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A Scottish clock dial for determining Easter

John A. Robey*

A very unusual dial from a Scottish clock, probably added to a lantern clock to convert it into a longcase clock, has manually adjustable indicators that show the dominical letters and epacts. The use of these to determine the date of Easter is explained, and biographical details of the clockmaker and the dial's first owner are given.

Apart from a few Edinburgh lantern clocks, thirty-hour clocks are said not to have been made in Scotland, but here is a rare exception, made by Andrew Watson of St Andrews, Fife, the earliest clockmaker recorded in the town. The only other published record of a Scottish thirty-hour clock is a London lantern clock converted into a longcase clock by the same maker.[1] A few other thirty-hour dials by Watson are known, including another one similarly converted from a lantern clock, but no photographs are available.[2] Of the clock described here only the dial survives, the movement being missing.

The 12in square dial is signed by the clockmaker on the lower edge of the chapter ring (Fig. 1). The dial plate, which has been gilded, is also inscribed with the name of the first owner along the bottom edge: 'David Peatie Wever [weaver] in Kings Barns 1726'. Kingsbarns is a small village on the coast about six miles south of St Andrews.

The dial is naïvely engraved, probably by Watson himself, with a matted centre, a ringed central hole for the hands and a very small ringed calendar aperture. The corner spandrels show twin cherubs holding a crown, a pattern popular at this period. There are no winding holes, so the movement was pull wound. The remains of small holes and rivets indicate that an arch has been added at some time and subsequently removed. Apart from the special subsidiary dials and the inscription near the lower edge, this dial is virtually the same as the one with a lantern clock movement described by Spittler (n.1), and it is typical of a 30-hour country-made dial of the period, apart from the special features in the centre considered here.

The rear of the dial (Fig. 2) shows the supporting rollers for the date ring, which is missing, and there are marks indicating its location. The dial feet are widely spaced which might accommodate a large horizontal plate-frame movement, but a few other clocks are known with a new dial fitted to a lantern movement using a large falseplate. The dial of the clock illustrated by Spittler fits directly onto the lantern clock movement, but the bell overhangs the top of the dial, which has to sit back in the hood, resulting in a large gap between the dial and the door frame, there being no mask. It is likely that Watson soon appreciated the problem and solved it by using a falseplate to bring the dial forward of the movement. The spacing of the feet on the present dial indicates that it too had a falseplate, almost certainly to fit a re-used lantern clock movement. (The label on the back of the dial is by a previous owner and the information is not correct.)

Above the centre is a silvered plaque engraved with the dominical letters A B C D E F G, also known as the Sunday letters, while to the right of centre is a silvered ring engraved with the epact: 1• 12 • 23 • 4 • 15 • 26 • 7 • 18 • 29 • 11 • 22 • 3 • 14 • 25 • 6 •

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1. T. Spittler, 'Converted Clock. An early Scottish 30-hour longcase with a lantern movement', *Clocks*, August 2005, 14-18.

