DANIEL O'CONNELL
TEACHER AND SLATE SUNDIAL MAKER

MICHAEL J. HARLEY

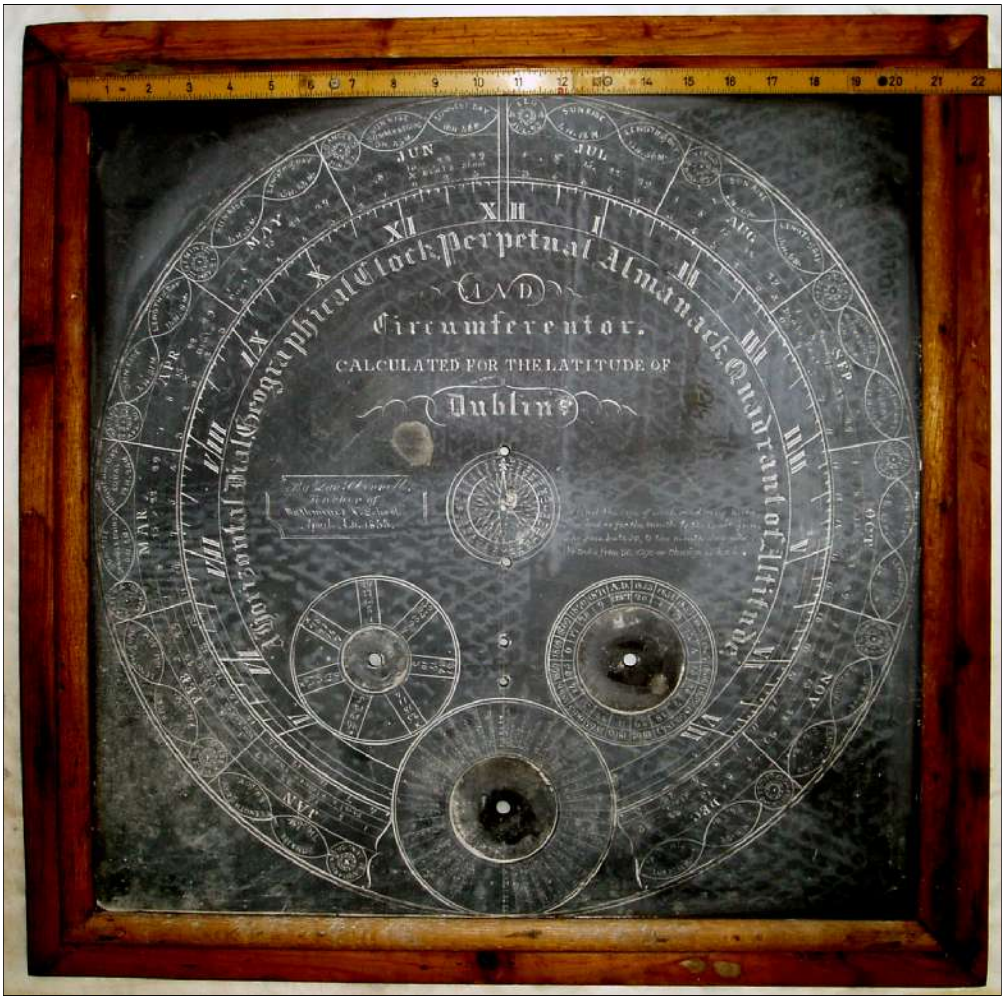

Fig. 1. 1853 O'Connell dial in the National Museum of Ireland Collection.

In the March 2006 BSS Bulletin,[1] Peter Ransom described an 1843 slate dial made by one D. O'Connell for a Rev. Spratt of Enniskean, Co. Cork, Ireland. He made reference to another dial by a maker of the same name and which is in the National Museum of Ireland (NMI) Country Life at Turlough, Castlebar, Co. Mayo.[2] As a result of Tony Wood's ongoing Survey of Irish Museums[3] contact was made with Curatorial Assistant Silas Higgins and so, on a recent solo sundial safari to the West of Ireland, the NMI gave me permission to inspect and photograph the O'Connell dial (Fig. 1) in their collection.

