difference of twelve. This is an instance of the necessary readjustment of the epacts to which reference has been made above. It will also be noticed that twenty-six is the epact for 1916, following fourteen for 1915, and preceding six for 1917. This substitution of twenty-six for twenty-five is an artifice

corresponding to that employed in the arbitrary shifting of one of the Golden Numbers, as already explained, to prevent the occurrence of two calendar full moons on the same date twice during a single cycle. Such a collision would occur were twenty-five to be used as the epact in this place of the cycle of epacts which is at present applicable. This will be understood when it is explained that, to obtain the date of the Paschal full moon from the epact, it is necessary to subtract the amount of the latter from April 13, or its equivalent, March 44. Since the epact is the age of the moon on January 1, it is also the age of the moon on March 31, and as the date of full moon is found by adding thirteen days to that of new moon, the reason for the rule is evident. The application of this rule gives the date of the Paschal full moon directly if the epact is not greater than twenty-three. But when the epact is twenty-four, or greater, the number of days between the calendar full moons, with which we are concerned, must be added to the date so found. Thus when the epact is twenty-four, we find March 20 (by the subtraction from March 44), and must add twenty-nine days, which brings us to April 18 as the date of the Paschal full moon. An epact of twenty-five, or greater, brings us, by the necessary subtraction, to March 19, or earlier in March, as the case may be, and then, in accordance with the convention already explained, we must add thirty days to the date so found. The epact twenty-five would, therefore, bring us again to April 18, but as twenty-six is the value to be used, the adopted day of Paschal full moon is, in this case, April 17.

Although the explanation of these matters that has now been given may appear tedious, and the rules complicated, still, as was said at the beginning of the paper, once the requisite tables are available, their application is extremely simple and easy. Thus to find Easter Day in 1916: We have seen already that the Sunday Letters are B A; the Golden Number is xvii; the epact is twenty-six. Opposite to xvii in the table of Golden Numbers we find April 17, and the next Sunday is April 23. Or, if we prefer to use the epact, subtraction of twenty-six from March 44 gives March 18, the addition of thirty to this brings us to April 17, and, as before, the next Sunday is April 23. That is how to determine the date of Easter Day in 1916.

It will probably surprise those who have not considered the matter to find how the dates of Easter sometimes diverge widely according as we use the Julian or the Gregorian style for the determination.

The following comparison of dates for a few years will serve as an illustration.

Year.	Eastern Church.		Western Church.
	Old Style.	New Style.	
1913	April 14	April 27	March 23
1914	„ 6	„ 19	April 12
1915	March 22	„ 4	„ 4
1916	April 10	„ 23	„ 23
1917	„ 2	„ 15	„ 8

The equivalent new style date is added, in the case of the Eastern Church dates, for convenience of comparison with the Western Church dates. It is quite unusual for Easter Day in the two systems to occur on the same day in two consecutive years as they do in 1915 and 1916.

It will be understood that the various corrections and readjustments that have been enumerated are for the purpose of preserving a near agreement between the phases of the calendar moon and those of the real moon. The difference is seldom more than two or three days at most. But it is remarkable that, in some critical cases near the Paschal Limits, a difference of a few hours in the times of the phases sometimes makes a large difference in the date of Easter, according as we rely on the real or the calendar moon for the determination. Such a case occurred in 1905, to which it may be of interest to refer. In that year the real moon of the heavens was full at 4 hours 56 minutes Greenwich mean time on the morning of March 21. Therefore, if we were to depend on the real moon, Easter Day would have fallen on the following Sunday, March 26. But, actually, Easter Day in that year fell on April 23, because the calendar moon was full on March 20, and again on April 18; the latter date, therefore—that of the Paschal full moon of the calendar—causing Easter Day to fall on the following Sunday, April 23. In this instance the dates thus differ by four weeks according as we take the real or the calendar moon for our guide in determining them.

The adoption of the calendar moon for such purposes as fixing the date of Easter has certain practical advantages, such as applicability to every terrestrial longitude, that would not be present in the case of the actual moon. Thus, in the instance quoted above, in which the real moon is full at 4 hours 56 minutes Greenwich mean time on the morning of

March 21, we see at once that, for places adopting a time five hours west of Greenwich (the Eastern Standard Time of the U.S.A.) the moon would be full on March 20. And so, in the circumstances supposed, Easter would be celebrated on a different date, depending on the adopted time at different meridians. This inconvenience is avoided by adopting the artificial moon, no attempt being made in the calendar, either in the date of the vernal equinox, or in that of the full moon, to subdivide the day. These dates may, therefore, be considered applicable to every terrestrial meridian.