2. Information from Michel Dareau.

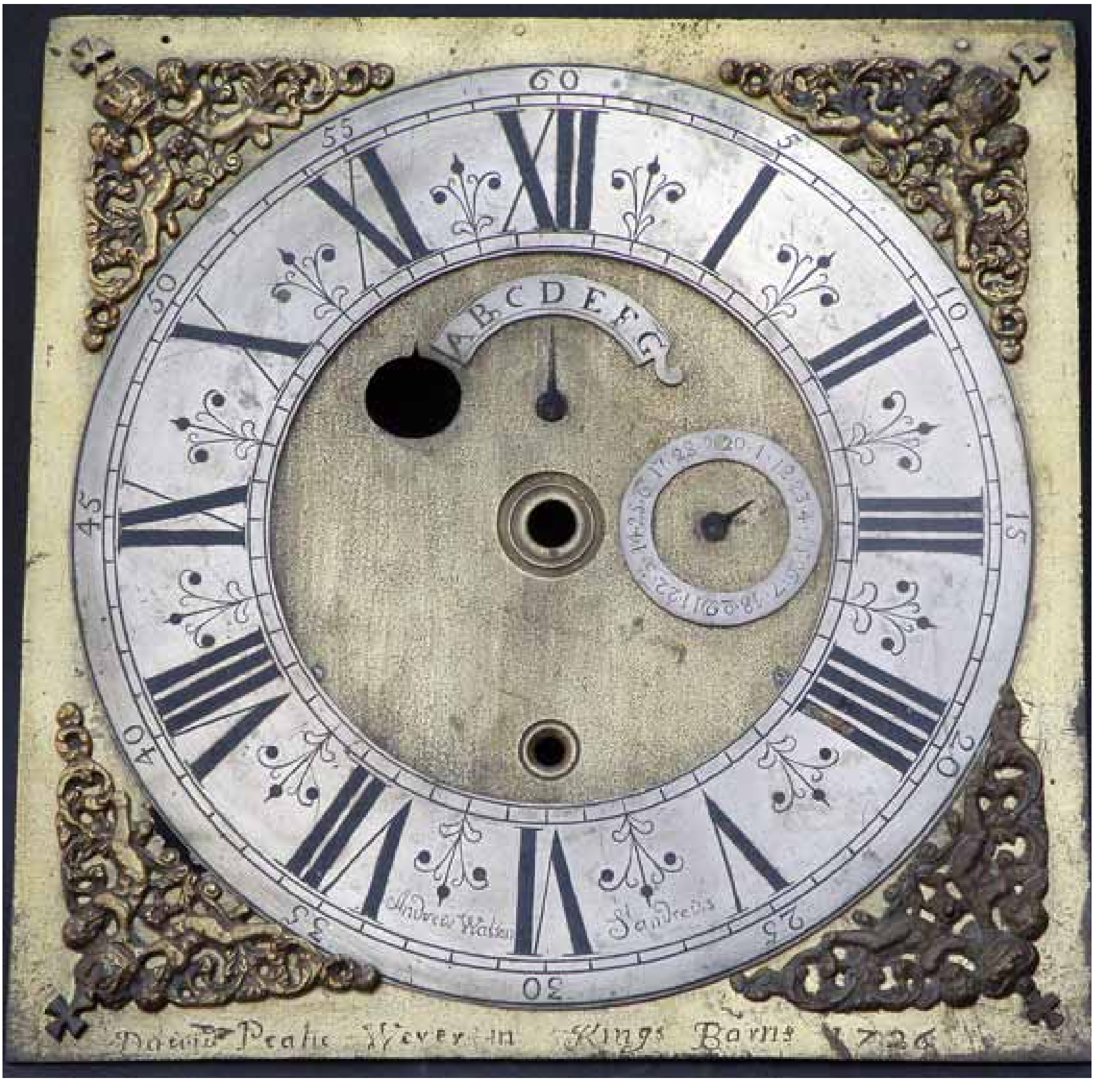


Fig. 1. Two-handed thirty-hour dial signed ‘Andrew Watson St andrews’. The matted centre has a ringed centre hole, small calendar aperture, a large round hole (possibly for adjustment of the date ring) and subsidiaries showing the dominical letter and epact. Note the naïvely engraved chapter ring and the name of the first owner on the lower edge: ‘David Peatie Wever [weaver] in Kings Barns 1726’.

17 • 28 • 9 • 20 (Fig. 3). The pointers of both subsidiary dials are riveted at the back to small pieces of brass that act as friction washers. These appear to be original, with no signs that the pointers ever connected to the movement. It is suggested that they were intended to be adjusted manually every year as an *aide-mémoire*.

The two subsidiary dials would have been used in conjunction with a printed table to find the date of Easter and the other movable feasts, which are determined by the phases of the moon. To find the date of Easter Sunday for a particular year the dates on which Sundays and full moon occur are needed. The former is given by the dominical letter, the latter by the epact.

