Former clock & watchmakers and their work

Frederick James Britten

FORMER CLOCK AND WATCHMAKERS
AND THEIR WORK.

Former Clock & Watchmakers and their Work.

INCLUDING

AN ACCOUNT OF THE DEVELOPMENT OF HOROLOGICAL INSTRUMENTS FROM THE EARLIEST MECHANISM, WITH PORTRAITS OF MASTERS OF THE ART;

A DIRECTORY OF OVER FIVE THOUSAND NAMES,

AND

SOME EXAMPLES OF MODERN CONSTRUCTION.

BY

F. J. BRITTEN,

AUTHOR OF "THE WATCH AND CLOCKMAKERS' HANDBOOK."

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PREFATORY NOTE.

SO large a number of inquiries respecting the productions of old watch and clockmakers has reached me in recent years, that I am induced to collate for publication facts and information relating to the subject which I have been enabled to gather. The present work is in no way intended to supersede "The Watch and Clockmakers' Handbook," which still forms the most useful guide for clock or watchmakers' apprentices, and reference for practical workmen.

F. J. B.

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SUMMARY OF INCIDENTS CONNECTED WITH THE DEVELOPMENT OF CLOCKS AND WATCHES.

	YEAR.
Weight clocks credited to Gerbert about	990
Clock at St. Paul's Cathedral (p. 20) prior to	1298
Hall-marking powers conferred in the Goldsmiths' Company at London (p. 283)	1300
Clock at Exeter Cathedral (p. 22) prior to	1318
Clock of Lightfoot at Glastonbury (p. 23)	1335
First Strasburg clock (p. 139)	1350
Clock by Henry de Vick (p. 26)	1360
Clock at Dover Castle (p. 30)	1360
Clock at Lübeck (p. 146)	1405
Hele invented the mainspring (p. 34) about	1500
Watches first made (p. 34) about	1500
Stackfreed (p. 36) about	1500
Zech invented the fusee (p. 36) about	1525
Clock by Zech, Society of Antiquaries (p. 38)	1525
Anne Boleyn's clock (p. 46)	1532
Turret clock at Hampton Court Palace (p. 32)	1540
Paris clockmakers incorporated by statute	1544
Book-shaped watch (p. 56)	1550
Skull watch by Moyse (p. 48) about	1560
Clock by Bartholomew Newsam in the British Museum (p. 62) ...	1580
Clock by Isaac Habrecht at British Museum (p. 149)	1589
Glasses for table clocks first used about	1598
Clock at Lyons Cathedral (p. 139)	1598
Watches by Ramsay (p. 67)	1600-1640
Watch-glasses introduced about	1600
Queen Elizabeth's watches (p. 59)	1571-1603
Large oval calendar watch by Combret (p. 55)	1613
English lantern chamber clocks first manufactured (p. 168) about ...	1620
German clock-watch (p. 54) about	1620
Oval watch by Aspinall (p. 57) about	1625
Watches first worn in the pocket (p. 71) about	1625
Clockmakers' Company incorporated (p. 74)	1631
Opaque enamel painting for watch cases (p. 71) about	1630

	YEAR
Introduction of the pendulum (p. 191) about	1641
Plain enamelled dials for watches about	1650
Balance spring invented by Hooke (pp. 104, 217) about	1658
Pendulum first applied to domestic clocks (p. 191)	1660
Fusee chain to supersede catgut invented by Gruet	1664
Huygens' pendulum clock with cycloidal cheeks (p. 105) about...	1670
Clock in Piazzi at Venice (p. 151) about	1670
Anchor escapement invented by Hooke (p. 250) about... ...	1670
St. Dunstan's clock (p. 138)	1671
Rack striking work invented by Barlow (p. 201)	1675
Falling ball clock (p. 151) about	1680
Rolling clock (p. 158) about	1680
Revocation of the Edict of Nantes, by which many French horologists were driven to England	1685
Repeating watches patented by Quare (p. 246)	1687
Long pendulum clock by John Fromanteel (p. 102)	1690
Lichfield clock (p. 164) about	1690
Equation clock introduced (p. 111) about	1690
Dead-beat escapement for watches invented by Tompion (p. 86) ...	1694
Cylinder escapement patented (p. 82)	1695
First keyless watch (p. 240) about	1700
Clock presented to Bath Pump Room by Tompion (p. 86) ...	1709
Rack-work for winding repeating watches invented by Stogden about	1710
One-year clock by Quare at Hampton Court (p. 98) about	1710
Dead-beat escapement for clocks invented by Graham (p. 258) about	1715
Mercurial pendulum invented by Graham (pp. 92-197) about ...	1723
Pinchbeck alloy invented (p. 123) about	1725
Hogarth's satirical dial (p. 160)	1727
Ellicott's lever pendulum (p. 108) about	1735
Curious clock by Henry Bridges (p. 156) about	1740
Watch with changing hour figures (p. 165) about	1750
Harrison's chronometer taken on a voyage to Jamaica (p. 116) ...	1761
Half-quarter repeater in a finger-ring by Arnold (p. 128)	1764
Lever escapement invented by Mudge (p. 262) about	1765
Lovelace's Exeter clock (p. 161) about	1770
Helical spring patented by Arnold (pp. 129, 217)	1775
"Fencing Soldiers'" watch (p. 167) about	1780
Urn timepiece of Marie Antoinette (p. 154)	1780
Spring detent escapement by Earnshaw and Arnold (pp. 130, 271) about	1780
Compensation balance by Earnshaw (p. 221) about	1782
Duties imposed on owners of watches and clocks in	1797
Mysterious clock with watch movement in hand (p. 159)	1808
Electric clock patented by Bain (p. 187)	1843
Westminster great clock fixed (p. 208)	1859
Self-winding clock by Horstmann (p. 190)	1865
Pneumatic clocks in Paris (p. 189)	1875

FORMER CLOCK AND WATCHMAKERS AND THEIR WORK.

AS the most interesting period in connection with our subject begins with the seventeenth century, when English horologists of commanding ability flourished, and when serious efforts towards perfecting the construction of clocks and watches were made, it will not be necessary to make more than a very brief reference to the earlier history of time-keepers.

Ancient methods of recording intervals by the motion of the earth with relation to the sun are almost beyond the scope of our title; but before approaching the earliest mechanical time-keepers, it will probably be convenient and useful to give some explanation of the various standards of time.

Standards of Time.

Solar Time. SOLAR time is marked by the diurnal revolution of the earth with regard to the sun, so that the instant the sun is seen at its greatest height above the horizon it is true midday, which sometimes takes place 16 min. 18 sec. sooner, and at others 14 min. 28 sec. later, than twelve o'clock mean time. The diurnal rotation of the earth on its axis might naturally be supposed to bring each place to the meridian at regular intervals; this would be nearly the case if the earth had no other movement; but it advances at the same time in its orbit, and as the meridians are not perpendicular to the ecliptic, the days are not of equal duration. This may be easily perceived by placing a mark at every 15° of the equator and ecliptic on a terrestrial globe, as, by turning it to the westward, the marks on the ecliptic, from Aries to Cancer, will come to the brazen meridian sooner than the corresponding ones on the equator, those from Cancer to Libra later, from Libra to Capricorn sooner, and from Capricorn to Aries later; the marks on the ecliptic and equator only coming to the meridian together at Aries, Cancer, Libra, and Capricorn; thus, true and mean time would agree on the days in which the sun enters these signs, which is on the 20th March, 21st June, 23rd September, and 21st December, were it not that the earth moves with greater rapidity in December, when it is nearest the sun, than it does in July, when it is at its greatest distance from it. The regularity of the earth's motion is also further disturbed by the attraction of the moon, Venus, and Jupiter. True and mean agree about the 25th December, 15th April, 14th June, and 31st August; these coincidences vary slightly in different years, because the earth takes about a quarter of a day more than a year to complete a revolution in its orbit, and this error accumulates from leap year till the fourth year after, when the extra day is taken in.

Sun-dials mark apparent time, while clocks measure *equal* or *mean* time; if, therefore, a timekeeper, perfectly regular in its motion, were set to apparent solar time, it would be found to agree with it only on four days in the year.

Solar noon at any particular place may be obtained by a transit instrument, which is a telescope pointing north and south, by a sextant, or by a meridian dial. The Equation Table on p. 3 shows the amount to be added to or subtracted from true solar time to give mean solar time, that is, the time shown by a clock. But if it is desired that the clock should show the mean time of Greenwich, or some other standard meridian, a further correction for longitude must be made. The difference between mean time at Greenwich and other places is given on pp. 4–7.

Greenwich time is the standard adopted throughout Great Britain. In Ireland, Dublin time is kept. Five different standards have been established in America. A central meridian,

EQUATION TABLE COMPUTED TO MINUTES OF TIME.

Clock faster than the Sun.	Min.	Clock slower than the Sun.	Min.	Clock faster than the Sun.	Min.	Clock slower than the Sun.	Min.
December 26	1	April 17	1	June 17	1	September 2	1
„ 28	2	„ 22	2	„ 22	2	„ 6	2
„ 30	3	„ 28	3	„ 26	3	„ 8	3
January 1	4	May 6	4	July 1	4	„ 11	4
„ 3	5	„ 23	3	„ 7	5	„ 14	5
„ 5	6	June 1	2	„ 14	6	„ 17	6
„ 7	7	„ 7	1	August 8	5	„ 20	7
„ 9	8	„ 14	0	„ 14	4	„ 23	8
„ 12	9			„ 19	3	„ 26	9
„ 15	10			„ 23	2	„ 29	10
„ 18	11			„ 27	1	October 2	11
„ 21	12			„ 31	0	„ 5	12
„ 25	13					„ 9	13
„ 30	14					„ 12	14
February 24	13					„ 17	15
March 1	12					„ 23	16
„ 6	11					November 14	15
„ 10	10					„ 19	14
„ 14	9					„ 23	13
„ 17	8					„ 26	12
„ 21	7					„ 29	11
„ 24	6					December 2	10
„ 27	5					„ 4	9
„ 30	4					„ 7	8
April 3	3					„ 9	7
„ 6	2					„ 11	6
„ 10	1					„ 13	5
„ 15	0					„ 15	4
						„ 18	3
						„ 20	2
						„ 22	1
						„ 25	0

NOTE.—In an equation table for use in any year of the four from leap year to leap year, absolute exactness is impossible, on account of the error in the computation of the year, which is referred to on p. 2. Seconds and intermediate days are therefore omitted.

90° west and 6 hours slow of Greenwich, which serves for the Mississippi Valley, Missouri Valley, Upper Lakes, and Texas, is called "Valley Time." A meridian, 75° west and 7 hours slow of Greenwich, called "Atlantic Time," serves for the district from

Maine to Florida, from Ohio to Alabama, and the Lower Lakes, as well as for Canada. A meridian, 60° west and 4 hours slow of Greenwich, known as "Eastern Time," serves for Newfoundland, New Brunswick, and Nova Scotia. A meridian, 105° west and 7 hours slow of Greenwich, known as "Mountain Time," serves for the Rocky Mountain region. A meridian, 120° west and 8 hours slow of Greenwich, known as "Pacific Time," serves for the Pacific States and British Columbia.

The Astronomical Mean Solar Day. The Astronomical Mean Solar Day is reckoned from noon to noon, and the hours are counted continuously from 1 to 24, instead of being divided into two equal spaces of 12 hours each, as is the ordinary custom; thus half-past six o'clock in the morning of, say, the 2nd day of January would be expressed by astronomers as January 1st, 18 hours 30 minutes. In an astronomical regulator the hour circle is accordingly divided into 24, and the hour-hand goes round once in 24 hours.

Difference between Greenwich Mean Time and Local Time at the Principal Places throughout the World.

The word "fast" after any place indicates that the local time is fast of Greenwich time, and the word "slow" that it is slow of Greenwich time.

NOTE.—Four minutes in time = 1 degree of longitude. In estimating the time of any place by comparison with Greenwich, add to G.M.T. for *East* and subtract for *West*.'

ENGLAND AND WALES.

		M.	S.
LONDON—			
Aldgate Church ...	slow	0	17
Bank of England ...	"	0	20
Battersea Church ...	"	0	42
Berkeley Square ...	"	0	35
Blackfriars Bridge ...	"	0	24
British Museum ...	"	0	30
Fulham Church ...	"	0	50
Hampstead Church ...	"	0	48
Highgate Church ...	"	0	35
Horological Institute	"	0	24
Kensington Palace ...	"	0	45
Muswell Hill ...	"	0	29
St. Paul's	"	0	23
Streatham Church ...	"	0	31
Westminster Abbey ...	"	0	30

		M.	S.
Abingdon	slow	5	4
Alnwick	"	6	52
Andover	"	5	52
Appleby	"	9	52
Arundel	"	2	20
Ashford, Kent	fast	3	22
Ashton-under-Lyne ...	slow	8	24
Aylesbury	"	3	20
Banbury	"	5	12
Bangor	"	16	32
Barnstaple	"	16	20
Bath	"	9	28
Bedford	"	1	52
Berwick-on-Tweed ...	"	8	0
Beverley	"	1	44
Bideford	"	16	56
Birkenhead	"	12	4

		M.	S.
Birmingham	slow	7	36
Blackburn	„	9	52
Bodmin	„	19	0
Boston	„	0	6
Bradford, Yorkshire ...	„	7	0
Brecknock	„	14	0
Brentford	„	1	20
Bridgnorth	„	9	40
Bridgwater ...	„	12	0
Brighton	„	0	30
Bristol	„	10	22
Buckingham	„	3	56
Burnley	„	8	56
Burton-on-Trent ...	„	6	28
Bury (Lanc.)	„	9	4
Bury St. Edmunds ...	fast	2	48
Cambridge	„	0	23
Canterbury	„	4	30
Cardiff	slow	13	0
Cardigan	„	18	20
Carlisle	„	11	44
Carmarthen	„	17	16
Carnarvon	„	17	0
Chatham	fast	2	10
Chelmsford	„	2	0
Cheltenham	slow	8	20
Chester	„	11	36
Chichester	„	3	10
Chippenham	„	8	20
Christchurch	„	7	0
Cockermouth	„	13	30
Colchester	fast	3	38
Coventry	slow	6	0
Darlington	„	6	8
Deal	fast	5	36
Derby	slow	5	52
Devizes	„	7	52
Devonport	„	16	48
Dewsbury	„	6	28
Dorchester	„	9	48
Douglas, Isle of Man ...	„	17	46
Dover	fast	5	16
Droitwich	slow	8	42
Dudley	„	8	26
Durham	„	6	20
Eastbourne	fast	1	20
Epsom	slow	1	4
Exeter	„	14	12
Falmouth	„	20	38
Faversham	fast	3	36
Flint	slow	12	31
Folkestone	fast	4	36
Gateshead	slow	6	24
Gloucester	„	9	0
Grantham	„	2	40

		M.	S.
Gravesend	fast	1	40
Grimsby	slow	0	16
Guernsey	„	10	22
Guildford	„	2	10
Halifax	„	7	8
Harrogate	„	6	8
Hartlepool	slow	4	40
Harwich	fast	5	8
Hastings	„	2	24
Hereford	slow	11	0
Hertford	„	0	20
Holyhead	„	18	36
Horsham	„	1	20
Huddersfield	„	7	10
Hull	„	1	20
Huntingdon	„	0	44
Ilfracombe	„	16	28
Ipswich	fast	4	40
Isle of White (Newport)	slow	5	5
Jersey (St. Helier's) ...	„	8	28
Kendal	„	10	40
Kew Observatory ...	„	1	15
Kidderminster ...	„	9	0
King's Lynn	fast	1	40
Lancaster	slow	11	5
Leamington	„	6	0
Leeds	„	6	4
Leicester	„	4	33
Leominster	„	11	0
Lewes	fast	0	5
Lichfield	slow	7	10
Lincoln	„	2	6
Liskeard	„	17	50
Liverpool	„	12	0
Llanelly	„	16	40
Louth	—		—
Macclesfield	slow	8	30
Maidstone	fast	2	10
Malvern (Great) ...	slow	9	16
Manchester	„	8	52
Margate	fast	5	32
Merthyr Tydfil ...	slow	13	30
Middlesborough ...	„	4	56
Monmouth	„	10	56
Montgomery	„	12	40
Morpeth	„	6	46
Newcastle	„	6	24
Northampton	„	3	32
Norwich	fast	5	12
Nottingham	slow	4	30
Oakham	„	2	50
Oldham	„	8	30
Oxford	„	5	2
Pembroke	„	19	40
Penzance	„	22	10

		M.	S.
Peterborough	slow	0	56
Plymouth	"	16	30
Poole	"	7	50
Portsmouth	"	4	24
Preston	"	10	50
Ramsgate	fast	5	40
Reading	slow	3	55
Reigate	"	0	48
Rochester	fast	2	0
Runcorn	slow	11	0
Salford	"	9	4
Salisbury	"	7	8
Scarborough	"	1	35
Sheerness	fast	2	59
Sheffield	slow	5	50
Shields (North)	"	5	46
Shields (South)	"	5	37
Shoreham	"	1	8
Shrewsbury	"	10	56
Southampton	"	5	36
Southport	"	12	0
Stafford	"	8	30
Staleybridge	"	8	15
Stamford	"	1	55
Stockport	"	8	40
Stockton-on-Tees	"	5	10
Stroud	"	8	50
Sunderland	"	5	28
Swansea	"	15	40
Taunton	"	12	25
Tavistock	"	16	35
Teignmouth	"	13	46
Tiverton	"	14	0
Torquay	"	20	10
Truro	"	14	0
Tunbridge Wells	fast	1	4
Wakefield	slow	5	50
Walsall	"	7	55
Wareham	"	8	25
Warrington	"	10	20
Warwick	"	6	15
Wednesbury	"	8	10
Wenlock (Much)	"	10	10
Westbury	"	9	30
Weston-super-Mare	"	11	54
Weymouth	"	9	45
Whitby	"	2	24
Whitehaven	"	14	24
Wigan	"	10	30
Winchester	"	5	20
Windsor	"	2	25
Wisbech	fast	0	45
Wolverhampton	slow	8	25
Woodstock	"	5	52
Worcester	"	8	52
Worthing	slow	1	30
Yarmouth	fast	7	0
York	slow	4	16

SCOTLAND.

		M.	S.
Aberdeen	slow	8	20
Ayr	"	18	36
Banff	"	10	5
Dumbarton	"	8	16
Dumfries	"	14	24
Dundee	"	11	52
Edinburgh	"	12	44
Elgin	"	13	20
Forfar	"	11	20
Glasgow	"	17	10
Greenock	"	19	1
Inverness	"	16	54
Kilmarnock	"	18	0
Kirkcaldy	"	12	36
Kirkwall	"	11	48
Leith	"	12	36
Montrose	"	9	52
Paisley	"	17	40
Perth	"	13	46
Stirling	"	15	40
Wick	"	12	28

IRELAND.

NOTE.—Dublin time is kept throughout Ireland.

		M.	S.
Dublin	slow	25	22
Armagh	"	26	36
Bandon	"	34	48
Belfast	"	23	46
Cork	"	33	56
Downpatrick	"	22	52
Drogheda	"	25	20
Dundalk	"	25	30
Enniskillen	"	30	40
Galway	"	36	12
Kilkenny	"	29	0
Limerick	"	34	30
Lisburn	"	24	8
Londonderry	"	29	20
Queenstown	"	33	0
Sligo	"	33	52
Waterford	"	28	30
Wexford	"	25	56
Wicklow	"	24	8
Youghal	"	31	24

OTHER COUNTRIES.

NOTE.—Five standards of time are used in America. (See pp. 3, 4.)

		H.	M.	S.
Adelaide	fast	9	14	30
Alexandria	„	1	58	20
Algiers	„	0	12	10
Amsterdam	„	0	19	33
Athens	„	1	34	55
Auckland	„	11	39	4
Barbados (Bridgtown)	slow	3	59	0
Berlin	fast	0	53	35
Bombay	„	4	51	36
Boston, U.S.A. ...	slow	4	42	0
Brisbane	fast	10	11	40
Brussels	„	0	17	29
Buenos Ayres ...	slow	3	53	30
Cairo	fast	2	5	6
Calais	fast	0	7	28
Calcutta	„	5	53	46
Canton	„	7	32	56
Cape Town	„	1	13	54
Chicago	slow	5	50	38
Christiania	fast	0	52	54
Colombo	„	5	19	24
Constantinople ...	„	1	56	0
Copenhagen ...	„	0	50	19
Geneva	„	0	24	37
Gibraltar	„	0	21	22
Hamburg	„	0	39	53
Havre	„	0	0	26
Jamaica (Kingston)	slow	5	7	12
Jeddo	fast	9	19	0
Jerusalem	„	2	20.	56
Lima...	slow	5	8	10
Lisbon	„	0	36	35
Madeira	„	1	7	36
Madras	fast	5	20	57
Madrid	slow	0	14	45
Malta	fast	0	58	0
Melbourne	„	9	39	54
Mexico	slow	6	36	0
Milan	fast	0	36	46
Montreal	slow	4	54	30
Moscow	fast	2	30	17
Munich	„	0	46	26
Naples	„	0	56	59
New York	slow	4	56	0
Palermo	fast	0	53	24
Paris	„	0	9	21
Pekin	„	7	45	52
Philadelphia ...	slow	5	40	0
Pietermaritzburg ...	fast	2	0	0
Quebec	slow	4	45	0
Rangoon	fast	6	25	10
Rio Janeiro	slow	2	52	36
Rome	fast	0	49	54
St. Helena	slow	0	25	10
St. John, N.B. ...	„	4	24	24
St.John,Newfoundland	„	3	30	52
St. Petersburg ...	fast	2	1	13
San Francisco ...	slow	8	10	0
Santa Cruz	„	4	18	36
Shanghai	fast	8	5	20
Stockholm	„	1	12	14
Suez	„	2	10	0
Sydney	„	10	5	0
Teheran	„	3	25	32
Tripoli	„	0	52	44
Tunis	„	0	40	44
Venice	„	0	49	25
Vienna	„	1	5	31
Warsaw	„	1	24	7
Washington ...	slow	5	8	11
Wellington, N.Z. ...	fast	11	39	14

Cycle of the Sun. A cycle of the sun is a period of 28 years, after which the days of the week again fall on the same days of the month, as during the first year of the former cycle. The cycle of the sun has no relation to the sun's course, but was invented for the purpose of finding the Dominical Letter which points out the days of the month on which the Sundays fall during each year of the cycle. Cycles of the sun date nine years before the Christian era. If it be required to know the year of the cycle in 1892, nine added will make 1901, which, divided by 28, gives the quotient 67, the number of cycles that have passed, and the remainder 25 will be the year of the cycle answering to 1892.

Sidereal Time. Sidereal time, the standard used by astronomers, is measured by the diurnal rotation of the earth, which turns on its axis in 23 hours 56 min. 4·1 sec. The sidereal day is therefore 3 min. 56 sec. less than the mean solar day, and a clock to show sidereal time must have its pendulum a trifle shorter than a mean-time clock with the same train. About the 15th of April the sidereal clock and the mean-time clock would agree, but from that time the divergence between the two would be increased each day by 3 min. 56 sec.

Days.	STARS GAIN.		
	Hours.	Min.	Sec.
1	0	3	56
2	0	7	52
3	0	11	48
4	0	15	44
5	0	19	39
6	0	23	35
7	0	27	31
8	0	31	27
9	0	35	23
10	0	39	19
11	0	43	15
12	0	47	11
13	0	51	7
14	0	55	3
15	0	58	58
16	1	2	54
17	1	6	50
18	1	10	46
19	1	14	42
20	1	18	38

Mean-time clocks, though, can be regulated by the stars with greater facility than by the sun, for the motion of the earth with regard to the fixed stars is uniform, and a star will always appear at the meridian 3 min. 56 sec. sooner than it did on the preceding day. In the absence of a transit instrument and a table giving the right ascension of particular stars, choose a window having a southern aspect, from which the steeple of a church, a chimney, or any other fixed point may be seen. To the side of the window attach a thin plate of brass having a small hole in it, in such a manner that by looking through the hole towards the edge of the elevated object, some of the fixed stars may be seen; the progress of one of these being watched, the instant it vanishes behind the fixed point a signal is made to a person observing the clock, who then notes the exact time at which the star disappeared, and on the following night the same star will vanish behind the same object 3 min. 56 sec. sooner. If a clock mark 10 hours when the observation is made, when the star vanishes the following night it should indicate 3 min. 56 sec. less than 10 hours. If several cloudy nights have rendered it impossible to compare the clock with the star, it will then be necessary to multiply 3 min. 56 sec. the number of days that have elapsed since the observation, the product deducted from the hour the clock then indicates gives the time the clock ought to show. The same star can only be observed during a few weeks, for as it gains nearly one hour in a fortnight, it will, in a short time, come to the meridian in broad daylight and become invisible; to continue the observation, another star must be selected. In making the observation, care must be taken that a planet is not observed instead of a star; Mars, Jupiter, and Saturn are those most likely to occasion this error, more especially Saturn, which, from being the most distant of the three, resembles a star of the first magnitude. The planets may, however, be easily distinguished, for, being comparatively near the earth, they appear larger than the stars; their light also is steady because reflected, while the fixed stars scintillate and have a twinkling light. A sure means of distinguishing between them is to watch a star attentively for a few nights; if it change its place with regard to the other stars it is a planet.

The Nautical Day. The nautical day commences when the sun is on the meridian; 8 blows are then struck on the ship's bell, and the afternoon watch is begun. At 12.30 one blow is struck, and the time is spoken of as "1 bell;" at 1 o'clock, 2 bells; at 1.30, 3 bells; at 2, 4 bells; 2.30, 5 bells; 3, 6 bells; 3.30, 7 bells; at 4 o'clock, 8 bells again. At 4 o'clock begins the first dog watch, which lasts two hours, the periods being struck as before, ending at 6 o'clock with 4 bells. Then begins the second dog watch, also of two hours' duration, ending at 8 o'clock, half-hour intervals being struck 1, 2, 3, 8; 8 bells marking the completion of the second dog watch. Next comes the middle watch, lasting four hours, and struck like the afternoon watch. The night watch, the morning watch, the forenoon watch, each of four hours similarly marked, follow in succession; the forenoon watch ending at noon with 8 bells completes the day.

Duration of a Year. The earth performs its revolution round the sun in 365 days 5 hours 48 min. 49·7 sec. No account was taken of the odd hours till the year B.C. 45, when the error in the computation of the year had become very considerable. The surplus, 5 hours 48 min. 49·7 sec., was then taken as 6 hours, making one day in four years; this day was therefore added to every fourth year. There still remained the apparently trifling difference of 11 min. 11 sec. between the computed and the real year; this, however, produced an error of about seven days in 900 years. In 1582, Pope Gregory XII. struck out ten days, which represented the accumulated error, from the calendar, and it was decided that three leap years should be omitted every 400 years; thus, as 1600 was leap year, the years 1700, 1800, and 1900 are not, but 2000 will be leap year. This rectification was not adopted in England till 1752, when eleven days were omitted from the calendar. As our year still exceeds the true year, although by an extremely small fraction, another leap year in addition to those should be omitted once in 4000 years.

The Golden Number. Meton, an Athenian astronomer, B.C. 432, discovered that after a period of nineteen years the new and full moons returned on the same days of the month as they had done before; this period is called the cycle of the moon. The Greeks thought so highly of this calculation, that they had it written in letters of gold, hence the name Golden Number; and at the Council of Nice, A.D. 325, it was determined that Meton's cycle should be used to regulate the movable feasts of the Church. Our Saviour was born in the second year of the lunar cycle. To find the year of the cycle, add one to the present year, divide this by 19, and the remainder will give the year of the cycle. 1892 + 1 divided by 19 leaves a remainder of 12, which is, therefore, the Golden Number for 1892.

The Epact. The Epact serves to find the moon's age by showing the number of days which must be added to each lunar year, in order to complete a solar year. A lunar month is composed of 29 days 12 hours 44 min. 3 sec., or rather more than 29·5 days; 12 lunar months are, therefore, nearly 11 days short of the solar year—thus, the new moons in one year will fall 11 days earlier than they did in the preceding year, so that were it new moon on January 1st, it would be nearly 11 days old on the 1st of January of the ensuing year, and 22 days on the third year; on the fourth year it would be 33; but 30 days are taken off as an intercalary month (the moon having made a revolution in that time), and the three remaining would be the Epact; the Epact thus continues to vary, until, at the expiration of 19 years, the new moons again return in the same order as before. If the solar year were exactly 11 days longer than 12 lunar months, it would only be necessary to multiply the Golden Number by 11, divide the product by 20, and the remainder would be the Epact; but, as the difference is not quite 11 days, one must be taken from the Golden Number, and the remainder multiplied by 11, and the product, if less than 30, shows the Epact; but if more, it must be divided by 30, and the remainder is the Epact for that year. The Golden Number for 1892 being 12, 12 multiplied by 11 = 121, and 121 divided by 30 leaves a remainder of 1, which is the Epact for 1892.

To find the moon's age upon any particular day, add the number placed against the month in the following table to the Epact and day of the month; the product, if under 30, will be the moon's age. Should it exceed this number, divide by 30, and the remainder will show it:—

January	2	April	2	July	5	October	8
February	3	May	3	August	7	November	10
March	1	June	4	September	7	December	10

From the irregularity of the number of days in the calendar months and other causes, it is difficult to make an exact calculation, but the error resulting from this rule does not exceed one day.

The Number of Direction. The Council of Nice decided, A.D. 325, that Easter Day is always the first Sunday after the full moon which happens upon or next after the 21st of March. Easter Day, therefore, cannot take place earlier than the 22nd of March or later than the 25th of April. The Number of Direction is that day of the thirty-five on which Easter Sunday falls.

The Roman Indiction. The Roman Indiction was a period of 15 years, appointed A.D. 312 by the Emperor Constantine for the payment of certain taxes.

The Julian Period. The Julian Period of 7980 years is the product obtained by multiplying together 28, 19, and 15, which numbers represent the cycles of the sun, the moon, and the Roman Indiction. The beginning of the Julian Period is reckoned from 709 before the creation of the world, so that its completion will occur A.D. 3267, until which time there cannot be two years having the same numbers for three cycles.

Sun-dials.

Meridian Dials. THE simplest form of sun-dial, and a useful one for setting a timekeeper when no standard is available for comparison, is one for showing when the sun is on the meridian. With a timekeeper showing mean time and an equation table, a meridian line may, of course, be at once traced for future reference. In the absence of these, the following, which are practically Ferguson's instructions, may be followed: "Make four or five concentric circles, a quarter of an inch from one another, on a flat stone, and let the outmost circle be but little less than the stone will contain. Fix a pin perpendicularly in the centre, and of such a length that its whole shadow may fall within the innermost circle for at least four hours in the middle of the day. The pin ought to be about an eighth of an inch thick, with a round blunt point. The stone being set exactly level, in a place where the sun shines, suppose from eight in the morning till four in the afternoon, about which hours the end of the shadow should fall without all the circles; watch the times in the forenoon when the extremity of the shortening shadow just touches the several circles, and there make marks. Then, in the afternoon of the same day, watch

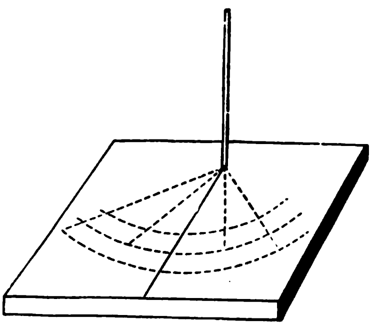


FIG. 1.

the lengthening shadow, and where its end touches the several circles, in going over them, make marks also. With a pair of compasses, find exactly the middle points between the two marks on any circle, and draw a straight line from the centre to that point, which line will be covered at noon by the shadow of a small upright wire, which should be put in place of the pin. The reason for drawing several circles is, that in case one part of the day should prove clear, and the other part somewhat cloudy, if you miss the time when the point of the shadow should touch one circle, you may perhaps catch it in touching another."

By observation the hours of the morning and afternoon may be marked on the meridian dial, and it will be noticed that, although the position of the hour immediately preceding corresponds with the one immediately after noon, these divisions will not answer for any of the remaining hours.

The art of dialling is somewhat complex. A glance at the figure below will show why, except for places on the equator,

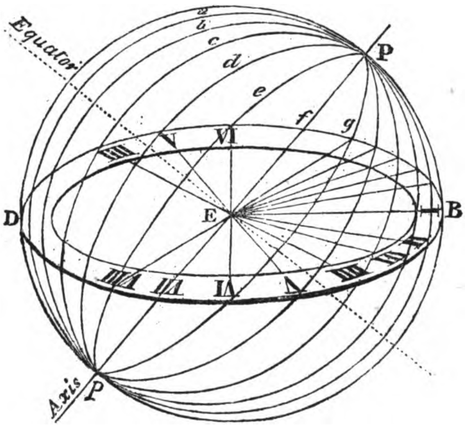


FIG. 2.

the hour spaces cannot be equal. A sun-dial may be regarded as a circle round the earth, or as the edge of a disc which passes through the centre of the earth from the spot where the dial is fixed. *a*, *b*, *c*, *d*, *e*, *f*, *g*, etc., are longitudinal circles, representing the hours, B the spot where the dial is situated, D the corresponding latitude, P P the poles, and E the centre of the earth. The only way the hour divisions can be made equal away from the equator is by curving the dial to a cylindrical form, the gnomon being the axis of the cylinder.

A dial prepared for any particular place is useless for another place in a different latitude, with the exception that a *horizontal* dial for a certain latitude will be a vertical dial for a latitude which is the complement of the first, or what it wants of 90°. That is, a horizontal dial for our latitude of 51½°, would have to be placed in a vertical position facing the south in latitude 38½°.

Horizontal Sun-dial. To set out a horizontal dial, first draw two lines parallel to each other, at a distance equal to the thickness of the gnomon which is to cast the shadow. Next, draw a line at right angles to these, the extremities of which will indicate respectively the hours of 6 in the morning and 6 in the evening. Then, with A and B as centres (see engraving), draw quadrants of circles, and divide each into 90°. Lay

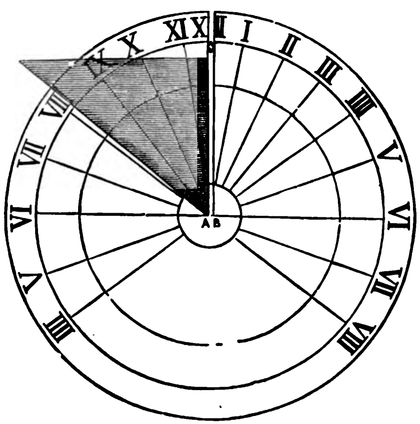


FIG. 3.—Horizontal sun-dial.

a rule over B, and draw the first line through $11\frac{2}{3}$°, and second through $24\frac{1}{4}$°, third $38\frac{1}{2}$°, fourth $53\frac{1}{2}$°, and fifth $71\frac{1}{15}$°. Proceed the same with the other side. Extend the afternoon hour lines of 4 and 5 across the dial, and these will form the morning hours, while 8 and 7 of the morning hours prolonged will give the same evening hours. To form the style or gnomon, draw a radial line through that degree of the quadrant which is the latitude of the place. For London this would be 51½°. This will show the elevation of the style, which is here represented as if lying on the surface of the dial. The thickness of the style must be equal to the distance between A and B. Place the style truly upright on the dial, and it is finished.

Clepsydræ, or Water Clocks.

THESE indicate intervals of time by the passage of water. These may be divided into two classes: the ancient recorders for hours of varying length, and the more simple instruments used during and after the seventeenth century, when equal hours were measured.

One of the earliest forms of the Clepsydra, which was in use in Egypt about 300 B.C., is shown in Fig. 4. A supply of water ran through the pipe H into the cone A, and from there dropped into the cylinder E. A conical stopper B regulated the flow, and the superfluous water escaped by the waste pipe I. The Egyptians divided the period between sunrise and sunset into twelve equal hours, so that the conical stopper had to be adjusted each day, and marks for every day in the year, and for the particular latitude of the place, were cut on the stalk D as a guide to the position of the stopper. A floating piston terminating in a rack served to actuate a pinion, to the arbor of which an hour hand was fixed.

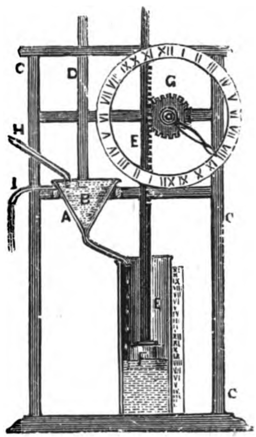


FIG. 4.

In Fig. 5 is shown an improved clepsydra, constructed so that its aperture is adjusted as the year advances by the putting of an index to the sun's place in an ecliptic circle.

It consists, first, of a reservoir A, to the top of which is attached a waste pipe to carry off the superfluous water, and thus keep it at the same level. A pipe B projects from this vessel into the rim of a drum M N, on the front of which is a circle with the signs of the ecliptic engraved thereon. A smaller drum O F L passes within the large one, having attached to it an index. This drum has a groove or slot *a b* cut through it, tapering in breadth both ways to a point. When in its place, this tapering groove comes just under the orifice of the pipe leading from the reservoir. This inner drum turns on a pipe or tube F, which is continued within and has a funnel at the end (not seen) for receiving the

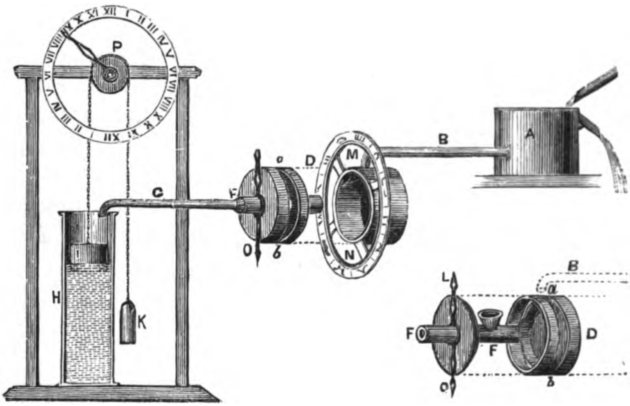


FIG. 5.

water as it drops through the groove in the drum. The index is double, L for day and O for night, and it will be evident that, as it is turned, the capacity of the orifice is altered, and the water passes more or less rapidly through the pipe.

The ecliptic being properly divided, the hand was set to the proper sign in which the sun then was, and was altered as he shifted round the ecliptic. The water thus regulated, dropped into a cylindrical vessel H, within which was a float I, connected by a chain passing over a pulley on an arbor P, and having a counterpoise K at its other end. This pulley carried an index which pointed out the hours on a circle.

The next is ascribed to Ctesibius, the son of a barber, about 200 B.C. It was a self-adjusting machine, and is shown in Fig. 6.

The water dropped into a funnel A, from the eyes of a figure placed over it, and connected with a full reservoir, thus ensuring a constant pressure. The tube conveyed the water into an open cylinder with a float and a light pillar C attached. On the top of this pillar a human figure is placed, which points to the divisions on a large column. As the water rises in the cylinder, it also rises in the small tube or short leg of a syphon F B E, till it reaches the top, when it flows over the bent part, and quickly empties the cylinder, bringing down the float, and with it the index to the starting-point. So far it would have measured hours of equal length; but the Egyptian method required some further contrivance to accommodate it to hours of varying length. This was done by drawing the divisions around the large column out of a horizontal line, so as to vary in their distance on different sides. The water as it came from the syphon fell into a chambered drum K, which turned with the weight as each compartment became filled. On the axis of this drum was placed a pinion gearing with a contrate wheel I, which, by another pinion H, turned a wheel G, to the axis L of which the column was fixed. The lines were drawn slanting round the column to suit the hours of varying length throughout the year. The clepsydra was introduced into Greece by Plato. The introduction of the clepsydra into Rome took place about 157 B.C., by Scipio Nasica. Pliny tells us that Pompey brought a valuable one among the spoils from the eastern nations, which he made use of for limiting the speeches of the Roman orators. Julius Cæsar is said to have met with an instrument of the kind in England, by the help of which he observed that the summer nights of this climate are shorter than they are in Italy.

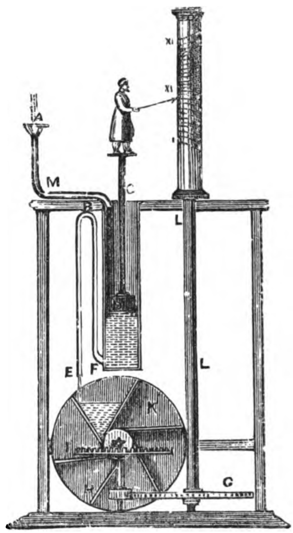


FIG. 6.

Beckmann, in his "History of Inventions," dates the revival of clepsydræ to some time between 1643 and 1646; and Dr. Hutton asserts that in 1693 the first water clock was brought to Paris from Burgundy.

Fig. 7 represents a clepsydra of the seventeenth century, consisting of an oblong frame of wood, A B C D, to the upper part of which two cords are fixed, their lower ends being wound round the axis of the drum E. The drum is shown in section at Fig. 8.

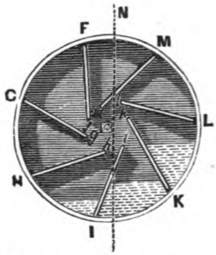


Fig. 8.—Section of drum.

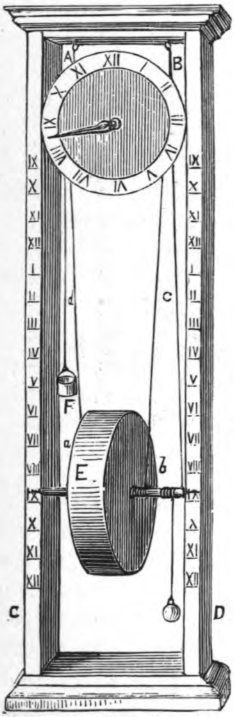


Fig. 7.

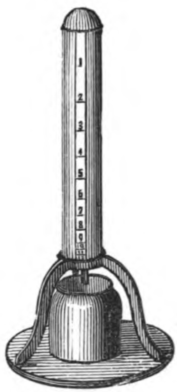


Fig. 9.

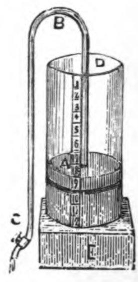


Fig. 10.

It has seven water-tight metallic partitions, F *f*, G *g*, H *h*, I *i*, K *k*, L *l*, and M *m*. If, now, the cord be wound around the axis until the drum rises to the top of the frame, and the drum be left to obey the force of gravity, it will of course tend to fall, and the cord resisting this tendency will cause it to revolve rapidly as it descends. But if we introduce water into the vessel, it will be retained in certain parts of the circumference by these partitions, and, one side being thus heavier than the other, the tendency to revolve will be counteracted, and the drum will remain stationary. If now we pierce a small hole near the bottom of each cell, the water will slowly ooze from it into another, thus reducing the opposing weight of water, and causing the drum slowly to revolve. The rate of motion being properly regulated by altering the size of the apertures, the axis will point out the hours on the side of the frame; or a cord *c d*, with a weight F, may be made to pass over a pulley attached to an arbor bearing an index or hand to point out the hours on a circle properly engraved or painted.

A very simple form of clepsydra is shown in Fig. 9. It is merely a glass vessel which has an orifice at the bottom, and is filled with as much water as will flow out in exactly twelve hours, figures being placed at the proper distances to denote the successive hours. Fig. 10 shows an open vessel with a syphon attached to a float. The syphon will empty the vessel of the whole of the contained fluid, and the pressure exerted, being equal to the difference in length between the shorter and longer leg, remains always the same in consequence of the float falling as the water falls. Other clocks were also made, in which the weight of the water was made to keep a pendulum in motion.

The construction of clepsydræ and of weight clocks went on contemporaneously for a long period. A water clock was among the contrivances of the boyhood of Sir Isaac Newton.

Weight Clocks.

SO many vague and contradictory records exist as to the invention of clocks composed of an assemblage of wheels actuated by a weight, that any attempt to fix the exact date of their introduction would be mere guesswork.

It is claimed that Pacificus, Archdeacon of Verona, who died in the middle of the ninth century, devised a clock which Bailley, in his "History of Modern Astronomy," considers was furnished with an escapement; but this is not substantiated, and other authorities decide that it was a water clock.

Gerbert, a monk, afterwards Pope Sylvester II., placed a clock in Magdeburg Cathedral at the end of the tenth century; but Ditmar declares it was only a kind of sun-dial; on the other hand, the Rev. H. L. Nelthropp, who seems to have taken some pains to investigate the matter, considers Gerbert to be the originator of the escapement, and his claim to be well founded. Whether Gerbert really constructed such mechanism or not, it is pretty certain that clocks existed in cathedrals and monasteries during the twelfth and thirteenth centuries.

The word "clock," whether derived from the Saxon *clugga*, the Teutonic *glocke*, the Latin *glocio*, or the French *cloche*, signified "a bell," and there is reason to suppose that many of the early efforts consisted merely of a bell sounded at regular intervals by hand, the instant of ringing being determined by a sun-dial or sand-glass.

In monasteries prayers were recited at certain fixed hours of the night as well as of the day, and as the monks were not always unfettered by sleep at the needful moment, this horologe or alarum was probably invented to rouse the drowsy *religieux* to a due sense of his duties.

Chaucer speaks of the cock crowing as regularly as clock or abbey horologe.

About 1326 Richard Wallingford, Abbot of Saint Albans, placed a "horologe" in his monastery, and the account which he gave of his machine is still preserved in the Bodleian Library at Oxford. From this Wallingford's conception really appears to have been more of a planetarium, for showing the course of the heavenly bodies, than a timekeeper, for his description contains no mention of any escapement or regulator for ensuring equable motion. There was, prior to 1298, a clock at St. Paul's Cathedral which struck the hours on a bell by means of mechanical figures; and Decker, in his "Gull's Hornbook," calls them "Paul's Jacks." In the accounts of the cathedral for the year 1286 the allowances to Bartholomo Orologiario the clock-keeper are entered, namely, of bread at the rate of a loaf daily. In 1344 the dean and chapter entered into a contract with Walter the Orgoner of Southwark to supply and fix a dial. It is suggested that the clock previously struck the hours, but had no dial. In Dugdale's history of the old cathedral the dial is referred to as follows: "Somewhat above the stonework of the steeple was a fine dial, for which there was order taken in the 18th of Edward III., that it should be made with all splendour imaginable, which was accordingly done; having the image of an angel pointing to the hours both of the day and night."

In the reign of Edward I., about 1300, a large stone tower was built in Palace Yard opposite to Westminster Hall, and a

FIG. 11.—Clock tower in Palace Yard, Westminster, 1300.

clock placed therein, which struck every hour upon a great bell. The Hon. Daines Barrington states that "the Lord Chief Justice Randulphus de Hengham, having made an alteration in a record, was fined 800 marks by the king's order, and the money was applied to defray the cost of erecting a public clock opposite the entrance to Westminster Hall." From an old print I am enabled to give an engraving of this interesting erection. In an Issue

Roll of the forty-fourth year of the reign of Edward III. is recorded the payment of two pounds to John Nicole, keeper of the great clock of the king within the Palace of Westminster, being his wages for eighty days at the rate of sixpence a day. In subsequent reigns further references are made to the keeper of this clock. Henry VI. entrusted its custody to William Warby, Dean of St. Stephen's, together with sixpence a day remuneration. The tower was pulled down about the middle of the seventeenth century. The exact date of its destruction is uncertain; but that it remained until the time of Elizabeth is evident by Judge Southcote mentioning the tradition, and stating that the clock still remained which had been made out of the Chief Justice's fine. On the old Houses of Parliament a dial on the second pediment of the buildings in Palace Yard marked the site, the remarkable motto on which, "Discite Justitiam Moniti," may be taken to relate to its origin. The clock tower of the present home of our Legislature is, it is conjectured, but a few paces from the situation of the original clock. The great bell, "Tom of Westminster," was broken up and re-cast for the St. Paul's Cathedral clock, of which more particulars will be given later on.

Exeter Cathedral could boast of an early clock, for in the Patent Rolls, 1318, is mentioned a grant of lands in Pennington to Robert Fitz Walter, for repairing the organ and the clock in the cathedral of Exeter. Whatever its construction, no trace of this horologe can be found, but of its successor, stated to have been presented by Bishop Courtenay in 1480, the wrought-iron framing and the great wheel are preserved, and still to be seen at the cathedral. It is stated that this clock was made by Peter Lightfoot, but if the date of its construction, 1480, is correct, this cannot be true, for Lightfoot had then been dead some years. The dial which still does duty bears a remarkable likeness to the one of Lightfoot's at Wimborne, from which it was possibly copied. Underneath it is the inscription, "Pereunt et duputantur x. horæ." In 1760 an additional circle was added to the dial, and motion work to show the minutes provided. The movement was replaced by a modern one in 1885.

There was also a large clock in Canterbury Cathedral at the end of the thirteenth century, which, according to Dart's history of the sacred edifice, was put up at a cost of £30 in 1292.

The earliest clock worthy of our modern definition, of which we have any authentic details, is the one which is said to have been made about the year 1335, by Peter Lightfoot, an ingenious monk, of Glastonbury Abbey, for and at the expense of his superior, Adam de Lodbury, who was promoted to the Abbacy of Glastonbury in 1322, and died in 1335. The first of the celebrated Strasburg Cathedral clocks was begun about 1350, under the direction of John, Bishop of Lichtenberg. Henry de Vick, of Würtemberg, constructed a clock for Charles V. of France, surnamed the Wise, in the tower of whose palace it was placed about the year 1360. In Rymer's "Fœdera" it is mentioned that the protection of Edward III. was accorded to three Dutchmen, orlogiers, who were invited from Delft, in Holland, to England in the year 1368, from which time we may probably date the introduction of clockmaking as an art into England. These pioneers were named John Lietuyt, John Uneman, and William Uneman. According to Froissart, Courtray had a clock about 1370, which was carried away by the Duke of Burgundy in the year 1382. The "horologium" of Dondi, constructed at Padau about the end of the fourteenth century, by order of Hubert Prince of Carrara, seems also to have been a true clock. It is described as being placed on the top of a turret on the steeple, and designating the twenty-four hours of the day and night. At Spire there was a clock in the year 1395; one at Lubeck was completed in 1405; Nuremberg had one in 1462, Auxerre in 1483, and Venice in 1497; and, on the authority of Camaldulensis, clocks began to be common in private families on the Continent about the end of the fifteenth century. It is also probable that clocks began to be generally known in England about the same period.

The Glastonbury ancient and complicated piece of machinery was, according to William of Worcester, originally in the south transept of the abbey church; but it was removed with all its appendages from thence to Wells Cathedral at the time of the dissolution of the monastery in the reign of Henry VIII., where, in an old chapel in the north transept, it still remains. The face of the clock as it now appears is shown in Fig. 12. The dial is six feet six inches in diameter, and contained in a square frame, the spandrels of which are filled with angels, holding in their hands the head of a man. The outer circle is painted blue, with gilt stars scattered over it, and is divided into twenty-four parts, corresponding with the twenty-four hours of the day and night, in two divisions of twelve hours each. The horary numbers are painted in old English characters on circular tablets, and mark the hours from twelve at noon to midnight, and from thence to twelve at midday again. The hour-index, a large gilt star, is attached to the machinery behind a second circle, which conceals all except

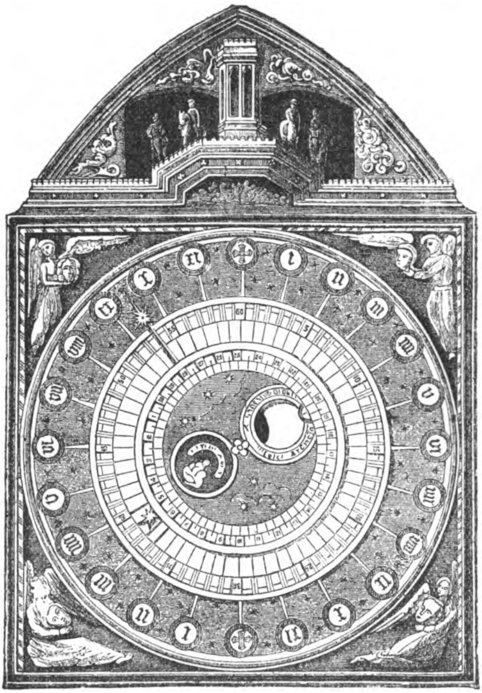


FIG. 12.—Dial of Glastonbury clock.

the index. On this second circle are marked the minutes, indicated by a smaller star. A third and lesser circle contains numbers for indicating the age of the moon, which is marked by a point attached to a small circular opening in the plate, through which the phases of the moon are shown. Around this aperture is an inscription, not very intelligible, which one author reads as "Ab hinc monstrat micro . . . ericus archery pung," meaning, probably, that in this microcosm were displayed all the wonders of the vast sidereal hemisphere. On the opposite side of the dial-plate is a circle, in which is a female figure, with the motto "Semper peragrat Phœbe." An arched pediment surmounts the whole, with an octangular projection from its base line, forming a cornice to the face of the clock. A panelled turret is fixed in the centre, around which four equestrian knights, equipped for a tournament and mounted on two pieces of carved wood, used to revolve in opposite directions rapidly round a centre, two on each side, as if running at the ring in a tilt, when set in motion by a connection with the clock. A man seated at one angle of the transept, within the church, is connected by rods with the clock, and he is made to strike the quarters with his feet on two little bells, and the hours on another bell before him with a battle-axe that is in his hands. If the date of the construction of this clock be correct, the figures at present moved by its machinery cannot, according to Mr. Planché, be the original ones, or they have undergone strange alteration. Those that circulated in a sort of tilting match are very clumsily carved, and have suffered some injury from time; but two of them appear to be intended for jesters; one wears a hood with ears to it; the third is a nondescript; but the fourth is painted in the civil costume of the reign of James or Charles I., with falling collar, striped doublet, and the peaked beard and moustache of that period. The two figures that strike the bell on the outside with their battle-axes are in armour of the fifteenth century, and the time of Henry VI. or Edward IV.

The old interior works of this clock were of iron, not differing materially in principle from the mechanism of much later date clocks, except that the appliances for the variety of the movements of the dial-plate were necessarily complicated. They exhibited a rare and interesting specimen of the art of clock-making at so early a period, in which the monks particularly excelled. After going for nearly five centuries, the works were found to be so completely worn out that, about the year 1835, they were replaced by a new train. The old movement, now controlled by a pendulum, may be seen in action at South Kensington Museum. Except for the quarter striking part and the lunation work, the movement is identical with that of De Vick's clock, presently to be described

Another clock attributed to Lightfoot was erected at Wimborne, in Dorsetshire. The dial as it at present appears is shown in Fig. 13, and an examination will show many features in common with these two fourteenth-century clocks.

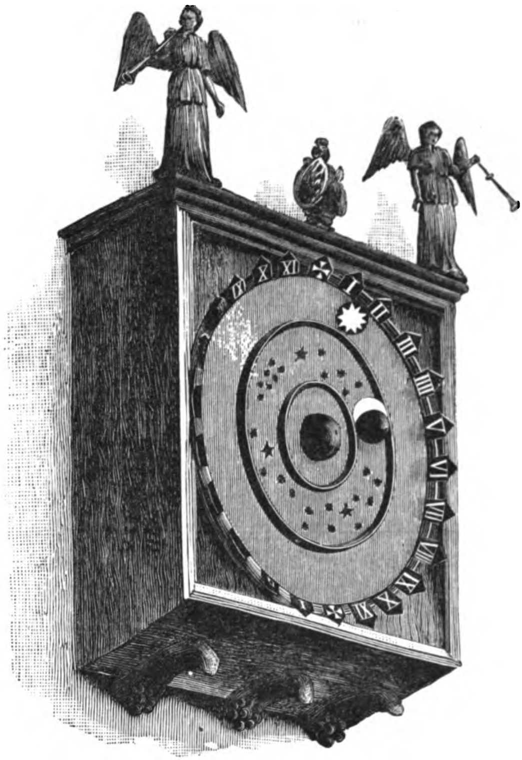


FIG. 13.—Dial of Wimborne clock.

Figs. 14, 15, and 16 represent De Vick's clock in front and in profile.

There was but one hand, and that in its revolution round a dial-plate indicated the hours. A heavy weight being tied to a rope, which was wound round a cylinder or barrel, served as the power to cause the hand to revolve; but the hand, instead of being fixed to the axis of the barrel, had its motion communicated through a wheel and pinion, so that the weight did not need to

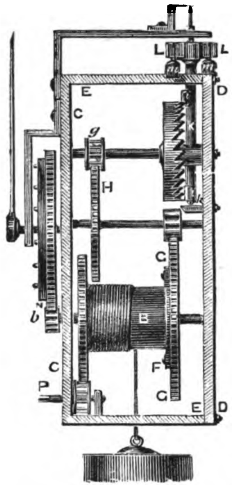


FIG. 14.—Side view of going part.

B, barrel; C, D, E, plates; F, ratchet and click; G, great wheel; P, O, winding pinion and wheel; H, second wheel; g, escape pinion.

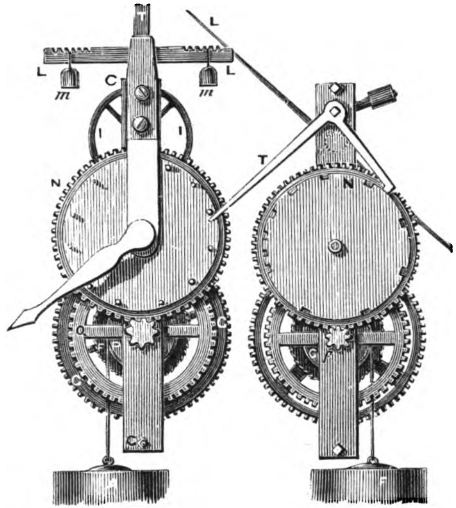


FIG. 15.—Front view of De Vick's clock.

K, verge; L, balance; m, shifting weights for adjusting the clock to time; b, pinion driving hour wheel; N, hour wheel, the arbor of which carries the hand.

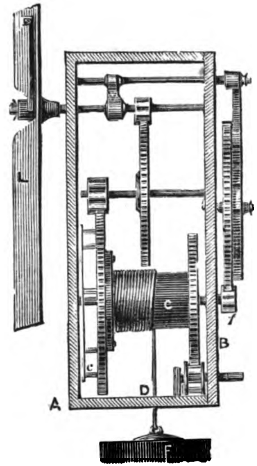


FIG. 16.—Side view of striking part.

F, weight; A, B, plates; C, barrel; c, pins for raising the hammer tail; L, fly; f, pinion for driving count wheel; N, count wheel or locking plate; T, lever for letting off striking work.

be wound up so frequently as would otherwise be the case. If the weight were freely subjected to the influence of gravity, its motion would have been accelerated, and so an escapement and controller had to be devised in order that all the spaces traversed by the hand should be passed through in the same time as each other. The device adopted to check the progress of the weight was as follows: Connected with the arbor carrying the hand is a spindle carrying a wheel with ratchet-shaped teeth, as will be seen from Fig. 14. This wheel, called the "escape wheel," has an odd number of teeth, and on a vertical rod or "verge" are two beds or "pallets," of a distance from each other equal to the diameter of the wheel. The acting faces of these pallets form nearly a right angle, and the verge is planted close to the teeth

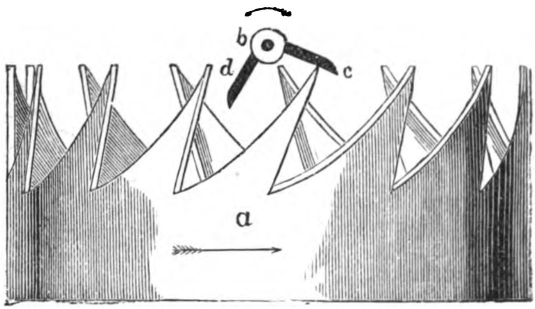


Fig. 17.—Verge escapement. ***a*, wheel; *b*, verge.**

of the wheel, so that one of the projecting pallets is always intercepting the path of the wheel teeth. In this way an alternating rotary motion is imparted to the verge, the escape wheel slipping by a space equal to half the distance between two teeth at every alternation. The action of the teeth of the wheel on the pallets will perhaps be better understood by a reference to Fig. 17, which is a plan to an enlarged scale. A tooth of the escape wheel is just leaving the upper pallet (*c*); as it drops off, the under tooth will reach the root of the lower pallet (*d*), but the motion of the verge will not be at once reversed. The escape wheel will recoil until the impetus of the balance is exhausted. The teeth of the wheel are undercut to free the face of the pallet during the recoil.

Mounted on the top of the verge is a cross-bar, on each end of which is a weight. The inertia of the cross-bar and weights, by opposing the rotary motion, forms the regulator, and as the centre of gyration may be altered by shifting the weights along the bar, the time occupied by each vibration may be increased or lessened, as may be required. This controller, admirable as it was, did not give anything like the exact result now attained by means of a superior escapement and the pendulum, for its constancy was seriously affected through variations in the motive force, such as would be caused by deterioration and thickening of the lubricant used to the pivots and bearing surfaces. It is, however, curious to note that the balance of a modern chronometer or watch, which vibrates with such marvellous accuracy, is analogous in its action to that of the early cross-bar regulator.

To understand the way the weight was raised after the rope was uncoiled from the barrel, it may be necessary to explain that, though the great wheel is tight on its arbor, the barrel on the same arbor is loosely fitted, the connection between the two being established by means of a ratchet-wheel and click. To lessen the labour of winding, a wheel is attached to the barrel, into which a pinion gears, and on the squared extremity of the pinion-arbor the winding handle is placed. The different parts are shown and lettered in Fig. 14.

The manner of striking the hours in regular order will be apparent from Figs. 15 and 16, with a little explanation. The striking part of the clock is distinct from the going part, and is actuated by a separate weight. It occupies the right in Fig. 15. The wheel to which the hand is attached turns once in twelve hours, and it will be observed that, projecting from its face, are twelve pins, equidistant from each other. Although continually solicited by the weight, the striking train of wheels cannot turn except once at each hour, because it is locked by a tooth at one extremity of a "bell-crank" lever, T, engaging with one of a series of notches in the locking-plate, N. At the completion of each hour this tooth is lifted out by one of the twelve pins depressing the other end of the lever, and the striking train then rotates till the tooth of the lever falls into the next notch of the locking-plate. The tail of the hammer which strikes the bell intersects the path of the lifting pins, *c*, which are arranged around the great wheel of the striking train. The notches around the edge of the locking-plate are placed at such distances that at one o'clock the tooth enters a notch directly one blow has been struck on the bell. At the next hour there is a longer space before a notch is reached, and so two blows are struck before the train is again locked; at the succeeding hour the space permits of three blows, and so on, till at twelve o'clock the plate has made a complete rotation, and the action of the preceding twelve hours recurs. The striking train would run down with increasing velocity but for the fan L, which keeps the periods between the strokes of the bell practically uniform. This is the principle of the striking work still used in most turret clocks, and till recently in nearly all small clocks of French make. The chief objection to it is that the hours are struck in regular progression without reference to the position of the hands; so that if the striking part happens to run down before the going part, the striking will be all wrong when it is started again, unless the precaution has been taken to set it going at the same hour as that at which it stopped.

The bell on which De Vick's clock struck the hours was cast by John Jouvance, and it is said that upon this bell the signal for the massacre of St. Bartholomew in 1572 was given.

A turret clock was also erected at Dover Castle in the fourteenth century. This is still in action at South Kensington Museum. In construction it is somewhat similar to Lightfoot's and De Vick's. On the wrought-iron frame are the letters R. L. arranged as a monogram. The train, however, consists of only one wheel, which drives the escape-pinion so fast that there must have been either a very long driving cord, or the clock must have been wound at frequent intervals. The winding is accomplished by means of handles or spokes projecting radially from one end of the barrel, which runs freely on the arbor of the wheel. On the face of the barrel which is nearest the wheel is a spring click, catching into the arms of the wheel, the arms thus serving the purpose of a ratchet. This click and ratchet arrangement was long favoured by some makers, and is often found in lantern clocks of the seventeenth century. The wheels of these early clocks were of wrought iron, the arms being riveted into the rim.

Whatever variations were made in the form or size of clocks during the fifteenth century, the principle of the mechanism remained unaltered, and such as were constructed appear to have been mostly for public buildings or persons of exalted position.

The appended Fig. 18, from the Bibliothèque Nationale de Paris, purports to represent the remains of a fifteenth-century chamber clock. It is pretty evident there was originally a bell at the top of the case, and perhaps a hand to indicate the hour. It is not certain there was a hand, for some of the early clocks had

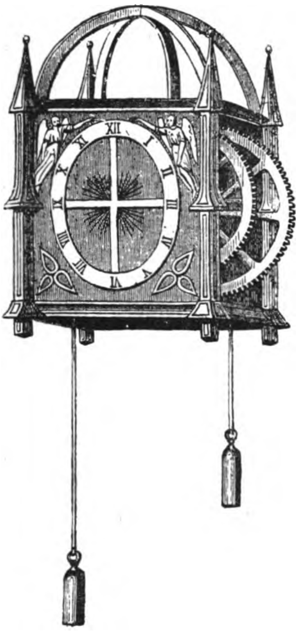


Fig. 18.—Chamber clock, fifteenth-century. Bib. Nat. de Paris.

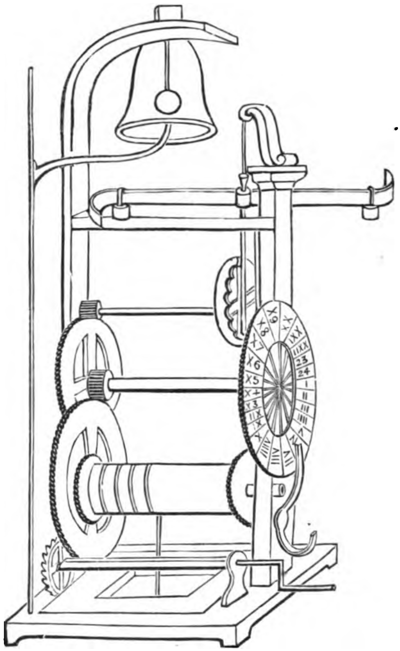


Fig. 19.—Fifteenth-century clock from Italian tarsia-work.

revolving dials. In the South Kensington Museum there is on a "tarsia," or inlaid work panel of Italian late fifteenth-century production, a representation of a clock with a revolving ring, on which the twenty-four hours are marked, as seen in Fig. 19. The whole panel shows an open cupboard, in which there are, besides the clock, a flagon, a chalice, a cross, etc., so that one may infer that the clock was of comparatively small size, and of course of older date than the panel, which careful comparison by the experts of the museum fixes at *certainly not later than* 1500. The action of the winding work is obscure, but with that exception the construction of the clock is tolerably clear.

Clock at Hampton Court Palace.

DERHAM gives the number of the wheels and pinions of a large clock which appears to have been erected at Hampton Court Palace, about 1540. This date is assumed from the marks N.O. or N.C. and the figures 1540 engraved on a bar of the wrought-iron framework. If the letters are N. C., they may refer to Nicholas Cratzer, a Bavarian, who was "deviser of the king's horologies and astronomer" to Henry VIII. In 1711, the clock was repaired by Langley Bradley, of Fenchurch Street. The original and curious dial of the clock is on the eastern side of the gate-tower in the second quadrangle. It is composed of three separate copper discs of different sizes, with a common centre, but revolving at varying rates. The smallest of these is 3 ft. 3½ in. in diameter, and in the middle of this is a slightly projected globe, painted to represent the earth. The quarters marked on the centre disc by thick lines are numbered with large figures, and round the edge this disc is divided into twenty-four parts, a red arrow painted on the second disc pointing to these figures and showing at once the quarter in which the moon is, and the time of southing. Next to the figure of the earth in this centre disc, a circular hole, 10 in. in diameter, allows a smaller disc travelling behind to show the phases of the moon. On the second disc, 4 ft. 1½ in. in diameter, but of which only the outer rim is seen, are twenty-nine divisions, and a triangular pointer, projecting from behind the central disc, shows the moon's age in days. The largest of the three discs is 7 ft. 10 in. in diameter. There are many circles painted on so much of the rim of this as is seen, the inner, or, following the order above observed and proceeding from the centre, the first circle, giving the names of the months, the second the days of the months (only twenty-eight for February), the third the signs of the zodiac, and on the rim, with 30° for each space filled by a sign, a circle divided into 360 parts. A long pointer with a gilded figure of the sun attached, projecting from behind the second disc, shows on this third or outmost disc of the dial the day of the month and the position of the sun in the ecliptic. This pointer performs another duty, acting like the hour hand of an ordinary clock, and showing the time of day or night as it passes the twenty-four figures—two sets of twelve—painted on the stonework within which the dial revolves. The diameter of this outer immovable circle on the stone is 9 ft. 8 in., and the characters for the hours are Roman numerals, 9 in. in length.

There is a record of a payment made in 1575 to George Gaver, serjeant painter, for painting the great dial at Hampton Court Palace, containing hours of the day and night, the course of the sun and moon, and doubtless since that time the same necessary restoration has been often undertaken.

In 1835 an extraordinary transposition was made, for the works of the old clock were removed, and have since disappeared. In their place was placed a movement with the following inscription: "This clock, originally made for the Queen's Palace in St. James's Palace, and for many years in use there, was, A.D. 1835, by command of his Majesty King William IV., altered and adapted to suit Hampton Court Palace by B. L. Vulliamy, clockmaker to the king;" and on another plate on the clock—"Vulliamy, London, No. 352, A.D. 1799." Worse than all, the precious dial was taken down and stowed away in a workshop at the palace, the gap left being filled by a painted board. In 1879, however, a new and sufficient clock movement was provided, the dial found, restored and replaced, and now shows the hours, the motions of the sun and moon, etc., with certainly as much regularity as N. O. or N. C. could have desired.

Portable Timekeepers.

IT was not until driving weights depending from cords or chains were superseded by a more compact motor, which allowed of their being readily transported from place to place, that timekeepers were regarded as objects of interest, the acquisition of which was sought in fashionable circles. The production of a portable timekeeper was accomplished about 1500 by Peter Hele, a clockmaker of Nuremberg, who used a long ribbon of steel tightly coiled round a central spindle to maintain the motion of the mechanism. Although timekeepers were not in general use for a long period afterwards, a taste for table clocks and watches was at once apparent among wealthy people, who delighted in the possession of curious novelties.

The earliest watches are scarcely to be distinguished from small table-clocks. The case was a cylindrical box, generally of metal, chased and gilt, with a hinged lid on one side to disclose the dial, the lid being usually engraved and pierced with an aperture over each hour, through which the position of the hand might be seen. Most of the watches were provided with a bell, and either struck the hours in regular progression or acted as an alarum. There are several specimens in the British Museum of a date between 1500 and 1530. Of two by Jerimia Metzger, Augsburg, one is furnished with a bow and one is without any provision for suspending the watch.

A large oval case, with geometrical perforations in the lid, was almost contemporaneous with the circular-box form, and an oval shape, either small and plain or larger with more or less of decoration, remained in favour for over a century. The luxury and extravagance in dress which characterized the Elizabethan period required more variety of form and colour than could be found in a plain regular form of gold or silver, and rock crystal or other stones were often formed into cases, cut in the form of crosses, stars, shells, and other extraordinary fancies, while the dials and mounts were occasionally enriched with coloured enamels. The most elegant of these costly toys emanated from France, Blois being distinguished as an early seat of manufacture.

Early in the seventeenth century plain circular cases came into use.

The origin of the term "watch" is not very clear. It may have been taken from the Swedish *vacht*, or from the Saxon *wæcca*, "to wake;" but whatever its derivation, it had not, when introduced, the signification we now attach to it, because timekeepers were not then worn in the pocket. The small oval ones were sometimes worn on a girdle and attached to the dress, and the larger circular watches were either placed on a table or suspended by the bow to the wall or any suitable article of furniture. But "watch," or "clock," or "orologe," seems to have been used indifferently as a title for timekeepers, and so it is often difficult to decide whether a weight clock of large size or a very minute spring timepiece is meant. Derham, in 1690, speaks of the train for driving the hands of a clock as the watch train, and the striking train as the clock train.

The action of the mainspring, which still retains its place as a motor for portable timekeepers, will be understood with the aid of the subjoined figure.

Here, as is usually the case, the spring is contained in a circular box or barrel *c*, its inner edge being hooked on to the enlarged part of the arbor *a*, and its outer end attached to the inside of the rim of the barrel. One end of the arbor fits loosely in a hole in the bottom of the barrel, and the other in a hole in the barrel cover *e*. The spring is wound by turning the arbor, and then if the spring barrel is attached to the largest wheel of the clock, in place of the cylinder or drum from which the weight was suspended, the spring in its effort to unwind turns the barrel, and with it the wheels composing the clock train. Of course some provision must be made to prevent the spring from at once uncoiling when the arbor is released after winding, and the simplest plan is to have a ratchet wheel fixed on one end of the arbor, with which a click pivoted to the framing of the timekeeper engages. When the barrel is used in conjunction with a fusee, as will be described presently, the spring is wound by turning the barrel.

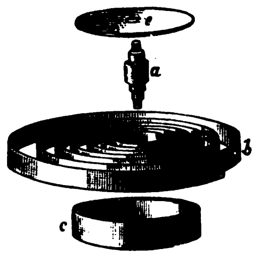


FIG. 20.—Mainspring and barrel.

But it is evident that just as the spring offered increased resistance to every successive turn of the arbor in winding, so the force transmitted by it when fully wound would be very much greater than the force exerted after the barrel had made a few turns and the spring had partially run down, and this variation of force was the cause of considerable perplexity for some time after the invention of the mainspring, for with the verge escapement variation of force means variation of timekeeping. The first contrivance applied with a view of overcoming or abating the drawback was, I believe, that known as the "stackfreed." It did not prove to be an enduring device, and is very rarely to be met with; but among the collection of Mr. Evan Roberts is a watch containing it, and by his kindness I am enabled to examine and give a representation of what is at all events an interesting relic.

Fixed to the mainspring arbor above the top plate is a pinion having eight leaves. This gears with a wheel having twenty-four teeth, which do not quite fill out the circumference of the wheel, but leave a block of two spaces in width which acts as a stop to the pinion when the mainspring is wound, and after it has run down three whole turns. Fastened to the wheel is a cam, concentric for about seven-eighths of its circumference and indented for the remainder, as shown in the drawing (Fig. 21). There is a groove in the concentric portion of the edge, into which is pressed a roller which is pivoted at the free end of a strong curved spring. When the mainspring is fully wound the roller rests in the curved depression of the cam, and the effort required to lift the roller up the incline till it is placed upon the concentric contour absorbs so much of the force of the mainspring as to prevent banking. When the mainspring has nearly run down, the roller, in entering the depression by pressing the cam in the direction that it is moving, really aids the mainspring in its effort.


FIG. 21.—Watch movement with "stackfreed."

It is not a matter for surprise that a frictional brake like the stackfreed, which must have absorbed an appreciable proportion of the force, failed to give satisfaction for equalizing the pull of the mainspring. The fusee invented for the same purpose by, it is said, Jacob Zech, of Prague, about 1525, is of a far different nature, and still survives. It consists of a spirally groved pulley, which is interposed between the mainspring barrel and the great or driving wheel of a clock or watch, the connection between the barrel and the fusee being made by a cord or chain, one end of which is attached to the barrel and the other to the fusee. When the spring is relaxed there must be at least as many coils of the cord around the outside of the barrel as the barrel is to make turns in winding the spring. To wind the spring, the fusee is rotated by means of a key fitting a square formed at one end of its arbor, whereby the cord is drawn from the barrel on to the fusee, the first coil being on the larger end of the fusee, as shown in the accompanying sketch (Fig. 22).

Then, as the mainspring runs down, the barrel rotates and coils the cord on to its periphery again. But while the mainspring when fully wound turns the fusee by uncoiling the cord from the smallest part of the fusee, it gets the advantage of a larger radius as its energy becomes lessened, and by proportioning the diameter of the fusee to the varying pull of each successive turn of the mainspring an excellent adjustment is obtained, so that the pressure exerted by the great wheel on the centre pinion is constant. The fusee is fixed to its arbor, on which the great wheel rides easily, the connection between the fusee and great wheel being made by means of a ratchet wheel and click; this allows of the fusee being rotated to wind the mainspring. To prevent undue strain on the cord when the winding is completed, the cord as it is being coiled on to the smallest turn of the fusee, pushes an arm which is pivoted to the framing of the timekeeper in the path of a snail-shaped flange of the fusee, and this forms a stop. The barrel arbor is always stationary. In the early fusees the cord was of catgut, and this material is still sometimes used for clocks. Chains were introduced in place of catgut for watches in 1664, by one Gruet, a Swiss, and they are still used for marine chronometers, for some clocks, and for the few fusee watches that are made.

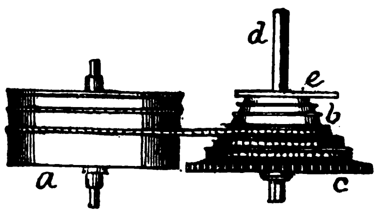


FIG. 22.—Mainspring barrel and fusee.
a, mainspring barrel; *b*, fusee; *c*, great wheel
d, winding square; *e*, snail-shaped flange.

Table clocks or watches of the sixteenth century are exceedingly rare. Many specimens put forward as such are found on examination to be of a later date. There is no doubt that the manufacture of portable timepieces extended to Holland and France before the end of the century, but very few examples of that period survive. Genuine specimens have wheels and frames of iron or steel, no covering glass over the dial, and, if a fusee is present, the connection between it and the barrel is by a piece of catgut, and not a chain. There is, of course, no controlling spring to the balance. The workmanship of the movement is comparatively rough, however lavishly the case may be ornamented.

The Society of Antiquaries possess a specimen of the handiwork of Jacob Zech, the inventor of the fusee. It is a table timepiece with a circular brass gilt case 9¾ in. in diameter, and 5 in. in height, and was bequeathed to the society by Mr. Henry Peckitt, of Compton Street, Soho, and handed over by his executrix in 1808. It was in the possession of James Ferguson, the astronomer and mechanician, at the sale of whose effects it was bought by Mr. Peckitt in 1777.

From the decoration of the case and dial, it is inferred that the clock was made for Sigismund I., King of Poland, and that he presented it to Bona Sforza, to whom he was married in 1518. There are three shields equidistant round the case, which is altogether nicely decorated. On one shield is an eagle displayed and crowned, representing Poland; the second contains a serpent entwined and wavy pale crowned, a child issuant from its mouth and surmounted by a ducal crown—this is typical of the house of Visconti; the third shield bears the arms of Lithuania, a knight armed *cap-à-pie*, and mounted on a horse proper, holding in his dexter hand a drawn sword, and having pendent from his neck a shield charged with the Hungarian cross. The regulator is a cross-bar balance of the kind used in De Vick's clock, except that instead of loose weights of iron there are leaden weights screwed one on each end of the cross-bar, and the adjustment is made by screwing to or from the centre of motion. There are two yielding brass arms to act as a banking, and check excessive vibration of the cross-bar. There are eight turns to the fusee, and in a circle on the face of the barrel is engraved in Bohemian an inscription which has been translated as follows: "Year when made me Jacob Zech at Prague is true when counted 1525."

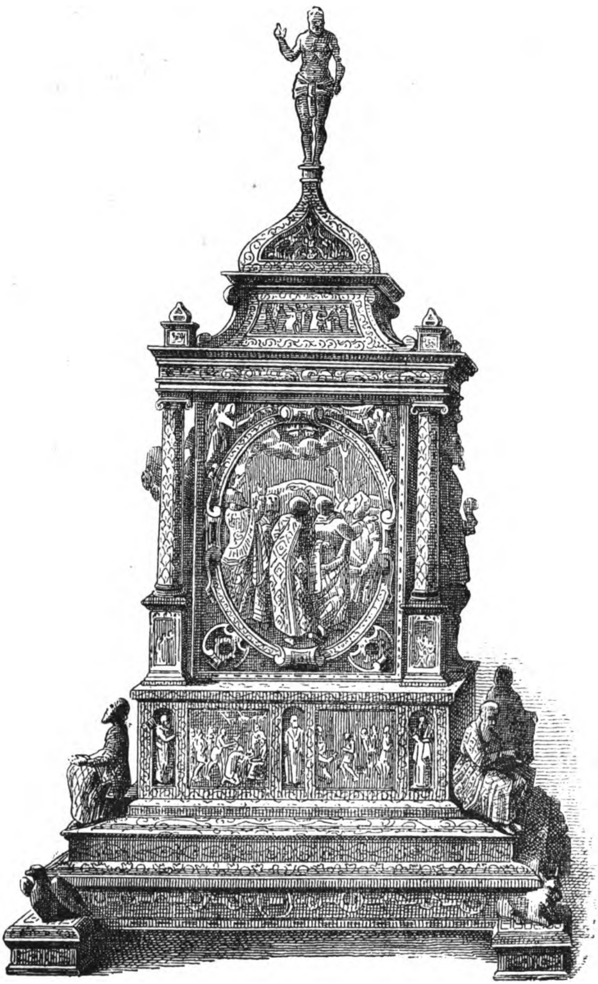


Fig. 23.

There was originally some additional wheelwork to show the motion of the sun and moon on an engraved ecliptic, and also a contrivance to strike one at every hour. The wheels are of iron, and show punch marks of division, proving that they had been cut with a file by hand. A catgut had been used to connect the barrel with the fusee, but a metallic chain has been applied, which destroyed several of the threads. Before this was done it went for 48 hours with one winding, and gave about 3600 beats in the hour.

In the British Museum is an excellent specimen of a German early table clock of a square oblong shape. The works are of iron. It has no fusee. It fits into an engraved metal box, having a hinged cover. The date of production is stated to be 1530.

Nuremberg and Augsburg pursued the manufacture of portable timekeepers with considerable spirit. The plain square brass towers, round and octagonal boxes, gave place to cases of a much more ornate design when expense was no object. A very choice example is shown in Fig. 23 ; it is of iron, damascened with precious metals, a style of work for which Augsburg was particularly famous.

Most German towns have a trade or work mark, and in the absence of the maker's name the locality of manufacture may be ascertained from this mark, which is occasionally found on sixteenth and seventeenth century clocks. The work-mark for Augsburg is a pineapple, and for Nuremberg the letter N in a circle.

Sixteenth-Century Octagonal Table Clock.

I HAVE lately had through my hands a curious sixteenth-century striking clock of octagonal form, the property of Mr. Shapland, 207, High Holborn, of which a view is subjoined.

It is probably of Nuremberg or Augsburg manufacture, and has a peculiar method of indicating the rising and setting of the sun daily throughout the year, by means of two thin metal dials within the hour circle. One of these dials is of silver and the other of steel, for contrast; each of them forms a segment of a circle being nineteen twenty-fourths of the circumference, divided by radial lines into nineteen parts, which are numbered at the circumference from one onward in Arabic figures, so that each division is one twenty-fourth of the whole circle. A brass disc, divided into twenty-four, is fixed to the steel dial by rivets at No. 1 and No. 3; No. 24 or zero point of the circle coinciding with what may be called the initial edge of the steel dial. The steel and silver dials are interlaced—that is to say, the concealed portion of the steel dial is underneath the silver one, while the initial edge is above it. At the shortest day in the year the least portion of the silver dial would be visible, and the figure on the

Fig. 24.—Curious table clock.

silver dial next to the initial edge of the steel dial would represent the number of hours the sun was above the horizon, while the figure on the central brass circle, which happened to be coincident with the initial edge of the silver dial, would represent the number of hours he was below the horizon, and the subdivisions of the hour could be well estimated to within a tenth.