It has already been stated that the decision of the Council of Nicæa, with regard to the determination of Easter, established a close relation between the time of celebration of the Christian Festival and of the Jewish Passover. But under the reformed Jewish calendar, which has been in use since the year A.D. 358, this close relationship does not necessarily exist. For example, the following cases of discordance occur in the years that have elapsed from 1900 up to the present time :—

Year.	Easter Day.	Nisan 15.
1902	March 30	April 22
1910	„ 27	„ 24
1913	„ 23	„ 22

A brief consideration of the Jewish calendar may, therefore, be of interest.

It is known that in very early times the Jewish year consisted usually of twelve lunar months. But it was recognised even then that for the due observance of the religious ceremonies, many of which were ordained to be observed in relationship with certain seasons of the year, as well as on certain days of the lunar month, the year must be made a luni-solar one. The first effort in this direction was the intercalation of an extra month once in about every three years. Afterwards the more accurate system was adopted of intercalating seven months in every cycle of nineteen years. It appears fairly certain that from the first the new moons, and consequently the commencement of the months, were determined by observation. The moon was assumed to be new when the crescent was first visible, and this was considered to be the commencement of the first day of the month. A great deal has been made of David's statement (1 Samuel xx, 5), "To-morrow is the new moon," as evidence that a cycle, or some method of computation, was used

even in those early days. But there is no corroborative evidence that would warrant us in drawing such a conclusion. And the statement may plausibly be explained as meaning that the date of the last new moon being known, the date of the next one may be inferred with a considerable degree of confidence. The time of new moon, found from the first visibility of the crescent, must, however, have been subject to some uncertainty, especially during periods of unsettled weather. It appears that, under such circumstances, the Mohammedans, whose calendar is wholly lunar, do not postpone the beginning of the month beyond the third evening after the new moon is expected to appear. It would be natural to suppose that the Jews had some such regulation to guide them. But if they had, it does not appear that any record of the fact has come down to us. The month "Abib" (or "Nisan" as it was afterwards called), the first month of the Jewish ecclesiastical year, is of great interest to us on account of its connection with the Passover, and consequently with Easter. The concurrence of the month with the commencement of spring was ensured by the ordinance that a sheaf of barley was to be offered immediately after the Passover, on the sixteenth day of the month. When, in any year, it was found that the barley would not be ripe in time to be offered in the month which would, by anticipation, have been called Nisan, it was the practice to lengthen the current year by the addition of an extra month. The new year would then commence a month later than it would otherwise have done, thus allowing time for the barley to ripen. In later times the identity of the first month was fixed by its relation to the time of the vernal equinox. It is supposed that the new moon of Nisan was held to be that new moon that occurred nearest to the day of the equinox.

The practice of determining the time of new moon by observation and announcement by means of messengers sent out to surrounding places, appears to have been continued in Palestine up to the time of the Dispersion of the Jews, consequent on the destruction of Jerusalem in A.D. 70. It is significant that in outlying districts it was customary even before that event to observe two days for the celebration of the full moons, as there would necessarily be some uncertainty as to the actual day. And it seems necessary to conclude that some special arrangements must have been made, in the case of the large colonies of Jews that were settled abroad, *e.g.*, in Egypt, long before the Dispersion, to enable them to observe their religious ceremonies at the proper time. But after the

Dispersion it was found impossible to continue such a primitive system, and recourse was had to calculations, involving the use of a cycle, for determination of the times of observance of the religious festivals. These cycles were used up to the time of the reformation of the Jewish calendar by Hillel, in A.D. 358. In this system (which continues in use up to the present day), the Metonic Cycle of nineteen years, with which we are already familiar, is adopted as consisting of 235 calendar lunations. The adopted calendar lunation (in which the moon is reckoned "new" at the time of astronomical conjunction) is taken from the very accurate value of a mean astronomical lunation found by Hipparchus, and the calendar year is taken from the not so accurate value of the length of the tropical year found by the same astronomer. In the nineteen years of the cycle there are twelve common years consisting each of twelve lunar months, and seven embolismic years consisting each of thirteen lunar months. The common years consist of 353, 354, or 355 days; whilst the embolismic years consist of 383, 384, or 385 days. The orderly recurrence of the years of different lengths is regulated by elaborate rules. The observance of these rules ensures that the error of the Jewish reformed calendar accumulates very slowly. Assuming that it was correct in the year A.D. 358, when it was first established, the calendar dates are now about seven days later in the year, with reference to the sun, than they were at that time.