The Dominical Letter

The days of the year from 1 January to 31 December are denoted by a continuous recurring cycle of seven dominical letters: A, B, C, D, E, F, G. The letter A is set against 1 January, B against 2 January, C against 3 January, and so on. The dominical letter of a year is the letter of the cycle corresponding

Fig. 2. Dial rear showing the rollers for the missing date ring and the friction ‘washers’ for the subsidiary indicators. Note the very wide spacing of the dial feet (one missing).

Fig. 3. Detail of the epact dial. The Julian epact starts at 11 near the bottom.

to the day on which the first Sunday (and thus every subsequent Sunday) falls. For leap years there are two dominical letters, one for January and February, the other for the rest of the year after the leap day. Since the first and last days of the year fall on the same day of the week, the day for any date advances by one day every year, and by two days from March to December in a leap year. Hence the dominical letter decreases by one every year and by two letters in a leap year. For example. in the Julian calendar which was still in use in Great Britain when this clock was made, 1 January 1726 was a Saturday, so the first Sunday was 2 January and the dominical letter was B. For subsequent years it would be A for 1727, FG for 1728 (a leap year), E for 1729, and so on.

The Epact, Golden Numbers & the Date of Easter

The epact arises from the inequality of the solar and lunar year: the Julian calendar year of 365 days exceeds twelve lunar months of alternatively 29 and 30 days (giving an average lunar cycle of approximately 29½ days) by 11 days. As a result, the age of the moon on corresponding days of successive years differs by 11. By adding 11 days to the age of the moon on a certain day, the age of the moon on the same day of the subsequent year can be found. The epacts for succeeding years are 12, 23, 34, and so on, but after the thirtieth day the numbers are regarded as being in the next lunar month. After the epact of 29 the next one is 11 rather than 10, followed by 22, 3, 14, and so on.

The epact of a particular year was originally defined as the age of the moon in days on January 1 and while it can be used to find the lunar date from the solar date it was primarily used in connection with tabular methods for determining the date of Easter.[3]

Calendars are only approximations to represent the actual solar cycle in terms of whole days and inaccuracies build up until major corrections are necessary. The most notable correction was the change from the Julian calendar, introduced by Julius Caesar in 46 BC as a reform of the Roman calendar, to the Gregorian calendar, introduced by Pope Gregory XIII in 1582. This was adopted by a handful of Catholic countries in that year, followed later by other

3. There are many websites on the internet giving full details of these calculations and the various calendar complications. The National Maritime Museum website is particularly comprehensible, www.nmm.ac.uk/explore/astronomy-and-time/time-facts/the-date-of-easter.

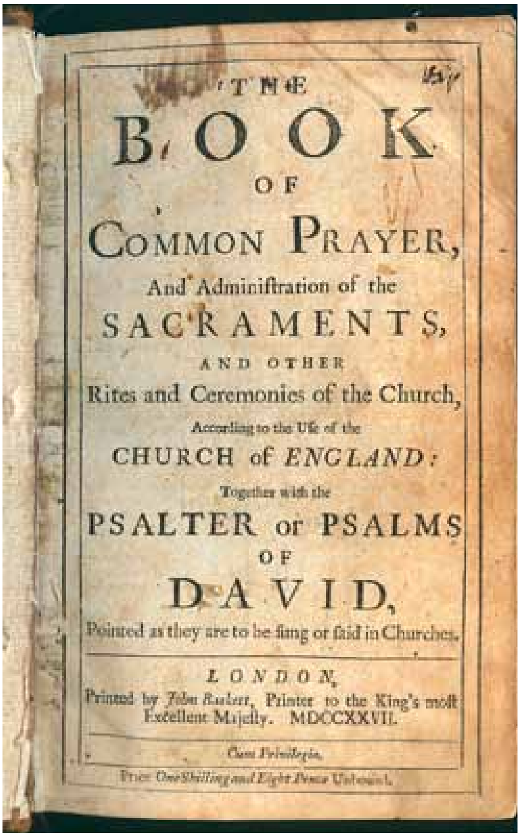


Fig. 4. Title page of *The Book of Common Prayer*, 1727 edition.