The dials are continually revolving in opposite directions, so that, as the days lengthened, more of the silver and less of the steel dial would be seen. At the close of the longest day the motion of the dials would be reversed, and the visible surface of the silver dial would be diminished each day in the same ratio that it was formerly increased, till the shortest day recurred.

It is probable that these dials were arranged to show the beginning of the Hebrew day at sunset, as well as its duration and close at the succeeding sunset.

On removing the dial plate, the way in which the dials are actuated is apparent. Fitting closely on the centre wheel which carries the hour hand is a pinion of twenty-four leaves. The pipe of this has a cruciform top fitting into the centre of the silver dial. On the pipe of this pinion is another, larger in diameter, but also of twenty-four leaves, and with a similar top to carry the steel dial. A double rack or segment of a wheel, having internal and external teeth, is pivoted close to the edge of the movement, and engages with both of the dial-plate pinions, the internal teeth being farthest from the centre of motion, and of such a distance that they reach beyond the centre arbor and engage with the teeth of the larger pinion on the other side of it; the external teeth are so placed that they engage with the teeth of the smaller pinion, but on the side of the centre arbor nearest to the centre of motion of the rack. There is on the plate of the movement, midway between its centre and its edge and driven from the fusee, a wheel which turns once a year. This carries a crank, from which is a connecting rod catching hold of the double rack, so that, as the crank revolves, it gives a to-and-fro motion to the rack. To meet the varying length of the years from leap year to leap year, there are four pins by which the position of the crank could be altered, but, so far as one could see, there is no provision for automatic regulation, so that, if the reading of the scale is to be exact, the dial would have to be removed and the position of the crank altered once a year.

Recessed into the under side of the clock case is an annual dial engraved with the signs of the zodiac, the titles of the months, and the days. The index for this is fixed to the arbor of the annual wheel already mentioned, and the annual dial is therefore less than half the diameter of the movement.

The case is of brass engraved and gilt. The hour band is of silver, divided into two periods of twelve hours each, and marked with Roman numerals. Within the hour ring, and separating it from the sun rising and setting discs, is a brass gilt ring engraved with a cable pattern.

All the dial work, the striking train and the going train wheels, up to the fusee, are of iron or steel; the connection between the fusee and barrel is by a catgut, and the balance is very light, of the old cross-bar pattern, but with weights riveted on with no provision for after adjustment. There is, of course, no balance spring. The hours are struck on a cap-shaped or cylindrical bell.

FIG. 25.

A remarkable point in the construction is that there is not a single screw used throughout. All fastenings are either pins or wedged-shaped keys or rivets.

There is in the South Kensington Museum a clock, in an elegant case of metal gilt, in the form of a temple, as shown in Fig. 25. Its height is 13½ in. and its width 8 in. It is most elaborately chased and engraved with figures and arabesques. The pierced dome covers two bells, and is surmounted by a figure standing on a globe. The base is chased with masks and cartouche

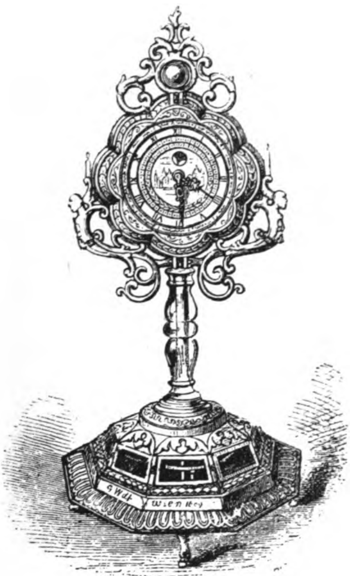


Fig. 26.

Fig. 27.

ornaments, with winged horses at the angles, and a dial on each of the four sides, showing, besides the hours and minutes, motions of various heavenly bodies. This choice and interesting timekeeper, which formed part of the Bernal Collection, was produced at Munich, and is dated 1587. Every minute is figured from 1 to 60, as was the custom on early timekeepers with minute hands. Though the presence of the concentric minute hand on sixteenth-century work is exceptional, there is nothing to lead one to suppose that it is in this case an addition to the original construction; and providing the minute hand would certainly present no difficulty to the mind capable of devising the intricate mechanism for the astronomical motions as is contained in this clock.

The next example, also in the South Kensington Museum,

FIG. 28.—French table clock, latter part of sixteenth century.

is an elegant form of medallion clock in a rock-crystal case, on a stem, as shown in Fig. 26. The plinth is of metal gilt, with crystal plaques, and contains the striking train. The remainder of the movement is in the upper case. The longer of the two hands, which at the first glance seems to be a minute hand, really points to the day of the month marked on a ring outside the hour ring. The age of the moon is shown by a revolving gilt plate behind the dial, which is cut away to make the moon plate visible. The total height is $7\frac{3}{4}$ in. It is signed "J. Wolf Wienne," and dated 1609. It was formerly in the Bernal Collection.

Fig. 27 is a fair example of the more costly German cabinet or library clocks of the seventeenth century.

A splendid specimen of French table clocks in Henry IV. style is shown in Fig. 28, in which the movement is visible through panels of glass or crystal, most probably the latter.

Anne Boleyn's Clock.

THERE is in the possession of her Majesty Queen Victoria the case of a clock which is said to have been presented to Anne Boleyn by Henry VIII. It is 4 in. square and $5\frac{1}{2}$in. high, surmounted by a figure of a lion. Horace Walpole described it, as "a clock of silver gilt [brass] richly chased, engraved and ornamented with fleur-de-lys, little heads, etc. On the top sits a lion holding the arms of England, which are also on the sides. On the weights are the initial letters of Henry and Anne in true lovers' knots; at the top 'Dieu et mon droit;' at the bottom 'the most happye!'" The present movement in it is a modern one. There is no record as to the maker of Anne Boleyn's clock, of which a drawing is appended, but at this time most of the "orologes" were the production of foreign artists, judging from the names quoted in State Papers of the period. There is a record that in July, 1530, £15 was paid to the Frenchman who sold the king "ij clocks at Oking." In the following month was paid to "a Frenchman called Drulardy for iij dyalls and a clokk for the King's Grace the sum of £15." In December of the same year £19 6*s.* 8*d.* was "paid to Vincent Keney clok maker for xj clokks and dialls." So many payments within a brief period warrant the assumption that clocks were a form of present favoured by his Majesty.

In the "Sixth Report of the Historical Manuscripts Commission" mention is made of an agreement, dated 1599, between one Michael Neuwers, a clockmaker, and Gilbert, Earl of Shrewsbury, for the construction of a clock. "It is agreed that Michael

FIG. 29.—Anne Boleyn's clock.

should make a striking clock about the bigness of that which he made for the Earl six years past; it is to be made by the last of December next. The cover or case of it to be of brass, very well gilt, with open breaking through all over, with a small fine hand like an arrow, clenly and strongly made, the . . . or white dial-plate to be made of French crown gold, and the figures to show the hour and the rest to be enamelled the fynelyest and daintyest that can be, but no other colour than blew, white, and carnalian; the letters to be somewhat larger than ordinary; the price of the clock must be £15, which makes with the earnest already given £16, but the circle I must pay for, besides the gold which shall make it; the sides of the brass case must not be sharp, but round, and the case very curiously made."

That the same Earl of Shrewsbury was somewhat of a connoisseur of timekeepers, as well as an authority on horological matters, is borne out by the following letter, dated 1611, from him to Sir Michael Hickes, which is preserved in the Lansdowne MSS. at the British Museum.

"I perceived by you to-day that you understood My Lord Treasurer's design was to have a watch, but I conceaved he wysshed a stryknge clock, made lyke a Watch, to stande oppon a Cubbart, & suche a one (though no new one, & yet under a dozen years ould) I have found oute, & send you by this bearer, which I pray you deliver to his Lordship from me, & tell him that I am very well perswaded of the truth of it, or else I should be ashamed to send him so gross & rude a piece as this is, & if I hadd thought his Lordship could have well forborne it but for four or five days longer, I would have bestowed a new case for it, for this is a very bad one. If his Lordship would not have it stryke, either in the dayes or nights, the striker may be forborne to be wounde up, and so the Watch being wounde up it will go alone. It will goe twenty-six houres, but I wysh it may be wounde up every mornyng or nyght about 8 or 9 o'clock, which will be sufficient until the next day or nyght at the same tyme."

In Devon's "Issues of the Exchequer," the "Pell Records" of the time of James I., we find the following entry: 1605, 10th of October. "By Order, the last of September, 1605. To Uldrich Henche, clockmaker, or to his assignee, the sum of 100*l.* for a clock, in manner of a branch, made by him, & set up in his Highness's chamber at Whitehall. By writ dated 23rd of July, 1605, 100*l.*"

Among the State Papers of the time of James I. there is an original letter, dated August 4th, 1609, addressed by Sir Julius

Cæsar to the clerks of the signet, requesting them to prepare a warrant to pay £300 to Hans Niloe, a Dutchman, for a clock with music and motions. And on the 17th of the same month Sir Julius wrote from the Strand to Salisbury, stating that he was pressed by Hans Niloe for the £300 for his clock.

In "A true certificat of the names of the Straungers residing and dwellinge within the City of London," etc., taken by direction of the Privy Council, by letters dated September 7th, 1618, it is stated that in the ward of Farringdon Within was then living "Barnaby Martinot, clockmaker; *b.* in Paris; a Roman Catholicque." In Portsoken ward was living "John Goddard, clockmaker; lodger and servant with Isack Sunes in Houndsditch; *b.* at Paris, in Fraunce; heer 3 years; a papist; yet hee hath the oath of allegiance to the king's supremacy, & doth acknowledg the king for his soveraigne dureing his abode in England; & is of the Romish church."

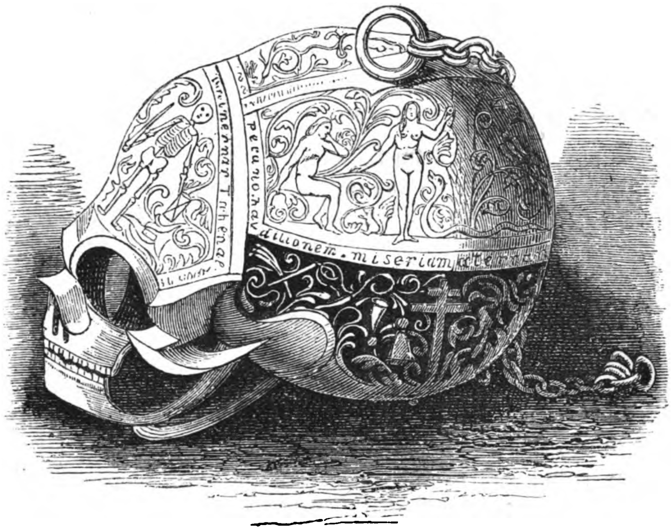


FIG. 30.

The skull watch, Fig. 30, is an excellent example of the fantastic forms in which some of the early makers delighted to encase their work.

The skull is of silver-gilt, and on the forehead is the figure of

Death with his scythe and sand-glass; he stands between a palace on the one hand and a cottage on the other, with his toes applied equally to the door of each; around this is the legend, from Horace—

"Pallida mors æquo pulsat pede pauperum tabernas regumque turres."
(Pale Death visits with impartial foot the cottages of the poor and the palaces of the rich.)

On the opposite or posterior part of the skull is a representation of Time devouring all things, with another inscription from Horace—

"Tempus edax rerum tuque invidiosa vetustas."
(Time, and thou too, envious Old Age, devour all things.)

He also has a scythe; and near him is a serpent with his tail in his mouth, being an emblem of Eternity.

The upper part of the skull is divided into two compartments. On one is represented our First Parents in the Garden of Eden, attended by some of the animals, with the motto—

"Peccando perditionem miseriam æternam posteris mernere."
(By sin they brought eternal misery and destruction on their posterity.)

The opposite compartment is filled with the subject of the salvation of lost man by the crucifixion of our Saviour, who is represented as suffering between two thieves, whilst the Marys are in adoration below; the motto to this is—

"Sic justitiæ satis fecit mortem superavit, salutem comparavit."
(Thus was Justice satisfied, Death overcome, and salvation obtained.)

Running below these compartments on both sides there is an open work, of about an inch in width, to permit the sound to come out freely when the watch strikes. This is formed of emblems belonging to the crucifixion—scourges of various kinds, swords, the flagon and cup of the Eucharist, the cross, pincers, lantern used in the garden, spears of different kinds, one with the sponge on its point, thongs, ladder, the coat without seam, and the dice that were thrown for it, the hammer and nails, and the crown of thorns. Under all these is the motto—

"Scala cœli ad gloriam via."
(The way to glory is the "ladder" to heaven.)

The watch is opened by reversing the skull, and placing the upper part of it in the hollow of the hand, and then lifting the under jaw, which rises on a hinge. Inside, on the plate, is a representation of the Holy Family in the stable, with the infant Jesus laid in the manger, and angels ministering to Him; in the upper part an angel is seen descending with a scroll, on which is written—

> "Gloria [in] excelsis Deo, et in terra pax hominibus bonæ voluntate."
> (Glory to God in the highest; on earth peace to men of goodwill.)

In the distance are the shepherds with their flocks. A representation of this cover is given separately.

The works of the watch occupy the position of the brain in the skull itself, the dial plate being on a flat where the roof of the mouth and parts behind it under the base of the brain are to be found in the human subject. The dial is of silver, and fixed within a golden circle richly carved in a scroll pattern; the hours are marked in large Roman letters, and within them is the figure of Saturn devouring his children, with this legend—

FIG. 31.—Interior of skull watch above the dial.

> "Sicut meis sic et omnibus idem."

There is no date, but the maker's name and the place of manufacture, "Moyse, Blois," are distinctly engraven on the plate. A silver bell fills the entire hollow of the skull, and receives the works within it when shut; a small hammer, set in motion by a separate train, strikes the hours on it.

The workmanship of the case is admirable, and the engraving really superb.

The date of this relic may be taken to be between 1550 and

1600. It is stated that it belonged to Mary Queen of Scots, by whom it was given to Mary Seaton, one of her maids of honour, and much circumstantial evidence adduced in support thereof, but the Rev. H. L. Nelthropp disputes the accuracy of such a conclusion. A careful investigation of the catalogues of the jewels, dresses, furniture, belonging to Queen Mary has, he says, proved beyond doubt that watches were not among her valuables. In a description of another Death's-head watch, also said to have been the property of the same royal lady, an inscription on the watch which seemed to favour the idea was set forth, followed by the date 1560, but examination showed that these figures formed no part of the engraving. They do not. I have recently had an opportunity of examining this watch, which belongs to Miss Mary Laura Browne, of Anerley. Except that beside the ring on the top of the skull is a screw for the reception of a cross, the case is an exact *facsimile* of the Mary Seaton one, with the additional inscription around the eyebrows, "EX. DONO FR^{S}. R. FR. AD. MARIAS DE SCOTORUM FR. REGINA."

I cannot say that Mr. Nelthropp's criticism is quite destructive of the original account. The absence of the date proves nothing; and if both of the watches were given away by the queen, they could hardly be expected to figure in any subsequent inventory of her property. It is certain that watches were made during her lifetime; also that Blois was one of the earliest manufactories of watches, and that the family of Moyse flourished there during the sixteenth century. In face of the fact that Elizabeth had such a large number of watches, it seems almost incredible that the Scottish queen should never have possessed any of the fashionable novelties.

These two skull watches were doubtless intended to occupy stationary positions; the cross on one of them suggests a *prie-dieu* or small altar in a private oratory. At all events, they are too large and heavy to be worn on the person. The engravings represent the natural size of the relics, each of which weighs over three-quarters of a pound.

In the British Museum are two Death's-head watches much smaller and with plain cases. One of these was made by Johann Maurer, and the other by J. C. Vuolf. A similar watch, in the Dunn Gardner Collection at South Kensington, is marked Isaac Lenard, and is labelled as sixteenth-century work.

While the probability is that Mary Queen of Scots possessed watches of some kind, it must be confessed that the statements made respecting her ownership of specimens which have survived will not always bear examination. In the Massey-Mainwaring Collection, at the Bethnal Green Museum, is a round rather thin watch by Moysant of Blois, in a case whereon is splendidly painted, in enamel, a representation of the Adoration of the Magi. The label states that this watch was given by Mary Queen of Scots to the Earl of Mar, from whom it passed into the possession of the family of Lord Forbes. But the style of the watch and the enamel painting do not seem to be entirely in accord with other productions of the sixteenth century.

There is at the Horological Institute a print of a very old striking or clock-watch, the case of which is enriched with remarkably fine arabesque work, pierced to emit the sound. This watch is shown in Fig. 32. The dial has two hour circles, the divisions of the outer circle being marked with Roman and those of the inner with Egyptian characters, while between the two is a circle of minute marks. This curious piece of mechanism, which came from Germany, weighs thirteen ounces, ten pennyweights troy. It is one inch and three-quarters in thickness, and three inches in diameter; the wheels are of iron, but it has neither barrel nor fusee. It has two springs, one for conducting the works and the other for striking, which is effected upon a broad bell occupying the whole bottom of the watch. Here the outer end of the mainspring appears to be attached to a pillar between the plates—an arrangement reintroduced in quite modern times for cheap clocks.

FIG. 32.—German clock-watch.

Fig. 33 is an exterior view of a large circular clock-watch in the possession of Mr. Evan Roberts, of which the interior, fitted with the primitive stackfreed, was shown in Fig. 21. It is unnamed, and is most probably of German or Dutch origin; the steel dial and brass openwork case are very fine, as may be judged from the drawing.

This watch has been pronounced to be a production of about the middle of the sixteenth century; but in this I cannot concur, for while the stackfreed and the wheels of steel may agree with

Fig. 33.—Clock-watch. Type of early German manufacture.

that period, it must not be forgotten that the very earliest watches were usually made with plates of iron or steel, and not of brass, as these are. Many people are slow to recognize improvements, and it is easy to understand the application of this stackfreed after the introduction of the fusee, just as clocks with but one hand were made a century after the invention of the concentric minute hand.

An interesting astronomical watch of French make is shown in the appended engravings. It has a silver case highly ornamented, with mythological subjects elaborately chased, bearing the following inscription on the inner rim: "From Alethea Covntess of Arvndel, for her deare sone, Sir William Howard, K.B. 1629." It is of an oval form; the extreme size two inches and a half, and an inch and a half in thickness. It strikes the hours and has an alarum; shows the days of the week, the age and phases of the moon, with the days and months of the year, and the signs of the zodiac. On the inside of the cover there is

Fig. 34. French astronomical watch. Fig. 35.

a Roman Catholic calendar with the date 1613. This watch bears the name of P. Combret, à Lyons, as the maker.

On pages 56 and 57 are shown some examples of curiously shaped watches.

Fig. 36, from the Bernal Collection, which was dispersed by auction in 1855, is in the form of a padlock. It has a crystal front and ribbed crystal back; gilt metal engraved mounting, dial of gilt metal, the days of the month are noted on a silver circle,

Fig. 36.

Fig. 37.

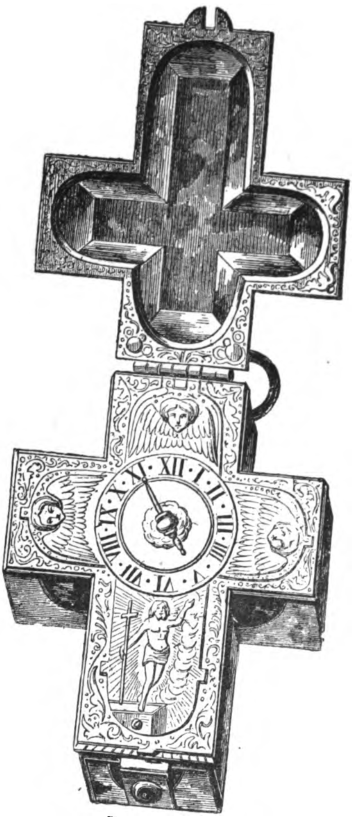


Fig. 38.

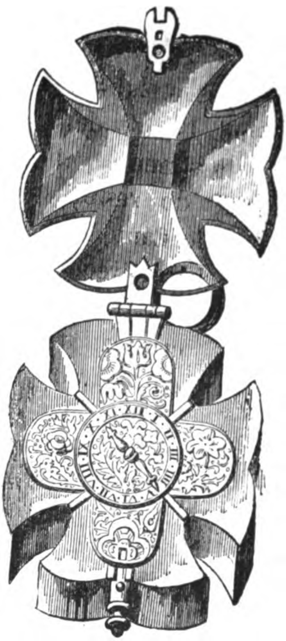


Fig. 39.

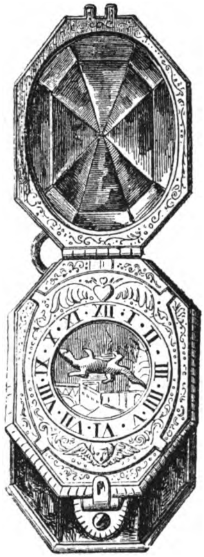


FIG. 40.

FIG. 41.

with a steel plate apparently for the moon's age. The maker's name is Gio. Batt. Mascarone, and it is probably sixteenth-century work.

The book-shaped watch shown in Fig. 37 was also in the Bernal Collection, and belonged to Bogislaus XIV., Duke of Pomerania, in the time of Gustavus Adolphus. On the dial side there is an engraved inscription of the duke and his titles, with the date 1627, together with his armorial bearings; on the back there are engraved two male portraits, buildings, etc. The covers are of brass gilt; the clasps and other ornaments are of silver; the dial is of silver, chased in relief; the insides of the covers are chased with birds and foliage. There are apparently two separate movements, and a large bell at the back; over the bell, the metal is ornamentally pierced in a circle with a dragon, etc.; the sides are pierced and engraved in scrolls. The maker's name is "Dionistus Hessichti."

There is in the British Museum a book-shaped watch dated 1550.

Of other more quaint and grotesque designs for watch cases favoured by the early makers may be mentioned one in the form of an eagle, which was in the collection of Lady O. Fitzgerald. It illustrated the story of Jupiter and Ganymede, and could either be suspended from a ring in the back of the bird or rested by its claws on a flat surface. In the British Museum is a watch shaped like an acorn, another resembling a dog, and one with silver cases made in imitation of cockle shells. There is in the South Kensington Museum an early German watch like a duck, and a diminutive timekeeper in the Mainwaring Collection is concealed in one of two enamelled cherries with stalks connected.

The Latin cross, Fig. 38, represents a very favourite pattern among French artists for a long period. The dials were generally engraved with scenes from the life of the Saviour. In the British Museum is one with a case of rock crystal, very similar to the drawing. Its approximate date is 1580; maker, Jean Rousseau. Close to it is another of emerald glass, labelled as the work of a century later. Another of an earlier period with a metal cover is by Tinnelly, Aix.

Irregular shaped octagonal watches are met with among the productions of the latter part of the sixteenth till quite the close of the seventeenth century. An example is shown in Fig. 40, on page 57, but many variations in the size and material of the cases were made by English and French artists to suit their own taste or the desires of their patrons. The cover was often of crystal, agate, or other semi-precious stone. In the British Museum is a choice example, dated 1620, by the celebrated Edward East. The body as well as the cover of the case is of crystal, and faceted. Another, somewhat similar, but dated 1609, is inscribed Michaell Nouwen, London.

In Fig. 41, page 57, is represented an English watch of the early part of the seventeenth century, from the collection of Mr. Evan Roberts. It is of a flattened oval form, with finely engraved silver dial, having mounted thereon a brass hour ring. At each hour, near the exterior edge of the ring, is a slight knob to allow of the time being ascertained by feeling the hand and estimating its position with relation to the knobs. Over the hour ring is the engraved inscription, "Our time doth passe a way." A hinged cover of silver, fastened with a spring snap, secures the hand from accidental interference as it takes its course round the dial.

The movement and wheels are of brass; a piece of catgut connects the fusee and barrel, and there is no controlling spring to the balance. The balance cock is of a width to cover the balance, and is handsomely pierced. A bracket or cock, perforated to a similar design, is spread to cover the click for the barrel ratchet. The pillars are round and solid, with nicely engraved square bases and caps. The detent for the fusee stop is also well wrought to match. On the upper plate is engraved "Thomas Aspinwall, fecit." The name of Aspinwall is not unknown among the celebrated early English watchmakers; it is recorded that in 1675 Josiah Aspinwall was admitted as a brother of the Clockmakers' Company. His admission as a "brother" signifies that he was free of one of the other City Guilds. In 1863 Lord Torphichen exhibited, at the Archæological Institute, a clock-watch made by Samuel Aspinwall, of a date presumably about 1650 or 1660. But I should be inclined to place this watch as among the productions of an earlier date. In Hollar's plates of the four seasons, dated 1641, summer is represented by a lady having an egg-shaped watch on her left side depending from her girdle. The British Museum contains several similar specimens, most of which are assigned to the first half of the seventeenth century. One, by Nicholas Waller, is dated 1610.

Messrs. Grimshaw and Baxter showed me a few years ago a watch very similar to the one here depicted, on which was engraved Samuel Aspinall, fecit. Bearing in mind the vagaries of seventeenth-century orthography, we may assume that this was a member of the same family.

There is a very small oval watch in the British Museum by Grinkin, London. It measures but half an inch across by three-quarters of an inch long, and has plain silver capsule-shaped outer cases. The South Kensington Museum contains a still more diminutive oval watch.

Queen Elizabeth. As evidence of the prevailing desire for novel and curious "ologes," the following relating to the possessions of Elizabeth will be of interest. In 1571 the Earl of Leicester gave to his royal mistress "one armlet or shakell of golde, all over fairely garnished with rubyes and dyamondes, haveing in the closing thearof a clocke." In the same year two other gifts are mentioned, a "juell, being a chrsolite garnished with rubyes and dyamondes, haveing in the closing thearof a clocke;" and "a juell, being a chrsolite garnished with golde, flagon facyon, th'one side sett with two emeraldes, . . . th'other side having in it a clocke." In 1573 Elizabeth received from Margaret, Countess of Derby, "a white beare of gold and mother of perle, holding a ragged staffe, standing upon a toune of golde, whearin is a clocke, the same toune staffe garnished with dyamondes and rubyes." The "clock and all" weighed three ounces. In 1575 Mr. Hatton, captain of the guard, gave the queen "a riche juell, being a clocke of golde, garnished with dyamondes, rubyes in the bottome, and a fayre emeralde pendante sett in golde and two mene perles pendaunte, all ix oz. iii q[a]." In 1578 the Earl of Leicester presented Elizabeth with "a tablet of golde, being a clocke fully furnished with small diamondes and rubyes; abowte the same are six bigger diamondes pointed, and a pendaunte of golde, diamondes, and rubyes very smale. And upon eche side losengye diamonde, and an apple of golde enamuled green and russet." In the same year the Earl of Russell gave to the queen "a ring of golde, called a parmadas, sett with vj small diamonds and garnished round about with small rubies and two sparcks of ophalls, and in the same backeside a dyall." In 1580 the Earl of Leicester gave her "a cheyne of golde made like a payre of beades contayning viii long peeces fully garnished with small diamondes, and fower score and one smaller peeces fullie garnished with like diamondes; and hanging thereat a rounde clocke fullie garnished with dyamonds, and an appendante of diamondes hanging thearat." In the same year was presented to the queen by Lord Russell, "item, a watche sett in mother of pearle with three pendaunts of goulde garnished with sparckes of rubyes, and an ophall in everie of them, and three small pearles pendaunte." In the same year Mr. Edward Stafford gave her "a little clocke of goulde with a cristall, garnished with sparckes of emeraldes, and furnished on the back syde with other dyamondes, rubies, and other stones of small value." There were also many humbler contributors to her store. In 1556 her clockmaker, Nicholas Urseau, presented "a faire clocke in a case cover with blake vellat;" and her "clocke keeper, John Demolyn, a cloke with a lambe on it of copper guilt."

The following is from an inventory of the possessions of Queen Elizabeth. "A watche of golde sett with small rubies, small diamondes, and small emerodes, with a pearle in the toppe called a buckett, watinge two rubies; a clocke of golde conteyning in the border four table diamonds and two very small rocke rubies, havinge on th'one side foure table rubies and sixe small diamondes; and on th'other side eleven table diamondes, whereof the one is more bigger than the residue. On the one side a man sitting aslepe with a childe before him; a clocke or tablett of golde garnished on th'one side with five faire diamondes and one faier rubie; and on th'other side five faire rubies and one faire emerod garnished with lij litle diamonds, and liij litle rubies, with a pearle pendant at it; one clocke of golde curiosly wrought and fullie furnished with diamonds, rubies, emerodes, and opalls, havinge in middes thereof a beare and a ragged staffe of sparkes of diamondes and rubies; one clock of gold curiously wrought with flowers and beastes, with a queene on the toppe on th'one side; and on the other side a beare and a ragged staff of sparkes of diamonds, fullie furnished with diamonds and rubies of sundry sortes and bignes; one emerode under it, a faier table diamond with a ragged staff in the foyle thereof and a faier rubie under it squared, and a pearle pendaunt of either side of the clocke; one clocke of golde wrought like deyses and paunseyes, garnished with little sparks of diamonds, rubies, and emerodes, and eight small pearles on the border, and a pendant acorn; one clocke of gold curiously wrought with small sparkes of stones, having on th'one side a horse bearing a globe with a crowne over it; one clocke of golde with a George on both sides garnished with sparkes of diamondes and a pendant of opalls; a litle watche of christall slightly garnished with golde; one litle clocke of golde th'one side being agate with a mouse on the toppe and heddes round about it; one litle watche of golde garnished on the border with very small sparkes of rubies and emerodes with christall on both sides, and a pearle pendand garnished with golde like a flesh flye; one rounde clocke of golde enameled with a man on horseback, and divers colors aboute it; a watch of golde garnished with three small diamondes and eight sparks of rubies, with a very little pearle; one little clocke of golde enameled of the History of Time; a litle watche of golde, th'one side with a frogge on the topp, th'other side garnished with small garnets like a pomegranite; one litle clocke sett in eliotropie and garnished with golde; a litle watche of golde enameled with sundry colors on both sides alike; a litle watche of christall slightlie garnished with golde, with her Ma'ties picture in it; one faier flower of golde fully garnished with rubies and diamonds enameled on the backside with a man and a scripture about him having a watch in it and a pearl pendant; one flower of gold fully garnished with emerods of sondrie bignes and sparkes of emerods and rubies, with thre antique women and five litle perles with a watch or clocke therein; a watch of agatte made like an egg garnished with golde; one clocke garnished with golde, being round and sett with 6 table diamondes and 6 rubies in the same border, and garnished with xvij diamondes on th'one side, and 8 diamonds and one rubie on th'other side, lacking two pearles."

Bartholomew Newsam.

Bartholomew Newsam, who lived in the Strand, was one of the earliest English makers of portable clocks whose work survives. In the British Museum is a very fine example, which proves Newsam to have been a master of his craft. This is a striking clock, in a case of brass, gilt and engraved, about $2\frac{1}{2}$ in. square and 4 in. high, exclusive of an ornamental domed and perforated top, which brings the total height to $6\frac{1}{2}$ in. The centre of the dial as far as the hour ring is below the surface of the case, so that on removing the base, the movement, together with the centre of the dial and hand, may be drawn out. The hours are engraved on a broad bevelled ring, which extends from the sunk part of the dial to beyond the front of the case. An exterior view of Newsam's clock is appended. The movement is arranged in stories, there being three plates held in position by four corner posts. Above the top plate is a semi-circular bell; between the upper and middle plate is the going train, and between the middle and lower plate the striking train, the locking plate occupying a position below the lowest plate. The arbors are placed vertically, and the winding holes are at the bottom of the case. The wheels are of steel or iron, the fusees very long, and with but little curve in their contour, are connected with the barrels by means of catgut. The plates, posts, and barrels are of brass, the barrel covers of iron held in by a number of tenons around the edge. The hand is driven from the fusee of the going part by a contrate wheel. The escapement is, of course, the verge. The workmanship is unusually fine for the period, and remarkably free from subsequent interference. There is a very small hinged door on each side of the case, giving, when open, a view of the fusees.

FIG. 42.—Clock by Bartholomew Newsam.

In the "Calendar of State Papers" of the time of Queen Elizabeth is a record of a grant in 1572 to B. N. (who no doubt was Bartholomew Newsam), of the office of the clockmaker to the queen in reversion after the death or surrender of N. U. (probably Nicholas Urseau). In the same calendar is a letter dated August 5th, 1583, from Bartilmew Newsham to Sir Francis Walsyngham, desiring him to favour the writer's petition to her Majesty for the augmenting a certain term of years, wherein he had moved Sir Philip Sydney to speak to him. And under date 1590 we find a grant to Bartholomew Newsham, of the office of clockmaker to the queen, in place of Nicholas Urseau, deceased.

By Newsam's will, dated in 1586, he bequeathed to his apprentice his "seconde clocke;" to a relative, his "best vice save one, a beckhorne to stand upon borde, a great fore hammer, and to (two) hand hammers, a grete longe beckhorne in my backe shoppe; and all the rest of my tooles I give unto Edward

Newsom, my sonne, with condicion that he become a clockmaker as I am, yf not I will the foresaid tooles to be sould by my executors." He gave to a friend "a sonne dyall of copper gylte;" to another "one cristall jewell with a watche in it, garnished with gould;" to another, "one watch clocke, in a silken purse, and a sonne dyall to stande uppon a post in his garden;" and to another, "a chamber clocke of fyve markes price."

Watch Glasses. Watch glasses seem to have been introduced about 1600. The first ones were flat, rather thick, and fitted into split bezels, the opening in the bezel being at the middle of the joint, so that the corresponding knuckles of the case would keep the slit tightly closed on to the glass. Glasses of this kind are found on oval watches, and also on circular ones with dials much smaller than the cases, which were a fashion at the beginning of the seventeenth century. Then followed the high, rounded glasses, which were cut from spheres. Afterwards came the bull's-eyes, with a circular flat centre; these, which were of German origin, gave place to the flatter "lunettes" from France, such as to-day divide popular favour with the thick "crystals."

Glasses were apparently used for table clocks some years before they were applied to watches. German and French table clocks, dating from the latter part of the sixteenth century, are occasionally to be met with having glasses over the dials, and some octagonal ones with glass panels in the sides. But the innovation did not at once prevail, as table clocks, either without any covering over the dial, or with metal covers, were made long after the first examples with glasses, and watches with metal covers continued in fashion till the middle of the seventeenth century.

In the British Museum is an oval watch by Guy Mellin, Blackfriars, dated 1600, the dial of which is covered with a glass in a split bezel; also a circular watch by John Duke, Fleet Street, with a dial one-half the size of the case, and a glass of corresponding size fitted into a split bezel. Several other watches, whose manufacture is ascribed to the beginning of the seventeenth century, may be noticed with glasses; but these adjuncts in some instances have been subsequent additions. The split bezel is a tolerable criterion of originality, but it does not absolutely follow that such a bezel was originally fitted with a glass, for the frames of early watches and clocks were occasionally furnished with crystal.

Rainulph or Randolph Bull. Rainulph or Randolph Bull appears to have been an English horologist of some note. In the British Museum is a rather large oval watch by him, dated 1590. It has on a shield the arms of the owner and his name, "W. Rousey." Bull was also keeper of the Westminster great clock. In Devon's Manuscript of the Exchequer there is an entry under date 1617, 1st of April: "By Order, dated 29th March, 1617. To Ranulph Bull, keeper of his Majesty's great clock, in his Majesty's palace of Westminster, the sum of £56 13*s.* 4*d.*, in full satisfaction and discharge of and for divers sums by him disbursed for mending the said clock, in taking the same and other quarter clocks all in pieces, and repairing the same in the wheels, pulleys, hammers, weights, and in all other parts, and in new hanging, wiring, and cordings of the same clock, and other necessary reparations thereunto belonging, the charge whereof, with his own workmanship and travail therein, doth amount to the sum aforesaid, appearing by a note of the particular demands, delivered upon his oath, taken before one of the Barons of his Majesty's Exchequer, without account or imprest to be made thereof. By writ dated 27th of March, 1617, £56 13*s.* 4*d.*"

In an account of the household expenses of Prince Henry, in 1610, "Emanuel" Bull, the "clocke-keeper," is mentioned.

An exceedingly curious English watch by Edward Bysse, with a peculiarly japanned metal case in the form of an insect or fritillary flower, is in the British Museum, and is dated 1580.

Humphrey Flood. Humphrey Flood, goldsmith, was, by a State paper dated July 5, 1607, to receive the sum of £120, in full satisfaction and payment for a clock covered with gold, and set with diamonds and rubies, and by him delivered to his Majesty's use, at the price of £220, whereof £100 had been already received.

William North.

"William North, Londini," is the inscription on an oval astronomical watch also in the British Museum. It may with tolerable certainty be affirmed that the movement of this watch was made about 1620, although the case is probably of a later date. William North was admitted as a brother of the Clockmakers' Company in 1639, and the fact of his being noted as a brother would indicate that he had then been established for some time, and was free of another company. An exterior view of this interesting example is given in the subjoined engraving. It shows the hours on the lower and day of the month on the upper circle. There are, in addition, four apertures in the dial. Through the largest of these, on the left, is shown the days of the week, with the corresponding allegorical figures: Apollo for Sunday, Diana for Monday, Mars for Tuesday, Mercury for Wednesday, Jupiter for Thursday, Venus for Friday, and Saturn for Saturday. Through the three openings on the right are seen the phases of the moon, the quarters of the moon, and its age in days. These three subjects are all engraved on one circular plate below. Symbols of six planets appear in rotation below the small square on the right, just outside and lower than the centre of the hour ring.

Fig. 43.—Watch by William North, London, about 1620.

In the South Kensington Museum is a particularly diminutive watch in a plain oval case, which measures outside but half an inch in length and three-eighths of an inch across. It was made by Richard Crayce, London, and is said to have belonged to Lord Hussey, who was beheaded in 1536. I am not aware what evidence exists to warrant this statement, but 1536 is rather an early date for a watch of this character to be in existence. There was a Richard Crayce, or Crayle, who was a member of the Blacksmiths' Company before the existence of the Clockmakers' Company, and who signed the petition for its incorporation. If he was not the actual maker of this watch, it was doubtless the production of some member of his family. In the British Museum is a round watch-movement by Richard Crayle (or Crayce), Fleet Street, a production of about 1620, but the engraving on it is of such a flourishing character that the penultimate letter cannot be ascertained with certainty.

David Ramsay.

One of the earliest British watchmakers of particular renown was David Ramsay. Among the Salting Collection at South Kensington Museum is a very early watch by him in a small irregular octagonal case of gold and silver. It has hinged covers over the front and the back, and is decorated with engravings of the Annunciation and the Nativity.

There is a record that in 1610 he made three watches for the Prince of Wales, for which he appears to have been paid from the "privie purse" in 1622.

In the British Museum is an oval watch of his make, with a gold case in the French style. The period assigned to this watch is 1600 to 1610. It is inscribed, "David Ramsay, *Scotus*, me fecit."

On the plate of another watch made by him, and supposed to have belonged to James I., is engraved, as before, "David Ramsay, *Scotus*, me fecit," and these inscriptions, together with the fact that he had a grant of denization in 1619, prove that he was a native of Scotland.

The engravings on page 68 show a clock-watch with alarum by him, from the collection of Mr. Evan Roberts. Mr. Crewe, in describing the movement, remarks that, in consequence of there being a wheel less in the train than was usual in verge watches of a later period, the balance wheel is cut the contrary way. The great wheel of the fusee works in what is now known as the *third* wheel, and this last gives impulse to the contrate wheel, which in its turn moves the balance wheel, and this gives motion to the verge and balance.

The fusee is cut for twelve turns, and the end of its arbor, which goes through the pillar plate, is fashioned into six pegs or leaves, identical with a lantern pinion in its action. These leaves work in a wheel pivoted into the centre of the pillar plate, having sixty teeth, and carrying the single hand of the watch. Thus ten turns of the fusee are equivalent to an entire circuit of the hand on the dial, and so the watch would require to be wound twice a day. The stop work to the fusee is precisely the same as that used now in nearly all English watches with chains, and is almost the only part of a watch which has reached finality. The ratchet wheel, which sets up the mainspring, is on the top plate, and is identical in principle with that in ordinary use in English

Front view. View of edge and back.

FIG. 44.—Clock-watch and alarum by David Ramsay.

watches with fusees. The stop work for the alarum part is effected by a wheel and pinion, the wheel having a portion the size of two teeth left uncut, and which serves as a block to the pinion after it has been wound three turns. The wheels and pinions have a wonderfully smooth action, though they appear to be cut by hand rather roughly. The count or locking wheel of the striking portion is made of silver, and the notches have been certainly made with a file. The alarum part has a verge escapement with counter and crown wheels. Attached to its verge is a V-shaped piece of brass with an arm, and this pressed by a spring drops into a notch made in the edge of a brass disc on the hand or hour wheel, and so liberates the verge and lets off the alarum. Between this disc and the hour wheel, and working concentrically with them, is a star wheel having twelve teeth, which by lifting up a brass arm connected with the count wheel causes it to strike. The potence is a rather slender piece of square brass, and is riveted to the top plate, and the banking is made by steps cut in it. These riveted potences are found in nearly all watches made before 1700. The balance cock is a slender piece of work, and is pierced throughout, and the neck very narrow, so different from specimens of Tompion and other later masters. The case is very elegant in design, and is pierced in the back and band, the bezel being engraved, and in every respect it will compare favourably with any work of the kind. Curiously enough, the band is silver, and bezel and back of bronze, and the whole case gilt. On the margin of the top plate, in tiny characters, as if almost to escape observation, is engraved, "David Ramsay inv$^{t.}$ Fecit," the *et* having been obliterated. This *invenit et fecit* seems to have been for some time copied by succeeding watchmakers of importance.

In the "Audit Office, Declared Accounts," is the following entry: "Watches, three bought of Mr. Ramsay, the Clockmaker, lxj$^{li.}$" [£61]. In the list of "Guyftes and Rewardes" in the same account will be found—"Mr. Ramsay, the Clockmaker, xj$^{s.}$" [11*s.*]. In 1613, James, prodigal of promises, gave him a pension of £200 per annum, probably for his services as groom of the bedchamber to the late Prince of Wales, and in the same year a further pension of £50 per annum. In the grant he is styled "Clockmaker Extraordinary." In 1616 a warrant was signed to pay him £234 10*s.* for the purchase and repair of clocks and watches for the king. On November 26, 1618, he was appointed to the office of "Chief Clockmaker" to his Majesty, with fees and allowances for workmanship. On September 30, 1622, he received £232 15*s.* for repairing clocks at Theobalds, Oatlands, and Westminster, and for making a chime of bells adjoining the clock at Theobalds.

In 1625 James I., his patron, died, but Ramsay appears to have retained his appointments, for on January 25, 1626, a warrant to pay to David Ramsay £150 for coins to be given by the king, Charles I., on the day of his coronation, was signed. We again find, "March 17th, 1627, a warrant to David Ramsay, Page of the Bedchamber and Clockmaker, £441 3*s.* 4*d.* for work done for his late Majesty; and £358 16*s*. 8*d*. in lieu of diet and bouche of Court." In 1628, July 10, a warrant was signed to pay him £415 for clocks and other necessaries delivered for the king's service.

Sir Walter Scott introduces Ramsay as a character in "The Fortunes of Nigel," and in a note to that novel he is described as "Constructor of Horologes to His Most Sacred Majesty James I."

That Ramsay was the most celebrated watchmaker of the day may be inferred from the fact that when the clockmakers obtained their charter of incorporation, he was therein appointed to the office of master.

He does not seem to have taken a very active part in the management of the company. During his absence in the country, Mr. Henry Archer was appointed deputy-master. David Ramsay died in 1650. His age is not stated, but he was certainly very much past the meridian. He is known to have been an inventor or schemer from the beginning of the century, and between 1618 and 1638 he took out no less than eight patents, none of which, however, seem to be connected with horology; they related to raising water, draining mines, making saltpetre, separating gold and silver from the base metals, smelting iron, constructing furnaces of various kinds, dyeing fabrics, etc.

William Partridge.

In the "Calendar of State Papers" (Domestic Series), under date May, 1660, there appears the following petition to the king from Captain William Partridge, setting out "that hee was sworne servant to yo^r^ Royall father of blessed memory, and so yo^r^ Ma^tie^ in the yeare 1645, to attend ye in the qualitie of a Clockmaker, and did officiate in that place, all the time of his Ma^ties^ being at Oxford, And did likewise serve his Ma^tie^ a yeare and a halfe in his life Guard of foote; And afeterwards did raise a Company att his owne charge; And hath bene a great sufferer by Plundring Imprisonm^ts^ and expulcōns. Hee most humbly prayeth that yo^r^ Ma^tie^ will vouchsafe unto him the like grace and favo^r^ as to others of yo^r^ servants is extended, That hee may bee restored unto his said place of Clockmaker to yo^r^ Ma^tie^ w^ith^ all such priviledges and Impunities as belong unto it according to his warrant."

On the same page there is also a petition from Sarah his wife, begging that her husband's place may not be filled up until he has been heard for himself.

At the foot of the petition is the note, "To succeede Da. Ramsey." But nothing further is known of Partridge, and he may be passed over. The king's clockmaker, after Ramsay, really seems to have been Edward East, of whom more will be said hereafter.

Pocket Watches.

Watches were not carried in the pocket for a century after they were introduced. The larger ones were kept on a table or cabinet, and the smaller ones, when attached to the person, were originally on a chain worn round the neck. The fob, from the German *fuppe*, "a small pocket," seems to have been introduced by the Puritans, whose dislike of display induced them to conceal their timekeepers from the public gaze; besides which, for men engaged in active pursuits, who carried timekeepers for use rather than for ornament, the fob was decidedly more convenient. This conjecture as to the origin of the fob is borne out by the fact that a short "fob" chain belonging to a watch of Oliver Cromwell's, in the British Museum, is, in point of date, the first appendance of the kind to be found. The arms and initials of the Protector are engraved upon the seal end of the chain. The watch is a small oval one, in a silver case, and was made about 1625, by John Midnall, of Fleet Street, who was one of the first members of the court of the Clockmakers' Company, and warden in 1638. Mr. Evan Roberts has another watch said to have belonged to Oliver Cromwell. It is in a very plain round silver case.

In the South Kensington Museum is a round watch by Johannes Boyes, with the inscription "Johne Pyme, hes watch, A.D. 1620." The outer case is of tortoiseshell.

Enamel Painting.

Beautiful decoration in enamel was introduced rather before the middle of the seventeenth century for watch cases and dials. The process of painting in opaque enamels is of French origin, and is said to have been the invention of Jean Toutin, a goldsmith of Château Surr, who was distinguished for painting in transparent enamels, and, about 1630, succeeded in applying to thin gold plates thick colours of different tints, which would melt with fire, and yet retain their lustre. Others besides the inventor devoted themselves to the new art. Among those who excelled in it may be mentioned Henry Toutin, a brother of the inventor, a goldsmith and enameller at Blois; Dubie, a court goldsmith who worked at the Louvre; Paul Viet, of Blois; Morlière, a native of Orleans, who worked at Blois; Robert Vaugner, a pupil of Morlière; Chartière, of Blois, who was noted for his painting of flowers; and Huand le Puisné, who was equally celebrated for figure-painting. Several examples are to be found in the British and South Kensington Museums. Among those in the British Museum may be cited a representation of some nymphs bathing, excellently executed in enamel by Jean Toutin; also an enamelled watch-case, very finely painted by Henry Toutin, illustrating the story of Tancred and Clorinda in "Orlando Furioso;" another by the same artist treats of the "History d'Apain." A watch by D. Bouquett, a well-known London watchmaker, the case being ornamented with flowers in relief, and enriched with diamonds; a very finely enamelled watch-case, illustrating the early life of Christ; two cases painted in enamel by H. le Puisné; a very thick rounded watch by Tompion, with case splendidly painted in enamel by Camille André.

Pair Cases. The fragile surface of enamel required the protection of an outer case. Sometimes this was of base metal covered with leather, but when expense was no object it was of gold and highly decorated. From this time the practice of adding loose outer case to watches, forming what are called "pair cases," continued to the early part of the present century.

Gold cases, with designs worked up in *repoussé*, were at this period an important art in connection with watchmaking. Some very choice specimens, marked H. Manley, are in the British Museum. Other fine examples bear the signature Parbury in very small characters, but as a rule decorative work of this kind bears no indication of the producer.

Occasionally cases decorated in *repoussé à jour* are to be met with, some of the best of them being the work of Dutch artists, but this form of ornament is hardly suitable for watch cases, as it affords no protection against the ingress of dirt, unless a separate lining is employed.

As a curiosity may be mentioned an outer case of carnelian belonging to a watch made by Strigner for James II., and by him given to his daughter, Catherine Countess of Anglesey and Duchess of Buckingham, about 1687.

Outer cases of tortoiseshell, either plain or *piqué*, were not uncommon. Strong and inexpensive outer cases of metal, covered with shagreen, were also made. Shagreen is a remarkable tough kind of leather, made chiefly at Astrachan from the strong skin that covers the crupper of the ass or horse. In its preparation a peculiar roughness is produced by treading into the skin hard round seeds, which are shaken out when the skin has been dried; it is then stained green with copper filings and sal-ammoniac, and the grains or warts are then rubbed down to a level with the rest of the surface, which thus presents the appearance of white dots on a green ground.

It was customary to insert in the outer case of pair-case watches circular pieces of velvet, muslin, or other material, adorned with fancy needlework, or "watch papers," having printed thereon sometimes an advertisement of the watchmaker, and occasionally admonitory or sentimental verses. The following lines are often to be met on old watch papers—

"Onward perpetually moving,
These faithful hands are ever proving
How quick the hours fly by;
This monitory, pulse-like beating,
Is oftentimes, methinks, repeating,
'Swift! swift! the moments fly.'
Reader, be ready, for perhaps before
These hands have made one revolution more
Life's spring is snapped—you die!"

The same exhortation pervades many others, of which another example may be given—

"Time is—the present moment well employ;
Time was—is past—thou canst not it enjoy;
Time future—is not and may never be;
Time present—is the only time for thee."

An apposite but more uncommon inscription which was engraved around a watch case is *Tempus metitur omnia sed metior ipsum;* "Time measures all things, but I measure it."

The Clockmakers' Company.

IN 1627 a proposal to grant letters patent authorizing French clockmakers to carry on their trade within the city appears to have occasioned an agitation among the London craftsmen in favour of incorporation as a trade guild. Prior to that date, individual freemen had been associated with one or other of the existing companies, that of the blacksmiths having been most favoured. In 1630 a committee of clockmakers was formed, funds were raised to defray expenses, and petitions were addressed to the king, with the result that a charter was obtained from Charles I. on the 22nd of August, 1631.

In this document, "the Master, Wardens, and Fellowship of the Art or Mystery of Clockmaking of the City of London" had very comprehensive powers for ruling and protecting the rights of the craft. They were entitled to make by-laws for the government of all persons using the trade in London, or within ten miles thereof, and for the regulation of the manner in which the trade should be carried on throughout the realm. And in order to prevent the public from being injured by persons "making, buying, selling, transporting, and importing any bad, deceitful, or insufficient clocks, watches, larums, sun-dials, boxes, or cases for the said trade," powers were given to the company "to enter with a constable or other officer any ships, vessels, warehouses, shops, or other places where they should suspect such bad and deceitful works to be made or kept, for the purpose of searching for them;" and, if entrance should be denied, they might effect it by force. Any such works as were faulty or deceitfully wrought they had power to seize and destroy, or cause them to be amended. Every member of the fellowship paid fourpence a quarter to meet the necessary expense of these searches. In 1708 this quarterage produced over £28.

By the charter, David Ramsay was appointed to be the first master, and Henry Archer, John Wellowe, and Sampson Shelton were the first wardens; and James Vautrollier, John Smith, Francis Foreman, John Harris, Richard Morgan, Samuel Linnaker, John Charlton, John Midnall, Symon Bartrum, and

Edward East, assistants of the said fellowship of the said art or mystery.

The charter also declared that future masters and wardens must be, or have been, professed clockmakers, an important regulation, which certainly appears to have been contravened in late years. The right of search was exercised regularly till 1735, when it was abandoned.

On the incorporation of the company, stringent by-laws were made regarding apprentices. No person was to take an apprentice without leave of the master, and then to have but one, until he shall be called to bear the office of master, warden, or assistant, and, after that, not to exceed the number of two apprentices at any time whatsoever. But when his first apprentice had served five years, any member of the fellowship might take another, but not sooner, under a penalty of £10. And in the early history of the company several of its members were brought to account and fined for disobeying this regulation. Among them were several eminent members of the craft, including Thomas Loomes and Ahasuerus Fromanteel.

Then it was ordained that after an apprentice had served his time, he should serve his master or some other member of the fellowship for two years as journeyman, and produce his "masterpiece" of work before he was allowed to be a workmaster. This period of probation might, if the company saw fit, be commuted to one year on payment of a fine.

Those craftsmen who had joined the Blacksmiths' and other Companies prior to the incorporation of the Clockmakers', were from time to time admitted as "brothers" of the Clockmakers' Company.

As provided by the charter, the "court" or directorate consists of the master, three wardens, and ten or more assistants. The assistants are chosen for life from among the freemen, and the usual, but not invariable, course is that the assistants fill the higher offices in succession, according to seniority; each one being elected first as junior warden, the next year as renter, the next year as senior warden, and the following year as master. After his retirement as master, he resumes his seat as an ordinary member of the court.

Occasionally members were transferred from and to other companies. In 1636 Mr. Richard Masterton was transferred from the Clothiers' at a cost to the Clockmakers' Company of £10 9*s.* 6*d.* A lesser sum sufficed for the transference, in the same year, of Mr. Dawson and Mr. Durant from the Imbroderers'. In 1724 Mr. John Shirley gave a bond to pay the Clockmakers' Company £20 for being transferred to the Vintners'. On Mr. James Masters applying in 1811 to be transferred to the Goldsmiths', a little haggling appears to have ensued. The Clockmakers' Company at first demanded £50 for consenting; Masters offered £30 in 1812, and this amount was accepted. George Russell, in 1844, had to pay the Clockmakers' Company £30 for permission to be transferred to the Salters', and an additional £5 for a special meeting of the court to attend the Court of Aldermen with the Salters' Company.

In 1656 Ahasuerus Fromanteel and 31 other members complained to the Court that, in spite of members having to pay xii$^{d.}$ a quarter, the meetings were held in taverns. They also objected to the presence of Frenchmen among the ruling body, and recounted other grievances. A counter petition traversed the allegations, and asserted the confidence of the signatories in the management of the company.

In 1671 the company obtained the right to bear arms, and in that year letters patent were granted for this distinction. They recounted "that whereof at present Nicholas Coxeter is Master, Samuell Horne and Jeffery Bailey are Wardens, as also Edward East, the only person now living of those mentioned in the said Letters Patents of Incorporation, John Nicasius, John Pennock, Edmond Gilpin, Jeremie Gregory, Thomas Taylor, Thomas Clayton, John Freeman, Evan Jones, Isaac Daniell, John Browne, Nicholas Payne, Richard Ames, and Benjamin Bell, are Assistants, and to the rest of the Fellowship and Company thereof, and to their successors for ever. The Armes, Crest, Supporters and Motto hereafter mentioned, viz$^{t.}$ Sable, A Clock y^{e} 4 Pillars therefore erected on four lyons, and

Fig. 45.

on each capitall a globe with a Crosse, and in the middest an Imperial Crowne all Or, and for Their Crest upon an helmet Proper Mantled Gules Doubled Argent and Wreath of their Colours a Spheare Or, The Armes Supported by the Figures of a Naked Old man holding a Scithe and an Hour Glasse representing Time, and an Emporour in Roabes Crowned holding a Scepter, Their Motto—

TEMPVS RERVM IMPERATOR.

As in the margent they are all more lively Depicted."

In 1677 Mr. George Deane, engraver, a member of this company, "having by the hands of Henry Jones presented to this court the company's coat of arms engraved on a copper-plate fit to be used for tickets and divers other occasions of the company which was very well liked, this court did kindly accept it, and returned him thanks."

During the latter part of the seventeenth century the suitability of watchmaking as a profession for women was recognized, and in 1715 the company sanctioned the taking of female apprentices. The names of several will be found in the list at the end of the book, where also is recorded the admission of a few female members of the company. The employment of female labour in watch work does not, however, seem to have made much progress in England till watch factories were established in quite recent years.

In 1781 it was decided to elect leading members of the trade as honorary free men. This course, politic as it probably was, seems to indicate that at this period the prestige of the company in the horological world was insufficient to induce them to take up the freedom in the ordinary way.

The company have never risen to the importance and comfort of possessing a hall of their own for meetings and other business. For brief periods during their history they had the use of a hall belonging to a more favoured guild, but most of their meetings were held in taverns, more than forty of these establishments having been so favoured.

Their last meeting before the Great Fire of London was held on August 20th, at the Castle Tavern, in Fleet Street; and the first meeting after, on October 8th, 1666, at the Crown Tavern, in Smithfield. Later still the Devil Tavern, near Temple Bar, was patronized.

Only a certain number of freemen from certain of the companies is permitted to take up the livery of freedom of the City, the whole matter being in the discretion of the Court of Aldermen. The claims of the Clockmakers' Company were not recognized in this respect till 1766, when they were allowed to select 60 of their members for the privilege; this number was upon petition increased to 120 in 1786, a still further increase to 200 was sanctioned in 1810, and in 1826 the present limit of 250 was reached.

No. 2 of the by-laws provided "that every person of the said Fellowship chosen in the said Livery shall accept and take upon him to be of the said Livery, and shall within fourteen days after notice of such election, take such oaths as by these ordinances shall be appointed for him."

The honour of election to the livery does not seem to have been always appreciated, for in 1813 "William Mansell, of Rosoman St., Clerkenwell, Watch casemaker, who was summoned to take the Livery on the 19 August, 1812, again on 7 September, 1812, and repeated on the 11th October last, was peremptorily summoned to be at this court, and being now in attendance for the first time, refused to take the Clothing, and the penalty of Fifteen Pounds being awarded against him for such refusal, he paid the sum in Court, and his Election to the Livery was thereupon discharged."

"William Welborne, of Leather Lane, Holborn, has been summoned to take the Livery in November, 1811, and also in January, February, and July, 1812, but having failed so to do, was again summoned for that purpose to the last Quarter Court, when he attended and requested until this day promising either to take the clothing or pay the penalty for refusal, he being now present and declining to take the same, the penalty of £15 was ordered to be enforced, which being paid in Court, his election to the Livery was likewise thereupon discharged."

The fine on taking up the livery was then fixed at £21.

In 1820 it was resolved to allow the quarterly payments or quarterage from members in support of the company to be commuted by an immediate payment; the amount to be paid being dependent on the age of the member availing himself of the arrangement.

The fee to be paid on taking up the freedom of the company by purchase was in 1876 increased to £20.

In 1873 the company handed over its library and museum to the Corporation of London, and they are now accessible to the public in the Guildhall.

It is a matter for regret that the directorate of a guild so closely identified with the most brilliant members of the craft in its early history, should have resigned the duties cast upon them by the charter of incorporation, and thus have lost their hold upon the clock and watchmaking trades.

Edward East. Edward East, watchmaker to Charles I., was a true horologist and a worthy successor to David Ramsay. He at one time resided in Pall Mall, near the tennis court, and attended the king when tennis and other games were being played in the Mall, his Majesty often providing one of East's watches as a prize. Edward East seems to have removed to Fleet Street, for it is related that at a later period the king's attendant, Mr. Herbert, failing in the punctual discharge of his duties in the morning, his Majesty provided him with a gold alarum watch, which was fetched from the king's watchmaker Mr. East, in Fleet Street. In Wood's "Curiosities" is mentioned a silver alarum clock-watch which was presented by the king on his way to execution at Whitehall, on January 30, 1649, to his faithful and attached servant, Mr., afterwards Sir, Thomas Herbert. Amongst the collection of autographs and manuscripts in the possession of Mr. Alfred Morrison, of Fonthill House, Wilts, is a warrant, dated June 23, 1649, from the Committee of Public Revenue to Thomas Fauconbridge, Esq., Receiver-General, authorizing him to pay "vnto Mr. Edward East, Watchmaker, the so'me of fortie pounds for a Watch and a Larum of gould by him made for the late King Charles by directions of the Earle of Pembrooke, by order of the Committee, and deliuered for the late King's use the xviith of January last." In the Fellows Collection at the British Museum is a splendid octangular crystal-cased watch, a recumbent female figure holding an hour-glass being engraved on the dial; 1620 is mentioned as the probable date of this specimen. Wood mentions another watch with silver case in the form of a cross, the dial being engraved with the crucifixion and angels.

There is in the Ashmolean Museum at Oxford a watch with gold case in the form of a melon. Two undoubted specimens of this master's work are in the Guildhall Museum. One, a watch movement, inscribed, "Eduardus East, Londini," is thus described by Mr. E. J. Thompson: "The fusee of ten turns is cut for gut. There are great second and contrate wheels, and a left-handed cut balance wheel, the verge being of course left-handed. The end of the verge is driven into the balance, which has one straight bar or arm. The cock is secured on a stud by a pin. There is no provision for a pendulum spring, and the regulating must have depended upon the setting up or down of the mainspring by the endless screw. It had one hand only. The fusee is hollow, having the cap and winding square solid; it is fitted on to an arbor riveted on the great wheel, and the end shake is eased by a very thick click and ratchet work. The great wheel has fifty-five, the second forty-five, the contrate forty, and the balance-wheel fifteen teeth; the second, contrate, and balance pinions being all of five leaves."

The second example is a watch in a silver oval case with hunting cover, having a crystal centre which Mr. Thompson says is finely worked in to suit its shape. The dial is of silver, and is traversed by an hour hand only. The movement is inscribed, as in the first instance, "Eduardus East, Londini." There is a twelve-turn fusee cut for gut. The mainspring is white and no doubt original.

In the British Museum is a watch of his make with a tortoise-shell case, period about 1630–1640. South Kensington Museum also possesses a specimen of his work.

Edward East was one of the ten original assistants named in the charter of incorporation of the Clockmakers' Company, and at once took a leading part in their proceedings, and after serving in the subordinate capacities was elected master in 1664, a post he again occupied in 1682. He was the only treasurer ever appointed, and the creation of the office came about in a curious way. In 1647, the renter warden, Mr. Helden, refused to give the usual security for the stock of the company, and in this dilemma the office of treasurer was created, Mr. East and Mr. Hackett being nominated thereto, and the former chosen. On the death of Mr. East the office was allowed to lapse.

Edward East lived to a good age. There is no record of his death, but it probably occurred not long after 1693. In 1692 his quondam apprentice and friend, Mr. Henry Jones, who was also master of the company, acquainted the Court that Mr. East desired during his lifetime to make a gift of £100 to the company for the benefit of the poor. Mr. Jones added that he would also contribute a like sum for a similar purpose. In the following year Mr. East gave the £100, and it was ordered "that the master and wardens do go to Mr. East and give him hearty thanks for his charity."

Henry Jones. Henry Jones, already referred to, was apprenticed to Edward East on August 22, 1654. He was made free of the Clockmakers' Company in 1663, and served as master in 1691–92. He resided near the Inner Temple Gate, and attained a considerable reputation, and what remains of his work shows that it was justified. The earlier examples had the inscription in Latin, thus, "Henricus Jones, Londini," as had been the custom. Charles II., according to tradition, gave to Mrs. Jane Lane a clock, in memory of her services after the battle of Worcester. On the clock was engraved, "Henricus Jones, Londini," as before quoted. In Overall's "History of the Clockmakers' Company" is a record which just possibly refers to this clock. It states that, on January 19, 1673, "Mr. Henry Jones, clockmaker, acquainted the Court of the Company that he had made for the King (Charles II.) a clock of the value of £150, whereon was engraven 'Henricus Jones, Londini,' and which stood in His Majesty's closet for about seven years, but being by His Majesty given unto a lady it came into the hands of Robert Seignor, clockmaker, of Exchange Alley, to be repaired, and he caused Edward Staunton, clockmaker, or some other person, to take out the maker's name and insert his own."

In North's "Life" it is stated that barometers were first made and sold by one Jones, a noted clockmaker in the Inner Temple Gate, at the instance of Lord Keeper Guildford; and very probably Jones was the first *Englishman* who constructed a Torricellian tube, as the barometer was originally called, after its inventor, Evangelista Torricelli, who propounded its theory about 1650.

In the *London Gazette* for October 21 to 24, 1689, was the following advertisement: "Lost, the 21st Instant, between the Hay Market near Charing Cross and the Rummer in Queen St. near Cheapside, a round Gold Pendulum Watch of an indifferent small size, shewing the hours and minutes, the Pendulum went with a strait Spring, it was made by Henry Jones, Watchmaker in the Temple, the Out-Case had a Cypher pin'd on it, and the Shagreen much worn. If it comes to your hands, you are desired to bring it to the said Mr. Jones or Mr. Snag, a goldsmith in Lumbard Street, and you shall have two Guineas Reward."

In the Guildhall Museum is one of Henry Jones's watches, which Mr. E. J. Thompson speaks of as having very fine pillars. Another watch by the same maker is in the collection of Mr. Evan Roberts.

Mr. Holden, of Yeadon, has an eight-day long inlaid case-clock with a brass dial, inscribed "Henry Jones in ye Temple," which is a later production than any of those already quoted.

Henry Jones, who was the son of William Jones, vicar of Boulder, Southampton, died in November, 1695, aged 53 years, and was buried within the precincts of the old church of St. Dunstan's in the West, Fleet Street, where a monument was erected to his memory by his widow.

Edward Barlow (Booth). This talented man was born near Warrington in 1636. He was ordained in the English Church at Lisbon, and took the name of Barlow from his godfather, Ambrose Barlow, a Benedictine, who suffered at Lancaster for his religion. Edward Booth devoted considerable attention to horological instruments. He was undoubtedly the inventor of the rack repeating striking works for clocks, which was applied by Tompion about 1675. He also made a repeating-watch on the same principle, and made application to patent it in 1686. His claim was successfully opposed by Daniel Quare, who was backed by the Clockmakers' Company. The king, James II., tried both watches, and gave his preference to Quare's, which repeated the hours and quarters with one push from the pendant, whereas Barlow's required two.

Booth invented the cylinder escapement, and patented it in conjunction with William Houghton and Thomas Tompion in 1695 (No. 344). The invention is described as a "ballance wheele either flatt or hollow, to worke within and crosse the centre of the verge or axis of the balance with a new sort of teeth made like tinterhooks to move the balance and the pallets of the axis or verge, one to be circular, concave, and convex." He died in 1716.

Tompion and Graham.

Thomas Tompion, "the father of English watch-making," was born at Northhill, Bedfordshire, in 1638. It is said that his father was a farrier, and that he was brought up to the same trade; but the first reliable

FIG. 46.—Thomas Tompion, 1638–1713.

record shows him to have been in business as a clockmaker at Water Lane, Blackfriars, when quite a young man.

He afterwards removed to 67, Fleet Street, on the corner of Whitefriars Street, where the offices of the *Daily News* now are.

His advent marks a distinct epoch in the history of the horological art. Throughout his career he was closely associated with some of the leading mathematicians and philosophers of his time. The theories of Dr. Hooke and the Rev. Edward Barlow would probably have remained in abeyance but for Tompion's skilful materialization of them. He soon became the leading watchmaker at the court of Charles II., and was everywhere welcomed as an artist of commanding ability. When he entered the arena the performance of timekeepers was very indifferent. The principles on which they were constructed were defective, and the mechanism was not well proportioned. The movements were regarded as quite subsidiary to the exterior cases, and English specimens of the art had no distinctive individuality. After years of application he, by adopting the inventions of Hooke and Barlow, and by skilful proportion of parts, left English watches and clocks the finest in the world and the admiration of his brother artists. Of course he did not reach finality; improvements continued under his immediate successors. Indeed, some of the most remarkable and progressive horological conceptions emanated from the mind of his favourite pupil, Graham, whom he inspired, and who continued the work which Tompion began. The only horologist of Tompion's time who can be admitted as his peer is Daniel Quare.

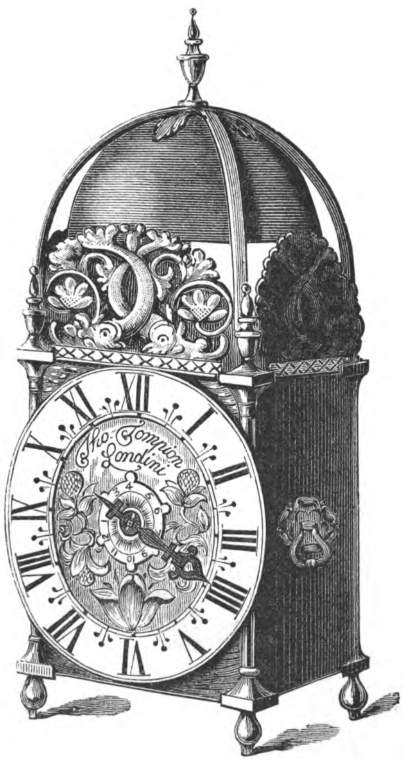


Fig. 47.

By favour of Mr. Percy Webster, of St. John's Wood, I am enabled to give the annexed drawing (Fig. 47) of one of Tompion's earlier clocks which Mr. Webster has in his possession. It has a light pendulum six inches in length fixed to the verge ; the escapement for the alarum is behind the going train, and when the alarum is let off the hammer strikes the bell which forms the domical top of the clock. This is an excellent specimen of mid-seventeenth-century work.

In the British Museum is another chamber clock by Tompion, as well as a very thick watch by the master in a case superbly painted in enamel by Camille André. In the same repository is a curious universal pocket sun-dial with compass, all of gold, also by Tompion.

The movements of Tompion's watches were deep, with broad flanches to the cocks, elaborately worked pillars, mainsprings adjusted by an endless screw, third wheel working above the crown or balance wheel arbor, and the potences riveted to the top plate. The banking of the verge was on the potence. The top plates were exceedingly thin, and on the margin thereof, somewhat cramped, was the inscription thus—"Tho. Tompion, London."

As an example of the versatility of Tompion's genius, is appended a drawing of a watch from the collection of Mr. Evan

Fig. 48.

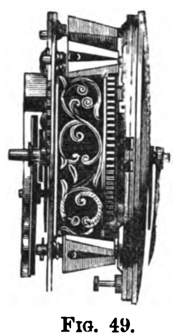


Fig. 49.

Roberts. The distinctive feature of this watch is that, although a verge, the fusee has been discarded for a resting barrel. In order that the watch might have a barrel of the largest possible dimensions, what is usually the *centre* wheel is planted out of the centre; the cannon pinion rides loose on a stud planted in the centre of the frame; and in order to get the proper motion for the minute-hand without the introduction of an intermediate wheel in the motion work, the train rotates reversely to the usual direction.

Prior to September, 1695, Tompion produced a watch in which the teeth of a horizontal escape wheel dropped on to the cylindrical body of the verge, as shown in the appended drawing, thus avoiding the recoil incidental to the usual verge construction; and in September, 1695, he, in conjunction with Booth and Houghton, patented the cylinder escapement. In the account of Barlow the wording of the description is given.

Fig. 50.

During the building of St. Paul's, it was said that Tompion was to construct a wonderful clock for the cathedral; but for the last years of his life he allowed himself considerable relaxation from his profession, and was absent from London for extended periods. During his migrations he visited Bath, possibly to derive benefit from the healing properties of the hot mineral water which wells up in the Queen of the West, as the chief Somersetshire city is called. In the Grand Pump Room there is a splendid example of Tompion's later work, which he presented to the city, as is thus recorded on a tablet adjacent to the timekeeper: "The Watch and Sun-dial was given by Mr. Thos. Tompion, of London, Clockmaker. Anno Dom. 1709." By the kindness of Mr. R. E. Peach, I am enabled to give a drawing and description of this stately timekeeper.

The dial is of brass, with ornamental corner pieces and silvered rings; minute circle 15 in. in diameter; seconds circle and day of the month through an opening. On a high arch above is an equation index and scale, 0 being in the centre, and the variation to a maximum of 15 minutes shown on each side; on the right, "Sun faster," and to the left, "Sun slower." The months and days are engraved on a silvered 10-in. circle, of which an arc of 62 days is shown through an opening. The date is indicated by a small point in the centre of the opening. The number of minutes shown by the index gives the difference between sun time and mean time: this 10-in. circle has over

2000 finely cut teeth, and makes its annual circuit by means of an endless screw and pinion, worked from the dial wheel, which makes one revolution per hour. The index is kept in position by a small counterpoise with pulley fitted to its arbor; the pulley is attached by a fine chain to a "cranked" arm, which rises and falls with the indentations and protuberances of a properly shaped plate or cam attached securely to the 10-in. circle.

The train and frame of the timepiece are in remarkably good order, considering its age. The driving-power is a lead weight of 32 lbs. hung on a 3-in. pulley, having a fall of 6 feet. It is wound monthly on to a $2\frac{1}{2}$-in. barrel; the great wheel of 94 teeth, and $4\frac{3}{4}$ inches in diameter, drives a pinion of 16 leaves; thereon is a 3-in. wheel of 80 teeth, and this drives the centre pinion of 10 teeth; this is a $2\frac{7}{8}$-in. wheel of 72 teeth, driving the third pinion of 9 teeth; on this is a $2\frac{5}{8}$-in. wheel of 60 teeth, driving the escape pinion of 8 teeth; on this is a 2-in. escape wheel of 30 teeth, shaped as in a recoiling escapement. The pallet staff is $2\frac{3}{4}$ in. above the escape arbor, and carries pallets of the anchor pattern, having inclined planes to allow recoil. The one-second pendulum rod is

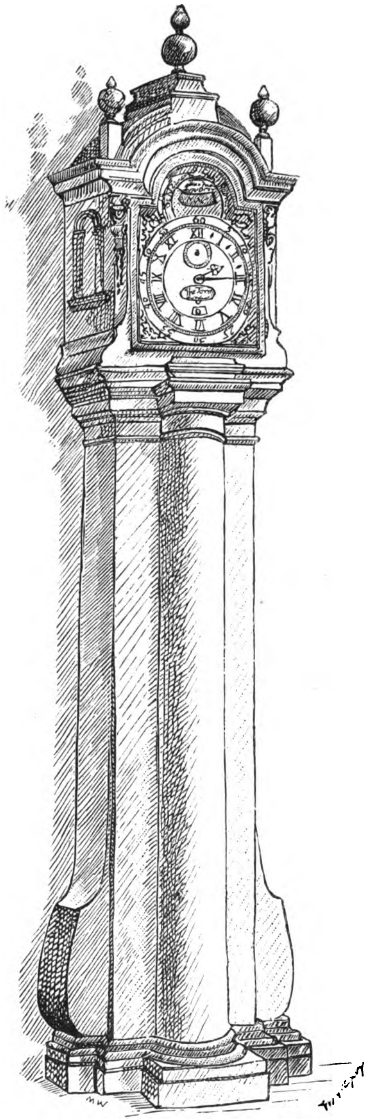


FIG. 51.—Clock by Tompion at the Pump Room, Bath.

of steel, of a flattened oval section, with 6-in. bob of lenticular form. The amount of oscillation, being only $2\frac{3}{4}$ in., causes the recoil of the escapement to be barely apparent.

The day of the month circle is moved by an extra wheel from the hour wheel. Maintaining power while winding is given by a spring-propelled click through a steel arm on an arbor between the plates, acting on the teeth of the centre wheel, which is put into action by lifting the sliding cover of the winder hole in the dial.

The case, strongly secured into the wall, is of solid unpolished oak, 9 feet high, and brass ball ornaments above. The head is arched, having few brass ornaments, though relieved with elaborate mouldings, morticings, and plinths. The body of the case is 17 in. wide (about 6 in. narrower than the head and base), with semi-circular door 8 in. across and 5 ft. in length. As will be seen from the drawing, the case has much the appearance of a pillar rising from a substantial base.

The clock is in a recess at the eastern end of the room, and it occupied a similar position in the old Pump Room, the erection of which was finished in 1706. As the spot is particularly suited for the reception of a clock, it may be conjectured that Tompion was in Bath when the old Pump Room was being built, and that the ever-vigilant "Beau" Nash obtained from him a promise to present a timepiece when the building was completed.

At first sight the phrase "watch and sun-dial" on the tablet recording the gift seems to include a gnomon of some sort for regulating the timekeeper from observations of the sun. There would be nothing far-fetched in this surmise, because sun-dials to check the going of public timekeepers were not at all an unusual adjunct. But I am inclined to think that in this instance sun-dial meant the equation dial over the ordinary one.

At the Guildhall Museum is a clock by Tompion which goes four months between windings, and at Buckingham Palace is a one-year long-case clock by him.

Tompion died and was buried in Westminster Abbey in 1713. In the same grave were interred the remains of Graham, and particulars of their tomb had therefore better be left till after the brief notice of Graham which follows.

Little is known of Tompion's domestic life, but he apparently had a son, who was brought up to the business of watchmaking.

Tho. Tompion, junr., was admitted as a member to the Clockmakers' Company in 1702, presumably when he had completed his apprenticeship. A "Tompion," watchmaker, attended the funeral of Daniel Quare, in 1724. Watches by Tho. Tompion, junr., are to be met with occasionally, and I have examined two or three inscribed "Tho. Tompion, Edw. Banger, London." Edward Banger was apprenticed to *the* Tompion in 1695, and it may therefore be fairly assumed that he was in partnership with Tompion junr. I saw a watch for sale but a few months ago, inscribed "Tompion, London," the hall mark in the case of which corresponded to the year 1745. But Tompion bequeathed his business to Graham, who, it is pretty certain, secured the best of the trade on the demise of his patron and friend.

George Graham.

George Graham, "Honest George Graham," who was born at Kirklinton, or Rigg, Cumberland, in 1673, tramped to London at an early age, and in 1688 became apprenticed for seven years to Henry Aske. He was admitted a freeman of the Clockmakers' Company on completing his indentures, in 1695, and immediately entered the service of Thomas Tompion, thus beginning a lifelong friendship, severed only by the death of Tompion, in 1713. In 1720 Graham removed from Tompion's old premises to the Dial and One Crown, opposite the Bolt and Tun, Fleet Street, and resided till his decease in the rooms over his shop. The quaint little shop had two plain bowed windows, with the doorway between them, and with but little alteration in appearance remained as a watchmaker's for many years, being occupied first by Mudge, who succeeded Graham, then by Mudge and Dutton, and afterwards by the younger Duttons. It is No. 148, and now the offices of the *Sporting Life*. Graham was elected as a fellow of the Royal Society in 1720, and was chosen as a member of the council of that body in 1722. He contributed twenty-one papers on various subjects to the Philosophical Transactions.

After the expiration of Booth, Houghton, and Tompion's patent, Graham devoted some thought to the cylinder escapement, which in 1725 he modified to practically its present form, and introduced into some of his watches. Securing to himself the monopoly of any of his discoveries was foreign to his disposition.

The reputation which English horology acquired on the Continent during the eighteenth century was due in no small measure to Graham's candid treatment of his brethren in the art in other countries. In answer to inquiries, Julien Le Roy received from Graham one of his cylinder escapement watches in 1728, and the French horologist's generous acknowledgment of its superiority is worthy of his acknowledged greatness. But it must be admitted, after examination of surviving specimens, that the wheel teeth in Graham's cylinder escapement had too much shake in the cylinder, and were wanting in the necessary closeness of construction afterwards attained by Ellicott and others; and as Graham continued to use the verge escapement till his death, it may be assumed that he was not oblivious of the constructional difficulties presented by the cylinder. In his younger days he would undoubtedly have pursued the matter with his usual acumen and patience, till nothing was left for later artists to improve; but now his mind was taken up with astronomy and astronomical instruments, and the production of a perfect clock as an aid to the astronomer absorbed him, as I venture to suggest, almost to the exclusion of horological instruments for the pocket.

In all Graham's work his first consideration was to make every part most suitable for its purpose. Judicious embellishment in its proper place was not wanting, but it was quite subsidiary to usefulness. This trait is apparent in many little details of a splendid repeating watch I have, and which was made by him in 1714, when he was in the zenith of his power as a watchmaker. Thus the pillars are of a plain cylindrical form with turned bases and caps, whereas Tompion before, and Ellicott, Mudge, and other distinguished horologists after him, were lavish in shaping, decorating, and piercing these passive items, whose characteristic of strength and holding power was certainly not less apparent by Graham's more simple treatment. A little addition I have not noticed in the watches of any other maker, is a light spring jumper or click on the under side of the cap, for securely locking the cap spring.

Attached to this repeater is also a useful little adjunct which appears to have been invented by Graham, which, though not much seen in English work, became very popular with French makers. Projecting from the case is a small nib, or "pulse piece," called by the French *sourdine*, or "deaf piece," which upon being pressed keeps the hammer off the bell and receives each blow. It not only enables those who have defective hearing or sight to ascertain the time by touch, but persons whose organs are perfect, who may desire to know the hour at night without disturbing an adjacent sleeper, can do so by pressing the pulse piece and counting the beats.

Graham used stout proportionate-looking bows for his watch

FIG. 52.—George Graham, 1673–1751.

cases in place of the thin wiry rings heretofore in vogue, but by a curious obliquity Ellicott seems to have reverted to the former style. The difference in the two "handles" is very marked in specimens of the two makers I have before me.

With the introduction of the pendulum, and more exact workmanship and consequent improvements in the performance of timekeepers, the errors arising from the expansion and contraction of metals in varying temperatures became manifest. Graham therefore turned his attention to the best means of preventing irregularity in the going of clocks when exposed to thermal changes. His paper, communicated to the Royal Society in 1726, on "A Contrivance to avoid Irregularities in a Clock's Motion by the Action of Heat and Cold upon the Pendulum," is so much to the point, that I am tempted to quote from the abridgment given in the Philosophical Transactions.

"Whereas several who have been curious in measuring of time, have taken notice that the vibrations of a pendulum are slower in summer than in winter, and have very justly supposed this alteration has proceeded from a change of length in the pendulum itself, by the influences of heat and cold upon it, in the different seasons of the year; with a view, therefore, of correcting, in some degree, this defect of the pendulum, I made several trials, about the year 1715, to discover whether there was any considerable difference of expansion between brass, steel, iron, copper, silver, etc., when exposed to the same degree of heat as nearly as I could determine, conceiving it would not be very difficult, by making use of two sorts of metals, differing considerably in their degrees of expansion and contraction, to remedy, in great measure, the irregularities to which common pendulums are subject. But although it is easily discoverable that all these metals suffer a sensible alteration of their dimensions by heat and cold, yet I found their differences in quantity from one another were so small, as gave me no hopes of succeeding this way, and made me leave off prosecuting this affair any further at that time. In the beginning of December, 1721, having occasion for an exact level, besides other materials I made trial of, quicksilver was one, which, although I found it was by no means proper for a level, yet the extraordinary degree of expansion that I observed in it when placed near the fire, beyond what I had conceived to be in so dense a fluid, immediately suggested to me the use that might be made of it by applying it to a pendulum. In a few days after I made the experiment, but with much too long a column of quicksilver, the clock going slower with an increase of cold, contrary to the common pendulum; however, it was a great confirmation of the advantage to be expected from it, since it was easy to shorten the column in any degree required. The only doubt I entertained was lest there should not be a proportional expansion and contraction between the quicksilver and the rod of the pendulum, through the various degrees of heat and cold, from the one extreme to the other. To make this experiment the more convincing, I placed a clock in a part of the house the most exposed of any to the changes of heat and cold—the room having no fire in it in the winter, and exposed to a south sun, with leads above it, which, in the summer, made it extremely hot. I hung a thermometer by it, and had likewise another clock at no greater distance from it than was necessary to keep the cases from touching one another. This clock, having a pendulum about 60 lbs. in weight, and not vibrating above $1\frac{1}{2}°$ from the perpendicular, and which, in a more temperate situation, had not altered above 12″ or 14″ in 24 hours, between winter and summer; but in this place it altered 30″ a day, between the hottest and coldest weather in the year 1722, a year no way remarkable for either extreme. But this great alteration was owing to the situation I mentioned above, and which I made choice of for the sake of making the experiment the more sensible. The two clocks being firmly screwed to a party wall, I began to make the first trial of this kind of pendulum, December 18, 1721, and by January 3 [1722], perceiving the pillar of quicksilver considerably too long, I procured a shorter glass, which I got ready by the 8th, and made use of until the beginning of June following, by which time I was well satisfied of the advantage of the contrivance, notwithstanding both these pendulums were but rudely executed, and this last had the pillar of quicksilver too short, but much nearer the true length than the first. This encouraged me to provide another glass a little longer than the last, and to bestow more care upon all the parts of the pendulum that required exactness. This being finished by the 9th of June, I began then to observe the motion of the clock by the transits of the fixed stars as often as the weather permitted, making use of a telescope which moved in the plane of the meridian: with this instrument I could be sure of not erring above two seconds in time. The clock was kept constantly going, without having either the hands or the pendulum altered, from the 9th of June, 1722, to the 14th of October, 1725, being three years and four months.