This 21″ square dark grey slate dial is mounted inside a softwood frame which no doubt has protected it from damage over the years. An inscription inside a cartouche on the dial (Fig. 2) tells us that it was made "By Dan[l] O'Connell. Teacher of Rathmines N. School: April. A.D. 1853". (Rathmines is a district in Dublin; the 'N.' stands for National.)

The maker describes his dial as being "A Horizontal Dial, Geographical Clock, Perpetual Almanack, Quadrant of Altitude And Circumferentor. Calculated for the Latitude of Dublin".

The Horizontal Dial

The 14″ internal and 16″ external diameter chapter ring shows the time from five am to seven pm in Roman numerals, with IIII for four, and is subdivided into ½ hour, ¼ hour and 5 minute divisions. The time is read from inside the dial, that is with the observer's back to the sun. There is a ¼″ noon gap to allow for the thickness of the now missing gnomon. There is a 32 point fully qualified compass rose at the centre of the plate. The angular layout of the hourlines was checked using a transparent computer-generated drawing for Latitude 52° 20′ and found to be accurate.

The Geographical Clock

Inscribed within a 5½″ circle are the names of 48 distant places (See Appendix I for full listing). They are arranged at 7½° intervals going east and west, starting with Dublin at the North point and ending with the Antipodes at the South. It has a 2¼″ diameter by $^{1}/_{8}$″ deep circular recess sunk into the plate and a $^{3}/_{8}$″ hole through the plate at its centre. The disk insert that would have fitted into this recess is missing

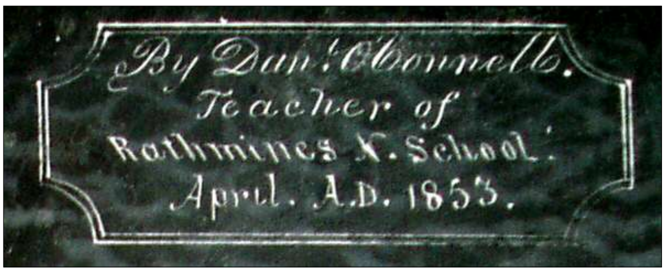

Fig. 2. Signature on the O'Connell dial

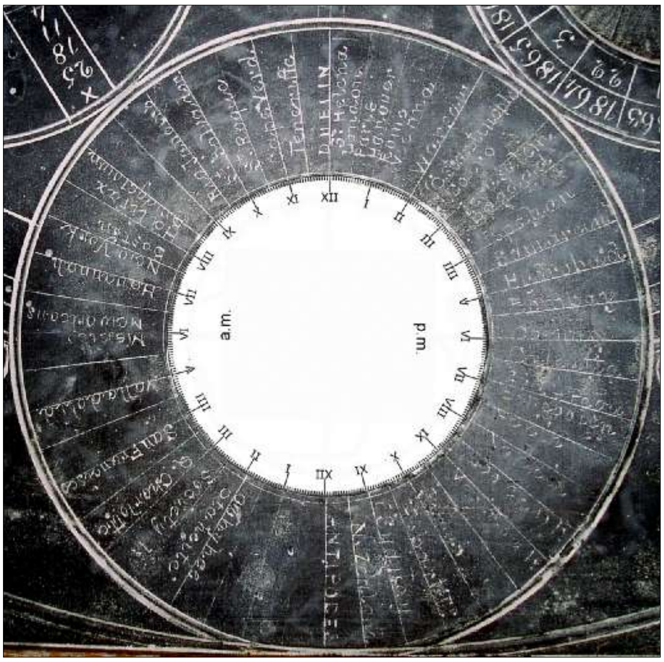

Fig. 3. O'Connell's Geographical Clock with suggested Time Disk.

but is presumed to have been made from brass because of the shallow depth of the sinking. Fig. 3 shows the author's suggestion as to what this disk might have looked like in position on the dial plate.

In operation, the inserted disk would have been rotated to align the current time on the disk with Dublin on the plate: the time of day at the other places could then be read from the disk. Alternatively, if XII noon on the disk were aligned with Dublin on the dial plate then the difference in time between Dublin and any of the others places could be calculated from the disk.

