So that

$$w = 6\left(\frac{Y}{7}\right)_r + 3\left(\frac{11\,Y + 3}{30}\right)_r \text{ (rejecting sevens),}$$

the values of which obviously circulate in a period of 7 times 30 or 210 years.

Let C denote the number of completed cycles, and y the year of the cycle; then $Y = 30\,C + y$, and

$$w = 5\left(\frac{C}{7}\right)_r + 6\left(\frac{y}{7}\right)_r + 3\left(\frac{11\,y + 3}{30}\right)_r \text{ (rejecting sevens).}$$

From this formula the following table has been constructed:—

TABLE VIII.

Year of the Current Cycle (y.)				Number of the Period of Seven Cycles = $\left(\frac{C}{7}\right)_r$ 0	1	2	3	4	5	6
0	8			Mon.	Sat.	Thur.	Tues.	Sun.	Frid.	Wed.
1	9	17	25	Frid.	Wed.	Mon.	Sat.	Thur.	Tues.	Sun.
*2	*10	*18	*26	Tues.	Sun.	Frid.	Wed.	Mon.	Sat.	Thur.
3	11	19	27	Sun.	Frid.	Wed.	Mon.	Sat.	Thur.	Tues.
4	12	20	28	Thur.	Tues.	Sun.	Frid.	Wed.	Mon.	Sat.
*5	*13	*21	*29	Mon.	Sat.	Thur.	Tues.	Sun.	Frid.	Wed.
6	14	22	30	Sat.	Thur.	Tues.	Sun.	Frid.	Wed.	Mon.
*7	15	23		Wed.	Mon.	Sat.	Thur.	Tues.	Sun.	Frid.
	*16	*24		Sun.	Frid.	Wed.	Mon.	Sat.	Thur.	Tues.

To find from this table the day of the week on which any year of the Hegira commences, the rule to be observed will be as follows :—

Rule.—Divide the year of the Hegira by 30; the quotient is the number of cycles, and the remainder is the year of the current cycle. Next divide the number of cycles by 7, and the second remainder will be the Number of the Period, which being found at the top of the table, and the year of the cycle on the left hand, the required day of the week is immediately shown.

The intercalary years of the cycle are distinguished by an asterisk.

For the computation of the Christian date, the ratio of a mean year of the Hegira to a solar year is

$$\frac{\text{Year of Hegira}}{\text{Mean solar year}} = \frac{354\frac{11}{30}}{365\cdot2422} = 0\cdot970224.$$

The year 1 began 16 July 622, Old Style, or 19 July 622, according to the New or Gregorian Style. Now the day of the year answering to the 19th of July is 200, which, in parts of the solar year, is 0·5476, and the number of years elapsed $= Y - 1$. Therefore, as the intercalary days are distributed with considerable regularity in both calendars, the date of commencement of the year Y expressed in Gregorian years is

$$0\cdot970224\,(Y - 1) + 622\cdot5476,$$
$$\text{or } 0\cdot970224\,Y + 621\cdot5774.$$

This formula gives the following rule for calculating the date of the commencement of any year of the Hegira, according to the Gregorian or New Style.

Rule.—Multiply 970224 by the year of the Hegira, cut off six decimals from the product, and add 621·5774. The sum will be the year of the Christian era, and the day of the year will be found by multiplying the decimal figures by 365.

The result may sometimes differ a day from the truth, as the intercalary days do not occur simultaneously; but as the day of the week can always be accurately obtained from the foregoing table, the result can be readily adjusted.

Example.—Required the date on which the year 1362 of the Hegira begins.

```
   970224
     1362
 --------
  1940448
 5821344
2910672
970224
 --------
1321·445088
 621·5774
 --------
1943·0225
      365
 --------
     1125
    1350
    675
 --------
   8·2125
```

Thus the date is the 8th day, or the 8th of January, of the year 1943.

To find, as a test, the accurate day of the week, the proposed year of the Hegira, divided by 30, gives 45 cycles, and remainder 12, the year of the current cycle.

Also 45, divided by 7, leaves a remainder 3 for the number of the period.

Therefore, referring to 3 at the top of the table, and 12 on the left, the required day is Friday.