"For the first year I wrote down every day the difference between the two clocks, with the height of the thermometer, not omitting the transits of the stars as often as it was clear. The result of all the observations was this, that the irregularity of the clock with the quicksilver pendulum, compared with the transits of the stars, exceeded not, when greatest, a sixth part of that of the other clock with the common pendulum; but for the greatest part of the year, not above an eighth or ninth part; and even this quantity would have been lessened had the pillar of mercury been a little shorter, for it differed a little the contrary way from the other clock, going faster with heat, and slower with cold; but I made no alteration in length, to avoid an interruption of the observations. To confirm this experiment the more, about the beginning of July, 1723, I took off the heavy pendulum from the other clock and made another with quicksilver, but with this difference, that instead of a glass tube, I made one of brass, and varnished the inside to secure it from being injured by the mercury. This pendulum I have made use of ever since, and find it about the same degree of exactness as the other. The reason why this kind of pendulum is more exact than the common sort will be evident to any one who considers that as heat lengthens the rod of the pendulum, at the same time it increases the length of the pillar of quicksilver, and its centre of gravity is moved upwards; and when by cold the rod of the pendulum is shortened, the pillar of quicksilver is likewise shortened, and its centre of gravity carried downwards. By this means, if the column of quicksilver be of a proper length, the distance between the point of suspension and the centre of oscillation of the pendulum will be always nearly the same, upon which the exact motion of a clock principally depends. Were the pendulum of a clock to remain invariably of the same length, yet some little inequalities would appear in its motion, from the difference of friction arising from the imperfection of the materials, as well as different degrees of foulness, upon which account the force communicated to the pendulum would not be constantly equal, which would cause some small alteration. But when the pendulum is very heavy, and vibrates in a small arc, and the workmanship of all the parts is well performed, there will be very little inequality in the motion besides what proceeds from the heat and cold.

"In making use of quicksilver for a pendulum, by varying the diameter of the vessel that contains it, or the thickness of the rod of the pendulum, whether it be of brass or steel, they may be reduced nearly to an equality as to the receiving or retaining the impressions of heat or cold, upon which the greater regularity of the motion depends; and particular care ought to be used to free the mercury from all blebs of air, otherwise their great and sudden expansion or contraction may cause a considerable disorder; but the air may as easily be excluded in this as in a barometer, and the great specific gravity of quicksilver renders it a proper material for the weight of a pendulum."

The form of Graham's mercurial pendulum is shown in the sketch. *a* is the rod, *b* the stirrup containing the glass jar of mercury, *o*. For regulating the time, Graham employed a sliding weight, *d*, upon the rod, and this is the only particular in which his construction has been changed (see page 197).

Another of Graham's inventions applicable to clocks of precision, and which is still unsurpassed in the opinion of many leading horologists, is the dead-beat escapement.

Graham's mode of living was distinguished by its simplicity. As already stated, his latter years were chiefly occupied with astronomical work, which he carried on as the valued coadjutor of Halley and Bradley. It is stated that Graham married a daughter of Tompion's brother James, but Dr. Lonsdale speaks of him as having remained in single blessedness up till his death, which occurred in November, 1751. The grave of Tompion, in Westminster Abbey, was opened to receive his pupil, and the exceptional honour of their interment in that place is the best testimony that can be adduced as to the estimation in which these eminent horologists were held. On the next page is a reduced facsimile of the stone placed to mark their resting-place by an appreciative nation.

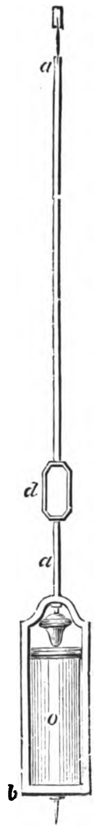


Fig. 53.

HERE LIES THE BODY
OF Mr. THO TOMPION
WHO DEPARTED THIS
LIFE THE 20TH OF
NOVEMBER 1713 IN THE
75TH. YEAR OF HIS AGE

ALSO THE BODY OF
GEORGE GRAHAM OF LONDON
WATCHMAKER AND F.R.S.
WHOSE CURIOUS INVENTIONS
DO HONOUR TO Ye BRITISH GENIUS
WHOSE ACCURATE PERFORMANCES
ARE Ye STANDARD OF MECHANIC SKILL
HE DIED Ye XVI OF NOVEMBER MDCCLI
IN THE LXXVIII YEAR OF HIS AGE

At the beginning of the present century this slab was removed, and small lozenge-shaped stones, with the name and date, as in the sketch on p. 97, were substituted. In a little work, "Time and Timekeepers," published in 1842, Adam Thomson, a Bond Street watchmaker, wrote: "Who would suppose that a small lozenge-shaped bit of marble is all that is left to indicate where lie the bodies of the 'Father of Clockmakers,' Thomas Tompion, and Honest George Graham, greater benefactors to mankind than thousands whose sculptured arms impudently emblazon merits that never existed?" To this outspoken, indignant protest, and the good feeling of the late Dean Stanley, is due the reinstatement of the original memorial, for which English horologists will be ever grateful. "The passage was pointed out to me by a friend," said the Dean, "in consequence of the strong irritation expressed on the subject by an obscure watchmaker in a provincial town. The gravestone had not been destroyed, and was restored in 1866." Let future generations of clock and watchmakers jealously guard this tribute to the worth of their fellow craftsmen against any further attempt at desecration.

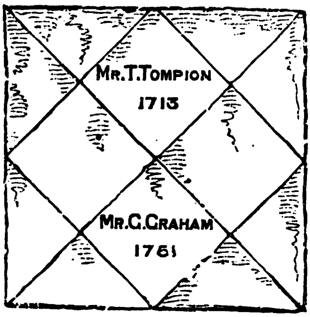


FIG. 54.

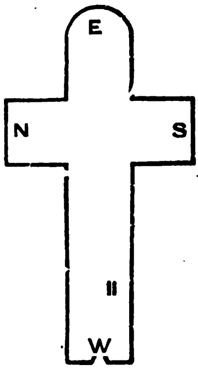


FIG. 55.

The position of the tomb is marked by the two parallel lines on the accompanying plan of the cathedral. E is the altar floor; W the nave and western entrance; N, north transept; S, south transept and poets' corner.

Daniel Quare. This worthy contemporary of Tompion was born in 1632, and carried on business at the Plow and Harrow in Cornhill.

About 1680 he produced repeating watches of his own design, and when the Rev. Edward Barlow, in 1687, made application to patent his own repeating device, Quare successfully opposed the monopoly sought for by his rival. In Quare's arrangement one pressure at the pendant sufficed to sound the hour and the quarters, while Barlow's required a distinct action for each.

The king, after a trial of each of the repeating watches, gave the preference to that of Quare, which fact was notified in the *Gazette*. Quare afterwards made for William III. a highly finished repeating watch, which, in 1823, was in the possession of John Stanton, of Benwell, near Newcastle-upon-Tyne, who gave a description of it: "The outer case, of 22-carat gold, is embossed with the king's head in a medallion. The dial is of gold, with black Roman numerals for the hours, and figures for the minutes. In the centre is a piece of pierced work in gold upon blue steel, representing the letters J.R. R.J. combined so as to appear like an ornamental scroll, above which is the royal crown. The box is pierced with scroll-work intermixed with birds and flowers. About the joint is engraved a landscape. On the back of the box two circular lines are drawn, between which is the following inscription: 'James II. gloria Deo in excelsis sine pretio redimi mini malâ lege ablatun bno. Regi restituitur.' The watch is considerably thicker than, but otherwise not much above, the common size."

Quare, in 1695, patented a portable weather-glass.

There is in the British Museum a small lantern alarum clock of his make, which has, above the bell, a perforated dome surmounted by a handle for carrying.

As splendid specimens of Quare's later work, may be mentioned one-year clocks, of which he made three or four. One of them is at Buckingham Palace; another was at Hampton Court Palace. Twenty-two years ago one of them was in the possession of Mr. J. H. Arkwright, of Hampton Court, near Leominster, where it probably is still. Many stories have been told of the structure of this remarkable production, and in 1873 I obtained the following very precise details concerning it from Mr. Palmer, a clockmaker of Leominster.

The hands are of steel, and blued; the hour hand, beautifully pierced, fits tight on to the hour socket with a square; the minute hand is pinned on to a square with a collet as usual; it has a counterpoise, and is not so elaborately pierced as the hour hand. The dial is of brass and silver, it is 14 in. square, and is an excellent specimen of the old style of work. The centre is matted and gilt, the mandrels are also gilt, but left plain to show up the silver fretwork corner pieces. The hour circle is brass, silvered; it is divided into minutes on the outside and into quarters of hours on the inside. The name "Dan Quare" is engraved between the hour figures 7 and 6, and "London" is engraved between the 6 and the 5. On the dial-plate itself, and just below the figure 6, the name is again engraved in full, "Daniel Quare, London." The numbers of the teeth of the 6 wheels in the train are as follows :—

Great wheel	... ...	96 teeth.	
First „	... ...	96 „	pinion 12 leaves.
Second „	... ...	90 „	„ 10 „
Centre „	... ...	60 „	„ 10 „
Third „	... ...	56 „	„ 8 „
Swing „	... ...	30 „	„ 7 „

The minute wheels are both cut 36 ; the teeth are well shaped and very regular ; the minute pinion has 6 leaves ; the hour wheel has 72 teeth, and it is keyed on to the hour socket.

The centre, third, and swing wheels are very small and light, the diameter of the last-named is $\frac{7}{8}$ in., the pivots also are very small. These three pinion arbors are an inch shorter than the other arbors of the train, and are pivoted into a small false plate which is pinned by four small pillars on to the inside of the large pillar plate. The collets on which these three wheels are mounted are either braised or driven on to the pinion arbors. The third and swing wheel pinions are thickest at the collet, and taper off with a gentle curve to the head of the pinion, thus giving the appearance of the greatest strength with least material. The same also with the smaller wheels—they are thickest in the middle.

The frame plates and 6 pillars are no larger nor heavier than those of many a modern regulator, the plates are 7 in. by 5 in., and the length of the pillars is $2\frac{3}{4}$ in.; they are riveted into the back plate, and the front plate is kept on by pins. The pallets are of the original anchor form.

The seconds pendulum has a lenticular bob, and altogether weighs 2 lbs. $1\frac{1}{2}$ oz. It is suspended from the same cock that carries the back pivot of the verge.

The suspension spring is $2\frac{1}{4}$ in. long, narrow, and very thin. There is no degree plate, but a brass finger projecting from the base of the case is filed to an edge just below the pendulum, and serves to estimate the vibration (which is about 1° on each side of zero), and also to set the clock in beat when fixing it. The case is of oak, handsomely veneered with walnut.

The barrel has 14 grooves. The clock weight and pulley weigh 81 lbs.; the fall is 4 ft. 6 in.; the length of the weight and pulley is 1 ft. 6 in., which, added to the fall, makes 6 ft., which is the distance from the bottom of the clock case up to the seat board; the weight is hung by a double line.

On casting up the numbers of the train it will be found to go 403 days, 4 hours, and 24 minutes.

Now, I cannot help thinking this is a very extraordinary achievement. It is true that the pendulum is light, and that, unlike Tompion's clock at Bath, there are no other motions beyond the hour and minute hands, but for 81 lbs. × 4 ft. 6 in. to drive the clock for more than 13 months seems almost incredible; still I believe the facts are as I have stated them. There is no doubt that everything was done that was possible to economize the force. The very small and light swing wheel, the balanced minute hand, and the small shortened arbors with extra fine pivots, all conduce to the end in view.

Quare and Tompion are each credited with the invention of equation clocks, for showing the difference between mean and apparent time, which came into use about 1699.

Among other relics of Quare's genius may be mentioned a clock to show apparent solar time by suspending the pendulum from a lever which was actuated by an equation cam, so as to lengthen or shorten the pendulum each day as required.

Quare was one of the first English makers to apply the motion work for concentric minute hands. Clocks and watches of his make, with an hour hand only, are to be met with, as well as later examples with the additional index. He was admitted as a brother of the Clockmakers' Company in 1671, and served as master in 1708.

During the latter part of his career he took into partnership Edward Horsman, who had been apprenticed to him, and the business was carried on at the same address, under the title of Quare and Horsman.

Daniel Quare died in 1724, and was buried in the Quakers' ground at Bunhill Fields.

Fromanteel. Fromanteel, also spelt "Fromantel," "Fromantil," and "Fromenteele." Ahasuerus Fromanteel, *primus* of Dutch extraction, was a maker of steeple clocks at East Smithfield. In 1630 he was warned by the Blacksmiths' Company to bring in his certificate of seven years' service as apprentice. This he complied with, and was forthwith elected free of the company. On the incorporation of the clockmakers, he joined them. In 1656 he became restive under the somewhat inquisitorial proceedings of the court relating to his apprentices and to the antecedents of his workmen, and for a long period in the history of the guild his name appears in petitions and other documents, expressing disapproval of the management of the company, or as being called to account for infraction of its rules, some of which, it must be confessed, could not fail to be exasperating to a man with an extensive business, as Fromanteel appears to have had.

A second Ahasuerus Fromanteel appears on the list as free of the Clockmakers' Company in 1655.

A third Ahasuerus Fromanteel was, in 1663, on completion of his apprenticeship with Simon Bartram, admitted as a member of the Clockmakers' Company.

In 1663, also, John Fromanteel, who had been apprenticed to Thomas Loomes, was admitted to the freedom.

Then Abraham, son of Ahasuerus Fromanteel, was elected in 1680.

In 1658 proceedings were taken against Ahasuerus Fromanteel and his son Louis for keeping more apprentices than the regulations of the company allowed, so that there was a fairly large family of the Fromanteels in the clock trade at that period, and most of them seem to have been connected in business.

Beyond their squabbles with the Clockmakers' Company, there is a celebrity attaching to them as being the first to introduce the pendulum into England, the assumption being that one of the family had seen or heard of Huygens' clock in Holland, and brought it over to his relatives. However, their claim has been challenged on behalf of Richard Harris; and it has also been asserted that Dr. Hooke investigated the properties of the pendulum as a controller for timekeepers before Huygens applied it. However, there is evidence that the claim of the Fromanteels to its introduction from Holland, if not unanimously allowed, was accepted pretty generally at the time.

Under date November 1, 1660, Evelyn, in his Diary, writes, "I went with some of my relations to Court to show them his Maj[ties] cabinet and closet of rarities. . . . Here I saw . . . amongst the clocks one that showed the rising and setting of the sun in Y[e] Zodig, the sunn represented by a face and raies of gold upon an azure skie, observing Y[e] diurnal and annual motion rising and setting behind, and landscape of hills, the work of our famous Fromantel."

Again, under date May 3, 1661, Evelyn records that he "returned by Fromantel's, the famous clockmaker, to see some pendules."

The *Commonwealth Mercury* of Thursday, November 25, 1668, contains the following advertisement :—

"There is lately a way found out for making clocks that go exact, and keep equaller time than any now made without this regulator, examined and proved before his Highness the Lord Proctor, by such doctors whose knowledge and learning is without exception, and are not subject to alter by change of weather, as others are, and may be made to go a week, a month, or a year, with once winding up, as well as those that are wound up every day, and keep time as well, and is very excellent for all house clocks that go either with springs or weights; and also steeple clocks that are most subject to change of weather. Made by Ahasuerus Fromanteel, who made the first that were in England. You may have them at his house on the Bankside, in Mosses Alley, Southwark, and at the sign of Mere Maid, in Lothbury, near Bartholomew Lane end, London."

Mosses Alley, or Moses Alley, was a passage leading from the northern end of Bankside, Southwark, to Maid Lane.

The Mermaid in Lothbury was for over a century a noted shop for clocks. In 1650 Thomas Loomes, who was associated with the eldest Fromanteel in his attacks on the government of the Clockmakers' Company, and to whom John Fromanteel was apprenticed, resided there, and, after the time of Loomes, it was occupied by John Fromanteel. He was clearly a first-rate clockmaker, as will be gathered from a description, by Mr. Percy Webster, of a long-case clock of John Fromanteel's production.

"The style of the clock is from 1680 to 1690, and is distinguished by many ingenious contrivances and good work. The frame is large, having three trains, viz. going, striking, and ting-tang; the back plate is in one piece, but the top is composed of three separate plates, one for each train, held rigid by means of thirteen neatly turned pillars and two cross-braces. It has the old bolt and shutter maintaining power, and the escape wheel is no more than one inch in diameter, the pallets being recoil and very long in the arm, taking in nearly half the wheel. The pendulum is nearly 8 ft. long, reaching to the bottom of the case, and the regulating is effected by means of a large milled nut fixed above the pendulum cock, the spring rising and falling between chops in the same way as many modern English clocks. The striking at the hour is peculiar, there being four bells of different notes, the shape of Chinese gongs, and four hammers on one staff, consequently striking a chord at each blow. The fixing in case is firmly done by means of four shaped brass brackets gripping the two side cheeks of the case and screwed on the movement, thus dispensing with a seat board. It has a 10-in. square dial, which has originally been water-gilded in the old style, with the cherub corners that were no doubt adapted from the favourite design of Grinling Gibbons, and the earliest found on clock dials. The circle is silvered in the usual way, and on the plate below is engraved "Johannes Fromanteel, Londini fecit." It is evidently one of the first with the concentric minute hand, as each division is numbered individually from 1 to 60. The case is quaintly made of dark wood, with a number of small panels somewhat in the style of an old Dutch cabinet; there are spiral pillars each side of the dial, and it is characterized throughout by great luxury of execution."

Dr. Hooke. Robert Hooke was born at Freshwater, Isle of Wight, on July 18, 1635. As a youth he resided with Dr. Busby, head master of Westminster School. He entered Christ Church College, Oxford, in 1653, and there his genius soon attracted the notice of Dr. Wallis, whom he frequently assisted in his chemical operations. Dr. Wallis introduced Hooke to the Hon. Robert Boyle, who engaged him as an assistant in the mechanical and philosophical works he was then employed on.

Hooke took part in and wrote upon all the scientific questions of his time. Sir Isaac Newton styled him "The Considerer." On the institution of the Royal Society he became one of its fellows, was afterwards entrusted with the care of its Repository, and made Professor of Mechanics to that body. About the same period he was elected Professor of Geometry in Gresham College.

I have been unable to obtain any portrait of Hooke, but will quote the following description of him from Aubrey's "Lives of Eminent Men": "He is of middling stature, somewhat crooked, pale faced, and his face but little belowe, but his head is lardge; his eie is full and popping, and not quick; a grey eie. He has a delicate head of haire, browne, and of an excellent moist curle. He is and ever was very temperate and moderate in dyet, &c. As he is of prodigious inventive head, so he is a person of great vertue and goodness."

There is no reasonable doubt that Hooke invented the balance spring. He thoroughly investigated its properties about 1658, and propounded the whole theory in the sentence, "Ut tensio sic vis," meaning that the force is proportionate to the tension. Hooke proposed to patent his discovery, and, in his own words, "Sir Robert Moray drew me up the form of a patent, the principal part whereof, viz. the description of the watch, is his own handwriting, which I have yet by me; the discouragement I met with in the progress of this affair made me desist for that time." Several watches were made by Tompion under Hooke's supervision. One of the first to which the balance spring was applied Hooke presented to Dr. Wilkins, afterwards Bishop of Chester, about 1661.

The ultimate volute form of spring was evolved only after many experiments. Straight springs, and some in the form of a pothook, were among the earlier essays.

A watch, subsequently made for Charles II., was inscribed, "Robt. Hooke, inven: 1658. T. Tompion, fecit, 1675."

In 1660, Hooke devised a pendulum timekeeper for ascertaining the longitude at sea. This was tried in 1662, and he subsequently proposed a compensation pendulum in the form of a rhomboid, the outline being of steel, and the long horizontal diagonal of brass. This form, being wider than it was long, was considered to be impracticable. Troughton afterwards constructed a pendulum in which the rod was a series of small rhomboids arranged to compensate on Hooke's plan.

Hooke also invented the anchor escapement for clocks about 1675, and it is stated that he also devised a wheel-cutting engine. Among his conceptions for a marine timekeeper was one with two balances geared together, the idea being to avoid the effect of external motion. It is stated that this timekeeper had an escapement resembling the duplex.

Hooke seems to have been of a restless disposition. With him age brought an increased desire for new discoveries. No sooner was he satisfied of the feasibility of any project, than he left it, thus allowing others to perfect his discoveries. By an order of the Royal Society he was requested to give a full description of all the instruments which he had contrived, but ill health prevented him from performing it. During the last year of his life he was almost helpless. He died at Gresham College, March 3, 1703, and was buried at St. Helen's, Bishopsgate.

Christian Huygens. This distinguished Dutch mathematician was born at the Hague in 1629. Early in life he devoted his attention to the principles on which timekeepers were constructed, and in 1657 presented to the States of Holland a clock controlled by a pendulum. In 1665 his reputation induced Louis XIV. to invite him to Paris, in order to found a Royal Academy of Sciences there. In 1673 Huygens published his folio work, "Horologium Oscillatorium," from which the appended drawings of his clock are taken.

The upper part of the pendulum is a double cord hanging between two cycloidal cheeks, to give a cycloidal path to the bob. Fig. 57 give a better idea of this device, which was no doubt of advantage with the long arcs required by the verge escapement. Another feature of Huygens' clock is the maintaining power. P (Fig. 58) is the driving weight, supported by an endless cord passing over the pulley D attached to the great wheel, and also over the pulley H, which is provided with ratchet teeth and pivoted to the inside of the clock case. The cord *m* is pulled down to wind the clock, and the ratchet wheel H then runs under its click. So that while winding, as in going, one-half of P minus one-half of p is driving the clock. The pulleys D and H are spiked to prevent slipping of the cord.

This ingenious maintaining power is to be found in many eighteenth-century clocks. When applied to a clock with a striking train, the pulley with the ratchet is attached to the great wheel of the striking part, one weight thus serving to drive both trains. A chain is preferable to a cord, owing to the dust which

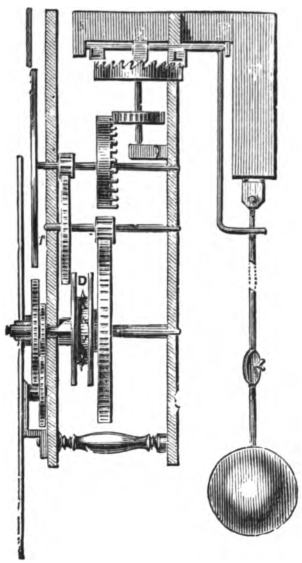


FIG. 56.

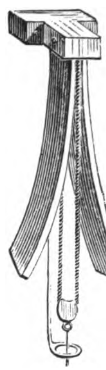


FIG. 57.

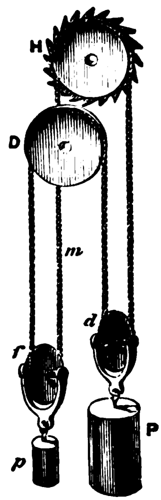


FIG. 58.

accumulates in the clock through the wearing of the latter. The drawback to the arrangement is that it is not suitable for clocks going for more than 30 hours between windings.

Huygens devoted much attention to the production of a timekeeper for ascertaining the longitude; and finding the pendulum too unstable at sea, he constructed a marine timekeeper controlled by a balance and balance spring. The balance, instead of being on the verge, was on a separate staff, and driven by a wheel and pinion, so as to vibrate through very long arcs; and this necessitated the use of a very long balance spring. Huygens endeavoured to obtain a patent for the application of the balance spring, but in this he was successfully opposed by the Abbé Hauteville, who alleged a prior use of springs for the purpose. The marine timekeeper was not a complete success, for Huygens found himself baffled by the error in changes of temperature. He returned to Holland in 1681, and died in 1695.

An exceedingly well-made clock, exactly corresponding to Huygens' drawing, is in the possession of Mr. Percy Webster. It bears the inscription, "Johanne Van Ceulen, fecit, Hagæ," and has a very handsome gilt skeleton dial, upheld by a figure of Time. This clock suggests the possibility of Huygens and Van Ceulen being associated in Holland as were Barlow and Tompion in England.

John Ellicott. John Ellicott was born in 1700. His father was a clock and watch maker. His grandfather, who was a native of Bodmin, in Cornwall, settled in London at the time of the formation of the Bank of England.

John Ellicott, about 1728, established himself in business at Sweeting's Alley, situated just where the statue of Rowland Hill now stands, near the Royal Exchange. Sweeting's Alley was not rebuilt after the fire which destroyed the old Royal Exchange in 1838. Ellicott had a house at Hackney. He was elected a fellow of the Royal Society in 1738. Amongst the eminent men who recommended him for that honour were Sir Hans Sloane, Bart., Martin Ffolkes, John Senex, the celebrated globe maker, and John Hadley, the astronomer.

Ellicott was the inventor of a compensation pendulum in which the bob rests on the longer ends of two levers, of which the shorter ends are depressed by the superior expansion of a brass bar attached to the pendulum rod. In Fig. 59 *a* is the suspension spring ; *s s s* screws for uniting the steel rod to the brass bar, slotted holes in the latter allowing it to move freely in answer to changes of temperature ; *f f* the two levers pivoted to the steel rod ; on the shorter ends rests the brass bar ; the screws *g g* pass through the pendulum bob C C, and rest on the longer ends of the levers. By turning the screws their bearing on the levers may be adjusted. This device has not proved to be of much practical value, although there is a clock to which it is attached still going at the London Institution, Finsbury Circus.

Ellicott's productions were distinguished by excellent workmanship. He paid great attention to the cylinder escapement, and did much to bring it into use. In some of his later examples the cylinders were of ruby. His more costly watches were lavishly decorated, the cases in *repoussé*, and the dials enamelled on gold, some of these being really works of art. They are now rarely to be met with, as the iconoclastic dealer as a rule ruthlessly changes the dial for one of cheaper material. In reference to the prices Ellicott obtained, it may be mentioned that Horace Walpole, writing to Sir H. Mann at Florence, on June 8, 1729, with regard to a commission to purchase a watch, states that for one of Ellicott's the price was 150 guineas.

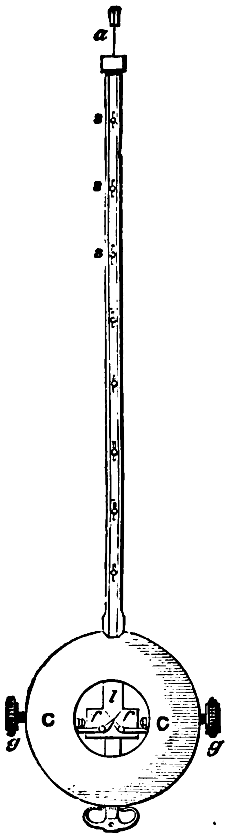


FIG. 59.

Ellicott was on the council of the Royal Society for three years, and read several papers before the Society. They included one on the "Influence which two Pendulum Clocks were observed to have on each other." The ball of each pendulum weighed above 23 lbs.; the cases were placed sideways to each other, so near that the pendulums when at rest were little more than two feet asunder. In less than two hours after they were set going, one of them, called No. 1, always stopped. As it had always kept going with great freedom before the other regulator, No. 2, was placed near it, Ellicott conceived its stopping must be owing to some influence the motion of one of the pendulums had upon the other; and upon watching them narrowly, the motion of No. 2 was found to increase as No. 1 diminished. At the time No. 1 stopped, No. 2 described an arc of 5°, being nearly 2° more than it would have done if the other had not been near it, and more than it moved in a short time after the other pendulum came to rest. On this he stopped the pendulum of No. 2, and set No. 1 going, the pendulum describing as large an arc as the case would admit, viz. about 5° ; he presently found the pendulum of No. 2 begin to move, and the motion to increase gradually, till in 17 min. 40 sec. it described an arc of 2° 10′, at which the wheel discharging itself off the pallets the regulator went, the arcs of the vibra-

FIG. 60.—John Ellicott, 1700–1772.

tions continued to increase till, as in the former experiment, the pendulum moved 5°, the motion of the pendulum of No. 1 gradually decreasing as the other increased, and in 45 minutes it stopped. He then left the pendulum of No. 1 at rest, and set No. 2 going, making it also describe an arc of 5° ; it continued to vibrate less and less till it described but about 3°, in which arc it continued to move ; the pendulum of No. 1 seemed but little affected by the motion of No. 2. Ellicott's explanation was that, as the pendulums were very heavy, either of them set going communicated a slight motion to the case and in a lesser degree to whatever the case touched. Ellicott's experiment was useful as showing the necessity of fixing clocks with heavy pendulums to the wall of a building or other ponderous and unyielding structure.

Ellicott designed several of our public clocks, amongst them that of the London Hospital, and was appointed clockmaker to the king. He died suddenly, in 1772, having dropped from his chair and instantly expired. The accompanying likeness (Fig. 60) is from a fine portrait of him by Dance, afterwards Sir Nathaniel Holland. He was succeeded in business by his son Edward, and he in turn by his son, who, however, had a better liking for other pursuits, and retired in 1795.

Henry Sully. This talented but unfortunate horologist was apprenticed to Charles Gretton in 1697. On the completion of his apprenticeship he travelled over the Continent, visiting Holland and Austria. From Vienna he went to Paris with the Duke d'Aremberg, where he made the acquaintance of Julien Le Roy, Law the noted Scottish speculator, and others. Law commissioned Sully to go to London and engage sixty watch and clock makers,who, with their families, were located at Versailles, where a factory was started. After two years Sully was displaced. Shortly after, under the protection of the Duke de Noailles, another factory was established at St. Germains. This lasted but a year, when Sully returned to England, bringing his staff of workpeople with him. The same ill fortune dogged his steps here, and in his extremity he returned to Paris, where for a time he sustained existence by repairing watches. When a little more prosperous, he, in 1721, turned his attention to the production of a marine timekeeper, and in 1724 presented it to the Academy of Sciences. This instrument had a modification of Debaufre's escapement, which Sully devised for the purpose, and a vertical balance which was really a pendulum. It carried cycloidal metal pieces, around which the upper end of a slender wire was wound, the lower end being attached to a lever with an adjustable weight, with the idea of keeping the vibrations of the balance isochronous. The pivots of the balance, instead of being in holes, were supported on the edges of large rollers, to diminish the friction, a device adopted afterwards by Mudge. In 1726 Sully published

"Abrégée d'une Horologe d'une Nouville Invention pour la Juste Mesure du Temps sur Mer." But when subjected to the tossing of the ocean, his timekeeper failed to yield the results anticipated from its performance on land. Though mortified by his failure, he again set himself to the solution of the problem. He had already made a marine watch with two balances geared together, as designed by Dr. Hooke. He now proceeded with a new timekeeper of different construction. While engaged thereon he was seized with a serious illness, induced by over application and worry, and he succumbed to inflammation of the lungs, in 1728.

In the Guildhall Museum is a timekeeper with Sully's curious vertical balance. It is in the form of a bracket clock with a walnut bell-top case, has a seconds hand above the centre of the dial, and shows the days of the month through a slit below the centre. It is inscribed "Henricus Sully, invenit et fecit (1724), Horologer to the Duke of Orleans."

Equation Clock by Enderlin. To meet the perplexity caused by the fact that sun-dials recorded true solar time and clocks mean solar time, as explained on p. 2, equation dials to indicate the difference each day were added in the latter part of the seventeenth century. Figs. 61 and 62 are drawings of an early specimen by Enderlin, which gives, in addition to true and mean solar time, a perpetual day of the month, the sun's place in the zodiac, his rising and setting, and the moon's age and phases.

Fig. 61 is the dial work, and Fig. 62 the dial itself. In Fig. 61 the wheel Q, of 24 teeth, takes its motion from the striking part. It impels the wheel R, of 32 teeth, with a vertical arbor, which has a bend and compound joint T. This arbor has an endless screw, S, in the middle of the inclined half, turning a wheel A, of 487 teeth, and also a pinion *a*, of 24 leaves, actuating a wheel V, of 32 teeth. This last wheel revolves in 24 hours, *a* in 18 hours, and with it the arbor R T S *a*. Q revolves in 13 hours 30 minutes, and A in 8760 hours, or 365 days 6 hours, whence it is called the annual wheel. The wheel X, with 62 inclined teeth, and the wheel Z, with 90 teeth, revolve separately round one common centre 5, Z being in front. X is impelled by a tooth or pallet on the 24 hours arbor of the wheel V, and Z by an endless screw Y. This screw has a pinion 6, of 21 leaves, upon its upper end, and, impelled by the pinion *a*, turns Z in 59 days 1 hour 30 minutes, being the sum of two lunations. The wheel X is impelled one tooth every 24 hours, therefore an entire revolution would be performed in 62 days; but it does not, in fact, make more than one-half of a revolution when it jumps back to its original situation.

Into the plane of the annual wheel A are inserted 12 pins, at

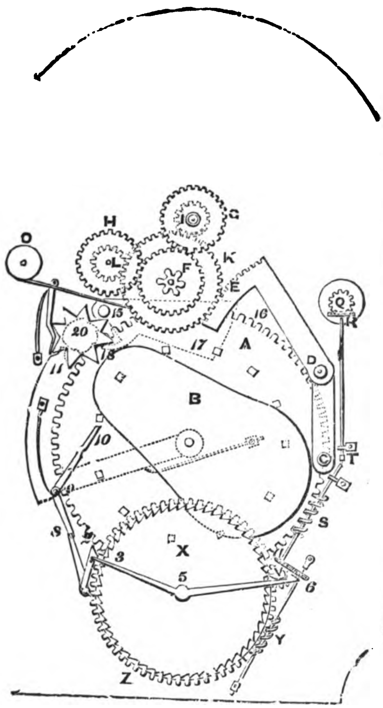


Fig. 61.

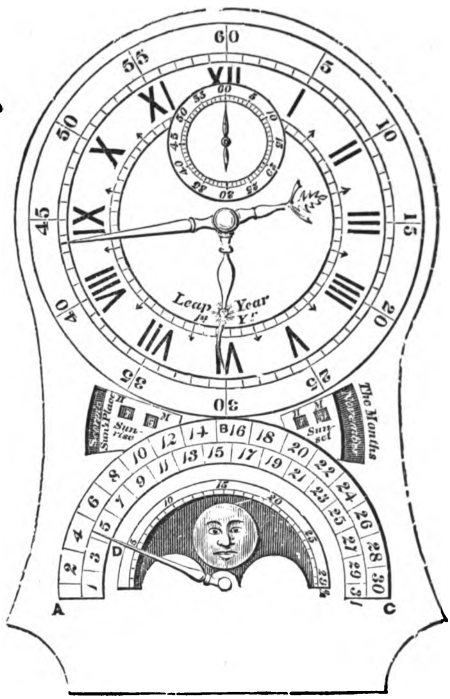


Fig. 62.

such distances from each other in a circle as correspond to the number of days in each month, the January space being 31 parts out of 365, the February space 28 parts, and so on. On the centre of the annual wheel is also fixed a cam B, which varies its radius of curvature as required to suit the equation of time. Round the centre 5 is movable the lever 5, 6, with a claw at

6 and a tail 5, 3, resting on a pin in the click 28. A second lever, 10, has also its tail resting by a pin at 8 on the tailpiece of the click, while the end 10 falls in the way of the month pins in the annual wheel, being kept up to them by means of a spring acting near the centre of its motion. The pallet at V gathers up a tooth of X every 24 hours, and the click 2 lays hold of it when past and keeps it till next day. This goes on till one of the month pins, meeting the end of the lever 10, depresses it; at the same time the tail of this lever pushes, by its pin, the tail 3 of the click back and releases the wheel X. This, having a spring coiled round its centre, jumps back to the place at which it was at first, and the hand D (Fig. 62), being fast to the wheel, returns with it and recommences its motion from A. The month semi-circle is divided into two, and numbered alternately on the inner and outer arcs, to avoid crowding of the figures. At D is an arc divided into $29\frac{1}{2}$ equal parts. The interior part is cut away, showing the moon in full phase as painted on the wheel Z, of 90 teeth. Over the figure of the moon is an index, and both are repeated at the opposite diameter of the wheel, so that one appears at the first division as soon as the other disappears at the end. The face of the annual wheel has engraved upon it the sun's place in the ecliptic, the names of the months, and the time of the sun's rising and setting for each day. These appear through apertures of the dial, shown by the blackened spaces.

When the wheel X has returned to its original position, the pallet at V goes on; and when it has made half a revolution, it touches the end of the lever 6, and discharges the tail 3 from the click 2, which falls back into the teeth of the wheel X, to perform its office until again disengaged at the end of the month. The annual wheel revolves in $365\frac{1}{4}$ days, therefore the fractional portion of a day will amount to unity every fourth year, and it will then be required that February should have 29 days. This is effected by a piece of brass 15, 16, 17, 18, shown by dots, being hidden behind the annual wheel. It is movable on the point 15, and has marked on the concealed flat part the four years successively—leap year, and the first, second, and third after, which are brought yearly in succession to an aperture in the dial above VI. in Fig. 62. This is effected by the star 20 with eight angular points. Two of these points are carried forward by pins in the annual wheel, one on the night of the last day in December, and the other on that of the last day in February. The star is kept in its place by the click or leg. A snail of four steps is fastened to the star, and regulates the position of the piece 15, 16, 17, 18, by supporting the end 18; thus the number 1, 2, 3, or leap year, will appear in the dial according as step 1, step 2, step 3, is presented to the projection 18 of the plate having the four years marked on its face. The piece 11 is movable on the centre of the annual wheel with a spring, pressing it so as to make it rest on a second snail behind the star. The lever 10 is pivoted to this rack, and is thus made to meet the pins, or recede from them, a space corresponding to one day, or more if required. The concealed snail, having a contrary spiral, removes the lever at the last day in February so far from the corresponding pin in the annual wheel that the hand D arrives at the 29th day before it is released, thus giving February 29 days once in four years.

The *Equation Movement.*—On the point D, in Fig. 61, the rack E moves its tail *c*, resting on the circumference of the equation curve. At *o* is a box with a spring, which keeps the cord 15 always stretched. This cord surrounds a pulley on the plane of a concealed wheel N, under K, but not attached to it. This wheel acts into the rack which is always resting on the equation curve. The pinion I, of 30 teeth, revolving in 60 minutes and carrying the minute hand, turns the wheel K, of 60, which drives a pinion L, of 30, also in 60 minutes. To L is attached a wheel H, of 48 teeth, which turns a similar wheel F, and this again a third similar wheel G, the tube of which surrounds the arbor of I, and carries the equation hand with a little sun on it pointing to 30, in Fig. 62. The wheel N, below K, is pinned to a bar, which is not seen, but which carries the wheel H and pinion L; and as the teeth of the rack are acting in the wheel N, the concealed bar moves alternately towards I and 15 as the radius of the equation cam varies. This motion makes the pinion L sometimes advance and sometimes retrogade a few teeth, independently of the motion it receives from the rotation of K; and this additional motion is also communicated to the wheel H in consequence of its connection with L, and hence to both F and G, the latter bearing the equation hand.

Altogether this is an interesting example of the mechanism of early complicated clocks. The perpetual calendar work is now done with more simplicity, as will be seen from a drawing given later on; and the equation indicator of Tompion's Bath clock, of which a detailed description is also given, is actuated in a more direct way, as will be seen from comparison.

John Harrison. John Harrison was born at Faulby, near Pontefract, in Yorkshire, in 1693. He was the son of a carpenter, which business he followed for several years of his life. In 1700, the family removed to Barrow, in Lincolnshire. At a very early age Harrison showed a great predilection for mechanical pursuits, and particularly directed his attention to the improvement of clocks.

One of his early efforts with wheels and pinions of wood is at the British Museum, and in the Guildhall Museum may be seen a very similar relic.

The offer, by Act of Parliament, of large sums for the production of a timekeeper sufficiently accurate to ascertain the longitude at sea, induced him to turn his attention to the subject of compensation for temperature, and he suceeeded in constructing a pendulum in which the effects of heat and cold in lengthening and shortening the pendulum were neutralized by the use of two metals, having different ratios of expansion. Harrison's pendulum, called the *gridiron*, will be illustrated under the head of Pendulum.

He then proceeded to devise an escapement for a longitude clock, and in 1728 he journeyed to London, taking with him his pendulum, his escapement, and drawings of his proposed timekeeper, hoping to obtain the approbation and aid of the Board of Longitude. Before, however, submitting them to the notice of that body, they were inspected by Graham, whose maturer advice was, to first make the timekeeper, and then ascertain, from its actual going, what claims it might have to further notice.

Harrison continued plodding on in the country, repairing watches and clocks, and making a variety of experiments, till his forty-second year, when in 1735 he came up to London with a timepiece he had invented and constructed. It was a cumbersome affair in a wooden frame, and had two balances. He obtained certificates of the excellence of his timekeeper from Halley, Graham, and others, and on their recommendation he was allowed, in 1736, to proceed with it to Lisbon in a king's ship, and was enabled to correct the reckoning to within 1° 30′.

On this result, the Board of Longitude gave him £500 "to proceed with his improvements." From this it appears that the performance of his first timekeeper failed to attain the precision required by that Board; for had it determined the longitude to a degree, Harrison would have been entitled to £10,000. The rewards were £20,000 for any invention which would determine the longitude to half a degree, £15,000 to two-thirds of a degree, £10,000 to a degree. In 1741 he finished another timekeeper, smaller than either of the preceding ones, and which appeared to the members of the Royal Society more simple, and less likely to be deranged; and in 1749 he received the gold medal which was annually awarded by the Royal Society to the most useful discovery.

Having improved and corrected this third chronometer, Harrison applied to the Commissioners of the Board of Longitude in order to obtain a trial according to the Act of Parliament. This, after much delay, was granted, and his son was allowed to take a voyage to Jamaica instead of himself. William Harrison embarked in the *Deptford*, at Portsmouth, on November 15, 1761. After 18 days' navigation the vessel was supposed to be in 13° 50′ west of Portsmouth by ordinary calculations, but the watch marked 15° 19′, and was at once condemned as useless. Harrison, however, maintained that if a certain island were correctly marked on the chart, it would be seen on the following day; and in this he persisted so strongly, that the captain was induced to continue in the same course, and accordingly the island was discovered the next day at seven o'clock. In like manner Harrison was enabled by his watch to announce all the islands in the order in which they would fall in with them. When he arrived at Port Royal, after a voyage of 81 days, the chronometer was found to be about nine seconds slow; and finally, on his return to Portsmouth, after a voyage of five months, it had kept time within about one minute five seconds, which gives an error of 18 miles. This was much within the limits of the 30 miles prescribed by the Act of 1714; yet, several objections being raised (chiefly, it is supposed, by Dr. Maskelyne, the Astronomer Royal, who gave preference to lunar observations), William Harrison was obliged to undertake a second voyage, the proof from the first not being considered sufficiently decisive by the Board, although they advanced £5000 on account of the reward.

William Harrison embarked on board the man-of-war *Tartar*, on March 28, 1764, and arrived in Barbadoes on the 13th of May, and the return to England is recorded on the 18th of September

Fig. 63.—John Harrison, 1693–1776.

the same year. In order to obviate any doubts as to the definition of correct longitude, or undue meddling with the correction of the instrument, Dr. Maskelyne defined the longitude of Barbadoes by observation of the eclipse by the transit of Jupiter before starting for Barbadoes; and the instrument was kept under three different locks and keys, one in care of Harrison, and the two others in the hands of the captain and the official of navigation on board. Whenever Harrison had occasion to observe the instrument, or to re-wind it, the two officers had to be present. The result of this second voyage was so satisfactory, that the Board unanimously declared that Harrison had really exceeded all expectations and demands of the Act of Parliament, and paid a further advance of £5000, with the condition that Harrison explained the construction of his timekeeper. A sub-committee, consisting of Maskelyne, John Mitchell, Ludlam, Bird, Mudge, Motheu, and Kendal, were appointed, and instructed to make themselves acquainted with the mechanism of the instrument. But even after the committee reported themselves satisfied, considerable delay occurred, and the final payment was not made to Harrison till 1769.

Harrison's timekeeper is in the form of a large silver pair-case watch, with a centre seconds hand. It is not in gymbals, but reposed on a soft cushion, and on its trial voyages was carefully tended by William Harrison, who avoided position errors as far as possible by shifting the timekeeper to suit the *lie* of the ship.

The plates are 3·8 in. in diameter, the balance 2·2 in. in diameter, the fusee makes $6\frac{1}{4}$ turns. The escapement beats five times in a second. The pivot holes are jewelled with rubies.

One of the chief features is a bimetallic arm fixed at one end, and carrying at its free end two pins, to embrace the balance spring near its outer point of attachment. "The thermometer kirb is composed of two thin plates of brass and steel riveted together in several places, which, by the greater expansion of brass than steel by heat, and contraction by cold, becomes convex on the brass side in hot weather, and convex on the steel side in cold weather; whence, one end being fixed, the other end obtains a motion corresponding with the changes of heat and cold, and the two pins at this end, between which the balance spring passes, and which it touches alternately as the spring bends and unbends itself, will shorten or lengthen the spring."

Harrison at first provided additional curb pins for mean time adjustment, but had to abandon them; for it is clear, if they were placed behind the pins on the compensation curb, they would not act, and, if placed in front, the movement of the temperature pins would be ineffective.

It is, of course, easy to be wise after the event; but, on examining the remontoire and escapement of Harrison's chronometer in the presence of the simple detent escapement introduced shortly after, it seems marvellous that Harrison should have spent so many years over such complicated and by comparison inefficient contrivances. Harrison's drawings are most difficult to understand, but I venture to reproduce some contributed to the *Horological Journal* by Mr. H. M. Frodsham, which were made

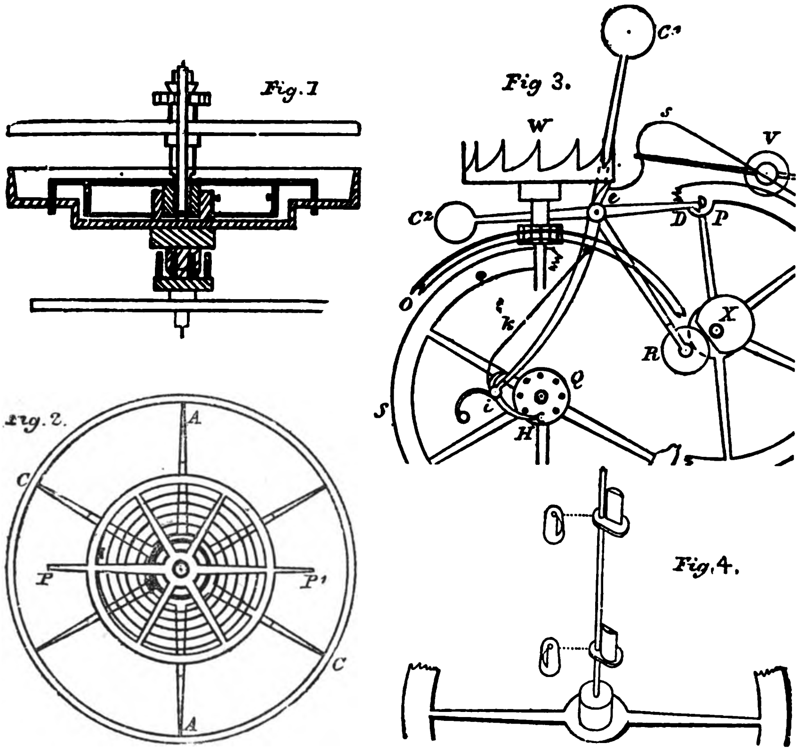


FIG. 64.—Harrison's remontoire escapement.

from Kendal's duplicate of Harrison's timekeeper at the Greenwich Observatory.

Fig. 1 is a section through the fourth wheel. Fig. 2 a plan of the remontoire and contrate wheel. Fig. 3 a plan of the remontoire and escapement. The pinion at the top of Fig. 1 is driven by internal teeth on the third wheel of the train. The wheel immediately below the pinion in Fig. 1 is the fourth wheel, which drives a pinion X (Fig. 3). The dished wheel below the fourth wheel in Fig. 1 is the contrate wheel (C Figs. 2 and 3). In the recess of the contrate wheel is contained the remontoire spring which is wound eight times in a minute. The wheel at the bottom of Fig. 1 is the seconds wheel. This and the contrate wheel move continuously, while the fourth wheel and the other part of the train are locked by the lever D catching the stop P on the wheel P X, except during the winding of the remontoire. On the collet of the contrate wheel are eight pins shown in Fig. 1, and at Q in Fig. 3. The eight pins in the contrate wheel in succession push the arm H (Fig. 3), and so unlock the train. The locking wheel P X drives a fly pinion and fly, V, to moderate the velocity with which the remontoire was wound. The seconds arbor is in the centre of the watch, and is driven by the seconds wheel below the contrate wheel. The projections P P′ on the barrel of the remontoire are to prevent the remontoire running down.

Fig. 4 shows the pallets, which, instead of forming an angle of 95° or so, as is usual, are set parallel to each other, and in this way there is very little recoil, but increased tendency, to set. These acting surfaces of the pallets are diamonds set in brass collets.

On Harrison's tomb in the south-west corner of Highgate churchyard is the following inscription :—

"In memory of Mr. John Harrison, late of Red Lion Square, London, inventor of the timekeeper for ascertaining the longitude at sea. He was born at Foulby, in the county of York, and was the son of a builder at that place, who brought him up to the same profession. Before he attained the age of twenty-one, he, without any instruction, employed himself in cleaning and repairing clocks and watches, and made a few of the former, chiefly of wood. At the age of twenty-five he employed his whole time in chronometrical improvements.

"He was the inventor of the gridiron pendulum and the method of preventing the effects of heat and cold upon timekeepers by two bars fixed together; he introduced the secondary spring to keep them going while winding up; and was the inventor of most (or all) the improvements in clocks and watches during his time. In the year 1735 his first timekeeper was sent to Lisbon, and in 1764 his then much-improved fourth timekeeper having been sent to Barbadoes, the Commissioners of Longitude certified that it had determined the longitude within one-third of half a degree of a great circle, having not erred more than forty seconds in time. After sixty years' close application to the above pursuits, he departed this life on the 24th day of March, 1776, aged seventy-three. This tombstone was put up many years after his death."

In 1878 the tomb had become very dilapidated, the inscription being barely decipherable, and I then suggested to Mr. W. H. Prosser that he should obtain subscriptions, and have it restored. This he proceeded to do; but on applying to the Clockmakers' Company they suggested the desirability of the matter being placed in their hands, and the restoration was accordingly made under their direction forthwith.

Pinchbeck. Among the celebrated clock and watch makers of the last century must be reckoned Christopher Pinchbeck, known principally as the discoverer of an alloy of metals, called after him *Pinchbeck*, and as an inventor of "Astronomico-Musical Clocks." He was born in, and resided at, Clerkenwell, in a turning out of St. John's Lane called Albion Place; but prior to 1822, when it was rebuilt, it was known as St. George's Court. From here he removed to Fleet Street, as is shown by the following advertisement which appeared in *Applebee's Weekly Journal* of July 18, 1721:—

"Notice is hereby given to Noblemen, Gentlemen, and Others, that Chr. Pinchbeck, Inventor and Maker of the famous Astronomico-Musical Clocks, is removed from St. Georges Court, St. Jones's Lane, to the sign of the Astronomico-Musical Clock in Fleet Street near the Leg Tavern. He maketh and selleth Watches of all sorts and Clocks, as well for the exact Indication of Time only, as Astronomical, for showing the various Motions and Phenomena of planets and fixed stars, solving at sight several Astronomical problems, besides all this a variety of Musical performances, and that to the greatest Nicety of Time and Tune with the usual graces; together with a wonderful imitation of several songs and Voices of an Aviary of Birds so natural that any who saw not the Instrument would be persuaded that it were in Reality what it only represents. He makes Musical Automata or Instruments of themselves to play exceeding well on the Flute, Flaggelet or Organ, Setts of Country dances, Minuets, Jiggs, and the Opera Tunes, or the most perfect imitation of the Aviary of Birds above mentioned, fit for the Diversion of those in places where a Musician is not at Hand. He makes also Organs performing of themselves Psalm Tunes with two, three, or more Voluntaries, very Convenient for Churches in remote Country Places where Organists cannot be had, or have sufficient Encouragement. And finally he mends Watches and Clocks in such sort that they will perform to an Exactness which possibly thro' a defect in finishing or other Accidents they formerly could not."

His reputation was world-wide, to judge from the appended extract from a letter of the period :—

"Mr. P. has finished a fine musical clock, said to be a most exquisite piece of workmanship, and worth about £1500, wch is to be sent over to ye King of France (Louis XIV.) and a fine organ to ye great Mogul, worth £300."

It is recorded that Pinchbeck exhibited his "astronomico-

FIG. 65.—Christopher Pinchbeck, 1670–1732.

musical clocks," together with a variety of curious automata at Bartholomew Fair. He also attended Southwark Fair, and with Fawkes, a celebrated juggler and conjurer of that day, had a united "show." This may shock many who avail themselves of the fine arts of advertising in vogue to-day; but, however undignified it may have been, it cannot detract from his ability as a horologist.

Pinchbeck gold was much used for watch cases and the like. It is an alloy of three parts of zinc to four of copper; but its composition was jealously guarded by the inventor, as the following will show.

"Mr. Xtopher Pinchbeck had a curious secret of new-invented metal wch so naturaly resembles gold (as not to be distinguished by the most experienced eye), in colour, smell, and ductibility. Ye secret is communicated to his son."

He died in 1732, at the age of 62 years.

Edward Pinchbeck, son of Christopher, succeeded his father in the business, as is evident from a "Caution to the Public" which he inserted in the *Daily Post* of July 9, 1733.

"To prevent for the future the gross imposition that is daily put upon the publick by a great number of shopkeepers, hawkers, and pedlars, in and about this town, Notice is hereby given, that the ingenious Mr. Edward Pinchbeck, at the Musical Clock, in Fleet Street, does not dispose of one grain of his curious metal, which so nearly resemble gold in colour, smell, and ductility, to any person whatsoever; nor are the toys made of the said metal sold by any one person in England except himself." After recounting the various articles he makes from the alloy, the notice continues: "And in particular watches, plain and chased in so curious a manner as not to be distinguished by the nicest eye from real gold, and which are highly necessary for gentlemen and ladies when they travel, with several other fine pieces of workmanship of any sort made by the best hands. The said Mr. Pinchbeck likewise makes astronomical and musical clocks; which new invented machines are so artfully contrived as to perform on several instruments great variety of musick composed by the most celebrated masters, with that exactitude, and in so beautiful a manner that scarce any hand can equal them. They likewise imitate the sweet harmony of birds to so great a perfection as not to be distinguished from nature itself. He also makes repeating and all other sorts of clocks and watches; particularly watches of a new invention, the mechanism of which is so simple, and the proportion so just, that come nearer truth than any others yet made."

In the *Gentleman's Magazine* of June, 1765, it is stated that Pinchbeck and Norton "had just set up at the Queen's House a new complicated clock. It had four dials, and amongst them it denoted clock and sun time, sunrise and setting for every day in the year in various places of the world, the Copernican motion of the planets, the ages and phases of the moon, high water at thirty-two different seaports, and the days of the week and the months of the year." But the fact is, there are two astronomical clocks at Buckingham Palace, one by Pinchbeck and one by Norton, and it is doubtful if they were ever in partnership. Each of these clocks has four dials, one on each face of the square case closely resembling the dials on the old clock in the South Kensington Museum, which is represented on p. 43. Pinchbeck's clock is the larger of the two, and has a handsome tortoiseshell case with silver spandrels at the corners of the dial.

At about this time there was in Cockspur Street a Christopher Pinchbeck, clockmaker to George III. In 1766 he is said to have bought from Ferdinand Berthoud for George III. the first pocket watch made with a compensation curb.

Thomas Mudge.

Thomas Mudge was born at Exeter, in 1715; his father was a clergyman, and kept a school at Bideford. Young Mudge showed great taste for mechanics, and his father, noticing his extraordinary inclination for horology, placed him, at the age of fourteen, as an apprentice with Graham. Mudge here made great and rapid progress in his art, and soon had confided to his charge many difficult and delicate pieces of workmanship. After Graham's death Mudge succeeded to his business, and at this time one of the best English watchmakers had been ordered by King Ferdinand the Sixth, of Spain, to obtain him an equation watch, and this artist had recourse to Mudge. King Ferdinand, who was a great amateur in mechanical works, hearing of this circumstance, sent an order direct to Mudge to construct for him any piece of work which he thought the most curious, and to charge for it whatever he choose. The artist constructed for this monarch a repeating watch, which showed true and apparent time, struck and repeated not only the hours and quarters, but the minutes also. The king set great store by this piece of workmanship, for which Mudge charged him 480 guineas. In 1750 he entered into partnership with Mr. Dutton, another apprentice of Graham's. In 1765 he published "Thoughts on the Means of Improving Watches, particularly those for Use at Sea," and in order to better bestow his attention on the making of chronometers, he quitted London in 1771, and went to reside at Plymouth, where he was for many years occupied in constructing his first chronometer, which was sent to Greenwich Observatory, and afterwards to Baron Zach (who was astronomer to the Duke of Gotha), and lastly to Admiral Campbell, who took it a voyage to Newfoundland, when its performance was pro-

FIG. 66.—Thomas Mudge, 1715–1794.

nounced to be satisfactory. The Board of Longitude sent him £500, requesting him to continue his researches.

Dr. Maskelyne and Mudge could not agree. Maskelyne, who was Astronomer Royal, carried the Board of Longitude with him. It was asserted that chronometers of Arnold's performed better than those of Mudge. Arnold had not submitted his chronometers for the Government reward, and therefore Mudge objected to the comparison. On the petition of Mudge, the House of Commons, in 1791, appointed a committee to investigate the performance of Mudge's chronometers, the Bishop of St. David's, Mr. Atwood, Mr. D. Luc, Mr. Ramsden, Mr. Edward Troughton, Mr. Holmes, Mr. Haley, and Mr. Howells, the three last-named being watchmakers. After much bickering, Mudge, in 1793, was paid £2500, in addition to £500 he had already received as encouragement, although the Board of Longitude dissented from the course.

Mudge invented the lever escapement about 1765, but it appears only constructed two watches on this principle: one for Queen Charlotte, which performed admirably, the other for Count Bruhl, which, after several journeys, subjected to all the inconveniences of changes of position and quick travelling, kept time within a few seconds during several weeks. Mudge showed this escapement to Berthoud, when he was in London in 1766, but he did not think so favourably of it as Margetts, Emery, and other English horologists did. Mudge was in 1777 named the king's clockmaker by George III., who often employed him on delicate pieces of work.

Mudge died, at his son's house in Walworth, on November 14, 1794.

Mudge junior engaged Messrs. Howells, Barraud, and Jamison to produce chronometers on his father's plan; but they were too costly, and not successful. One of these instruments is in the Horological Institute and another at the Guildhall Museum.

That an accomplished horologist and sound mechanic as Mudge seems to have been should, after his invention of the lever escapement, have persisted in the complication of a remontoire and vertical escapement for his marine timekeepers, must be ascribed to the perversity of genius.

The salient features of his chronometer are shown in the accompanying drawings. To obviate the difficulty of the compensating curb action interfering with the action of the regulating curb pins there are two balance springs. The upper one for regulating has its stud C screwed to the balance cock, the stud D of the lower spring, with which the pins of the compensation curb engage, being fixed to the upper plate of the chronometer. There are two *remontoire* springs, H and I, which are wound by the escape wheel G, and which alternately impel the balance through the pins *a*, *b*, connected with the upper, and *e*, *f* with the lower one. The wheel and pallet actions will be understood from an examination of the lower figure, which is a plan. After the wheel tooth has given impulse to the pallet, and thereby wound the remontoire, it is locked on the projecting nib of the pallet till the balance in its excursion unlocks it, and allows the tooth on the

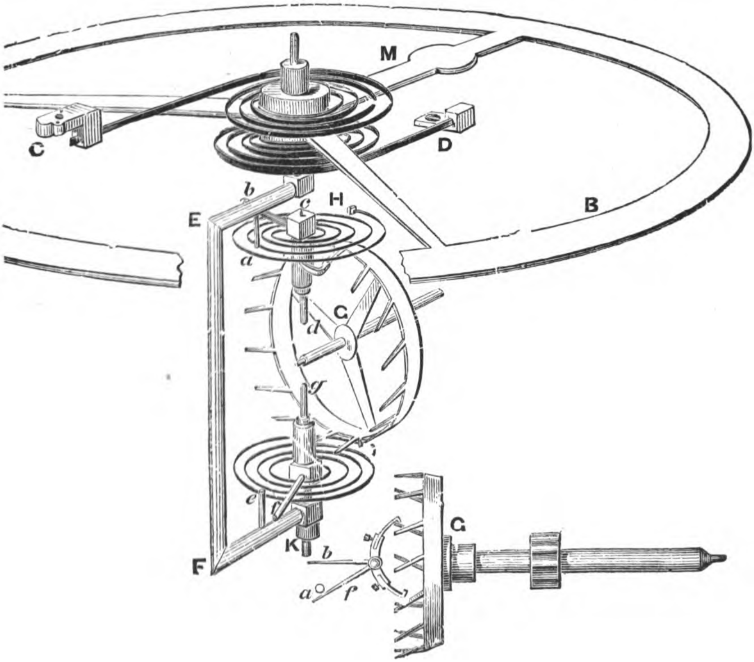


FIG. 67.—Mudge's remontoire.

opposite side of the wheel to impel the other pallet. The balance staff is cranked, and the pallets with the remontoires are pivoted partly in the balance staff and partly in separate cocks, so that there are six pivots moving from the balance staff centre.

John Arnold. This famous horologist was born in 1734, at Bodmin, in Cornwall, where he was apprenticed to his father, a watchmaker. While a youth he left home, and after a stay of some time in Holland, he determined to try his fortune in London. At first he worked as a journeyman, but soon found an opportunity of establishing himself at Devereux Court, Fleet Street. One of his earliest acts here was to make an exceedingly small half-quarter repeating watch, which he had set in a ring and presented to his Majesty George III. in 1764. When it is stated that the whole movement measured but little more than one-third of an inch across, his ability as a fine workman and his marvellous sense of touch will be appreciated.* The escapement selected was a cylinder one, the cylinder, made of ruby and measuring one fifty-fourth of an inch in diameter, being the first one made of that material. The king accepted the repeater, and in return presented the clever watchmaker with five hundred guineas as an acknowledgment of his surpassing skill.

Arnold's achievement at once brought him into notice, and from that time his future success was assured.

It is said that the Emperor of Russia offered Arnold a thousand guineas for a duplicate of the repeater made for George III., but the offer was declined, not that Arnold doubted his ability to produce it, but because he desired the miniature timekeeper to remain unique.

Arnold now turned his attention seriously to the problem which was engaging the thoughts of leading horologists here and in France. John Harrison had already fulfilled the conditions laid down by the Board of Longitude, and thus practically secured the £20,000 offered by Parliament in 1714 for a timekeeper sufficiently exact to ascertain the longitude within certain limits.

* According to the *Annual Register* for 1764, the whole of this repeater, composed of 120 parts, weighed but 5 dwts. $7\frac{3}{4}$ gr., the following being the weight of the principal items: The movement, complete, is 2 dwts. $2\frac{1}{8}$ gr.; great wheel and fuzee, $2\frac{3}{4}$ gr.; second wheel and pinion, $\frac{3}{4}$ gr.; barrel and mainspring, $3\frac{1}{2}$ gr.; third wheel and pinion, $\frac{1}{9}$ gr.; fourth wheel and pinion, $\frac{1}{10}$ gr.; cylinder, wheel, and pinion, $\frac{1}{16}$ gr.; balance spring, cylinder, and collet, $\frac{2}{3}$ gr.; the balance spring, $\frac{1}{300}$ gr.; the chain, $\frac{1}{2}$ gr.; barrel and mainspring, $1\frac{3}{4}$ gr.; great wheel and ratchet, 1 gr.; second wheel and pinion, $\frac{1}{7}$ gr.; third wheel and pinion, $\frac{1}{8}$ gr.; fourth wheel and pinion, $\frac{1}{9}$ gr.; fly-wheel and pinion, $\frac{1}{17}$ gr.; fly pinion, $\frac{1}{20}$ gr.; hour hammer, $\frac{1}{2}$ gr.; quarter hammer, $\frac{1}{2}$ gr.; rack, chain, and pulley, $1\frac{1}{3}$ gr.; quarter and half-quarter rack, $\frac{2}{3}$ gr.; the quarter and half-quarter snail and cannon pinion, $\frac{2}{3}$ gr.; the all-or-nothing piece, $\frac{1}{2}$ gr.; two motion wheels, 1 gr.; steel dial-plate with gold figures, $3\frac{1}{2}$ gr.; the hour snail and star, $\frac{1}{2}$ and $\frac{1}{16}$ gr.

A subsequent Act of Parliament, however, devoted a further £10,000 as a stimulus to continued research and improvement. Mudge was already in the field, and seemed bent on adhering to the remontoire principle somewhat on Harrison's plan. But it was clear to other minds that a nearer approach to perfection might be attained by a chronometer of altogether a different construction to the one invented by Harrison.

One of Arnold's first essays was a chronometer which Captain Cook took with him in the *Resolution* on his second voyage, in 1772. Two other timekeepers of Arnold's were on board the *Adventure*. Mr. J. U. Poole, who has examined these early examples, two of which are the property of the Royal Society, states that they have plain circular balances with flat balance springs acted on by a compensation curb; the escapements are a compound of the lever and the spring-detent, and they beat half-seconds, the workmanship being very rough compared with the finish exacted in the present day. It seems certain that a timekeeper of Larcum Kendal, which was also carried on the *Resolution*, performed better than those of Arnold did.

Arnold was not to be daunted. He profited by experience, and devised the helical form of balance spring, and a form of compensation balance. The spring, as shown in the sketch, is very similar to the one now in most general use for marine chronometers, but the balance was rather a complicated affair. These components he patented in 1775 (Patent No. 1113), and his specification describes compensation to be effected by a brass and steel volute fixed at its inner end to the collet of the balance, and actuating weighted rods by means of a lever attached to its outer end. Some years later he adopted the simple circular bimetallic-rim balance practically as now used, except that he soldered the brass and steel together and formed the circular rim with pliers, whereas Earnshaw first turned a steel disc and then melted the brass on to its periphery in the way that has survived.

Fig. 68.

In May, 1782, Arnold patented his improved detent escapement (Patent No. 1328). This is practically the chronometer escapement of to-day, which was almost simultaneously invented by

Thomas Earnshaw, except that in Arnold's escapement the escape wheel teeth, instead of being flat where they gave impulse, were epicycloidal curves, as shown in Fig. 69; but they required oiling, and were consequently abandoned. While Earnshaw's wheel is locked on the points of the teeth and the detent moves away from the centre of the wheel to unlock, Arnold's locked on the heel of the tooth and the detent moved towards the centre of

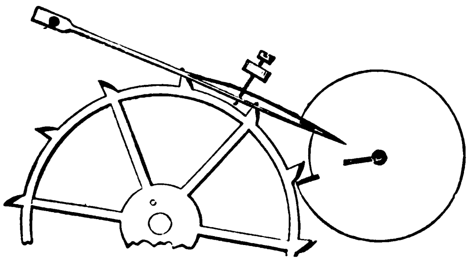


FIG. 69.

the wheel to unlock, the sunk part of the body of the wheel allowing the locking stone to pass.

Arnold was now admitted to be a very successful chronometer maker, but he still continued his investigations, and made countless experiments with a view to improvements. He constructed compensation balances of various materials. Among others may be mentioned balances insensible to the influence of magnetism, which were composed of platinum and silver laminæ.

About 1778 Arnold removed to 112, Cornhill, where the business was carried on until his death, his son being admitted into partnership during the latter part of the time. Arnold and Son also had a chronometer manufactory at Chigwell, in Essex.

The rival claims of Mudge, Arnold, and Earnshaw to the rewards offered for the best chronometer were submitted to a Select Committee of the House of Commons, assisted by a committee of experts, and eventually each was awarded £3000; but a moiety of Arnold's portion was not paid till after his death, when it was received by his son. Arnold had not laid claim to the reward when depositing his chronometers at the Greenwich Observatory; but their good performance was made use of by Maskelyne as a reason why Mudge's claim should not be recognized.

John Arnold was admitted as a member of the Clockmakers Company in 1783, and chosen on the livery 1796. He died at Well Hall, near Eltham, Kent, in 1799.

John Roger Arnold, his son, seemed to have inherited neither the horological ability nor the commercial aptitude of his father.

FIG. 70.—John Arnold, 1734-1799.

He subsequently removed from Cornhill to 84, Strand, where he entered into a partnership agreement for ten years with E. J. Dent, and during this period the business flourished ; but immediately the term expired Dent set up for himself at 82, Strand, carrying with him the confidence of most of the customers of the late firm.

Thomas Earnshaw.

Thomas Earnshaw was born at Aston-under-Lyne, in 1749. To him must be ascribed the merit of having devised the chronometer escapement and compensation balance precisely as they are used to-day.

That he was a true horologist by intuition is evident. He bears the reputation of being honest, rugged, and straightforward. There are, however, but few details of his life to be obtained.

FIG. 71.—Thomas Earnshaw, 1749–1829.

The comparison of Arnold's and Earnshaw's escapement and balance just given in the sketch of the former's career need not be repeated. Several years younger than his rival, Earnshaw came to London when a young man, and opened a shop at 119, High Holborn, one door east of the turning now called Southampton Row. He died at Chenies Street, in 1829.

The committee of investigation appointed to consider the claims of chronometer improvers awarded Earnshaw £3000. Rightly or wrongly, he was of opinion that he was not well treated, and in 1808 issued "An Appeal to the Public," declaring he was entitled to a more pre-eminent recognition.

Vulliamy. This noted family of clockmakers was of Swiss origin. Justin Vulliamy emigrated from Switzerland and settled in London about 1730. He became connected with Benjamin Gray, of Pall Mall, whose daughter he married, and with whom he subsequently entered into partnership. Watches of very fine quality, inscribed "Benj. Gray, Just. Vulliamy," are occasionally to be met with. At Mr. Gray's death the business was carried on by Justin Vulliamy. Mr. Gray was appointed as clockmaker to George II., and the family of Vulliamy held the office of clockmaker to the reigning sovereign till the death of Benjamin Lewis Vulliamy, in 1854.

Benjamin Vulliamy, the son of Justin, was much favoured and consulted by George III. on mechanical subjects, especially in connection with the Kew Observatory, which was a hobby of the king.

Benjamin Lewis Vulliamy, born in 1780, was noted for the exactness and excellent finish of his work, in both clocks and watches. The large clock at the old Post Office, St. Martin's-le-Grand, turret clocks at Windsor Castle, and at Christ Church, Oxford, are among the public timekeepers by him. He took an active interest in the Clockmakers' Company, of which he was five times master. He wrote several pamphlets on trade subjects. One of them, on the construction of the dead-beat escapement for clocks, advocated the turning of the pallets for ensuring greater exactness.

When the new Houses of Parliament were being built, the architect, Mr. Barry, applied to Mr. Vulliamy for information respecting the construction of the clock-tower, and this circumstance, together with Mr. Vulliamy's influential position in the horological world, led people to think he would make the clock, as indeed it was intended by Mr. Barry and others that he should. But Mr. Vulliamy objected to the conditions laid down by Mr. Denison, who was commissioned by the Government to draw up a specification in conjunction with the Astronomer Royal, and, backed by the Clockmakers' Company, declared the stipulations to be too onerous and unnecessary. Mr. Vulliamy submitted drawings of what he considered the clock should be like, and this design Mr. Denison ridiculed as being merely suited for a village clock of the old style, and quite unworthy of the national time-keeper. Mr. Denison's masterful attitude prevailed, and Mr. Vulliamy had to succumb, feeling, there is no doubt, the keenest mortification at being ousted from the proud position of leading clockmaker. It must be admitted that his talent lay rather in the perfection of details than in comprehensive departures from the beaten track. He died in January, 1854.

James Ferguson. James Ferguson, born 1710; died and buried in Marylebone churchyard, 1776. Among other conceptions of this celebrated astronomer and mechanician is the clock here shown, which is contrived with only three

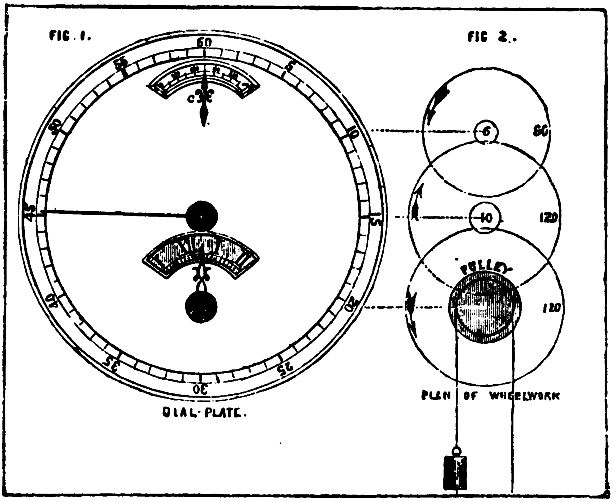


FIG. 72.

wheels and two pinions. The hours are engraved on a plate fitting friction-tight on the great wheel arbor; the minute hand is attached to the centre wheel arbor, and a thin plate divided into 240 equal parts is fitted on the escape wheel arbor, and shows the seconds through a slit in the dial. The clock has a seconds pendulum. The number of teeth in the escape wheel is higher than is desirable, and the weight of the thin plate or ring in the escape wheel arbor is objectionable, though it might now be made of aluminium, vulcanite, or other very light material.

Ferguson also designed a curious and useful clock for showing the time of high and low water, the state of the tides at any time of the day, and the phases of the moon. The outer circle of the

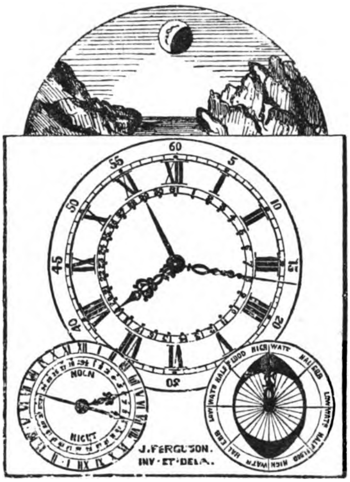


FIG. 73.

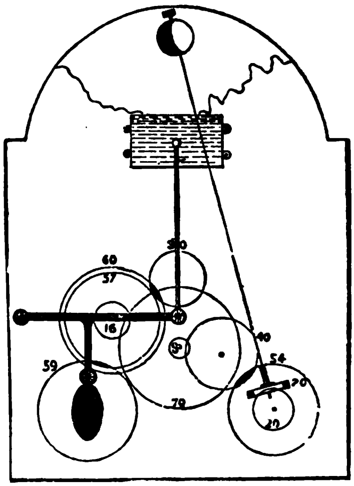


FIG. 74.

dial in the left-hand corner of Fig. 73 is divided into twice 12 hours, with halves and quarters, and the inner circle into 29·5 equal parts for showing the age of the moon, each day standing under the time of the moon coming to the meridian on that day. There are two hands on the end of the arbor coming through this dial, which go round in 29 days 12 hours 45 min., and these hands are set as far apart as the time of high water at the place the clock is to serve differs from the time the moon comes to the meridian; so that, by looking at this dial, one may see at what time the moon will be on the meridian and at what time it will be high water. On the dial in the right-hand corner all the different states of the tide are marked. The highest points on the shaded eclipse represent high, and the lowest, low water. The index travels round this dial in the time that the moon revolves from the meridian to the meridian again. In the arch above the dials a blue plate, to represent the sea, rises and falls as the tides do, and over this a ball, half black and half white, shows the phases of the moon.

The mechanism as it would appear at the back of the dial is shown in Fig. 74. A wheel of 30 fixed to the hour wheel on the centre arbor goes round once in 12 hours, and gears with a wheel of 60, on whose arbor a wheel of 57 drives a wheel of 59, the arbor of which carries the hand for the right-hand dial. On this arbor is an elliptical cam which carries and lets down the tide plate twice in 24 hours 50·5 min. On the arbor of the wheel of 57 is a pinion of 16, driving a wheel of 70, on whose arbor is a pinion of 8, driving an idle wheel of 40. This idle wheel is merely to reverse the direction of the wheel of 54 with which it gears, and which carries the hands for the left-hand dial. The moon is driven from this last arbor by means of a pair of mitre wheels.

Jenkins' Astronomical Clock.

Henry Jenkins, who flourished from 1760 to 1780, first at 46, Cheapside, and afterwards at 68, Aldersgate Street, must be reckoned among the celebrated clock-makers of his time. The drawing opposite shows one of several astronomical clocks he contrived and produced. There are concentric second and minute hands, and among other motions are shown: equation of time, days of the month, age and phases of the moon, time of high water at many seaports, the apparent motion of the fixed stars, motions of the planets, etc.

The lunar and other motions, except the rotation of the planets, are nearly as in Enderlin's clock, and need not be recapitulated. From the earth's diurnal motion wheel, rotating once in twenty-four hours, is driven a worm which carries forward an annual wheel, and the representation of the fixed stars one tooth each day. From thence is a communication to the planetary system dial above, and the motions of the planets are obtained by six wheels fixed together on one stud and driving six other wheels whose sockets are circles and represent their respective orbits. On the stud are wheels of 108, 78, 84, 40, 8, 5, driving on sockets 26, 48, 84, 75, 95, 147.

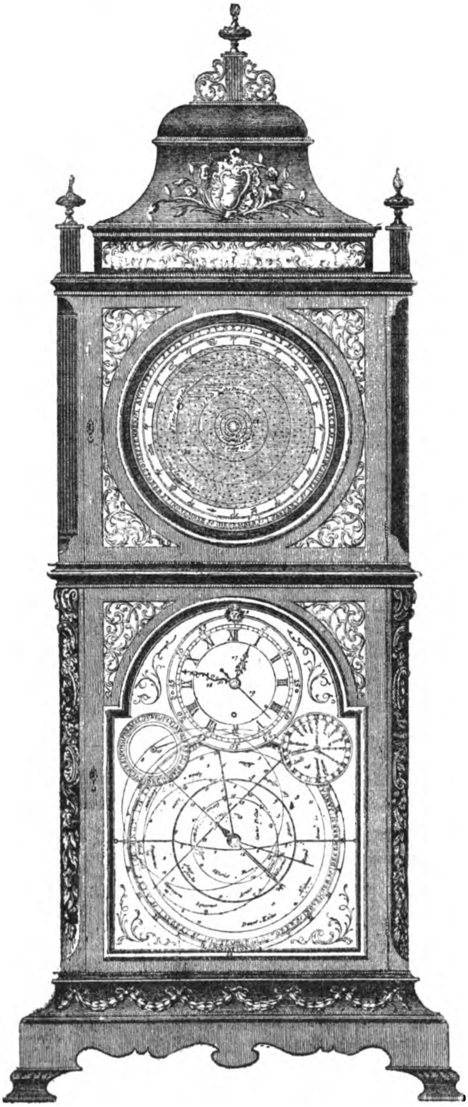


FIG. 75.—Jenkins' astronomical clock.

St. Dunstan's Clock.

ABOVE the main entrance at the western end of the old church of St. Dunstan's in the West, in Fleet Street, were erected in 1671 two gilt clock dials, placed back to back, and mounted in a handsome square case, with circular pediment, which projected well out over the footway, the tube containing the rod for actuating the hands being supported by a well-carved figure of Time. An alcove was built on the roof of the gateway, and within were large gaudily painted and gilt

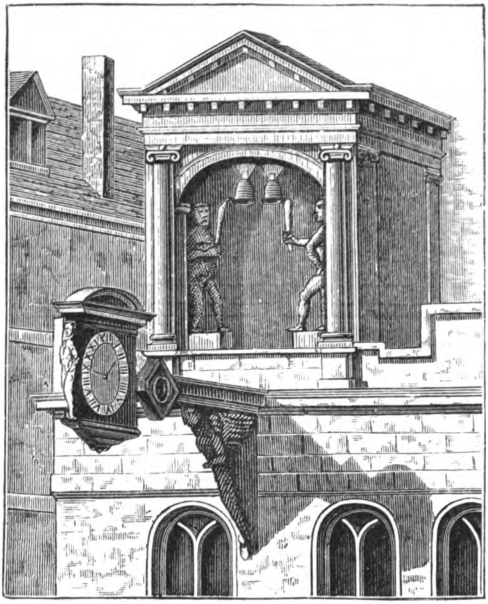


FIG. 76.

figures of Gog and Magog, which struck "ting tang" quarters with clubs on two bells suspended above them. The clock and figures were designed and erected by Thomas Harrys, a clock-maker, then living at Water Lane, Blackfriars. Harrys submitted a statement of what he proposed to do, and, after describing the "two figures of men with poleaxes to strike the quarters," continues, "I will do one thing more, which London shall not show the like ; I will make two hands show the hours and minutes without the church, upon a double dial, which will be worth your observation, and to my credit." The figures of Gog and Magog proved to be a great attraction ; they speedily became one of the sights of London, and their removal, in 1830, when the church was rebuilt, elicited many expressions of regret. Fig. 76, taken from an old print of the church in my possession, represents the clock as it was in 1737.

In 1830, when the old church was in course of demolition, the Marquis of Hertford bought for two hundred guineas the clock, the quarter figures, and three old statues representing King Lud and his sons.

The Marquis of Hertford was at that time building a residence at the north-west corner of Regent's Park. This he called St. Dunstan's Lodge, and in the grounds thereof the clock and accessories are still to be seen from Regent's Park. The dials are now in a circular case ; but the movement, though it has of course undergone repair from time to time, is still substantially the one Harrys supplied over two centuries ago.

Lyons Clock. In the cathedral of Lyons is a remarkable specimen of complicated horological work. The clock was originally constructed by a mechanician named Nicholas Lippius, of Basle, who completed it in 1598, but during the last century Nourisson, a well-known clockmaker of Lyons, entirely remodelled the interior. A view of the original exterior is given on page 140. On different dial plates are exhibited the diurnal and annual motion of the earth, the course of the moon, the day of the year with its length from sunrise to sunset, and a calendar of remarkable feasts. There are seven figures, to represent the seven days of the week, and on the morning of his particular day each one of the figures takes his place in a niche, and remains there till midnight.

Strasburg Clocks.