European states, but not in Great Britain until 1752. As a result of updates to the calendar there are several different epact cycles,[4] but here we are only concerned with the Julian epact.

Since the Middle Ages the epact of a year became associated with the golden number of that year in an epact-cycle. The golden numbers 1–19 are so called because the moon is in exactly the same position in the sky with respect to the stars every nineteen years (the Metonic cycle), and the ancient Greeks thought that this was so extraordinary that they are said to have cut these numbers on buildings and highlighted them in gold. However, the term was not used in classical times and its first documented use was not until the year 1200. The golden number is determined by dividing the year by 19 and adding 1 to the remainder. For the Julian epact a year with the golden number 1 has an epact of 11, for the golden number 2 the epact is 22, and so on.

Easter is simply defined as the first Sunday after the full moon on or after the vernal equinox. If the full moon falls on a Sunday then Easter is the next Sunday. The vernal equinox is an artificial one, assumed to be 21 March (the first day of Spring). Also the full moon used is not the true full moon but the paschal full moon, an artificial construct based on the Metonic cycle. The paschal full moon may differ from the actual event by up to two days. As a result of these definitions the calculations to determine Easter for any particular year are complex and most clergy would have used the tables issued by the Church.

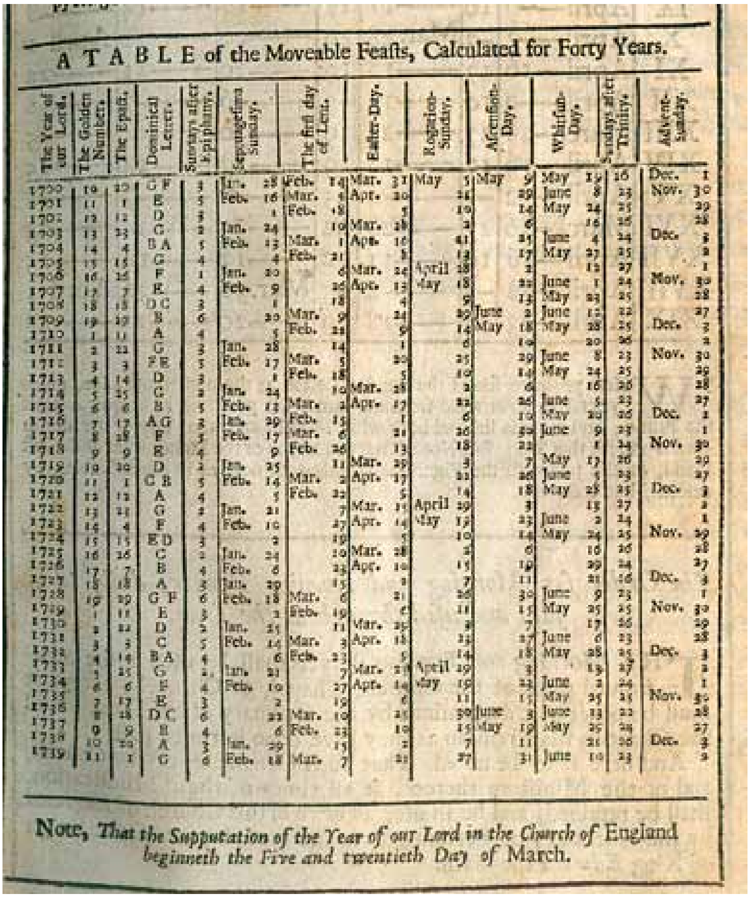
The Watson Dial in Use

Near the beginning of *The Book of Common Prayer* (Fig. 4) are sixteen pages of tables giving the lessons and prayers that are to be used on every day of the year as well as rules and tables for the moveable and immoveable feasts. Of concern here are the final two tables, the first one being 'A TABLE of the Moveable Feasts, Calculated for Forty Years' (Fig. 5). This tabulates the year, golden number, epact and the dates of various feasts, including Easter. For the various versions consulted, the table in the 1715 and 1727 editions starts at 1700 and the 1729 edition at 1727. The second table 'To find Easter for ever' (Fig. 6) uses the golden number and the dominical letter to determine Easter. With hindsight we now know that these tables would not have applied after the calendar was changed in 1752, when a new set of tables had to be produced to take into account the Gregorian epact.