The tables, page 670, show that 8th January 1943 is a Friday; therefore the date is exact.

For any other date of the Mahometan year it is only requisite to know the names of the consecutive months, and the number of days in each; these are—

Muharram, ...	30	Shaaban, ...	29
Saphar, ...	29	Ramadân, ...	30
Rabia I., ...	30	Shawall, ...	29
Rabia II., ...	29	Dulkaada, ...	30
Jomada I., ...	30	Dulheggia, ...	29
Jomada II., ...	29	and in intercalary years	30
Rajab, ...	30		

The ninth month, Ramadân. is the month of Abstinence observed by the Turks.

The Turkish calendar may evidently be carried on indefinitely by successive addition, observing only to allow for the additional day that occurs in the bissextile and intercalary years; but for any remote date the computation according to the preceding rules will be most efficient, and such computation may be usefully employed as a check on the accuracy of any considerable extension of the calendar by induction alone.

The following table, taken from Woolhouse's *Measures, Weights, and Moneys of all Nations*, shows the dates of commencement of Mahometan years from 1845 up to 2047, or from the 43rd to the 49th cycle inclusive, which form the whole of the seventh period of seven cycles. Throughout the next period of seven cycles, and all other like periods, the days of the week will recur in exactly the same order. All the tables of this kind previously published, which extend beyond the year 1900 of the Christian era, are erroneous, not excepting the celebrated French work, *L'Art de vérifier les Dates*, so justly regarded as the greatest authority in chronological matters. The errors have probably arisen from a continued excess of 10 in the discrimination of the intercalary years.

TABLE IX. -*Mahometan Years.*

43d Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1261	Frid.	10 Jan. 1845
1262*	Tues.	30 Dec. 1845
1263	Sun.	20 Dec. 1846
1264	Thur.	9 Dec. 1847
1265*	Mon.	27 Nov. 1848
1266	Sat.	17 Nov. 1849
1267*	Wed.	6 Nov. 1850
1268	Mon.	27 Oct. 1851
1269	Frid.	15 Oct. 1852
1270*	Tues.	4 Oct. 1853
1271	Sun.	24 Sept. 1854
1272	Thur.	13 Sept. 1855
1273*	Mon.	1 Sept. 1856
1274	Sat.	22 Aug. 1857
1275	Wed.	11 Aug. 1858
1276*	Sun.	31 July 1859
1277	Frid.	20 July 1860
1278*	Tues.	9 July 1861
1279	Sun.	29 June 1862
1280	Thur.	18 June 1863
1281*	Mon.	6 June 1864
1282	Sat.	27 May 1865
1283	Wed.	16 May 1866
1284*	Sun.	5 May 1867
1285	Frid.	24 April 1868

43d Cycle—*continued.*

Year of Hegira.	Commencement (1st of Muharram).	
1286*	Tues.	13 April 1869
1287	Sun.	3 April 1870
1288	Thur.	23 Mar. 1871
1289*	Mon.	11 Mar. 1872
1290	Sat.	1 Mar. 1873

44th Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1291	Wed.	18 Feb. 1874
1292*	Sun.	7 Feb. 1875
1293	Frid.	28 Jan. 1876
1294	Tues.	16 Jan. 1877
1295*	Sat.	5 Jan. 1878
1296	Thur.	26 Dec. 1878
1297*	Mon.	15 Dec. 1879
1298	Sat.	4 Dec. 1880
1299	Wed.	23 Nov. 1881
1300*	Sun.	12 Nov. 1882
1301	Frid.	2 Nov. 1883
1302	Tues.	21 Oct. 1884
1303*	Sat.	10 Oct. 1885
1304	Thur.	30 Sept. 1886
1305	Mon.	19 Sept. 1887
1306*	Frid.	7 Sept. 1888
1307	Wed.	28 Aug. 1889

44th Cycle—*continued.*

Year of Hegira.	Commencement (1st of Muharram).	
1308*	Sun.	17 Aug. 1890
1309	Frid.	7 Aug. 1891
1310	Tues	26 July 1892
1311*	Sat.	15 July 1893
1312	Thur.	5 July 1894
1313	Mon.	24 June 1895
1314*	Frid.	12 June 1896
1315	Wed.	2 June 1897
1316*	Sun.	22 May 1898
1317	Frid.	12 May 1899
1318	Tues.	1 May 1900
1319*	Sat.	20 April 1901
1320	Thur.	10 April 1902