The Perpetual Almanack

The Perpetual Almanack is in the form of two 4" diameter circles, one for Days of the Week (Fig. 4) and one for the Age of the Moon (Fig. 5). In addition, there is a clockwise Equation of Time (EoT) ringaround the outside of the hour circle. As well as the EoT values, this ring also shows the name, symbol and dates of the Zodiac as well as the time of sunrise and length of the day at the Zodiac entry. It also marks the beginning of each of the four seasons and indicates the length of the shortest and longest days (see Appendix II).

The Days of the Week

The Days of the Week circle has a 1½″ diameter by $^1/_8$″ deep circular recess sunk into the plate and a $^3/_8$″ hole through the plate at its centre. The insert that would have fitted into this recess is also missing. Spiralling out from the centre in 7 columns by 5 rows are the consecutive numbers 1 to 31, the number of days in the longest month. 'x' is used to fill in the columns where there is space for a number in excess of 31. The missing insert would have had the names of the days of the week engraved on it. Align a known day with a date and all other days/dates in that month would be matched. Fig. 4 shows how the author thinks this Days/ Dates disk functioned.

The Age of the Moon

The Age of the Moon circle (Fig. 5) has a 2½″ diameter by $^1/_8$″ deep circular recess sunk into the plate and a $^3/_8$″ hole through the plate at its centre. The insert that would have fitted into this recess is also missing. Engraved within the outside circle are the dates of 19 consecutive years, the lunar cycle from 1853 to 1871, with their Epact numbers.

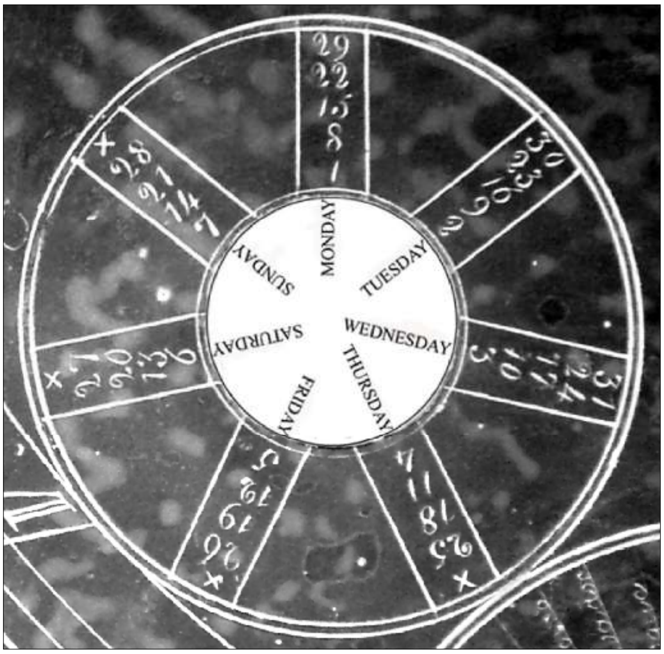

Fig. 4. Suggested Days of the Week disk for O'Connell's dial.

Fig. 5. Suggested index disk for O'Connell's Epact table.

A.D.	1853	1854	1855	1856	1857	1858	1859
EPACT	20	1	12	23	4	15	26

A.D.	1860	1861	1862	1863	1864	1865
EPACT	9	18	29	11	22	3

A.D.	1866	1867	1868	1869	1870	1871
EPACT	14	25	6	17	28	9

The Epact is the age of the moon at the beginning of the year i.e. the number of days since the moon was 'new'. So had there been a new moon on January 1st 1853, the Epact would have been zero (because the moon is new, i.e. zero days 'old'); if there had been a new moon on 29th Dec. 1852, the Epact for 1853 would have been three. So as the Epact for 1853 is 20, the first new moon of the year occurred on 10th Jan.

O'Connell engraved a formula on the dial for finding the age of the moon on any given day of the year in verse form.