THE first clock set up in the interior of the cathedral at Strasburg was begun in 1352, and completed two years after, under John, Bishop of Lichtenberg. It consisted of a calendar, representing in a painting some indications relative to the principal movable feasts. In the middle part there was an astrolabe, whose pointers showed the movements of the sun and

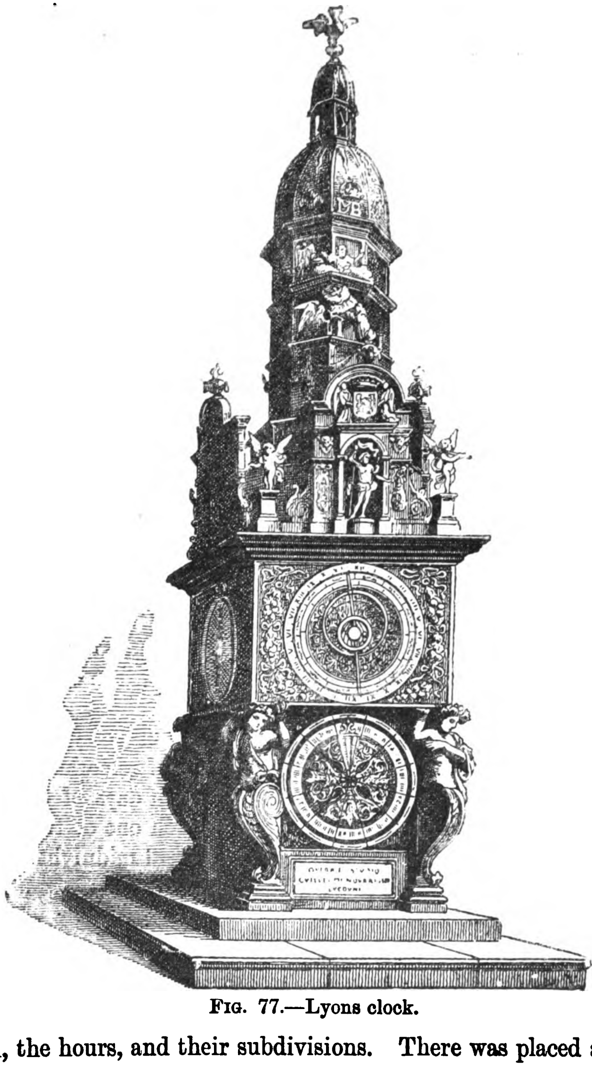


FIG. 77.—Lyons clock.

moon, the hours, and their subdivisions. There was placed at the same elevation the prime mover, and the other wheel work which caused the clock to go. The upper compartment was adorned with a statuette of the Virgin, before which, at noon, the three Magi (wise men of the East) bowed themselves. An automaton cock, placed upon the crown of the case, crew at the same moment, moving its beak and painfully flapping its wings. A small set of chimes, composed of several cymbals, formed a part of this work.

The second clock, of which an exterior view is given on page 142, was certainly a triumph of ingenuity. It was projected in 1547; but though the designs appear to have been then ready, the execution went no further than the building of the chamber, and the preparation of some of the heavier ironwork, till 1570, when Conrod Dasypodius, a native of Strasburg, undertook to supervise the completion of the horologium. By his advice the mechanical works were confided to Isaac and Josiah Habrecht, clockmakers of Schaffhausen, in Switzerland, while Tobias Stimmer, of the same place, was employed to do the paintings and the sculpture which were to serve as decorations of the achievement.

Before, and at the foot of the clock, there was a celestial globe supported on four columns of wood richly carved. It performed a revolution on its axis, showing the stars known in the time of Ptolemy, about A.D. 140. These stars, to the number of 1020, were grouped in 48 constellations, represented by as many figures. Two circles, one carrying the sun and the other the moon, turned round the globe, the first in 24 hours, the second in the space of about 25 hours.

Immediately behind the celestial globe there was a large wooden disc, in which was painted a calendar for the space of a century, the months, the days, the Dominical letter, the names of the saints, and the dates of the principal movable feasts. This calendar, of which one of the least defects was to make all the years bissextile, or of 366 days, made an entire revolution every year. The statues of Apollo and Diana, placed on two sides of the disc, pointed out, with their sceptres, the one the day of the year, the other the corresponding day at the end of six months. The central part of the calendar was immovable; on it were represented the countries of Germany situated along the Rhine and the topographical plan of the city of Strasburg.

The compartments situated on the two sides of the calendar were occupied by the large panels upon which were painted the

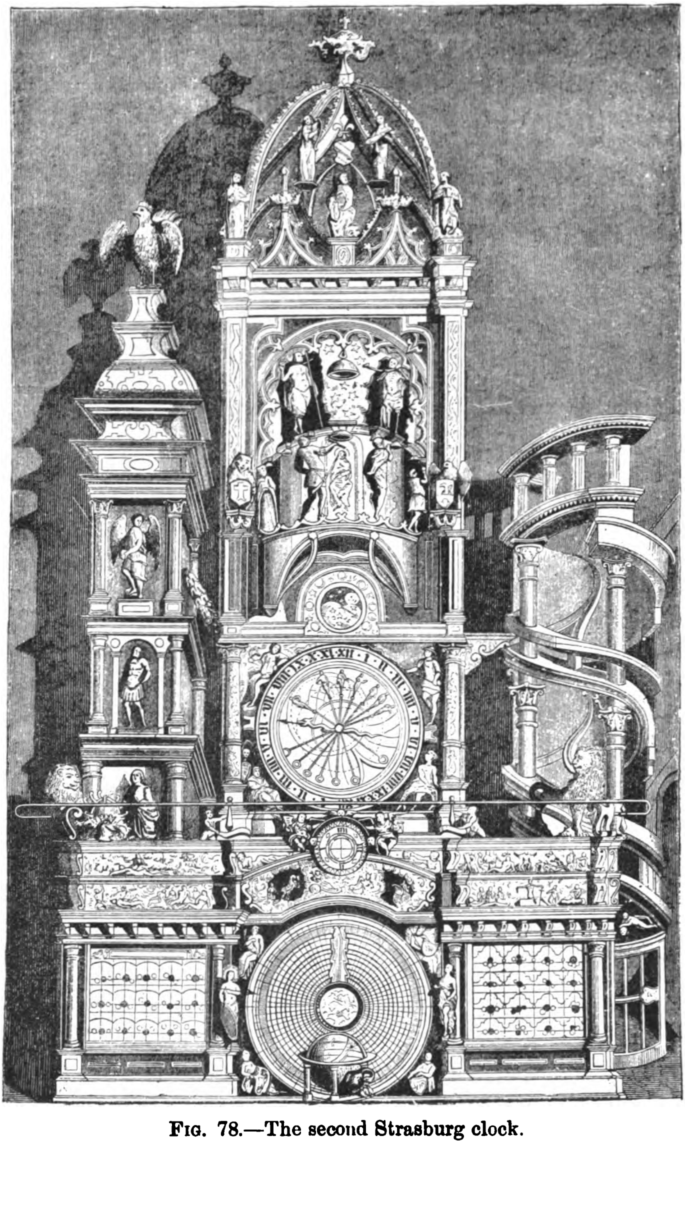


FIG. 78.—The second Strasburg clock.

principal eclipses of the sun and moon visible in the northern hemisphere, and answering to an interval of thirty-two years only; that is to say, the period from 1573 to 1605.

Above the calendar there were seen in the clouds the seven pagan divinities that have given their names to planets, and afterwards to the days of the week. These allegorical figures, seated in chairs drawn by the divers animals which mythology assigns to each of these divinities, showed themselves successively on the days which were sacred to them.

On Sunday, Apollo was seen, this day being dedicated to the sun. The ancients named it *Dies solis* (the day of the sun), and the Christians the Lord's day (*Dies Dominica*), whence is derived the French word, *Dimanche*, for Sunday. Diana showed herself on the second day, which was called *Dies luna* (day of the moon)—*Lundi*—Monday. Mars, the god of war, appeared on (*Mardi*) Tuesday, the English word being derived from *Tuesco*, the Saxon name of the god of war. The fourth day was represented by Mercury, the messenger of Olympus; French, *Mercredi;* English, Wednesday (the latter being derived from *Wodin*, the Saxon name of the same deity). The following day *Dies Jovis*, Jupiter's day; French, *Jeudi;* English, Thursday (derived from *Thor*, the Saxon name for Jupiter). The beautiful Venus showed herself on Friday (which in English is derived from *Friga*, the Saxon name of the goddess Venus). Last of all, Saturn, the god of time, came on Saturday, to close the Olympian procession.

Immediately above the divinities of the week was a gallery. The middle was occupied by a small dial plate which indicated the quarter-hours and the minutes, the hours being represented upon the astrolabe; at the sides of the dial plate were seated two genii, of which the one placed on the right raised a sceptre each time the hour was to strike, and of which the other at the same moment turned upside down an hour-glass which he held in one hand, turning it always in the same direction. An astrolabe, constructed according to Ptolemy's system, occupied the greater part of the middle story, in the interior of which was contained the wheel work of the clock. Six pointers, bearing the same number of planets, pointed out, upon twenty-four divisions of the astronomical day, the movements of these heavenly bodies; one pointer, larger than the others and terminated by a sun, finished in twenty-four hours an entire revolution round a small map of the world placed in the central part of a large dial plate, which was ornamented at the same time by the circles of a horoscope and by the twelve signs of the zodiac.

The upper part of the astrolabe was crowned with the phases of the moon. There was visible a small dial plate cut in its lower part by two semicircles, behind which the moon, represented by a gilded disc, disappeared at the time of the new moon, and came out from day to day to show successively a quarter part of its orb, till it presented to view its entire disc, at the time of full moon.

At the third story of the clock there was a platform, upon which were fixed four small statues representing the four ages (periods of life)—infancy, youth, manhood, and old age; these figures struck the quarter-hours upon cymbals.

Above this platform was suspended the bell intended for sounding the hours. Two figures stood beside this bell; the one was Death under the form of a skeleton, the other represented Christ, having in one hand the cross and the palm branch. At the instant the hour ought to strike, the Saviour came forward, and the skeleton drew back; but hardly had this movement taken place when Christ retreated precipitately, and Death advanced in the same way, to strike on the bell the number of strokes required. This movement was repeated as many times as there were strokes in the hour.

The structure is over twenty feet in height, and is surmounted by a remarkably handsome dome. On the right is a spiral staircase, by means of which the various galleries are reached.

The turret, placed on the left of the principal edifice, contained the weights of the clock, as well as the machinery intended for the cock which was perched on the summit of this turret. This cock (the only piece which was preserved from the first clock, called the clock of the three kings) crowed at first daily, at noon, flapping its wings and opening its beak; but having been struck with lightning in 1640, it was not made any longer to crow, except on Sundays and feast days. It ceased crowing entirely in 1789, at the time when overwhelming attention bestowed upon the great events that were taking place caused it to be completely forgotten.

Third Strasburg clock. At length it was evident that some reconstruction was necessary. After considerable debate, the necessary work was entrusted to Charles Schwilgue, who entered on his task in 1838, and completed it about the middle of 1842. On the 2nd of October of that year the life of the resuscitated marvel was solemnly inaugurated. Some of the former actions were altered or omitted, and fresh ones added, the greater part of the movement being entirely new, for only in some few cases was a restoration of the former mechanism practicable. The motions now are briefly as follows :—

On the floor-level is a celestial globe, indicating sidereal time. In its motion round its axis the globe carries with it the circles that surround it—namely, the equator, the ecliptic, the solstitial and equinoctial colures, while the meridian and horizon circles remain motionless, so that there are shown the rising and setting, as well as the passage over the meridian of Strasburg, of all stars that are visible to the naked eye, and which appear above the horizon. Behind the celestial globe is the calendar ; on a metallic band, nine inches wide and thirty feet in circumference, are the months, days of the month, Dominical letters, fixed and movable feast days. The band is shifted at midnight, and a statue of Apollo points out the day of the month and the name of the saint corresponding to that day. The internal part of the annular band indicates true solar time ; the rising and setting of the sun ; the diurnal motion of the moon round the earth, and its passage over the meridian ; the phases of the moon, and the eclipses of the sun and moon. Adjacent compartments are devoted to a perpetual calendar, solar and lunar cycles, and other periodic recurrences, solar and lunar equations, etc. Above the calendar appear allegorical figures, seated in chariots, and representing the days of the week. These chariots, drawn by such animals as are assigned as attributes of the divinities, run on a circular iron railway, and appear each in order.

The dial for showing mean solar time is in the gallery above, called the Gallery of Lions. A genius stands on each side of the dial. The one on the left strikes the first note of each quarter-hour with a sceptre he holds in his hand, the second note being struck by one of the four ages in a still higher gallery, as will be described presently. At the completion of each sixty minutes the genius on the right of the dial reverses an hour-glass filled with red sand.

The story above is occupied by a planetarium, in which the revolutions of the planets are represented upon a large dial plate.

Above the planetarium, and upon a star-decked sky, is a globe devoted to showing the phases of the moon.

Next come movable figures representing the four ages, one of which in turn appears and gives upon a bell the second stroke of each quarter of an hour. At the first quarter a child strikes the bell with a rattle; a youth in the form of a hunter strikes it with an arrow at the half-hour; at the third quarter the blows are given by a warrior with his sword; at the fourth quarter an old man produces the notes with his crutch. When he has retired a figure of Death appears and strikes the hour with a bone.

In the upper apartment is a figure of Christ; and when Death strikes the hour of noon the twelve Apostles pass before the feet of their Master, bowing as they do so. Then Christ makes the sign of the cross.

During the procession of the Apostles, the cock perched at the top of the weight-turret flaps his wings, ruffles his neck, and crows three times.

In addition to the mean time dial in the gallery, there is one, seventeen feet in diameter, above the principal entrance to the cathedral.

The foregoing particulars are extracted from a descriptive pamphlet issued by the sons of Charles Schwilgue, who refer with pardonable pride to the arduous labours incidental to the production of this extraordinary piece of mechanism.

Beauvais Cathedral possesses a clock bearing a strong resemblance to the Strasburg one. It is thirty-six feet high, and contains no less than fifty dials, recording the movements of planetary bodies and other recurring intervals.

Clock at the Church of St. Mary, Lübeck.

A MOST remarkable clock was in 1405 erected in the church of St. Mary, at Lübeck. Doubtless it has been much altered since that time; but in 1820, from the description of Downes, it was in good order. It consists of three compartments, the lowest of which contains the original inscription:—

"Hoc horologium factum est primum,* Anno MCCCCV.
Hanc rempl. gubernantibus Dn. Proconsulibus Henrico Westof et
Goswino Clingenberg, Provisoribus hujus ecclesiæ. Ipso die purificationis Mariæ.

"Aspectum cœli, Solis Lunæque nitorem,
Lumina per certos ignem ducentia cursus,
Ut fluat hora fugax, atque irrevocabilis annus,
Hoc tibi, conspiciens! oculis haurire licebit.
Sed resonos quoties modulos campana remittit,
Pronus astripotens Numen laudare memento."

These lines may be translated as follows :—

"This horologe [clock] was first made
in the year 1405. The lord pro-consuls of this state,
H. Westof and G. Clingenberg, being overseers of
this church. In the very day of the Purification
of the Virgin Mary.

"The aspect of the heavens and the gleam
of the Sun and Moon—luminaries drawing
their light through certain courses,
as flows the swift hour and irrevocable year,
to thee, O beholder, will it be permitted
to take in with thine eyes.
But as often as the bell with resonant sounds
[beats upon thine ears] remember in reverent
attitude to praise the starpotent deity."

There are also several other inscriptions recording the different dates at which the clock underwent repair.

The principal division of the compartment is occupied by a plate, on which several concentric circles are described. This has a progressive motion, and is calculated to exhibit the various details of the calendar from 1753 to 1875, such as the Sunday letters, the days of the week and month, the hours of sunrise, the golden number, the solar circle, the day of Easter full moon, and the number of weeks intervening between Christmas and Shrove Tuesday. The centre plate contains a specification of all the solar and lunar eclipses visible at Lubeck between the years 1811 and 1860, drawn up by the celebrated Bode, of Berlin.

In the middle compartment another plate is inserted, contain-

* "Factum est primum" may possibly mean the first made [of its kind].

ing an hour circle, a movable zodiac, and a dial which points out the hours and the solar place in the ecliptic. A gilt representation of the sun, accompanied by the inferior planets Venus and Mercury, appears on the dial. There are four other dials, respectively calculated for Saturn, Jupiter, Mars, and the moon. On two side columns the planetary hours are marked.

The highest compartment contains a small tower, with a set of bells which play every hour, and a clock which is struck by a figure of Time, while, on the opposite side, that of Transiency, which, as here personified, reverts its face at every stroke. Under this tower is the figure of our Saviour, before which a procession, representing the emperor and the seven electors, passes at twelve every day, entering at one side, and retiring at the other. The first-mentioned figure bestows a blessing on those of the potentates as they move by, which express adoration by bowing the head. Two angels always announce the ceremony by sound of trumpet. An attendant stands before each of the little doors through which the train appears and disappears, and pays obeisance as they pass. The number of figures amounts to twelve; hence some people have considered that they represent the Apostles.

The sides of this stupendous horologe, which is enclosed by an iron railing, exhibit various scenes from the narrative of Christ's sufferings; and carved in the corner of the framework surrounding one of these scriptural pieces is the figure of a mouse, which is the work-mark of Lubeck.

Clock at the Dome Church, Lübeck.

DOWNES describes another extraordinary clock at Lübeck, in the Dome Church. This is of a much later date. The dial plate represents the face of the sun, the eyes of which, turning alternately to the right and left with the oscillation of the pendulum, produce a most hideous effect. Above are two figures, one of which personifies Faith, and beats the quarters; the other, a skeleton, said to represent Time, exhibits rather the lineaments of Death. In the left hand it holds an hour-glass, and in the right a hammer, with which it strikes the hours, slowly moving the head to the right and left during the process.

Curious Clock by Isaac Habrecht at the British Museum.

AT the top of the main staircase of the British Museum is a most curious clock, which was bequeathed to the nation by Mr. Octavius Morgan. It was made in 1589 by Isaac Habrecht, one of the two ingenious brothers who made the second famous clock at Strasburg. It is about four feet in height, and the general design is the same as that of the left tower of the Strasburg clock, and on the sides of both are figures of the three Fates, Clotho, Lachesis, and Atropos, and each is surmounted by a figure of the cock of St. Peter, which at the stroke of the hour flaps its wings and crows. It had originally a balance as a controller, for which a pendulum was subsequently substituted. The quarters are struck by four figures representing the ages of man, and the hour by a figure of Death. On a lower balcony is a seated figure of the Virgin and Child, before whom passes a circle of angels, who, as they are set in movement by the striking of the clock, are caused to make an obeisance in front of the Virgin. Below this the gods of the days of the week perform their circuit, each driving in a chariot, while the dials on the lower stages fulfil the more useful functions of indicating the hour, the phases of the moon, the feasts of the Church, etc. The case is of gilt

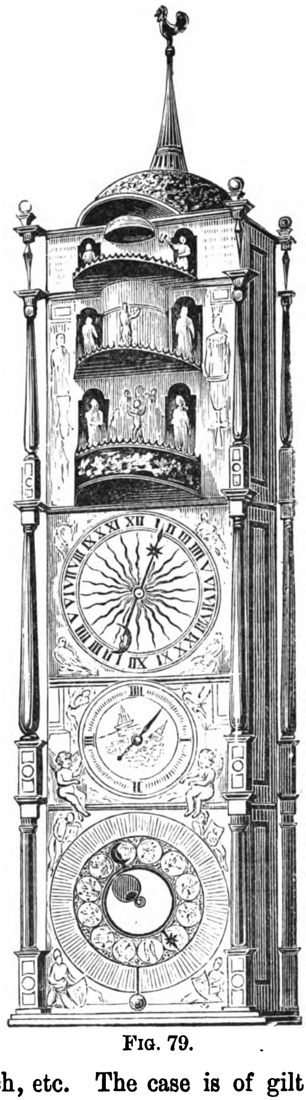


FIG. 79.

copper, with well-engraved figures and ornamental designs, perhaps by Tobias Stimmer, who was employed to decorate the original clock at Strasburg. The history of this clever piece of

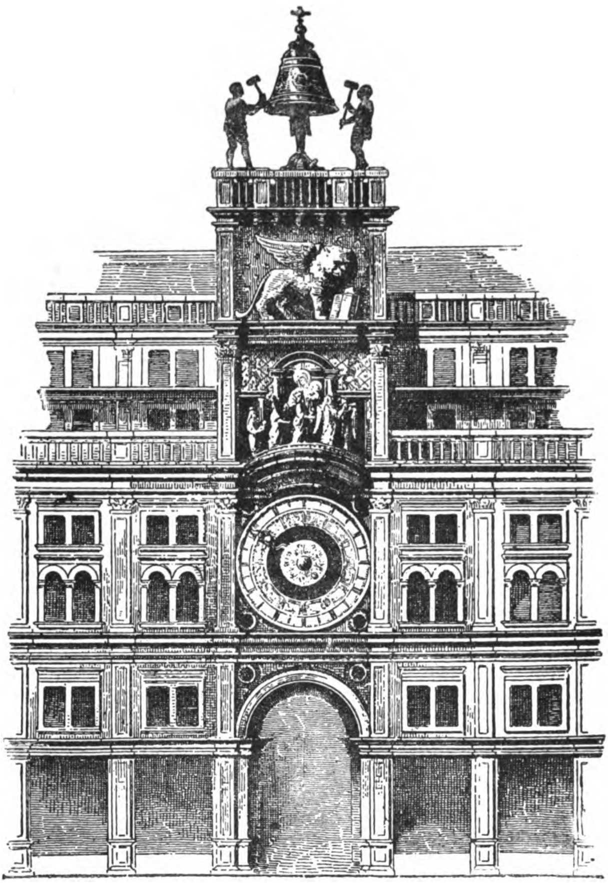


FIG. 80.—Venice Clock.

mechanism is somewhat curious, though it rests upon slender foundations. It is stated that Pope Sixtus V. was so pleased with the Strasburg clock that he ordered Habrecht to make one of the same kind. This was made, and remained at the Vatican for two hundred years. Its next appearance was in Holland, where it was in the possession of the king; from Holland it was brought to London and exhibited about 1850.

Venice Clock.

ON page 150 is shown a monumental timekeeper erected at the Grand Piazza at Venice early in the seventeenth century. There is a large dial showing the hours, and above is a balcony of gilt lattice surrounding an image of the Blessed Virgin, seated between two doors overlaid with gold. Evelyn, in his "Memoirs," under date 1645, speaks of this "admirable clock, celebrated next to that of Strasburgh for its many movements; amongst which abound twelve and six—which are their houres of Ave Maria, when all the towne are on their knees—come forth the 3 kings led by a starr, and passing by ye image of Christ in his Mother's armes do their reverence, and enter into ye clock by another doore." Another writer in 1841 remarked that at a certain period of every year, on the Feast of the Ascension, and fourteen days afterwards, as the hour struck, the door on the right hand opened and an angel with a trumpet issued forth, followed by three Eastern kings, each of whom, as he passed the Virgin, raised his crown, bowed, and then disappeared through the other door. The hours are struck by two bronze giants on a large bell which surmounts the structure.

Falling Ball Timekeepers.

IN the British Museum are two specimens of this remarkably clever and elegant piece of seventeenth-century mysterious horology. One of them is inscribed "Jacob Behan, Vienna." It is a sphere of brass four inches in diameter, to be suspended from a bracket, or the ceiling of a room. The upper and lower portions of the ball are gilt, while around a silvered band in the middle are marked two series of Roman numerals from I. to XII., and subdivisions for the quarter-hours. The extremity of one of the wings of a Cupid on the lower part of the ball points to the hour of the day or night. The construction may be gathered from the vertical and horizontal sections which are given in Fig. 81. The suspending cord is coiled round a barrel, with which is connected a train of wheels terminating in an escapement and balance. While the top and bottom of the ball are rigidly connected, the middle is free to move, and is

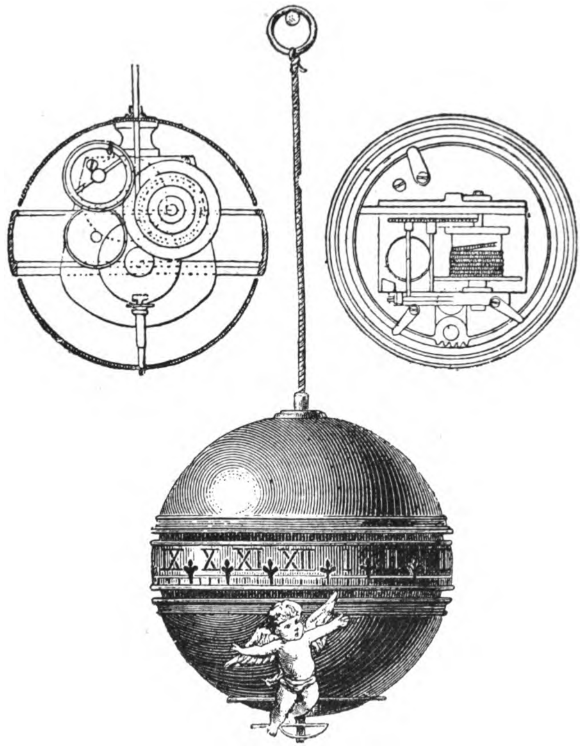


FIG. 81.

furnished with a ring of teeth projecting inside, through which the middle is rotated once in twenty-four hours, the weight of the ball acting as a driving force. The mechanism is wound by simply raising the ball with the hand, there being a weak spring in the barrel, which causes it to turn and coil the suspending cord on to itself.

French Pedestal and Bracket Clocks.

THREE elegant examples of French pedestal clocks are shown below. Fig. 82, of Louis XIV. period, does not show the minutes; it has an hour hand and a hand

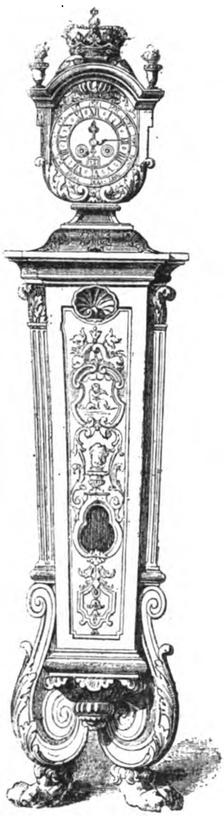


FIG. 82.

FIG. 83.

FIG. 84.

for pointing to the day of the month on a circle outside of the hours. Fig. 83 is of a slightly later period. Fig. 84 is a specimen of the buhl work popular in the time of Louis XV. The style of this clock, apart from the pedestal, was long in favour with French manufacturers. The hour figures were usually on plaques of enamel.

Urn and vase timekeepers with a revolving band, and with varied exteriors, were favoured in France at the latter end of the last century. The one represented by Fig. 85 belonged to Marie Antoinette. The movement was covered by the handsome carved

Fig. 85.

Fig. 86.

marble pedestal, the urn being of porcelain with bronze mountings. A serpent curled round the foot of the vase had its head erect to point to the hour on the double polygonal band.

Fig. 86 represents a magnificent design by Falconet, wherein the three Graces are portrayed, one of whom indicates the hour with her finger. The vase is supported by a column standing on a handsome plinth; the panels of the plinth show very choice carvings of groups of children at play. The upper and lower portions of the vase are stationary; the hour band alone revolves once in twelve hours.

The superbly designed bracket clock shown in Fig. 87 is also

Fig. 87.

of French origin, in the style of Louis XIV. The original drawing of it is in the Bibliothèque Nationale de Paris.

Negress-Head Clock. Among the eccentricities of French horology is one at Buckingham Palace in the form of the head of a negress, figures corresponding to the minutes appearing in proper order in one of the eyes of the negress, the hours being denoted in the other eye in a similar way. By closing the eyelids the figures may be rendered invisible.

Henry Bridges.

HENRY BRIDGES, who lived at Waltham Abbey, and was brought up as an architect, seems to have obtained a greater reputation abroad than at home as the producer of clocks with motions representing the heavenly bodies. The specimen of his work delineated in the accompanying figure was publicly exhibited in about 1770 by Edward Davis, who wrote a pamphlet describing it. It is a monumental clock ten feet high and six feet broad at the base. Within the pediment at the top of the structure is a scene representing the Muses on Parnassus; this changes periodically to a forest with Orpheus and wild beasts, which in its turn gives place to a sylvan grove with birds.

On the upper large dial and the four small ones are indicated the seconds, minutes, and hours; the rising and setting of the sun; equation of time, the age phases of the moon, and signs of the zodiac. On the lower of the large dials is exhibited the Copernican system of time, consisting of seventeen bodies, the sun being in the centre and the planets moving round it. On a panel below are a landscape and the sea with representations of moving persons and vessels, and on a second panel men at work in a carpenter's yard. These automata were very popular, and quite suited to the taste of the period. Besides these, the edifice contained an organ, which was played at intervals. Altogether there were, it is stated, over a thousand wheels and pinions in the composition of the mechanism.

It is remarkable how little is to be gathered respecting Henry Bridges among English horological records. Dubois, quoting from the Bibliothèque Nationale de Paris, says he was clockmaker in the court of Charles I., and that the identical clock illustrated on p. 156 was made for the Duke of Buckingham. But this account cannot be accepted, for seconds and minute hands were not usual in the time of Charles I.

The wig and dress of Bridges, as given in the same repository, are of the style in vogue at the beginning of the eighteenth

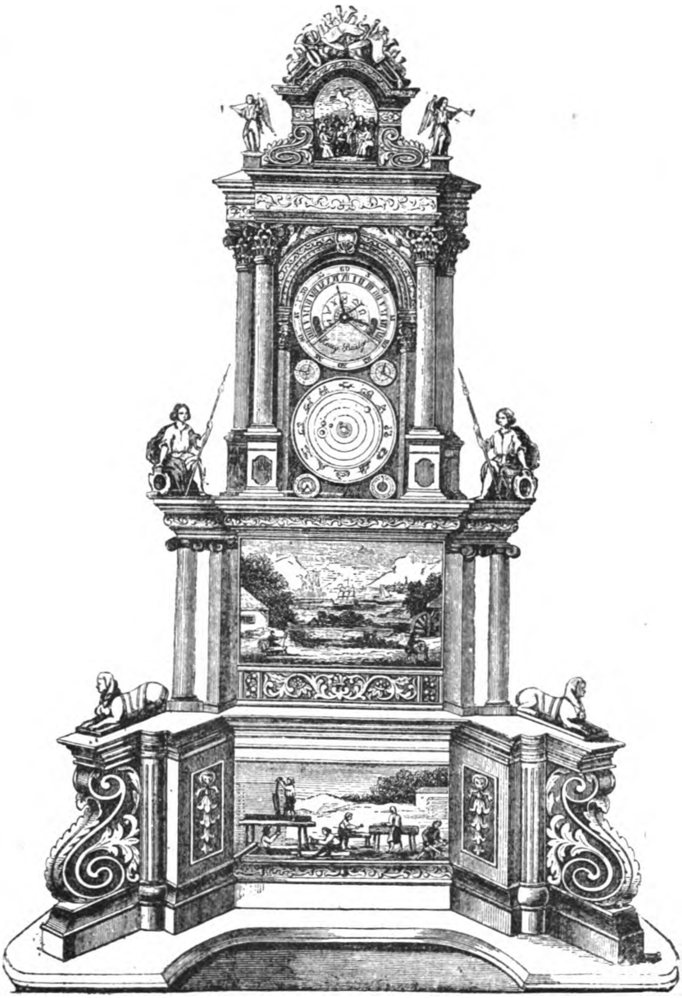


FIG. 88.—Bridges' clock.

century, and we may conclude that this was about the period he flourished.

Weighted Lever Timekeepers.

Rolling Clock.

THIS ingenious device appears to have been patented by that universal genius the Marquess of Worcester, in 1661 (No. 131). It was also made by Nicholas Grollier about 1670. The con-

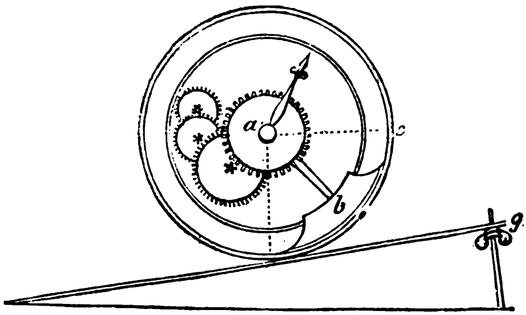


FIG. 89.

struction of it will be understood from the uncovered view of the front. There is a train of wheels and an escapement as in

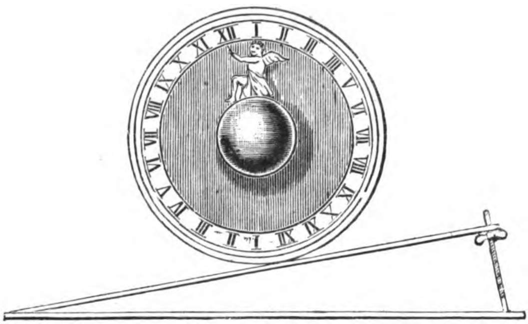


FIG. 90.

a watch. The great wheel *a* carries the hand and also the weight *b*. The clock never requires winding. It is every morning simply placed at the top of the inclined plane, down which it gradually rolls during the day, the hand pointing to the hour marked on a dial, which of course covers the mechanism.

The length of the plane had better be more than twice the circumference of the clock case *c*. Its inclination may be regulated by the screw *g*. The hand may be in the form of a figure of Time, as in Fig. 90, a serpent's head, or other grotesque design.

Schmidt's Mysterious Clock.

The controlling principle of the rolling clock, as shown in Fig. 89, has been utilized in another form of mysterious timekeeper, an exterior view of which is appended. It was patented in 1808 (No. 3185) by John Schmidt, a watchmaker, living in St. Mary Axe. He called it "The Mysterious Circulator, or Chronological Equilibrium."

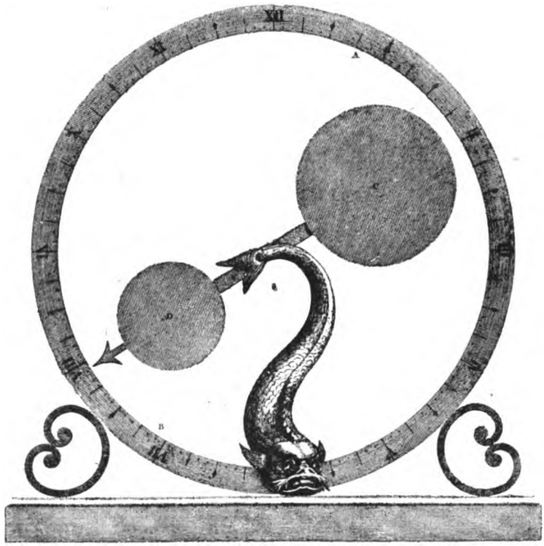


FIG. 91.

The ring A is divided into hour and five-minute spaces. The watch movement, with the weighted lever, is contained in the box, C, but it is now driven by a mainspring in the usual way. The hand is pivoted to the tail of the dolphin. D is a counter-weight. The weighted lever revolves once in 12 hours; it would be nearest to the centre of motion of the hand at 6 o'clock, and furthest from it at 12 o'clock; it is easy, therefore, to see that by this displacement of the centre of gravity the weighted lever would cause the hand to revolve and point to the time. It appears that Schmidt was a German, who was taken prisoner at Copenhagen, and brought to England. The clocks were sold by Rundle and Bridge, whose shop was in Ludgate Hill. Several distinguished persons are stated to have become purchasers.

This device has been several times re-invented, but never, I think, in so elegant a form as the original.

Curious Dial by Hogarth.

IN 1727 William Hogarth, the eminent satirical artist, published a curious print called "The Masquerade Ticket." On the top of it was shown a clock dial like

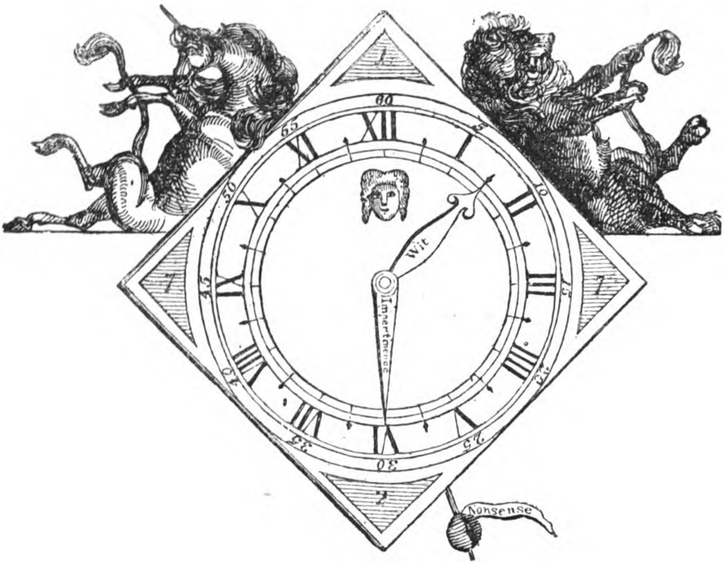


FIG. 92.

Fig. 92, which was thus described in John Ireland's "Hogarth Illustrated," where it was also represented: "The head of the renowned Heidegger, master of the mysteries and manager in chief, is placed on the front of a large dial, fixed, lozenge fashion, at the top of the point, and, I believe, intended to vibrate with the pendulum; the ball of which hangs beneath, and is labelled Nonsense. On the minute finger is written Impertinence, and on the hour hand Wit; which seems to intimate, nonsense every second, impertinence every minute, and wit only once an hour! The time is past one—the witching hour is gone. 1727, the date of the year this print was published, is on the corners of the clock. Recumbent on the upper line of the print, and resting against the sides of the dial, the artist has placed our British lion and unicorn, lying on their backs, and each of them playing with its own tail. The lion sinister, and the unicorn dexter; the supporters of our regal arms being thus ludicrously introduced, may perhaps allude to the encouragement King George II. gave Heidegger, who at that period might be said to 'teach kings to fiddle, and make senates dance,' who, by thus kindly superintending the pleasures of our nobles, gained an income of £5000 a year, and, as he frequently boasted, laid out the whole in this country."

Lovelace's Exeter Clock.

JACOB LOVELACE was born at the beginning of the eighteenth century, in the city of Exeter, where he ended his days in great poverty, aged 60 years, having been 34 years engaged in constructing the monumental clock shown in the accompanying engraving. The mechanism is enclosed in an elegant cabinet 10 ft. high, 5 ft. wide, and weighing half a ton, ornamented with Oriental figures and finely executed paintings, bordered by richly carved fretwork. The movements are: 1. A moving panorama descriptive of day and night. Day is represented by Apollo in his car drawn by four spirited coursers, accompanied by the 12 hours; and Diana in her car drawn by stags, attended by the 12 hours, represents Night. 2. Two gilt figures in Roman costume, who turn their heads and salute with their swords as the panorama revolves, and also move in the same manner while the bells are ringing. 3. A perpetual almanack, showing the day of the month on a semicircular plate, the index returning to the first day of every month on the close of each month, without alteration even in leap years, regulated only once in 130 years. 4. A circle, the index of which shows the day of the week, with its appropriate planet. 5. A perpetual almanack, showing the days of the month and the equation of

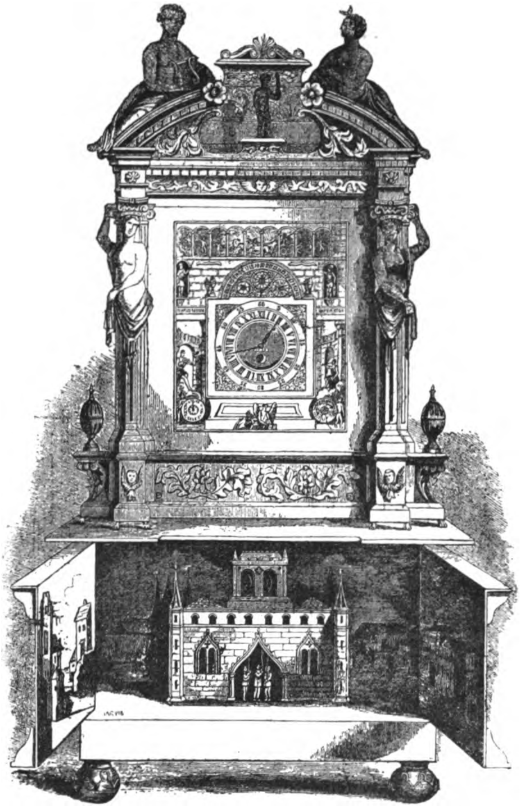


FIG. 93.—Lovelace's clock.

time. 6. A circle showing the leap year, the index revolving only once in four years. 7. A timepiece that strikes the hours and chimes the quarters, on the face of which the whole of the 24 hours (12 day and 12 night) are shown and regulated; within this circle the sun is seen in his course, with the time of rising and setting, by an horizon receding or advancing as the days lengthen or shorten, and under is seen the moon, showing her different quarters, phases, age, etc. 8. Two female figures on either side of the dial-plate, representing Fame and Terpsichore, who move in time when the organ plays. 9. A movement regulating the clock as a repeater, to strike or to be silent. 10. Saturn, the god of Time, who beats in movement when the organ plays. 11. A circle on the face shows the names of eight celebrated tunes played by the organ in the interior every four hours. 12. A belfry with six ringers, who ring a merry peal. The interior of this part of the cabinet is ornamented with beautiful paintings, representing some of the principal ancient buildings in the city of Exeter. 13. Connected with the organ is a bird organ, which plays when required. Beside the dial is the inscription, *Tempus rerum Imperator*.

According to an advertisement in the *Flying Post*, July 5, 1821, this clock was about to be publicly exhibited; and in the same publication for September 8, 1834, it was announced that "Lovelace's celebrated clock," which for several years was in the collection of Mr. James Burt, had the previous week been sold by auction for 680 guineas by the noted George Robins.

At the International Exhibition, 1851, it was a prominent feature in the Western Gallery. It then belonged to Mr. Brutton, who had it put in order by Mr. Frost, of Exeter, after being deranged for some years. In 1888 a suggestion was made in the Exeter Press that the clock should be purchased for the Imperial Institute.

Green's Lichfield Clock.

IN the *Universal Magazine* for 1748 is illustrated a singular clock with a peculiar outer case, about 4 ft. high, built in three tiers, and shown on p. 164. The early history of the clock does not appear to be known, but at the date quoted it belonged to Mr. Richard Green, of Lichfield.

On the lowest section and under a cornice are two tables of brass, plated with silver, containing the Decalogue. Above, in a niche, stands a crucifix of pearl, studded with crystals set in silver. In a square compartment on one side of the tables is engraved, on a plate of brass, the Lord's Prayer, and on the other side the Creed, both of which, as well as the Commandments, are in Latin. On a panel between each plate is a festoon of fruit and flowers, over which, on each side, is seen a cherubim, with several other ornaments neatly gilt.

Above this cornice, and immediately in front, is the face of the clock, which shows the day of the month, day of the week,

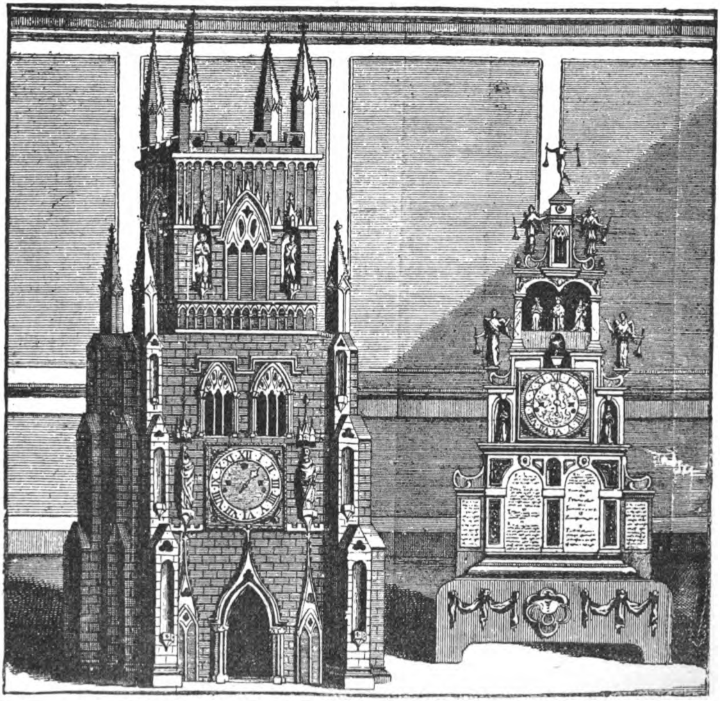


FIG. 94.—Lichfield clock.

the hour of the day, and age of the moon. In a niche on each side of the dial is placed a brass statue, gilt; that on the right of St. John the Evangelist, on the left, of St. Peter. In the middle of the second cornice, and over the dial, stands a cock, alluding to St. Peter's denying his Master.

The upper part represents a stately pavilion, adorned with four order, and terminating at the top in a lofty pinnacle, upon which stands a brazen statue of Fame with wings expanded, holding a trumpet in each hand. Within the pavilion, in the centre, appears Pontius Pilate, having a basin of water before him, as washing his hands; and round him move continually three images, representing our Saviour as going to His crucifixion, the Virgin Mary, and Simon the Cyrenian bearing the cross. These three last-mentioned figures make one entire revolution every minute.

The musical part of this clock executed eight different tunes, any one of which it played several times over every three hours, with provision also to play it occasionally.

The outward case of this horological machine occupies the left of the engraving. It represents a high finished tower steeple of Gothic architecture, with pinnacles, battlements, windows, mouldings, images, buttresses, etc., admirably painted and well carved. This perspective view of the outward case is so contrived that no part of the inner structure but the dial appears to view, except the front of this case (which consists of an upper and lower door) is thrown open. The clock may be then taken out, appearing then as is shown on the right of the engraving, and placed on a table or elsewhere. The height of the outside case is 5 ft. 2 in.

Watch with Changing Hour Figures.

IN the celebrated Marfels Collection of antique watches was one in which the hour figures are caused to appear as required on the dial, a principle favoured in recent years by several inventors, who have devised means of accomplishing this end. This watch of Marfels was made in the last century by M. Lögg, of Vienna. It has no hands; the time is shown upon the dial in an ingenious as well as a very simple arrangement. It has an upper silver dial on which is chased a group, said to be a representation of Saturn dragging the car of Helios. As may be seen by the illustration (Fig. 95), there is above the group on the silver dial a semicircular slit or opening, through which is visible a second dial lying under it. This second dial is gilt, for contrast. Above the opening of the silver dial are engraved the minutes from 1 to 60, and underneath it the quarter-hours I. to IV. The lower dial is movable, and revolves once in two hours. This dial has two circular openings lying exactly opposite to each other, through which the figure of the hour appears upon a silver disc. For this purpose a fixed pin is fastened upon and near the edge of the front plate, over which the dial revolves. The dial passes freely by it, while the projecting teeth of the two figure wheels in turn strike against the pin, and as the dial revolves the figure wheels are each time advanced one hour (see Fig. 96). As

Fig. 95.

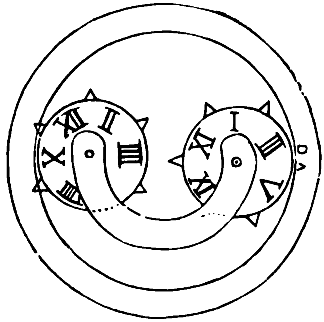


Fig. 96.

the dial with the two discs revolves once in two hours, one of the discs passes each hour by the stationary pin upon the plate, and, as already explained, is pushed forward one hour. Let us suppose, for instance, in the opening under which is located the disc with the even figures, we see the number II., as in the engraving, Fig. 95. This number has entered from the left into the semicircle of the silver dial, through which it slowly passes in one hour, while the other figure wheel (which is during the same time under the Saturn group, and therefore invisible), with the odd figures, passes by the stationary pin, and is by it turned one tooth, or from I. to III. When the number II. has passed its course through the semicircle it disappears to the right under the Saturn group, and the number III. enters from the left into the semicircle, in order to pass through its course in the same manner. The disc with the escaped hour II. meanwhile keeps on its way invisibly, passes the stationary pin, and is also turned one tooth further on, so that at the next hour it enters again with the number IV. from the left into the semicircle of the silver dial. This procedure is, of course, repeated every hour in the same manner. It is but just to say that the mechanism of the old master will bear comparison with the devices of later date.

"Fencing Soldiers'" Watch.

THE subjoined engravings show a watch of very peculiar construction, which was made during the last century, and was at one time in the Marfels Collection. The dial is metal plate, blue enamelled, with thin white lines, upon which is fastened two quadrants. Upon one of them is marked the hours from I. to XII., and upon the other the minutes from 1 to 60. It also bears two chased figures of soldiers in a fencing attitude, one on each side of the quadrants. By pressing upon the crown, the soldiers draw their swords, the one to the left pointing with his sword to the hour, while the one to the right points to the minute upon their respective quadrants. The construction is shown in Fig. 98, where the movement is shown without the dial. Upon the arbor of the wheel, which is usually in the centre, is the cannon *a*, upon which is fixed the snail used for determining the minutes. The cannon drives in the ordinary manner a minute wheel, the pinion of which depths in a wheel located to one side, which it rotates once in twelve hours. Upon the latter wheel is fastened a snail for determining the hour. When the pendant is pressed down, the two levers *b b* are first unlocked, which unlocking actuates the four racks *c c* and *e e*, each two of which depth together into pinions *f f*. Upon the arbors of the two pinions *f f* are placed the arms of the soldiers. By the unlocking of the levers *b b*, the racks *e e* (situated above the centre of the plate), freed from the arm *d d*, are then moved upward by springs operating on them. The pinions *f f*, into which the racks depth, turn an appropriate distance, and with them the arms of the soldiers, which are located on the pinions, and thereby carry with them downward at the same time the lower stationary racks *c c*. These racks *c c* are provided with projections, which in their downward motion finally strike upon the snails, the one to the left lying upon the hour rack, and that to the right upon the minute rack. When the pressure upon the pendant is removed, all the parts of the motion work, and with them also the arms of the soldiers, are by a spring brought back to a position of rest.

FIG. 97.

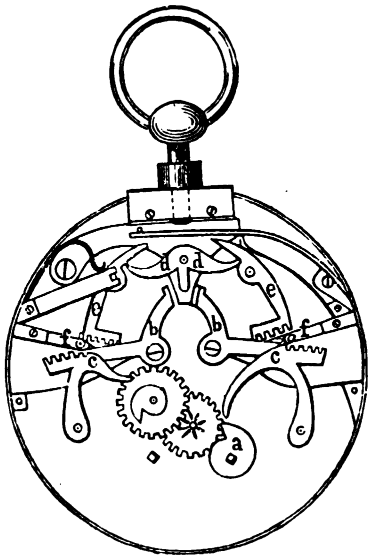


FIG. 98.

The cannon pinion *a*, fitting with gentle friction upon the centre wheel arbor, is provided with a setting square passing through the dial, for the purpose of setting the motion work mechanism.

The Progression of English Domestic Clocks.

THE manufacture of chamber clocks for domestic use, as distinguished from the costly and highly decorated timekeepers made for public buildings, or to gratify the tastes of the wealthy, seems to have commenced about 1615 or 1620.

These chamber clocks were of the pattern known as "lantern," "birdcage," or "bedpost." They were supported on a bracket,

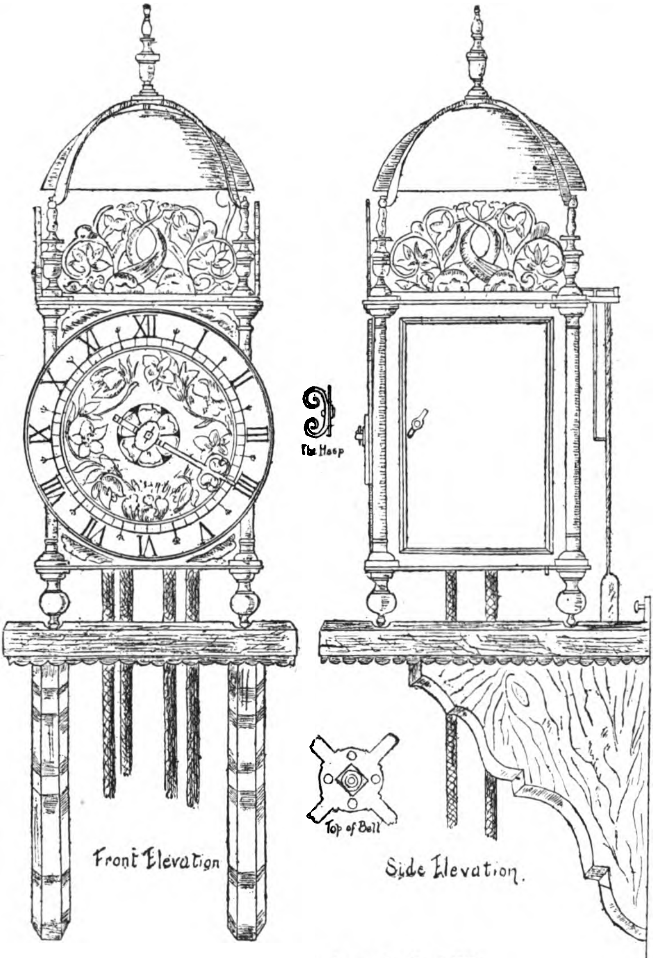


Fig. 99.—Lantern clock, 1670.

and wound by pulling down the opposite ends of the rope to that from which the driving weights were hung. In some instances all the hours were struck in regular progression on the bell surmounting the structure, and sometimes the bell was only utilized as an alarum. In all cases the second train, for actuating the hammer, was placed behind the train for the watch, or going part. The framing was composed of four corner posts connecting top and bottom plates, the pivots of the trains being supported in vertical bars. All had trains calculated for going 30 hours. At first the escapement with vertical verge and a balance as in De Vick's clocks was used as the controlling medium, the verge being usually suspended from a string.

About 1661 the pendulum was introduced, and quickly superseded the balance. The escape wheel was then as a rule planted to work in a horizontal plane, the pendulum being attached to the verge. The pendulum was arranged either between the two trains of wheels or behind, according to the fancy of the maker. The alternate appearance of the pendulum weight at each side of the case led to its being called a "bob" pendulum, and pendulums of this kind as still known as bob pendulums, in contradistinction to the longer variety which at a later period, and with the anchor ecapement, vibrated in a much smaller arc.

The movement was enclosed at the back with a brass plate; at the front with the dial, also of brass, with silvered hour circle and engraved numerals; at the sides with brass doors, and when the pendulum was between the trains, a slit was cut in each door for the pendulum to "bob" in and out of.

The size of the lantern clocks varied from about three inches by two and a half inches to five inches square. The engraving on page 169, taken from a small specimen made about 1670, is drawn to one-half of the real size. The larger movements were more favoured at the end of the seventeenth and beginning of the eighteenth century; but no absolute rule can be laid down, for I have seen a splendid specimen, five inches square, by William Bowyer, who appears to have been one of the first members of the Clockmakers' Company, and probably was a maker even earlier. It is inscribed, "William Boyear, in Ledenhall Streete, fecit." The movement of this clock is arranged in the usual manner, the striking train behind the going, and working in three upright bars. It requires a great length of rope to go thirty hours, as each of the main wheels makes one rotation per hour. The original vertical escapement, as usual, has been removed; but from parts remaining it can be seen that it was identically the same as the drawings of De Vick's. The wheels and pinions, as one sometimes finds, are very little cut, and though evidently rounded by hand, seem beautifully correct, and run easily without chattering. The hour wheel is driven by a pinion of four, the end of the main wheel staff being filed up into four pins to serve the purpose. The doors of the case, which seem to be the original ones, are made of old sun-dial plates, which were, as is generally known, common previous to the introduction of clocks. The dial is very quaintly engraved and thickly coated with gold, having stood unimpaired until the present time, being a great contrast to the other parts of the case, which are green with age.

In the history of the Clockmakers' Company it is recorded that in July, 1642, "Mr. Bowyer did present one great chamber clocke to the Company." This gift is not among the Guildhall Collection, and it would be interesting to know what has become of Bowyer's "great chamber clocke."

In the earliest of these clocks it will be noticed that the hour circles are narrow and the numerals stumpy, the frets round the bell at top usually having a shield for the crest or initials of the owner. About 1630 the maker's name was often engraved along the base of the fret; later, the name was inscribed at the top or bottom of the centre of the dial, just within the hour ring; or placed out of sight under the alarum plate, the latter practice leading to the assumption that the clock was to be sold by some one other than the maker. Then the hour circles were made wider, and the numerals longer, and the fret with the crossed dolphins came into use. It is probable that nearly all the ordinary makers had their materials from the same foundry, or imitated the original design very closely. Occasionally a maker seems to have had frets of an exclusive design, of which one or two examples are given.

The next alteration in lantern clocks, which was certainly no improvement to their appearance, was to increase the size of the dial, so that it projected as much as from two to three inches each side of the frame. Clocks of this form are commonly termed "sheep's-head." A great number of them appear to have been made in the latter part of the reign of William III., and in the time of Queen Anne.

With such little variations in the style, these brass clocks seem to have been made from the time of Elizabeth until about the beginning of the reign of George III., the later specimens being

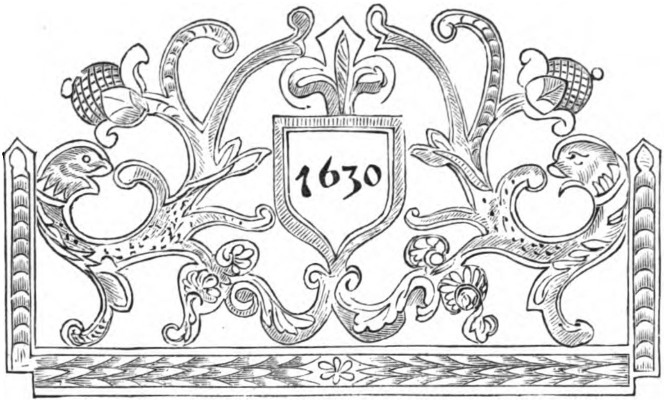


FIG. 100.—Heraldic.

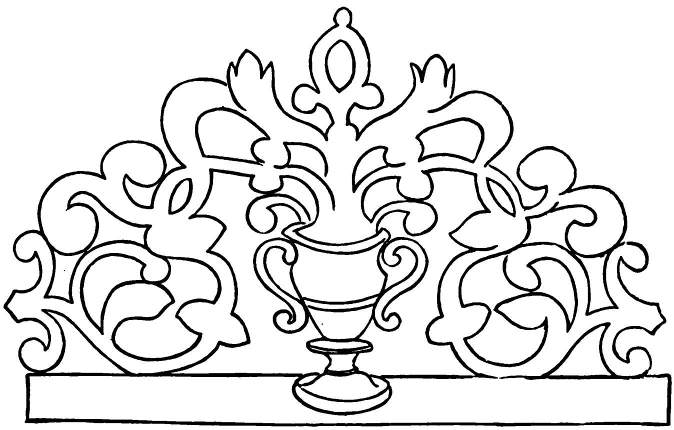


FIG. 101.—The fret of William Bowyer.

principally of provincial manufacture, and with square arched-top dials.

They are still often to be met with in the country, enclosed in a wooden hood as a protection from dust, with pendulum and weights hanging below. Sometimes they are without any extra case, and instead of being placed on a bracket, are simply attached to the wall by means of an iron loop and two prongs.

The "fret" at the top of the case may in many instances be

FIG. 102.

FIG. 103.—The fret of Thomas Pace at the Crown.

somewhat of a guide in estimating the period of a lantern clock. Appended are some examples, for which, and for much other information, I am indebted to Mr. Percy Webster, of Loudoun Road, St. John's Wood, who is an authority on ancient clocks and watches.

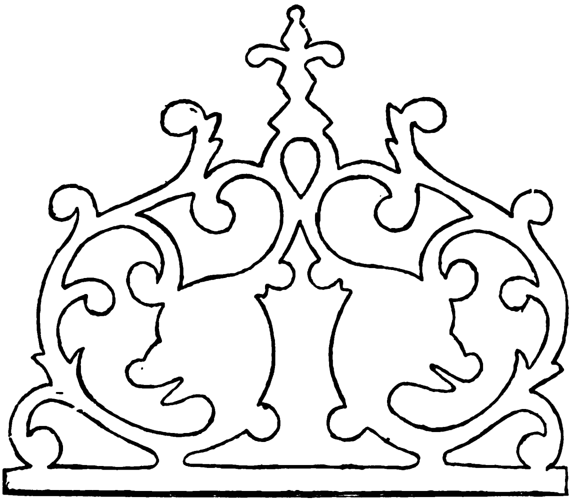


FIG. 104.—The fret of Thomas Loomes.

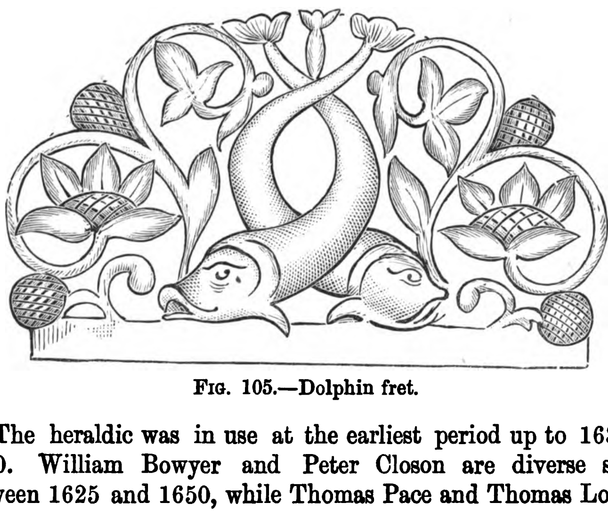


FIG. 105.—Dolphin fret.

The heraldic was in use at the earliest period up to 1630 or 1640. William Bowyer and Peter Closon are diverse styles between 1625 and 1650, while Thomas Pace and Thomas Loomes may be taken to represent the period between 1630 to 1660. The crossed dolphins came into use about 1650, and were a favourite

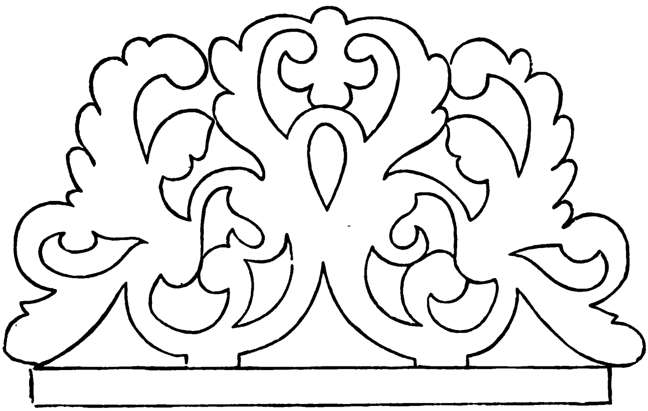


FIG. 106.—Late period fret used especially in the Eastern Counties.

pattern from then as long as lantern clocks were made. Fig. 106 is found upon later specimens, particularly those made in the Eastern Counties.

Long-case Clocks.

THE brass chamber clock with the wooden hoods developed into the long-case eight-day clock now familiarly termed "grandfather" towards the close of the reign of Charles II.; and although veritable specimens of that period are very rare, examples, between then and the close of the seventeenth century, are occasionally to be seen.

Some of these primitive "grandfathers'" were exceedingly narrow in the waist, only just sufficient width being allowed for the rise and fall of the weights. The escapements were either of the ancient balance or bob pendulum description. A curious addition to these cases is sometimes seen in the form of wings or projections on each side of the waist, to permit the swing of a long or "royal" pendulum, when it came into general use about 1680. As the conversion was a simple process, it is now very difficult to meet with an example having the original balance escapement.

But for a few exceptions that mark the rule, the long-case clocks have the movement contained between two brass plates held together by horizontal pillars. This change came with the rearrangement of the trains side by side, to allow of winding with a key from the front of the dial. The earliest were small in size, with square dials, and had no door to the hood, which had consequently to be taken off completely before the clock could be wound. The cases were frequently covered with marqueterie work of more or less artistic merit, most likely the production of the many Dutch artists who were settled in London at that time. Corkscrew pillars at the angles of the hood were also a distinguishing mark of the period, and were often used in the reign of Queen Anne. Sometimes these cases had a bull's-eye of bottle-glass let in the door opposite the pendulum bob, causing a peculiar appearance as it swung to and fro, the bob being magnified and distorted in appearance when seen through the glass.

The hour circles on the dials have many distinguishing marks. To a close observer particularly it will be noticed that in the earliest specimens the inner circle is retained, dividing the hour into quarters, the half-hour being shown by a longer stroke, terminating in a "fleur-de-lys" or similar ornament. This form of circle was used before the adoption of the minute hand, but, being found unnecessary, was soon abolished; the minute divisions on the outer edge had, besides the numerals denoting the number of minutes, a cross or dagger marking the half-quarters. There was no lack of engraving on the early dials, especially on those of the William III. and Queen Anne periods. Round the edge was often a "herring-bone" or laurel-leaf border, and on the "matting" in the centre, something in the form of birds and foliage bordered the aperture showing the day of the month; this had a very good effect when burnished bright in contrast to the matting. Further relief was given by turning a number of rings round the winding-holes. On the early clocks of the seventeenth century the maker's name will be found in Latin under the circle on the bottom of the dial, thus,—"Henricus Jones, Londini, fecit;" later it was engraved on the circle between the figures VII. and V. About 1715 name plates appear to have been first used, and individual makers used their own discretion in the matter, the Latin inscription going out of use excepting for such popular mottoes as *Tempus fugit*, *Tempus edax rerum*, etc.

The addition of the arch to the dial was a great improvement to its appearance. It is first seen in some of Tompion's later clocks, and was very generally adopted for the better class of work in the time of George I. Old square dials will often be found to have had the arch added, the square and arch being made in separate pieces and riveted together. The idea may have come from the old lantern clocks, for the form and decoration of the arch resemble the fret at the top in front of the bell, which was used in some of them, especially those with the favourite dolphin pattern. Why the old clockmakers were so attached to this conventional device does not appear to be recorded, but dolphins were for a long time retained as an ornament to the arch dial, one being engraved on each side of a domed plate on which was inscribed either the owner's or the maker's name, occasionally with a crest or motto. The strike-silent hand was a later addition.

During the latter part of the eighteenth century there was a great taste for moving figures placed in this part of the dial, such automata as see-saws, heaving ships, time on the wing, etc., being especially favoured.

The date of the introduction of plain silvered and painted dials may be put down as about 1780; those having engraving instead of matting in the centre are earlier, and will be found on clocks made about 1740.

Calendar circles in the arch of the dial were very popular. The hands for these were generally worked as shown on p. 178. Gearing with the hour wheel is the wheel having twice its number of teeth, and turning therefore once in 24 hours. A three-armed lever is planted just above this wheel; the lower arm is slotted, and the wheel carries a pin which works in this slot, so that the lever vibrates to and fro once every 24 hours. The three upper circles in the drawing represent three star wheels. The one to the right has seven teeth corresponding to the days of the week; the centre one has 31 teeth for the days of the month; and the left-hand one has 12 teeth for the months of the year. Every time the upper arms of the lever vibrate to the left, they move forward the day of the week and day of the month wheels each one tooth. The extremities of the levers are jointed, so as to yield on the return vibration, and are brought into position again by a weak spring, as shown. There is a pin in the day of the month wheel which, by pressing on a lever once every revolution, actuates the month of the year wheel. This last lever is also jointed, and is pressed on by a spring, so as to return to its original position. Each of the star wheels has a click or jumper kept in contact by means of a spring.

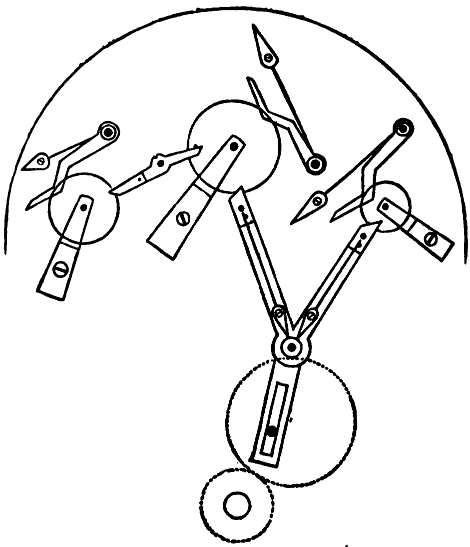


FIG. 107.—Simple calendar work.

For months with less than 31 days the day of the month hand has to be shifted forward.

The phases of the moon, usually accomplished by a disc turning once in two lunations, as shown in Enderlin's clock on p. 112, was also a favourite device for the arch of the dial.

The raised ornamental spandrels or corners are another sign of the times in connection with the dial. The earliest were the cherubs or angels' heads (Fig. 108). This pattern will be seen on the clock represented in the coat-of-arms granted to the Clockmakers' Company in 1671, and was largely used until the end of the century. It was succeeded by the larger and more elaborate pattern (Fig. 109). Then more ambitious designs came into use, notably two Cupids or nude boys supporting a crown in the

FIG. 108.

FIG. 109.

midst of ornamental scroll-work (Fig. 110); or a crown with crossed sceptres and foliage, as in Fig. 111. This is an unusually

FIG. 110.

fine specimen taken from a clock by W. Draper, *tempo* Queen Anne. These well-known patterns were followed later in the

FIG. 111.

eighteenth century by various combinations and those of a rococo character, such as Fig. 112, until we come to the degenerate patterns of the George III. period (Fig. 113), when many were rough castings never touched by a chasing tool after leaving the sand. Traces of water-gilding will often be found on those first made, clearly showing that such clocks were only for the wealthy.

Soon after the pendulum was introduced, concentric minute hands were commonly applied, although one-hand clocks con-

Fig. 112.

tinued to be made to a much later date, especially by makers in country districts.

The hands on eight-day clocks of the William III. period are most artistic, not only being elaborately pierced, but also carved and shaped on the surface.

Fig. 113.

The success of eight-day movements induced clockmakers to calculate trains to go for a month and even a year, of which there are several examples by Tompion and Quare.

It will be noticed in the striking part of the eight-day clocks made before the invention of the rack, about 1675, the locking-plate or count wheel was on the outside of the pillar plate; those fixed on the great wheel, though later, cannot be dated from any particular period. When the rack was first introduced it was placed between the plates and lifted by a pin in the arbor, instead of a gathering pallet. This method does not seem to have been used later than 1700, the outside rack being found so much more convenient.

As material for the cases, oak has been used from first to last, but rarely for high-class work. Walnut cases, both plain and inlaid, were largely made during the latter part of the seventeenth and beginning of the eighteenth centuries. Numbers of cases with the English copy of quaint-looking Japanese or Oriental lacquer work were made about 1745, but the most highly prized cases are those of mahogany in the Chippendale and Sheraton styles, inlaid with satinwood, etc.

As an example of the better class of early long-case clocks, a drawing of one by Tompion is given on p. 182. The case is of walnut, and has a rather tall plinth and narrow body; on each side of the dial the fluted pillars which distinguished the period, and a handsome carved ornament surmounting the entablature. An unusually fine specimen of a square-headed clock-case with the Oriental lacquer work decoration in relief, is also shown on p. 182. The clock is by Anthony Marsh, who was free of the Clockmakers' Company in 1726, and it may be assumed to have been made about 1746; that is, twenty years after he took up his freedom.

Chippendale. An example of what is generally accepted as an orthodox Chippendale case is represented on p. 183. It is not easy to define exactly what constitutes a Chippendale case, nor why cases of this pattern should be ascribed to Chippendale. Thomas Chippendale was a noted upholsterer and cabinet maker in St. Martin's Lane. He published a splendid folio book of designs, of which three editions appeared between 1755 and 1763. In it there are representations of two long-case clocks, two bracket-clocks, a cartel case, and two other small wall timepiece cases. They are all of a very ornate description, the long ones carved very much in the French style, as Figs. 82, 83, delineated on p. 153. One of the bracket-cases is domed, and resembles the Elizabethan example on p. 43; the top of the other is pyramidal with hollow curved sides. The characteristics of the cases now generally known as "Chippendale" are the pillars or pilasters rising at the front corners of the case, from the plinth to the entablature under the hood, and the corresponding pillars at the front corners of the hood. Generally the bases and caps are of

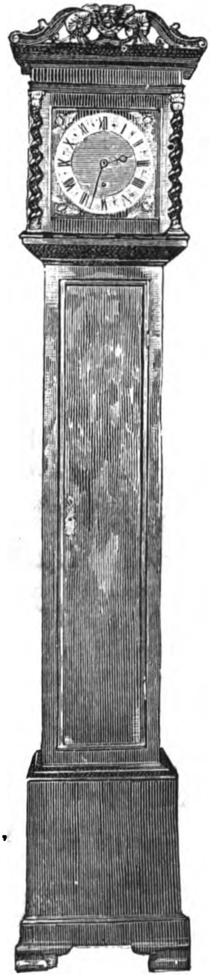


Fig. 114.—Early long-case clock by Tompion, about 1680.

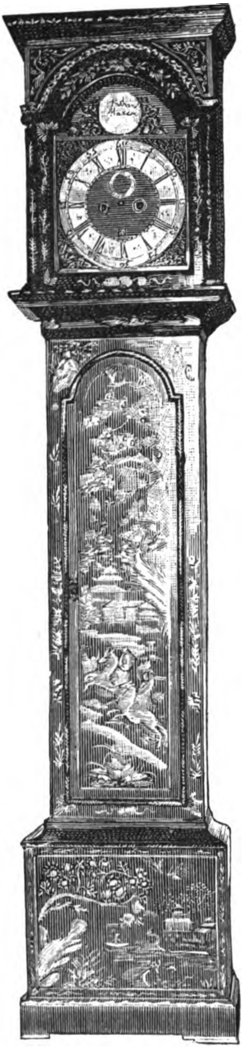


Fig. 115.—Oriental lacquer-work case, about 1746.

metal, and the shafts fluted. The case is much higher than the dial, and may be of the pattern shown in the engraving, which is considered the more correct, or of the horn-top kind, in

FIG. 116.—Chippendale case.

FIG. 117.—Sheraton case.

which the upper part terminates in two carved "horns," curving inwards.

Sheraton. In 1803 was published "The Cabinet Dictionary," by Thomas Sheraton, of which another edition appeared in 1808. No mention is made of clock cases in this work, but the ornate style and beautiful inlaid work associated with Sheraton have been very successfully applied by clock-case makers. The popularity of Sheraton cases has never waned. A very good idea of an elegant example may be gathered from the drawing on p. 183.

Duties on Clocks and Watches.

"Act of Parliament Clocks." IN 1797 a tax was imposed on all persons in respect of the possession and use of clocks as well as watches.

The Act ordained that—

"For and upon every Clock or Timekeeper, by whatever name the same shall be called, which shall be used for the purpose of a clock and placed in or upon any dwelling house, or any office or building thereunto belonging, or any other Building whatever, whether private or publick, belonging to any person or persons, or Company of Persons, or any Body Corporate, or Politick, or Collegiate, or which shall be kept and used, by any Person or Persons in Great Britain, there shall be charged an Annual Duty of Five Shillings. For and upon every Gold Watch, or Watch enamelled on Gold, or Gold Timekeeper used for the Purpose of a Watch by whatever Name the same shall be called, which shall be kept, and worn, or used, by any Person or Persons in Great Britain, there shall be charged an Annual Duty of Ten Shillings. And for and upon every Silver or Metal Watch, or Silver or Metal Timekeeper used for the purpose of a Watch or any other watch, or Timekeeper used for the like purpose, not before charged, of whatever materials the same shall be made, and by whatever name the same shall be called, which shall be kept and worn, or used, by any Person, there shall be charged an Annual Duty of Two Shillings and Sixpence."

It requires an effort to realize that such an impost prevailed here less than a century ago. Among the other provisions of the Act was one declaring that every watch or clockmaker or dealer in the cities of London and Westminster, the parishes of St. Marylebone and St. Pancras, the Counties of Middlesex and Surrey, shall pay an annual duty of two shillings and sixpence. In any other part of the country such a maker or dealer was let off by paying a shilling duty.

The produce was far from reaching the estimated yield, while the operation of the tax was such as nearly to ruin the manufacturers. The demand for clocks and watches decreased to such an extent, that in less than a year the general manufacture of these articles in the kingdom, and the various branches of trade connected therewith, had diminished by half, and thousands of persons were deprived of employment. It is not therefore surprising that the Act was repealed in April, 1798.

A writer in *Notes and Queries* mentions that he met with a printed form of receipt for a half-year's taxes, due from a small farmer in Essex, in which occurred the item, "For clocks and watches, 5 . 7½." The receipt was dated April 10, 1798, the month in which the Act was repealed.

Although the imposition of this obnoxious tax paralyzed the horological trades, it had the effect of creating one new kind of timekeeper, for tavern keepers, anticipating a scarcity of timekeepers among individuals, with one mind seem to have adopted a bold mural timepiece for the benefit of those who visited their public rooms. These "Act of Parliament Clocks," as they were called, had a large dial of wood painted black, with gilt figures, not covered by a glass, and a trunk long enough to allow of a seconds pendulum. In country inns an Act of Parliament Clock may still occasionally be seen.

Bracket or Pedestal Clocks.

BRACKET or pedestal clocks, with enriched cases, as distinguished from the plain metal covering of the ordinary chamber clock, were in favour before the advent of the long-case variety.

The earliest English wooden bracket clock cases were of the square pattern, at first usually with a flat top, and afterwards with a pediment, as in the arms of the Clockmakers' Company, or else surmounted by a rounded projection of wood, into which was fixed a brass handle, generally more or less enriched.

Then came the domical top, occasionally varied into the "basket" form, which consists of a flat domical top of perforated metal.

Next in order are the "bell" shape, from the hollow curved character of the top, which was surmounted usually by a rather plain brass handle, and the "lancet," in the form of a Gothic arch, and named from its resemblance to the well-known cutting instrument used by surgeons.

These were succeeded by the "broken arch," in which the upper part is a semicircular arch less in diameter than would be required to reach the piers on each side of the dial, and therefore connected therewith by short horizontal bands.

It is remarkable with what pertinacity some people cling to old customs. Lantern clocks were made long after the long case was introduced. Indeed, one occasionally sees an adaptation of the bedpost movement to the needs of the later construction, the two trains being placed side by side to allow of winding with a key from the front, but with six pillars instead of the more simple and convenient back and front plates.

Then, in the old four-post Dutch movements, made at the beginning of the last century, a long while after the adoption of the pendulum, the crown wheel and verge were retained in a vertical position, and the pendulum was suspended above the movement at the back of the case, quite detached, and connected with the escapement only by means of a light wire crutch, working horizontally over the frame. Owing to this peculiarity, clocks of such a construction are often supposed to be much older than they really are, especially if, as occasionally happens, the pendulum gets removed or lost; for when this occurs, the remaining part of the movement almost identically resembles the drawings of De Vick's clock.

Another instance of the slow appreciation of improvement is the very gradual acknowledgment of the minute hand. Clocks with an hour hand only were produced by country makers till quite the end of the eighteenth century. The demand for verge watches continued till late in the present century. Verge watches were made in Clerkenwell till 1882, and then only ceased because the verge finishers died out. The last specimens had lever balance cocks, only because there was no one left to make the orthodox pattern.

Electric Clocks. Electric clocks may be divided into four classes. (1) Clocks in which electricity is used to impel the pendulum or turn the hands, so that periodical winding of a spring or weight is dispensed with; (2) clocks that are driven by a weight or spring and wound in the usual way, but in which the vibrations of the pendulum are controlled by currents transmitted automatically from a standard timekeeper; (3) clocks wound by electricity; and (4) clocks in which the mechanism is quite uncontrolled, but the proper position of the hands is ensured by periodical electric currents from a standard.

Alexander Bain, in 1843, invented (patent 9754) a system of driving clocks and keeping a number of them in circuit going to time by an electric current applied to the pendulum.

Sir Charles Wheatstone also devoted attention to the subject, and patented, in 1858 (No. 1241), a system of synchronous clocks in circuit.

Mr. Charles Shepherd, Mr. F. J. Ritchie, and many others, have also elaborated methods for attaining the same end.

Mr. Henry Campiche, one of the latest inventors in this direction, dispenses with the clock train altogether. On the pendulum rod, just above the bob, he places an arm, which, once a minute or at other prearranged intervals, receives, through the armature of an electro-magnet, a sufficient impulse to maintain its vibrations. On the pendulum rod, but near the suspension, is a springy arm or detent, which at each vibration of the pendulum in that direction moves forward one tooth of a ratchet wheel. This wheel carries an arm, which completes the electric circuit once or more every revolution, and so causes the movement of the impulse armature. This ratchet wheel may carry a hand to show seconds and other indicators, and motion work may of course be added. A battery is used to provide the current, and other clocks in circuit may be actuated by means of a ratchet wheel on the hand arbor moved round by the armature of an electro-magnet acting on a click.

It is clear that if the current fail in clocks of the first class, not only do they cease to register, but on the resumption of the current they start with the error accumulated during its cessation. Mr. R. L. Jones, recognizing the difficulty of driving clocks by electricity, proposed to control the vibrations of the pendulum by attaching to its lower end a magnet which passed through a coil at each vibration. A standard clock with the same length of pendulum as those controlled was caused to transmit currents which accelerated or retarded the motion of the controlled pendulums according as their vibrations were a little too slow or a little too fast. This system works very well in the Greenwich Observatory, where the circuit is short, and constant attention is paid to the electric apparatus; but the late Mr. C. V. Walker, after many years' trial with a clock at London Bridge, controlled from Greenwich, pronounced it to be impracticable. If the current failed long enough for the controlled pendulum to get one beat out, the controlling apparatus had no means of setting the clock right again.

In Pond's electric clock a motor attached to the frame winds the weight or spring once an hour or after other periodical intervals, the motor being started by an arm, which, carried round by the train, completes the electric circuit on arriving at a certain point; when the barrel has made nearly a rotation a projection from it strikes the arm away, breaking the contact and stopping the motor. The motor is actuated by one or more Leclanche or other cells. This invention, though regarded favourably when introduced, a few years ago, does not seem to have been largely adopted in England.

In London the Standard Time Company adopted a system, invented by Mr. John A. Lund, of setting clocks right by sending an electric current from a master clock which causes two clips to close on the minute hand of each clock in the circuit exactly at each hour, so that if the hand is in advance of or behind the twelve on the dial, the clips adjust it to its proper position.

Another means used to bring the hand to the twelve is a heart-shaped cam attached to the pipe that carries the minute hand, against which a lever with a pointed end is made to press exactly at the hour. This forces the cam into its lowest position and the minute hand to the twelve.

Pneumatic Clocks. In the Popp-Resche system used in Paris for public clocks, air, dried by passing over lime, is pumped into strong iron reservoirs to a pressure of about 40 lbs. per square inch. From these reservoirs a constant pressure of 10 lbs. per square inch is maintained in a closed vessel from which the air is used for driving the clocks. Behind the dials of the public clocks is a ratchet wheel fixed to the arbor of the minute hand, as in the appended sketch. A click, working into this ratchet wheel, is pivoted to a lever whose extremity is attached to a bellows of thin metal. Pipes are laid to all the public clocks, and at the completion of every minute a master clock at the central station opens communication between the supply vessel and the bellows, the pressure of air expands the bellows, and the ratchet wheel is advanced one tooth.

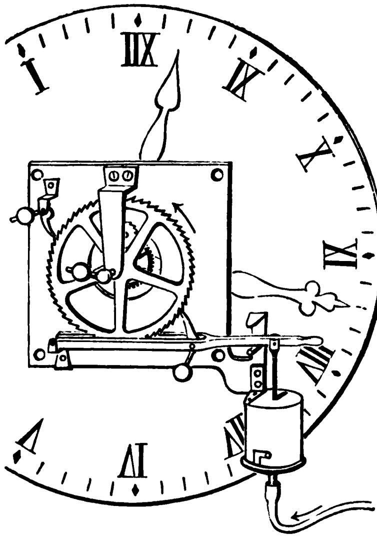


FIG. 118.