45th Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1321	Mon.	30 Mar. 1903
1322*	Frid.	18 Mar. 1904
1323	Wed.	8 Mar. 1905
1324	Sun.	25 Feb. 1906
1325*	Thur.	14 Feb. 1907
1326	Tues.	4 Feb. 1908
1327*	Sat.	23 Jan. 1909
1328	Thur.	13 Jan. 1910
1329	Mon.	2 Jan. 1911
1330*	Frid.	22 Dec. 1911
1331	Wed.	11 Dec. 1912
1332	Sun.	30 Nov. 1913
1333*	Thur.	19 Nov. 1914
1334	Tues.	9 Nov. 1915
1335	Sat.	28 Oct. 1916
1336*	Wed.	17 Oct. 1917
1337	Mon.	7 Oct. 1918
1338*	Frid.	26 Sept. 1919
1339	Wed.	15 Sept. 1920
1340	Sun.	4 Sept. 1921
1341*	Thur.	24 Aug. 1922
1342	Tues.	14 Aug. 1923
1343	Sat.	2 Aug. 1924
1344*	Wed.	22 July 1925
1345	Mon.	12 July 1926
1346*	Frid.	1 July 1927
1347	Wed.	20 June 1928
1348	Sun.	9 June 1929
1349*	Thur.	29 May 1930
1350	Tues.	19 May 1931

46th Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1351	Sat.	7 May 1932
1352*	Wed.	26 April 1933
1353	Mon.	16 April 1934
1354	Frid.	5 April 1935
1355*	Tues.	24 Mar. 1936
1356	Sun.	14 Mar. 1937
1357*	Thur.	3 Mar. 1938
1358	Tues.	21 Feb. 1939
1359	Sat.	10 Feb. 1940
1360*	Wed.	29 Jan. 1941
1361	Mon.	19 Jan. 1942
1362	Frid.	8 Jan. 1943
1363*	Tues.	28 Dec. 1943
1364	Sun.	17 Dec. 1944
1365	Thur.	6 Dec. 1945
1366*	Mon.	25 Nov. 1946
1367	Sat.	15 Nov. 1947
1368*	Wed.	3 Nov. 1948
1369	Mon.	24 Oct. 1949
1370	Frid.	13 Oct. 1950
1371*	Tues.	2 Oct. 1951
1372	Sun.	21 Sept. 1952
1373	Thur.	10 Sept. 1953
1374*	Mon.	30 Aug. 1954
1375	Sat.	20 Aug. 1955
1376*	Wed.	8 Aug. 1956
1377	Mon.	29 July 1957
1378	Frid.	18 July 1958
1379*	Tues.	7 July 1959
1380	Sun.	26 June 1960

47th Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1381	Thur.	15 June 1961
1382*	Mon.	4 June 1962
1383	Sat.	25 May 1963
1384	Wed.	13 May 1964
1385*	Sun.	2 May 1965
1386	Frid.	22 April 1966
1387*	Tues.	11 April 1967
1388	Sun.	31 Mar. 1968
1389	Thur.	20 Mar. 1969
1390*	Mon.	9 Mar. 1970
1391	Sat.	27 Feb. 1971
1392	Wed.	16 Feb. 1972
1393*	Sun.	4 Feb. 1973
1394	Frid.	25 Jan. 1974
1395	Tues.	14 Jan. 1975
1396*	Sat.	3 Jan. 1976
1397	Thur.	23 Dec. 1976
1398*	Mon.	12 Dec. 1977
1399	Sat.	2 Dec. 1978
1400	Wed.	21 Nov. 1979
1401*	Sun.	9 Nov. 1980
1402	Frid.	30 Oct. 1981
1403	Tues.	19 Oct. 1982
1404*	Sat.	8 Oct. 1983
1405	Thur.	27 Sept. 1984
1406*	Mon.	16 Sept. 1985
1407	Sat.	6 Sept. 1986
1408	Wed.	26 Aug. 1987
1409*	Sun.	14 Aug. 1988
1410	Frid.	4 Aug. 1989