"To find the Age of each evolving moon,
The index for the month to the Epact join,
The sum, bate 30, to the month day add,
Or take from 30, Age or change is had."

The index is what is needed to apply this formula so it is reasonable to assume that this is what was engraved on the disk. The index for Jan is 0, for Feb it is 1 etc. Let us see if applying O'Connell's formula to what might have been engraved on the disk (Fig. 5) works and gives us an age of 1 for the 11th Jan 1853.

"The index for the Month (0) *to the Epact* (20) *join* [add]*"* = *20*
"*The sum bate* [subtract] *30*" = -10 . "*to the month day* (11) *add*" = 1.

Success!

The Equation of Time

The EoT is shown at seven day intervals viz. 1, 8, 15, 22 and 29 including February. (See Appendix III for full EoT listing.) The changeover points, '0' on the EoT value scale, are marked with an 'x' (Fig. 6) and the instruction "Dials slower than watches and clocks" shown at January is abbreviated to "dials fast" or "dials slow" thereafter until December when it becomes "slow".

'0' values are shown at 15th April, 15th June and the 1st September and then in December something went wrong and on the value line, in line with the 22 date, he repeated the 22! He then put the 'x' against the value 4 on the 15th which is of course incorrect (Fig. 7). The correct position for the 'x' would have been between the 22 and the 29. This is the only engraving error noted on this elaborate plate and repeats a similar error on his 1843 dial.[1]

Fig. 6. EoT showing 0 value marked with an 'x' on 15th Apr.

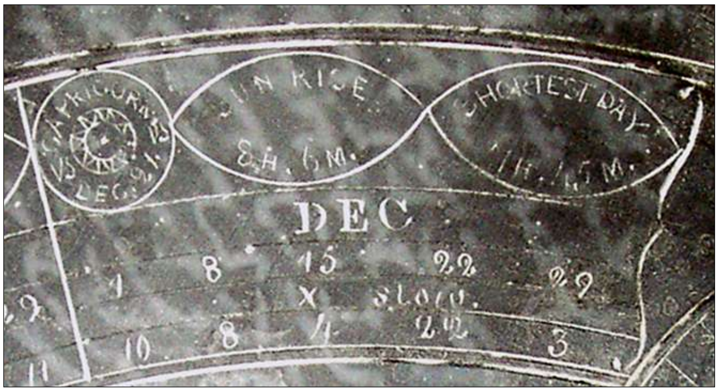

Fig. 7. EoT showing changeover marked with an 'x' on 15th Dec.

The Quadrant of Altitude and the Circumferentor

A circumferentor is a surveying instrument which used a sighting arm for the measurement of horizontal angles. In its simplest form it consisted of two horizontal circular plates, a bottom fixed plate graduated in degrees and a top movable plate with a pointer. The observer aligns the device in the north-south direction, then swivels the movable

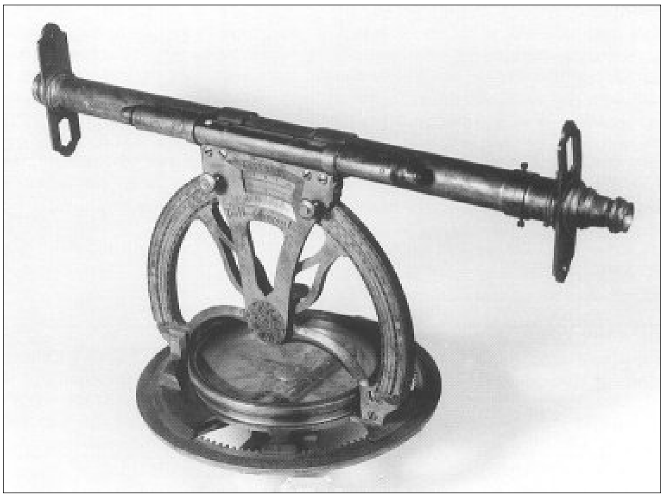

Fig. 8. A theodolite in the National Science Museum of Ireland.

plate horizontally and lines it up on the point of interest using the sight. The pointer indicates the angular distance travelled on the fixed plate.