Compressed air is probably more reliable in its action than electricity, and the mechanism needed is simple; but the time occupied by the transmission of signals appears to preclude its use for clocks at any considerable distance from the central station, if absolute exactness is required.

Fan or Windmill Clocks. Fans actuated by currents of air have been from time to time used as motors for actuating timekeepers. In Dardenne's patent the weight is wound up by the current of air in a chimney acting upon the blades of a fan, which is stopped by a self-acting brake as soon as the weight nears the top of its course.

A clock on this plan was at work in London a few years ago, and seemed to perform satisfactorily.

Horstmann's Self-winding Clock. Here the expansion and contraction of a liquid are used to wind the clock.

A strong metal vessel, A in the figure, is filled with an easily expanding fluid, such as benzoline, mineral naphtha, etc. Connected to this vessel by a strong tube with a very small bore are a cylinder and piston, B and C. Owing to the fact that most expanding fluids are incapable of driving a piston, being too volatile and thin, the cylinder and tube are charged with a thicker and more of a lubricating fluid, such as glycerine. The vessel containing the expanding fluid is on a higher elevation than the piston and cylinder. This is done to prevent them mixing, as benzoline is lighter than glycerine, and, therefore, rises to the top. It is easy now to see how that when the temperature rises the expanding liquid will force the piston upward, and, by means of a slight counterforce, the piston will fall on the temperature lowering.

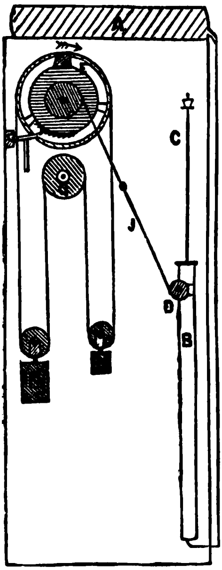


FIG. 119.

The piston terminates in a cross-bar, to each end of which is attached a steel ribbon like a wide watch mainspring. These two bands are brought down over pulleys at D, fixed on each side of the cylinder, and then carried direct to the winding mechanism, E, of the clock, which is all fixed on the back of the case and independent of the movement. The two bands join into one a little before they reach the winding. A large pulley, E, is fitted on a stud at the back of the case, and is driven by means of a ratchet and click. The pulley E has a flat groove, and is studded with short pins at equal distances apart, over which works a long steel ribbon perforated with oblong holes. This chain passes down through the weight pulley F, which also has a flat groove, but no pins, and is carried over the main wheel pulley G, which is supplied with pins, the same as the winding pulley. It then passes under the pulley of the counterweight H, and is then joined to its other end, thus forming an endless chain. As the piston falls a coiled spring causes the smaller pulley at the top of the case to turn independently of E, and to coil the band J on to itself ready for the next rise of temperature.

The Pendulum.

IT is not certain who first used the pendulum as a controller for clocks. Galileo, the famous astronomer in 1582, remarked the synchronous vibrations of the lamps suspended by long chains from the roof of the cathedral at Pisa, and it is said that when blind he dictated to his son Vincent a method of using the pendulum as a timekeeper, which the latter carried out in 1649. From the drawing of this contrivance it seems to have been merely a train of wheels and a rude escapement to keep a pendulum in motion, in order to determine the time by counting its vibrations. A working model of it is to be seen at South Kensington Museum.

Then it is stated that Richard Harris constructed a turret clock with a pendulum for the church of St. Paul's, Covent Garden, which has since been burnt down. The authority for this statement rests chiefly on an engraved plate affixed in the vestry-room of the old church, with the following inscription on it:—

"The turret clock and bells of this church were made, A.D. 1797, by Thomas Grignon, of Great Russell Street, Covent Garden, the son and successor of Thomas Grignon, who (A.D. 1740) brought to perfection what the celebrated Tompion and Graham never effected, viz. the horizontal principle in watches and the dead beat in clocks, which dead beat is a part of the mechanism of the turret clock. Thomas Grignon, senior, made the time-piece in the pediment at the east end of this parish church, destroyed by fire A.D. 1795. The clock fixed in the turret of the said church was the first long pendulum clock in Europe, invented and made by Richard Harris, of London, A.D. 1641, although the honour of the invention was assumed by Vincenzio Galilei, A.D. 1649, and also by Huygens in 1657. This plate is here affixed by Thomas Grignon, of this parish, the son of the above Thomas Grignon, as a true memorial of praise to those two skilful mechanicians, his father and Richard Harris, who, to the honour of England, embodied their ideas in substantial forms that are most useful to mankind."

It would be idle to treat this as conclusive evidence in favour of Harris; still it is entitled to consideration, for the elder Grignon alluded to was regarded as a man of integrity. He was a contemporary and friend of James Ferguson, and one of the first members of the Society of Arts, to which society he presented a regulator in the year 1759, which is yet to be seen at the house of the society in the Adelphi. Besides, that Galileo's observation would be followed by the application of a pendulum to a clock is only just what might have been expected. The weak part of the claim on behalf of Harris is that his application of a superior controller should have remained a solitary instance for twelve years or so, and have evoked no attention from scientists and others interested in the subject.

Huygens, it is certain, studied the action of the pendulum between 1650 and 1655, and demonstrated the fact that the path described at the centre of oscillation should be a cycloid for vibrations of varying extent to be passed through in the same time.

Dr. Hooke also saw the advantage of the pendulum about the same time, and proceeded to apply it.

Fromanteel and others have also been named with confidence by their respective admirers as being entitled to the honour of introducing the pendulum; but indisputable proof of any one's claim to originality in the matter there is none, and it is therefore useless to pursue this part of the subject further.

A pendulum drawn aside from its point of rest and then released, is impelled by gravity to fall at once to its lowest possible point, and but for the momentum acquired in falling it would remain there at rest, but its momentum carries it up as far on the other side as it fell at first through the action of gravity. The length of the pendulum determines the time occupied in its vibrations; a long pendulum moving slowly, and a short one quickly, because with a long pendulum the curve described at the centre of oscillation is flat, and with a short pendulum it is steep. The course of the pendulum bob attached to a long suspending rod, and that of one attached to a short suspending rod, may be compared to rolling a ball first down a slight decline, and then down a steep hill.

Gravity, a constant force, requires to act through four times the distance to impart twice the velocity to a body, and therefore a pendulum to vibrate twice as fast as another must describe a path four times as steep, and to attain this condition it must be but one-fourth the length of the first.

In estimating the time that a pendulum takes to vibrate, it must not be forgotten that after gravity has impelled it to its lowest position it takes just as long to rise on the other side as it did to descend, so that each vibration takes twice as long as it might be expected to do if the influence of gravity on it, as it descended, were alone considered. Then as the pendulum swinging freely describes nearly a circular arc, the time in which a pendulum vibrates bears the same relation to the time in which a body would fall through a distance equal to half the length of the pendulum, as the circumference of a circle bears to its diameter.

The mathematicians' simple pendulum, in which all the mass is supposed to be collected in a point at the centre of oscillation, and in which the suspending cord has no weight, does not, of course, exist in connection with clockwork. Clock pendulums are now suspended from a weak spring, and are adjusted to the exact length required by raising or lowering the spring at its upper attachment, or by varying the position of a rating nut screwed to the bottom of the rod, and on which the bob rests.

A clock has only to overcome the resistance of the air and the slight friction of the suspending spring in order to keep the pendulum going when it is once started; and although a heavy pendulum requires a greater force to start it than a lighter one, the retardation afterwards, due to the extra resistance of the air on the larger surface, is insignificant. As inaccuracies in the clockwork, currents of air, and other disturbing influences are likely to interfere with the regularity of a light pendulum, it is desirable always to use as heavy a pendulum as possible in reason.

The theoretical length at the sea level in London of a seconds pendulum for mean solar time—that is, the distance between the point of suspension and the centre of oscillation *—is approximately 39·14 in.; the length of pendulum for vibrating sidereal seconds in the same latitude is 38·87 in.

As the force that gravity exerts on a body depends on the distance of the body from the centre of the earth, the length of a pendulum varies in different latitudes. A seconds pendulum is 39 in. long at the equator, and 39·206 in. at the poles.

At Rio Janeiro	it is 39·01 inches.		At Paris	it is 39·13 inches.	
At Madras	„ 39·02	„	At Edinburgh	„ 39·15	„
At New York	„ 39·10	„	At Greenland	„ 39·20	„

The long and short vibrations of a free pendulum will only be isochronous if the path described at the point of oscillation is a cycloid, which is a curve described by rolling a circle along a straight line. But a pendulum swung freely from a point travels through a circular path, and the long arcs are performed slower than the short ones. The divergence from the theoretical cycloid was of importance when the arc described was large, as it was of necessity with the verge escapement, and many devices were tried to lead the pendulum through a cycloid. With an arc of about 3° only, such as regulator pendulums describe now, the divergence is very small.

Compensated Pendulums. With increase of temperature, the pendulum, in common with most other substances, lengthens; with decrease of temperature the contrary effect is produced. The object of the compensation pendulum is to meet the error arising from change of temperature by keeping the distance between the point of suspension and the centre of oscillation constant.

The admirable paper of Graham (pp. 92–95) proves that he

* The centre of oscillation is that point in a vibrating body in which, if all the matter composing the body were collected into it, the time of the vibrations would not be affected. In a straight bar suspended at one extremity, the centre of oscillation is at two-thirds of its length, and in a long cone suspended at the apex, at four-fifths of its length from the apex. From the irregular form of the pendulum, the position of its centre of oscillation is not easy to calculate, but it is always situated below the centre of gravity or centre of mass of the pendulum. Although not absolutely correct, it will be a close estimate to assume the centre of oscillation to be coincident with the middle of the bob.

thoroughly tested the ratios of expansion of most materials suitable for the construction of such a controller, and his ultimate selection of mercury as a compensating medium is quite justified by experience, though the zinc tubular construction has proved to be equally good.

Zinc Tube Compensation. Fig. 120 is a longitudinal section of a zinc tube compensation pendulum, similar in principle to those employed in the Westminster clock, and in the Standard sidereal clock at Greenwich. In the Greenwich clock the central rod and the outer tube are of steel, and the bottom half of the hole in the bob is enlarged to bring the seat to the middle of the bob, as in Fig. 120; the idea being that, as the bob by reason of its greater bulk answers more slowly to changes of temperature than the other members of the pendulum, it should be neutral as far as the compensation is concerned. In the Westminster clock the rod and outside tube are of iron, and the bottom surface of the bob rests upon the collar of the outer tube. Preference is now generally given to the centrally supported bob. Resting on the rating nut at the bottom of the rod is a drawn zinc tube, just large enough to slip easily over the rod. Outside the zinc tube, slipping freely over it, is a thin iron or steel tube, having at the top a cap recessed to fit the end of the zinc tube, with a hole in the centre of a size to slip freely over the central rod, and at the bottom an outer collar to form a seat for the bob.

The zinc tube is of such a length that, however much the central rod and outer tube expand downwards with an increase of temperature, the zinc tube expands upwards the same, and so the centre of oscillation remains unchanged. The usual length of zinc tube for a seconds pendulum is twenty-eight inches, the central rod of steel, and outer tube of iron.

Fig. 121 shows two side rods of steel substituted for the outer iron tube. They are of the same diameter as the central rod, and pass through a brass cap at the top, as shown. At their lower ends is a collar fitting loosely round the zinc tube, to form a seat for the bob. In other respects the pendulum is similar to Fig. 120.

In the foregoing description it will be observed that there is no means of adjusting the zinc tube to length, except by having it long, and then cutting it shorter as may be required. I have lately seen an old pendulum by Arnold on the plan of Fig 121, except that a thread was formed on the outside of the upper end of the zinc tube, and the collar supporting the outer rods had a

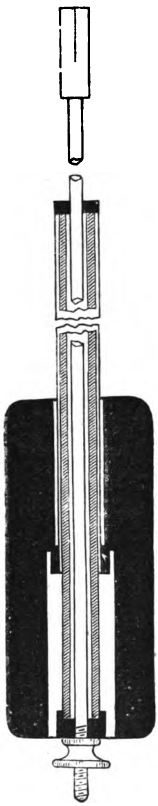


Fig. 120.

Fig. 121.

Fig. 122.

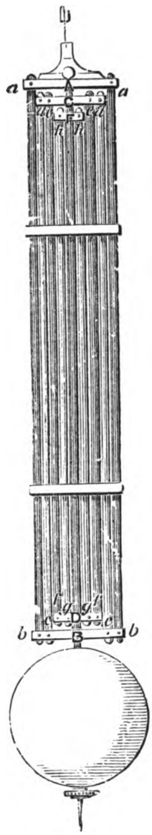


Fig. 123.

corresponding internal thread, and was screwed on to the zinc tube, so that the acting length of zinc tube could be adjusted by screwing the collar on or off. This seems a more rational way of proceeding.

Mercurial Compensation. In the mercurial pendulum with a glass jar, as originally constructed by Graham, the mercury does not answer so quickly to a change of the temperature as the steel rod; there is difficulty, also, in obtaining glass jars perfectly true. Preference is therefore now generally given to thin metal jars for precision clocks, although the elegant appearance of the glass jar in a stirrup causes it to be retained for regulators when a showy appearance is desired. In Fig. 122 is represented Graham's arrangement, with a little addition by Mr. Adam Reid for regulating the time without altering the position of the outer frame C C, D D, or the index, H; a second frame sliding within the first, and carrying the jar of mercury, F, is adjusted by means of the screw E.

Harrison's Gridiron Pendulum. This, shown in Fig. 123, is still the form of compensation adopted in many foreign regulators. It is composed of nine parallel rods, five of steel and four of brass, the total length of each kind being nearly as 100 to 60, that being the ratio of expansion of the two metals. Depending from the cross frame A are two rods of steel *a a*. The frame B, to which they are fixed at their lower extremities *b b*, carries also two brass rods *c c*, which at their upper ends, *d d*, are carried in the frame C, together with two other steel rods *e e*. Those at their lower extremities *f f*, are fastened in the frame D, which also carries the brass rods *g g*. The frame F carries the upper ends of this last pair of brass rods at *h h*, and also the central steel rod to which the bob is attached.

Wood Rod and Lead Bob. A cheap and good compensated pendulum may be made with a wood rod and lead bob. For a seconds pendulum the rod should be of thoroughly well-seasoned straight-grained deal, and coated with something to render it impervious to the atmosphere. It may be either gilded, varnished, or polished; but painting answers the purpose well. The bob, in the form of a hollow cylinder with the hole just large enough to go freely over the wood rod, rests on a washer above the rating nut.

Shorter pendulums for chime and other clocks are made of teak, mahogany, and ebony, simply because in such small sizes deal does not allow of sound attachments to the ends. These pendulums have generally lenticular-shaped bobs. Such rods cost scarcely any more than brass or iron, and are infinitely preferable.

It is essential that the grain of a wood pendulum rod should be perfectly straight, for if the grain is not straight, the rod is likely to bend, causing the clock to go very irregularly.

Importance of Fixing.

Whatever kind of pendulum is used, it will not keep time unless it swings from a rigid attachment.

Length of Pendulums.

One-second pendulums are long enough for all but turret clocks, and longer than two-seconds pendulums should not be used. The very long pendulums used by foreign clockmakers for turret clocks, in order to get, as they expressed it, "a dominion over the clock," were very unwieldy and unsteady, from the action of the wind and other causes. Vulliamy was the only English maker of repute who favoured long pendulums. The requisite "dominion" is better obtained by making the bob heavy, as was the practice of Graham.

Barometric error is the alteration in the timekeeping of a clock due to changes in the density of the atmosphere through which the pendulum has to move. It has been stated to be about a third of a second a day for a change of one inch in the barometer, but its effect is dependent on the arc of vibration of the pendulum and other circumstances. Chronometers and watches are doubtless affected from the same cause to a lesser extent. Experiments by Mr. Ellis showed that if a magnet were fixed vertically to a pendulum, just above the pole of another magnet attached to the clock case, the rate of the clock could easily be altered by causing the magnets to recede from or approach each other, as the attractive power of dissimilar poles caused it to gain. Taking advantage of this fact, he devised a barometric compensation (as shown in the engraving) for the standard sidereal clock at the Greenwich Observatory, where, I believe, it answers admirably. Two bar magnets, each about six inches long, are attached to the pendulum bob, one behind and one, *a*, in front, with their dissimilar poles towards a horseshoe magnet *b*, carried by a lever resting at A on knife edges, so that the horseshoe is *always* attracting the pendulum and increasing the acceleration due to gravity, having of course its least effect when most distant. The poles of the horseshoe are exactly under the bar magnets and about 3·75 in. below them. At the other extremity of the lever is a rod *d* carrying a float *e*, which rests on the mercury in the short leg of a barometer, as shown. The area of the cistern part of the short leg is four times the area of the upper part of

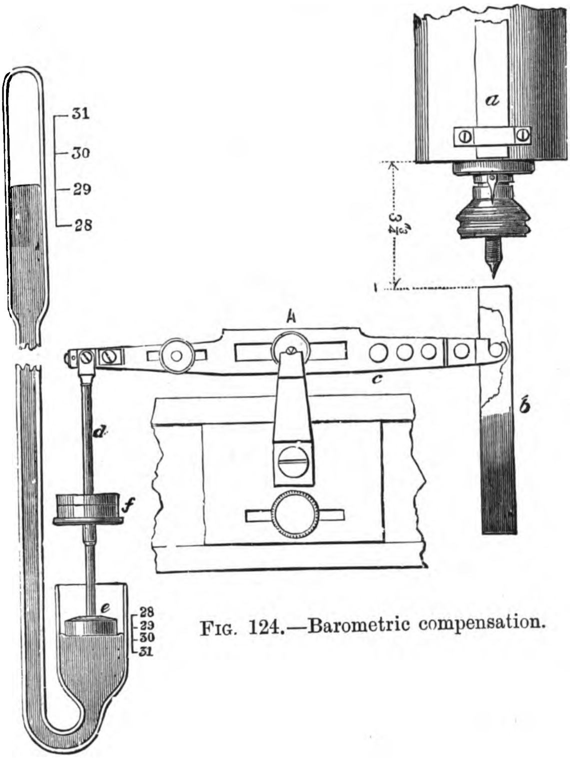


FIG. 124.—Barometric compensation.

the barometer tube, so that a variation of one inch in the barometric pressure would affect the height of the mercury in the cistern but 0·25 of an inch. As the clock gained with a falling barometer, the bar magnet over the south pole of the horseshoe magnet is placed with its north pole downwards, and the bar magnet over the north pole of the horseshoe magnet with its south pole downwards, so that there should be attraction between the bar magnets and the horseshoe magnet. The bracket supporting the knife edges can be shifted to increase or diminish the action of the magnet, and the lever is balanced by placing weights in the pan *f*.

In the Westminster clock the pendulum vibrates 2·75° on each side of zero, and Sir Edmund Beckett pointed out that with this large arc the circular error just compensates for the barometric error. Where the escapement is suitable, this is doubtless the best way of neutralizing the barometric error; but it is not applicable to the dead beat, for extra run on the dead faces of the pallets or larger angle of impulse than usual is found to be detrimental as the oil thickens.

Striking Work.

RECORDING the completion of each hour by strokes on a bell has always been regarded as an important function of public timekeepers. In some of the early clocks, notably the first one at St. Paul's Cathedral, the sound of the striking was the sole indicator of time provided, and in many later edifices, where the exhibition of dials was considered to be incongruous with the general design, timekeepers similarly restricted have been adopted and their convenience appreciated. Clocks striking the quarters as well as the hours are common enough, but Westminster Abbey furnishes a solitary instance of striking work for the quarters only. This is done, not by the turret clock with the well-known exterior dial, but by the timekeeper in the Poets' Corner, which is also peculiar in being probably the largest spring clock ever made, for the barrels and fusees are each over seven inches in diameter.

Some of the early Dutch and German clocks were furnished with two bells, one larger than the other, mounted on the top of the case. The hour was struck on the larger bell; the first quarter noted by one stroke on the smaller bell; at the half-hour strokes corresponding in number to the previous hour were given on the smaller bell, and the third quarter was proclaimed by one stroke on the larger bell. This plan has the advantage of giving fuller information than modern methods. Where one stroke is given at the half-hour, as in most modern French clocks, half-past twelve, one, and half-past one convey the same unmeaning sound.

The earliest device for causing the hours to be struck appears to be the locking-plate construction, as shown in De Vick's clock. The modern modification of this principle, to ensure greater exactness by using quicker moving parts to unlock the striking-train, may be seen in the description of the Westminster clock.

Rack Striking Work. Fig. 125 is a view of the front plate of an English striking clock on the rack principle, the invention of Barlow, which is the most reliable and the most generally used now, except by turret-clock makers, the majority of whom still prefer the locking plate. The going train occupies the right and centre, and the striking train the left hand on the other side of the plate. The wheels of the striking train are indicated by dotted circles. The connection between the going train and the striking work is by means of the motion wheel on the centre arbor, and connection is made between the striking train and the striking work by the gathering pallet, which is fixed to the arbor of the last wheel but one of the striking train, and also by the warning piece, which is shown in white on the boss of the lifting piece. This warning piece goes through a slotted hole in the plate, and during the interval between warning and striking stands in the path of a pin in the last wheel of the striking train, called the warning wheel. The motion wheel on the centre arbor, turning once in an hour, gears with the minute wheel, which has an equal number of teeth. These two wheels are indicated by dotted circles. There is, projecting from the face of the minute wheel, a pin which in passing raises the lifting piece every hour. Except for a few minutes before the clock strikes, the striking train is kept from running by the tail of the gathering pallet resting on a pin in the rack. Just before the hour, as the boss of the lifting piece lifts the rack hook, the rack, impelled by a spring at its tail, falls back until the pin in the lower arm of the rack is stopped by the snail. This occurs before the lifting piece is released by the pin in the minute wheel, and in this position the warning piece stops the train. Exactly at the hour the pin in the minute wheel gets past the lifting piece, which then falls, and the train is free. For every hour struck the gathering pallet, which is really a one-toothed pinion, gathers up one tooth of the rack. After it has gathered up the last tooth, its tail is caught up by the pin in the rack, and the striking ceases. The steps of the snail are arranged so that at one o'clock it permits only sufficient motion of the rack for one tooth to be gathered up, and at every succeeding hour additional motion equal to one extra tooth.

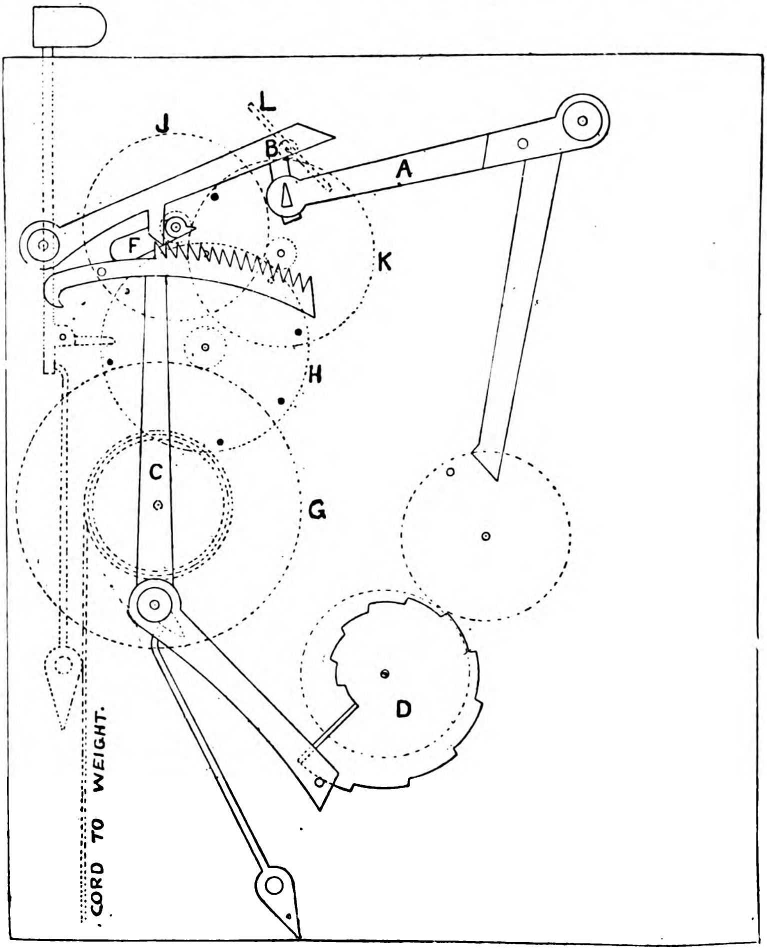


FIG. 125.—Rack striking work.

A, Lifting piece.
B, Rack hook.
C, Rack.
D, Hour snail.
F, Tail of gathering pallet.
G, Great wheel.
H, Pin wheel.
J, Third wheel.
K, Warning wheel.
L, Fly.

The lower arm of the rack and the lower arm of the lifting piece are made of brass, and thin, so as to yield when the hands of the clock are turned back; the lower extremity of the lifting piece is a little wider, and bent to a slight angle with the plane of the arm, so as not to butt as it comes into contact with the pin when this is being done. If the clock is required to repeat, the snail is placed on a stud with a star wheel and jumper; the movement of the star wheel being begun by a pin in the motion wheel and finished by the jumper, so that the surface of the snail corresponding to the previous hour is presented to the rack tail as long as possible.

Half-hour Striking. The usual way of getting the clock to strike one at the half-hour is by making the first tooth of the rack lower than the rest, and placing the second pin in the minute wheel a little nearer the centre than the hour pin, so that the rack hook is lifted free of the first tooth only at the half-hour.

Striking One each Hour. Clocks may be made to strike one at each hour very simply by having the hammer tail lifted by a snail on the minute wheel.

Three Train Quarter Chime Clock. The engraving on p. 204 is a front elevation of the mechanism of a quarter clock, as arranged by Mr. Barnsdale. The going train occupies the centre of the plate; the striking train is planted on the left, and the chiming on the right hand. All the train wheels are represented by circles, except the fusee wheel of the going train.

GOING TRAIN.

Fusee wheel	96	Pinion	7
Pinion	8	Third wheel	78
Centre wheel	84	Pinion	7

STRIKING TRAIN.

Fusee wheel	84	Pallet wheel	70
Pinion	8	Pinion	7
Pin wheel	64	Warning wheel	60
Pinion	8	Fly pinion	7
Pins in pin wheel	8		

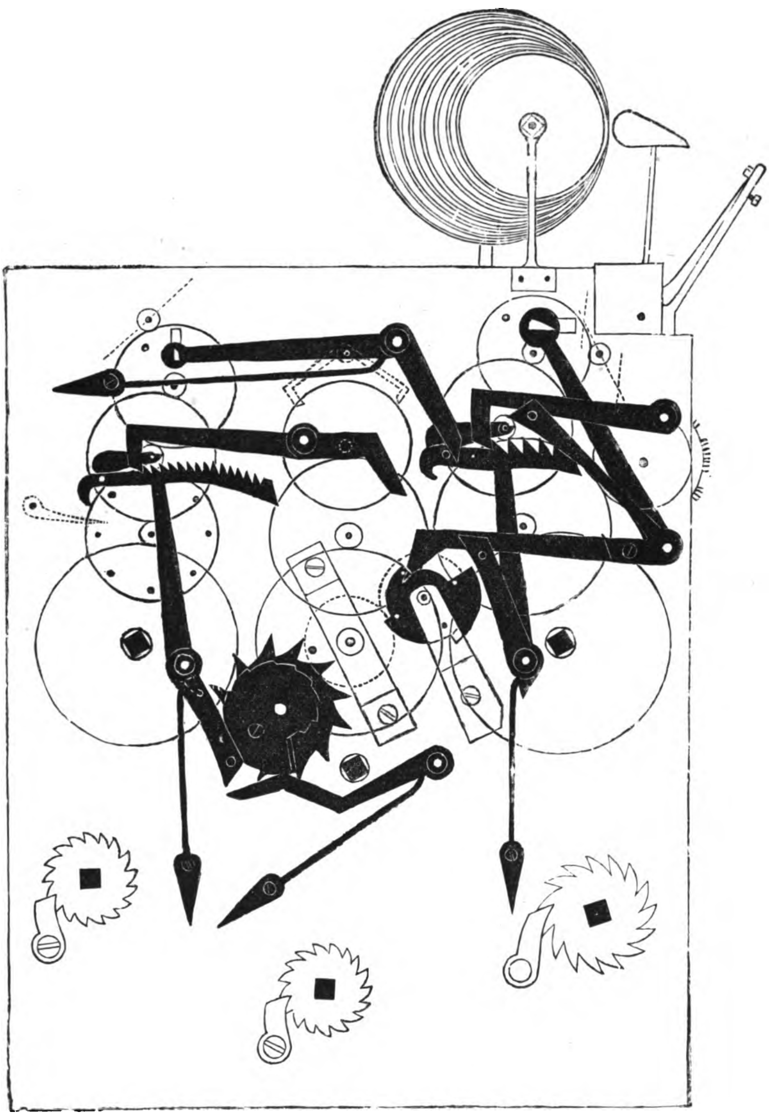


Fig. 126.—Striking mechanism of quarter-chime clock.

As the gathering pallet makes one complete revolution for every blow struck, the pin wheel must contain as many times more teeth than the pinion on the gathering pallet arbor as there are pins in the pin wheel. The number of teeth in the pallet wheel must also be a multiple of the teeth in the pinion on the warning wheel arbor.

CHIMING TRAIN.

Fusee wheel	100	Pinion	8
Pinion	8	Chime wheel	40
Second wheel	80	Warning wheel	50
Pinion	8	Fly pinion	8
Pallet wheel	64		

The barrels for the going and striking parts are each $2\frac{3}{8}$ in. in diameter, and the barrel for the chiming part $2\frac{3}{4}$ in., and the rough rule for the size of the fusee wheel is that it should freely go into the barrel.

There are four pins in the minute wheel for raising the quarter lifting piece, and, therefore, the quarter rack hook every quarter of an hour. One, two, three, or four quarters are chimed according to the position of the quarter snail, which turns with the minute wheel. At the hour when the quarter rack is allowed to fall its greatest distance, it falls against the bent arm of the hour rack hook, and releases the hour rack. As the last tooth of the quarter rack is gathered up, the pin in the rack pulls over the hour warning lever, and lets off the striking train. The position of the pieces in the drawing is as they would be directly after the hour was struck.

Turret Clocks.

St. Paul's.

THE noted clock of St. Paul's Cathedral made by Langley Bradley when the cathedral was built, and which did good service till 1893, deserves a notice, for until the giant dials and Big Ben at Westminster took the popular favour, the St. Paul's clock was regarded as the standard timekeeper of the metropolis. The frame consists of a cast-iron rectangular base plate, from which rise cast-iron columns supporting an entablature of the same metal. The going train occupies the centre of the space between the base and entablature, the wheels being arranged vertically; while the gun-metal bushes for the pivots are carried in wrought-iron straps bolted to the base plate and entablature. On one side of the going train is the quarter part, and on the other side the hour-striking part, similarly arranged. All the wheels are of gun-metal, the great wheels being 2 ft. 8 in. in diameter, 1 in. pitch, and 1¾ in. wide. For the original recoil escapement was substituted the present half-dead one in 1805, but with this exception it may be said that the whole of Bradley's mechanism remained in good working order till the clock was taken down. The two-second pendulum had a wooden rod and a cast-iron bob, weighing nearly 180 lbs. The striking work was on the rack principle. The mitre wheels for driving the dial works were commendably large, being 20 in. in diameter, and for supporting the dial end of the minute-hand arbor there were three friction wheels placed at equal distances apart round the outside of, and carried to the hour-hand tube. Slits were cut in the tube to allow a portion of the circumference of the friction wheels to enter, and the wheels were of such a size that they projected into the tube just sufficient to meet the minute-hand arbor. This ingenious contrivance is also applied to the Westminster clock, and is generally supposed to have been invented for it. As is well known, the St. Paul's clock tower has two dials, one facing down Ludgate Hill, and the other looking towards the south side of the churchyard. They were formed by black rings painted on the stonework, on which the hour circles and the numerals were engraved and gilt. Each dial is a trifle over 17 ft. in diameter, and the central opening measures about 10 ft. 6 in., the hour numerals being about 2 ft. deep. The clock was a 30-hour one, and therefore required winding daily. Though but two sets of dial-work were used, the stonework of the four faces of the tower is alike, and on the eastern side, which faces down Cannon Street, although the dial was not painted, the hour numerals were cut in the stone; this suggests the inference that it was at one time intended to show the time there; it was probably found that the pediment over the southern entrance to the cathedral so obscured the view as to render the third dial comparatively useless. On the roof, just outside of this dial aperture, is a horizontal sun-dial, with a plate over 2 ft. in diameter. This was fixed for the purpose of regulating the clock by the sun.

From the clock room the upper part of the belfry is approached by a stone staircase formed in the wall of the tower itself, which is five feet thick, composed of two stone shells, with a space of fifteen inches between them. Here, forty feet from the clock floor, was hung the celebrated hour bell which, in addition to its primal duty of recording the hours, was tolled when the Sovereign, the Bishop of London, the Dean of St. Paul's, or the Lord Mayor of London passed away. It was 6 ft. $9\frac{1}{2}$ in. in diameter at the mouth, and weighed 5 tons 4 cwt. Round the waist was the inscription, "Richard Phelps made me, 1716," and though the clock is said to have been completed in 1709, these figures may be taken to fix the date when the clock and bells were dedicated to the public service. For tolling it had a clapper weighing 180 lbs. The hammer-head which struck the hours on the outside of the sound bow weighed 145 lbs. Just below the hour bell were two bells on which the "ting-tang" quarters were struck; the larger of these weighed 1 ton 4 cwt., and the smaller 12 cwt. 2 qrs. 9 lbs.

The commissioners appear to have had just as much trouble with their hour bell as was experienced over the casting of Big Ben for the Houses of Parliament. In the year 1700, when the cathedral was approaching completion, they purchased, for 10*d.* a pound, from the churchwardens of St. Margaret's, Westminster, the celebrated Great Tom, which formerly hung in a clock tower facing Westminster Hall, and which appears to have been given to the churchwardens by William III. They then entered into a contract with William Whiteman to recast the bell, and when the work was done the bell was temporarily hoisted into the north-west tower of St. Paul's and exhibited to the public, Whiteman being paid £509 19*s.* for his labour. But lo! after sustaining many blows for the delectation of the ears of the citizens, Great Tom the second exhibited a crack which rapidly developed, so that the bell was pronounced to be useless. The commissioners suggested that of course Whiteman would make good his work by recasting the bell. "Not so," rejoined Whiteman. "I delivered to you a sound bell for which I was paid, and since it has been in your possession it has been cracked." So to make the best of a bad job a very stringent agreement was entered into with another founder—Richard Phelps to wit—in which he covenanted for a certain consideration to cast a bell of similar dimensions to the fractured one of all new metal, to deliver the same to the Commissioners, and when they expressed themselves satisfied he was to be paid, then, and not till then, removing the old bell and allowing the value thereof. This accident with the first hour bell accounts for the difference between the date of the finishing of the clock and the time when the present hour bell was cast.

The new St. Paul's clock is as nearly as possible a counterpart of the one at Westminster.

Westminster Clock.

PERHAPS no part of the new Houses of Parliament gave rise to more discussion and correspondence than the grand clock in the north-eastern tower. The parliamentary papers referring to it extend from 1844, when the building was in course of erection, till 1862, some years after the clock was finished.

In 1851 Mr. Denison, a barrister holding a good position at the parliamentary bar, was requested by the Government to draw up, in conjunction with Mr. G. B. Airy, the Astronomer Royal, a specification for its construction. Vulliamy and some other leading clockmakers who were invited to tender for the work, demurred to a stipulation that the clock should be guaranteed to perform within a margin of a minute a week, which they declared to be too small. Mr. Denison would not yield, and the clockmakers were equally firm. Eventually it was decided to entrust the work to Mr. Dent, who was to make a clock from designs to be furnished by Mr. Denison. Shortly afterwards the Astronomer Royal declined to act further, and Mr. Denison acted alone, furnishing the plan and superintending the construction of the clock, which was finished in 1854, fixed in the tower in 1859, and permanently set going in 1860. His temerity was justified by his success, for the Westminster clock turned out to be the finest timekeeper of any public clock in the world.

There are four dials, 180 ft. above the ground level; each of them is $22\frac{1}{2}$ ft. in diameter, or nearly 400 square ft. in area. They are formed of cast-iron framework which forms the divisions and figures, the spaces being filled in with opalescent glass. The hour figures are 2 ft. long and the minute spaces 1 ft. square. The hour hands are solid, and cast of gun-metal. For lightness the minute hands are tubular; they are of copper, the shells being thin, but strengthened by diaphragms at intervals. The copper tubes are tapered and closed at the tips, their open ends being fitted to gun-metal centres, which also form the outside counterpoises. Each minute hand measures 11 ft. from its centre of motion to the point, besides the counterpoise of 3 ft., so that the load on the clock when the hands are subjected to a high wind or covered with snow can be appreciated.

Between the backs of the dials and the walls of the clock-room is a passage about three feet wide, and here are fixed a number of gas-jets to illuminate the dials at night. When the gas is alight, this passage is very hot, but the clock-room is so isolated, that the heat and products of combustion cannot enter. It has been suggested that the electric light should be substituted for gas, but it has been tried and found to be not so suitable. The fact is, the dead whiteness of the glass, that is such an admirable ground by day, militates against the complete success of artificial illumination from within.

The driving weight of the clock being sufficiently heavy to carry the hands round, even under the most adverse circumstances, the force transmitted to the escapement would clearly be excessive when the wind or snow happened to be helping instead of retarding the hands in their course. Hitherto, the practice had been in such cases to interpose a remontoire consisting of a small spring, which was wound by the train and discharged at intervals. However great the force which wound the spring, its pressure in unwinding would be constant, so that by using this spring to drive the escapement, the impulse given to the pendulum could be maintained nearly at the required amount. Mr. Denison at first tried a remontoire of this kind, but discarded it in favour of the double three-legged gravity escapement, which he invented for the purpose. The action of this is described fully under the head of escapements. The movement is contained in a frame made up of two cast-iron girders, $15\frac{1}{2}$ ft. long, placed side by side 4 ft. apart, and braced together. There are three trains or sets of wheels, each one driven by a separate weight. The "going" or "watch" train, that drives the hands, and is controlled by the escapement and pendulum, occupies the centre of the frame; on the left hand in the drawing on p. 211 is the hour striking train, which only moves once an hour when it is released by the going train, and locks itself after it has struck the number of blows corresponding to the hour of the day; on the right is the quarter train, which is released by the going train every fifteen minutes, and chimes either one, two, three, or four quarters as required, and again locks itself.

As it has less to do, the going train is lighter than either of the striking trains; and in all three the strength of the wheels and other parts is greatest near the weight barrels, and is gradually diminished as the velocity of the parts increases. In the going train the parts near the escapement can hardly be too light, for it is necessary that they should get into action quickly directly they are unlocked, and to give as light a blow or shock as possible when they are locked again. The four pairs of hands are driven by four horizontal minute arbors placed high above the movement, and leading each one to the centre of one of the dials. These carry the minute hands. Each dial has separate motion wheels for reducing the rate of travelling of the hour hand, the motion work being carried on the walls of the clock room. Connection between the movement and the minute arbors is made by means of the oblique shaft *a*, p. 211, and the mitre wheels *b*, *c*, *d*, and *e*.

The numbers of the watch train are, great wheel 180, driving a pinion of 48 on the right for the hand work, and one of 12 on the left; on the arbor of the latter is the second wheel of 120 driving a pinion of 12, which carries the third wheel of 90, driving the escape pinion of 9. The great wheel is 2 ft. 3 in. in diameter.

For striking the quarters the four-armed cam or snail, *g*, turns once in an hour. It is gradually pressing down the lever *h*, and allows it to escape once every fifteen minutes. The quarter train is held by the locking lever *j*, which rests on the upper one of two blocks on the lever *k*. The lever *h* acts on the lever *k*, and as the quarter hour approaches the lever *k* rises and allows the locking

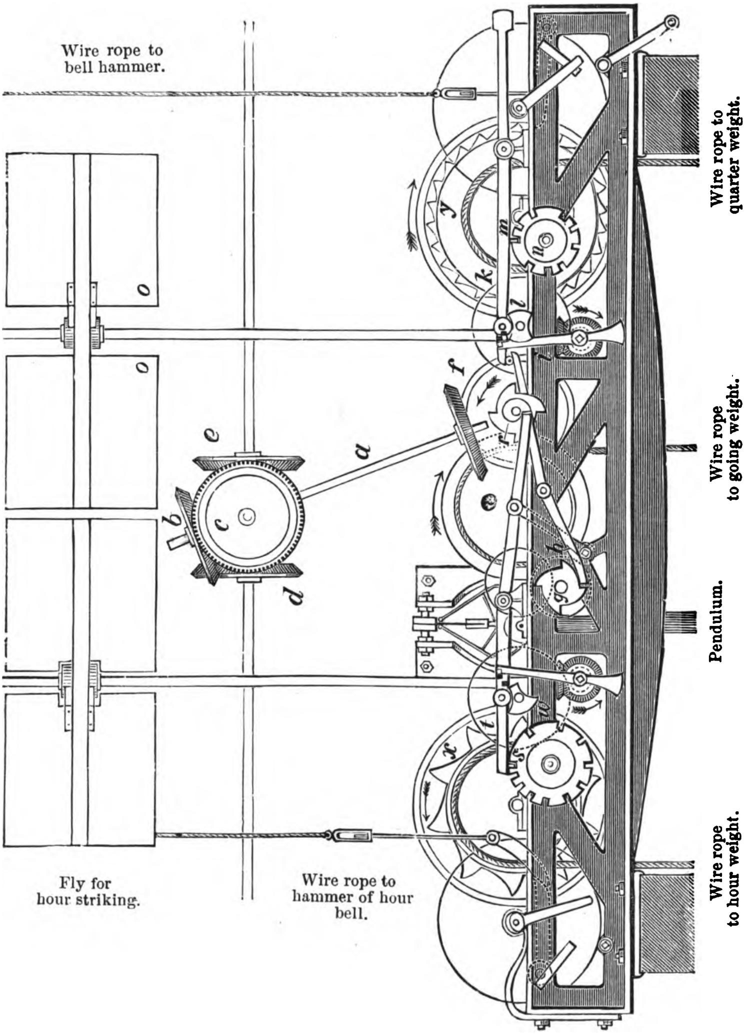


FIG. 127.—Movement of the great clock at the Houses of Parliament.

lever *j* to escape from the first locking block to the second one, which is rather lower on the lever; this allows the train to move a little, and causes the noise generally known as warning. Exactly at the quarter, the lever *k* falls free of the locking lever *j*, and the train of wheels begins to run, the lever *k* being lifted sufficiently high by the cam *l* to disengage the tongue *m* from the notch of the locking plate or count wheel *n*, in which it is resting. If one chime only is to be struck, the tongue *m* descends into the same notch of the locking plate, for that notch is wide enough to receive the tongue again after the small angular movement made by the plate, and the upper block on the lever *k* catches the locking lever *j* as it comes round. But at the next quarter, after one chime has been sounded, the tip of the tongue rests on the periphery of the locking plate till another chime is struck, when it falls into the next notch. The locking plate makes one rotation in three hours, and it will be observed that it is spaced out to allow of three sets of quarters. The intervals between the notes of the quarters is kept constant by the resistance of the air against the revolving fly *o*, which is composed of two large blades of sheet iron.

The action for letting off the hour striking is very similar to that for discharging the quarters, except that there is a double warning before the clock strikes. The hour striking train is held by a stop on the locking lever, resting against the upper of two blocks on the lever *t*. A few minutes before the hour the locking lever falls on to the lower block and is released thirty seconds before the hour by the snail *r*, which revolves once in an hour.* The locking lever is then held by a small independent lever till two seconds before the hour, when a snail on the second wheel arbor, which rotates once every fifteen minutes, allows one extremity of a rocking lever to fall, and the other extremity then hits up the independent lever and releases the locking lever. By the time the two seconds have elapsed the first stroke is sounded on the bell.

While one o'clock is striking, the lever *t* is held clear of the locking lever by the cam *w*; the tongue on the lever then descends into the wide notch of the locking-plate *s*; at two o'clock it is retained on the edge of the plate till two blows have been struck,

* The four-armed snail attached to the hour snail is for actuating a lever which stops the winding of the quarter part when the time for striking the quarters approaches.

and so on, the locking plate, which turns once in twelve hours, being divided so as to allow all the hours to be struck in rotation.

Around the side of the great wheel, *x*, of the hour part, are ten cams for pressing down the lever, which through the intervention of the wire rope, shown on the drawing, raises the hammer of the great bell in the chamber above. This wheel is 3 ft. in diameter, has 140 teeth, and gears with a pinion of 21; the second wheel has 90 teeth, and gears with a pinion of 15 or the arbor of the locking lever. The great wheel of the quarter part, *y*, is 3 ft. in diameter, and the side of it is spaced out for 60 cams. This wheel has 150 teeth, gearing with a pinion of 20; the second wheel of 90 teeth gears with a pinion of 15 on the arbor of the locking lever.

Attached to the clock frame over the hour striking lever is a strong curved spring, as shown in the drawing, to check the upward motion of the lever. The length of the wire rope connecting this lever with the bell hammer lever is so adjusted that the hammer is lifted after the last blow is struck; when the train is again released, the lifting arm is disengaged from the cam at once, and the hammer immediately falls.

To maintain the vibration of the pendulum during the twenty minutes or so that it takes to wind the going part of the clock, Mr. Denison invented a special kind of maintainer. The back bearing of the winding-pinion arbor is carried in a loose link slung from the barrel arbor. To obtain a resisting base so that the winding pinion should not run round the wheel with which it gears, a click presses against the ratchet-teeth on the side of the great wheel, and so drives the clock. But as the great wheel travels on, the back end of the winding arbor in following it is taken out of the horizontal line and soon becomes so oblique that the winder has to stop and let it down to its normal position again. Though this maintaining work is ingenious, it is not in my judgment so good as the continuous sun and planet maintainer. For clocks of moderate size, that take but a few minutes to wind, I would prefer a spring maintainer.

To obtain a sufficient purchase in winding the hour and quarter parts there is an intermediate wheel and pinion to each, and the bearing of the arbor of the intermediate pinion is formed of an eccentric bush, so that the pinion may be readily disengaged from the wheel when the time for striking approaches, or when the winding is completed. The hour pinion is shown out of gear, the lever attached to the eccentric being pushed away from the spring catch, while the one for the quarter winding is shown in gear ready for winding.

The weight for the going part is comparatively light, and requires winding once a week only. The hour and the quarter weights have to be wound twice a week, the operation taking about five hours in each case. The weight for the quarters is just upon a ton and a half, and the hour weight is over a ton.

The clock frame is not in the centre of the room, but placed so as to allow a space of about two feet clear from one of the walls, to which a very strong cast-iron bracket is fixed, and from this bracket the pendulum is hung. The pendulum, 13½ feet long from the point of suspension to the centre of oscillation, vibrates once in two seconds. It weighs nearly 700 lbs., and is compensated by a zinc tube ten feet long in the way shown under the head of pendulum.

The bells are arranged in a chamber above the dials, and hung from massive wrought-iron framing. The hour bell is 9 ft. in diameter; is 8¾ in. thick at the sound bow, and it weighs 13 tons 11 cwt. It is struck by a hammer with a cast-iron head weighing 4 cwt., which is lifted 9 in. vertically, and 13 in. altogether from the bell before it falls. There are four quarter bells weighing respectively 78 cwt., 33½ cwt., 26 cwt., and 21 cwt.

The hammers for the quarters are each about one-fortieth of the weight of the bell it strikes. To prevent the hammers jarring on the bells, they are kept from contact by indiarubber buffers, on which the shanks fall.

The following is the notation of the chimes. They are founded on a phrase in the opening symphony of Handel's air, "I know that my Redeemer liveth," and were arranged by Dr. Crotch for the clock of Great St. Mary's, Cambridge, in 1793; they are in consequence often spoken of as the Cambridge Chimes.

The first hour bell that was cast weighed 16 tons, or two tons over the prescribed weight. It was called "Big Ben," after Sir Benjamin Hall, who was first Commissioner of Works when the order for the clock was given. Shortly after the clock was started the bell cracked. As in the case of the St. Paul's bell, a century and a half earlier the question arose, who was to pay for recasting it? The founder would not, as he declared too heavy a hammer had been used; but the authorities averred that the hammer was only of a weight sufficient to bring out the tone of the bell. Eventually the present bell was obtained from another founder, duly hung and approved. But after being in use a few months, its tone altered, and it was found to have developed a crack on its inside three inches deep. For three years afterwards the hours were struck on the largest of the quarter bells, and then some one suggested turn-

The Cambridge Chimes.

ing "Big Ben the Second" round, so as to present a fresh place for the hammer to strike on. This was done, and a lighter hammer provided, with a result so far satisfactory that during the twenty-six years that have elapsed the fissure does not seem to have increased.

From first to last £22,000 were spent on the clock and bells. The clock movement cost about £4000; £5500 were paid for the dials and hands; the bells absorbed £6500, including £750 for recasting Big Ben; and the iron framing for the bells, which at first was too weak and had to be strengthened, took the remaining £6500.

There is electrical connection between the clock and Greenwich Observatory, not for controlling the clock, but that its performance may be ascertained. Two signals a day are sent automatically by the clock, and, from the reports of the Astronomer Royal, its error is rarely over a second a week.

Many people take the time from the first note of Big Ben at the hour; but to be exact, allowance should be made for the interval which has elapsed between the striking of the bell and the reception of the note. Sound travels at the rate of 1110 feet a second, and Big Ben can sometimes be heard at Greenwich Park, the sound taking 26 seconds to get there.

Balance and Balance Spring.

Balance.

THE annexed figure shows the simplest form of the balance or vibrating wheel of a watch or chronometer which, in conjunction with the balance spring, regulates the progress of the hands. The time in which a balance controlled by a spring will vibrate cannot be predicated from the dimensions of the balance alone. A pendulum of a given length always vibrates in the same time as long as it is kept at the same distance from the centre of the earth, because gravity, the force that impels it, is always the same; but the want of constancy in the force of the balance spring, that in watches and chronometers takes the place of gravity and governs the vibrations of the balance, is one of the chief difficulties of the timer. There is another point of difference between the pendulum and the balance. The time of vibration of the former is unaffected by its mass, because every increment of mass carries with it a proportional addition to the influence of gravity; but by adding to the mass of a balance, the strength of the balance spring is not increased at all, and therefore the vibrations of the balance become slower.

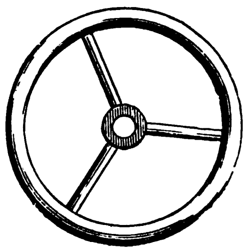


FIG. 128.

There are three factors upon which the time of the vibration of the balance depends:

1. The weight, or rather the mass, of the balance.
2. The distance of its centre of gyration from the centre of

motion, or, to speak roughly, the diameter of the balance. From these two factors the moment of inertia may be deduced.

3. The strength of the balance spring, or, more strictly, its power to resist change of form.

There is no exact rule for the diameter of a balance to a given movement, but the practice is generally to make the diameter of the balance equal to the diameter of the mainspring barrel. But though the diameter of a balance is not absolute, it may not be varied indefinitely even if the moment of inertia is kept the same. With a very large, light balance, there is but little friction at the pivots, and the variation between the hanging and lying positions is small, but it is not so alert, and is more susceptible to external motion than a smaller one. On the other hand, an unduly small and heavy balance, though it is less affected by external influence, has excessive friction at the pivots, and correspondingly large variations between hanging and lying, besides which a fall or jerk is very likely to damage the balance pivots.

Gold balances are preferable to steel. Steel has the advantage of being less affected by alterations of temperature, but, on the other hand, gold is denser than steel, and is not liable to rust nor to be magnetized.

The Balance Spring.

This is a long, fine spring that determines the time of vibration of a balance. One end of the balance spring is fixed to a collet fitted friction tight on the balance staff, and the other to a stud attached to the balance cock or to the watch plate. The most ordinary form of balance spring is the volute or flat spiral, like Fig. 130. A Bréguet spring is a volute with its outer end bent up above the plane of the body of the spring, and carried in a long curve towards the centre, near which it is fixed. M. Phillips, a distinguished French mathematician, laid down certain rules for the form of curve best suited for overcoils, and springs made in accordance with these rules are sometimes spoken of as Phillips' springs; but among English watchmakers overcoil springs are generally called "Bréguet," whatever the form of curve employed. For marine chronometers helical springs, in which both ends (A and B) curve inwards, are universally used. Either helical or Bréguet springs are as a rule applied to pocket chronometers, although a form of spring called "*duo in uno*" is sometimes preferred. The bottom of this spring is in the form of a volute, from the outer coil of which the spring is continued in the form of a helix; the upper end is curved in towards the centre as in the ordinary helical spring.

A very generally accepted rule is that the diameter of a balance spring for a watch should be half the diameter of the balance (rather under than over).

The dimensions of the spring, its form at the attachments, the position of the attachments with relation to each other, are all factors affecting its controlling power.

The length is important, especially in flat springs without overcoils. By varying the thickness of the wire two flat springs may be produced, each of half of the diameter of the balance, but

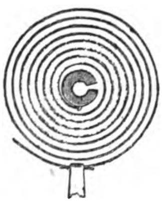


FIG. 129.—Ordinary balance spring.

Elevation. Plan.

FIG. 130.—Helical spring.

of very unequal lengths, either of which would yield the same number of vibrations as long as the extent of the vibration remained constant; yet if the spring is of an improper length, although it may bring the watch to time in one position, it will fail to keep the long and short vibrations isochronous. Then, again, a good length of spring for a watch with a horizontal escapement vibrating barely a full turn would clearly be insufficient for a lever vibrating a turn and a half.

The great advantage of an overcoil spring is that it distends in action on each side of the centre, and the balance pivots are thereby relieved of the side pressure given with the ordinary flat spring. The Bréguet spring, in common with the helical and all other forms in which the outer coil returns towards the centre, offers opportunities of obtaining isochronism by slightly varying the character of the curve described by the outer coil, and thereby altering its power of resistance.

The position of the points of attachment of the inner and outer turns of a balance spring in relation to each other has an effect on the long and short vibrations quite apart from its length. For instance, a very different performance may be obtained with two springs of precisely the same length and character in other respects, but pinned in so that one has exactly complete turns, and the other a little under or a little over complete turns. This property, which is more marked in short than in long springs, is depended upon by many for obtaining isochronism.

In ordinary watches provision is made for varying the controlling power of the balance spring by means of two short fingers or curb pins, which embrace the spring near its outer attachment. This method seems to have been adopted very soon after the introduction of the volute spring. The pins were carried in a circular slide, which had teeth on its outside edge. A pinion geared into these teeth, and by turning the pinion with a watch key, the acting length of the spring could be increased or diminished. In 1755 Bosley patented the sliding index, which is now preferentially used to carry the curb pins. Its action is more certain because it avoids the backlash incidental to a wheel and pinion when their motion is reversed. In marine chronometers and the very finest watches curb pins are dispensed with.

Compensation Balance. In this form of balance the centre of gyration is caused to approach or recede from the centre of motion in different temperatures, so as to compensate for the effect of such variation, not only on the balance itself, but upon the balance spring.

Berthoud, in 1773, tabulated the effect of temperature upon one of his marine watches. He reckoned that in passing from 32° to 92° (Fahr.) it lost per diem by—

Expansion of the balance	62 secs.
The loss of spring's elastic force	312 „
Elongation of the spring	19 „
	393 or 6 m. 33 s.

Doubtless Berthoud's observation was correct as far as the total amount of the temperature error goes, but there appears to be no warrant for assuming that a part of the loss was due to elongation of the spring. The thickness and the width of the spring would be increased in precisely the same proportion as the length; and as the strength of a spring varies as the cube of its thickness, the spring would be absolutely stronger for a rise of temperature if the relative dimensions only were considered.*

Sir G. B. Airy, by experiment in 1859, showed that a chronometer with a plain uncompensated brass balance lost on its rate 6·11 secs. in 24 hours for each degree of increase in temperature.

To counteract this effect of change of temperature is the function of the compensation balance. The halves of the rim are free at one end and fixed at the other to the central arm, which is of steel. The inner part of the rim is of steel, and the outer part, which is of brass twice the thickness of the inner, is melted on to the steel. As brass expands more than steel, the effects of an increase of temperature is that the brass in its struggle to expand bends the rim inwards, thus practically reducing the size of the balance. With a decrease of temperature the action is reversed. The action, which is very small at the fixed ends of the rim, increases towards the free ends, where it is greatest. In a marine chronometer there is one large weight at about the middle of each half rim, which is shifted to or from the fixed end, according as the compensation is found on trial to be less or more than is desired. In pocket chronometers and watches a number of holes are drilled and tapped in the rim, and the compensation is varied by shifting screws with large heads from one hole to another, or by substituting a heavier or a lighter screw. In the marine balance there are two screws with heavy nuts on opposite sides of the rim, close to the central arm, for bringing the chronometer to time. These nuts are slit, as shown in the drawing, to clasp the screw spring-tight and so avoid backlash. In watch balances there are four such screws placed at equal distances round the rim. These, of course, are not touched for temperature adjustment.

Although approximately correct in its action and sufficiently near for the requirements of all pocket watches and most marine chronometers, it is yet noticed that the compensation balance fails to meet the temperature error with mathematical exactness: the

* It is curious that Berthoud's statement should have been accepted without question by all authorities and writers till Mr. Wright, the able theoretical teacher at the Horological Institute, pointed out its fallacy in 1882.

rims expand a little too much with decrease of temperature, and with increase of temperature the contraction of the rims is insufficient; consequently a watch or chronometer can be correctly adjusted for temperature at two points only. A marine chronometer is usually adjusted at 45° and 90°, unless special adjustment is ordered to suit particularly hot or cold climates; pocket watches at about 50° and 85°. In this range there would be what is called a middle temperature error of about 2 secs. in 24 hours with a steel balance spring. The amount of the middle temperature error cannot be absolutely predicated, for in low temperatures when the balance is larger in diameter, the arc of

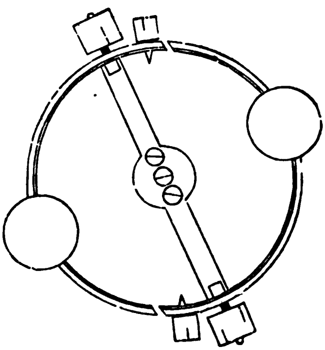


Fig. 131.—Marine chronometer balance.

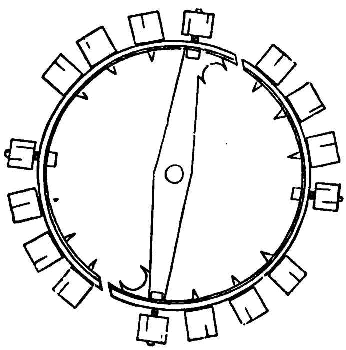


Fig. 132.—Compensation balance for watches.

vibration is less than in high temperatures when the balance is smaller, and consequently its time of vibration is affected by the isochronism, or otherwise, of the balance spring. And advantage is sometimes taken of this circumstance to lessen the middle temperature error by leaving the piece fast in the short arcs. To avoid middle temperature error in marine chronometers, various forms of compensation balances have been devised, and numberless additions or auxiliaries have been attached to the ordinary form of balance for the same purpose.

Molyneux's and Poole's may be taken to represent the two principles on which most auxiliaries are constructed. Molyneux's (Fig. 133) is attached by a spring to each end of the central arm, and is acted on by the free ends of the rim in high temperatures only. A screw in the end of the rim and another in the auxiliary serve to adjust the action as may be required. Molyneux's patent also covered the use of a short laminated arm instead of the spring by which the auxiliary is attached to the central arm, and many successful auxiliaries are now made in that way. Poole's (Fig. 134) consists of a piece of brass attached to the fixed ends of the rim, and carrying a regulating screw, the point of which checks the outward movement of the rim in low temperatures.

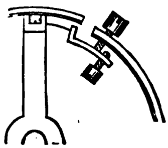


FIG. 133.

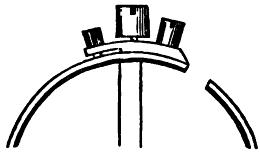


FIG. 134.

William Hardy attempted to avoid the middle temperature error without using an auxiliary by altering the form of the balance. Abandoning the cylindrical laminæ used by Arnold and Earnshaw, he used a straight laminated bar of brass and steel, the brass being underneath. A hole in the centre of the bar served to attach it to the staff, and at each end of the bar was a stalk carrying a spherical weight. These weights could be made more or less active as compensators by screwing them up or down on the stalks which had threads cut on them. By slightly curving the laminated bar upwards or downwards, the weights could be caused to approach or recede from the centre of the balance more or less as desired. At first sight it appeared that the difficulty of the middle temperature error had been overcome. But to obtain sufficient compensation the laminated bar must be so thin and the stalks so long as to leave the balance wanting in rigidity. Nevertheless, Hardy's attempt led to the invention of many other balances on the same principle.

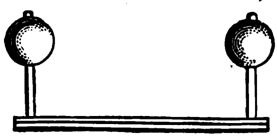


FIG. 135.

Massey, in 1814, patented (No. 3854) a balance very much resembling Hardy's in appearance, but in which the central arm was solid, and the upright stalks formed of brass and steel.

In 1849 Mr. John Hartnup, Director of the Liverpool Observatory, invented the balance shown in Fig. 136. The rims are composed of brass and steel, as usual, but they are neither upright nor flat, but bevelled, or placed at an angle midway between these two positions. The central arm *a* is also bimetallic, the brass being uppermost, and connecting the arm with the sections of the rim are two other bimetallic strips *b c*, the brass of these being underneath, and the steel on top; *e e* are the weights, and at the ends of the rim the screws for timing and poising.

Subsequently Mr. Victor Kullberg constructed a flat-rimmed

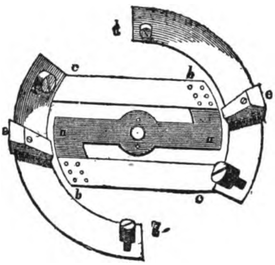


FIG. 136.—Hartnup's balance.

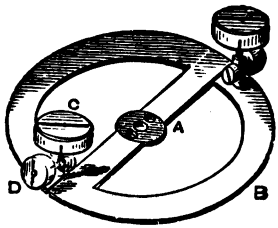


FIG. 137.—Kullberg's balance.

balance, as shown. Here the central arm A, and the rim B, composed of brass and steel, are in one piece, but in the arm the brass is on top and in the rim underneath, so that with a rise of temperature the ends of the arm bend down and the free ends of the rim are lifted upwards and inwards. The weights C are carried on stalks, which also afford a support for the timing nuts D.

E. T. Loseby's Balance. Chronometers with this balance were remarkably successful at the Greenwich trials from 1846 to 1853. The rims are bimetallic of brass and steel, shorter than usual; at the end of each segment of the rim is a cup-joint in which is placed a glass vessel consisting of a curved arm and a bulb, which contains mercury. The curved arm is sealed with a little air in it to ensure the continuity of the thread of mercury when it contracts. It is apparent that by bending the cup-joint, the direction of the glass arms may be altered, and in this way a very exact temperature adjustment obtained.

Loseby's invention was admitted by the Greenwich authorities to be an improvement, but his application for a reward was refused, the Admiralty, as a sort of recompense, buying a larger number of his chronometers than they otherwise would have done. This rather shabby treatment disgusted Loseby, who gave up

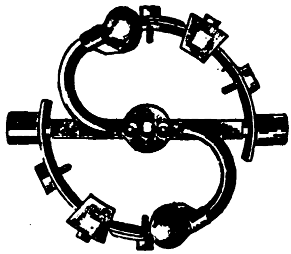


FIG. 138.—Loseby's balance.

chronometer-making and returned to Warwickshire, where he died in 1890; but the manufacture of balances on his principle has been occasionally revived, with, I believe, encouraging results.

Mercer's Balance. This is one of the latest adaptations of Molyneux's principle. The balance itself is of the ordinary kind, the special feature being the auxiliary, which consists of a laminated arm of brass and steel fixed at one end to the central bar of the balance. The auxiliary may be arranged to act in either extreme of temperature. For low temperatures the

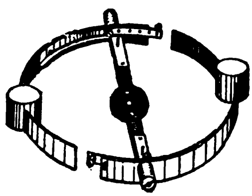


FIG. 139.—Mercer's balance.

steel would be the outer of the two metals composing the arm, and for high temperatures it would be the inner one. The free end of the arm carries two screws, the weight and position of which may be varied as required. A banking screw tapped through the rim of the balance serves to regulate the action of the auxiliary.

Ascertaining the Longitude at Sea. Development and Use of the Marine Chronometer.

THE discovery of America, in 1497, caused some attention to be paid to the question of finding the longitude at sea, for it was evident that if ocean navigation was to be carried on with anything like safety, some more certain means of ascertaining the position of a ship than was possible by dead reckoning would have to be provided.

Columbus had not an azimuth compass, nor a sextant, nor a chronometer, nor a patent log, and he, and his immediate successors, were several months making the voyage across the Atlantic, while the early voyagers took about three years to circumnavigate the globe. Even in the middle of the last century Commodore Anson, in his celebrated voyage round the world, had no safe guide. When he rounded Cape Horn he unexpectedly made the land on the western side, and found himself in consequence three hundred miles more to the east than he expected, and so his voyage was delayed. Then, again, he wanted to make the island of Juan Fernandez to recruit the crew. He got into the latitude of the island and thought he was to the west of it, but he was really to the east; he ran eastward and made the mainland of America, and turned round and had to sail westward again before he got to the island.

With a sextant the latitude may be readily ascertained by measuring the altitude above the horizon of certain of the heavenly bodies and reducing the observations by reference to tables.

Finding the longitude is not so simple a matter, owing to the rotation of the earth on its axis, and the apparent change of places of the stars. As early as 1530 Gemma Frisius suggested solar observations and a timekeeper as a possible solution of the problem. As the captain of a ship can readily ascertain the instant of noon at any place by observation of the sun, it is clear that if he had an instrument that could be depended on to show him the time at Greenwich or any other starting-point, the calculation of his longitude would be an easy one. But the most important adjunct, an accurate timekeeper, was wanting.

In 1598 the matter had risen to such importance that the

King of Spain offered a reward of one hundred thousand crowns for any invention which should gain that object. The rulers of one or two other maritime states followed his example, but all without effect.

Early in the seventeenth century John Baptist Morin proposed the preparation of tables with a view of making lunar observations available. Although Morin's suggestion was ridiculed at the time, it has become a perfectly practicable method. The moon is nearer the earth than the stars, and consequently appears to occupy a different position with regard to them when viewed from different points on the surface of the globe. And as the moon moves so swiftly from night to night through the sky, she shifts her position with respect to the stars very rapidly. If the sailor be provided beforehand with a book giving the distances of the moon from certain fixed stars for certain hours of say Greenwich time on every day of the year, he can, in any position in which he may be, by observing the position of the moon, secure a datum from which the longitude may be deduced. But even after the position of the moon with relation to these fixed stars has been ascertained, and the voluminous tables provided, somewhat tedious calculations are necessary to reduce the elements afforded by the observations obtained; besides which, if the lunar method alone is relied on, there is the disadvantage that the moon is not always visible. However, Morin's suggestion led to nothing at the time, and the greater simplicity of solar observations induced most investigators to consider the possibility of providing a correct timekeeper. The first attempts to supply the want seems to have been made by Huygens and Hooke.

Huygens' marine clock, constructed about 1660, suspended in gymbals and actuated by a spring, was controlled by a pendulum. It was tried at sea by a Scottish captain named Holmes, with but moderate success. A marine pendulum clock constructed under the direction of Dr. Hooke, was tried by Lord Kincardine, in 1662, only to demonstrate the futility of relying on the pendulum as a regulator when tossed about in a ship on the ocean.

In the course of a paper he read before the Royal Society in 1662, Dr. Hooke said, "The Lord Kingcardine did resolve to make some trial what might be done by carrying a pendulum clock to sea, for which end he contrived to make the watch to be moved by a spring instead of a weight, and then, making the case of the clock very heavy with lead, he suspended it underneath the deck of the ship by a ball and socket of brass, making the pendulum but short, namely, to vibrate half seconds; and that he might be the better enabled to judge of the effect of it, he caused two of the same kind of pendulum clocks to be made, and suspended them both pretty near the middle of the vessell underneath the decks. Thus done, having first adjusted them to go equal to one another, and pretty near to the true time, he caused them first to move parallel to one another, that is, in the plane of the length of the ship, and afterwards he turned one to move in a plane at right angles with the former; and in both these cases it was found by trials made at sea (at which I was present) that they would vary from one another, though not very much." Dr. Hooke concludes by saying that "they might be of very good use to the sea if some further contrivances about them were thought upon and put into practice."

In 1714 the British Parliament, on the recommendation of a commission, of which Sir Isaac Newton was a member, passed "an Act for providing public reward for such person or persons as shall discover the longitude at sea." This Act made provisions that any offered method or invention on this subject shall, in the first instance, be investigated by a specially selected body of practical men, who may then recommend it to the Royal Commissioners constituting "the Board of Longitude." The award was fixed at £10,000 for a method or invention to define on a voyage from England to any of the West India Islands and back the longitude within one degree, £15,000 to define the longitude within two-thirds of a degree, and £20,000 to within half a degree.

The Paris Academy of Sciences in 1720 offered a prize for the best description of a suitable timekeeper. This was won by Massy, a Dutch clockmaker. In 1721 Sully produced a clock which he laid before the Academy in 1724. It had a vertical balance, which from the description seems to have been a pendulum with cycloidal guides. This timekeeper promised success till tested in the open sea, when its performance, like that of the preceding instruments, was found to be unsatisfactory. Sully, however, seemed to be on the high-road to success, and he was engaged on another timekeeper just before his untimely decease.

In 1675, Greenwich Observatory was founded. Flamsteed was instructed to rectify the tables of the motions of the heavens and the places of the fixed stars. He made a large star catalogue, and many obversations on the moon and other bodies, and the results of his lunar observations were taken in hand by the philosophers of the time, Newton and others. The construction of lunar tables, and to predict the place of the moon with sufficient accuracy for the adoption of the lunar method of longitude, was a very serious task.

It was not until 1767 that Maskelyne, a succeeding Astronomer Royal, founded the "Nautical Almanac," and gave therein, for the first time in any country, distances of the moon from certain fixed stars, that the lunar method came into use. In the early part of the present century the reliability of the chronometer was established, and since then the chronometer method has gradually superseded the lunars. In the "Nautical Almanac" the lunar distances are still retained, and circumstances occasionally arise when the mariner is glad to have recourse to them.

Stimulated by the prospect of obtaining the reward offered by the British Parliament, John Harrison, after thirty years of unremitting labours and vicissitudes, recounted in the sketch of his life (see pp. 115–121), fulfilled, in 1761, the conditions laid down by the Board of Longitude. Thoroughly as Harrison deserved the reward he so laboriously earned, it is curious to note that of all his inventions embodied in his timekeeper, the maintaining spring in the fusee is the only one that has survived.

Other Acts of Parliament relating to the subject were passed in 1741, 1753, and 1774. The last, repealing all former Acts, offered £5000 for a timekeeper determining the longitude to or within one degree; £7500 for determining the same to within 40 geographical miles; and £10,000 for a determination at or within half a degree. Further, to obtain the smallest portion of the reward, the error of the timekeeper was not to exceed more than four minutes in six months.

Mudge, the inventor of the lever escapement and an experienced horologist, with almost incredible infatuation, proceeded on the lines adopted by Harrison. Though he produced a superior instrument to Harrison's (see p. 124), he allowed Arnold (p. 127) and Earnshaw (p. 129) to develop the marine chronometer of to-day.

The investigations of Berthoud and Pierre Le Roy were nearly contemporaneous with those of Mudge, Arnold, and Earnshaw. Each of the French masters designed a detached escapement, and while Berthoud used a gridiron arrangement of brass and steel to compensate for temperature errors, and fitted his timekeeper with two balances geared together, Le Roy experimented with a balance composed of two mercurial thermometers, the bulbs being furthest from the centre of motion and the ends turned inwards. No one could question the ability of Berthoud and P. Le Roy, but in executing their respective conceptions the Englishmen showed superior judgment. The French marine timekeepers were by comparison very unwieldy, which may perhaps be traced to the influence of M. Daniel Bernoulli, an eminent mathematician, who, says P. Le Roy, "wishes marine watches to be as large as good clocks are commonly made, that the pieces may be worked with greater exactness, and that their defects, if there are any, may be more easily perceived. This is nearly what I have practised in the new marine watch." However, the simplicity of construction and the compactness of Arnold and Earnshaw's chronometers have ensured their general adoption.

Sextant. The construction of this, the angle-meter of mariners, which is used in conjunction with the chronometer for ascertaining the longitude of a ship at sea, may be explained with the aid of the subjoined Fig. 140. At I is a mirror pivoted into the frame of the instrument, but attached to an index arm which is free to travel round a brass graduated arc on the frame at R. On the frame at H is the horizon glass, the half of which next to the frame is a mirror, and the other part clear glass. If a ray of light from the sun or other object at S impinges on the mirror I, it will be reflected on to the horizon glass. At O T is a telescope. On looking through the telescope at T, the horizon *h* may be viewed through the clear part of the horizon glass by direct vision, and the index arm may be moved round till the reflected image from the mirror I coincides with the horizon. The angle N between the mirror I and the horizon glass H will then be half the angle S O *h*. The arc R, though really but 60° of a circle, is divided into 120°, so that the reading correctly denotes the angle S O *h*. When the index arm points to zero Z, the faces of the mirror and horizon glass are parallel.

When using the sextant to ascertain the longitude by observation of the sun, the most usual plan is to take equal altitudes. The index arm is clamped at any convenient degree, and the instant the sun is observed at that altitude is noted both in the forenoon and the afternoon; the mean of these times is the solar noon of that particular spot. As the time of apparent noon at Greenwich is also known, it is clear that the difference between

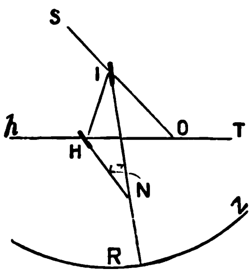


Fig. 140.

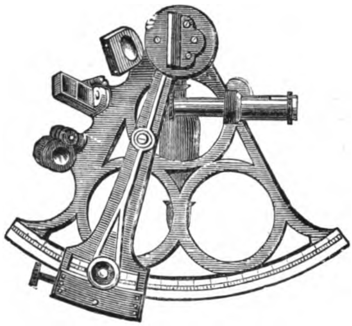


Fig. 141.

the two will give the longitude of the place of observation, each degree of longitude being equal to four minutes of time.

Modern marine chronometer movements are $3\frac{1}{2}$ inches in diameter. They are fitted into brass boxes, which are suspended on gymbals and enclosed in a square wooden box having an inner glazed lid. The dials, $4\frac{1}{2}$ inches in diameter, are silvered, and have a seconds circle between the centre and the VI. The balance makes 14,400 vibrations an hour, and the seconds hand therefore beats half-seconds. Chronometers were not regularly supplied to the Royal Navy till about 1825, and then the rule was that the Admiralty furnished one chronometer for each ship; but if the captain chose to provide a second, the Admiralty would give him a third. Now the Admiralty find all necessary chronometers, each ship usually carrying three. Deck or assistant watches are used to note the observations, and these are checked by the chronometers, which are not removed from the chronometer room.

From 1822 till 1835 prizes were given by the Government for the chronometers which performed best when tried at the Greenwich Observatory. The trials are still held annually, lasting for about twenty-eight weeks. When over, the chronometers are arranged in order of merit, and the Admiralty make offers to purchase such a number of the best that will meet the requirements of the navy.

Watch Jewelling.

IN the early part of the eighteenth century was introduced the practice of using highly polished surfaces of hard stone for the bearings of the smaller quickly moving watch pivots and other rubbing contacts.

In 1704 a patent was granted to Nicholas Facio, Peter Debaufre, and Jacob Debaufre, for the application of jewels to the pivot holes of watches and clocks. Facio, the inventor, was a native of Basle, where he was born in 1664, coming to England in the early part of 1687. Here he seems to have busied himself with scientific pursuits, and towards the end of the century he was elected a Fellow of the Royal Society. His co-patentees were watchmakers, living in Church Street, Soho, and an advertisement in the *London Gazette* of May 11, 1704, announced that jewelled watches were to be seen at their shop, stating also that they made "free watches." A watch bearing the name of "Debauffre" is to be seen at the South Kensington Museum.

Before the patent was many months old, the patentees applied to Parliament for a Bill to extend it; but this was opposed by the Clockmakers' Company, and on evidence produced by them a Committee of the House of Commons recommended that the Bill be rejected.

In reporting the successful result of their opposition, the master of the Clockmakers' Company acquainted the court that in the proofs brought against the Bill, there was an old watch produced, the maker's name Ignatius Huggerford, that had a stone fixed in the cock and balance work, which was of great use to satisfy the committee.

But the best of the story has yet to be told. In recent years Huggerford's watch was taken down by Mr. E. J. Thompson, a member of the court of the company, and he reported that "The movement is not in any sense jewelled, the verge holes being of brass. A piece of coloured glass or soft stone, fastened in a disc of silver and burnished into a sink in the steel cock, gives a fictitious appearance of jewelling."

About 1720 Facio settled at Worcester, where he died at the age of ninety, and was buried at St. Nicholas' Church in that city in 1753.

In a watch all the escape pivots and the fourth wheel pivots usually run in holes made of jewel. The watch is then said to have four pairs of holes jewelled, or to be jewelled in eight holes. In addition the acting parts of the pallet and the impulse pin of the escapement are always of hard stone. Sometimes the whole of the holes are jewelled. In the best class of work sapphires or rubies are used, in a lower grade crystal, and in the commonest garnet. In good clocks the pallets and verge holes are jewelled. In thorough holes, such as are used for the train, the bottom jewel hole is usually fitted into a recess hole turned in the plate, and the metal rubbed over in the form of a rivet to secure it. In the upper plate the jewel hole is sometimes fixed in a loose setting, and held in its place by the heads of two screws tapped into the plate close to the recess. In watch escapement holes, where end stones are used, the jewel in a loose setting is fitted into a recessed hole, and upon it is laid the end stone which is also set in metal. The heads of two small screws tapped into the watch plate or cock, as the case may be, serve to secure the jewel hole and the end stone.

A jewel, pierced not through its axis of crystallization, sometimes presents a ridgy appearance which no amount of polishing will remove. Such a hole will rapidly cut the pivot working in it. A diamond-end stone, whose surface is not coincident with the line of cleavage, will also wear away the end of the pivot in contact therewith. Such a stone is occasionally met with in the balance cock of a marine chronometer.

Ruby, which is really a red variety of the sapphire, though it has a rich appearance, is said to exert a deleterious influence on the oil used for lubrication, and many watchmakers accordingly give the preference to sapphires of a light bluish tint.

Concentric Minute Hand.

Although the earliest timekeepers were made with an hour hand only, there is no doubt that minute hands were occasionally applied long before they became the rule. Some of the clocks made in Nuremberg and Augsburg, about 1600, had concentric minute hands, the minute hand being carried round by the centre arbor, and the hour hand driven from the fusee. Mr. Percy Webster had a specimen a short time ago with this arrangement. There is also a clock in the South Kensington Museum, from the Bernal Collection, described on page 43, which has a concentric minute hand, and each minute figured, as most of the early minute circles were. The figures were necessarily crowded, and this method of marking was soon abandoned.

Drawings of many early seventeenth-century timekeepers of French origin are shown with concentric minute hands.

That timekeepers of a later period were fitted with an hour hand only goes for nothing, because one-hand clocks were made up to quite the end of the eighteenth century.

Huygens' clock, made some time before 1675, had a concentric minute hand, with motion work similar to that in modern timekeepers. Daniel Quare was, it is said, the first to apply the concentric minute hands in England. Thomas Harrys proposed minute hands for the St. Dunstan's clock, erected in 1671, and they are shown on the old engraving of the clock ; so that Quare must have introduced the double index prior to 1671 for his claim to be well founded. But it is probable that Quare's originality applied to the motion work as now used for causing the hour hand to travel twelve times slower than the minute hand.

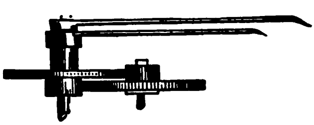


FIG. 142.

The appended sketch shows the arrangement of this for a watch. The centre arbor rotates once in an hour, and on it is fixed friction tight a pinion with a long boss or pipe called the cannon pinion. The cannon pinion drives the minute wheel, which, together with the minute wheel pinion attached to it, runs loosely on a stud fixed to the plate of the watch. The last-named pinion drives the hour wheel, which has a short pipe, and runs loosely on the pipe of the cannon pinion. The minute hand is fixed to the pipe of the cannon pinion, and the hour hand to the pipe or body of the hour wheel. The product obtained by multiplying together the number of teeth in the minute and hour wheels must be twelve times the product obtained by multiplying together the teeth in the cannon and minute wheel pinions.

Centre Seconds. In the simplest forms of centre-seconds watches the centre seconds hand revolves round the dial once a minute, as in Harrison's prize chronometer. The train is usually arranged so that the fourth wheel pinion, which carries the seconds hand, is planted in the centre of the movement. This necessitates an unusual arrangement of the motion work, the minute wheel being driven by an extra wheel (of the same number as the cannon) attached to the second wheel pinion. The cannon wheel works on a pipe screwed to the plate.

If this kind of centre seconds is to be a stop-watch, a slide in the band of the case, when pushed round, presses a thin wire brake against the roller of the escapement. Owing to the extra shake from the additional wheel in the motion work, the minute hand is not so exact in its movement, unless the minute wheel is composed of two thin ones, kept one in advance of the other by a spring, or there is some other provision to avoid backlash. But altogether, this is a most unsatisfactory way of obtaining a centre seconds.

Independent Centre Seconds. This is a much sounder arrangement. The seconds hand is driven by a special and separate train. The independent seconds hand generally beats full seconds. It is discharged by a push piece running through the pendant, which releases a flirt on the last arbor of the train. This flirt regulates the progress of the hand, by taking into a pinion on the arbor of the escape pinion.

The independent train is arranged on the pillar plate. The first wheel is on a small separate barrel. The fourth wheel pinion of the independent train carries the seconds hand, and passes through a pipe screwed to the centre of the plate. The cannon pinion fits freely on this pipe, and the motion work is driven as described under the head of centre seconds. The last pinion of the independent train carries a flirt which takes into the leaves of the escape pinion of the usual train. The flirt, and therefore the last pinion of the independent train, thus makes six revolutions for each one of the escape pinion. It is essential that the centre wheel of the independent train should rotate once in a minute, and that the flirt should revolve once in a second. If, therefore, with an 18,000 train and escape wheel of fifteen teeth a higher numbered escape pinion is used, a separate pinion of six for the flirt to take into is fixed on the escape wheel arbor.

Chronograph. This is strictly a timekeeper that leaves a record of its going, and appears to have been first applied to those centre-seconds watches in which the extremity of the hand was in the form of a small funnel containing ink, into which a spring pointer dipped ; the pointer could at pleasure be pressed on to the dial, where it would leave a dot of ink to record when the pressure was made.

The term has, however, a wider significance now, and is used as a title for watches that have a centre seconds hand driven from the fourth wheel, which may be started, stopped, and caused to fly back to zero, by pressing either the pendant or a knob at the side of it. The chronograph hand generally beats fifths of seconds, and to permit of this an 18,000 train is necessary.