48th Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1411	Tues.	24 July 1990
1412*	Sat.	13 July 1991
1413	Thur.	2 July 1992
1414	Mon.	21 June 1993
1415*	Frid.	10 June 1994
1416	Wed.	31 May 1995
1417*	Sun.	19 May 1996
1418	Frid.	9 May 1997
1419	Tues.	28 April 1998
1420*	Sat.	17 April 1999
1421	Thur.	6 April 2000
1422	Mon.	26 Mar. 2001
1423*	Frid.	15 Mar. 2002
1424	Wed.	5 Mar. 2003
1425	Sun.	22 Feb. 2004
1426*	Thur.	10 Feb. 2005
1427	Tues.	31 Jan. 2006
1428*	Sat.	20 Jan. 2007
1429	Thur.	10 Jan. 2008
1430	Mon.	29 Dec. 2008
1431*	Frid.	18 Dec. 2009
1432	Wed.	8 Dec. 2010
1433	Sun.	27 Nov. 2011
1434*	Thur.	15 Nov. 2012
1435	Tues.	5 Nov. 2013
1436*	Sat.	25 Oct. 2014
1437	Thur.	15 Oct. 2015
1438	Mon.	3 Oct. 2016
1439*	Frid.	22 Sept. 2017
1440	Wed.	12 Sept. 2018

49th Cycle.

Year of Hegira.	Commencement (1st of Muharram).	
1441	Sun.	1 Sept. 2019
1442*	Thur.	20 Aug. 2020
1443	Tues.	10 Aug. 2021
1444	Sat.	30 July 2022
1445*	Wed.	19 July 2023
1446	Mon.	8 July 2024
1447*	Frid.	27 June 2025
1448	Wed.	17 June 2026
1449	Sun.	6 June 2027
1450*	Thur.	25 May 2028
1451	Tues.	15 May 2029
1452	Sat.	4 May 2030
1453*	Wed.	23 April 2031

49th Cycle—*continued.*

Year of Hegira.	Commencement (1st of Muharram.)		Year of Hegira.	Commencement (1st of Muharram.)	
1454	Mon.	12 April 2032	1463	Frid.	4 Jan. 2041
1455	Frid.	1 April 2033	1464*	Tues.	24 Dec. 2041
1456*	Tues.	21 Mar. 2034	1465	Sun.	14 Dec. 2042
1457	Sun.	11 Mar. 2035	1466*	Thur.	3 Dec. 2043
1458*	Thur.	28 Feb. 2036	1467	Tues.	22 Nov. 2044
1459	Tues.	17 Feb. 2037	1468	Sat.	11 Nov. 2045
1460	Sat.	6 Feb. 2038	1469*	Wed.	31 Oct. 2046
1461*	Wed.	26 Jan. 2039	1470	Mon.	21 Oct. 2047
1462	Mon.	16 Jan. 2040			

TABLE X.—*Principal Days of the Hebrew Calendar.*

Tisri	1,	New Year, Feast of Trumpets.
,,	3,[1]	Fast of Guedaliah.
,,	10,	Fast of Expiation.
,,	15,	Feast of Tabernacles.
,,	21,	Last Day of the Festival.
,,	22,	Feast of the 8th Day.
,,	23,	Rejoicing of the Law.
Kislev	25,	Dedication of the Temple.
Tebet	10,	Fast, Siege of Jerusalem.
Adar	13,[2]	Fast of Esther, } In embolismic
,,	14,	Purim, } years. Veadar.
Nisân	15,	Passover.
Sivan	6,	Pentecost.
Tamuz	17,[1]	Fast, Taking of Jerusalem.
Ab	9,[1]	Fast, Destruction of the Temple.

TABLE XI.—*Principal Days of the Manometan Calendar.*

Muharram	1,	New Year.
,,	10,	Ashura.
Rabia I.	11,	Birth of Mahomet.
Jomada I.	20,	Taking of Constantinople.
Rajab	15,	Day of Victory.
,,	20,	Exaltation of Mahomet.
Shaaban	15,	Borak's Night.
Shawall	1, 2, 3,	Grand Bairam.
Dulheggia	1,	Kurban Bairam.