It is easy now to see why the dates of the Passover, according to the reformed Jewish calendar, sometimes fall in the month following that in which Easter occurs. It is the month preceding Nisan—the last month of the ceremonial year—that is duplicated in the embolismic years. This proceeding, of course, causes Nisan 15 to occur a lunar month later than it would otherwise have done, and frequently causes it to occur during the lunar month subsequent to that in which Easter is celebrated.

This cursory sketch of certain features of the Jewish calendar must not conclude without drawing attention to a very important rule with regard to the observance of the First Day of the Passover. This day is never allowed to fall on a Monday, Wednesday, or Friday. The prohibition is nowhere expressly stated in the Levitical Law, but it is a Rabbinical rule, which appears to have been made after the building of the second Temple. It is designed to prevent the occurrence of subsequent fasts or festivals on days when it would be

impossible to observe them properly without infringing some precept of the law. But the point to which it is desired to direct attention is that, if it were found that Nisan 15 would, in the ordinary course, fall on a Friday, then the celebration of the First Day of the Passover was postponed to the following day. The bearing of this rule on the much debated question of the date of the Crucifixion of our Lord is obvious, and it is proposed to add a few remarks on the subject, strictly from the astronomical point of view. Assuming that the day of the Crucifixion was a Friday—though even this has been controverted—we have to find in what years within practical limits (say between A.D. 29 and A.D. 34) the date of Nisan 14, counted from first visibility of the moon, would have fallen on a Thursday or on a Friday. A number of computers have applied themselves, from time to time, to the elucidation of this problem, some uncertainty necessarily being attached to the actual day of first visibility of the moon, in any particular case. On the whole it appears, however, that, so far as astronomy can help us in the matter, the evidence available seems to point to the years A.D. 30 and A.D. 33 as being possible years, and, moreover, as being the most probable years, of those that may be considered possible on historical grounds. In A.D. 30 a new moon would possibly have been visible on the evening of March 23. As the Jewish day commenced at sunset, Nisan 1 would accordingly fall on March 24, and Nisan 14 on April 6, Thursday. But it is more probable that this moon would not have been seen until the evening of March 24, thus making Nisan 14 to occur on April 7, Friday. In A.D. 33 a new moon would pretty certainly have been visible on the evening of March 20. Nisan 1 would therefore fall on March 21, and Nisan 14 on April 3, Friday. But the year A.D. 29, which has often been quoted by writers with apparent confidence, as being the year of the Crucifixion, is an impossible one from the astronomical point of view. Nisan 14 fell in that year on either a Saturday or a Sunday, according to the lunation that may be adopted as being the Paschal lunation. It will thus be seen how inconclusive the astronomical evidence necessarily is, but, so far as it goes, it supports the supposition that the Crucifixion occurred on Nisan 14.

We have already seen that the observance on a Friday of the religious ceremonies appropriate to Nisan 15 was prohibited by rule. We now find that independent evidence points to the conclusion that the original Good Friday did not clash with the First Day of the Passover, but did coincide with the day on

which the Paschal lamb was sacrificed. It is well known that there is an apparent discrepancy between the accounts given in the Synoptic Gospels and the account given in the Fourth Gospel as to the day on which the Crucifixion took place: whether it was the First Day of the Passover (Nisan 15), or the preceding day (Nisan 14). It is suggested that —assuming Nisan 14 to have fallen on a Thursday in that year—an explanation of the apparent discrepancy may be found in the observance or non-observance of the Rabbinical rule as to Friday by different sections of the Jewish people (for instance the "rulers," and the "common people") at the time with which we are concerned. On the other hand, the assumption that Nisan 14 fell on a Friday—supported as it is by the astronomical calculations referred to above—accords with the Johannine account. It may be remarked, too, that the trend of modern opinion on the subject appears to be setting in favour of the date Nisan 14, rather than Nisan 15, as the day of the Crucifixion. This is, of course, quite independent of any considerations of an astronomical character, and is, after all, but a return to the view of the matter that was entertained by early Christian writers generally.