The foundation of this mechanism is the heart-shaped cam, patented by the late A. Nicole in 1862 (No. 1461). Its action may be traced by means of the diagram on p. 236. The chronograph hand is fixed to the pipe of a brass wheel which runs freely on the centre arbor under the cannon pinion. This wheel has a finely serrated edge, and is usually driven by a smaller wheel having its edge serrated in the same manner. This latter is attached to the pinion which gears with the fourth wheel. The two serrated wheels bear the same proportion to each other as the fourth wheel does to the pinion already mentioned, so that the chronograph hand travels round the dial in a minute, which is the time that the fourth wheel takes to make a rotation. The smaller serrated wheel, and the pinion to which it is attached, are mounted on a pivoted carriage with a projecting tail. On the left of the engraving is a "castle ratchet," which has eighteen ratchet-shaped teeth around its edge, and six projections or castle teeth rising from its upper face. In the figure the two serrated wheels are in contact, and the chronograph hand is consequently travelling. If

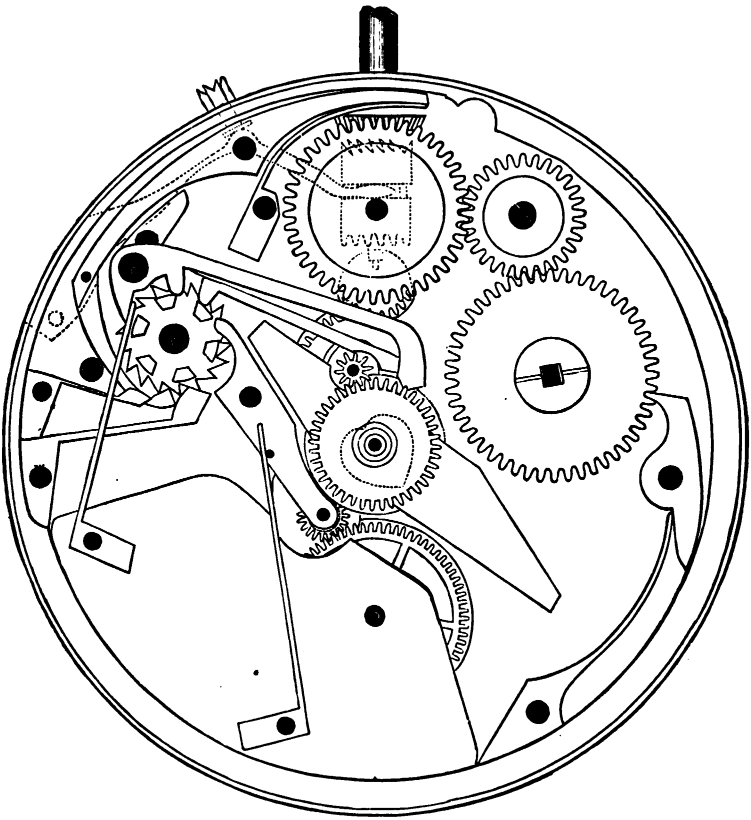


FIG. 143—Centre-seconds chronograph.

now the button in the pendant is pressed, the shorter end of the bent lever which is lying around inside the case is depressed, and the hooked end of the lever draws the ratchet round, so that the tail of the carriage on which the small serrated wheel is mounted is moved far enough to take it from contact with the larger wheel, and the chronograph hand consequently stops. At the same time a castle tooth, which has been keeping a circular brake off the larger serrated wheel, is moved out of the way, so that the brake drops, thus keeping the chronograph hand from being shifted by accidental motion of the watch. When the button is again depressed, the castle ratchet is shifted round still further, and the returning lever with the pointed end is allowed to drop on to the heart-shaped cam, which is fixed to the larger of the serrated wheels. As the returning lever drops, its tail lifts the brake off the serrated wheel, and the lever impelled by a spring, as shown in the drawing, turns the cam from whatever position it may happen to be in, till the lever rests on that part of the edge of the cam which is nearest to its centre of motion. The chronograph hand is then at zero. Each time that the bent lever is pressed it draws the ratchet round one tooth, and as there are three ratchet-teeth to one castle tooth, it is evident that all the pieces in contact with the castle return to their original position after every three movements of the lever.

Perpetual Calendar Watch. As an example of modern perpetual calendar work the drawing on p. 238 of a watch arranged by Mr. C. H. Audemars may be of interest. The wheel H, driven by the minute wheel, makes one turn in 24 hours and carries a movable finger *a*, which by contact with a pin moves the armed lever D by its extremity *p*. This lever, which has its centre of motion at *i*, acts through its different arms. Firstly, at *c* it moves the day of the week star wheel (7 teeth). Secondly, at *b* the star wheel for the day of the month (31 teeth). The finger *a* makes engagement and passes one tooth each day of the star wheel E (59 teeth), for showing the phases of the moon.

The part of the mechanism which renders the calendar perpetual is composed of a wheel of 31 teeth F, engaging with the star wheel C. This wheel, which makes one turn per month, passes at each turn, by means of the movable finger *n*, one tooth of the star wheel G (48 teeth), which latter by this means makes a revolution in four years. The circumference of account disc fixed to this star wheel corresponds to the months of 31 days, the shallowest notches to those of 30 days, and the four quarter notches to the month of February. At *e*, which is for February in leap year, the notch is hardly so deep as the other three-quarter notches.

Each day, after moving the day of the week and the day of

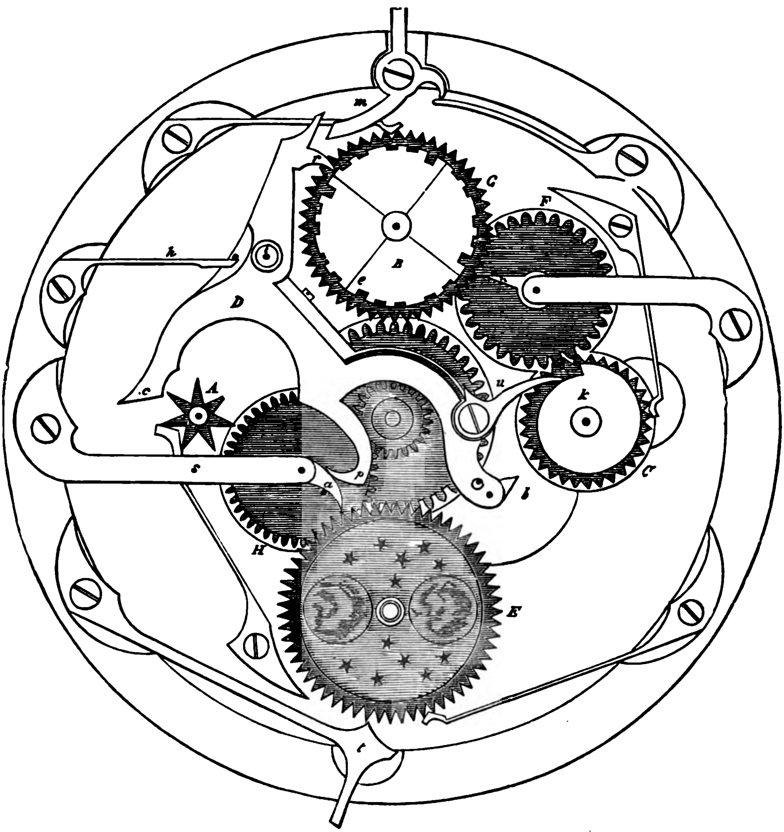


FIG. 144.—Perpetual calendar work.

the month, the lever D, solicited by the spring *h*, returns its arm *r* to rest on the circumference of the count disc or in one of its notches according to the position of the disc.

The point of the piece *u* pressed by its spring rests on the snail *k*. Before the last day of the month it falls on to the small part of the snail, and then its action is substituted for that of the arm *b*; the point of the piece *u* presses against the notch of the snail, and advances the star wheel the number of teeth necessary for the hand to indicate the 1st of the following month. It will be understood that the distance the point of the piece *u* falls is regulated by the position of the arm *r* on the disc or in one of its notches.

In the engraving the mechanism is set to the 1st December of the last year before leap year. The two pieces *m* and *t* are at the disposition of the watch wearer; the first for adjusting the day, and the second for the age of the moon. The finger *a* is movable, to permit of putting the hands back without fear of deranging the mechanism. When the wheel H is turned back, the finger is arrested by the arm *p*, and, as it is sloped at the back, the pin carried by the wheel is able to pass easily, because the flexibility of the piece *s* permits it to give a little. The wheel F should be the same diameter as the star wheel C.

If it is desired to record operations of longer duration than sixty seconds, a small minute chronograph hand is added to the dial, and actuated by means of the seconds heart piece in its revolution or in some similar way, the hand being returned by a heart piece just as the seconds hand is.

Split Seconds.

Where it is required to record two operations of varying duration, this form of double chronograph is used. There are two centre seconds hands, one under the other, usually of different metals for contrast. When the chronograph is started, the two hands travel together until a button in the band of the case is pressed, when the under one remains stationary, while the other continues to travel till stopped by the chronograph push-piece. Attached to the pipe of the lower hand is a brake disc, which may be clasped by two stop levers, and when the button in the band of the case is pressed the click pulls round the ratchet wheel a little, the tail of the lever then sinks into the space between two of the teeth, and the levers are released and clasp the brake disc.

The connection between the two hands is made in the following way. A very light curved spring arm is fixed at one extremity to the brake disc on the pipe of the lower hand. A small roller, preferably of jewel, carried by the free end of the arm, bears on the edge of a heart-shaped cam fixed to the pipe of the upper hand; so that, when the lower hand is released, the pressure of the spring causes the roller to fly to the point of the heart piece nearest the centre, and the two hands are then coincident.

Evolution of Winding Mechanism for Watches. One of the first references to winding without opening the case of a watch is to be found in the history of the Clockmakers' Company. In 1712 John Hutchinson desired to patent a watch which, among other improvements, "has likewise a contrivance to wind up this or any other movement without an aperture in the case through which anything can pass to foul the movement." The Clockmakers' Company opposed the application, and a committee of the House of Commons examined witnesses, among others George Graham and Charles Goode. Mr. Goode produced a movement made fourteen years before. Mr. Hutchinson confessed Goode's movement was like his, and eventually withdrew his application.

This appears to give Charles Goode the honour of being the first inventor of keyless mechanism; but it is not quite conclusive, because Hutchinson's claim included some kind of horizontal escapement, and it is just possible that the verdict turned on that.

The next in order is Pierre Auguste Caron, a clever watchmaker of Paris, who in 1752 made for Madame de Pompadour a very small watch, which gained for him a prize from the Academy of Sciences. This appears to have been wound either by turning the bezel or with a slide very similar to the winding slide now used for repeaters. He thus described the watch: "It is in a ring, and is only four lignes across and two-thirds of a ligne in height between the plates. To render this ring more commodious, I have contrived, instead of a key, a circle round the dial carrying a little projecting hook. By drawing this hook with the nail two-thirds round the dial, the watch is rewound and it goes for thirty hours." Caron was an accomplished musician, and is better known, under the name of Beaumarchais, as the composer of "Le Barbier de Seville," and "Le Mariage de Figaro."

Lepine, who was associated with Voltaire in the establishment of a watch factory at Ferney, in Switzerland, devised a method of winding in which the button at the pendant was turned partly round, and then pushed in several times till the winding was completed. This was the first of a series of what is known as "pumping" keyless actions.

In 1792 Peter Litherland, who patented the rack lever, claimed (patent No. 1889) "winding up watches, etc., by means of an external lever connected by mechanism with the barrel arbor."

Robert Leslie, in 1793, patented (No. 1970) another pumping keyless arrangement. His claim says, "on the square on which the key should go is a ratch; the pendant, being alternately moved in and out, turns this ratch by means of two clicks on either end of a fork fastened to the pendant."

J. A. Berrollas, in 1827 (No. 5586), patented a somewhat similar contrivance, but used a chain coiled round the winding wheel. I wore for some years a duplex watch by Ganthony with this keyless work, and it answered well.

Edward Massey, in 1814 (3854), Francis J. Massey in 1841 (8947), and Edward Massey again in 1841 (9120), patented varieties of pumping keyless work.

Charles Oudin exhibited at Paris, in 1806, an arrangement shown in the subjoined engraving: *k* is the barrel, *j* and *g* intermediate wheels gearing with the contrate pinion *h*; *a* is a disc at one extremity of a rod *n b*. The rod is supported by the cock *d*, and has two grooves, into one of which the spring *f* presses, according to the position of the rod. One of these grooves is seen at *c*, the other is hidden, owing to the position in which the parts are shown. When out of use the disc *a* forms part of the ball of

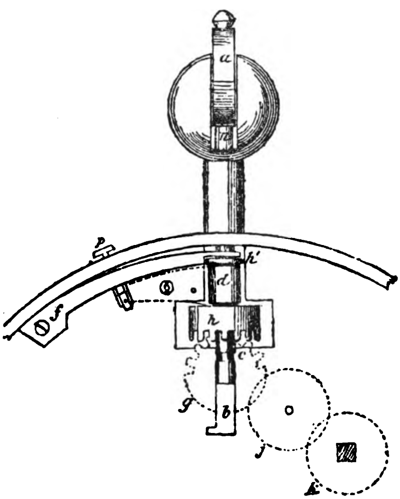


Fig. 145.

the pendant. In order to wind, the rod *n b* is pulled up until the nib at the end of *b* comes in contact with the interior of the pinion *h*, where there is a catch; the spring *f* then falls into the groove *c*, and then the winding is accomplished by turning the ball at *a*. There was no provision for setting hands.

Thomas Prest, foreman to J. R. Arnold at his Chigwell chronometer factory, patented in 1820 (No. 4501) a very similar arrangement to the foregoing as far as the winding is concerned, but no provision was made for disconnecting the wheels from the pendant knob.

A. L. Breguet applied winding work to many of his watches, and an arrangement to connect with the motion work for setting hands by pulling out the bow.

Isaac Brown in 1829 (5851) patented a winding-rack attached to the bezel, the bezel being moved round to wind.

Adrien Phillipe, in 1843, invented the shifting sleeve keyless mechanism used in many foreign watches. Lecoultre and Audemars subsequently made alterations in the construction which is shown in the drawing of chronograph work, p. 236, as now constructed.

Adolphe Nicole, in 1844, patented (10,345) a fusee keyless work in which a knob or the pendant was pushed in to make connection with the fusee wheel, and pulled out to connect with the minute wheel.

The rocking bar mechanism for winding and setting hands was patented in 1855 (2144), by Gustavus Hughenin.

Hand-setting arrangement patented by D. L. A. Nicole, in 1855 (2438).

Pierre Noyer, in 1856 (1934), patented fusee winding mechanism with a friction spring to the winding wheel.

In 1856 (2068) William S. Mitchell and Charles M. Gartner combined to patent the application of the rocking-bar to fusee watches, the pinions on the rocking-bar being kept from gearing with either the fusee or the minute wheels by springs. This is a sound action for fusee keyless work, but necessitates the use of two push pieces, one of which must be held in while winding, and the other when setting hands.

Many other devices for fusee winding have been patented, but in view of the decreasing demand for fusee keyless watches, the matter need not be pursued further.

Rocking Bar Keyless Mechanism.

THIS is the keyless mechanism most generally adopted in English going-barrel watches. For winding the watch, connection has to be made between the serrated button projecting above the pendant and the wheel to the left hand of the figure which is attached to the barrel arbor. For setting the hands the winding connection must be broken and connection made with the minute wheel on the right hand of the figure, so that it may be actuated in either direction by turning the button. Three wheels gearing together are planted on the rocking bar.

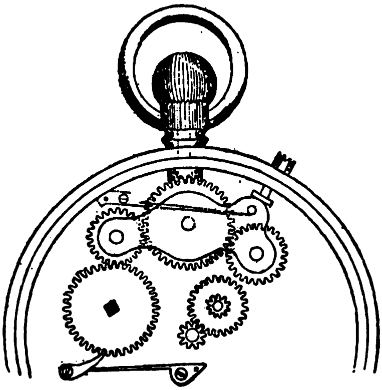


Fig. 146.

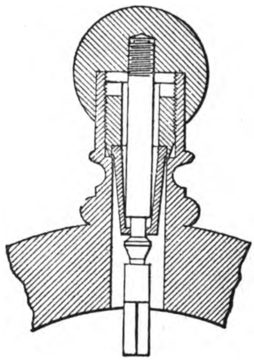


Fig. 147.

The middle one rides freely on a stud which projects from the rocking bar. This stud forms the centre of motion of the rocking bar, which is free to move up or down so as to engage with either the barrel wheel or the minute wheel. In its normal position the connection is with the barrel wheel. A spring fixed at one end to the pillar plate presses against a small stud on the rocking bar just sufficiently to keep the winding wheels in gear. A contrate wheel squared on to the stem of the winding button gears with the middle wheel on the rocking bar. As the button is turned for winding, the resistance of the barrel wheel ensures the safety of its depth with the wheel on the rocking bar. When the knob is turned the reverse way, the teeth of this latter wheel slip over the teeth of the barrel wheel. There is a click to prevent the barrel wheel running back.

For setting hands a push piece, projecting through the band of the case, is pressed with the thumb-nail, so as to depress the right hand side of the rocking bar till the wheel on that side engages with the minute wheel. The thumb-nail presses on the push piece till the operation of setting the hands is completed, and directly the push piece is released the winding wheels engage again.

The push piece in the edge of the case for setting hands is sometimes abandoned in favour of a pendant setting arrangement. An example is given in Fig. 147. The keyless work is of the usual rocking-bar kind, except that a light spring to the rocking bar keeps the setting wheels in action. In the pendant is a steel spring sleeve, split into four from the lower end for nearly its whole length. This sleeve is kept into its place by a screwed brass plug. Normally, the spring that would keep the setting wheels into gear is overcome, and the winding wheels are kept into gear by the lower end of the sleeve pressing on a collar on the winding arbor. When it is desired to set hands, the button is pulled out, the lower end of the sleeve is sprung open by the pressure of the bevelled face of the collar, and the sleeve closes on to the arbor again below the collar, allowing the set hand wheels to be in contact. When the setting is completed, the button is pushed down again, and the arbor returns to the position shown in the sketch.

Shifting Sleeve Keyless Mechanism.

THIS form of keyless work, which is mostly used in Swiss watches, is shown on the chronograph drawing at p. 236. A bevelled pinion with clutch teeth underneath rides loose on the stem of the winding button, and gears with bevelled teeth on the face of the large wheel which is just below the pendant. The part of the winding stem below the bevelled pinion is square, and upon this part is fitted a sleeve with clutch teeth corresponding with those on the bevelled pinion at its upper extremity, and a contrate pinion at its lower extremity. A groove is formed around the sleeve, in which is a spring pressing the sleeve upwards so as to keep the clutch teeth engaged. While the clutch teeth are so engaged the winding may be proceeded with. To set hands a push piece, projecting through the band of the case, acts on a knuckle of the spring just mentioned, so that, as the push piece is pressed in, the spring draws the sleeve away from the clutch teeth of the bevelled pinion, and brings the contrate pinion into gear with a small wheel, which latter gears with the minute wheel.

Self-Winding Watches.

SEVERAL methods have been devised for automatic winding, of which two examples are given.

Fig. 148 shows an arrangement by Lebet for winding a watch by the action of closing the hunting cover. There is a short gold arm projecting beyond the joint. This arm is con-

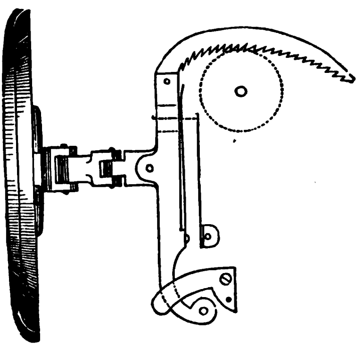


Fig. 148.—Self-winding watch mechanism to act on the closing of the hunting cover.

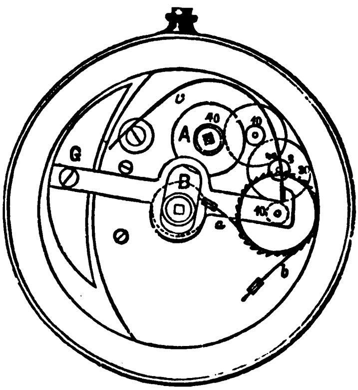


Fig. 149.—Pedometer winding.

nected by means of a double link to a lever, one end of which is pivoted to the plate. To the free end of this lever is jointed a scythe-shaped rack, which works into a wheel with ratchet-shaped teeth on the barrel arbor. A weak spring fastened to the lever serves to keep the rack in contact with the wheel teeth.

Instead of the ordinary fly spring there is a spring fixed to the plate and attached by means of a short chain to the lever. As this spring pulls the cover open, the teeth of the rack slip over the teeth of the wheel on the barrel arbor. Each time the wearer closes the cover, the watch is partly wound. By closing the case eight or nine times the winding is completed. The ordinary method of hooking in the mainspring would be clearly unsuitable with this winding work, because after the watch was fully wound the case could not be closed. Inside the barrel is a piece of main-spring a little more than a complete coil with the ends overlapping, and to this piece the mainspring hook is riveted. The adhesion of the loose turn of mainspring against the side of the barrel is sufficient to drive the watch, but when the hunting cover is closed after the watch is wound, the extra strain causes the mainspring to slip round in the barrel.

The method of winding just described can be applied only to a hunting watch. Fig. 149 represents what is known as a pedometer winding. Louis Recordon, in 1780, patented it (No. 1249), and it has been several times re-invented. The motion of the wearer's body is utilized for winding. There is a weighted lever, G, pivoted at one end, and kept in its normal position against the upper of two banking pins by a long curved spring so weak that the ordinary motion of the wearer's body causes the lever to continually oscillate between the banking pins. Pivoted to the same centre as the weighted lever is a ratchet wheel with very fine teeth, and fixed to the lever is a pawl, *a*, which engages with the ratchet wheel. This pawl is made elastic, so as to yield to undue strain caused by the endeavour of the lever to vibrate after the watch is wound. A is the barrel arbor, and the connection between it and the ratchet wheel is made by a train of wheels as shown. *b* is a second pawl to prevent the return of the ratchet wheel.

Repeaters.

THE principle on which Barlow's and Quare's repeating watches were constructed will be understood from an examination of the large engravings of the rack striking work. It will be seen that the number of hours or quarters struck depends on the position of the snails which revolve with the timekeeping mechanism. The hammers were actuated by a separate mainspring, which was wound every time it was desired that the watch should repeat. This was done by pushing the pendant in. Connected to the inner end of a pendant was a chain coiled round a pulley attached to the mainspring barrel, and also a lever, which, by coming in contact with the snail, stopped the pendant; so that the mainspring was wound much or little according to the number of blows to be struck.

The chain was found to be the most unsatisfactory part of the mechanism, and at the beginning of the eighteenth century Matthew Stogden substituted a rack for it. Other alterations have since been made in the arrangements, one of the chief being the winding of the mainspring by means of a slide projecting from the band of the case. Barlow and Quare used a bell shaped to the inside of the case, such as had been used before their time for clock watches; wire gongs, introduced by Julien Le Roy, are now used instead.

Graham invented a "pulse piece," which upon being pressed kept the hammers off the bell, but allowed the time to be ascertained by counting the throbs or beats on the pulse piece.

Repeaters of a later date usually allow the time to be estimated to within smaller fractions than a quarter of an hour. A minute repeater in addition strikes the number of minutes since the last quarter.

Half-quarter repeaters, instead of giving the minutes, strike one additional blow if the half-quarter has passed. Five-minute repeaters give after the hour the number of five minutes past it.

On page 248 is a very fair representation of half-quarter repeating work, double the actual size. It is still too small to allow of reference letters without confusion, but if the rack striking work is first understood, the action may, I think, be easily traced.

The small mainspring which supplies the force for repeating is wound up by the wearer pushing downwards the slide projecting from the outer circle at the right-hand of the figure. This slide is the extremity of a lever which presses against a pivoted rack engaging with a segment on the barrel arbor. There is underneath a segment of greater radius, containing twelve ratchet teeth. The number of hours to be struck is regulated by the position of the hour snail in precisely the same way as the striking work of a clock. At twelve o'clock the lowest step of the snail is presented to the stop, so that the rack can be traversed its full extent. In returning, each one of the twelve ratchet teeth in turn lifts the tail of the hammer which strikes the hours. The quarter rack has two

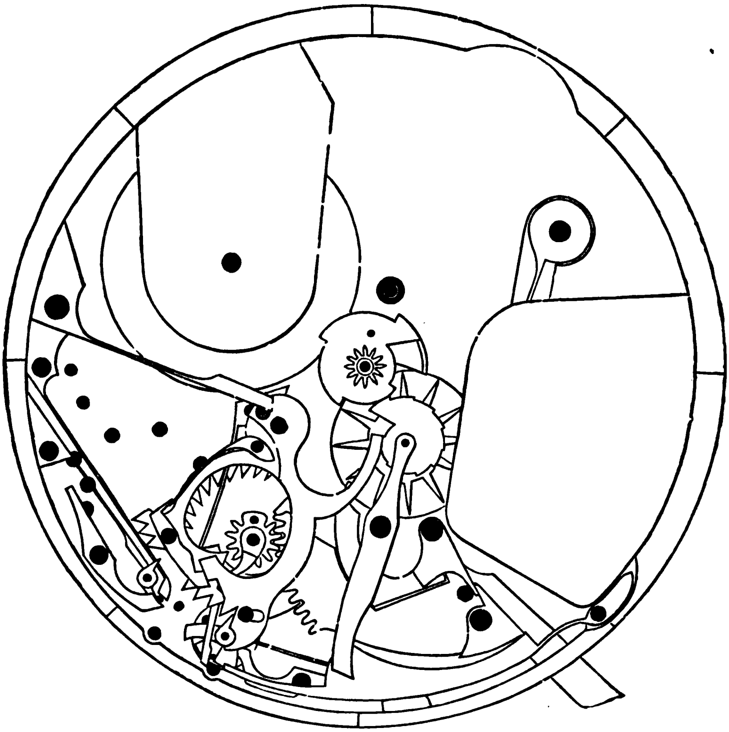


FIG. 150.—Half-quarter repeating work.

sets of three ratchet teeth each, and as the slide is moved round the all-or-nothing piece, as it is called, releases the quarter rack, against which a spring is constantly pressing. The quarter rack is stopped by the quarter snail. After the hours are struck, a curved finger or gathering pallet on the barrel arbor presses the quarter rack to its original position, and in passing each of the ratchet teeth, by pushing aside a pallet fixed to the same arbor as the hammer, strikes a blow. Whether one, two, or three quarters are struck depends, of course, on the position of the quarter snail.

The half-quarter rack, with but one ratchet tooth, is placed on top, and works with the quarter rack. Between each quarter and seven minutes past it yields as it passes the lifting pallet.

The quarter snail attached to the cannon pinion is doubled with steps just dividing each other, so that after the half-quarter the quarter rack gets round a little nearer to the centre of the snail than the half-quarter rack. This allows the spring catch which is mounted on the quarter rack to lock the half-quarter rack, and then, after the quarters have struck, it lifts the hammer and strikes one more blow.

The hour snail is mounted on a star wheel, as shown, and the star wheel is moved by a pin in the quarter snail, or rather in the loose surprise piece underneath, which flies out to the position shown in the drawing directly the star wheel is moved. The surprise then prevents the quarter rack reaching any step of the quarter snail, and consequently no quarters are struck. When the pin in the surprise piece comes round to the star wheel again, the pressure of the pin on a tooth of the star wheel causes the surprise piece to retire so that the third quarter and half-quarter can be struck, but as the star wheel jumps forward the succeeding tooth flirts out the surprise.

The hammer arbors go through the plate, and the hammers are on the other side. The gongs of steel wire, fixed at one end to the plate, curl round it and lie between the plate and the band of the case.

There is also on the other side of the plate a train of runners for regulating the speed of striking. The centres of the wheels are indicated by dots on the left hand of the barrel. The last pinion is not furnished with a fly as in clocks, but there is a screw with an eccentric head, by means of which the depth of the last pinion can be increased or made shallower. This is found to be sufficient regulation, though latterly an escape wheel and pallets have been applied at the end of the train of runners to regulate the speed in some repeaters. This is perhaps more scientific than making a bad depth, but the pallet staff holes are found to wear very much if not jewelled.

In 1804, John Moseley Elliott patented (No. 2759) an ingenious device for dispensing with the repeating train, as well as striking the hours and quarters and other subdivisions with one hammer. By turning a rod running through the pendant to the right, a pallet on the inner end of it moved round a lever till it came in contact with the hour snail, and while this was being done, each of the teeth of a ratchet wheel also mounted on the inner part of the pendant rod, engaged with the hammer stalk and caused it to strike on the bell. The number of blows struck depended of course on the position of the hour snail. By turning the pendant to the left, another lever was carried to the quarter snail, and the proposed number of quarters struck in like manner.

The time might in this arrangement be ascertained without a bell, by first turning the pendant rod as far as the snail allowed, and then reversing it and counting the number of clicks or obstructions caused by engagement with the ratchet. The elder Grant made some dumb repeaters on this plan.

Escapements.

THE anchor or recoil escapement, invented by Dr. Hooke about 1675, is still the one most generally applied to the ordinary run of dials and house clocks. When well made it gives very fair results. There is no rest or locking for the pallets, but directly the pendulum in its vibration allows a tooth, after giving impulse, to escape from the impulse face of one pallet, the course of the wheel is checked by the impulse face of the other pallet receiving a tooth. The effect of this may be seen on looking at the drawing (Fig. 151), where the pendulum, travelling to the left, has allowed a tooth to fall on the right-hand pallet. The pendulum, however, still continues its swing to the left, and in consequence the pallet pushes the wheel back, thus causing the recoil which gives the name to the escapement. It is only after the pendulum comes to rest and begins its excursion the other way that it gets any assistance from the wheel, and the difference between the forward motion of the wheel and its recoil forms the impulse.

Fig. 151 shows the original form, and the one best suited for long-case clocks. For clocks with shorter, and therefore quicker-moving pendulums, the pallets are usually curved, as shown in Fig. 152.

The first application of the anchor escapement seems to have been made about 1680, by William Clements, a London clock-maker.

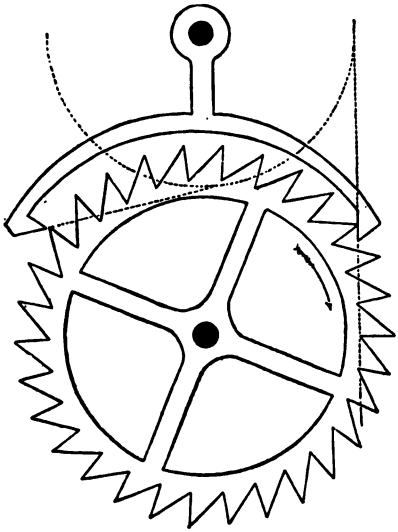


Fig. 151.—Anchor escapement.

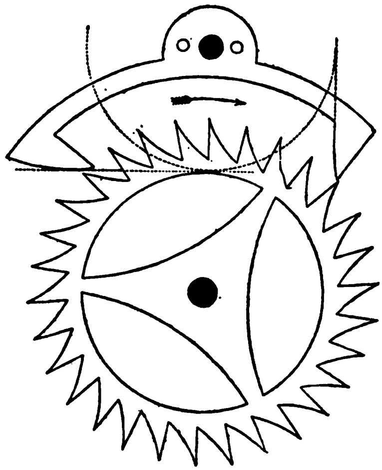


Fig. 152.—Anchor escapement.

The Dead Beat or "Graham" Escapement. For regulators and other fine clocks with seconds pendulums this escapement is the one most generally approved. The only defect inherent in its construction is that the thickening of the oil on the pallet will affect the rate of the clock after it has been going some time. Notwithstanding this it has held its own against all other escapements, on account of its simplicity and certainty of action. The pallets of the Graham escapement were formerly made to embrace fifteen teeth of the wheel, and until recently ten, but now many escapements are made as shown in the drawing, with the pallets embracing but eight. This reduces the length of the impulse plane and the length of run on the dead face for a given arc of vibration, and consequently the relative effect of the thickening of the oil. The angle of impulse is kept small for the same reason.

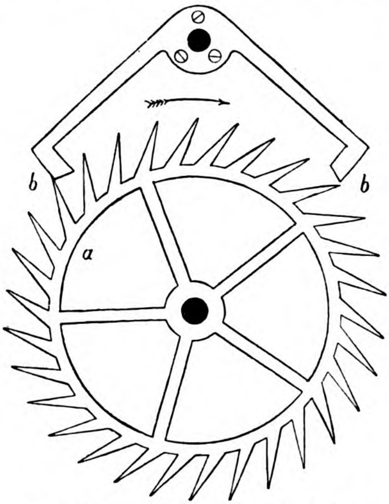


FIG. 153.—Dead beat or "Graham" escapement.
a, escape wheel; *bb*, pallets.

There is not much gained by making the pallets embrace a less number of teeth than eight, for the shake in the pivot holes and inaccuracies of work cannot be reduced in the same ratio, and are therefore greater in proportion. This involves larger angles and more drop. It is purely a practical question, and has been decided by the adoption of eight teeth as a good mean for regulators and fine clocks where the shakes are small. For large clocks of a rougher character, 10 teeth are a good number for the pallets to embrace.

Pin Wheel Escapement. This clock escapement, invented by Lepaute about 1753, is analogous in its action to the "Graham." The impulse is given by nearly half-round pins standing out from the face of the escape wheel. The one advantage over the Graham is that the pressure on the pallets is always downwards, so that excessive shake in the pallet staff hole, which may be looked for in the course of time, especially in large clocks, would not affect the amount of impulse.

The pin wheel escapement is used principally in turret clocks. The chief objection to it practically is the difficulty of keeping the pins lubricated, the oil being drawn away to the face of the wheel. To prevent this a nick is sometimes cut round the pins, close to the wheel, but this weakens them very much. The best plan is to keep the pallets as close as they can be to the face of the wheel without touching.

Lepaute made the pins semi-circular, and placed alternately on each side of the wheel so as to get the pallets of the same length. This requires double the number of pins, and there is no real disadvantage in having one pallet a little longer than the other, provided the short one is put outside, as shown in the drawing. Sir Edmund Beckett introduced the practice of cutting a piece off the bottoms of the pins, which is a distinct improvement, for if the pallet has to travel past the centre of the pin with a given arc of vibration before the pin can rest, the pallets must be very long unless very small pins are used.

Pin Pallet Escapement. This excellent escapement, invented by M. Brocot, rarely seen except in small French clocks, appears to be worthy of more extended use. The fronts of the teeth of the escape wheel are sometimes made radial, as shown in the engraving; sometimes cut back so as to bear on the point

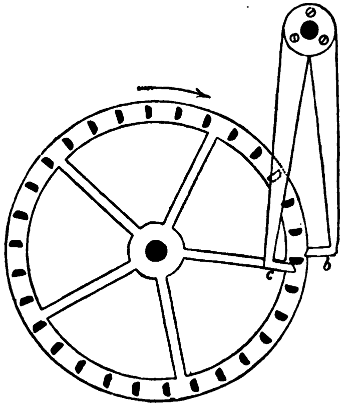


FIG. 154.—Pin wheel escapement.

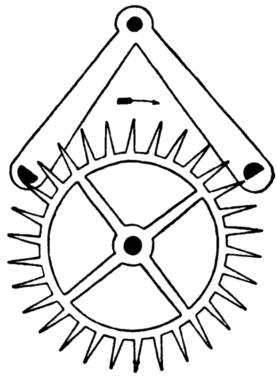


FIG. 155.—Pin pallet escapement.

only, like the "Graham;" and sometimes set forward so as to give recoil to the wheel during the motion of the pendulum beyond the escaping arc. The pallets, generally of carnelian, are of semicircular form. The diameter of each is a trifle less than the distance between two teeth of the escape wheel.

English clockmakers rather object to this escapement on account of the difficulty of keeping oil to the pallets, which is aggravated if there is much space between the root of the pallet stone and the face of the wheel. The effect of the want of oil is much more marked if the pallets are made of steel instead of jewel. Any tendency of this escapement to set is generally met by flattening the curved impulse faces of the pallets.

Gravity Escapements. For large turret and other clocks which have to move a number of heavy hands exposed to wind and snow, the Graham and similar escapements are not perfectly adapted. The driving weight of the clock must be sufficient to move the hands under the most adverse circumstances. Then at times, when the wind and snow assist the hands in their motion, the whole of the superfluous power is thrown on the escapement, and accurate performance cannot be expected.

Until a gravity escapement was successfully applied to the Westminster clock, it was customary to use a remontoire of some kind, that is, an arrangement by which the train, instead of impelling the pendulum direct, winds up a spring. This spring, in unwinding, administers a constant impulse to the pendulum. A gravity escapement partakes somewhat of this principle. The train raises an arm of certain weight a constant distance, and the weight of this arm in returning impels the pendulum. Mudge, about 1760, invented a gravity escapement having two gravity arms with sloped lifting faces acted on by a wheel of thirty teeth. But the arms were apt to be jerked up a little too far by the quick action of the wheel teeth. Cumming also devised a gravity escapement about 1763, with separate arms for locking and lifting.

But all gravity escapements were regarded with suspicion, as having a tendency to trip, until Mr. Denison designed the double three-legged one for the great clock at the Houses of Parliament. He accomplished the lifting by slowly moving pins near the centre of the escape wheel, and by employing a wheel with but few teeth, which therefore moved through a large arc each time it was unlocked, was enabled to use a fly to steady its motion, by which all danger of tripping was avoided.

Denison's Double Three-legged Gravity Escapement. This escapement, shown in Fig. 156, consists of two gravity impulse pallets pivoted as nearly as possible in a line with the bending point of the pendulum spring. The locking wheel is made up of two thin plates having three long teeth or "legs" each. These two plates are squared on the arbor a little distance apart, one on each side of the pallets. Between them are three pins which lift the pallets. These pins are generally the bodies of three screws used to connect the locking plates, though a three-

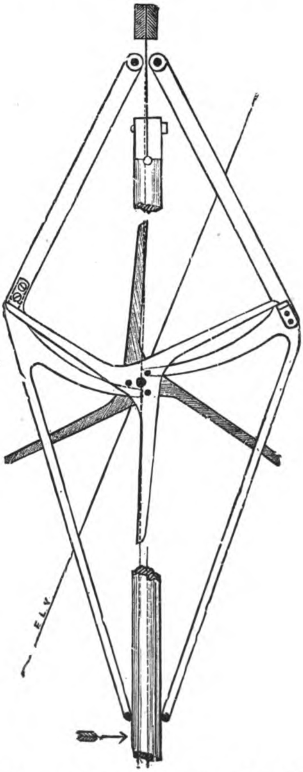


FIG. 156.—Double three-legged gravity escapement.

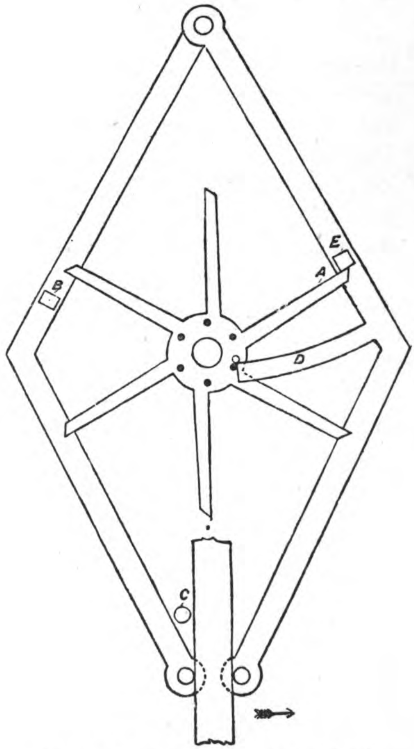


FIG. 157.—Thwaites and Reed's six-legged gravity escapement.

leaved pinion answers the purpose. In the drawing, one of the front legs is resting on a block screwed to the front of the right-hand pallet. This forms the locking. There is a similar block screwed to the back of the left-hand pallet for the legs of the back plate, which is shaded in the drawing, to lock upon. Projecting from each of the pallets is an arm. The tip of the one on the right-hand pallet is just in contact with one of the pins which has lifted the pallet to the position shown. The pendulum is travelling in the direction indicated by the arrow, and the left-hand pallet has just given impulse. The pendulum rod in its swing will push the right-hand pallet far enough for the leg of the front locking plate, which is now resting on the block, to escape. Directly it escapes, the left-hand pallet is lifted free of the pendulum rod by the lowest of the three pins. After the locking wheel has passed through 60°, a "leg" of the back locking plate is caught by the locking plate on the left-hand pallet. There should be a couple of banking pins to stop the pallets from going lower than the left-hand one is shown. This allows the lifting pins to have a little free run before reaching the arm.

As the three-leaved pinion always lifts the pallets the same distance, the pallets in returning give a constant impulse to the pendulum. The friction in unlocking would, of course, vary with the pressure transmitted through the train, but the effect of such variation is found to be practically of no moment. To avoid any jar when the locking leg fall on the block, there is a fly kept by a spring friction-tight on an enlarged portion of the arbor. This fly causes the legs to fall smoothly and dead on the blocks.

All the parts are made very light, of steel, with the acting surfaces hardened. The distance of the lifting pins from the centre should not be more than one-eighth or less than one-twelfth of the radius of the locking legs. They should be placed as shown, the one last in action and the one about to lift being vertically under each other; the lifting is then performed across the line of centres. The distance of the centre of the escape wheel from the pivots of the pallets equals the diameter of the escape wheel. The length of the tails of the pallets is immaterial. For symmetry they are generally made as shown. The most frequent mistake in constructing this escapement is that the parts, especially the locking plates, which can hardly be too light, are made too heavy. Lord Grimthorpe suggests that the fly should be made of aluminium for lightness. The beat pins may be of brass or ivory. They, and the pendulum rod where they touch, should be left perfectly dry. If oiled they become sticky, and the action of the escapement will be unsatisfactory.

Thwaites and Reed's Six-legged Gravity Escapement. In this modification of Denison's gravity escapement impulse is given to the pendulum at each alternate vibration only. The rotations of the escape wheel are only half what are required with the double three-legged, and a much lighter driving weight will suffice. In the engraving on p. 255 the pendulum swinging

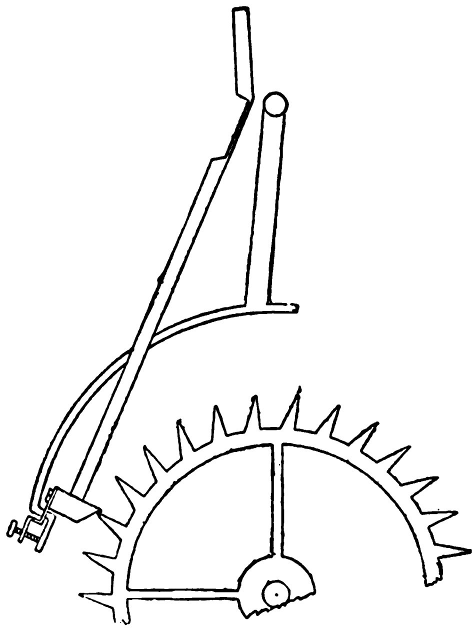


Fig. 158.—Reid's gravity escapement.

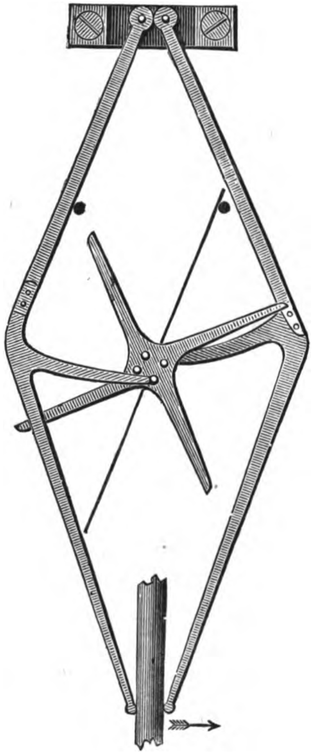


Fig. 159.—Four-legged gravity escapement.

in the direction of the arrow will unlock the tooth A, and allow the wheel to move till it is stopped by the block B on the neutral arm; by this time the lifting pin which had been in contact with the arm D is carried to the position indicated by the outline just above the real pin, which is black; so that in the return vibration the arm D clears the lifting pin and follows the pendulum, giving it impulse. In its excursion the pendulum moves the neutral arm till the wheel is unlocked from the block B, and the wheel then again takes the position shown in the drawing. The neutral arm simply rises and falls, giving no impulse; but when resting against the banking pin C is in the proper position to lock the wheel.

The action of a gravity escapement invented at the beginning of this century, by Thomas Reid, of Edinburgh, with arms lifted on Mudge's plan, but suspended from springs instead of being pivoted on studs, will be understood from Fig. 158, which shows one of the arms. A regulator with this escapement, at the Horological Institute, is an excellent timekeeper, until it gets dirty, or is subjected to the slightest disturbance, when it is unreliable. Even taking the hood off has been known to cause it to trip.

In 1820, William Hardy received from the Society of Arts a gold medal and fifty guineas for an escapement similar in principle to Reid's.

A four-legged escapement on Denison's principle, so excellent for turret clocks, is occasionally used for regulators and other clocks with seconds pendulums. It may, perhaps, when thoroughly well made, and with the locking blocks jewelled, be better than the Graham for such a purpose, as it is free from the error due to thickening of the oil; but from the small number of teeth in the escape wheel, it requires in the train either very high numbered wheels or an extra wheel and pinion. This is a distinct advantage in a turret clock, because the large amount of power required to drive the leading off rod is thereby more reduced by the time it reaches the escapement. But for regulators and house clocks the extra wheels are a drawback sufficient to prevent its general adoption, considering the extra cost of the escapement and the good performance of the Graham. There is the additional advantage with the Graham that the escape wheel rotates once in a minute, and affords a ready means of obtaining the seconds indicator.

Cylinder Escapement.

With this escapement the balance is mounted on a hollow cylinder large enough in the bore to admit a tooth of the escape wheel. Nearly one-half of the cylinder is cut away where the teeth enter the shell, and impulse

Cylinder Escapement.

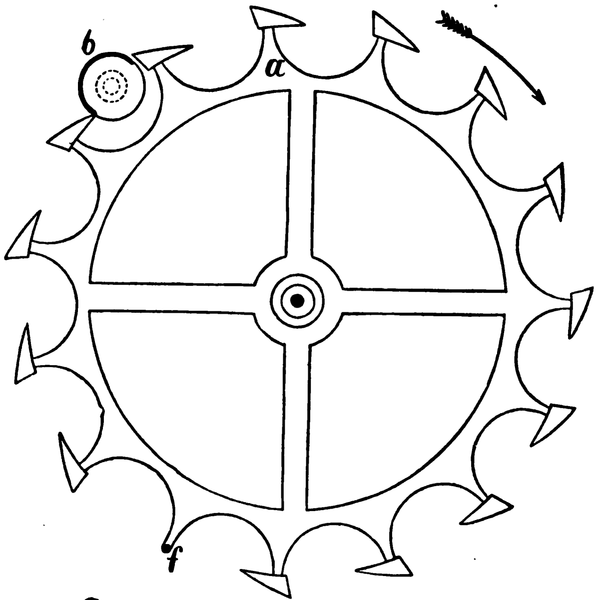


Fig. 160.—Plan.

a, Escape wheel.
b, Cylinder.
c, Entering lip of cylinder.
d, Exit lip of cylinder.
e, Passage for escape wheel.
f, Tooth removed, showing the stalk on which teeth are supported.
g, Collet for balance.

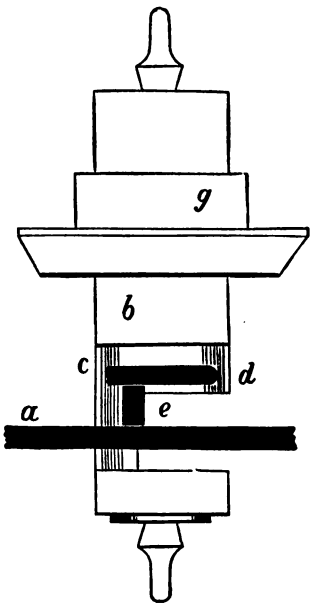


Fig. 161.—Elevation of cylinder and one tooth of escape wheel therein.

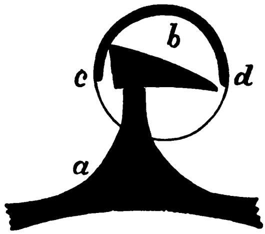


Fig. 162.—Plan of cylinder and one tooth of escape wheel therein.

is given to the balance by the teeth, which are wedge-shaped, rubbing against the edge of the cylinder as they enter and leave.

The cylinder is essentially a frictional as distinguished from a detached escapement. It performs fairly well, and is just suited for the lower grades of watches. The vibrations of the balance are not so much affected by inequality in the force transmitted and other faults if the escapement is a frictional one, and the work comparatively coarse, as when a highly detached escapement and very fine pivots are used. It is certainly remarkable that English watchmakers should have been so baffled by a constructional difficulty as to throw aside the cylinder escapement. Ellicott, Mudge, and other eminent English makers used hard brass for the escape wheel, and, occasionally, ruby for the cylinder, but without overcoming the tendency to cutting and excessive wear of the acting surfaces. It remained for the Swiss to bring the problem to a successful issue by making both wheel and cylinder of steel, and hardening them. The production of the cylinder escapement is now monopolized by the Swiss and the French, who, with the aid of machinery, manufacture the escape wheels and cylinders for an almost incredibly low price.

Action of the Escapement.

Fig. 160 is a plan of the cylinder escapement, in which the point of a tooth of the escape wheel is pressing against the outside of the shell of the cylinder. As the cylinder, on which the balance is mounted, moves round in the direction of the arrow, the wedge-shaped tooth of the escape wheel pushes into the cylinder, thereby giving it impulse. The tooth cannot escape at the other side of the cylinder, for the shell of the cylinder at this point is rather more than half a circle; but its point rests against the inner side of the shell till the balance completes its vibration and returns, when the tooth which was inside the cylinder escapes, and the point of the succeeding tooth is caught on the outside of the shell. The teeth rise on stalks from the body of the escape wheel, and the cylinder is cut away just below the acting part of the exit side, leaving only one-fourth of a circle in order to allow as much vibration as possible. This will be seen very plainly on examining Fig. 161, which is an elevation of the cylinder to an enlarged scale.

Duplex Escapement.

The idea of having the locking at a greater distance from the centre of motion of the escape wheel than the impulse, proved seductive to many of the early inventors. Hooke, Hauteville, Sully, Le Roy, and Dutertre all devised escapements on this plan. In 1782 Thomas Tyrer obtained a patent for it (No. 1311). As will be seen from the engraving, the escape wheel has two sets of teeth. One set lock the wheel by pressing on the balance staff, and the other set standing up from the face of the wheel give impulse to the balance.

Like the chronometer, the duplex is a single beat escapement, that is, it receives impulse at every other vibration only. The escapement has two sets of teeth. Those farthest from the centre lock the wheel by pressing on a hollow ruby cylinder or roller fitted round a reduced part of the balance staff, and planted so that it intercepts the path of the teeth. There is a notch in the ruby roller, and a tooth passes every time the balance, in its excursion in the opposite direction to that in which the wheel moves, brings this notch past the point of the tooth resting on the roller. When the tooth leaves the notch, the impulse finger, fixed to the balance staff, receives a blow from one of the impulse teeth of the wheel. The impulse teeth are not in the same plane as the body of the wheel, but stand up from it so as to meet the impulse finger. There is no action in the return vibration. In the figure the detaining roller travelling in the direction of the arrow is just allowing a locking tooth of the wheel to escape from the notch, and the pallet is sufficiently in front of the tooth from which it will receive impulse to ensure a safe intersection.

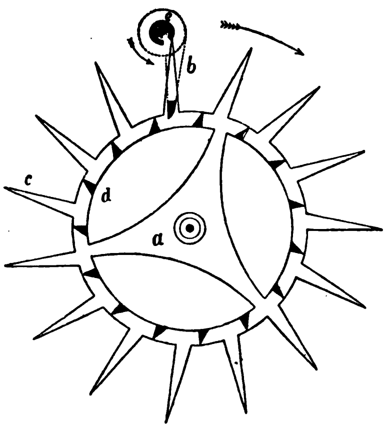


FIG. 163.
a, escape wheel; *b*, impulse pallet; *c*, locking teeth; *d*, impulse teeth; *e*, ruby roller.

Lever Escapement. In this escapement, which was invented about 1765 by Thomas Mudge, the communication between the pallets and the balance is made by means of two levers, one attached to the pallets, and the other, in the form of a roller with a pin projecting from its face, to the balance staff.

The lever escapement, when made with ordinary care, is so certain in its action that it is generally selected, in preference to all others, for pocket watches. For steady timekeeping over a lengthened period it is slightly inferior to the chronometer escapement, owing to the necessity of applying oil to the pallets. However close the rate of the watch at first, the thickening of the oil in the course of time will inevitably affect its going.

The lever escapement which Mudge applied to a watch for Queen Charlotte was analogous in its action to the present form of double roller escapement, except that the impulse pin was divided, for the purpose of ensuring the safety action after the finger enters the crescent, and before the impulse pin is fairly in the notch, a result now attained very simply by having horns to the lever. Curiously enough, the advantages of Mudge's invention seem to have remained unrecognized for many years.

Peter Litherland in 1794 patented the rack lever escapement, in which the lever terminates in a segmental rack which gears with a pinion on the balance axis. Although this was an undetached escapement, and therefore wanting in the chief excellence of Mudge's conception, it met with considerable success, a large number being made by Roskell of Liverpool, chiefly for the American market.

About 1800, Edward Massey, a Staffordshire watchmaker, invented the crank roller, in which the impulse pin is projected beyond the periphery of the roller, something like the finger in the going barrel stopwork. Contact of the extremities of the lever with the edge of the roller formed the safety action. The final perfecting of the table roller variety is ascribed to George Savage, a Clerkenwell watch finisher, some years afterwards.

But, by favour of Mr. George Burrell, I had the privilege a short time ago of inspecting a very fine watch which Josiah Emery, of Charing Cross, who was a friend of Mudge, made for the Duke of Portland. It had a lever escapement and a second roller for the safety action, practically similar to the arrangement in first-class timekeepers of to-day. The impulse pin was of steel, and pivoted in jewel holes, so that it rolled in and out of the notch. The watch, Mr. Burrell said, was originally hung in gymbals in a wooden box. In his evidence before the select committee appointed to inquire into Mudge's claim to a government reward for improvements in chronometers, Emery said his price for such watches was £150.

Action of the Escapement. Fig. 164, p. 265, shows the most usual form of the lever escapement in English watches. A tooth of the escape wheel is at rest upon the locking face of the entering left-hand pallet. The impulse pin has just entered the notch of the lever, and is about to unlock the pallet. The action of the escapement is as follows: The balance, which is attached to the same staff as the roller, is travelling in the direction indicated by the arrow which is around the roller, with sufficient energy to cause the impulse pin to move the lever and pallets far enough to release the wheel tooth from the locking face, and allow it to enter on the impulse face of the pallet. Directly it is at liberty, the escape wheel, actuated by the mainspring of the watch, moves round the same way as the arrow and pushes the pallet out of its path. By the time the wheel tooth has got to the end of the impulse face of the pallet, its motion is arrested by the exit or right-hand pallet, the locking face of which has been brought into position to receive another tooth of the wheel. When the pallet was pushed aside by the wheel tooth it carried with it the lever, which in its turn communicated a sufficient blow to the impulse pin to send the balance with renewed energy on its vibration. So that the impulse pin has the double office of unlocking the pallets by giving a blow on one side of the notch of the lever, and of immediately receiving a blow from the opposite side of the notch. The balance proceeds on its excursion, winding up as it goes the balance spring, until its energy is expended. After it is brought to a state of rest its motion is reversed by the uncoiling of the balance spring, the impulse pin again enters the notch of the lever, but from the opposite direction, and the operation already described is repeated. The object of the safety pin is to prevent the wheel from being unlocked except when the impulse pin is in the notch of the lever.

The banking pins keep the motion of the lever within the desired limits. They should be placed as shown, where any blow from the impulse pin on to the outside of the lever is received direct. They are sometimes placed at the tail of the lever, but in that position the banking pins receive the blow through the pallet staff pivots, which are liable to be broken in consequence.

The width of each pallet is made as nearly as possible half the distance between one tooth of the escape wheel and the next. As the teeth of the wheel must be of an appreciable thickness, and the various pivots must have shake, it is not found practicable to get the pallets of greater width than 10° of the circumference of the wheel instead of 12°, which would be half the distance between one tooth and the next. This difference between the theoretical and actual width of the pallet is called the drop. The lever is pinned to the pallets, and has the same centre of motion. The distance between the centre of the lever and the centre of the roller is not absolute. The distance generally preferred is a chord of 96° of a circle representing the path of the tips of the escape wheel teeth, that is, the distance from the tip of one tooth to the tip of the fourth succeeding tooth. The proportion, as it is called, of the lever and roller is usually from 3 to 1 to $3\frac{1}{2}$ to 1. In the former case the length of the lever (measured from the centre of pallet staff to centre of the mouth of the notch) is three times the distance of the centre of the impulse pin from the centre of the roller, and in the latter case $3\frac{1}{2}$ times. The portion of the lever to the left of the pallet staff-hole acts as a counterpoise, and should really have the metal in it disposed at as nearly as possible the same distance from the centre as that in the other end of the lever, though this is rarely the case.

When, from setting the hands of a watch back, or from a sudden jerk, there is a tendency for the pallets to unlock, the safety pin butts against the edge of the roller. It will he observed that when the impulse pin unlocks the pallets, the safety pin is allowed to pass the roller by means of the crescent which is cut out of the roller opposite the impulse pin. The teeth of the escape wheel make a considerable angle with a radial line (24°), so that their tips only touch the locking faces of the pallets. The locking faces of the pallets, instead of being curves struck from the centre of motion of the pallets, as would be otherwise the case, are cut back at an angle so as to interlock with the wheel teeth. This is done so that the safety pin shall not drag on the edge of the roller, but be drawn back till the

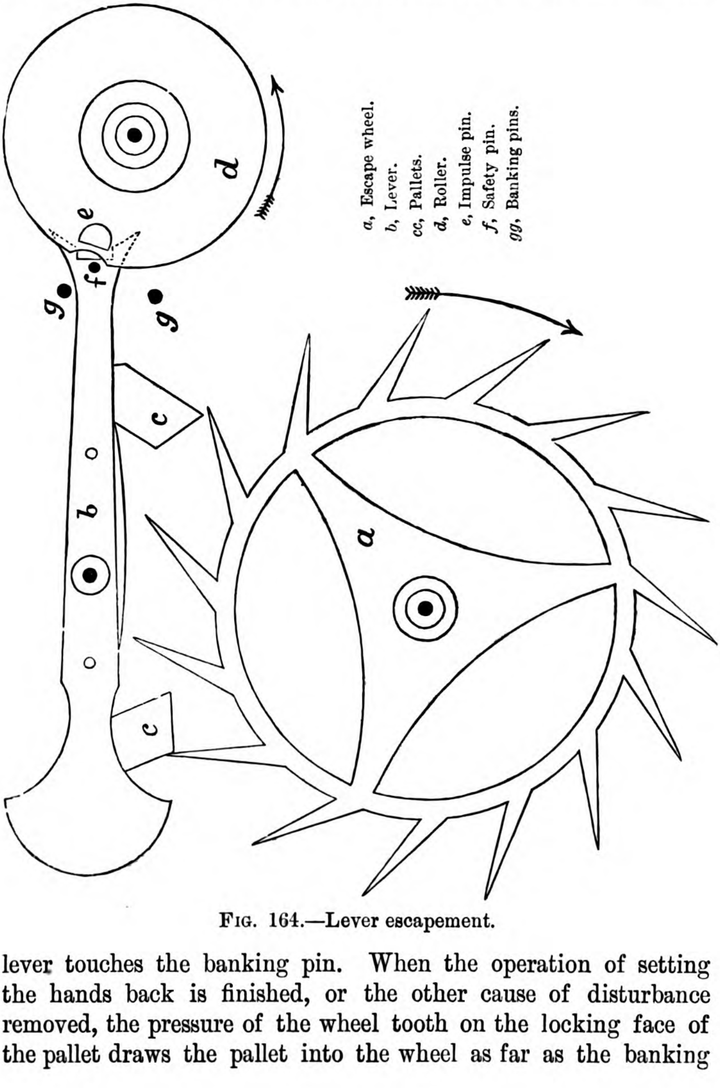


Fig. 164.—Lever escapement.

lever touches the banking pin. When the operation of setting the hands back is finished, or the other cause of disturbance removed, the pressure of the wheel tooth on the locking face of the pallet draws the pallet into the wheel as far as the banking pin will allow. The amount of this "run" should not be more than sufficient to give proper clearance between the safety pin and the roller, for the more the run, the greater is the resistance to unlocking. This rule is sometimes sadly transgressed, and occasionally the locking is found to be, from excessive run, almost equal in extent to the impulse. It will generally be found that in these cases the escapement is so badly proportioned that the extra run has had to be given to secure a sound safety action. In common watches the safety action is a frequent source of trouble. The more the path of the safety pin intersects the edge of the roller, the sounder is the safety action, and if the intersection is small the safety pin is likely to jamb against the edge of the roller, or even to pass it altogether.

Double Roller Escapement. The Horn of the Lever. Low-angled pallets (*i.e.* pallets having but little motion) and small balance arcs are preferred for fine watches; the low-angle pallets as being less affected by changes in the condition of the oil which is used to lubricate the faces of the pallets than when the motion is greater, and the small balance arc because it allows the balance to be more perfectly detached from the escapement. With a double roller escapement, pallets with from 8° to 9° of motion are generally used, with a lever and roller to give a balance arc of from 28° to 32°. With low-angled pallets, and less than 30° of balance arc, a different arrangement than the usual upright pin in the lever must be made for the safety action. A second roller, not much more than one-half the diameter of the one in which the impulse pin is fixed, is mounted on the balance staff for the purpose, and a small gold finger, projecting far enough to reach the edge of the smaller roller, is screwed to the lever. The safety roller should not be less than half the diameter of the impulse roller, for the smaller the safety roller, the farther the safety finger enters the crescent before the impulse pin enters the notch of the lever; and, as directly the safety finger enters the crescent, the impulse pin must be within the horn of the lever, the smaller the safety roller, the longer must be the horn. Then, if the horns are excessively long, the extent of the free vibration of the balance is curtailed, because the impulse pin touches the *outside* of the lever sooner. It will be seen that in the single roller escapement

(Fig. 164) the safety pin does not enter the crescent before the impulse pin enters the notch, and, therefore, in the single roller escapement the lever really requires but the smallest possible amount of horn. Fig. 165 shows the double-roller arrangement. Here it will be seen that the safety finger enters the crescent some time before the impulse pin gets to the notch. During this interval, should the hands of the watch be set back, the

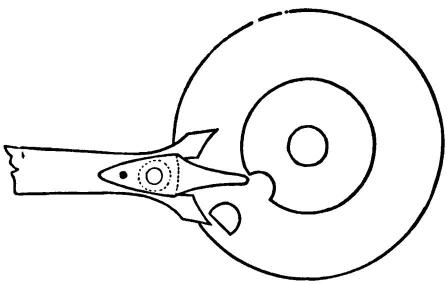


FIG. 165.

pallets could not trip, for the horn of the lever would be caught on the impulse pin. I have tried to explain this fully, because double roller escapements occasionally fail to give satisfaction owing to the lever having insufficient horn. On the other hand, the levers of single roller escapements, where scarcely any horn is required, are often made with very long ones.

Besides getting a sound safety action with small balance arc, the double roller has three other advantages. (1) The impulse is given more nearly on the line of centres, and consequently with less engaging friction. (2) The safety roller being of a lesser diameter, the safety finger when in contact with it offers less resistance to the motion of the balance; and (3) the requisite amount of shake between the safety roller and banking pins is obtained with less run on the pallets.

Savage's Two-pin Escapement. With a view to avoid the somewhat oblique action of the impulse pin, Savage introduced the two-pin escapement (Fig. 166). In place of the ordinary impulse pin, two very small pins are placed in the roller so that one of them begins to unlock just before crossing the line of centres. The passing space for the safety pin, instead of being formed like a crescent, is a notch into which the safety pin fits, and by the time the unlocking is finished, the safety pin has been drawn into the notch and gives the first portion of the impulse. After it has left the notch, the impulse is completed by the notch of the lever striking the second small pin in the roller, which has by that time reached the line of centres or nearly so. In order to get the safety pin well into the notch, this escapement requires pallets having 12° to 15° of motion, which is objectionable, and the lever and roller action is besides a very delicate job, and fails

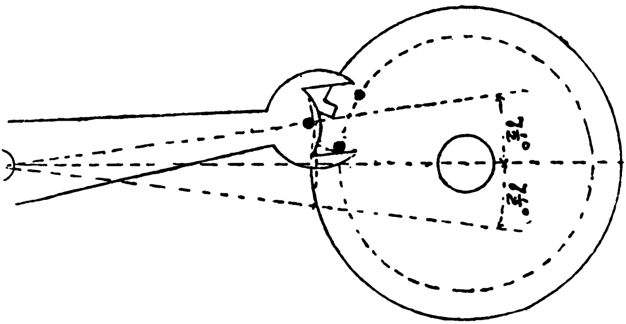


FIG. 166.—Savage's two-pin escapement.

if not thoroughly well done ; so that, although the idea is taking, this form of the escapement has never come much into use, and when it is made, one wide stone is generally substituted for the two pins in the roller.

The unlocking nearer the line of centres is also accomplished in what is called the anchor or dovetail escapement, in which the impulse pin is wider than usual, and of a dovetail form. It is open to the objection that, on account of the increased width of the impulse stone and of the lever, banking will occur with a smaller vibration of the balance than with the usual form.

Resilient Escapements.

A watch balance in general use rarely vibrates more than a turn and a half, that is, three-quarters of a turn each way; yet occasionally, from tight winding of the mainspring, sudden movements of the wearer, or other cause of disturbance, the balance will swing round till the impulse pin knocks the *outside* of the lever. If this banking is violent, the timekeeping of the watch is deranged, and a broken pivot may also result if the pivots are small. To obviate the evil of such banking, various plans have been tried. The most usual is to make the banking pins yield to undue pressure, and to allow the impulse pin to pass the lever, the wings of which are omitted, as shown in Fig. 167. Spring bankings are objectionable, as they are likely, in their recoil, to drive the safety pin against the edge

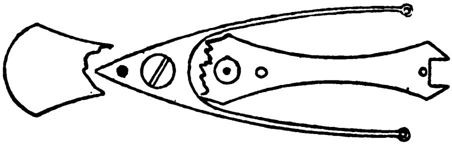


Fig. 167.—Spring bankings.

of the roller. J. F. Cole devised a resilient escapement without any banking pins, in which the teeth of the escape wheel were so formed as to resist the entrance of the pallet into the wheel more than was required for ordinary locking (see Fig. 168). In the

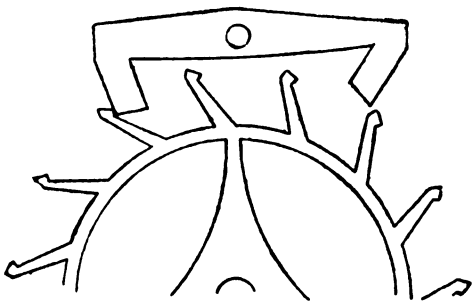


Fig. 168.—Cole's resilient escapement.

event of over-banking, the pallet compelled the escape wheel to recoil, so that the mainspring was really utilized as a spring banking. But in the use of resilient arrangements on this plan, there is a danger of "setting." When the banking is so violent that the impulse pin drives the lever before it, all is well; but it is sure to happen sometimes that just as the impulse pin is passing the lever its motion is exhausted, and it jams against the point of the lever, and stops the watch.

Whittaker's Resilient.

In this variety there are inclined planes on the lever on each side of the notch as shown, a thin lever to yield *downwards*, as the point of the impulse pin touches it when the vibration is so much increased as to cause over-banking. This admits of rigid banking pins being used, and avoids points or corners on which the impulse pin can set.

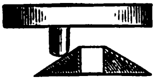


FIG. 169.

Taylor's Resilient.

Here on the lever A are springs with horse-shoe curves B, and points C, which form the notch ; E the usual solid banking pins for lever ; F banking for the springs C. It is claimed that when the impulse-pin, after a vibration of excessive amplitude, strikes the notch formed by the springs, the spring, yielding backward and inward, allows it to pass freely, and there is no possibility of the impulse pin setting against the springs.

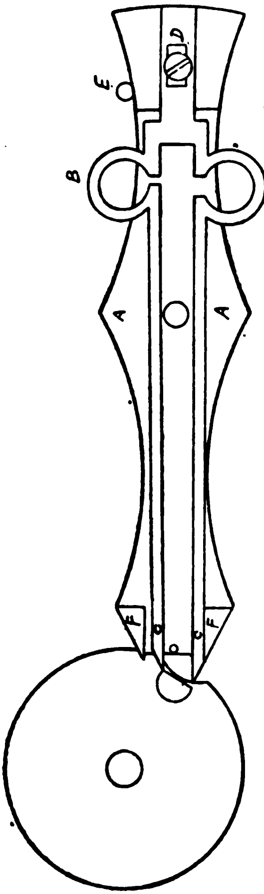


FIG. 170.—Taylor's resilient escapement.

Varieties of the Lever Escapement.

The Swiss, and indeed most foreign watchmakers, form the tips of the teeth of the escape wheel into inclined planes, so as to divide the impulse between the wheel teeth and the faces of the pallets, like Fig. 171. It is urged that the wheel is not so fragile when made in this way, that less drop is required, and that the oil is not drawn away from the tip of the tooth by capillary attraction. On the other hand, English watchmakers maintain that as at some time during each impulse the planes of the wheel and pallet nearly coincide, the increased surface then presented to the varying influence of the adhesion of the oil is a serious evil. Then with "club teeth," as they are called, there is more difficulty in satisfactorily replacing a wheel than with ratchet teeth, for in the former case the planes must be of exactly the same angle and of the same length in the new wheel as in the old one. With brass wheels the impulse faces on the wheel get cut into ruts, but the Swiss avoid this by using steel wheels, and also much reduce the extra adhesion due to increased surface by thinning the impulse planes of the teeth. Swiss escapements are as a rule commendably light, but the levers are disproportionately long. The Germans make an escapement

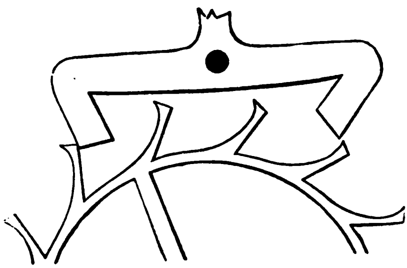


Fig. 171.

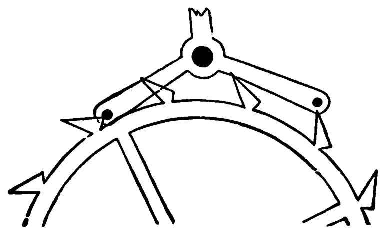
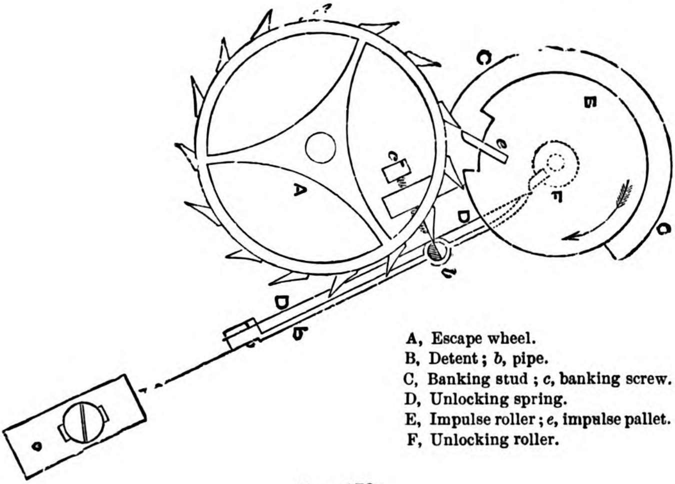


Fig. 172.

in which the whole of the impulse plane is on the wheel teeth, the pallets being small round pins, as in Fig. 172. This certainly seems a cheaper and simpler form. In most foreign lever escapements, and occasionally in English, the roller is planted in a line with the escape wheel and pallet staff holes instead of as shown in Fig. 164. This alteration of the position of the lever with relation to the pallets has often provoked controversy, but there is practically no advantage either way except as a matter of convenience in arranging the caliper of the watch or in manufacturing the parts, though the straight line escapement certainly allows of the poising of the lever and pallets with less redundant metal.

Chronometer Escapement. This escapement, which is unexcelled for time-keeping, was invented in principle by Pierre Le Roy, about 1765. It was perfected and brought into its present form by Earnshaw and Arnold about 1780. The escape wheel is locked on a stone carried in a detent, and impulse is given by the teeth of the escape wheel to a pallet on the balance staff once in every alternate vibration.

Action of the Escapement. In the annexed drawing a tooth of the escape wheel is at rest on the locking pallet. The office of the discharging pallet is to bend the detent so as to allow this tooth to escape. The discharging pallet does not press directly on the detent, but on the free end of the gold spring,



A, Escape wheel.
B, Detent; *b*, pipe.
C, Banking stud; *c*, banking screw.
D, Unlocking spring.
E, Impulse roller; *e*, impulse pallet.
F, Unlocking roller.

FIG. 173.

which presses on the tip of the detent. The balance, fixed to the same staff as the rollers, travels in the direction of the arrow, and then returns with sufficient energy to unlock the tooth of the wheel which is held by the locking pallet. Directly the detent is released by the discharging pallet, it springs back to its original position, ready to receive the next tooth of the wheel. There is a set screw to regulate the amount of the locking on which the pipe of the detent butts. This prevents the locking pallet being drawn further into the wheel. It will be observed that the impulse roller is planted so as to intersect the path of the escape wheel teeth as much as possible, and by the time the unlocking is completed, the impulse pallet will have passed far enough in front of the escape wheel tooth to afford it a safe hold. The escape wheel, impelled by the mainspring, through the medium of the train, overtakes the impulse pallet, and drives it on until the contact between them ceases by the divergence of their paths. The wheel is at once brought to rest by the locking pallet, and the balance continues its excursion, winding up the balance spring as it goes, until its energy is exhausted. The balance is immediately started in its return vibration by the effort of the balance spring to return to its state of rest. The nose of the detent does not reach to the end of the gold spring, so that the discharging pallet in this return vibration merely bends the gold spring without affecting the locking pallet at all. When the discharging pallet reaches the gold spring, the balance spring is at rest; but the balance does not stop, it continues to uncoil the balance spring until its momentum is exhausted, and then the effort of the balance spring to revert to its normal state induces another vibration; the wheel is again unlocked and gives the impulse pallet another blow.

Although the balance only gets impulse in one direction, the escape wheel makes a rotation in just the same time as with a lever escapement, because in the chronometer the whole space between two teeth passes every time the wheel is unlocked.

By receiving impulse and having to unlock at every other vibration only, the balance is more highly detached in the chronometer than in most escapements, which is a distinct advantage. No oil is required to the pallets, and another disturbing influence is thus got rid of. If properly proportioned and well made, its performance will be quite satisfactory as long as it is not subjected to sudden external motion or jerks. For marine chronometers it thus leaves but little to be desired, and even for pocket watches it does well with a careful wearer; but with rough usage it is liable to set, and many watchmakers hesitate to recommend it on this account. It is much more costly than the lever, and would only be applied to very high-priced watches, and in these the buyer naturally resents any failure of action. Its use in pocket pieces is therefore nearly confined to such as are used for scientific purposes, or by people who understand the nature of the escapement, and are prepared to exercise care in wearing the watch. There is another reason why watchmakers, as a rule, do not take kindly to the chronometer escapement for pocket work. After the escapement is taken apart, the watch does not so surely yield as good a performance as before. In fact, it is more delicate than the lever.

Occasionally a form of chronometer escapement is applied to precision clocks. The wheel is locked by the detent in the usual way, and unlocked by an arm on the verge, which also receives the impulse.

"Tourbillon" Escapements. The tourbillon, invented by A. L. Breguet, is not strictly a variety of escapement at all, but rather a revolving carriage in which the escapement is placed, the object of the revolution being to eliminate the errors due to

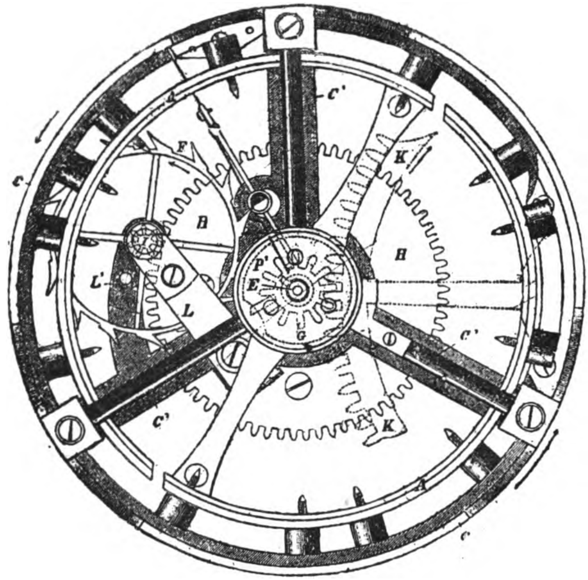


Fig. 174.

varying positions, and particularly the quarter positions, which present the greatest difficulty to the adjuster. In its original form, as Figs. 174 and 175, it was scarcely ever applied except to watches subjected to observatory or other competitive trials. In the drawing the chronometer escapement is shown, but the lever is equally applicable to the tourbillon. It will be observed that the fourth wheel, H, is screwed to the plate, and is stationary, and that the tourbillon cage or carriage, C C, is caused to revolve round it.

The third wheel, K, gears with the pinion, G, which is fixed to the carriage, and as the escape pinion, I, gears with the fixed fourth wheel, the motion transmitted by the third wheel causes the escape pinion to turn on its axis, and also to roll around the fourth wheel, which, so far as its connection with the escape pinion

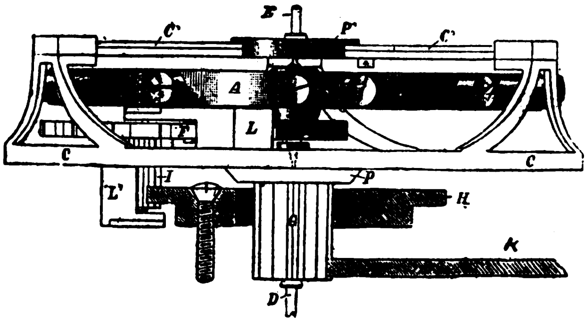


FIG. 175.

is concerned, may be regarded as a circular rack. The lower pivot, D, of the carriage runs in the main plate of the movement, and carries the seconds hand; the upper pivot, E, rotates in a high and long bridge which spans the carriage. LL are the cocks for escape pinion pivots.

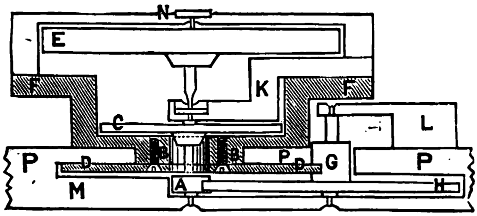


FIG. 176.—Bonniksen's tourbillon.

A, fourth pinion; B, pivot of carriage; C, fourth wheel; D, wheel attached to carriage driven by third pinion G; H, third wheel; E, balance; F, body of carriage; K, L, N, cocks M, bar screwed to pillar plate P.

B. Bonniksen has invented a simpler and more compact arrangement in which the carriage driven by the third pinion rotates once in $52\frac{1}{2}$ minutes, which gives sufficiently quick change of position for all practical purposes. Fig. 176 shows Bonniksen's tourbillon in which the section of the rotating carriage is shaded.

Maintaining Power.

Harrison's Maintaining Spring.

TO obviate the danger of a watch or clock stopping while being wound, Harrison introduced a maintaining spring, and a contrivance of this kind is now used in all fusee timekeepers, as well as in regulators, and the better class of house clocks.

Fig. 177 is a view of the larger end of a watch or chronometer fusee, which is fixed tight to the winding arbor. The great wheel rides loose on the arbor, as does also a thin steel ratchet wheel as large as the fusee, which is placed between the fusee and great wheel. There is a smaller ratchet wheel whose teeth are cut the reverse way, let into and screwed to the fusee, as seen in Fig. 177. Fig. 178 shows that side of the larger ratchet wheel which is placed next to the fusee. The two clicks thereon take into the ratchet on the fusee and thus establish connection between the two pieces.

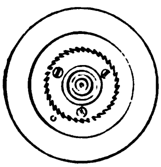


Fig. 177.

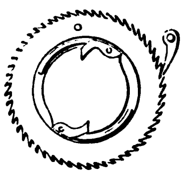


Fig. 178.

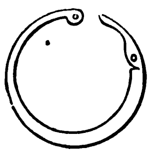


Fig. 179.

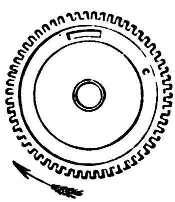


Fig. 180.

A pin passes through the ball end of the spring (Fig. 179), and enters a hole in the larger ratchet wheel. Fig. 180 shows the great wheel, round the inner face of which a recess is turned to cover the spring, so that the great wheel can be brought close to the large steel ratchet wheel. Near the other end of the spring it is fixed to the great wheel by means of the pin shown in the right-hand side of Figs. 179 and 180. It will thus be seen that while the ball end of the spring is fixed to the larger ratchet wheel, the other end is fixed to the great wheel. The spring, being made rather weaker than the force of the mainspring of the watch exerted at the radius of the pin, is bent up till the tail touches the ball as the watch is going, when the great wheel rotates in the direction indicated by the arrow, and the teeth of the larger ratchet pass under the click, or detent, as it is called. In winding, the fusee is turned the reverse way, and the teeth of the smaller ratchet slip under the two clicks, which are pivoted on the larger ratchet. The spring connecting the larger ratchet to the great wheel then, in striving to unbend, drives the watch, the larger ratchet forming a resisting base; for it cannot go back with the fusee because the click which takes into it is pivoted to the watch plate.

The application of Harrison's maintainer to weight clocks is shown in Fig. 181. Here the smaller ratchet is attached to one end of the barrel, which is tightly fixed to the arbor. Next to the smaller ratchet is the larger one, and at the back of that is the great wheel, the larger ratchet and the great wheel being both free on the arbor. The click for the smaller ratchet is pivoted to the nearest face of the larger ratchet, and to the outer face of the larger ratchet are screwed two springs whose free extremities bear on opposite arms of the great wheel. In the going of the clock the pressure of the weight acting on the click pivoted to the larger ratchet, bends the springs. There are two pins in the larger ratchet, one on each side of one of the arms of the great wheel, to circumscribe the action of the springs, which may be limited to three teeth of the great wheel. When winding the clock, the teeth of the smaller ratchet run under their click, but the click in the teeth of the larger ratchet, which is pivoted to the clock plate, keeps the larger ratchet fast, and the unbending of the springs is then utilized to drive the clock.