A quadrant of altitude was a vertical arc for the measurement of vertical angles. With a similar plate system to the circumferentor, it was used to measure vertical angles in the range of ± 45°. These two instruments were later amalgamated to become the theodolite. O'Connell's instrument may well have resembled the theodolite in the National Science Museum of Ireland,[4] shown in Fig.8.

The additional holes in the dial plate between the Days/Dates and Age of the Moon circles were probably used to hold the Quadrant/Circumferentor in place.

In 1857, at the age of 43 years, Daniel O'Connell left Rathmines National School in Dublin and moved to Shrule, Co. Mayo, as Master of a newly built school there at a salary of £20 per annum. He was accompanied by Margaret O'Connell, a teacher aged 23, who was paid an income of £10 per annum. He appears to have brought his dial with him as it was purchased from a resident of Shrule in 1963 by the NMI. It seems likely that this dial was a teaching aid rather than a functioning sundial. Whatever his teaching abilities, O'Connell certainly was a master engraver who used a variety of lettering styles, number systems and embellishments to produce this exceptional dial. Enquiries are ongoing in Shrule to see if any more of O'Connell's dials have survived and there is no doubt that Master O'Connell was also the maker of the 1843 dial described by P. Ransom, referred to earlier.

Appendix I — Place names on the Geographical Clock

East of Dublin			
Place Name	**Time on Disk**	**Implied Long.**	**Modern Long.**
DUBLIN	NOON	7° 30' W	6° 16' W
St. Helena	NOON	7° 30' W	5° 43' W
London	12:30 PM	00° 00'	00° 00'
Paris	12:30 PM	00° 00'	2° 20' E
Hanover	1:00 PM	7° 30' E	9° 44' E
Rome	1:00 PM	7° 30' E	12° 29' E
Vienna	1:30 PM	15° 00' E	16° 25' E
Warsaw	2:00 PM	22° 30' E	21° 01' E
Constantinople	2:30 PM	30° 00' E	29° 03' E
Cairo	2:30 PM	30° 00' E	31° 15' E
Jerusalem	3:00 PM	37° 30' E	35° 14' E
Bagdad	3:30 PM	45° 0' E	44° 24' E
Ispahan	4:00 PM	52° 30' E	51° 41' E
Samarcan	4:30 PM	60° 00' E	66° 48' E
Hyderabad	5:00 PM	67° 30' E	78° 29' E
Bombay	5:30 PM	75° 00'E	72° 50' E
Illegible	6:00 PM	82° 30'E	
Calcutta	6:30 PM	90° 00' E	88° 22' E
Illegible	7:00 PM	97° 30' E	
Benecolen	7:00 PM	97° 30' E	102° 30' E
Pekin	7:30 PM	105° 00' E	116° 37' E
Nankin	8:00 PM	112° 30' E	118° 47' E
Illegible	8:30 PM	120° 00' E	
Illegible	9:00 PM	127° 30' E	
No name	9:30 PM	135° 00' E	
Illegible	10:00 PM	142° 30' E	
Hobart I[s]	10:30 PM	150° 00' E	147° 20' E
Sydney	11:00 PM	157° 30' E	151° 13' E
N. Zealand	11:30 PM	165° 00' E	175° 35' E
ANTIPODES	MIDNIGHT	172° 30'E	173° 44' E