But the lengthy explanations given in this paper may reasonably be held to be a strong argument in favour of a fixed Easter—a subject that has been again brought to our notice during recent years. And really there is a good deal to be said in favour of the practical convenience of the proposal, quite independently of the complications involved in the determination of the fourteenth day of a certain artificial moon. Without having the least sympathy with the changes in the week and in the month that have been proposed, we may heartily agree that Easter Day should be a Sunday in a fixed week. But it would be undoubtedly a breaking away from the system that has been handed down to us from the early days of the Christian Church, and the prejudices of those who look with dislike on all such changes would have to be overcome. Practical unanimity between Christians of all denominations, and of all nations and languages, would be very desirable, and very difficult to secure. But any independent action that would tend to our insular isolation in such a matter would be deplorable. It is stated that the late Pope (Pius X.) was prepared to give his favourable consideration to the project. The authorities of the Orthodox Church do not appear to have expressed their views on the matter. But if the proposal ever comes within the range of practical politics it may be urged,

from the astronomical point of view, that, as there is evidence that the original Good Friday fell either on April 3 (A.D. 33), or on April 7 (A.D. 30), the change to be effected should ensure that Good Friday should be the first Friday in April. This meets both the cases mentioned above, and Easter Day would then be either the first or second Sunday in April. But alas! "the time is out of joint." All such proposals must now, it is to be feared, be relegated to the Greek Kalends.

Discussion.

The Chairman, in opening the discussion, said:—Not only is the Victoria Institute happy in hearing such a paper as we have now before us, but it is also happy in the prospect of a good discussion. We have with us this afternoon a great historian, Dr. J. K. Fotheringham, and Mr. R. Pearce, a Member of Parliament much interested in questions of the calendar, beside our Secretary, Mr. Maunder, who is well known as an Astronomer. If Dr. Fotheringham is prepared to address us we should be greatly pleased to hear him.

Dr. J. K. Fotheringham said that the paper to which they had listened was full of interest, and some of the points raised in it were new to him. Others seemed to call for a little further comment, since in the short time devoted to the paper it was difficult to explain every detail fully, and a condensed explanation was sometimes misleading. Thus on p. 153 the definition of Easter given in the English Prayer Book was said to have been handed down to us from the time of the Council of Nicæa. The Council of Nicæa did not define any rule in the matter: that arose from a later interpretation of their action. No acts of the Council were now extant, but there was a letter of the Council to the Church of Alexandria, and another letter from the Emperor Constantine to the Bishops who had not been present at the Council, from which it appeared that the Council decided that Easter was not to be observed at the same time as the Jews, but in accordance with a certain number of Christian churches that observed it rightly. Churches that had observed Easter in accordance with the Jewish practice were exhorted to alter their custom, and a list was given of Churches who were in harmony. Unhappily, so far as we can ascertain, these Churches were not all in harmony, and the rule that in the course of some centuries won its way to general acceptance was that in use in

the Church of Alexandria. A century after the Council, it was assumed that the Bishop of Alexandria had been ordered to compute the date of Easter, but there is no mention in the letter to the Bishop that he was to undertake that duty. There is a tendency among men to attribute too much definiteness to our ancestors.

Again, on p. 153, the full moon which happens upon, or next after, the 21st day of March is referred to. It was not until A.D. 1700 that any attempt was made to regulate a mid-month festival by the astronomical full moon, for the obvious reason that to ordinary observation the moon remained practically full for two or three days together. The direction, therefore, was to observe, not the full moon, but the 14th day of the month; the moon was observed when new, and was supposed to be full 14 days later. We had, therefore, no right to find fault with the use of a "mean full moon," as that expedient was practically an original one.

In A.D. 1700, however, the German Protestants resolved that Easter should be determined from the actual full moon, as computed by means of the Rudolphine Tables, drawn up by Kepler. They soon, however, give up this plan on account of its complication, and adopted the simpler rule current in the Roman Catholic Church. When the Germans gave up the real full moon the Swedes, however, adopted it, but have relinquished it since the middle of the nineteenth century. He hoped that history would not repeat itself in this particular, and that there would be no alteration in the calendar which would lead to the founding of a new astronomical sect.

On p. 169, Dr. Downing referred to the suggestion for having a fixed Easter. This was no novelty: we learned from Epiphanius, in his Refutation of all Heresies, that the Cappadocians kept March 25 as Easter; others, the Quartodecimans, kept it on the 14th day of the month in which the 25th of March fell; St. Martin of Dumes, a sixth century father, who wrote a Treatise on Easter, noted that many Gallican Bishops kept Easter on March 25, that being assumed to be the day of the spring equinox; hence Lady Day (March 25) is still taken as the quarter day. The Montanists kept Easter on the Sunday which fell on or next after April 6, and were represented as declaring that Easter might thus fall from April 6 to April 13, though in reality it could only have fallen from April 6 to April 12; perhaps they erred in their arithmetic as well as in their faith.