TABLE XII.—*Evochs, Eras. and Periods.*

Name.	Christian Date of Commencement.	Name.	Christian Date of Commencement.
Grecian Mundane era, .	1 Sep. 5598 B.C.	Sidonian era, .	Oct. 110 B.C.
Civil era of Constantinople, .	1 Sep. 5508 ,,	Cæsarean era of Antioch, .	1 Sep. 48 ,,
Alexandrian era, . . .	29 Aug. 5502 ,,	Julian year, .	1 Jan. 45 ,,
Ecclesiastical era of Antioch, . .	1 Sep. 5492 ,,	Spanish era, .	1 Jan. 38 ,,
Julian Period,	1 Jan. 4713 ,,	Actian era, .	1 Jan. 30 ,,
Mundane era, .	Oct. 4008 ,,	Augustan era, .	14 Feb. 27 ,,
Jewish Mundane era, .	Oct. 3761 ,,	Vulgar Christian era, . .	1 Jan. 1 A.D.
Era of Abraham	1 Oct. 2015 ,,	Destruction of Jerusalem, .	1 Sep. 69 ,,
Era of the Olympiads, .	1 July 776 ,,	Era of Maccabees, . . .	24 Nov. 166 ,,
Roman era, .	24 April 753 ,,	Era of Diocletian, . . .	17 Sep. 284 ,,
Era of Nabonassar, . .	26 Feb. 747 ,,	Era of Ascension, . . .	12 Nov. 295 ,,
Metonic Cycle,	15 July 432 ,,	Era of the Armenians, .	7 July 552 ,,
Grecian or Syro-Macedonian era, . . .	1 Sep. 312 ,,	Mahometan era of the Hegira,	16 July 622 ,,
Tyrian era. .	19 Oct. 125 ,,	Persian era of Yezdegird, .	16 June 632 ,,

[1] If Saturday, substitute Sunday immediately following.
[2] If Saturday, substitute Thursday immediately preceding.

The principal works on the calendar are the following:—Clavius, *Romani Calendarii a Gregorio XIII. P. M. restituti Explicatio*, Rome, 1603; *L'Art de vérifier les Dates*; Lalande, *Astronomie*, tom. ii.; *Traité de la Sphère et du Calendrier*, par M. Revard. Paris, 1816; Delambre, *Traité de l'Astronomie Théorique et Pratique*, tom. iii.; *Histoire de l'Astronomie Moderne*; *Methodus technica brevis, perfacilis, ac perpetua construendi Calendarium Ecclesiasticum, Stylo tam novo quam vetere, pro cunctis Christianis Europæ populis, &c.*, auctore Paulo Tittel, Göttingen, 1816; *Formole analitiche pel calcolo della Pasqua, e correzione di quello di Gauss, con critiche osservazioni sù quanto ha scritto del Calendario il Delambri*, di Lodovico Ciccolini. Rome, 1817; E. H. Lindo, *Jewish Calendar for Sixty-four Years*, 1838; W. S. B. Woolhouse, *Measures, Weights, and Moneys of all Nations*, 1869. (T. G.—W. S. B. W.)

CALENDER, a mechanical engine employed for dressing and finishing cloths and various descriptions of fabrics, preparatory to sending them into the market. It is also used by calico-printers to prepare the surface of their cloths for the operations of printing. The first object of calendering is to produce in the cloth as perfect extension and smoothness of surface as can be attained,—so that no wrinkle or doubled folding may remain in it. The second end attained by the calendering of cloth is the compression of the yarn or threads of which the texture is composed, which in some degree divests them of their cylindrical shape, and reduces them to a degree of flatness, which, by bringing them more closely into contact with each other, gives to the fabric a greater appearance of closeness and strength than it would otherwise possess. The operation of the calender also improves the superficial appearance, by flattening down all knots, lumps, and other imperfections, from which no material from which cloth is fabricated can ever be entirely freed during the previous processes of spinning and weaving. And, thirdly, in certain fabrics it is desirable that cloth should receive, by means of friction, an additional lustre or polish, which is distinguished by the appellation of glazing. For the accomplishment of these objects the agencies on which the calenderer has to rely are moisture, heat, pressure, and friction, and these he variously combines to produce many different effects.