West of Dublin			
Place Name	**Time on Disk**	**Implied Long.**	**Modern Long.**
DUBLIN	NOON	7° 30' W	6° 16' W
Teneriffe	11:30 AM	15° 00' W	16° 15'W
Cape Verd	11:00 AM	22° 30' W	23° 52' W
S. Roque	10:30 AM	30° 00' W	35° 16' W
S. Salvador	10:00 AM	37° 30' W	38° 30' W
Rio Janeiro	9:30 AM	45° 00' W	43° 14' W
No name	9:00 AM	52° 30' W	
Bridgetown	8:30 AM	60° 00' W	59° 29' W
Halifax	8:00 AM	67° 30' W	63° 34' W
Boston	7:30 AM	75° 00' W	71° 02' W
New York	7:30 AM	75° 00' W	74° 00' W
Havannah	7:00 AM	82° 30' W	82°23'W
N. Orleans	6:30 AM	90° 00' W	90° 05' W
Mexico	6:00 AM	97° 30' W	99° 09' W
No name	5:30 AM	105° 00' W	
Valladolid	5:00 AM	112° 30'W	
No name	4:30 AM	120° 00' W	
San Francisco	4:00 AM	127° 30' W	122° 25' W
Q. Charlotte	3:30 AM	135° 00' W	132° 05' W
No name	3:00 AM	142° 30' W	
Society I[s]	2:30 AM	150° 00' W	148° 04' W
Otaheite	2:00 AM	157° 30' W	149° 34' W
Oahyhee	2:00 AM	157° 30' W	
No name	1:30 AM	165° 00' W	
No name	1:00 AM	172° 30' W	
No name	12:30 AM	180° 00' W	
ANTIPODES	MIDNIGHT	172° 30' E	172° 44' E

Made for Dublin, Ireland. Longitude 6° 16' W (25 mins 4 secs of time).
Place names arranged on dial at 7½ degree (30 mins of time) intervals

Appendix II — Solar Data

Aquarius Jan. 20 Sunrise 7H. 56M. Length of day 8H. 50M. JAN	Pisces Feb. 19 Sunrise 7H. 9M. Length of day 10H. 40M. FEB	Aries Apr. 20 Sunrise 6H. 4M. Night and Day Equal 12H. 24M. MAR
Taurus Apr. 20 Sunrise 4H. 51M. Length of day 14H. 8M. APR	Gemini May 21 Sunrise 4H. 0M. Length of day 15H. 44M. MAY	Cancer Jun. 21 Sunrise 3H. 45M. Summer Begins Longest Day 16H. 46M. JUN
Leo Jul 23 Sunrise 4H. 12M. Length of day 15H. 56M. JUL	Virgo Aug 23 Sunrise 5H. 0M. Length of day 14H. 6M. AUG	Libra Sep. 23 Sunrise Autumn Begins 5H. 50M. Night and Day Equal 11H. 50M. SEP
Scorpio Oct. 23 Sunrise 6H. 40M. Length of day 9H. 56M. OCT	Sagittarius Nov. 23 Sunrise 7H. 30M. Length of day 8H. 2M. NOV	Capricorn Dec. 23 Sunrise 8H. 46M. Shortest day 7H. 45M. DEC

Appendix III — Equation of Time values shown on dial

JAN					FEB					MAR				
1	8	15	22	29	1	8	15	22	29	1	8	15	22	29
	Dials slower than watches or				clocks									
4	7	11	12	14	14	14	14	13	13	11	9	7	5	4

APR					MAY					JUN				
1	8	15	22	29	1	8	15	22	29	1	8	15	22	29
		X		Dials	Fast							X	Dials	Slow
3	2	0	2	3	3	4	4	4	3	2	1	0	2	3

JUL					AUG					SEP				
1	8	15	22	29	1	8	15	22	29	1	8	15	22	29
									X	Dials	Fast			
3	6	6	6	5	5	4	3	2	0	0	2	5	7	11

OCT					NOV					DEC				
1	8	15	22	29	1	8	15	22	29	1	8	15	22	29
												X	Slow	
11	12	14	15	16	16	16	15	14	11	10	8	4	22	3

ACKNOWLEDGEMENTS

A special word of thanks to Silas Higgins of the National Museum of Ireland, Country Life, at Turlough, Castlebar, Co. Mayo, who went out of his way to make my visit enjoyable and worthwhile.

REFERENCES AND NOTES

1. P. Ransom: 'An Irish Dial', *Bull. BSS* 18(i) pp.23-25 (2006).
2. National Museum of Ireland. Sundial Ref. F1963:185. Photographs are copyright and may not be reproduced without permission.
3. Tony Wood: see recent BSS Newsletters for details of the Museums Survey.
4. National Science Museum, St. Patrick's College, Maynooth, Ireland. Theodolite Ref. 371. Photograph is copyright and may not be reproduced without permission.

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