Andrew Watson's dial only shows the dominical letters and the epact and it would have been simpler to use if the corresponding golden number had been shown alongside each epact. It should be noted that the Julian epact cycle starts at 11 at the bottom of the dial, not at 1 at the top.[5]

4. E. Dekker, 'Epact Tables on Instruments: Their Definition and Use', *Annals of Science*, vol 50, 1993, 303–24.

5. The epact ring only fits in its present orientation.



A TABLE of the Moveable Feasts, Calculated for Forty Years.

The Year of our Lord.	The Golden Number.	The Epact.	Dominical Letter.	Sundays after Epiphany.	Septuagesima Sunday.	The first day of Lent.	Easter-Day.	Rogation-Sunday.	Ascension-Day.	Whitsun-Day.	Sundays after Trinity.	Advent-Sunday.
1700	10	20	GF	3	Jan. 28	Feb. 14	Mar. 31	May 5	May 9	May 19	26	Dec. 1
1701	11	1	E	5	Feb. 16	Mar. 5	Apr. 20	25	29	June 8	23	Nov. 30
1702	12	12	D	3	1	Feb. 18	5	10	14	May 24	25	29
1703	13	23	C	2	Jan. 24	10	Mar. 28	2	6	16	26	28
1704	14	4	BA	5	Feb. 13	Mar. 1	Apr. 16	21	25	June 4	24	Dec. 3
1705	15	15	G	4	4	Feb. 21	8	13	17	May 27	25	2
1706	16	26	F	1	Jan. 20	6	Mar. 24	April 28	2	12	27	1
1707	17	7	E	4	Feb. 9	26	Apr. 13	May 18	22	June 1	24	Nov. 30
1708	18	18	DC	3	1	18	4	9	13	May 23	25	28
1709	19	29	B	6	20	Mar. 9	24	29	June 2	June 12	22	27
1710	1	11	A	4	5	Feb. 22	9	14	May 18	May 28	25	Dec. 3
1711	2	22	G	3	Jan. 28	14	1	6	10	20	26	2
1712	3	3	FE	5	Feb. 17	Mar. 5	20	25	29	June 8	23	Nov. 30
1713	4	14	D	3	1	Feb. 18	5	10	14	May 24	25	29
1714	5	25	C	2	Jan. 24	10	Mar. 28	2	6	16	26	28
1715	6	6	B	5	Feb. 13	Mar. 2	Apr. 17	22	26	June 5	23	27
1716	7	17	AG	3	Jan. 29	Feb. 15	1	6	10	May 20	26	Dec. 2
1717	8	28	F	5	Feb. 17	Mar. 6	21	26	30	June 9	23	1
1718	9	9	E	4	9	Feb. 26	13	18	22	1	24	Nov. 30
1719	10	20	D	2	Jan. 25	11	Mar. 29	3	7	May 17	26	29
1720	11	1	CB	5	Feb. 14	Mar. 2	Apr. 17	22	26	June 5	23	27
1721	12	12	A	4	5	Feb. 22	9	14	18	May 28	25	Dec. 3
1722	13	23	G	2	Jan. 21	7	Mar. 25	April 29	3	13	27	2
1723	14	4	F	4	Feb. 10	27	Apr. 14	May 19	23	June 2	24	1
1724	15	15	ED	3	2	19	5	10	14	May 24	25	Nov. 29
1725	16	26	C	2	Jan. 24	10	Mar. 28	2	6	16	26	28
1726	17	7	B	4	Feb. 6	23	Apr. 10	15	19	29	24	27
1727	18	18	A	3	Jan. 29	15	2	7	11	21	26	Dec. 3
1728	19	29	GF	6	Feb. 18	Mar. 6	21	26	30	June 9	23	1
1729	1	11	E	3	2	Feb. 19	6	11	15	May 25	25	Nov. 30
1730	2	22	D	2	Jan. 25	11	Mar. 29	3	7	17	26	29
1731	3	3	C	5	Feb. 14	Mar. 3	Apr. 18	23	27	June 6	23	28
1732	4	14	BA	4	6	Feb. 23	9	14	18	May 28	25	Dec. 3
1733	5	25	G	2	Jan. 21	7	Mar. 25	April 29	3	13	27	2
1734	6	6	F	4	Feb. 10	27	Apr. 14	May 19	23	June 2	24	1
1735	7	17	E	3	2	19	6	11	15	May 25	25	Nov. 30
1736	8	28	DC	6	22	Mar. 10	25	30	June 3	June 13	22	28
1737	9	9	B	4	6	Feb. 23	10	15	May 19	May 29	24	27
1738	10	20	A	3	Jan. 29	15	2	7	11	21	26	Dec. 3
1739	11	1	G	6	Feb. 18	Mar. 7	22	27	31	June 10	23	2