On p. 155, it is stated that "the year of confusion" (46 B.C.), when the Julian calendar was established, consisted of 445 days; this is the statement given by Censorinus, who is followed by all German writers, but Dion Cassius gives 422 days for the year of confusion, and he is followed by all French writers. When the speaker last investigated the subject, he had come to the conclusion that the French were right: the Roman intercalary month was 22 or 23 days, and we are told that three months were intercalated on this occasion. It is nowhere stated that Julius Cæsar specifically designed that the new year should begin with a new moon; actually the new moon fell on January 2, 45 B.C.

The Julian calendar had been abused as being inaccurate, but this was undeserved. Julius Cæsar's Egyptian advisers determined the length of the year from observations of the heliacal rising of Sirius, and this was found to recur at an interval of $365\frac{1}{4}$ days exactly. The speaker felt that it had been a mistake at the time of the reformation of the calendar by Pope Gregory to fix the vernal equinox on March 21. Personally he felt very doubtful whether the Metonic Cycle was ever inscribed in characters of gold upon the walls of the Temple of Minerva.

Mr. R. PEARCE, M.P., said he felt much honoured in being invited to take part in the discussion upon Dr. Downing's able paper. His claim to speak on the subject lay in the fact that some two years ago he had brought forward a Bill for the reform of the calendar, based upon the fact that 52 weeks amounted exactly to 364 days, and that Easter Sunday could be fixed to the same date in all years; at least in Christendom, if Christendom would agree to a reasonable date. It would be of great advantage if this feast, which has been the subject of so much controversy in the past, could by common consent be fixed to one particular day. The history of the controversy was full of interest, as they had learned from the excellent paper which had been read before them that afternoon.

But Easter was observed long before the Christian era; its history went back further than either Dr. Downing or Dr. Fotheringham had indicated. Easter meant the dawn of the spring, and the determination of the vernal equinox. Easter was the same word as Esther or Ishtar, the great spring goddess of ancient Babylon; it was the same word as "East," the place of the sun-rising; and the word was similar in Hindu. The suggestion he had made for fixing

Easter would relieve them from the burdens which priestcraft had imposed and from the complications of the ecclesiastical calendar, which inflicted so much inconvenience and loss. Schoolmasters and parents wanted a fixed Easter, so that the school terms might not vary in length. The industrial classes also wished for it, as their principal holiday was taken at Whitsuntide, which depended upon Easter, and it was very inconvenient for them when they went for their holiday to Blackpool, etc., not to know beforehand what the weather would be like. But if you fixed Easter on the 1st or 2nd Sunday in April, you would please the children, the parents, the schoolmasters and the workers. But we could not have a fixed Easter because Christendom would not agree upon it. It would be of great advantage to have exactly 52 weeks in each year, and to call the remaining day a *dies non*, New Year's Day, not including it either in the week, or the month, or the quarter. This would simplify everything, as any given date in the calendar would always fall on the same day of the week, whatever the year. Of course in leap year there would have to be two extra days instead of one.

The SECRETARY then read the following notes, which had been received from the Rev. D. R. FOTHERINGHAM, F.R.A.S. :—

Page 155, line 3.—The old Roman calendar, in use before Julius Cæsar, was not lunar, except in the sense that all "months" are approximate lunations. It was quite an irregular and unscientific measure of time. No doubt the "Nones" and "Ides" are relics of the observance of the first quarter and the full moon. But the connexion between the moon and the calendar had long been lost, and was quite irrecoverable.

Dr. Downing is quite right in speaking of the introduction of the Julian calendar as one of the most remarkable achievements of that most remarkable man. It might have been noted in this connexion that, as the calendar came from Egypt, it was doubtless founded on the Egyptian calendar of *exactly* 365 days, without leap year. This calendar had been in use for more than four thousand years. And observations of Sothis (or Sirius) that had been carried on for nearly as long, revealed the error of a day in every fourth year. Hence the clever device of a leap year.

Page 155, line 11.—Julius Cæsar was not the only great Imperialist to select a new moon for a new epoch. Sir Edward Grey chose a new moon—being also a Friday—for the proclamation of the new

Sultan of Egypt last year. Doubtless the choice was intentional, a happy augury for the new reign!

Page 157, line 7.—I think we are all inclined to agree now with Simon Newcomb. The Julian calendar is the *only* calendar that has ever been in use throughout all Christendom, and it was so in use for more than a thousand years. It is a great pity that any change was ever made. As a matter of practical convenience the Julian calendar is better than the Gregorian; and if slightly further from the tropical year, it is nearer to the sidereal year. Let us hope the orthodox Russians will maintain it!