The term calender, which really means only the chief mechanical engine employed, gives the general name to the finishing establishments where all the varied operations of cloth-lapping are carried on; and it is as usual to say that goods are *packed* as that goods are *dressed* at a calender. The common domestic smoothing-iron may be regarded as a form of calendering utensil; as is also the old-fashioned domestic mangle, which consists of a cylinder applied to a plane, upon which it is rolled backward and forward, until some degree of smoothness is produced by this reciprocating motion. A form of mangle, consisting of an enormously heavy cylinder, which is worked forwards and backwards over a plane surface, is still used in calendering establishments for the finishing of very heavy linens and similar goods.

The smoothing calender completes the substitution of cylindrical for plane surfaces, all the parts which operate upon the cloth being of that form. This ingenious engine, which was introduced into Britain from Flanders and Holland during the persecution of the Huguenots, has, since its introduction and adoption, undergone no very material or important alteration or improvement in point of theoretical principle; nor, until the extension of the cotton manufacture had introduced a general spirit of mechanical improvement, were any great advances made in the practical applications of it.

Calenders are constructed with from two to five rollers or cylinders, technically termed "bowls,"—three or five-bowl calenders being most frequently employed. The materials of which these cylinders are made are wood, compressed paper, and metal, such as chilled cast-iron, brass, or copper. They are variously arranged in relation to each other, and as mechanical arrangements are required—1st, for varying pressure; 2d, for applying heat within a metal bowl from steam, hot iron, or burning gas; and 3d. for varying the rate of motion of a pair of the bowls so as to produce friction—the gearing of a calender is somewhat complex. Commonly a three-bowl calender has an upper and under cylinder of paper, the central one being of metal, and in such an implement either two pieces may pass through at the same time, or one piece may receive two pressures. An ordinary five-bowl calender has the first, third, and fifth cylinders of paper, the intermediate being of metal, and here four successive pressures may be given. Fig. 1, Plate XXXII., is an elevation of a five-roller calender for finishing cloth. A, A are two paper rollers, of 20 inches diameter each. B, B are two cast-iron cylinders, externally turned until perfectly smooth; their diameter is 8 inches, allowing the substance of iron to be 2 inches, and leaving a perforation of 4 inches diameter. C is a paper roller of 14 inches diameter; D, D is the framing of cast-iron for containing the bushes in which the journals of the rollers revolve; E, E are two levers by which the rollers are firmly pressed together while the cloth is passing through.

Fig. 2 is an end view of the same calender, with the wheels for glazing cloth. The wheel on the upper cylinder is 10 inches diameter, the wheel on the under cylinder is 13 inches diameter; they are connected by the wheel F, which communicates the speed of the upper cylinder, so that the wheel on the under cylinder being nearly one-third of an inch more in diameter, the difference of their motions retards the centre paper roller, by which means the upper cylinder passes over the cloth one-third faster than the cloth passes through the calender, and polishes it in consequence.

The construction of paper or pasteboard rollers for calenders is a process of great interest and importance. The frequent heating and cooling to which the apparatus is subject necessarily produces warping and splitting in wooden bowls, which are thereby rendered useless, but the substitution of paper afforded a radical cure for these defects as well as a collateral advantage arising from its being susceptible of a much higher degree of superficial polish, which is always transferred to the cloth. In the construction of paper cylinders an axis or journal of malleable iron and two circular plates of cast-iron of the same diameter as the cylinder to be made are, in the first place, provided. A plate is secured on one end of the journal. The entire space between the two iron plates is then to be filled with circular pieces of paper or pasteboard, exceeding by about 1 inch in diameter the iron plates, and having each a correspondent perforation, through which the iron journal passes. A cylinder is thus formed, the substance of which is of paper locked together by plates of iron at the extremities, and susceptible of immense compression which it receives in a hydraulic press. After undergoing this preparation, the cylinder is exposed to strong heat in a confined apartment in which the paper contracts and becomes loose. It is again put into the press, more sheets of paper are added, and this process goes on till the cylinder has gradually acquired the requisite compression. It is then re-exposed to the ordinary temperature of the atmosphere, and by its re-expansion presents a body almost remarkably compact, its specific gravity in this state being greater than even that of silver.