Note, *That the Supputation of the Year of our Lord in the Church of* England *beginneth the Five and twentieth Day of* March.

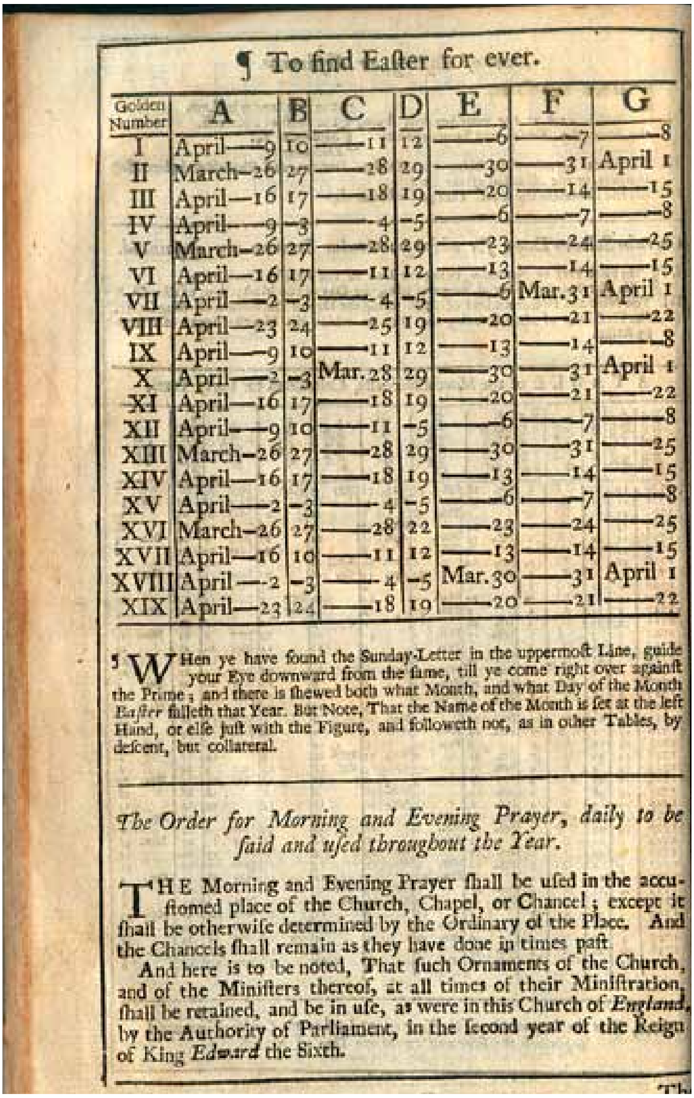
Fig. 5. 'A Table of the Moveable Feasts, Calculated for Forty Years', starting at 1700, from *The Book of Common Prayer.*