Page 158, line 5 (Jan. 1, A.D. 1).—There was confusion in the working of the calendar for some years. The Romans reckoned the fourth year (a leap year) inclusively, and thus made an average year of $365\frac{1}{3}$ days. Too many leap-year days having thus been accidentally inserted in the calendar, the Emperor Augustus discontinued the observance of leap year altogether for some time in order to restore the calendar to Julius Cæsar's intention. The result is that just over the period of the Christian era there is some discrepancy between the actual dates in use and the theoretical calendar dates.

There was an omission of two days in the fourth century, corresponding to the eleven days of 1752.

Page 166, line 14.—The Jews had a very simple precaution, and it worked very easily and satisfactorily. The average length of a lunation being *a little more than* $29\frac{1}{2}$ days, the rule was that no month could have less than 29 days, nor more than 30. Twenty-nines and thirties would come in approximate alternation, the thirties being a little more frequent. But two months of twenty-nine were not allowed to come together, nor *more than two* of thirty.

In practice it was only necessary to look for the crescent on *one* evening. If the crescent were seen then, the month would begin at once. If not, it would begin the next evening.

Page 168, line 32.—I think Dr. Downing is unquestionably right in rejecting the year 29. The weight of astronomical testimony seems to be as decisive against it as (in all the complexity of the circumstances) such testimony can possibly be made.

When it is added that the supporters of this date not only go against the available astronomical evidence, but are driven further to suppose an Easter *before the Vernal Equinox*, it would seem that the date must be abandoned.

The Latin Fathers (yet not the Greek) often give the year 29, yet always associate it with the date March 25, which was certainly not the true date. It seems to have been a common practice to put Church festivals on the 24th or 25th of the month—the eighth day before the Kalends—and three of our quarter days are so kept still. Now when once they had got the Crucifixion on March 25, they almost necessarily gave the year 29. For it was easy to see by the Julian calendar that in the year 29 March 25 was a Friday. The assumption of the wrong day led to the adoption of the wrong year. It is a pity that the error still persists in some distinguished quarters.

Page 170, end.—I should be sorry to see a fixed Easter. Our clocks and almanacs are but crutches for the use of an enfeebled age. The true clock and the true almanac are on the face of the sky. It is better to follow the sun and moon than the figures of a dial or the printed pages of a book.

In some of the Greek Churches it is the custom after nightfall on Good Friday to carry the Host in procession through the churchyard. The full moon shines on that procession even as the full moon shone on another procession, small and sad: when Nicodemus and Joseph of Arimathea, the faithful women and the Mother of our Lord bore His sacred Body from Calvary to the grave. For two nights the full moon watched over the sleeping Christ. It would be lamentable in this age of dulness to break the connexion between our astronomy and our Christianity, between our science and our faith, "to make a cockney holiday"!

Mr. WALTER MAUNDER said that Mr. Fotheringham had reminded them of that which they should always remember, *viz.*, "the true clock and the true almanac are on the face of the sky." Mr. Pearce had connected Easter with the Babylonian goddess Ishtar. There were Babylonian monuments which preserved the memory of a very simple method in use 6,000 years ago for identifying the new moon of springtime by a simple reference to the face of the sky. In the British Museum there were scores of little stone pillars, commonly known as "boundary stones," and on the top of these were three astronomical symbols—a new moon lying on its back, together with two stars. 6,000 years ago, when the new moon was seen setting together with the twin stars, Castor and Pollux, then the observers knew that the month of the spring equinox had begun. If the

moon set with the twin stars on the first evening of the month, or the second evening of the month, then the year would contain twelve months. If it was not till the third evening that it set near Castor and Pollux, the year would contain thirteen months.

This was a very simple observation, and it was sufficient for the needs of the ancient world for thousands of years. But then they did not try to introduce an artificial regularity into either the month or the year. It was very easy to assume that if we had been present at the Creation we could have arranged things much better than they were now ; we could have made the month exactly thirty days and the year exactly twelve months; but as things actually were, the month was not an exact number of days or of weeks, and the year was not an exact number of days, weeks or months, and by no possible device could we transform them, so as to make them commensurate.