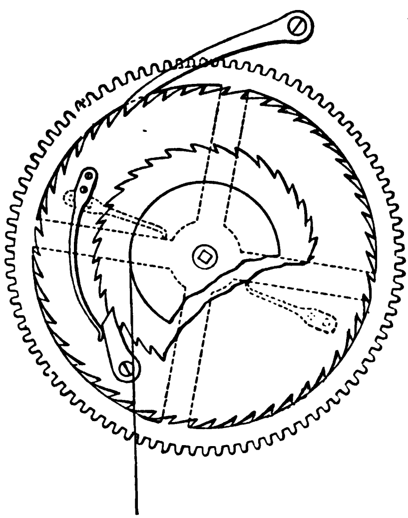


Fig. 181.—Maintaining power for weight clock.

For large clocks, Messrs. Thwaites and Reed use a spiral spring coiled round a curved pin fixed to one of the arms of the great wheel, as shown in Fig. 182; an eye screwed to the larger

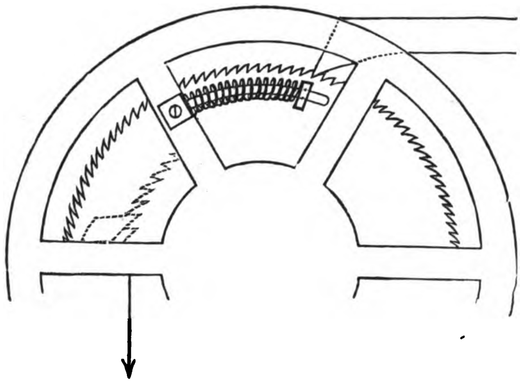


Fig. 182.

ratchet compresses the spring. This answers well if the spring is of sufficient length.

For Huygens' endless cord maintainer, see pp. 105, 106.

Sun and Planet Maintainer. In turret clocks there is often a weighted lever or segment brought to bear on the great wheel while winding; but this is open to the objection that it has to be renewed if the operation of winding takes long, and also because after winding, until the maintainer is removed, there is considerable extra pressure on the escapement. In some of Arnold's watches is a continuous maintainer, which also appears to have been invented by Harrison. Although not so suited for watches as Harrison's maintaining spring, it appears to be admirably adapted for turret clocks, which take some time to wind. The great wheel and barrel both ride loose on the arbor, to which is fixed a pinion, represented by the smallest circle in

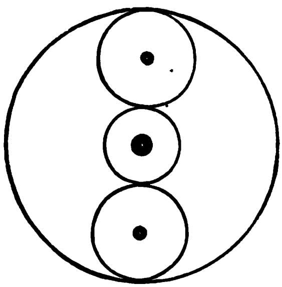


Fig. 183.

Fig. 183. The largest circle represents a ring of internal teeth fixed to the side of the great wheel next to the barrel. There are two wheels, which gear with both the pinion fixed to the barrel arbor and with the ring of internal teeth on the great wheel, as shown. These two wheels run on studs in the end of the barrel. While the handle attached to the barrel arbor is turned as in winding, a continuous pressure is exerted on the internal teeth, which really afford the resisting base in raising the weight. There is a ratchet wheel fixed to the barrel arbor, with a click pivoted to the barrel, to prevent the weight running down when

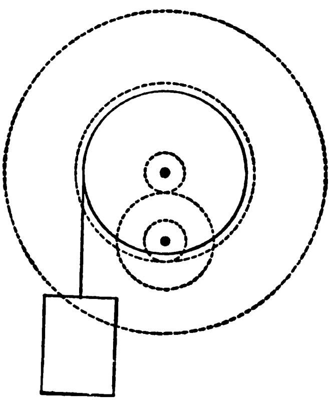


Fig. 184.

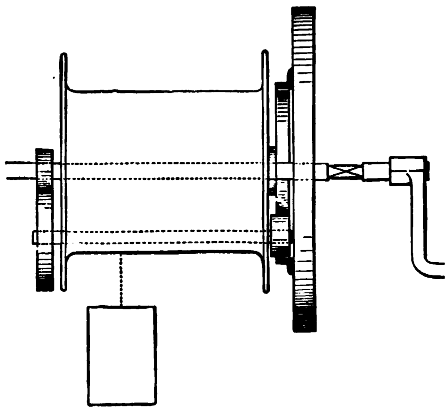


Fig. 185.

the winding is completed. During the going of the clock the whole system turns with the barrel arbor, so that there is no extra friction from the maintaining work. It is not absolutely necessary to have both of the wheels which run on studs at the end of the barrel, and sometimes one of them is omitted.

Mr. I. Herrmann has recently patented the adaptation of this maintainer as keyless work for fusee watches and chronometers. The ring of internal teeth is on the great wheel, the planet pinions are on the fusee, which rides loose on the arbor, and the arbor carries a wheel which gears with a winding pinion at the pendant.

Messrs. Gillett & Co. have introduced another form of the sun and planet maintainer for turret clocks, with double gearing to give additional purchase during winding. Of this side and end views are shown in Figs. 184, 185. As before, the great wheel and barrel both ride loose on the arbor. A pinion fixed to the barrel arbor gears with a wheel fixed to a spindle running in holes formed in the barrel near its circumference. On the other end of this spindle is a pinion which gears with the ring of internal teeth fixed to the great wheel. The extra winding wheels allow the ratchet and click to be dispensed with; but it would perhaps be safer to add them.

Watch Pillars. Though the pillars which connect the two plates of a watch movement are now universally made of a plain cylindrical form, they have been formerly the subjects of considerable enrichment. In most of the early time-keepers the pillars were square, and often engraved; but the first obvious departure from the utilitarian form, in order to please the eye, is shown in No. 1 of the subjoined engraving. This is known as the tulip pillar, and seems to have been introduced in

1 2 3 4 5

FIG. 186.

deference to what may be called the tulip-mania, when the bulbs of that flower were first imported. This particular pillar is from a watch by Tompion. In some other instances the vertical division was omitted. The square Egyptian pillar, No. 2, was favoured about 1680 and later, the central slit being often wider than the example, with a vertical division and decorations on the face; silver was the material favoured for the decorations and divisions. The plainer square pillar, No. 3, has had a long life, for it is met with in watches nearly two hundred years old, and also in specimens produced in the early part of the present century. No. 4 is taken from a watch by Ellicott, the case of which has the hall-mark for 1750, and the elegant outline is quite in accord with the popular taste at that time. No. 5 is later, and is taken from a watch by James Markham, a well-known maker for the

Dutch market. During the period devoted to fancy pillars, many watches were made without regard to the popular taste in this particular. A repeater by Graham in my possession is furnished with plain round pillars, with small bodies and collars formed at the top and bottom, to afford a more secure bearing on the plates.

Arrangement of a Watch Train. The arrangement of the "train" or assemblage of toothed wheels forming the connection between the motor and the regulator of a timekeeper, shown in the drawings of De Vick's clock (p. 27), of the Westminster clock (p. 211), and of the quarter clock (p. 204), makes this part of the construction sufficiently clear so far as non-portable timekeepers are concerned. In a modern watch the necessity of economizing space has led to considerable ingenuity in planning the movement. In the appended drawing A B is the great wheel attached to the barrel containing the mainspring, which forms the motor. On the barrel is planted at A a star wheel, and fixed to the barrel arbor is a finger, which, at each rotation of the arbor, engages with a space of the star wheel and moves it round one division. After four rotations, a swelled portion of the circumference butts against the hollow of the finger and stops further movement. This prevents the mainspring being unduly strained by overwinding.

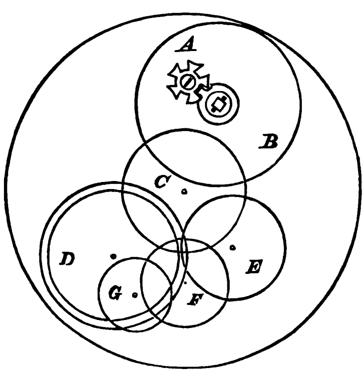


Fig. 187.

In order to obtain as large a barrel as possible, the great wheel extends from the extreme edge of the movement to the centre pinion, with which it gears. On the centre pinion is mounted the centre wheel C, which drives the third wheel pinion; the third wheel E, attached thereto, drives the fourth wheel pinion. The seconds hand is carried by the fourth wheel F pinion, which is therefore planted so as to obtain a seconds dial of adequate size between the centre and the edge of the main dial. The fourth wheel drives the escape pinion, on which is mounted the escape wheel G. The balance or controller D is as large, or nearly as large, as the barrel, and therefore must also be planted approximately midway betwen the centre and outside of the movement. The connection between the escape wheel and the balance is through the intervention of a lever or cylinder, or in some other way dependent on the kind of escapement adopted.

The proportion of the various wheels and pinions will be governed by certain data. The centre wheel rotates always once in an hour; the fourth wheel always once in a minute. Then, if the number of vibrations the balance is to make in an hour, and the number of turns the barrel is to make in the interval between the windings of the mainspring are decided, very little latitude will be possible in the relation of the various factors of the train to each other. Four turns are the usual number for the barrel in 30 hours, the period between winding, and either 16,200 or 18,000 the number of vibrations per hour of the balance; further, the escape wheel is almost universally made with 15 teeth.

The most favoured trains are—

	Centre.	Third.	Fourth.	Pinions.
For 18,000 vibrations per hour	80	75	80	10 10 8
	64	60	70	8 8 7
	64	60	60	8 8 6
For 16,200 vibrations	64	60	72	8 8 8
	64	60	63	8 8 7

In the old full plate construction, there are two circular plates which enclose the movement, the balance being outside of the plate furthest from the dial, which is called the top plate.

In the more modern three-quarter plate movement a portion of the top plate is cut away, and the balance lowered, so that the cock which carries the upper pivot of the balance staff is level with the plate. In this way a much thinner watch is possible, and the escapement can be more readily removed than with the full plate movement.

Hall Marks.

THESE marks are impressed on watch cases, jewellery, and plate, after the quality of the metal has been ascertained by assay at certain official Assay Halls. The marking of jewellery is with few exceptions optional. The hall marking of all watch cases of gold or silver made in Great Britain and Ireland is compulsory. The cost is only the actual outlay incurred in assaying and stamping. The hall mark consists of several impressions in separate shields: there are the standard or quality mark; the mark of the particular office at which the article was assayed; some character by which the date of marking may be traced, and, if duty is chargeable, the head of the reigning sovereign.

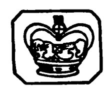
Hall Marking. The oldest and most important of the Assay Halls is that presided over by the Goldsmiths' Company of London, which is situated just at the back of the old General Post Office, in St. Martin's-le-Grand. The privilege of assaying and marking precious metals was conferred on the company by statute in 1300. The company received a charter of incorporation in 1327, and their powers have been confirmed subsequently by several Acts of Parliament.

Many early watch cases, especially silver ones of London make, are met with which have no hall mark, the powers of the company not being so strictly enforced then as now, or the value of the official assay not being so generally recognized.

Among other records of prosecutions for evading the Hall Marking Acts is one in 1778, when two watchmakers, John G—— and William V——, allowed judgment to go by default in respect of two unmarked silver cases found at the Custom House in a cask of hardware.

Repoussé cases, with other artistic wares of a similar character, are specially exempted from assay.

The standard mark of the London Hall is a lion passant for sterling silver. A lion passant was also the standard mark on 22-carat gold up to 1845, when lower standards of gold than 22-carat were recognized.



For gold of 22 carats the standard mark is now a crown, and the figures 22. For 18-carat gold the standard mark is a crown and the figures 18.

For 15-carat gold	15 and 0·625	Pure gold being 24 carats, these decimals represent the proportions of pure gold in the article so marked.
„ 12 „	12 „ 0·5	
„ 9 „	9 „ 0·375	

The London Hall Mark is a leopard's head, which prior to 1823 was crowned.

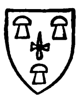
Date marks of the London Hall are given on pages 286, 287. Specimens of the earliest marks are not to be obtained.

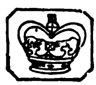
The head of the reigning sovereign denotes that duty has been paid. Watch cases were exempted from duty in 1798.

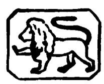
The maker's mark before 1697 was some emblem selected by him; in that year it was ordered to be the two first letters of his surname; since 1739 it has been the initials of the maker's Christian and surnames.

In 1697 the quality of standard silver was raised from 11 ozs. 2 dwt. to 11 ozs. 10 dwt. of pure silver in 12 ozs. of plate, and a lion's head used as the standard mark, and a figure of Britannia as the hall mark; but in 1823 the old standard of 11 ozs. 2 dwts., and the old marks of a lion passant and a leopard's head were reverted to, although the higher standard with the figure of Britannia is still occasionally used.

Marks of other Assay Offices.

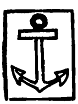


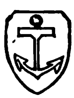


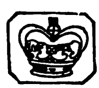


CHESTER.—Hall mark, a sword between three wheatsheaves. Prior to 1779 it was three demi-lions and a wheatsheaf on a shield. Standard mark for 18-carat gold, a crown and the figures 18. For silver, a lion passant.

Birmingham.—Hall mark, an anchor in a square frame for gold, and an anchor in a pointed shield for silver. Standard mark





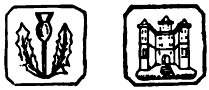


for 18-carat gold, a crown and the figures 18; for silver, a lion passant. The Birmingham date marks are given on page 288.

Sheffield.—A crown (silver only is assayed).

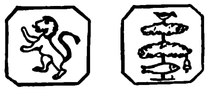
Exeter.—A castle with three towers.

York.—Five lions on a cross. **Newcastle.**—Three castles.

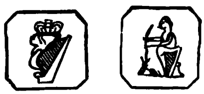


Norwich.—A castle and lion passant. (The Norwich Assay office is now closed.)

Edinburgh has a thistle for the standard mark, and a castle for the hall mark.

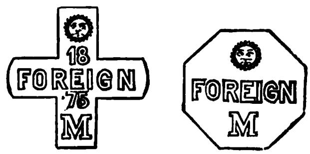


Glasgow has a lion rampart for the standard, and a tree, a fish, and a bell for the hall mark.



Dublin has a harp crowned as the standard mark for sterling silver and for 22-carat gold, with the figures 22 added in the latter case ; for 20-carat gold, a plume of three feathers and 20 ; for 18-carat gold, a unicorn head and 18. The lower qualities of 15, 12, and 9, are marked with the same standard mark as is used at the London Hall. The hall mark for Dublin is a figure of Hibernia.

For watch cases of foreign make, marked in Great Britain, special stamps have been provided as shown. That for gold is in the form of a cross, and for silver the mark is of octagonal shape. The representation of the sun only appears in the London mark. There is, instead, for Birmingham a triangle, and for Chester an acorn.



Swiss Hall Marks.

IN Switzerland the hall marking of watch cases is only compulsory when the article already bears some indication of the quality of gold or silver of which it is made, and even then the English or other recognized hall mark is accepted as a substitute for the Swiss.

GOLD. | SILVER.
18-C. (or 0·755). | 14-C. (or 0·583). | Sterling Silver (or 0·935). | 0·800.

Date Mark on Gold and Silver Plate and Watch Cases marked at Goldsmiths' Hall, London.

Note.—The Date Mark is altered on the 30th of May in each year.

a	1697	A	1716–7	a	1736–7	A	1756–7	a	1776–7
b	1697–8	B	1717–8	b	1737–8	B	1757–8	b	1777–8
c	1698–9	C	1718–9	c	1738–9	C	1758–9	c	1778–9
d	1699–0	D	1719–0	d	1739–0	D	1759–0	d	1779–0
e	1700–1	E	1720–1	e	1740–1	E	1760–1	e	1780–1
f	1701–2	F	1721–2	f	1741–2	F	1761–2	f	1781–2
g	1702–3	G	1722–3	g	1742–3	G	1762–3	g	1782–3
h	1703–4	H	1723–4	h	1743–4	H	1763–4	h	1783–4
i	1704–5	I	1724–5	i	1744–5	I	1764–5	i	1784–5
k	1705–6	K	1725–6	k	1745–6	K	1765–6	k	1785–6
l	1706–7	L	1726–7	l	1746–7	L	1766–7	l	1786–7
m	1707–8	M	1727–8	m	1747–8	M	1767–8	m	1787–8
n	1708–9	N	1728–9	n	1748–9	N	1768–9	n	1788–9
o	1709–0	O	1729–0	o	1749–0	O	1769–0	o	1789–0
p	1710–1	P	1730–1	p	1750–1	P	1770–1	p	1790–1
q	1711–2	Q	1731–2	q	1751–2	Q	1771–2	q	1791–2
r	1712–3	R	1732–3	r	1752–3	R	1772–3	r	1792–3
s	1713–4	S	1733–4	ſ	1753–4	S	1773–4	s	1793–4
t	1714–5	T	1734–5	t	1754–5	T	1774–5	t	1794–5
u	1715–6	V	1735–6	u	1755–6	U	1775–6	u	1795–6

Date Mark on Gold and Silver Plate and Watch Cases marked at Goldsmiths' Hall, London.

Note.—The Date Mark is altered on the 30th of May in each year.

A	1796–7	a	1816–7	A	1836–7	a	1856–7	A	1876–7
B	1797–8	b	1817–8	B	1837–8	b	1857–8	B	1877–8
C	1798–9	c	1818–9	C	1838–9	c	1858–9	C	1878–9
D	1799–0	d	1819–0	D	1839–0	d	1859–0	D	1879–0
E	1800–1	e	1820–1	E	1840–1	e	1860–1	E	1880–1
F	1801–2	f	1821–2	F	1841–2	f	1861–2	F	1881–2
G	1802–3	g	1822–3	G	1842–3	g	1862–3	G	1882–3
H	1803–4	h	1823–4	H	1843–4	h	1863–4	H	1883–4
I	1804–5	i	1824–5	I	1844–5	i	1864–5	I	1884–5
K	1805–6	k	1825–6	K	1845–6	k	1865–6	K	1885–6
L	1806–7	l	1826–7	L	1846–7	l	1866–7	L	1886–7
M	1807–8	m	1827–8	M	1847–8	m	1867–8	M	1887–8
N	1808–9	n	1828–9	N	1848–9	n	1868–9	N	1888–9
O	1809–0	o	1829–0	O	1849–0	o	1869–0	O	1889–0
P	1810–1	p	1830–1	P	1850–1	p	1870–1	P	1890–1
Q	1811–2	q	1831–2	Q	1851–2	q	1871–2	Q	1891–2
R	1812–3	r	1832–3	R	1852–3	r	1872–3	R	1892–3
S	1813–4	s	1833–4	S	1853–4	s	1873–4	S	1893–4
T	1814–5	t	1834–5	T	1854–5	t	1874–5	T	1894–5
U	1815–6	u	1835–6	U	1855–6	u	1875–6	U	1895–6

Birmingham Assay Office Date Letters.

NOTE.—The Date Mark is altered in July of each year.

CYCLE 1.		CYCLE 2.		CYCLE 3.		CYCLE 4.		CYCLE 5.	
A	1773–4	a	1799–0	A	1825–6	A	1850–1	a	1875–6
B	1774–5	b	1800–1	B	1826–7	B	1851–2	b	1876–7
C	1775–6	c	1801–2	C	1827–8	C	1852–3	c	1877–8
D	1776–7	d	1802–3	D	1828–9	D	1853–4	d	1878–9
E	1777–8	e	1803–4	E	1829–0	E	1854–5	e	1879–0
F	1778–9	f	1804–5	F	1830–1	F	1855–6	f	1880–1
G	1779–0	g	1805–6	G	1831–2	G	1856–7	g	1881–2
H	1780–1	h	1806–7	H	1832–3	H	1857–8	h	1882–3
I	1781–2	i	1807–8	I	1833–4	I	1858–9	i	1883–4
J	1782–3	j	1808–9	K	1834–5	K	1859–0	k	1884–5
K	1783–4	k	1809–0	L	1835–6	L	1860–1	l	1885–6
L	1784–5	l	1810–1	M	1836–7	M	1861–2	m	1886–7
M	1785–6	m	1811–2	N	1837–8	N	1862–3	n	1887–8
N	1786–7	n	1812–3	O	1838–9	O	1863–4	o	1888–9
O	1787–8	o	1813–4	P	1839–0	P	1864–5	p	1889–0
P	1788–9	p	1814–5	Q	1840–1	Q	1865–6	q	1890–1
Q	1789–0	q	1815–6	R	1841–2	R	1866–7	r	1891–2
R	1790–1	r	1816–7	S	1842–3	S	1867–8	s	1892–3
S	1791–2	s	1817–8	T	1843–4	T	1868–9	t	1893–4
T	1792–3	t	1818–9	U	1844–5	U	1869–0	u	1894–5
U	1793–4	u	1819–0	V	1845–6	V	1870–1	v	1895–6
V	1794–5	v	1820–1	W	1846–7	W	1871–2	w	1896–7
W	1795–6	w	1821–2	X	1847–8	X	1872–3	x	1897–8
X	1796–7	x	1822–3	Y	1848–9	Y	1873–4	y	1898–9
Y	1797–8	y	1823–4	Z	1849–0	Z	1874–5	z	1899–0
Z	1798–9	z	1824–5						

LIST OF FORMER CLOCK AND WATCHMAKERS.

THE dates following the names in this alphabetical list signify the period when the person referred to was connected with the Clockmakers' Company, or known to be in business, or when some example of his work was made. It does not necessarily follow that he then either began or relinquished the trade. Throughout the list C.C. stands for Clockmakers' Company, B.M. for British Museum, and S.K.M. for South Kensington Museum. Following the names or addresses of some of the makers is a slight description of their work which has been met with, or of some invention or distinguishing trait. Of the more important men, fuller descriptions are given in the body of the book, and reference is then made to the page where such particulars may be found.

On estimating the age of a timekeeper by a maker the only reference to whom is that he was admitted to the Clockmakers' Company, it may in the majority of cases be assumed that he was at the time of his admission a young man just out of his apprenticeship; but there are many exceptions. The first members of the Clockmakers' Company were many of them of mature years at the time of the incorporation; and afterwards, men who had made some mark or whom circumstances had brought into notice were then induced to join. Hon. freemen, elected after 1781, had all made their reputation before entry.

It is easy to understand that the roll of membership of the company at no time represented the whole of the clockmakers and watchmakers within its sphere of action. Many who did not care to join would escape observation, and then those who were free of other guilds at the incorporation made their apprentices free of the particular company to which they were attached.

Although the addresses of the freemen at first are rarely given, it may be taken for granted that they were nearly all within a radius of ten miles, and among the later ones it will be found that very few of them resided at any great distance from the metropolis.

On some of the early clocks and watches the name inscribed was that of the owner; but in 1777 an Act of Parliament required the name and place of abode of the maker to be engraved.

The locality of some of the residences may not in all cases be readily recognized. Sweeting's Alley, Cornhill, or Royal Exchange, evidently a favourite spot with the craft, was where the statue of Rowland Hill now stands. It was not rebuilt after the destruction of the Exchange by fire, in 1838. Bethlem, or Bethlehem, was in Moorfields. Cateaton Street is now Gresham Street. One side of Wilderness Row now remains; the row was widened and transformed into the thoroughfare which cuts through St. John's Square, and is called Clerkenwell Road. Union Street, Bishopsgate, or Spitalfields, is now Brushfield Street. The Bishopsgate Street end, with the larger part of Sun Street, was absorbed in building the terminus of the Great Eastern Railway. Wellington Street, St. Luke's, is now in Lever Street, and King Street, Holborn, is now Southampton Row. Grubb Street is now Milton Street. The Fleet Street end of what was Water Lane in Tompion's time is now Whitefriars Street.

Hicks' Hall is mentioned. This was the title given to the Sessions House, which at that time stood in the middle of St. John Street, near Smithfield market. It was afterwards rebuilt on Clerkenwell Green.

Taking into consideration the difficulty of obtaining precise information respecting the early names, added to the vagaries of seventeenth-century orthography, I hope and believe the list is as nearly as possible correct, and tolerably complete, so far as London makers are concerned. Outside of the metropolis I have not attempted to do more than record the facts which happen to be within my reach, and I venture to beg the favour of communications respecting corrections and additions.

After 1842 the names are given only of those above mediocrity, or concerning whom some peculiarity is known, *and who have ceased to carry on business.* Many of those who are traced to 1842 probably continued for years afterwards, but the list is not intended as a guide to clock and watchmakers of to-day.

Aaron, Benjamin, 17, Bury Street, St. Mary Axe, 1840–1842.

Abbis, J., 37, Bishopsgate Street Within, 1807.

Abbott, Philip, admitted C.C., 1703.

——, **Peter**, admitted C.C., 1719.

——, **John**, admitted C.C., 1788; charged with making an agreement to go to St. Petersburg to work at clockmaking, and convicted at Hicks' Hall of the offence. Known as a maker of long-case clocks, 1787-1800.

Abdy, William, 5, Oat Lane, Noble Street, 1768-1800.

Abelling, William, 7, Wynyatt Street, Clerkenwell, 1820; 36, Spencer Street, 1835; 1820–1842.

Abraham, John, 27, Steward Street, Bishopsgate, 1820.

Abrahams, H., 21, Bevis Marks, 1800–1820.

——, **Godfrey**, 51, Prescot Street, Goodman's Fields, 1835-1842.

——, **Samuel**, 23, Little Alie Street, 1840-1842.

——, **A.**, 9, Great Prescot Street, 1840–1842.

——, **Elijah**, 27, Hanway Street, Oxford Street, 1840-1847.

Absolon, —, London, maker of long-case clocks, strike-silent, sunk seconds, scroll and foliage corners, about 1770.

Ackers, W., Holborn; pair-case watch in S.K.M., early part of eighteenth century; 1700–1720.

Acklam, John Philip, 423, Strand, 1820; 138, Strand, 1840.

——, **T.**, 14, Birchin Lane, 1825–1833.

Acton, Thomas, Clerkenwell, admitted C.C., 1677.

——, **Abraham**, admitted C.C., 1790.

Adams, John, 1, Dove Court, Moorfield, 1770–1772.

——, **C. and J.**, 10, King Street, Cheapside, 1788.

Adams, Stephen, and Son, 3, St. Anne's Lane, Aldersgate, 1788.

——, **John**, 31, Maiden Lane, 1790.

——, **F. B.**, St. John's Square, Clerkenwell, master, C.C., 1848; 1815–1848.

——, **F. B., and Son**, 21, St. John's Square, 1830-1842.

Adamson, Humfry, maker of a clock for Whitehall Chapel, 1682.

——, **John**, admitted C.C., 1686. "A Gold Minute Watch, lately made by Mr. Adamson, over against the Blue Boar in Holborn" (*London Gazette*, March 3–7, 1686).

Addis, William, 3, Birchin Lane; son of Robert A., of Bristol; apprenticed to George Sims, 1738; admitted C.C., 1745; master, 1764; 1753–1788.

——, **George**, 79, Cornhill, 1786–1790.

——, **George C.**, 3, Birchin Lane, livery C.C., 1787; 1780–1798.

Adeane, Henry, admitted C.C., 1675.

——, admitted C.C., 1705.

Airy, George Biddell, Astronomer Royal, 1840-1881; K.C.B., 1874; died 1892, aged 90; devoted much attention to the perfecting of time-keepers.

Aitken, John, 55, St. John's Street, Clerkenwell, received in 1824 a prize of twenty guineas from the Society of Arts for a clock train remontoire; 1800–1826.

Alais, M., Blois, maker of watches, about 1680.

Albert, Isaac, admitted C.C., 1731.

Albrecht, Michael George, maker of gold repeating watch in the S.K.M., bearing the royal arms, outer case repoussé; about 1720.

Alcock, Thomas, petitioner for incorporation of C.C. In Kingdome's *Intelligencer*, February 4, 1661, was advertised as lost, "a round high watch of a reasonable size, showing the day of the month.

age of the moon, and tides; upon the upper plate Thomas Alcock, fecit," 1630–1654.

Alderhead, J., 114, Bishopsgate Without, 1783–1788.

Aldred, Leonard, C.C., 1671.

Aldridge, John, admitted C.C., 1726.

——, **James**, 11, Northumberland Street, Strand, 1830.

Aldworth, Samuel, C.C., 1697.

Alexander, W., 10, Parliament Street, 1830–1840.

——, **A., and Co.**, 25, Bedford Street, Bedford Square, 1840.

Aley, Thomas, 18, Park Side, Knightsbridge, 1840–1842.

Allam, Andrew, Grubb Street, admitted C.C., 1664; maker of lantern clocks, 1664–1685.

——, **William**, Fleet Street, 1780.

—— **and Stacy**, 175, Fleet Street, 1783.

—— **and Clements**, 119, New Bond Street, 1790.

——, **John**, 119, New Bond Street, 1798.

—— **and Caithness**, 119, New Bond Street, 1800–1804.

Allan, Robert, London, known as a maker of repeating watches, 1780–1790.

Allaway, John, admitted C.C., 1695.

Allcock, William, watch-hand maker, 36, Allen Street, Clerkenwell, 1820.

——, **Elias**, admitted C.C., 1653; master, 1636; 1654.

——, **John**, admitted C.C., 1653.

——, **John**, admitted C.C., 1720.

——, **John**, 42, Poultry, 1772–1775.

——, **George**, 9, New Bond Street, hon. freeman C.C., 1781; 1770–1783.

——, **James**, 76, New Gravel Lane, an ingenious watchmaker to whom the Board of Longitude awarded £105, for engine dividing, 1790–1800.

Allen, John, watch-case maker, Barbican; convicted in the Mayor's Court for refusing to become a member of the C.C., although he was at the time free of the Goldsmiths' Company; 1785.

Allen, George, Fleet Street, liveryman, C.C., 1776.

Allen, George, watchmaker, 14, Red Lion Passage; elected hon. freeman of C.C. at Devil Tavern, 1781–1842.

Allet, George, admitted C.C., 1691.

Alling, Richard, admitted C.C., 1722.

——, **James**, 22, Red Lion Street, Whitechapel, 1842.

Allsop, Joshua, Northamptonshire, admitted C.C., 1689.

Almond, Ralph, admitted C.C., 1646; master, 1678; 1646–1679.

——, **John**, admitted C.C., 1671.

——, **William**, Lothbury, maker of a clock for Hall, Bishop of Exeter, C.C., 1633–1635.

Ambrose, Edward, apprentice of Elias Voland, 1634.

——, **David**, admitted C.C., 1669.

Ames, Richard, admitted C.C., 1653; died in 1682, after election as master; a clock of his make has dolphin frets and bob pendulum working between going and striking, 1653–1682.

——, **William**, admitted C.C., 1682.

Amyot, Peter, Norwich, maker of lantern clocks, about 1660.

Anderson, —, sued in 1777 by Cabrier, for putting his name on five watches, 1777.

——, **Edward C.**, Newington Butts, a successful watchmaker who carried out the not unreasonable rule of making a charge for furnishing a repairing estimate if it involved taking down a watch, 1835–1842.

Andrew, J., 14, Queen Street, Ratcliff Cross, 1820.

Andrews, John, Leadenhall Street, admitted C.C., 1688; 1688–1710.

——, **Richard**, admitted C.C., 1703.

——, **Thomas**, admitted C.C., 1705.

——, **Robert**, admitted C.C., 1709.

——, **James**, admitted C.C., 1719.

——, **William**, admitted C.C., 1719.

——, **Abraham**, Bank Coffee House, Threadneedle Street, 1759.

——, **Richard**, 124, Leadenhall Street, 1775.

——, **Eliza**, 85, Cornhill, 1800.

Angel, Richard, repairer of clock at Wigtoft, Boston, Lincolnshire, 1484.

Anness, William, 102, Cheapside, 1798–1820.

Ansell and Son, watch-spring maker, 22, Whitecross Place, 1798–1820.
——, **H.**, 17, Colchester Square, Savage Gardens, 1830.
Anthony, —, clockmaker to Henry VIII., 1529.
——, **William,** 55, St. John Street, Clerkenwell. In the S.K.M. is a magnificent long oval watch by him. It is rather a large size, back enamelled and decorated with diamonds and pearls; but the peculiar feature is that the dial is also oval; the hands are jointed, and automatically lengthen and shorten as they travel round; 1770–1790.
——, **William,** 55, Red Lion Street, Clerkenwell, 1823.
Antt, G., 158, Strand, 1769–1788.
Antram, Joshua, London, maker of a long walnut-case clock, square dial, cherub corners, circles round winding holes, about 1700.
Apelyne, Francis (French), C.C., 1687.
Appleby, Joshua, apprentice of Daniel Quare; admitted C.C., 1719; master, 1745; 1719–1746.
——, **Edward,** admitted C.C., 1677.
Applegarth, Thomas, C.C., 1674.
Appleton, Henry, 50, Myddleton Square, 1840–1842.
Archambo, —, Prince's St., Leicester Fields, maker of a fine marqueterie case clock, arch dial; also of a repoussé case verge watch, hall mark, 1730; 1710–1730.
Archer, Henry, admitted C.C., 1630; subscribed £10 for incorporation of C.C., and was the first warden, 1630–1649.
——, **John,** admitted C.C., 1660.
——, **Edward,** admitted C.C., 1711.
——, **S., junior,** 35, Leather Lane, 1794; 33, Kirby Street, Hatton Garden, 1810; 1794–1830.
——, **Thomas,** 6, Long Lane, Smithfield, 1820.
Ariell, James, watch movement maker, 10, Wilderness Row, 1815–1820.
——, **John,** 10, Percival Street, Northampton Square, 1822–1830.
Arland, Benjamin, maker of a large silver repeating watch in the B.M., about 1680.
Arlandi, John, chain-maker for watches, Red Rose Street, Covent Garden, 1680.
Armitage and Co., 88, Bishopsgate Within, 1798.
Armstrong, John, C.C., 1724.
Arnold, Thomas, admitted C.C., 1703.
——, **Henry,** 46, Lombard Street, 1769–1783.
——, **John,** Devereux Court, Fleet Street, 1760; 112, Cornhill, 1780 (see p. 127).
—— **and Son,** 112, Cornhill, 1798.
——, **John Roger,** Bank Buildings, 102, Cornhill, 1804–1830.
——, **John R., and Dent,** 84, Strand, 1830–1840.
——, **John R.**, 84, Strand, 1842.
Arnoltt, Richard, 18, Red Cross Street, Barbican, 1820–1825.
Arthur, William, C.C., 1676.
Ash, —, subscribed £2 for incorporation of C.C., 1630–1632.
——, **Ralph,** admitted C.C., 1648.
Ashbourne, Leonard, at the Sugar Loaf in Paternoster Row, next Cheapside, inventor and maker of a clock lamp, 1731.
Ashley, J. P., 99, Bache's Row, City Road, 1800.
—— **and Mansell,** 34, Rosomon Street, Clerkenwell, 1835.
—— **Edward,** 9, John Street, Pentonville, 1842.
Ashurst, William, C.C., 1699.
Ashwell, Nicholas, C.C., 1649.
Aske, Henry, admitted C.C., 1676; George Graham was apprenticed to him in 1688; 1676–1696.
Askell, Elizabeth, apprenticed in 1734 to Elinor Moseley; 1734.
Aspinwall, Thomas, maker of small oval watch (see p. 58), about 1630.
—— **Samuel,** maker of a clock watch in possession of Lord Torphichen, about 1655.
——, **Josiah,** brother of C.C., 1675.
Atchison, Robert, apprenticed to Robert Harding, 1753; admitted C.C. 1760; 1760–1819.
Atkins, Samuel, and Son, Palgrave Court, Temple Bar, 1759–1763.
——, **Robert,** Palgrave Court, Temple Bar, 1769.
——, **Francis,** 35, Clement's Lane; apprenticed to Joshua Hassell,

1746; admitted C.C., 1759; master, 1780; clerk, 1785; 1760–1809.

Atkins, George, son of Francis, 35, Clement's Lane, warden, C.C., 1809; afterwards clerk, 1800–1838.

——, **George, and Son,** 6, Cowper's Court, Cornhill, 1840–1842.

——, **Robert,** 20, Salisbury Street, Strand, 1770–1788.

——, **S.,** watch-case maker, 14, Bridgewater Square, 1810.

——, **W.,** watch-case maker, 7, Upper Ashby Street, Clerkenwell, 1820.

——, **William,** 71, High Street, Poplar, 1835–1842.

——, **W.,** 3, High Street, Hoxton, 1835.

Atkinson, James, admitted C.C., 1667; assistant, 1697; 1667–1697.

Atis, Leonard, London, maker of lantern clocks, about 1660.

Attbury, J., watch movement maker, 15, York Street, St. Luke's, 1835.

Atwood, George, 17, Leonard Street, Shoreditch, 1820.

——, born 1746, died 1807; an eminent mathematician; studied watchwork, and reported to Parliament on Mudge's timekeeper, 1793.

——, **Richard,** 41, Poultry, 1800–1810.

Atwell, William, 11, Pitfield Street, Hoxton, 1825.

Auber, Daniel, Whitefriars, 1750.

Aubert and Klaftenberger, 157, Regent Street, 1835–1842.

Auld, William, Edinburgh, friend and partner of Thomas Reid, 1790–1818.

Augier, Jehan, Paris, maker of large watches, about 1650.

Ault, Thomas, 34, Prince's Street, Leicester Square, 1820–1825.

Austen, John, Shoreditch, admitted C.C., 1711; maker of a clock with square dial, pull-chime, black bell-top case, 1711–1725.

Austin and Co., 176, Oxford Street, 1820.

——, **John,** 136, Oxford Street, 1830–1840.

Aveline, Daniel, died 1770, when warden, C.C., 1760–1770.

Avenall, a family well known as clockmakers in Hampshire for over 150 years, 1640–1810.

Avenall, Ralph, Farnham, maker of a balance escapement clock, about 1640.

Avenell, Thomas, admitted C.C., 1705.

Avery, —, Cheapside, 1774.

——, **Philip,** Red Cross Square, 1790.

Ayeres, Richard, admitted C.C., 1680.

Aynsworth, J., Westminster, maker of lantern clocks, 1645–1680.

Ayres, Thomas, 160, Fenchurch Street, 1800–1830.

—— **and Bennett,** 160, Fenchurch Street, 1820.

Ayscough, Ralph, St. Paul's Churchyard, 1759.

——, **Ralph,** 18, Ludgate Street, 1768–1775.

Bachoffner, Andrew, 112, Shoreditch, 1775.

Bacon, John, admitted C.C., 1639.

——, **Charles,** admitted C.C., 1719.

Baddeley, Phineas, C.C., 1662.

Badger, John, admitted C.C., 1720.

Badollet, John, 50, Greek Street, Soho, 1842.

Baggs, Samuel, 3, South Street, Grosvenor Square, 1820–1835.

Bagley, Thomas, admitted C.C., 1664.

Bagnall, W. H., 42, Union Street, Bishopsgate, 1835–1840.

Bagnell, William, C.C., 1719.

Bagshaw, William, C.C., 1722.

Bagwell, Richard, 3, Queen Street, Cheapside, 1790.

Bailey, Jeffery, at y^e Turn Style in Holburn, admitted C.C., 1648; master, 1674; maker of lantern clocks, 1648–1675.

——, **Jeremiah,** admitted C.C., 1724.

——, **Catherine,** watch-case maker, 22, Clerkenwell, 1790.

—— **and Upjohn,** 12, Red Lion Street, Clerkenwell, 1798.

——, **W.,** 19, Radcliff Row, Clerkenwell, 1835.

Bain, Alexander, Edinburgh, inventor of electric clocks (see p. 187), 1838–1858.

Baird, John, 190, Strand, 1770–1783.

——, **W. and J.,** 4, Hatton Garden, 1810–1830.

Baker, Richard, admitted C.C., 1685; maker of an eight-day clock, ebony marqueterie case, square dial, cherub corners, no door to hood;

also a similar clock in oak case, fine hands, 1685–1710.

Baker, Richard, admitted C.C., 1726. "A silver Minute Pendulum watch with a silver outcase and a coat of arms engraven on it (A Lyon Passant with three Cross Croslets, made by Richard Baker, London), lost in Dunghil Fields nigh Whitechapel Church" (*London Gazette*, March 3–6, 1689).

"A silver watch with a shagreen case, with G. M. on it, and with Baker on the Dyal Plate" (*London Gazette*, April 15–18, 1685).

——, **Francis,** Poultry, 1738.

——, **John,** 5, King Street, Covent Garden, livery, C.C., 1781; 1770–1790.

——, **W.,** 35, Long Acre, 1835–1842.

——, **Edward,** 11, Angel Terrace, Pentonville, 1840–1842.

Baldwin, T., 69, Curtain Road, 1830–1835.

——, **Thomas,** 50, Brudenell Place, New North Road, 1840–1842.

Baldwyn, Thomas, C.C., 1706.

Bale, Thomas, admitted C.C., 1724.

——, **Robert Brittel,** Poultry, sold dials bearing his name, 1813.

Ball and Macaire, watch-case makers, 32, Northampton Square, Clerkenwell, 1820; 26, Myddelton Street, 1835.

Ballantyne, W., 6, Cable Street, 1820; 2, White Lion Street, Goodman's Fields, 1835; 1820–1842.

Balliston, Thomas, 5, Banner Street, St. Luke's, 1842.

Banbury, John, admitted C.C., 1685.

Banger, Edward, apprenticed to Joseph Ashby for Thomas Tompion, 1687; admitted C.C., 1695 (see p. 89), 1695–1720.

Banks, William, admitted C.C., 1698.

——, **J.,** 68, Long Alley, Finsbury, 1835.

Bannister, Anthony, C.C., 1715.

——, **Thomas and James,** 39, Kirby Street, Hatton Garden, 1825.

——, **James,** 14, Clerkenwell Close, 1820–1835; 32, Prince's Street, Leicester Square, 1810–1842.

Banting, William, C.C., 1646.

Barachin, Stephen (French), admitted C.C., 1687.

Barber, Jonas, Ratcliffe Cross, admitted C C., 1682.

——, **William,** 39, Cornhill, 1785–1790.

——, **Benjamin,** 21, Red Lion Street, Clerkenwell, 1788–1794.

——, **Abraham,** 56, Cheapside, 1835–1840.

Barberet, J., Paris, maker of a cruciform watch, about 1600.

Barbot, Paul, Great Street, Seven Dials, 1768, 1769.

Barclay, Samuel, apprenticed to George Graham, 1722.

——, **James,** 7, Jamaica Terrace, Commercial Road, 1820–1842.

Barcole, John, admitted C.C., 1648.

Bareham, Samuel, 9, Chapel Street, Pentonville, 1842.

Baril, Lewis, Tokenhouse Yard, 1754–1759.

——, **Bercher,** 29, Prince's Street, near Mansion House, 1763–1772.

Barin, John, livery, C.C., 1776.

Barjon, John, admitted C.C., 1685.

Barked, Edward, 2, St. Martin's Churchyard, 1820.

Barker, William, admitted C.C., 1632.

——, **R.** (tools), 4, Benjamin Street, Clerkenwell, 1820–1825.

——, **James,** 38, Colet Place, Commercial Road, 1840–1842.

Barlow (Booth), Edward, invented the rack striking work and cylinder escapement; born 1636, died 1716 (see p. 82).

Barnard, Thomas, 72, Strand, 1783–1813.

—— **and Kidder,** 72, Strand, 1809–1812.

——, **Franz,** 57, Leman Street, Goodman Fields, 1840–1842.

Barnes, —, Dorchester, maker of an oval watch, S.K.M., 1600.

——, **Thomas,** Litchfield county, U.S.A., maker of American clocks, 1790.

Barnett, John, at y^e^ Peacock in Lothebury, admitted C.C., 1682.

——, **John,** Lothbury, 1686–1693.

——, **G.,** 10, Staining Lane, Wood Street, 1800.

——, **J.,** 48, Shadwell, High Street, 1810–1815.

——, **J. W.,** watch-case maker, 43, Galway Street, St. Luke's, 1835.

Barnett, Montague, 16, Swan Street, Minories, 1842.
Barns and Co., 53, Duke Street, Smithfield, 1800.
Barnsdale, John, City road, a well-known clockmaker, 1840.
Barratt, P., 83, New Bond Street, 1830.
Barraud, Francis, Wine Office Court, 1790.
——, **Paul P.**, 86, Cornhill; master, C.C., 1810, 1811; 1798–1813.
—— **and Sons**, 85, Cornhill, 1813–1836.
—— **and Lund**, 41, Cornhill, 1838–1842.
Barrett, Robert, admitted C.C., 1687.
——, **Henry**, admitted C.C., 1692.
——, **Samuel**, admitted C.C., 1701.
——, **Thomas**, admitted C.C., 1702.
——, **Joseph**, Cheapside, 1738.
——, **William**, 50, Aldersgate Street, 1783.
——, **Henry William**, 25, Museum Street, Bloomsbury, 1820; 18, Plumtree Street, Bloomsbury, 1835–1842.
——, **John**, 47, New Compton Street, Soho, 1820.
Barrow, Nathaniel, apprenticed 1653, admitted C.C., 1660; master, 1689. In the Guildhall Museum are an astronomical watch and a repeater by him, 1660–1695. "A large silver chain watch, having two motions, the hour of the day, and the day of the month, with a black case studded with silver, lined with red sattin, and a silver chain to it, made by *Nathaniel Barrow*, in *London*" (*London Gazette*, July 26–30, 1677).
——, **John**, admitted C.C., 1681; master, 1714. Hatton, 1773, highly esteems the work of a clockmaker named Barrow, 1681–1716.
——, **Samuel**, admitted C.C., 1696; maker of an eight-day long marqueterie case clock, 1696–1720.
——, **William**, admitted C.C., 1709.
Barry, Walter, Still Yard, Tower, 1788–1790.
Bartholomew, J., C.C., 1675.
——, **Josiah**, 25, Red Lion Street, Clerkenwell; maker of a watch, B.M. He was a witness before the select committee of the House of Commons to inquire into the causes of the depressed state of the watch trade in 1817; 1810–1842.
Bartlett, H. and G., watch-case makers, 3, King's Square, St. Luke's, 1835.
Barton, Samuel, admitted C.C., 1641.
——, **Thomas**, Cheapside, 1750–1755.
——, **John**, 64, Red Lion Street, Clerkenwell, 1781.
——, **James**, 194, Strand, 1819–1823.
——, **T.**, 7, Bermondsey Square, 1819–1823.
Bartram, Simon, petitioner for incorporation of C.C., and one of the first assistants; master, 1650; 1630–1660.
——, **William**, admitted C.C., 1684.
Barugh, William, C.C., 1715.
Barwick, H. and B., 35, Wapping, 1794–1796.
——, **A.**, Great Alie Street, 1788–1793.
Barwise, John, 29, St. Martin's Lane, 1790–1842.
—— **and Sons**, 24, St. Martin's Lane, 1819–1823.
Baseley, Thomas, admitted C.C., 1683.
Basil, John, 76, St. Paul's Churchyard, 1768.
Basire, John, livery C.C., 1760.
Bass, George, admitted C.C., 1722.
Bassett, 58, Upper East Smithfield, 1788–1793.
Bateman, Henry, 106, Bunhill Row, 1780–1785.
—— **P. and A.**, 106, Bunhill Row, 1798–1802.
——, **Andrew**, 5, Great Tower Street, 1804–1820.
——, **Teresa**, 5, Great Tower Street, 1820–1830.
——, **William**, 108, Bunhill Row, 1828–1832.
Bates, Thomas, admitted C.C., 1684.
——, **Joseph**, Whit Alley, Holborn, admitted C.C., 1687.
——, **John**, watch pinion maker, 40, Great Sutton Street, Clerkenwell, 1820.
Bath, Thomas, 4, Cripplegate, about 1740.
Batten, John, admitted C.C., 1668.
Batterson, Robert, C.C., 1693.
——, **Henry**, admitted C.C., 1701.

Battin, Thomas; a contrate second wheel of a "dyal" taken from him, and judged by C.C. to be bad, 1658.
Baudit, Peter, 4, St. Martin's Lane, 1790.
Baufay, B., and Son, 3, Bridgewater Square, 1790–1794.
Baugham, John, Bridgewater Square, about 1745.
Baumgart, Charles, 37, Dean Street, Soho, 1840–1842.
Bawdyson, Allaine, clockmaker to Edward VI., 1550.
Baxter, Charles, admitted C.C., 1680.
——, **J. John,** watch-case maker, St. Luke's, 1835.
Bayes, John, admitted C.C., 1647; warden, 1658; maker of a watch given by Charles I. to Mr. Worsley, on his removal to Hirst Castle, November, 1647; 1640–1658.
——, **Benjamin,** admitted C.C., 1675.
Bayford, George, Upper Shadwell.
Bayle, Richard, admitted C.C., 1660.
——, **Thomas,** admitted C.C., 1703.
Bayley, William, C.C., 1653.
——, **Edward.** "A silver watch with a silver studded case, engraven Edwardus Bayley, London" (*London Gazette*, December 19–22, 1687).
——, **John,** 106, Wood Street, 1768-1775.
——, **Thomas,** summoned to take up livery, C.C., 1786.
—— **and Upjohn,** Red Lion Street, Clerkenwell, 1794.
——, **Barnard, and Son,** 3, Bridgewater Square, 1800–1805.
——, **Richard,** 12, Red Lion Street, Clerkenwell, 1807.
Bayly, John, admitted C.C., 1700.
Bayre, James, admitted C.C., 1692.
Bayse, Thomas, admitted C.C., 1695.
Bazeley, Nathaniel, C.C., 1694.
Beach, Thomas, Maiden Lane, Covent Garden, 1765–1770.
Beal, Martin, 19, Gerrard Street, Soho, 1842.
Beale, James, 38, Regent Street, Haymarket, 1820–1825.
Beasley, John, admitted C.C., 1719.
Beaton, Andrew, 22, Cannon Street Road, St. George East, 1835.
—— **and Campbell,** 110, High Street, Whitechapel, 1840.
Beauchamp, R., 147, Holborn Bars, 1819–1823.
Beauvais, Simon, admitted C.C., 1690. A celebrated maker. Among his productions is a double-case verge, with a rack and pinion motion work, the hour hand travelling round the dial in twelve hours, but the minute hand travelling only from IX. to III. in one hour, and, when arrived at the III. jumping back to the IX. The hand-setting is between III. and IIII., and the centre of the dial and motion work are hid by a small painting on ivory. There is in the B.M. a similar watch of a later period by a German maker; 1690–1730.
Beavan, Hugh, 34, Marylebone Street, Golden Square, 1800–1830.
Beavis, W., motion maker, 17, Peartree Street, St. Luke's, 1833-1837.
Beck, Richard, admitted C.C., 1653.
——, **Nicholas,** admitted C.C., 1669.
——, **Joseph,** admitted C.C., 1701.
——, **Christopher,** livery, C.C., 1787.
——, **James,** 5, Sweeting's Alley, Cornhill, 1818–1823.
Becke, John, admitted C.C., 1681.
Beckett, J., 23, Greenhill's Rents, Smithfield, 1798–1803.
Beckman, Daniel, admitted C.C., 1680. "A watch with a double case of Silver, with Minutes, Seconds, and Stops, the name [Beckman] under the Crystal" (*London Gazette*, March 27–31, 1701).
——, **John,** admitted C.C., 1695.
——, **Daniel,** admitted C.C., 1726.
Beckner, Abraham, Pope's Head Alley, admitted as a brother, C.C., 1652; warden, and died, 1665; known as a maker of oval watches, 1650-1665.
Bedford, Helkiah, in Fleet Street; admitted C.C., 1667; maker of lantern clocks, 1660–1680.
Beeg, Christiana, admitted C.C., 1698.
Bell, Joseph, admitted C.C., 1691.
——, **Benjamin,** admitted C.C., 1660; master, 1682; maker of a large verge watch weighing over 8 ozs., 1660-1683. "Taken way by 4 Highwaymen in Maiden-head Ticket, A plain silver chain

watch made by Benjamin Bell, the case lined with Red Satten, on the back of the case a Perpetual Almanack and little spikes placed at every Hour" (*London Gazette*, July 7-10, 1690).

"Lost on the 2nd inst., a gold watch with one motion, having a gold chain and a steel hook; made by Benjamin Bell. Whoever brings it to Mr. Sweetapple, a Goldsmith in Lombard Street, shall have 2 guineas reward" (*London Gazette*, May 4-7, 1691).

"Lost a silver watch with a black case studded with Silver, made by Benjamin Bell, with an Onyx Stone in a gold Ring tied to the watch in which is engraven the Head of King Charles the First. Whoever brings the said watch and seal to Mr. William Penrice, at the Black-Boy in Gracechurch Street, shall have 2 guineas reward" (*London Gazette*, December 3-7, 1691).

Bell, John, admitted C.C., 1719.

——, **Joseph,** Shoe Lane, 1759.

——, **John,** musical clock maker, 8, Elm Street, Gray's Inn Lane, 1835-1840.

——, **James,** 131, Mount Street, Berkeley Square, 1842.

Bellamy, A., 10, Poultry, 1775.

Bellard, John, admitted C.C., 1674.

Bellefontaine, A., 59, Brewer Street, Summers Town, 1835.

Belliard, Charles, Pall Mall, 1769-1783.

Bellinger, John, admitted C.C., 1725.

Bellinghurst, Henry, Aldersgate Street, liveryman, C.C., 1776; 1765-1777.

Bellis, James, 9, Pall Mall, 1769-1788.

Belsey, John, Poland Street, 1835.

Benfey, B., and Son, 3, Bridgewater Square, 1794.

Benford, John, 1, Garnauld Place, Clerkenwell, 1832-1838.

Benjamin, A., 3, Myrtle Street, Hoxton, 1835.

——, **J., and Co.,** 17, Bury Street, St. Mary Axe, 1840.

——, **Joel,** 12, Bury Street, St. Mary Axe, 1820-1835.

Benjamin, M., Berner Street, Commercial Road, 1820; 77, Leman Street, Goodman's Fields, 1840-1842.

Benn, Anthony, died 1763, when master C.C., 1758-1763.

——, **Robert,** admitted C.C., 1716.

Bennet, Mansell, Dial and 3 Crowns, Charing Cross, C.C., 1685-1691.

Bennett, Thomas, owner of movement condemned by C.C., 1677.

——, **John,** admitted C.C., 1678.

——, **William,** admitted C.C., 1692.

——, **John,** admitted C.C., 1712.

——, **Richard,** admitted C.C., 1715.

——, **Samuel,** admitted C.C., 1716.

——, **Thomas,** apprenticed to Windmill, admitted C.C., 1720.

——, **William,** admitted C.C., 1729.

——, **Joseph,** 60, Red Lion Street, Holborn, 1835.

——, **Wing, and Co.,** 60, Red Lion Street, Holborn, 1840.

——, **E.,** Stockwell Street, Greenwich, 1840.

——, **John,** 45, Seymour Place, 1842.

Bensley, J., maker of a watch for the Duke of Sussex, 1790-1820.

Benson, Samuel, admitted C.C., 1700.

——, **William,** watch and clock spring maker, 60, St. John's Street, Clerkenwell, 1818-1823.

Bentley, John, 5, Pope's Head Alley, 1820; 5, Sweeting's Alley, 1823.

Bergstien, Lulam, 116A, Great Titchfield Street, 1842.

Berguer, F., 201, High Holborn, 1815-1820.

——, **John,** 44, Great Russell Street, Bloomsbury, 1810-1820.

——, **Frederick,** 201, High Holborn, 1812; 135, High Holborn, 1818-1820.

——, **Charles,** musical clockmaker, 13, Richmond Buildings, Soho, 1825.

Berkenhead, John, 13, Gutter Lane, 1783.

Berman and Co., 30, Park Terrace, Regent's Park Road, 1835.

——, **J., and Co.,** wooden clockmaker, 40, Norton Folgate, 1830-1835.

Bernard, Nicholas, Paris, maker of a watch at S.K.M., about 1700.

Berninck, Jan., Amsterdam, maker of a watch, B.M., which has a French enamelled inner case by

G. Bouvier, and an outer repoussé case by H. Munley, about 1750.

Berquez, Francis, 17, Vere Street, 1822; 6, Thayer Street, Manchester Square, 1825–1835.

Berrand, Henry, presented C.C. with a silver spoon, 1636.

Berridge, William, 69, Oxford Road, 1780–1790.

——, **Robert,** 2, John Street, Oxford Street, 1790–1795.

——, **William,** 4, Holles Street, Cavendish Square, 1800–1825.

Berrington, Urian, C.C., 1684.

Berrollas, Joseph Anthony, Denmark Street, St. Giles-in-the-Fields, 1808; Coppice Row, Clerkenwell, 1810; afterwards 51, Wellington Street, Goswell Road; an ingenious watchmaker. In 1808 he patented a repeater somewhat similar to Elliott's (p. 249), in 1810 a warning watch, in 1827 an alarum watch, also pumping keyless work (p. 241). 1800–1830.

Berry, John, St. Clement's Lane, admitted C.C., 1688, master, 1723; maker of a long-case clock at Merchant Taylors' Hall, arch dial, brass figures holding trumpets on top of case, 1688–1730.

——, **Samuel,** admitted C.C., 1705.

——, **Francis Hitchin,** maker of lantern clocks, about 1710.

——, **John,** admitted C.C., 1728.

——, **Frederick,** 2, Arcade, Hungerford Market, 1842.

Berthoud, Ferdinand, born 1745, died 1807, an eminent French watchmaker, author of "Essai sur l'Horlogerie," "Traité des Horloges Marines," "Histoire de la Mesure du Temps," and other works containing a mass of useful information concerning the history, theory, and practice of the horological art, dealing with Harrison's, Sully's, and Le Roy's inventions, and, indeed, everything known in Berthoud's time.

Bertram, William, died in 1732, when master, C.C, 1720–1732.

Bertrand, Robert, 2, Stewart Street, Spitalfield, 1790.

Besse, Jeremy, 4, Richmond Buildings, Soho Square, 1840–1842.

Best, Robert, 5, White Lion Court, Birchin Lane. A watch by him in the B.M., hall mark, 1769; 1765–1788.

——, **Robert,** 4, White Lion Court, Birchin Lane, 1790; 4, Sweeting's Alley, 1798; 1, Windsor Place, St. Paul's, 1810–1820.

——, **Richard,** 3, Fountain Court, Strand, 1835–1842.

Besturck, Henry, admitted C.C., 1686.

Betts, Samuel, back of Exchange, died 1675.

——, **Job.** "Stolen from Cheyne Rowe, of Walthamstowe, in Essex, Esq., a gold watch with a gold chain made by Job Bets, with a silver Drinking Cup and other Plate. Whoever brings the said watch and chain or the watch only to Mr. Johnson, Jeweller, at the 3 Flower-de-Luces in Cheapside, shall have 20*s.* reward, and charges; or if pawned or sold their money again with content" (*London Gazette*, August 11–15, 1692).

——, **Samuel,** apprenticed to Samuel Davis for Job Betts, 1675; admitted C.C., 1682; maker of a calendar watch with revolving ring dials, to which a figure of Time points. Dover Museum. In the Guildhall Museum is another specimen of his work; 1682–1700.

Bezar, Stephen, admitted C.C., 1648.

Bibley, J., Corporation Row, 1790.

Bickerton, Benjamin, 14, Jewin Street, 1795–1810.

——, **T. W.,** 14, Jewin Street, Cripplegate, 1820.

Bickley, Thomas, 195, Ratcliff Highway, 1790.

Bicknell, Francis, C.C., 1665.

——, **Joseph, and Co.,** 119, New Bond Street, 1807–1813.

Biddle, Joseph, admitted C.C., 1684.

Bidlake, James, 31, Minories, 1768–1794.

——, **James,** 16, Sun Street, Bishopsgate Street, 1798–1804.

——, **Thomas,** 16, Sun Street, Bishopsgate Street, 1807–1810.

——, **James, and Son,** 8, Chiswell Street, Finsbury, 1820–1840.

Bidles, Thomas, London, maker of bracket clocks, about 1790.

Bidley, William, 24, Rahere Street, Clerkenwell, 1840–1842.

Biggs, Roger, 5, Crescent, Jewin Street, 1800.

Bilger, M., watch spring maker, 4, New Street, Covent Garden, 1790.

Bille, John, admitted C.C., 1687.

Billinghurst, Henry, 67, Aldersgate Street, livery, C.C., 1766; 1766–1771.

Billop, William, admitted C.C., 1688.

Bindley, William, 24, Rahere Street, Goswell Road, 1842.

Bingham, Thomas, watch chain maker, 3, Middle Row, Holborn, 1769–1781.

——, **William,** 27, Bucklesbury, 1842.

Binley, J. W., Ironmonger Row, Old Street, 1790.

Binns, George, 137, Strand, 1832–1838.

Birch, Thomas, admitted C.C., 1682.

——, **William,** 173, Fenchurch Street, 1840–1842.

Birchall, William, 5, St. James's Walk, Clerkenwell, 1820; 8, Wellington Street, Goswell Road, 1835; 1820–1842.

——, **Peter,** a well known chronometer maker. In partnership with Appleton, he succeeded Molyneux at Southampton Row; lived afterwards at Islington; died 1885, aged 85.

Bird, Michael, admitted C.C., 1682; maker of a bracket clock inscribed "Michael Bird, London." On a thirty-hour clock, one hand, period about 1650, was inscribed "Michael Bird, Oxon."

——, **Luke,** admitted C.C., 1683.

——, **John,** one of the examiners of Harrison's timekeeper, 1765.

—— **and Branstor,** 30, Cheapside, 1775.

——, **Jacob,** 7, Cornhill, 1783.

——, **Samuel Joseph,** watch-case maker, Little Compton Street, C.C., 1813.

——, **John, and Son,** 19, Bartlett's Buildings, Holborn, 1825.

——, **John,** 11, St. John's Square, Clerkenwell, 1840–1842.

Birdwhistell, Francis, C.C., 1687.

——, **Isaac,** admitted C.C., 1692; maker of a plain pair-case gold watch, small swivel bow to the inner case, larger bow on the outer one; high movement, gold dial, nicely wroug pillars, finely engraved a balance cock, no endsto lent work throughout;

Birdwhistell, Thomas, C.C

——, **John,** admitted C.C.,

Birkead, Nicholas, remo King's Head, Holborn, Hart, Knightsbridge *Gazette*, May 29, June 1

Bishridger, William, of fecit, on an old squar clock, period 1700.

Bishop, James Griffin, 9 Lane, 1820–1824.

——, **Samuel,** hon. freema 1781.

——, **Sam,** Portland Stree

——, **William,** 70, New Bo 1830.

Bittleston, John, 207, High hon. freeman C.C., 1781-

Bittner, William, 26, De Soho, 1840–1842.

Blackborow, James, died 1 warden C.C., 1734–1746.

Blackburn, William, sum take up livery, C.C., 178

——, **J.,** watch-spring m Aldersgate Street, 1790.

Blackie, George, born in settled in Clerkenwell a escapement maker and turer, afterwards had a s Strand; died 1885, aged

Blackwell, J., 43, Plumb City Road, 1820.

Blake, William, Whitecro 1789, 1790.

——, **Charles,** 14, Bishopsg Within, 1813.

Blanchard, Charles, Lond of a chiming quarter brac square black case, str bronze handle on top, pe 1760.

Blay, William, 6, Princ Leicester Square, 1825.

Bligh, Thomas, watch-ca 37, Great Sutton Street,

Bliss, Ambrose, admitted C signed a petition in 16 1656.

Blog, —, 129, Aldersgate St

Blundell, Richard, threate

prosecution by C.C. for exercising the art, not being admitted; he promised to take up his freedom at the next quarter court, 1682.

Blundell, William, C.C., 1715.

——, **Henry,** musical clockmaker, 7, Red Lion Street, 1830.

Blundy, Joseph, 21, St. John Street, Clerkenwell, 1781.

——, **Joseph,** Brookes Market, 1790.

Boak, Samuel, Golden Spread Eagle, without Aldgate, 1692.

Bock, J., an English watch showing days of the month inscribed with his name, period about 1640.

Bockell, —, London, maker of a silver-cased alarum watch, said to have belonged to Oliver Cromwell —Evan Roberts Collection—about 1648.

Bodd, Thomas, admitted C.C., 1692.

Bodenham, Edward, C.C., 1719.

Bodily, Elizabeth, C.C., 1692.

——, **N.,** 21, Butcher's Hall Lane, Newgate Street, 1823.

Boncher, A., musical watch maker, 23, Frith Street, Soho, 1835.

Boney, Caleb, a well-known Cornish clockmaker; died at Padstow, 1770-1827.

Bonner, Charles, admitted C.C., 1659.

——, admitted C.C., 1704.

——, **Thomas,** Fair Street, Southwark, 1790.

Bonnington, W., clock-case maker, 6, Red Lion Street, Clerkenwell, 1798.

—— **and Thorp,** clock-case makers, 21, Red Lion Street, Clerkenwell, 1800, 1810.

Bonny, London, maker of a repeater centre-seconds watch for the Duke of Sussex, 1790-1820.

Boone, Edward, admitted C.C., 1691.

Booth, J., 20, Little Tower Hill, 1788-1792.

——, **R.,** Church Hill, Woolwich, 1812-1817.

Bor, J., Paris, maker of a fine clock in a square brass case, minutes shown on a small circle below the hour dial, minute hand driven from fusee; about 1590.

Borellas, J., 15, Spencer Street, Goswell Road, 1840.

Borelli, J., 8, Aldersgate Street, 1790-1795.

Borgin, Henry, Without Bishopsgate, issued a token bearing a dial and hands, about 1677.

Borrell, Henry, 16, Wilderness Row, Clerkenwell, 1798-1815.

——, **Henry,** 15, Wilderness Row, Clerkenwell, 1820-1840.

——, **Maximilian, J.,** 19, Wilderness Row, 1840-1842.

Borret, P., 5, Staining Lane, Wood Street, 1805-1816.

Bosley, Charles, Ratcliff Cross, succeeded William Kipling, 1750-1763.

——, **Joseph,** Leadenhall Street, admitted C.C., 1725. In 1755 he obtained a patent for using in watches pinions with more teeth than usual. This involved an extra wheel and pinion, and the balance wheel turned the contrary way. Also for (secondly) a slide index for watches, which has no wheel, but turns upon a brass socket and points to an arc of a circle, with the word "faster" at one end, and "slower" at the other. Patent unsuccessfully opposed by C.C., 1725-1755.

——, **Charles,** livery C.C., 1766.

Boucher, W., 4, Long Acre, 1820.

Bouchet, Jacob, admitted C.C., 1728.

Boudry, Gustavus, 64, Frith Street, Soho, 1835-1842.

Boufier. *See* De Boufier.

Boult, Joseph, admitted C.C., 1709.

——, **Michael,** Cheapside, 1738.

Boulter, Samuel, 12, Gloucester Place, Chelsea, 1840-1842.

Boulton, T., watch-case maker, 49, Gray's Inn Lane, 1820.

Bouquet, David, London, maker of a watch in the B.M., fine case enamelled in relief and encrusted with jewels, 1630-1640. "A Pocket Clock made some years since by Mr. Boquett of Black-Fryars, Watchmaker, it hath two Silver Cases, the outmost plain, the other wrought; two Brass Keys, one of the usual form, the other forked for turning the hand of the Alarum, tied to a Silver Chain; it hath the day of the Month, Tides, age of the Moon, and some other motions, it strikes every hour" (*London Gazette*, March 3–7, 1689).

"Lost the 15 instant, between Rosse and Linton in Herefordshire, a watch with an alarum in a Silver Case, with a Silver Chain, the case lined with Crimson Satten, being an old piece; the name of the maker of it being exprest thus, *Daniel Bouquet, Londres*" (*London Gazette*, June 19–22, 1696).

Bouquet, Solomon, admitted C.C., 1650; a celebrated maker. Among other examples of his work is a touch watch supposed to have belonged to Milton—Evan Roberts Collection—1650–1670.

——, **Solomon**, admitted C.C., 1683; in the B.M. is a watch of his with highly engraved gold cases, 1680–1700.

Bourchier, W., 13, Broad Street, Long Acre, 1835.

Bourelier, John Francis, Arundel Street, Strand, 1769–1783.

Bourne Aaron, Maiden Lane, Covent Garden, 1769.

Bouvier, G., a well-known French painter of watch cases in enamel, about 1750.

Bowen, Richard, maker of a large silver watch with two cases, the outer one chased and engraved with a border of flowers and the figure of the king praying, and the words, "And what I sai to you I sai unto all, WATCH." Said to have been given by Charles I. while at Carisbrooke, to Colonel Hammond, 1647. "Lost, a watch in black shagreen studded case, with a glass in it, having only one Motion and Time pointing to the Hour on the Dial Plate, one spring being wound up without a key, and it opening contrary to all other watches. R. Bowen, Londini, fecit, on the back plate" (*London Gazette*, January 10–13, 1686).

——, **Francis**, apprentice to John Bowyer; brought his masterpiece on completion of his indentures, and was admitted C.C., 1654.

——, **John**, admitted C.C., 1709.

Bowen, Thomas, 6, Charing Cross, 1800.

——, 6, Charing Cross, 1798–1812.

——, **John**, 143, Long Acre, 1807–1810.

—— **J.**, 2, Tichborne Street, Haymarket, 1812–1842.

Bowley, Devereux, 54, Lombard Street, a well-known maker of repeating clocks; born 1696, died 1773; master of C.C., 1759; was a member of the Society of Friends, and bequeathed a large sum to their school in Clerkenwell, as well as £500 to the C.C., 1718–1773.

Bowrd, John, 4, Holles Street, Oxford Street, 1820–1823.

Bowtell, Samuel, admitted C.C., 1681.

——, **William**, C.C., 1703.

Bowyer, John, a good maker. Subscribed for incorporation of C.C. In 1642 he presented to the C.C. a great chamber clock, in consideration of his being thereafter exempted from all office and service, as well as quarterage and other fees (see p. 171), 1630–1642.

Box, John, 17, Ludgate Street, 1775–1783.

——, **William B.**, Clerkenwell; died 1892, aged 76.

Boyer, T., London, maker of lantern clocks, about 1690.

Boyle, William, 11, Arundel Street, Strand, 1840–1842.

Bracebridge, Edward, 8, Red Lion Street, Clerkenwell, 1805–1815.

——, **J. and E. C.**, 8, Red Lion Street, Clerkenwell, 1820–1842.

——, **James**, treasurer to the Watch and Clockmakers' Benevolent Institution; died 1892, aged 66.

Brackenrig, Robert, Edinburgh, made an escapement similar to the duplex, 1770.

Brackley, George, C.C., 1677.

Bradford, Thomas, C.C., 1680.

——, **Thomas**, admitted C.C., 1692.

——, **Thomas**, admitted C.C., 1710.

——, **Henry**, 89, Bethnal Green Road, 1820.

Bradin, Caspar, admitted C.C., 1715.

Bradley, Henry, admitted C.C., 1681.

——, **Langley**, Fenchurch Street,

admitted C.C., 1694; master in 1726; maker of the St. Paul's and other turret clocks (see p. 205). A watch by L. Bradley in B.M., period 1696; 1694-1727.

Bradley, L. and B., made a clock for Bancroft's School, Mile End, the date on the bell being 1734. The clock is now in Bancroft's new School at Woodford, 1734.

——, **Benjamin**, admitted C.C., 1728.

——, **John H.**, 3 Great Russell Street, Bloomsbury, 1842.

Bradshaw, Richard, C.C., 1725.

——, **John**, admitted C.C., 1731.

—— **and Ryley**, Coventry, about 1745-1790.

Brafield, William, C.C., 1678.

Bramble, Joshua, 407, Oxford Street, 1804-1835.

——, **William and Edward**, 407 Oxford Street, 1840.

——, **Eliza**, 9, Well Street, Oxford Street, 1842.

Brambley, Joseph, 10, Maiden Lane, Wood Street; in 1797 founder and citizen; petitioned against being compelled to take up freedom in C.C., 1783-1797.

Brandon, Benjamin, C.C., 1689.

Brandreth, Joseph, C.C., 1718.

Brandt, Charles, 82, Theobald's Road, 1820.

——, **Charles**, 22, Upper Belgrave Place, Pimlico, 1835.

Brant, Richard, admitted C.C., 1700.

Brathwaite, George, Lombard Street, 1738.

Braudt, Charles, 145, Regent Street, 1825.

Bray, Robert, admitted C.C., 1728.

——, **Thomas**, St. Margaret's Churchyard, 1798-1804.

——, **T.**, 8, Little Queen Street, Westminster, 1807-1825.

——, **William**, 171, Tottenham Court Road, 1840.

Brayfield, William, C.C., 1712. "Drop'd the 21st December, in Little Weld-Street, or thereabout, a middle siz'd Silver Minute Pendulum watch, going Thirty hours, with a chain, in a silver case, the name William Brayfield, London. Whoever brings it to Remond Regard, Clockmaker, at the upper end of Russel Street, near Drury Lane, shall have 40*s*. reward" (*London Gazette*, January 25-28, 1691).

Brayfield, John, admitted C.C., 1716.

Breese, James, 5 North Place, Gray's Inn Road, 1842.

Bréguet, Abraham Louis, born 1747, died 1823; a French watchmaker of rare attainments and inventive power. Berthoud, who was Bréguet's senior by two years, ends a brief notice of his brilliant contemporary thus, "Il n'a rien publié." Bréguet lived sixteen years longer than Berthoud, but, unfortunately for us, it must still be recorded "he published nothing."

Breton, Henry, keeper of the Westminster clock, *temp.* Henry V., 1413.

Brewer, John, admitted C.C., 1677.

——, **J.**, 25, New Surrey Street, Blackfriars, 1810-1815.

——, **W.**, 149, Great Surrey Street, Blackfriars, 1825.

Breynton, Voughan, C.C., 1693.

Brickle, William, 5, Church Street, Mile End, 1842.

Brickman, George, 13, Union Street, Bishopsgate, 1835.

Bridgden, Henry, C.C., 1682.

Bridgeman, Edward, Russell Street, Covent Garden, C.C., 1662.

Bridger, Samuel, admitted C.C., 1703.

Bridges, Henry, Waltham Abbey (see p. 156), about 1740.

Briggs, John, "a cutter of glasses for watches," admitted as a brother, C.C., 1669.

Bright, J., 72, Long Acre, 1790.

——, **Richard**, 9, Foster Lane, Cheapside, 1825.

Brind, Walter, 34, Foster Lane, Cheapside, 1783-1788.

Brinkman, George, 12, Union Street, Bishopsgate, 1820-1840.

—— **and Gollin**, 12, Union Street, Bishopsgate, 1842.

Briscoe, Stafford, Cheapside, 1738-1759.

—— **and Morrison**, 15, Cheapside, 1768.

Bristow, W. G., 6, Hoxton Fields, 1820.

——, **William**, 6, Britannia Row, Hoxton, 1835.

British Watch Company, Soho, formed in 1843, to manufacture watches with duplicating tools invented by P. F. Ingold. An excellent watch was designed and several were made, but the "trade" successfully opposed the application to Parliament for an Act of Incorporation, and the enterprise came to a close. Ingold afterwards went to America; and although he was not successful in forming a company there, it is said that some of the tools made for the British Watch Company formed the nucleus of the American factory system.

Brittayne, Stephen, C.C., 1692.

Britten, S., clock and morocco-case maker, 5, Baynes Row, Clerkenwell, 1810.

——, **S.,** watch-glass maker, 11, Charles Street, Hatton Garden, 1835.

Britton, Stephen, admitted C.C., 1728.

——, **Sandys,** 48, Wynyatt Street, 1835.

Broad, Thomas, admitted C.C., 1632.

——, **R.,** 204, Bermondsey Street, 1820.

——, **W.,** 53, Leadenhall Street, 1804–1830.

Broadhead, Benjamin, C.C., 1709.

Broadley, James, 24, Wood Street, 1772.

Broadwater, Hugh, C.C., 1692.

Brock, John, 18, George Street, Portman Square, 1840–1842.

Brockbank, John, 6, Cowper's Court; apprenticed to Joseph Hardin, 1761; admitted C.C., 1769; livery, 1777; 1769–1777.

——, **John and Myles.** Myles was the son of Edward Brockbank, of Corners, in Cumberland, and was apprenticed to his brother John, at 17, Old Jewry, 1769; admitted C.C., 1776. They were eminent chronometer makers, 1777–1808.

—— **and Atkins,** 6, Cowper's Court, 1815–1835.

——, **Atkins, and Son,** 6, Cowper's Court, 1840–1842.

Brogden, James, 148, Aldersgate Street, liveryman, C.C., 1768–1794.

Brogden and Marriott, 148, Aldersgate Street, 1770–1804.

——, **James,** 6, Bridgewater Square, 1820–1828.

—— **and Garland,** 6, Bridgewater Square, 1830.

Brook, Edmund, admitted C.C., 1709.

——, **Richard,** 7, Poultry, admitted 1810.

Brooke, John, admitted C.C., 1632.

——, **George,** admitted C.C., 1681.

Brooker, Richard, C.C., 1694.

Brookes, Edward, C.C., 1690.

——, **Samuel,** watch-case maker, 5, Ashby Street, Clerkenwell, 1835.

Brooks, William, Church Row, Aldgate, liveryman, C.C., 1776.

——, **John,** 115, Bunhill Row, liveryman, C.C., 1786–1788.

——, **Thomas,** watch-case maker, 22, Golden Lane, 1790.

——, **William,** 192, Upper Thames Street, 1783, 1790.

——, **John,** 4, Bridgewater Square, 1794–1813.

——, **W.,** 14, Clerkenwell Green, 1825.

——, **J. W.,** watch-spring maker, 5, Berkley Court, Clerkenwell, 1835.

Broome, Thomas, admitted C.C., 1652.

Broomhall, Charles, 41, Stanhope Street, 1794.

Bros, John, 106, Britannia Street, City Road, 1835.

Brown, James (Croydon), admitted C.C., 1687.

——, **Philip,** admitted C.C., 1688.

——, **Thomas,** admitted C.C., 1703.

——, **Henton,** Borough, admitted C.C., 1726; master, 1753; 1726–1754.

——, **James,** Birchin Lane, liveryman, C.C.; master, 1770; 1760–1776.

——, **Nathaniel,** Whitefriars, Liveryman, C.C., 1776.

——, **John,** 118, Fleet Street, 1775–1783.

——, **John,** 76, St. Paul's Churchyard, 1769–1783.

——, **John William,** 14, Cheapside, 1769–1783.

——, **Thomas,** Bunhill Row, liveryman, C.C., 1776.

——, **John,** 30, Grafton Street, Soho, 1790.

Brown, Richard, watch-key and pendant maker, Greenhill's Rents, Smithfield, 1790.
——, **Thomas,** 14, Cheapside, 1788–1800.
——, **William,** 40, Piccadilly, 1800.
——, **John,** 55, Charing Cross, 1804–1810.
——, **George,** 8, Great Sutton Street, 1820.
——, **James,** 56, George Street, Portman Square, 1820–1842.
——, **George,** watch-case maker, 14, St. James's Buildings, Clerkenwell, 1835.
——, **Isaac,** 32, Gloucester Street, Clerkenwell, maker of bezel winding watches, patented 1829, No. 5851; 1820–1835.
——, **James,** 60, Rahere Street, Goswell Road, 1842.
——, **Roger,** 25, Shepherd Street, Mayfield, 1842.
Browne, Matthew, C.C., 1633.
——, **John,** admitted C.C., 1652; master, 1681; 1652–1682.
——, **Richard,** at y^e^ Green Dragon in Cheapside, on lantern clock, gallery frets, bob pendulum, C.C., 1675. "A watch having two motions Richard Brown being engraved on it, in a studded case" (*London Gazette*, June 16–20, 1687).
Bruce, James, admitted C.C., 1721.
Brugercia, C., musical snuff-box and clock-maker, 13, Richmond Buildings, Dean Street, 1820.
Brugger, John, 252, High Holborn, 1830.
——, **Beck, and Co.,** 15, Crown Street, Finsbury, 1840–1842.
——, **L. A.,** wooden and musical clockmaker, 79, High Holborn, 1840–1842.
Brumwell, Pall Mall, about 1760.
Brunette, Samuel, 34, Gloucester Street, Queen's Square, 1825.
Brunion, Henry, Whitecross Street, 1775.
Brunsley, William, at Lilly House, against Strand Bridge, his halfpenny on reverse of token, obverse a clock dial and hands, about 1675.
Bryan, Richard, admitted C.C., 1696.
——, **Henry,** Strand, 1768.
Bryan, John, 3, Shadwell Dock, 1790.
——, **Samuel,** 104, Golden Lane, 1790.
Bryant, and Son, 47, Threadneedle Street, 1781.
——, **John,** Hertford, maker of good clocks, occasionally to be met with, 1790–1829.
Bryer, John, 20, Northampton Square, 1842.
Bryson, Alexander, Edinburgh, "Her Majesty's clockmaker for Scotland," 1830–1860.
Buchan, H., 37, Windmill Street, Finsbury, 1840–1842.
Buck, Edward, exhibited his masterpiece, and was admitted C.C., 1632.
Buckingham, Joshua, Black-moor's Head and Dial, Minories, 1700. "Stolen from Mr. Richard Parke, in Pey Alley, Fanchurch Street, a gold watch made by Jos. Buckingham" (*London Gazette*, July 13–16, 1691).
——, **Joseph, Junior,** Minories, 1760.
Bucklee, David, livery, C.C., 1787.
Buckman, John (German), admitted C.C., 1692.
Buckenhill, Edward, C.C., 1687.
Bucknell, W., 20, Kirby Street, Hatton Garden, 1810.
——, **William,** 10, Parliament Street, 1820–1823.
Buckner, Richard, C.C., 1701.
Bucknor, Philip, admitted C.C., 1667.
Bucquet, D., 56, Cannon Street, Ratcliff, 1812–1820.
Bukenhill, John, admitted C.C., 1672.
Bull, Rainulph, keeper of James I.'s "great clock in His Majesty's Palace of Westminster" (see p. 65), 1617.
——, **John,** admitted C.C., 1631.
——, **John,** admitted C.C., 1632.
——, **John,** admitted C.C., 1637.
——, **James,** 124, Leadenhall Street, 1813.
Bullby, John, admitted C.C., 1632.
Bullman, Thomas, Swan Alley, maker of long marqueterie case clock, twisted pillars, square dial, about 1690.
Bullock, James, Furnival's Inn Court, Holborn, 1790.
Bult, James, and Co., 86, Cheapside 1825.

Bumstead, Robert, in Holborn, maker of a fine pair-case repoussé repeater in leather case: C.C., 1707.
Bunce, Matthew, C.C., 1698.
Bunting, William, Pope's Head Alley, Cornhill; admitted C.C., 1646; maker of a watch in the B.M., on the dial of which is inscribed "Ioanni Miltoni, 1631;" 1631–1647.
Burchett, John, admitted C.C., 1731.
Burgar, John W., 23, Banner Street, St. Luke's, 1842.
Burgess, —, Old Bailey, 1774.
——, **E.,** clock-case maker, 23, Percival Street, Clerkenwell, 1835.
Burgis, John, admitted C.C., 1632.
——, **John,** maker of an early oval calendar watch, in Dover Museum, about 1625; gave £1 16s. for incorporation of C.C., 1625–1636.
——, **Thomas,** apprentice to Thomas Knilton, 1654.
——, **John,** London, 1680.
——, **Elais,** admitted C.C., 1681.
——, **Charles Edward,** apprentice to James Clowes, 1685.
——, **George,** London, maker of a tall oak-case clock, 1720–1740.
——, **William,** London, maker of a watch about 1720.
Burkham, —, London, inscription on a verge watch, style George I., 1720.
Burnap, Daniel, maker of brass clock movements at East Windsor, Connecticut, U.S.A., 1780–1800.
Burleigh, Ninyan, admitted C.C., 1692.
Burnet, Thomas, Bow, 1700.
Burnett, Richard, C.C., 1705.
——, **Philip,** admitted C.C., 1715.
Burns, James, 76, Lisson Grove North, 1804–1842.
Burpull, John, Tooley Street, near London Bridge, 1750.
Burrows, James, 30, Goodge Street, 1820–1825.
——, **E.,** 4, America Terrace, King's Road, Chelsea, 1835–1842.
Burton, John, Blue Anchor Alley, Liveryman, C.C., 1776.
——, **William,** London, known as a maker of spring clocks, about 1790.
——, **J.,** Lincoln's Inn Gate, Carey Street, 1806–1820.
Burwash, William, 45, Red Lion Street, Clerkenwell, 1790.
——, **William,** watch-case maker, 3, Red Lion Street, Clerkenwell, 1782–1804.
——, **Thomas,** 91, Bishopsgate Without, 1825.
Buschman, John Baptist, C.C., 1725.
Bush, James, admitted C.C., 1729.
——, **James,** 104, High Street, Shoreditch, 1804–1842.
——, **James,** 6, Hackney Road, 1835.
Bushell, Edward, London, 1694–1700.
——, **Samuel,** London, 1697–1710.
Butler, John, admitted C.C., 1724.
Butter, Joshua, 36, New Bond Street, 1804; 239, Oxford Street, 1807.
Butto, Daniel, admitted C.C., 1653.
Button and Putley, 204, Borough, 1788.
Bye, Henry, clockmaker to the City of Paris, 1413.
Byford, William, 23, St. Mary's-at-Hill, 1820–1835.
Bysse, Edward, maker of curious English watch, at the B.M., 1580.
Byworth, T., 12, Bridge Street, Lambeth, 1804–1842.