In practice the dial might be used by setting the two pointers at B and 7 in 1726, and Easter can then be determined from the printed table in *The Book of Common Prayer*. Every subsequent year the pointer for the dominical letter would be decreased by one (or by two in a leap year), the pointer for the epact advanced by one division and the date of Easter determined using the new dominical letter and golden number. The flaw in this supposition is that the first table in the prayer book included the year, so there was no need to know its dominical letter and epact. The second table does require knowledge of the dominical letter and golden number, but instead of the latter Watson's dial shows the epact. Unless the owner knew the golden number for a particular epact, to use the second table he would first have to find the golden number from the first table.

The implication is that this dial was not only used to determine Easter, but also, perhaps mainly, to find the dates of full moon and the times of high tide. The latter would be particularly important for a fisherman in a coastal village, but of much less concern to a weaver. The necessary information would be given in almanacs and navigational books, but the author has not managed to find one using the Julian calendar.[6]

However, if the dial was used mainly for determining the dates of full moon there

6. National museums and other institutions have been singularly unhelpful in this respect. The author would welcome details of any pre-1752 publication which gives the necessary information.



¶ To find Eaſter for ever.

Golden Number	A	B	C	D	E	F	G
I	April—9	10	11	12	6	7	8
II	March—26	27	28	29	30	31	April 1
III	April—16	17	18	19	20	14	15
IV	April—9	3	4	5	6	7	8
V	March—26	27	28	29	23	24	25
VI	April—16	17	11	12	13	14	15
VII	April—2	3	4	5	6	Mar. 31	April 1
VIII	April—23	24	25	19	20	21	22
IX	April—9	10	11	12	13	14	8
X	April—2	3	Mar. 28	29	30	31	April 1
XI	April—16	17	18	19	20	21	22
XII	April—9	10	11	5	6	7	8
XIII	March—26	27	28	29	30	31	25
XIV	April—16	17	18	19	13	14	15
XV	April—2	3	4	5	6	7	8
XVI	March—26	27	28	22	23	24	25
XVII	April—16	10	11	12	13	14	15
XVIII	April—2	3	4	5	Mar. 30	31	April 1
XIX	April—23	24	18	19	20	21	22

¶ WHen ye have found the Sunday-Letter in the uppermoſt Line, guide your Eye downward from the ſame, till ye come right over againſt the Prime; and there is ſhewed both what Month, and what Day of the Month *Eaſter* falleth that Year. But Note, That the Name of the Month is ſet at the left Hand, or elſe juſt with the Figure, and followeth not, as in other Tables, by deſcent, but collateral.

The Order for Morning and Evening Prayer, daily to be ſaid and uſed throughout the Year.

THE Morning and Evening Prayer ſhall be uſed in the accuſtomed place of the Church, Chapel, or Chancel; except it ſhall be otherwiſe determined by the Ordinary of the Place. And the Chancels ſhall remain as they have done in times paſt.

And here is to be noted, That ſuch Ornaments of the Church, and of the Miniſters thereof, at all times of their Miniſtration, ſhall be retained, and be in uſe, as were in this Church of *England*, by the Authority of Parliament, in the ſecond year of the Reign of King *Edward* the Sixth.