But there was an advantage about the fact that the motions of the heavenly bodies were irregular and incommensurable. Mr. Pearce had said that we could save millions of pounds if we could make a more symmetrical calendar. Supposing that were true, which was much to be doubted, what was that saving when compared with the immense advantage to mankind which had arisen from the irregularities of the movements of the heavenly bodies? It was no advantage to any particular man to make things so easy for him that he never had to use his brains; it would have been no advantage to the race of men if God had given them no problems to work out. The problems presented by the irregularities of the movements of the heavenly bodies had given rise to the science of mathematics, and upon mathematics all our mechanical science, our physical science, our engineering, were built; that is to say, the whole body of our modern civilization.

Mr. H. P. HOLLIS called attention to the recurrence of any particular day of the year as Easter Day and the intervals between such successive recurrences. As an example, in this year April 4 is Easter Sunday. Easter has not happened on that day since 1858, fifty-seven years ago, but that particular date will be Easter Day in 1920, five years hence, and again in 1926, six years later. It is clear why an occurrence of the same date may happen after five years, if those five years include two leap years, for in that case the date (April 4) will again be a Sunday, so that one condition is satisfied.

The second condition is that the Paschal Full Moon should again be in the week preceding April 4, and after five years the date of the Paschal Full Moon is, in general, shifted only by four or five days, so that being in the week preceding April 4, in the one year, it is very likely to be so five years later. Similar reasoning applies to the six years interval, but the chance of a recurrence of date after this interval is less likely, because the date of the Paschal Full Moon is, in general, six days earlier than it was six years previously. On the other hand, an eleven-year interval is very frequent, because, in the first place, after an eleven-year period which includes three leap years, the dates of the calendar recur on the same days of the week, and secondly, as may be seen from one of the Tables in the Prayer Book, an addition of eleven to the golden number in general causes the Paschal Full Moon to be ante-dated by only one day, so that the chance of a recurrence of Easter on any date after eleven years is large. Remembering how often a period of nineteen years occurs in lunar matters, it might be surmised that there should be sometimes an interval of this length between occurrences of the same date for Easter, but obviously this cannot be so, for neither 3, 4 nor 5 added to 19, because of leap years, gives a total divisible by 7, so that dates do not recur on the same days of the week after a nineteen-year period. On the other hand 57 years is a rather frequent interval, the number being a multiple of 19. This may happen, as in the present case (1858–1915), because the non-occurrence of leap year at centennial years, as in 1900, leaves only 13 leap years in the period, and hence dates fall on the same days of the week in both terminal years.

Mr. Hollis added that this point of view might be trivial and unimportant, but it was not without interest to those vho dabbled in figures.

Mr. M. L. ROUSE said:—The Lord distinctly foretold that he would be "three days and three nights in the heart of the earth," even as Jonah had spent "three days and three nights" miraculously beneath the sea; and I cannot see how this could have been fulfilled unless he was put to death on a Thursday. Now John records that the Lord Jesus arrived at Bethany "six days before the Passover" (John xii, 1), which means six before the 15th of Nisan when the passover lamb was eaten, not six before the 14th, when it was killed, which was called "the preparation of the passover"

(ch. xix, 13, etc.); nor must the "six days" be reckoned as five, else there will not be found room for all the days afterwards mentioned. Therefore He reached that village home on the 9th of Nisan; and that must have been a Sabbath day, else He would have had to travel either to Bethany or to Jericho on a Sabbath day, which was contrary to a custom that He seems to have acknowledged (Acts i, 12). He therefore entered Jerusalem on the 10th of Nisan —the city in which He was to be sacrificed, on the very day that the passover lamb was shut up in the pen of its doom (Exodus xii, 3, 6); and that was a Sunday, as indeed the tradition of the Church holds it to be. On that day, as Mark tells us (ch. xi, 11), after "looking round about" upon the state of things in the Temple, He returned to Bethany. On the next day, Nisan 11, a Monday, He cleared the Temple of its traffickers, and, after answering objectors withdrew; on the next, Nisan 12, a Tuesday, He told the parable of the husbandmen, answered subtle questions and propounded one, gave a chain of prophecy to His disciples, and then said, "After two days is the feast of the passover" (Matthew xxvi, 2). That was, therefore, the evening beginning Nisan 13, which, after midnight, became a Wednesday; and on it we find recorded the feast and anointing at Bethany, the bargain of the betrayer, and the command to make ready a passover supper for Jesus and His disciples (vv. 3, 6, and 14 ff.). To this they sat down on the evening that ushered in the 14th of Nisan (v. 17), which after midnight became a Thursday; and on the afternoon of that Thursday the Lord suffered death [yielding up His spirit shortly after the ninth hour, at the very time when the passover sacrifice was by Divine decree usually made (Exodus xii, 6 marg.)].