Fig. 6. 'To find Easter for ever', from *The Book of Common Prayer.*

was no need to know the dominical letter. A much more satisfactory solution would have been to have a clock with a moon phase and high tide indicator that was automatically advanced twice a day. This would have been a much more expensive option than a re-used lantern clock with indicators that needed manual adjustment just once a year and Andrew Watson was catering for a less affluent customer. Or is there a simpler explanation? Were these subsidiary dials just to give the impression that the owner was educated and knew about such things as dominical letter and epacts, even if they were of limited practical use?

The other mystery of this dial is the 1in diameter hole to the left of the dominical letters. There is no post on which a penny moon could rotate, and in any event it would be fouled by the attachment feet of the chapter ring and the A-G plaque as well as the date ring. As the hole is chamfered at the rear it was probably to move the date ring with a finger, the calendar aperture being too small to do this. Since a major feature of the dial was to assist in determining Easter, full moon and high tides, it was essential that the calendar could be adjusted with ease at the end of the short months.

Some astronomical clocks, particularly of Continental origin, include subsidiary dials that indicate the dominical letters, epact and golden numbers, which are operated by an annual wheel, with provision for leap years. These are by necessity complex and the indicators on Andrew Watson's dial were more appropriate for a Scottish clockmaker producing simple clocks. It might be expected that this clock would have been made for a clergyman, but its first owner was a weaver, perhaps one who was a devout Christian.

The Clockmaker and First Owner

The St Andrews Guild of Hammermen, to which the town's workers in metal such as clockmakers belonged, records that Andrew Watson, son of Robert Watson (who had been apprenticed to a cutler), was admitted as a freeman on 15 September 1710, hence he was likely to have been born about 1690. He was active in the guild in 1710–56 and served as Boxmaster (treasurer) in 1712–13, and Deacon in 1753–4. His grandfather was a smith in Leuchars, 6 miles northwest of St Andrews. The records do not state specifically the occupation of this Andrew Watson but he is likely to have been the maker of this dial. (Another Andrew Watson in St Andrews at this period was a surgeon apothecary and Provost to St Andrews University.) The clockmaker is likely to have been the 'wright Burgess in St Andrews' whose son, also Andrew Watson, was apprenticed to a weaver in 1760.[7] Several generations of the extensive Watson family were members of the St Andrews Hammermen, but none of the others are known to have been involved with clocks.[8]

Andrew Watson has been referred to above as a clockmaker, but it is highly likely that he primarily worked in the family blacksmithing business and had some, although limited, skill with clockwork. He appears to have satisfied a local demand by fitting new dials to old lantern clock movements, adding motionwork for two hands, a calendar wheel to operate a once-a-day calendar, converting the escapement to anchor with long pendulum and housing the clock in a simple longcase.[9] Whether he did this work himself or used a clockmaker in Cupar, at that period a horologically much more active town and only a short horse-ride away, is uncertain.

It is not known when Andrew Watson died, but he is the only clockmaker known to have been working in the town until the appearance of David Methven, recorded from 1768 to at least 1773.

The first owner of this clock, David Peatie, weaver in Kingsbarns, and his spouse, Allison Mores, are mentioned in a deed dated 1716. They were married in 1699. Nothing further is known about him.

Acknowledgements

The author is indebted to Dr John P. Thorpe for the opportunity to examine and photograph this unique dial; to St John the Baptist Parish Church, Mayfield, East Staffordshire, for providing acces to their copy of the 1727 edition of *The Book of Common Prayer* (which had been found propping up a table leg); and to two anonymous referees for helpful comments.

7. Fife Family History Society website, www.fifefhs.org.

8. Although many members of the family are listed in the Hammermen's records, very few of them are included in the International Genealogy Index (IGI), an exception being Charles Watson, a smith and Andrew's younger brother, baptised on 5 June 1701, son of Robert Watson and Isobel Anderson. No other Watson clockmakers are recorded in Fife in D. Whyte, *Clockmakers & Watchmakers of Scotland* (Mayfield, 2005).

9. As evidenced by the Watson clock in footnote 1 converted in this manner.