The CHAIRMAN said, I rise to propose a hearty vote of thanks to Dr. Downing for his valuable lecture.

On page 168 of the paper, I demur to the statement that the date A.D. 29 is an impossible one for the Crucifixion from an astronomical point of view. This question depends upon the visibility of the new moon to the naked eye on the evening of March 4, A.D. 29, at Jerusalem. If it could have been seen, then that year must have been a possible one for the Crucifixion.*

* This subject has been discussed at some length recently, see *Monthly Notices of the Royal Astronomical Society*, May, 1910, on "The Smallest

It so happens that the first visibility of the new moon is not a matter of general importance to modern astronomers, and few observations have been made with that end in view. Dr. J. K. Fotheringham has, however, propounded a rough empirical rule, based on the records of 76 observations (six being of the old moon), that the new moon is never to be seen by the naked eye when its angular distance from the sun is less than 12 degrees, and then only when it is in the most favourable direction.

An old moon was, however, observed (among the above 76) when only 9·2 degrees from the rising sun and not in the most favourable direction. Dr. Fotheringham, however, dismisses this observation with the remark that it must not be considered, because the atmosphere is clearer at dawn than at sunset. But every practical astronomical observer knows that the clearness of the atmosphere at sunset varies immensely on different evenings which are cloudless, and this particularly affects the visibility of faintly illuminated celestial objects near the horizon.

Jerusalem is at a lower latitude than were the places at which the 76 observations were taken; consequently darkness comes on more quickly after sunset, and faintly illuminated heavenly bodies are more easily seen. Also it must be remembered that Jerusalem is about 2,600 feet above the sea; celestial objects near the horizon can there be seen with greater clearness than from the lower levels at which the 76 observations were taken, because there is a less density of air to look through.

On February 10, 1910, Mr. D. W. Horner, a well-known observer, and others at Tonbridge, saw the new moon with the naked eye at an angular distance of only about 10 degrees from the setting sun, the direction not being very favourable.

Visible Phase of the Moon," p. 530, by J. K. Fotheringham, M.A., D.Litt.; also a paper on the same subject in *The Journal of the British Astronomical Association*, May and June, 1911, by E. W. Maunder, F.R.A.S. Also *Journal of Theological Studies*, "Astronomical Evidence for the Date of the Crucifixion," October, 1910, p. 120, by J. K. Fotheringham. Various articles in *The Churchman* on the date of the Crucifixion, April, 1910, to November, 1912, by Rev. D. R. Fotheringham, J. K. Fotheringham, E. W. Maunder, F.R.A.S., Lt.-Col. Mackinlay, and Mr. Bothamley. Also *The Observatory*, April, 1911, p. 162, and *The English Mechanic*, May 5, 1911, p. 308. Letters by D. W. Horner.

The new moon on March 4, A.D. 29, was at about 8·8 degrees angular distance from the setting sun, but in a somewhat more favourable direction for visibility than was the one seen recently. In March, A.D. 29, it was thus only a little more difficult to see the new moon than it was at Tonbridge, where the conditions due to latitude, direction of the moon with regard to the sun, and the altitude of the observer were less favourable.

Would it be scientific to assert that no one could live beyond the age of 80, if it were found that no one out of 76 selected lives had attained that age? If just afterwards someone was found in an unhealthy place to be certainly (say) 85 years of age, could we not imagine that someone else in a more healthy place might even exceed that age a little?

The simile is a fair one to make: uncertainty of visibility and uncertainty of life may well be compared; in each case a very extended amount of data should be obtained before we venture to assert the impossibility of visibility or of life.

With the present scanty data at our disposal it is therefore rash to assert that the new moon of March 4, A.D. 29, was not visible to the naked eye at Jerusalem; in other words, A.D. 29 cannot be considered an impossible year for the Crucifixion from an astronomical point of view.

Much more can be said on this subject, but want of space prevents: so I shall finish as I began by asking you to accord a sincere vote of thanks to Dr. Downing for his instructive and interesting paper.

Mr. JOSEPH GRAHAM proposed a hearty vote of thanks to the visitors, Dr. J. K. Fotheringham, Mr. R. Pearce, M.P., and Mr. H. P. Hollis, whose comments had added so much to the interest and value of the discussion. Also to the Rev. D. R. Fotheringham for his letter.

Both votes were then put to the Meeting and were carried by acclamation.

The Meeting adjourned at 6.10 p.m.