Cabrier, Charles, Broad Street, admitted C.C., 1697. In the B.M. is a very thick rounded repeater watch, period 1690; in the centre of the outer case is an enamel medallion; this is surrounded by a circle of repoussé work, outside of which the case is nicely pierced. Another example of his work is a silver verge watch, outside case embossed, 1690–1720.
——, **Charles,** 79, Broad Street, a celebrated maker; admitted C.C., 1726; master, 1757. In 1777 an action was tried in the King's Bench, Cabrier *v.* Anderson, the defendant having put on five watches the plaintiff's name, without his knowledge or consent. A verdict was given for the plaintiff with £100 damages. Specimens of Cabrier's work are in the Guildhall Museum. One of them is a bell repeating verge watch movement, with nicely wrought and pierced pillars having broad bases and caps, 1726–1780.

Cabrier, Charles, Stepney, 1707.
——**, John,** admitted C.C., 1730.
—— **and Leekey,** 15, Basinghall Street, 1781–1804.
——**, Favey, and Exchequer,** Wilderness Row, 1794.
——**, Favey, and Son,** 14, Wilderness Row, 1798.
Cachard, G., 13, Oxenden Street, 1820.
Cade, Simon, admitted C.C., 1688.
—— **and Robinson,** 153, Leadenhall Street, 1825.
Caesar, Daniel, admitted C.C., 1703.
Caithness, —, New Bond Street, maker of a verge watch, about 1750.
Calcot, Tobias, admitted C.C., 1664.
Calderwood, Thomas. C.C., 1724.
Callam, Alexander, C.C., 1790.
Calliber, John, admitted C.C., 1703.
——**, Thomas,** admitted C.C., 1727.
Calson, John, admitted as a brother, C.C., 1647.
Calston, John, admitted C.C., 1653.
Cam, William, admitted C.C., 1686; maker of a lantern clock, one hand, inscription, "William Cam, Londini, fecit."
Cambridge, Samuel, C.C., 1697.
Camden, William, Plumtree Court, Shoe Lane; admitted C.C., 1708; maker of a tall clock, brass dial, name on disc; also of a watch reputed to have belonged to Charles XII. of Sweden. It had a silver case, handsomely chased silver dial, silver balance cock, the movement altogether a very fine one, 1708–1720.
Camerer, Ropp, and Co., 2, Broad Street, Bloomsbury, 1794.
——**, A., and Co.,** wooden clockmaker, 2, Broad Street, Bloomsbury, 1830–1840.
Cammerer, M., wooden clockmaker, 13, Brownlow Street, Drury Lane, 1840.
Campbell, John, 3 Crowns, Strand, 1691–1701.
——**, Alexander,** 393, Strand, 1800–1805.
——**, W. F.,** 60, Hatton Garden, 1825–1835.
Camper, James, 99, Bridge Road, Lambeth, 1800–1805.
Cann, John, admitted as a brother, C.C., 1649.
Canche, Jacques, London. In the B.M. is a silver alarum watch, in plain silver cases, the outer one perforated, 1680–1690.
Cannans, John, London, maker of clocks, about 1790.
Capt, Henry, 56, Frith Street, Soho, 1840–1842.
Card, Edmund, admitted C.C., 1679.
Carduroy, Philip, admitted C.C., 1679.
Carey, George, admitted C.C., 1679.
——**, Thomas,** admitted C.C., 1705.
——**, George,** 3, Singleton Street, Hoxton, 1842.
Carfoot, Charles, 32, Aldersgate Street, 1825.
Carley, George, 18, Wilderness Row, 1842; afterwards at Ely Place; died 1879.
Carlow, P., maker of a watch for the Duke of Sussex, 1780–1800.
Carncel, C., Strasburg, maker of octagonal pillar timepiece in S.K.M., about 1600.
Carolan, James, 69, Red Lion Street, Holborn, 1825.
Caron, Peter Augustus, an eminent French watchmaker (see p. 240), 1753–1760.
Carpenter, William, 10, St. Martin's Court, hon. freeman, C.C., 1781; 1781–1810.
—— **and Son,** 4, Andrew Street, Seven Dials, 1785–1790.
——**, Thomas,** 5, Islington Road, summoned to take up livery, C.C., 1786; 1776–1794.
——**, William,** 15, Frith's Street, Soho, 1790–1795.
——**, Thomas and Richard,** watch-case makers, 5, Islington Road, 1798–1804.
——**, F.,** 21, Percival Street, Clerkenwell, 1830.
——**, William,** 4, Percival Street, Clerkenwell, 1842.
Carr, F., 18, Bridge Street, Westminster, 1825.
Carrington, James, warden, C.C., 1767; 1760–1768.
——**, Robert,** 22, Old Bethlem, livery, C.C., 1766; 1758–1790.
——**, Thomas,** Bishopsgate Street, liveryman, C.C., 1766; 1760–1787.

Carrington and Son, 22, Old Bethlem, 1794.

Carruthers, George, Blewett's Buildings, Chancery Lane, 1790.

Carswell, Joseph, Hastings, known as a maker of long-case clocks, about 1760.

——, **W.,** 58, Bishopsgate Within, 1825.

Carte, John, admitted C.C., 1695.

Carter, Thomas, admitted C.C., 1699.

——, **Leon Augustus,** C.C., 1726.

——, **John,** admitted C C., 1728.

——, **J.,** 14, Bartholomew Close, 1772.

——, **William,** Bermondsey Street, 1760; 207, Tooley Street, 1794-1825.

——, **J.,** 57, Church Street, Mile End, 1804–1820.

——, **John,** 61, Cornhill; apprenticed to Boys Err Burrill, 207, Tooley Street, 1829–1942; afterwards Lord Mayor, 1857; master C.C., 1856, 1859. 1864; died 1878.

——, **William,** watch-case maker, 22, Galway Street, St. Luke's, 1835.

Cartier, Jaques, maker of a watch said to have belonged to Oliver Cromwell, 1635-1650.

Cartwright, Thomas, apprenticed to Christopher Gould, 1693. In the Guildhall Museum is a watch by him with crystal cock, jewelled. He lived behind the Exchange, 1700–1730.

——, **George,** C.C., 1706-1712.

——, **N.,** Lombard Street, maker of a watch with pierced silver pillars, in Guildhall Museum, about 1720.

——, **William,** admitted C.C., 1713.

——, **Benjamin,** 18, West Smithfield, 1769-1772.

——, **Ann,** 45, New Bond Street, 1783.

Carver, Isaac, admitted C.C., 1667.

Casper, Ellis, and Co., 29, Finsbury Place, 1804–1842.

——, **Nathaniel,** 13, Bury Street, St. Mary Axe, 1804-1842.

Castlefranc, Peter, 40, Pall Mall, 1769-1783.

Catchpool, William, 114, Strand, 1823; Fenchurch Street, 1830-1835.

Catherwood, Joseph, 10, Bunhill Row, 1775-1825.

——, **Joseph and William,** 2, Newcastle Place, Clerkenwell, 1804–1830.

Catherwood, W., 24, Nelson Street, City Road, 1804–1842.

Cathro, G. and R., 14, Kirby Street, Hatton Garden, 1812–1830.

——, **Robert,** 55, Kirby Street, Hatton Garden, 1835.

Catrier, Charles, admitted C.C., 1697.

Catsworth, John, admitted C.C., 1669.

Cattell, William, Fleet Street, admitted C.C., 1671; maker of a lantern clock inscribed "William Cattell, in Fleete Street, Londini." 1671-1690.

——, **Thomas,** admitted C.C., 1688. "Lost in Chancery Lane, a silver Minute Pendulum Watch, with a green and silver ribbond to the key, the watch made by Cattle, London" (*London Gazette,* January 19–23, 1692).

Cattey, Daniel, admitted C.C., 1731.

Cattle, John, fecit 1633, inscription under the alarum disc of a lantern clock.

Cattlin, James, 58, Great Marylebone Street, 1804-1842.

Cauch, James, admitted as a brother C.C., 1692.

Cavendish, Richard, livery, C.C., 1810; 1800-1811.

Cayne, Andrew, without Bishopsgate, 1696.

Cext, Catharine, apprenticed to James Hubert and his wife, 1730.

Chaband, H., 9, Plumtree Street, Bloomsbury, 1825.

Chadd and Ragsdale, New Bond Street, 1775.

Chadwick, John, 36, Cornhill, 1783–1813.

——, **Joshua,** 138, Holborn Hill, 1820–1825.

——, **James,** 18, Great Bath Street, Clerkenwell, 1804-1842.

Chalfont, Walter, Barnsbury, a clever watchmaker, inventor of several forms of keyless mechanism, 1850–1886.

Chalk, James, 36, Bishopsgate Street Within, 1798.

Challoner, William, Skinner Street, liveryman, C.C., 1776.

Chalmers, George, 1, Prince's Street, Leicester Square, 1783-1788.

Chamberlain, John, maker of a round watch in S.K.M., about 1610.

——. **Thomas,** Chelmsford. In the B.M. is a watch by him with day of the month ring, about 1630.

Chamberlaine, Nathaniel, admitted C.C., 1685; master, 1717; 1685–1718. "These are to give notice that Nathaniel Chamberlain, Watchmaker (who hath lived several years at *Chelmsford*, in *Essex*), for the better accommodation of his friends and customers, hath, at the request of divers of them, taken a Chamber at *Mr. John Rust's*, in *Angel Court*, in *Lumbard Street*, where he doth intend, God willing, to attend the last Fortnight in every Term, for the mending his own Work, and accommodating all persons that shall have occasion for New" (*London Gazette*, January 22–25, 1676–77).

——, **John,** Bury, admitted C.C., 1687; maker of lantern clocks, about 1700.

——, **Joseph,** Norwich. "A little Gold Watch made by Joseph Chamberlain, of Norwich, with a plain Dial Plate in a plain black Shagreen Case" (*London Gazette*, March 15–19, 1687).

——, —, Mark Lane, 1717.

Chambers, James, 3 Squirrils, St. Dunstan's Church, 1690.

——, 56, Cornhill, 1823.

Champion, John, admitted as a brother, C.C., 1641; 1638–1650.

——, **John,** admitted C.C., 1651.

——, **John,** maker of a watch in S.K.M., outer case of shagreen, 1770–1785.

Chams, Charles Sampson, admitted as brother, C.C., 1692.

Chance, B., London, maker of a watch in the B.M. with a filigree and steel case, 1720.

Chancellor and Son, Dublin, well-known clockmakers, 1800–1830.

Chandler, R., 8, Leicester Square, 1825.

Chanville, James, C.C., 1699.

Chapman, Simon, C.C., 1675.

——, **William,** 6, New Round Court, Strand, 1790.

——, **J.,** clock-case maker, 6, Red Lion Street, Clerkenwell, 1835.

Chappel, Robert, admitted C.C., 1720; maker of small size sheep's-head arch-dial clocks, "Robert Chappel, London," on disc.

Chappell, Thomas, Tower Street, 1759–1763.

Charle, George, 19, Wilderness Row, 1804–1842.

Charlstron, William, livery, C.C., 1810; 1800–1811.

Charlton, John, one of the first assistants of the C.C.; master, 1640; 1630–1649.

——, **Matjonat,** apprenticed to G. Graham, 1728.

——, **James,** 13, Lisson Street North, 1842.

Charman, P., 63, Piccadilly, 1825.

Charrington, S., died while master, C.C., 1768; 1760–1768.

Chartièr, —, Blois, excelled as a watch-case enameller, about 1650.

Chartièr, Francis, 1, Angel Court, Throgmorton Street, 1771.

Charwell, James, London, maker of a repeating watch at S.K.M., outer case shagreen piqué, about 1740.

Chater, James, admitted C.C., 1727.

——, **James, and Son,** 3, Cherry Tree Court, Aldersgate, 1754–1759.

——, **Eliezer and James,** 3, Cherry Tree Court, 1760–1780.

——, **Eliezer,** 10, Exchange Alley, Cornhill; master, C.C., 1772; livery, 1776; 1768–1781.

—— **and Livermore,** 2, Exchange Alley, 1790; 10, Bartolomew Lane, 1794; 30, Tokenhouse Yard, 1800; 1790–1804.

——, **Richard,** 14, Cornhill, 1787–1810.

——, **William,** 163, Goswell Street, 1804–1842.

Chaters, J., watch motion manufacturer, 17, Gee Street, Goswell Street, 1835.

Chatfield, —, London, maker of a watch advertised in the *London Gazette*, 1694.

Chatier, Isaac, 1, Angel Court, Throgmorton Street, 1768–1788.

Chaulter. Hutton, writing in 1773, esteems his work, 1770.

Chauvell, James, Old Broad Street, maker of a watch in S.K.M., 1710–1740.

Chawner, Thomas, 34, Ludgate Hill, 1783-1788.
Cheeny, J., clockmaker at East Hartford, Connecticut, U.S.A., 1790.
Cheeseman, Daniel, C.C., 1699.
Cheltenham, Michael, C.C., 1712.
Cheney, Wither (Walter?), elected master, C.C., 1695, but excused on making a contribution to the poor-box; 1688-1695.
Cherril, E., and Son, 6, Newcastle Place, 1830.
Chesnon, Solomon, Blois, maker of a very diminutive watch in the B.M., with outer leather case, about 1640.
Chesson, Thomas, Ludgate Hill, 1754-1759.
Chester, William, 55 (112), Shoreditch, 1804-1835.
Chettle, W., 35, Commercial Road, Lambeth, 1835.
Chilcott, Richard, C.C., 1690.
——, **John,** admitted C.C., 1721.
Child, Richard, Fleet Street, admitted C.C., 1632; warden, 1640, 1643. In 1638 the Blacksmiths' Company sued "Child, the clockmaker," for breach of his oath, 1627-1644.
——, **Henry,** admitted as a brother, C.C., 1642; died, while master, 1664; 1640-1664.
——, **Ralph,** admitted C.C., 1662.
——, **Henry,** Tower Royal, Budge Row, 1677-1693. "Lost the 28 instant at Aldermary Church or between that and Tower Royal, a plain Gold Pendulum Watch, in a new Fashion Gold Grav'd case, name, Henry Child. It had a Tulip Hand, long freised hours, in the middle of the dial plate engraven with two Birds and Flowers; it was in a Gold Pinned Case" (*London Gazette,* May 25-29, 1693).
Chisman, Timothy, summoned to take up livery, C.C., 1786; master, 1803; 1780-1804.
Christie, William, 22, Chancery Lane, 1804-1842.
——, **Henry,** 3, Duke Street, Manchester Square, 1842.
Church, John Thomas, 19, Oakley Street, 1835.
Churchman, Michael, C.C., 1694.
Clampson, Richard, C.C., 1673.
Clare, Henry T., 15, Meredith Street, Clerkenwell, 1804-1842.
Clark, Thomas, admitted C.C., 1720.
——, **Edward,** 17, Middle Moorfields, 1772.
——, **William,** Bishopsgate Street, 1754-1774.
——, —, Paternoster Row, 1774.
——, **Edward,** 56, Cornhill, 1768-1775.
——, **Robert,** clock and watch-spring maker, Providence Row, 1775-1799.
——, **David,** watch-case maker, 58, Featherstone Street, 1790.
——, **Francis,** 10, Jewin Street, 1790.
——, **William,** 6, King Street, Clerkenwell, 1800; 26, Abingdon Street, 1730.
——, **John,** 73, Mark Lane, 1794-1823.
——, **Thomas,** 9, Goswell Street, 1830-1840.
——, **George,** 24, Bartholomew Terrace, St. Luke's, 1842.
Clarke, George, Whitechapel; admitted C.C., 1632; maker of an eight-day clock, locking plate, striking, handsome brass dial, name on disc, period 1690; 1632-1690.
——, **William,** admitted C.C., 1654.
——, **Humphrey,** C.C., 1668.
——, **John,** Bristol. In the B.M. is a watch of his make in an outer case of leather piqué, 1630-1640.
——, **John,** Stanford, C.C., 1696.
——, **Thomas,** admitted C.C., 1709.
——, **Richard,** admitted C.C., 1720.
——, **Edward,** 9, Holborn, 1768.
——, **William,** George Yard, Whitechapel, 1769-1772.
——, **John Basul,** St. John's Lane, liveryman, C.C., 1776.
——, **James,** 52, Rahere Street, Goswell Road, 1778.
——, **G.,** 3, Cherry Tree Street, Aldersgate Street, 1790-1810.
——, **Henry,** warden, C.C., 1822, 1826; 1810-1826.
——, **William, and Sons,** 8, Goswell Street, 1830-1842.
——, **William** (Clarke and Sons, Goswell Road), died 1875, aged 75.
——, **Abraham** (Clarke and Sons, Goswell Road), died 1890, aged 79.

Claxton, Thomas, admitted C.C., 1646; signed petition against oppression of the Company in 1656; master, 1670; 1646–1671.

Clay, William, maker of a watch Cromwell presented to Col. Bagwell, at the siege of Clonmel; 1646–1660.

——, **William,** apprenticed to Jeremy Gregory, 1680; admitted C.C., 1687. A watch by him in the Guildhall Museum: 1687–1700.

——, **Thomas,** Chelmsford, a well-known maker of lantern clocks, period about 1650.

——, **Charles,** Stockton, Yorkshire. Petitioned Parliament for a patent in respect of a repeating and musical watch or clock, his invention. Mr. Quare produced a watch to answer the same end as Mr. Clay's. The Attorney-General reported in favour of Mr. Clay. The C.C., however, opposed Mr. Clay, and after a tough fight, extending from Feb. 1716 to the latter part of 1717, the patent was not granted.

——, **Charles,** London, maker of a verge watch in S.K.M., 1720; another example, with chased outer case, about 1750; 1720–1750.

Clayton, Thomas, admitted C.C., 1646.

Cleeke, Henry, admitted C.C., 1655.

Cleeve, William, admitted as a brother, C.C., 1654.

Cleghorn, Samuel, 65, Shoe Lane, 1790.

Clement, Edward, C.C., 1670.

——, **William,** admitted as a brother, C.C., 1677; about this time he applied to clocks the anchor escapement invented by Dr. Hooke; master C.C., 1694; 1670–1695.

Clements, Robert, admitted C.C., 1686.

Clerke, George, 3, Cherry Tree Street, Aldersgate Street; summoned to take up livery C.C., 1786; 1786–1842.

Clewes, James, admitted as a brother, C.C., 1670.

Clifton, Thomas, admitted as a brother, C.C., 1651.

——, **Thomas,** admitted C.C., 1687.

Cliverdon, Thomas, C.C., 1722.

Closon, Peter, at Holborne Bridge; three years senior warden, C.C., 1636–1638; maker of lantern clocks; one with fret Fig. 102, balance escapement, description on fret, "Peter Closon at London, fecit" (see p. 173). On another example is, "Peter Closon, at Holborne Bridge," 1626–1640.

Clough, Edward, Fetter Lane. A watch of his make, with an outer case of leather piqué, in the B.M., is inscribed, "Mayor Johne Miller, his watche," 1630–1640. "Stolen a silver watch in a black case, studded about the edges, and one studded flower at the back of it, having a minute motion and the figures of the hours and minutes twice over the plate, made by Edward Clough, near Gray's Inn Gate, in Holborn" (*London Gazette*, October 6–9, 1690).

Clowes, John, admitted C.C., 1672; elected a warden, 1713, but unable to serve through ill-health; maker of a small square bracket-clock, bob pendulum, locking plate, cherub corners, inscribed, "J. Clowes, Londini, fecit;" 1672–1713.

Cluer, Obadiah, admitted C.C., 1709.

——, **John,** 22, Skinner Street, Clerkenwell, 1835.

Cluter, William, admitted C.C., 1709.

Clutton and Co., 48, Rupert Street, Piccadilly, 1825.

Clyatt, Samuel, admitted C.C., 1671, Bell Alley, Coleman Street.

——, **Abraham,** admitted C.C., 1680.

——, **John,** admitted C.C., 1708.

——, **William,** admitted C.C., 1709.

——, **Samuel,** admitted C.C., 1711.

Cobb, John, admitted C.C., 1703.

Cochard, George, 10, Henrietta Street, Covent Garden, 1825.

Cochran, Samuel, 291, Wapping, 1788–1794.

Cockford, Matthew, C.C., 1693.

Cogdon, Thomas, Budge Row, chronometer maker, died 1885.

Coggs, John, against St. Clement's Church, 1690–1700.

Cohen, A. S., 9, Newcastle Street, Whitechapel, 1820.

Coker, Ebenezer, Clerkenwell Close, 1754–1769.

Colambell, Anthony, Aldersgate Street, liveryman, C.C., 1776.
Colbert, J., Grafton Street, Tottenham Court Road, 1825.
Cole, Daniel, admitted C.C., 1726.
——, **Thomas,** Lombard Street, 1754–1759.
——, **John,** C.C., 1729; maker of long-case clocks, 1729–1760.
——, **William,** Gutter Lane, 1800–1805.
——, **James Ferguson,** 9, Motcomb Street, Belgrave Square; born 1799, died 1880; an able watchmaker and expert springer. He devoted much attention to the lever escapement, of which he devised several forms, and was for some time a vice-president of the Horological Institute.
——, **Thomas,** 11, Upper King Street, Bloomsbury, an excellent maker of spring clocks; brother of J. F. Cole; 1840–1864.
Coleman, John, 115, Newgate Street, hon. freeman of C.C., 1781–1783.
——, **William,** Arthur Street, 1790.
——, —, 14, Strand, 1794.
——, **Thomas,** 6, Westmoreland Street, St. Mary-le-bone, maker of bracket clock, Chippendale style of case, 1822–1842.
Coles, M. A., 25, Red Lion Street, 1790.
Collett, John, Chelsea, maker of mahogany long-case clock, and dial, silver centre, about 1780.
Colley, —, Fleet Street, 1774.
Collier, Benjamin, a noted maker; admitted C.C., 1693; Lord Chesham had a gold double-case repeater made by him; 1693–1730.
——, **John,** Red Lion Street, Clerkenwell, 1770–1775.
——, **Archibald,** 9, New Bond Street, 1790–1830.
Collingridge, Edmund, 27, Wilderness Row, livery, C.C., 1810–1830.
——, **Thomas,** 136, Aldersgate Street, 1842.
Collingwood, Samuel James, 8, Long Alley, livery, C.C., 1786–1790.
Collins, John, admitted C.C., 1701.
——, **Clement,** admitted C.C., 1705.
——, **John,** admitted C.C., 1727.
——, **R.,** 52, Strand, 1813.
Collomby, Abraham, maker of a watch in S.K.M., about 1750.
Collum, A., 74, Lower East Smithfield, 1800.
Collyer, Benjamin, C.C., 1693.
Colson, Richard, admitted C.C., 1682; maker of a curious 24-day clock at Battle Abbey, Sussex, 1682–1700.
Combret, P., Lyons, maker of watch (see p. 55), 1613.
Combs, Joseph, admitted C.C., 1720.
Comfort, William, admitted as a brother, C.C., 1647.
Compart, Ebenezer, C.C., 1728.
Compton, Walter, Vere Street, 1692.
——, **Adam,** admitted C.C., 1716.
Conden, Robert, 51, Clerkenwell Close, 1780–1785.
Congreve, William, inventor of curious clocks. In 1808 he patented (No. 3164) a clock in which a ball rolling down grooves in an inclined plane, which was movable on its centre, attained sufficient impetus to unlock the train, whereupon the inclination of the plane was reversed, and the ball entered the succeeding groove and rolled in the reverse direction. The grooves, instead of being at right angles to the centre of motion of the inclined plane, or tilting platform, were zigzag, forming a succession of V's, so that the ball, once started, traversed the whole surface of the plate by rolling down one groove and entering the next at the point of the V., 1800–1820.
Connell, William, Cheapside, a clever watchmaker who succeeded Ganthony, 1845–1862.
Connely, William, 93, Piccadilly, 1825.
Conrad and Reiger, makers of a German octagonal timepiece in S.K.M., about 1590.
Constable, W. and G., Bunhill Row, 1804; 27, Finsbury Street, 1807.
Constantin, —, Geneva, maker of a heart-shaped watch, S.K.M., about 1740.
Cony, John, admitted as a brother C.C., 1641.
Conyers, Richard, C.C., 1716.

Cook, Edward, 210, Borough, 1763–1772.
——, **John**, 22, Cheapside, 1768; 24, Wood Street, 1772.
——, **J.**, watch-cap maker, 5, Robert Street, Hoxton, 1835.
Cooke, Lewis, petitioner for incorporation of C.C., 1630–1632.
——, **John**, admitted C.C. 1649.
——, **John**, admitted C.C., 1662.
——, **Robert**, admitted C.C., 1667.
——, **William**, admitted C.C., 1681.
——, **Thomas**, admitted C.C., 1699.
——, **William**, admitted C.C., 1708.
——, **John**, admitted C.C., 1712.
——, **Joseph**, admitted C.C., 1715.
—— **and Gurney**, Foster Lane, 1754–1759.
——, **John**, 22, Cheapside, 1775.
——, **Robert**, 7, Star Alley, Fenchurch Street, 1810.
Coombs, Fisher, admitted C.C., 1728.
——, **James**, 3, Clerkenwell Green, 1825.
Coope, James, admitted C.C., 1654.
Cooper, Hugh, admitted C.C., 1653.
——, **Edward**, clock-case maker, 91, Sutton Street, 1790.
——, **Thomas**, 1, King Street, Little Tower Hill, 1800.
——, **E.**, Wynyatt Street, Northampton Square, 1820.
——, **W.**, 12, Gee Street, Goswell Road, 1820–1842.
——, **Thomas Frederick**, Duncan Place, City Road, and afterwards at 6, Calthorpe Street; a well-known watch manufacturer, who made chiefly for the American market, 1820–1862.
Cope, Peter, admitted as a brother, C.C., 1638.
——, **C. J.**, 58, Berners Street, Oxford Street, 1820.
Copeland, Alexander, 113, Leadenhall Street; livery, C.C., 1810; 1800–1815.
Corbet, Nathaniel, maker of a silver watch with studded case, frosted dial plate (*London Gazette*, September 21–25, 1693).
Corbett, J., 42, Clerkenwell Close, 1825.
——, **T.**, 22, Goswell Terrace, Clerkenwell, 1835.
Corbit, —, 10, Short's Buildings, Clerkenwell, 1835.

Cording, John, 232, Strand, 1812–1830.
——, **Charles**, 181, Minories, 1825.
——, **Thomas**, 21, Holborn Hill, 1825.
——, **Thomas**, 38, Aldgate High Street, 1830.
Cordon, Richard, C.C., 1729.
Cordrey, Thomas, C.C., 1670.
Corghey, John, Fleet Street, 1754–1759.
Corker, D., 18, Commercial Road, Whitechapel, 1820.
——, **D.**, 18, Langley Place, Commercial Road, 1835–1842.
——, **Nathaniel**, 48, South Moulton Street, 1842.
Cornelius, Jacob, London, maker of a small diamond-shaped spring timepiece, catgut line, about 1620.
Cornish, Michael, admitted C.C., 1661.
Corp, William, 84, Aldersgate Street, 1835.
Corson, Thomas, 119, High Street, Wapping, 1835–1842.
Cosbey, Robert, at y^e Diall, Rood Lane, admitted C.C., 1653; 1679.
Cosse, James, Cornhill, maker of a verge watch about 1720.
Cosson, S., 56, Cannon Street, St. George's East, 1835.
Coster, Robert, admitted C.C., 1655.
——, **William**, admitted C.C., 1660.
Cother, William, admitted as a brother, C.C., 1668.
Cotter, Ebenezer, 13, Goldsmith Court, Wood Street, 1775.
Cotterel. William, C.C., 1694.
——, **John**, admitted C.C., 1721.
Cotterell, Thomas, 163, Oxford Street, 1830.
Cottle, John, maker of a lantern clock inscribed, "John Cottle, fecit, 1653."
Cotton, John, C.C., 1695.
——, **John**, admitted C.C., 1718.
——, **R. and T.**, watch-spring makers, 17, President Street East, 1835.
Cottonbult, John, C.C., 1729.
Couche, Charles, admitted C.C., 1727.
Coulon, Charles, Prince's Street, Leicester Fields, 1768.
Coulson, Charles, Newport Alley, Soho, 1769.
——, **Robert**, livery, C.C., 1810.

Coulson, Samuel, 16, North Audley Street, 1825.
Courtauld, Samuel, Cornhill, opposite Royal Exchange, 1759–1763.
——, **P., and Cowles,** 21, Cornhill, 1768–1775.
Cousens, R. W., 6, York Street East, Commercial Road, 1835.
Cousins and Waitside, 20, Davies Street, 1842.
Couta, G., 12, Blenheim Street, Oxford Street, 1825.
Coventon, Joshua, clock-case maker, 60, Red Lion Street, Clerkenwell, 1835.
Coventry, R., 21, Queen Street, Clerkenwell, 1830.
——, **J.,** 8, Paragon Place, New Kent Road, 1835.
Cowan, James, went from Edinburgh to Paris, and worked under Julien le Roy, 1726.
Coward, William, C.C., 1681.
—— **and Jefferys,** 149, Fleet Street, 1783.
Cowell, John, 97, Royal Exchange, 1763–1800.
Cowen, H., 3, Sidney's Alley, Leicester Square, 1800.
Cowles, George, and Co., 30, Cornhill, 1780–1790.
Cowpe, Edward, admitted as a brother, C.C., 1687.
Cox, Thomas, admitted C.C., 1708.
——, **James,** 103, Shoe Lane, a clever mechanician, who in 1773 opened at Spring Gardens a museum of quaint clocks, singing birds, and costly mechanical toys. There were fifty-six pieces in the collection, and the charge for admission was half a guinea each person. A regulation providing for the presence of but few visitors at one time was, needless to say, quite unnecessary; 1768–1788.
——, **Jason,** Long Acre, 1760.
——, **Samuel,** Long Acre, 1770.
——, **William,** 70, Cox Court, Little Britain, 1763–1772.
—— **and Watson,** 23, Aldersgate Street, 1780–1785.
——, **James,** 103, Shoe Lane, Fleet Street, 1765–1785.
——, —. In the B.M. is a large centre second elaborate watch suited for the Oriental market, 1790–1800.
Cox, Nathaniel, 140, Goswell Road, 1835–1842.
Coxiter, William, C.C., 1654.
——, **John,** master, C.C., 1661–1663.
——, **Nicholas,** admitted C.C., 1648; master, 1671, 1677; a celebrated maker. Example: a lantern clock, fret Fig.104, inscription, "Nicholas Coxiter, neare Goldsmiths Hall," 1648–1680.
Cozens, William, 3, Wilderness Row, 1810; 13, Finsbury Place, 1822–1825.
——, **William, and Son,** 10, Bunhill Row, 1822–1830.
——, **J.,** 10, Bunhill Row, 1835–1842.
Cradock, E., 13, Charlotte Terrace, Lambeth, 1835.
Cragg, John, 10, President Street East, 1835–1841; 8, Northampton Square, 1842.
Craggs, Richard, C.C., 1660.
Craigingle, John, 90, Cork Street, Grosvenor Square, 1842.
Cranfield, Henry, C.C., 1706.
Cranze, F. and J., 39, Broad Street, 1788.
Craven, Thomas, admitted as a brother, C.C., 1688.
Crawley, Thomas, C.C., 1660.
Crayle (Crayce?) Richard, member of the Blacksmiths' Company, petitioner for incorporation of C.C. (see p. 67); 1627–1655.
——, **William.** "Lost on the 13 inst., a Gold Watch enamelled, the outside case seal-skin studded with gold; in the backside of it was the history of St. Paul's Conversion, with small character *Saul Saul quid me persequoris?* And on the Dial part was the stoning of Stephen, with Lanskip round about; and in the inside of the back, a Damask Rose exactly enamelled, the Key fastened with a black Ribon. Whoever gives notice of it to Mr. William Crayle, a watchmaker at the Black Boy in the Strand, near the Savoy, shall have 3*l.* reward" (*London Gazette*, July, 13–17, 1676). "Lost on the

22 inst., between St. Andrews Church in Holborn and the further end of Grays Inn Road, a gold watch with the outer case studded, with Mr. William Craile's name engraved on the bottom plate of the said watch. Whoever gives notice of the said watch to Mr. John Wheatley, at the 3 Cups in Hatton Street, shall have two guineas reward" (*London Gazette*, March 20–24, 1690).

Creak, William, Bunhill Row, maker of a verge watch in the Guildhall Museum, 1740–1763.

Creed, Thomas, admitted as a brother, C.C., 1668.

——, **Thomas**, admitted as a brother, C.C., 1674.

Creede, John, admitted C.C., 1727.

Creeke, Henry. A suit by C.C., for using clockmakers' trade contrary to the statute, compromised by Creeke promising to present to C.C. a new house clock and alarum, and 20*s*., 1654.

Crenze, Francis, and J., 59, Broad Street, 1759–1771.

Cressner, Robert, London, maker of lantern clocks, about 1680.

Creswell, Joseph, corner of Adelphia, Strand, 1775.

Cribb, William, 17, Southampton Row; a chronometer maker who succeeded Birchall and Appleton, formerly Molyneux, 1830–1842.

Cripple, William, C.C., 1702.

Cripps, John, St. Thomas Apostle, 1758–1763.

——, **John, and Francillon**, 43, Friday Street, 1769–1788.

Crisp, Nicholas, Bow Churchyard, 1754–1759.

——, **John**, 22, Old Jewry, 1783.

Croak, Sampson, admitted C.C., 1668.

Crocker, James, C.C., 1716.

——, **William**, 34, Great Alie Street, 1842.

Croft, John, admitted C.C., 1665.

——, **John**, watch-case maker, 51, Wynyatt Street, Clerkenwell, 1835.

Crofts, Richard, at the Bear in Foster Lane, right against Goldsmith's Hall. A gold watch by Goulon, à Paris, the inside a landscape, a studded case, lost near St. Martin's, to be taken to him if found (*London Gazette*, March 25–29, 1675).

Crooke, Peter, admitted C.C., 1724.

Cross, James, Fetter Lane, liveryman, C.C., 1776.

——, **Edward**, Blewitt's Buildings, Fetter Lane, 1790.

——, **John**, 131, Old Street, 1804; 10, Charterhouse Square, 1830–1842.

——, **John B.**, Jewin Street, C.C., 1831–1845.

Crossley, James, London, maker of lantern clocks, about 1710.

——, **Richard**, 14, Giltspur Street, 1800–1825.

Crouch, George, admitted C.C., 1668.

——, **Edward**, admitted C.C., 1691; master, 1719; 1691–1720.

——, **Robert**, admitted C.C., 1722.

——, **John**, Knightsbridge, about 1761.

Croucher, J., 27, Cornhill, 1830.

Crucifix, Robert, Sweeting's Alley; admitted C.C., 1689; 1730.

——, **John**, admitted C.C., 1712; maker of sheep's-head brass clock, with arch dial, bought from Holland, and of a similar one in Stirling Castle.

Croudhill, Thomas, Bedford Square, Bedford Row, 1790.

Cruickshanks, Robert, 17, Old Jewry, 1772-1775.

Crump, Henry, admitted C.C., 1667.

Cruttenden, Thomas, C.C., 1677.

Cubley, Thomas, 54, Crawford Street, Montague Square, 1820.

Cue, William, admitted C.C., 1691.

Cuendel, Samuel, 52, Red Lion Street, Clerkenwell, 1815.

Cuff, James, admitted C.C., 1699.

——, **John**, admitted, C.C., 1718.

——, **Broadhurst**, 204, Regent Street, 1823.

Cufford, Francis, admitted C.C., 1718.

Cullam, A., Lower East Smithfield, 1790.

Cumming, Alexander, born at Edinburgh, about 1732, died at Pentonville, 1814; a celebrated chronometer and clock maker; author of an excellent treatise on clockwork, which was published in 1766. He kept a shop in Leadonhall Street.

Among the fine and curious clocks at Buckingham Palace is one made for George III., which registers the height of the barometer every day throughout the year. He had £2000 for the clock, and £200 a year for looking after it.

Cumming, John, 202, Oxford Street, 1822-1842.

Cummins, Charles, 148, Leadenhall Street, a maker of chronometers and fine watches. A watch of his manufacture contained an ingenious and original form of fusee stop. A little finger projecting from the smaller end of the fusee was pressed by the chain into the way of a stop on the plate; 1842.

Cuper, Josiah (French), Blacksmiths' Company and C.C., 1627-1632.

Curryer, Thomas, watch-glass maker, 134, Whitecross Street, 1835.

Curson, George, livery, C.C., 1756.

Curtis, John, admitted C.C., 1671.

Cusin, Charles, born at Autun, in Burgundy, settled in Geneva, where it is said he introduced watch manufacturing, about 1587.

Cuthbert, Amariah, C.C., 1694.

——, **J.,** 27, Piccadilly, 1790.

Cutlove, John, Harleston, Norfolk, long-case clock, moving ship, about 1760.

Cutting, Christopher, C.C., 1694.

Dalby, John, 105, New Bond Street, 1783-1804.

Dalemaige, Jehan, Paris, clockmaker to the Duchess of Orleans, 1401.

Dallas, James, maker of a pocket chronometer for the Duke of Sussex, 1800-1820.

Dallington, William, London, maker of a watch, silver case and dial, day of the month circle, about 1680.

Dalton, James, watch movement maker, Red Lion Street, 1790; 12, Bunhill Row, 1810; 27, Percival Street, 1815-1820.

Dammant, Barn., Colchester, maker of lantern clock, square dial, about 1735.

Dane, Thomas, 133, Oxford Street, 1790-1815.

——, **Robert,** 72, Long Acre, 1507.

Danell, Joseph, 214, Oxford Street, 1830.

Daniel, Stephen, admitted as a brother, C.C., 1698.

——, **Robert,** admitted C.C., 1708.

——, **Thomas,** 20, Foster Lane, 1783.

Daniell, William, C.C., 1632.

——, **Edward,** admitted as a brother, C.C., 1648; 1640-1649.

——, **Isaac,** admitted C.C., 1648; warden, 1674; did not become master, 1648-1675.

Dannes, Robert, Clerkenwell, liveryman, C.C., 1776; 1766-1780.

Dapin, Paul, London. In the B.M. is a repeating watch by him inscribed, "Dr. Samuel Johnson, 1767;" 1750-1760.

Darby, John, 51, Gee Street, Goswell Road, 1820-1842.

Dare and Peacock, 103, Minories, 1770-1772.

Dargent, James, C.C., 1700-1705.

Dariford, —, maker of fine repoussé gold pair-case watch, gold dial, with calendar, about 1735.

Darle, Thomas, London, about 1769.

Darling, Robert, Fenchurch Street; Sheriff of London and knighted in 1766, on the court of C.C., 1766; 1750-1770.

Darrell, Joseph, 214, Oxford Street, 1812-1815.

Darwell, Edward, 64, Watling Street, 1775.

Dashper, Frederick, 10, Pierpoint Row, Islington, 1820-1835.

Dasypodius, Conrad, maker of second Strasburg clock (see p. 141), 1571.

Davenport, Samuel, 15, Lime Street, 1788.

Davidson, Adam, 21, Norton Street, Fitzroy Square, 1835; 44, Goswell Street, 1842.

Davie, Joseph, 201, High Holborn, 1830-1842.

Davies, Timothy, Clifford Street, Broad Street, 1783.

——, **Robert,** 35, Gracechurch Street, 1788.

——, **John,** 153, Leadenhall Street, 1788.

——, **T. and H.,** 39, Brewer Street, Golden Square, 1800.

——, **Richard,** 85, New Bond Street, 1800.

Davis, Samuel, at ye Golden Ball in Lothbury, admitted C.C., 1648; 1648–1660.
——, **Tobias**, admitted C.C., 1653.
——, **John**, admitted as a brother, C.C., 1653.
——, **Thomas**, admitted C.C., 1674.
——, **Benjamin**, admitted C.C., 1678.
——, **Jeffry**, admitted C.C., 1690.
——, **John**, admitted C.C, 1697.
——, **William**, admitted C.C., 1699.
——, **George**, admitted C.C., 1720.
——, **Thomas**, admitted C.C., 1726.
——, **John**, Lamb's Conduit Street, Bedford Row, 1769.
——, **William**, 124, Newington Street, 1810.
——, **David**, 28, Bury Street, St. Mary Axe, 1830–1842.
—— **and Plumley**, 9, Red Lion Street, Clerkenwell, 1830.
——, **A. and C.**, 118, Houndsditch, 1835.
Davison, William, C.C., 1686.
Dawes, William, 131, Upper Street, Islington, 1835–1842.
Dawkes, John, admitted C.C., 1707.
Dawson, John, Holborn Bridge, 1763.
——, **Robert**, admitted C.C., 1678.
——, **Thomas**, petitioner for incorporation of C.C., 1630–1632.
Day, Isaac, admitted C.C., 1678.
——, **Thomas**, admitted C.C., 1691.
——, **Edmund**, admitted C.C., 1692; maker of a bracket clock showing day of the month, and in an oak case veneered with tortoiseshell; 1692–1720.
——, **Richard**, 14, Drury Lane, 1790.
Deacon, F., St. Michael's Alley, 1835.
——, **J. C.**, 18, Guildford Street, Borough, 1835–1842.
Dealtry, Thomas, 85, Cornhill, 1783.
Dean, Thomas, 80, Minories, 1804.
——, **Thomas**, 1, Swithin's Lane, 1820.
Deane, George, engraver, admitted to C.C., 1671. In 1677 he presented to the Court, through Mr. Henry Jones, a plate with the coat of arms, 1671–1677.
Deard, J., Corner of Dover Street, Piccadilly, 1775.
Debaufre, Peter, Church Street, Soho; admitted C.C., 1689. The Debaufres were an exceedingly clever French family of horologists, probably driven over here by the revocation of the Edict of Nantes. Peter and Jacob were associated with Facio in the patent he obtained in 1704 for watch jewelling. Peter Debaufre also invented a dead-beat or "club-footed" verge escapement, in which there were two escape wheels, having between them a truncated cone formed of diamond, and cut away at the sides to form an impulse plane acted on by the wheels alternately. Sir Isaac Newton had a watch so made, and spoke favourably of its performance. Sully modified it by using two pallets and one wheel. More recently the two-wheel form has been revived for French carriage clocks; 1686–1720.
Debaufre, James, Church Street, Soho, admitted C.C., 1712; maker of a large size silver verge watch with day of the month circle; 1712–1750.
De Boufler, Andrew, London, completed his apprenticeship, 1769.
Debry, Theodore, a famous French chaser of watch cases, 1590–1630.
De Charmes, Simon (French), came here through the revocation of the Edict of Nantes; built Grove Hall, Hammersmith, in 1730. His son David lived there. Admitted as a brother, C.C., 1691; 1688–1730.
——, **David**, admitted C.C., 1692; maker of a plain silver pair-case repeater, rich cock and pillars, "Des Charmes, London," inscribed on enamel dial, 1692–1720.
Decka, John, apprenticed to J. W. Addis; admitted C.C., 1757; maker of an eight-day long-case clock, mahogany case, inlaid with marqueterie; 1757–1790.
—— **and Marsh**, Broad Street, Ratcliff Highway, 1790–1800.
Dee, William, Blackfriars, admitted C.C., 1729.
De Fontaine, L., 18, Wilsted Street, Somers Town, 1835.
De la Fonds, watch-spring maker, 44, Salisbury Court, Fleet Street, 1790.
——, **John**, Pinner's Court, Old Broad Street, 1790.
De la Fons, James, Royal Exchange

and 66, Threadneedle Street, 1790–1795.

De la Fons, John, 66, Threadneedle Street, 1800; corner of Bartholomew Lane, 1810; 25, St. Swithin's Lane, 1815.

Delafosse, Samuel (French), admitted as a brother, C.C., 1692.

De la Garde, Gustavus, 17, Lowther Arcade, 1840–1842.

De Jersey, Westminster, maker of long-case clocks, about 1810.

Delander, Nathaniel, admitted as a brother, C.C., 1668; 1668–1690.

——, **John,** case maker, admitted C.C., 1675. "Lost on Monday, August 2, between Fleet Street and the Old Bailey, a gold watch box not finished, in a brass case. Whoever gives notice of it to Mr. John Delander, watch-case maker, over against St. Clements Church, shall have 10*s*. reward" (*London Gazette*, August 5–9, 1675).

——, **Daniel,** C.C., 1699; 1699–1721.

——, **John,** Salisbury Court, C.C., 1705.

——, **Nathaniel,** Fleet Street, near Temple Bar, son of Daniel Delander, admitted C.C., 1721; master, 1747; 1721–1759.

De Landre, Roger, admitted as a brother, C.C., 1641; 1635–1650.

Delandre, James, admitted as a brother, C.C., 1668.

De la Salle, Thomas, 42, St. Catherine's, 1800–1810; 18, Cannon Street, 1820–1842.

Delaunce, James, admitted as a brother, C.C., 1677.

Delauney, Peter, 68, New Bond Street, 1822–1825.

Delaversperre, William, admitted as a brother, C.C., 1650.

Delolme, Henry, 48, Rathbone Place, 1840–1842.

Demaza, George, 95, Strand, 1825.

De Moylym, John, keeper of the Dulwich College clock in 1553.

Demster, Roger, London, about 1790.

Denison, Edmund Beckett, born 1816; elected president of the British Horological Institute, 1868; succeeded his father as baronet, taking the title of Sir Edmund Beckett; called to the House of Lords under the title of Baron Grimthorpe, 1886; designer of the Westminster clock (see p. 208).

Denman, G., 24, Greek Street, Soho, 1820.

——, **John F.,** 13, Cannon Street Road, Commercial Road, 1842.

Denne, John, 28, Lamb's Conduit Street, 1820.

Denning, J., 32, Ludgate Hill, 1840.

Dennis, Francis, admitted as a brother, C.C., 1673.

——, **Peter,** admitted C.C., 1712.

Dent, William, admitted C.C., 1674.

——, **Robert,** admitted C.C., 1681.

—— **and Son,** watch-glass makers, 50, Northampton Street, Clerkenwell, 1835.

——, **E. J.,** born 1790, died 1853. He worked as a finisher of repeating watches till 1830, when he joined J. R. Arnold in partnership, at 84, Strand. During the ten years they were together the business was greatly extended, chiefly through the energy and ability of Dent, who, after the partnership expired, established himself at 82, Strand, afterwards removing to No. 64. Mr. Dent accepted the stipulation laid down by Mr. Denison on behalf of the Government, that the Westminster great clock should be guaranteed to give exact time within a minute a week, and thus secured the contract for making it, on the understanding that it was to be designed by Mr. Denison.

Derham, William, born 1657, died, and buried in Upminster, in 1735; a clergyman and Canon of Windsor, author of "The Artificial Clockmaker," published in 1696.

Dermere, Abraham, C.C., 1703.

Derwood, —, London, about 1813.

De St. Leu, Daniel, 17, Cloak Lane, watchmaker to George III., 1763–1790.

Desbois, Jacob, admitted C.C., 1730. Several generations of this family have carried on business in the neighbourhood of Holborn.

——, **Daniel,** apprenticed to John Johnson, whom he succeeded at 9, Gray's Inn Passage, about 1787; 1787–1848.

Desbois and Wheeler, 9, Gray's Inn Passage; a watch by them is in the Guildhall Museum; 1803–1835.

——, **Daniel**, 9, Gray's Inn Passage, and afterwards 79, High Holborn, 1835–1885.

Desborough, Christopher, C.C., 1666.

Desbrow, Robert, admitted C.C., 1704.

Des Granges, Peter, 33, Cockspur Street, 1820–1842.

Deshais, Matthew, London, maker of bracket clocks, 1690–1710.

Desmarais, Peter, St. Martin's Court, 1794.

Desmore, T., 11, Clerkenwell Green, 1830.

Dettacher, John, admitted C.C., 1660.

Deveer, Frederick, 7, Angel Court, Throgmorton Street, 1769–1775.

De Vick, Henry. About 1364 he made for Charles V. of France the first turret clock of which we have reliable record (see p. 26); 1340–1364.

Devis, William, Fleet Street, 1750–1765.

——, **John**, 76, Lamb's Conduit Street, hon. freeman, C.C., 1770–1783.

De Welke, Christian, one of the signatories to the petition of incorporation of C.C. In the eighteenth century an oval watch by him was found in a field near Kettering; 1620–1630.

Dewey, William, Dutch clockmaker, 59, Broadwall, Blackfriars, 1835.

Dewin, —, watch-case maker, 17, Red Lion Street, Clerkenwell, 1835.

Dexter, M., London, watch movement in Guildhall Museum, about 1790.

Dickens, John, admitted C.C., 1688.

Dickie, Andrew, Edinburgh, maker of a repeating watch in S.K.M., about 1730.

Dike, Nathaniel, admitted C.C., 1663.

Dingley, Robert, maker of a gold watch, hour-hand only, case with appliqué gold flowers, enamelled; admitted, C.C., 1668; 1668–1679.

——, **Robert**, Bishopsgate Street, corner of Great St. Helen's, 1738–1740.

Dingwall and Bailliam, 9, St. James's Street, 1813.

Dinis, Francis, engraver, admitted C.C., 1666.

Dixon, William, 26, Smith Street, Clerkenwell, 1835; 32, King's Square, 1840; 1842.

Dobb, William, admitted as a brother, C.C., 1646.

Dobson, William, admitted as a brother, C.C., 1670.

——, **Arl**, London, maker of a watch with finely enamelled case, in the B.M.; another example is an oval watch, at S.K.M., inscribed: "This watch was a present from yᵉ King to the Countess of Monteith, 1675;" 1760–1780.

——, **Charles**, Coldbath Fields, liveryman, C.C., 1776.

Dod, Richard, London, maker of long-case clocks, 1695–1720.

Dodsworth, John, admitted as a brother, C.C., 1648.

Donaldson, George, 121, Pall Mall, 1842.

Dondé, John, maker of a clock with wheels and balance, 1334.

Donisthorpe, of Birmingham. Reid speaks of him as "the best maker of church clocks I know," about 1810.

Donne, Robert, Lamb's Conduit Street, 1790.

Door, George, admitted C.C., 1671.

Dorigny, Robert, clockmaker to the Duke of Orleans, 1397.

Dorrell, Francis, Honeysuckle Court, Grub Street; known as a maker of long-case clocks; admitted C.C., 1702; 1702–1710.

——, **William**, Bridgewater Square, summoned to the livery, C.C., 1786; restored Cripplegate Church clock, and made it to strike the hours on the tenor bell in 1797; 1786–1797.

Dossett, Gregory, C.C., 1662.

Doughty, Thomas, C.C., 1696.

——, **William**, 10, Great Ormond Street, Queen's Square, 1820.

Dove, Henry, admitted C.C., 1667.

Dovey, Richard, 6, Craven Buildings, Drury Lane, 1765–1770.

Dow, James, watch-case maker, 15, St. James's Buildings, Clerkenwell, 1820.

——, **William**, watch-case maker, 54, Percival Street, 1835.

Downes, John, admitted C.C., 1725.

Dow, Roger, Vere Street, 1780–1785.
——, **Robert,** Clerkenwell Close, 1790; 72, Long Lane, 1810–1835.
——, **Robert,** 96, Upper Street, Islington, 1842.
Downing, George, watch-chain maker, Covent Garden, 1790.
Downinge, Humfrey, apprenticed to Mr. Grinkin, free of Barber Surgeons; Blacksmiths' Company, in 1637, applied to have him disfranchised; 1637.
Dowsett, Jeremiah, admitted C.C., 1708.
Dowson, John, 77, Holborn Bridge, and Field Court, Gray's Inn; admitted C.C., 1781; 1781–1783.
Doyle, James, Glass Street, Queen's Square, 1790.
Drabble, J., London, known as a maker of good bracket clocks, 1710–1720.
Drake, John, Fleet Street; action by Blacksmiths' Company to disfranchise him; Lady Fellowes had a round silver watch of his make, with plain outer case, silver dial, and steel hand; 1633–1639.
Draper, John, admitted C.C., 1703; maker of long-case clocks (see p. 179); 1703–1720.
——, **James,** admitted C.C., 1712.
Draycott, Francis, C.C., 1678.
Drew, John, admitted C.C., 1684.
——, **Edward,** admitted C.C., 1692.
Droeshout, John, admitted C.C., 1632.
Drossati, Samuel, C.C., 1675.
Drury, James, admitted C.C., 1694; master, 1728; 1694–1729.
——, **John,** admitted C.C., 1720.
——, **D.,** 32, Strand, 1775–1785.
——, **William,** 32, Strand, 1800–1825.
——, **J. F.,** 19, Clerkenwell Green, 1810.
Dryden, G., 30, Little Guildford Street, Brunswick Square, 1835.
Dubie, —, Paris, Court goldsmith, who resided in the Louvre, excelled in fine enamelled watch cases, 1640–1650.
Ducastel, Isaac, admitted C.C., 1703.
Duchen. In the B.M. is a watch by him, in a chased case by D. Cochin, 1730.
Duchesne, Claude, in Long Acre (of Paris), admitted C.C., 1693; maker of a square full-repeating bracket clock, inscription on back plate: "Claudius du Chesne, in Long Aker." Many other examples of his work are to be met with, 1693–1720.
Duck, H., London, about 1720.
Ducker, H., 3, South Place, Kennington Lane, 1835–1842.
Dudds, Joseph, 6, Coleman Street; livery, C.C., 1766–1772.
Dudson, Simon, Tower Street, C.C., 1653.
Duff, James, 24, Castle Street, Houndsditch, 1840–1842.
Dugard and Simpson, 34, Red Lion Street, Clerkenwell, 1830.
Dugdale, Richard, 12, Broad Street, 1800–1805.
Du Hamel, Isaac, known as a maker of bracket clocks, about 1790.
Duke, John, Fleet Street, maker of a watch in the B.M. (see p. 64), 1650.
——, **Joseph** (apprenticed to Markwick), admitted C.C., 1682.
——, **Joseph,** admitted C.C., 1728.
——, **George,** 8, St. John's Street, Clerkenwell, 1835–1842.
Dulin, W. T., 10, Cornhill, 1822–1830.
Duncan, James, 98, Chancery Lane, 1804–1810; 44, St. James's Street, 1815–1825.
——, **James,** 33, Old Bond Street, 1830.
Duncombe, Richard, master, C.C., 1798; 1785–1799.
Dunkerley, Samuel, 1770.
Dunkley, John, 88, Bethnal Green Road, 1835.
——, **Thomas,** 25, Galway Street, St. Luke's, 1840–1842.
Dunlop, Andrew, admitted C.C., 1701; known as a maker of long-case clocks, 1701–1720.
——, **Conyers,** Spring Gardens, Charing Cross, master of C.C. in 1758; 1747–1790.
Dunn, Henry, admitted C.C., 1677.
——, **Anthony,** admitted C.C., 1719.
——, **William,** 5, Charlton Place, Islington Green, 1835.
Duntnell, Daniel, 131, Oxford Street, 1783.
Dupin, Paul, London, maker of a

repeating watch in the Guildhall Museum; three cases, inner case engraved and pierced, enclosed in a richly chased one, by Moser; outer case of leather piqué; about 1700.

Duplock, Charles, 129, Borough, 1790–1815.

—— **and Wiggins**, 129, High Street, Borough, 1820–1830.

Dupont, à Castres, maker of a watch in the B.M.: about 1650.

——, **Peter**, 27, Ivy Lane, Newgate Street, 1759–1772.

——, **Charles**, Cockspur Street, Charing Cross, 1798–1800.

Duppa, James, 15, Aldgate Within, 1765–1770.

Durant, Oswald, petitioner for incorporation of C.C.; admitted 1632: warden in 1645; did not become master; 1630–1645.

Durdent, Andrew, admitted C.C., 1662.

Durley, T., 33, Northampton Street, Clerkenwell, 1835.

Durrant, Richard, 36, Museum Street, Bloomsbury, 1840–1842.

——, **Thomas**, near the Broadway, Hammersmith, 1840.

Durtnall, Daniel, 131, Oxford Street, 1780–1805.

Dutens, Peter, Leicester Square, 1759–1765.

Dutertre, Jean Baptiste, Paris, inventor of an escapement with two balances, 1724.

Dutton, William, 148, Fleet Street; liveryman, C.C., 1766–1790.

——, **M. and T.**, 148, Fleet Street; Matthew Dutton, master, C.C., 1800; 1798–1802.

——, **Matthew**, 148, Fleet Street, 1803–1842.

Duval, John, admitted C.C., 1677.

——, **Francis and John**, Warnford Court, Throgmorton Street, 1755–1765.

Dwerrihouse, Ogston, and Co., 27, Davies Street, Berkeley Square, 1835–1842.

—— **and Bell**, 131, Mount Street, 1840.

Dwerryhouse, John, Charles Street; hon. freeman, C.C., 1781–1790; 23, Berkeley Square, 1798; 1778–1800.

Dwerryhouse and Carter, 23, Berkeley Square, 1810; 27, Davis Street, 1823.

Dyde, Thomas, London, maker of lantern clocks, about 1670.

Dyer, Joseph, Addle Street, 1735–1740.

—— **and Newman**, 9, Lombard Street, 1768–1772.

Dyke, —, Exchange Alley, 1685.

Dymond, John, watch-case maker, Windmill Court, Smithfield, 1790.

Dyson, John, admitted C.C., 1694.

Eady, William, 14, West Street, Smithfield, 1800.

Eagle, John, admitted C.C., 1690.

Eagleton, Christopher, apprenticed to Charles Halstead, 1683. In the Guildhall Museum is a watch by him; silver case, silver dial, outer case tortoiseshell piqué; 1690–1710.

Earle, Thomas, admitted C.C., 1720.

Earnshaw, Thomas, 119, High Holborn, born 1749, died 1829 (see p. 132).

——, **Thomas, junior**, 87, Fenchurch Street, 1825–1842.

East, Edward, Pall Mall, 1632; Fleet Street later. One of the first assistants of C.C.; a very eminent maker (see p. 79); 1610–1673.

——, **Jeremy**, admitted as a brother, C.C., 1641; maker of a small oval watch, plain silver dial, one hand; possibly a son of Edward East, 1641–1680.

——, **Thomas**, admitted C.C., 1677.

——, **Peter**, admitted C.C., 1692.

——, **Edward**, apprenticed to D. Lyon and L. Clyatt, admitted C.C., 1696; 1696–1710.

——, **Edward, junior**, apprenticed to Thomas East; admitted C.C., 1709.

——, **Jordon**, son of Edward East; admitted C.C., 1720–1725.

Eastland, Thomas, London, known as a maker of repeating watches, about 1750.

Eastwick, Adrian, 102, Aldersgate Street, 1780–1785.

Eave, John, 8, Oxford Street, 1790.

Ebben, W., 37, Hedge Row, Islington, 1835–1842.

Ebsworth, John, a good maker. On

many full-sized lantern clocks with dolphin frets (originally with balances) is inscribed the address "At ye Cross Keys in Lothebury." On another clock is the address, "New Cheap Side;" C.C., 1665; master, 1697; 1665–1697.

Ebsworth, Christopher, C.C., 1670.

Eden, William, admitted C.C., 1726.

Edington and Son, 10, Portland Street, 1830.

Edkins, James, 2, High Street, Kensington, 1835–1842.

Edlin, John, admitted C.C., 1687.

——, **George,** 6, Aldgate Within, livery, C.C., 1810; 1800–1813.

Edlyne, Edgar, Nevill Alley, Fetter Lane, maker of a verge bracket clock, dome case and dial, engraved back; 1690–1710.

Edmunds, J., 14, Strand, 1825–1830.

Edwards, Isaac, admitted C.C., 1719.

——, **W. J.,** Coleman Street, 1783.

——, **William,** 4, Holborn, 1775–1783; 109, Cheapside, 1790.

——, **James,** 180, Fleet Street, 1790.

——, **William,** 26, New Bond Street, 1800.

——, **James,** 93, Wood Street, Cheapside, 1820–1825.

——, **Robert,** Great Sutton Street, 1820–1825.

——, **Benjamin,** 17, Shoreditch, 1830–1842.

——, **J.,** 4, Commercial Road, 1835.

——, **W., and Son,** 2, Theberton Street, Islington, 1835–1842.

——, **A.,** watch-cap maker, 14, Great Sutton Street, 1835.

Effington, John, admitted C.C., 1702.

Egleton, Christopher, apprenticed to Charles Halstead in 1683; admitted C.C., 1696.

Eiffe, James Sweetman, born 1800, died 1880; a clever chronometer maker, who for some time carried on business in Lombard Street. He invented a compensation balance very similar to that patented by Molyneux.

Eldridge, John, admitted C.C., 1677.

Eley, James, 11, Fenchurch Street, 1780–1785.

Elfin, Benjamin, admitted C.C., 1674.

Eliason, Daniel, 18, Leman Street, Goodman Fields, 1785–1790.

Elisha, Caleb, 3, Marylebone Street, Golden Square, 1820.

——, **Caleb,** 175, Piccadilly, 1835.

——, **Caleb,** 8, New Bond Street, 1842.

Elkins, William, admitted C.C., 1709.

Ellicott, John, 17, Sweeting's Alley, Cornhill, an eminent maker (see p. 107); 1728–1772.

——, **John, and Sons,** 17, Sweeting's Rents, 1769–1788.

—— **and Taylor,** Sweeting's Alley, Cornhill, 1810–1820.

——, **Edward, and Sons.** Edward Ellicott, master, C.C., 1834; 17, Sweeting's Alley, Cornhill, 1783–1834.

——, **and Smith,** 17, Sweeting's Alley, Cornhill, 1835, 1836.

—— **and Smith,** 27, Lombard Street, 1840–1842.

Elliott, Henry, admitted as a brother, C.C., 1688.

——, **James,** Oxford Street, 1780–1800.

—— **and Son,** 119, Oxford Street, 1805.

——, **John Moseley,** Aylesbury Street, Clerkenwell; patented a repeater (No. 2759) (see p. 249); 1790–1812.

Ellis, James, admitted C.C., 1667.

——, **Thomas,** admitted C.C., 1682.

——, **Paul,** admitted as a brother, C.C., 1682.

——, **John,** admitted C.C., 1726.

——, **Richard,** Westminster, maker of bracket quarter clocks, about 1790.

—— **and Collins,** 52, Strand, 1804.

——, **Michael,** 18, Bevis Marks, 1842.

Elliston, Robert, 12, Charles Street, Covent Garden, 1790.

Ellwood, John, admitted C.C., 1702; maker of long marqueterie case-clock, square dial, 1702–1725.

Elmes, William, admitted as a brother, C.C., 1667.

Elson, David, admitted as a brother, C.C., 1646.

Elton, John, admitted C.C., 1675.

Elwood, Martin, admitted as a brother, C.C., 1687; a watch by him in the Guildhall Museum, silver dial, curious tortoiseshell case inlaid with silver, 1680–1700.

Ely, James, 8, Soho Square, 1825.
Emanuel, Joel, Bevis Marks, 1812-1815.
——, **Lewis, and Son,** 36, Swan Street, Minories, 1820-1842.
—— **Brothers,** 1, Bevis Marks, 1830.
Emery, Josiah, Charing Cross, livery, C.C., 1781; an eminent maker (see p. 262); a watch by him in the Guildhall Museum, ruby cylinder, helical balance-spring, compensation curb; 1770-1805.
Enderlin, —, maker of English clocks (see p. 111), 1720-1740.
Engall, Abraham, admitted as a brother, C.C., 1648.
Ennis, Edward, admitted C.C., 1658.
Enys, Edward, admitted C.C., 1684.
Erbury, Henry, admitted C.C., 1650.
Erhardt, J. C., maker of a watch, B.M., about 1700.
Eric, William, admitted C.C., 1730.
Ericke, Robert, admitted C.C., 1719.
Errington, F., Saville Row, Walworth, 1835.
Ester (Esther), Henry; a watch by him S.K.M.; another B.M. in the shape of a tulip, about 1600.
Eston, Edward, admitted C.C., 1708.
Etherington, George, Fleet Street, C.C., 1684; master, 1709; maker of long-case clocks, 1684-1710. "A Gold Minute Watch with a green Shagreen case, with gold studs, made by George Ethrington" (*London Gazette*, Dec. 25, 1689).
Etty, Marmaduke, C.C., 1716.
Evans, Thomas, admitted C.C., 1673.
——, **Henry,** admitted C.C., 1682.
——, **Thomas,** admitted C.C., 1718.
——, **Thomas,** admitted C.C., 1720.
——, **William,** 23, Aldgate Without, 1775.
——, **James and Son,** 7, Sweeting's Alley, 1770-1800.
Eve, John, 17, New North Street, Red Lion Square, 1842.
Everell, John, "by y^e^ new church in y^e^ Strand;" maker of a verge watch, square pillars, outer case of tortoiseshell, 1730-1760.
Exchagnet, Louis, Wilderness Row, 1790.
Exelby, James, St. John's Lane; C.C., 1718; known as a maker of long-case clocks; 1718-1730.
Exelby, George, 6, Red Lion Street, Clerkenwell, 1790.
Eyston, Edward, admitted C.C., 1659.
Eyre (Ewer), John, admitted C.C., 1703; maker of long-case and chime clocks, 1703-1720.

Facio, Nicholas, born at Basle, 1664, died in Worcester, 1753; introduced watch jewelling (patent No. 371, May, 1704), (see p. 231).
Fage, Edward, admitted C.C., 1667.
Faircloth, Thomas, C.C., 1660.
Fairey, John, 22, Ratcliff Highway, 1810-1842.
——, **Richard,** 150, Tooley Street, Borough, 1820-1842.
——, **Richard, junior,** 68, High Street, Borough, 1835.
Falkner, John, 153, Newman Street, Oxford Street, 1824-1828.
Falks, Robert, C.C., 1720-1725.
Farewell, John, C.C., 1695-1700.
Farmer, Thomas, admitted as a brother, C.C., 1647.
——, **Leonard.** Received £37 in 1617 for a clock and chimes and "twoe dyalls, and for a barrel and pricking thereof," from the churchwardens of St. Margaret's, Westminster.
——, **Thomas,** admitted C.C., 1653. In the St. Margaret's, Westminster, churchwardens' accounts for 1658 appears "Item to Mr. Farmer for making of the new diall on the westward of the church, as by his bill appeareth 14*l.* 10*s.*;" also, "Item to Mr. Farmer for a new diall at the west end of the church on the churchyard side, 7*l.*;" 1653-1660.
——, **Richard,** admitted C.C., 1684.
——, **Thomas,** admitted C.C., 1689.
——, **William,** 20, Hanover Street, 1800.
——, **G. W.,** 32, Tavistock Street, 1830.
Farquhar, W., 6, Up. East Smithfield, 1835-1842.
Farquharson, George, 66, Strand, 1775.
——, **George,** 421, Strand, 1780-1785.
Farran, Robert, watch-chain maker, 9, Moorfields, 1780-1783.
Farrend, B., 48, Cheapside, 1825.

Farrer, William, Pontefract, maker of one-day long-case clocks, about 1730.
Farrett, Richard, admitted C.C., 1670.
Faulkner, Edward, master, C.C., 1734; 1710–1735.
——, **William,** livery, C.C., 1787; 1770–1778.
Faux, John, Worship Street, Moorfields, 1780–1785.
Favey, Francis, 12, Wilderness Row, Goswell Street, 1785–1790.
—— **and Son,** 5, Corporation Row, Clerkenwell, 1804.
Favre, Henry, 27, Pall Mall, 1804–1815.
Fazy, John, 7, Red Lion Court, Fleet Street, 1780–1785.
Fearn, John, 114, Strand, 1800–1805; 10, Cornhill, 1813.
——, **J. G.,** 73, Strand, 1813; 22, Regent Street, 1840.
Fearon, Daniel, Fetter Lane, liveryman, C.C., 1776.
Feilder, Thomas, admitted C.C., 1689; master, 1715; 1689–1716.
Fell, William, admitted C.C., 1705.
——, **John,** admitted C.C., 1727.
Felter, Nicholas, admitted C.C., 1632.
——, **Thomas,** admitted C.C., 1709.
Fenn, Robert, admitted C.C., 1689.
——, **Daniel and Samuel,** 105, Newgate Street; D. Fenn master, C.C., 1766; 1760–1804.
——, **Samuel, and Sons,** 105, Newgate Street; S. Fenn, master, C.C., 1793; 1806–1815.
——, **Joseph,** 105, Newgate Street, master, C.C., 1842; 1830–1842.
Fennel, Richard, Kensington, maker of bracket clock, arch dial, bell top shape with handle, also a long mahogany case-clock, inscribed "R. Fennel, Kensington;" admitted C.C., 1679; 1676–1700.
Fenton, John, admitted C.C., 1662.
——, **Samuel,** 4, Goswell Place, Euston Square, 1840.
Ferguson, James, born 1710, died, and buried in Marylebone churchyard, 1776; astronomer and mechanician.
Ferment, John, admitted as a brother, C.C., 1679. Wood mentions a square pedestal watch by Ferment, 1670-1690.
Ferron, John, admitted C.C., 1692.
——, **Lewis,** London, maker of a long marqueterie case clock, pull chime quarters, angel and crown corners, about 1720.
Fetters, Henry, East Smithfield; free Blacksmiths', 1630; admitted, C.C., 1653; 1630–1653.
Fidgett, William, 3, Bell Court, Fenchurch Street, 1790–1825.
Fidley, George, 43, Ratcliff Highway, 1840.
Field, Daniel, 21, Red Lion Street, Clerkenwell, 1798.
Fielder, Thomas, London, about 1715.
Filton, Charles, admitted C.C., 1674.
Finch, John, admitted C.C., 1675; master, 1706; 1675–1707.
——, **Thomas,** admitted as a brother, C.C., 1676.
——, **William,** Kingston, admitted C.C., 1691; maker of long-case clocks, 1691–1720.
——, **Robert,** admitted C.C., 1691.
——, **Simon,** admitted C.C., 1706.
Findley, J., 5, Duke Street, 1820.
——, **George,** 43, Ratcliff Highway, 1835–1842.
Finelly, —, Aix, maker of a watch in the form of a pectoral cross, about 1560.
Finer, John, 5, Hatton Garden, 1791–1800.
——, **Thomas, and Nowland,** 5, Hatton Garden, 1800–1805; 48, High Holborn, 1808–1820.
——, **Horatio,** 48, High Holborn, 1840–1842.
Finnie, Henry, admitted C.C., 1728.
Fish, Henry (Henry Poisson?), 4, Sweeting's Alley, Royal Exchange; maker of a black bell-top case bracket clock, inscription on arch, "Henry Fish, Royall Exchange." A long-case clock in the S.K.M. and several other examples by him are extant; 1730–1775.
——, **John,** apprenticed to his mother, Mary, wife of William Fish; admitted C.C., 1766; 1760–1766.
——, **C. H.,** 13, Mill Street, Hanover Square, 1830–1835.
Fisher, Ebenezer, C.C., 1725.
——, **Joseph,** 2, Leicester Square, 1783–1800.

Fisher, Daniel, Bunhill Row, 1769–1772.

——, **Daniel, and Son,** 9, Worship Street, Finsbury, 1790–1804.

Fishwater, John, C.C., 1726.

Fitree, Samuel, Whitecross Street, 1790.

Fitter, John, admitted as a brother, C.C., 1685. Wood mentions a gold enamelled watch by Fitter, 1680–1700.

——, **Thomazon,** 37, St. John's Square, Clerkenwell, 1759–1783.

Flack, G., 9, Princess Street, Drury Lane, 1820.

Fladgate and Wilder, Conduit Street, Hanover Square, 1765.

——, **John,** Conduit Street, Hanover Square; hon. freeman, C.C., 1781. In the B.M. is a small clock by him, brass dial with arch, cherub corners, minute hand; 1770–1790.

Flaig, Robert, and Co., wooden clock-maker, 39, Kingsland Road, 1840.

Flashman, George, 18, Fleet Street, 1790–1813.

Fleetwood, Robert, Featherstone Buildings, Holborn, in 1760; 13, Abchurch Lane, 1776; liveryman, C.C., 1760–1790.

——, **John,** Dorrington Street, 1790.

Fleming, Andrew, C.C., 1725.

Fletcher, Daniel, admitted as a brother, C.C., 1646.

——, **Thomas,** in St. Martin's; admitted as a brother, C.C., 1676; threatened with prosecution by C.C. for undue taking of apprentices, 1682; 1672–1682.

——, **Edward,** admitted C.C., 1697.

——, **Charles,** 29, Marylebone Street, Piccadilly, 1840–1842.

——, **M.,** 25, Charlotte Street, Fitzroy Square, 1835.

——, **John.** Originally a Lancashire pinion maker, he started in London as a chronometer escapement maker, and afterwards manufactured unsprung marine chronometers for the trade at 14, Chapel Street, Liverpool Road. During a period of depression in the chronometer trade, Fletcher bought the business of Dwerrihouse in Davies Street, Berkeley Square, which he carried on for a year or two. But as a West End shopkeeper he was quite out of his element, and in looking out for a more congenial sphere of action he learnt that Eiffe, who had made for himself a name as a chronometer maker in Lombard Street, was anxious to retire, John Fletcher made arrangements to take over Eiffe's shop. In Lombard Street Fletcher was most successful. He learnt springing from William Cribb, and settled down as a chronometer maker, springing and adjusting his own work. When the lease of the premises in Lombard Street expired, he bought the business of Cummins, at 148, Leadenhall Street, and having by this time also established a reputation of his own, he did a very flourishing business there for many years. As age crept on him he gave up the more active superintendence of his business, which declined; and after removing from 148, which was pulled down, to 99, Leadenhall Street, and again to Billiter Street, he finally retired about 1880, and died in 1882, aged 80.

Fleurian, Esaye, maker of a clock in marqueterie case, Queen Anne style, *temp.* about 1705.

Flockhart, Andrew, 5, King Street, Covent Garden, 1820–1835.

Floden, Will am, 20, Skinner Street, and Coburg Street, Clerkenwell, 1835.

Flood, Humphrey, received £220 for a clock "covered with gold and set with rubies and diamonds, delivered to his Majesty's use" (James I.), 1607–1617.

Flook, J., London, maker of bracket clocks, about 1750.

Flower, Thomas, admitted C.C., 1730.

——, **Edward,** Rolls Buildings, Fetter Lane, 1769–1772.

Fogg, Hugh, near Exeter Change, Strand, 1765–1770.

Foilman, John, watch-glass maker, George Street, St. Martin's Lane, 1790.

Fole, Robert, admitted C.C., 1667.

Foote, William, admitted C.C., 1726.

Forbes, John, 122, Leadenhall Street, 1835.

Ford, William, admitted as a brother, C.C., 1770.

——, **Thomas,** admitted C.C., 1724.

—— **and Simmons,** 16, King Street, Seven Dials, 1842.

Fordham, Thomas, admitted as a brother, C.C., 1689.

Foreman, Francis, St. Paul's Gate, petitioner to Charles I. for incorporation of C.C., and one of the first assistants of C.C.; maker of a lantern clock; 1629–1649.

——, **Michael,** livery, C.C., 1810; 1800–1811.

Forfard, Augustin, Sedan, maker of an oval watch, about 1650.

Forgat, —. "A round brass clock, the Box well gilt and pearced all over, in a leather Case, the name *Forgat*" (*London Gazette,* March 29, April 1, 1680).

Forrest, Joseph, admitted C.C., 1692.

Forsaict, N., Paris, maker of an octagonal watch presented to John Knox by Mary Queen of Scots, 1550–1560.

Forster, William, admitted as a brother, C.C., 1681.

——, **Clement,** admitted C.C., 1682.

——, **John,** apprenticed to D. Quare; admitted C.C., 1689.

——, **John,** admitted C.C., 1726.

Forsyth, James, Albion Buildings, Bartholomew Close, 1790.

Forte, John, admitted C.C., 1672.

Foss, Thomas, 131, Strand, maker of 8-bell chime clock, brass dial, with strike-silent, silvered circles at top, and in Chippendale case, 1780–1795.

Foster, Joseph, Exchange Alley, admitted C.C., 1691.

Fowde, John, admitted as a brother, C.C., 1653.

Fowkes, Gabriel, Dartford, maker of long Oriental lacquer case, with picture in centre of door, arch dial, engraved silver centre, flower and scroll corners, about 1750.

Fowlds, Andrew, 9, St. John's Street, 1790.

Fowll, Edward, admitted as a brother, C.C., 1670.

Fox, Charles, admitted C.C., 1662.

Fox, Mordecai, admitted as a brother, C.C., 1689.

——, **Isaac,** 39, Minories, 1772; 7, Great Prescot Street, 1782; 1772–1790.

—— **and Son,** 7, Magdalen Buildings, Prescot Street, 1788.

——, **Thomas,** 131, Strand, 1790.

Framborough, Edward, admitted as a brother, C.C., 1689.

Francis, Bulmer, admitted C.C., 1731.

——, **William,** 15, King Street, Clerkenwell, livery, C.C., 1810; 1805–1840.

Franklin, William, C.C., 1712.

——, **William,** admitted C.C., 1731.

——, **William,** watch shagreen-case maker, Shoe Lane, 1790.

Frearson, John, admitted C.C., 1689.

Freeman, Stafford, C.C., 1664.

——, **John,** C.C., 1646–1680.

——, **Thomas,** admitted C.C, 1698.

——, **James,** admitted C.C., 1719.

——, **Nathaniel,** 26, Upper King Street, Bloomsbury, 1840–1842.

French, John, 21, Tavistock Street, 1783–1788.

——, **James,** 17, Castle Street, Holborn, and 21, Tavistock Street, 1810.

——, **James Morre,** 15, Sweeting's Alley, 1812–1835.

Frencham, James, C.C., 1698.

Freshfield, James, admitted by redemption, C.C., 1774; letter as to non-payment of quarterage, 1796; 1774–1800.

——, **James William,** son of the foregoing, admitted C.C., 1801.

Frippett, John, admitted as a brother, C.C., 1665–1670.

Frisby, J., 5, Duke Street, Grosvenor Square, 1820–1825.

Frisquet, Peter, 30. Lothbury, 1768–1775.

Frodsham, William, and Son, Kingsgate Street, 1790.

——, **John,** 12, Kingsgate Street, 1813.

——, **William James,** Change Alley, F.R.S.; master, C.C., 1836, 1837; died 1850. Some time in partnership with William Parkinson; bequeathed £1000 to C.C., to be known as the Parkinson and Frodsham Charity, 1802–1850.

Frodsham and Baker, 12, Kingsgate Street, Bloomsbury, 1810.
——, **John, and Son,** 38, Gracechurch Street, 1835-1842.
——, **Charles,** born 1810, died 1871; a skilful and successful watchmaker, 7, Finsbury Pavement, 1842; afterwards succeeded J. R. Arnold, at 84, Strand. He conducted many experiments with a view of elucidating the principles underlying the action of the compensation balance and the balance spring, and wrote several valuable technical works. He was for some time a vice-president of the Horological Institute; master, C.C., 1855-1862.
Fromanteel, Ahasuerus, East Smithfield; Blacksmiths' Company, 1630; C.C., 1632 (see p. 101); 1630-1650.
——, **Ahasuerus,** Moses Alley, Bankside, admitted C.C., 1655-1670.
——, **Ahasuerus,** Ye Mermaid at Lothbury and Moses Alley, Bankside; apprenticed to Simon Bartram; C.C., 1663-1675.
——, **John,** Ye Mermaid at Lothbury, apprenticed to Thomas Loomes; admitted C.C., 1663-1680.
——, **Abraham,** son of Ahasuerus Fromanteel; admitted C.C., 1680-1690.
Fry, Edward, 13, Park Side, Knightsbridge, 1835.
Fryer, William James, 50, Cheapside, 1842.
Fulkener, Edward, C.C., 1702.
Fuller, William, admitted C.C., 1675.
——, **Samuel,** 64, Red Lion Street, Clerkenwell, 1824-1840.
Furness, John, 9, Cross Street, Hatton Garden, 1830.
Furnesse, Thomas, near Three Compasses, Gravel Lane, 1701.
Furnifull, Richard, C.C., 1722.
Furnis, Thomas, 25, Crawford Street, 1840-1842.
Fury, Flack, admitted C.C., 1658.

Gale, James, 64, Cannon Street, 1783-1789.
——, **John,** Lamb Street, Spitalfields, 1800-1842.
Gambell, Thomas, C.C., 1656.
Gammage, I., musical clockmaker, 6, Bridgewater Square, 1823; 8, Wood Street, Goswell Road, 1835-1842.
Gamp, P. J., wood clockmaker, 28, Hatton Wall, 1835.
General, Aug., 7, Baker Street, Clerkenwell, 1835.
Ganter, J., 39, Marshall Street, London Road, 1835.
Ganthony, Richard, 27, Cannon Street, 1803; 29, Lombard Street, 1807; 88, Cheapside, 1825; master, C.C., 1828, 1829; 1803-1842.
Gany, Thomas, admitted C.C., 1699.
Garden, William, C.C., 1712.
——, **Philip,** St. Paul's Churchyard, 1759.
Gardener, John, admitted C.C., 1682.
——, **Henry,** 36, Norton Folgate, 1794-1804.
Gardiner, John, Croydon, admitted as a brother, C.C., 1687.
——, **Henry,** Rolls Buildings, Fetter Lane, 1759, 1760.
Gardner, Thomas, admitted as a brother, C.C., 1689.
——, **William Obadiah,** C.C., 1711.
——, **William,** Sandwich, maker of a walnut long-case clock and dial, about 1760.
Garfoot, William, C.C., 1680.
Garland, John, Barbican, liveryman, C.C., 1776; 1766-1798.
Garle, Thomas, Bennett Hill, liveryman, C.C.; master, 1769; 1760-1776.
Garnard, R., 31, Panton Street, Haymarket, 1830.
Garon, —, London. In the B.M. is a watch of his, with day of the month circle, 1680-1690.
Garrat, William, Ormskirk, maker of watches with Debaufre's deadbeat escapement, 1775-1800.
Garret, Ferdinando, maker of an early English watch, ornamented with a Tudor rose, in the B.M., about 1590. "A small eight square Watch, the edges Brass, and the Cover and Bottom silver, made by Ferdinando Garet" (*London Gazette*, March 29, April 1, 1680).
Garrett, Charles, admitted C.C., 1690.
——, **Charles,** admitted C.C., 1720.
——, **William,** 188, Wapping, 1804-1815.

Garron, Peter, admitted C.C., 1694.

——, **Peter**, "Bankrupt" (*London Gazette*, October 31, November 4, 1706).

Garth, John, Aylesbury Street, Clerkenwell, 1750–1755.

Gascoigne, Samuel. "Lost, between Ludgate and Lothbury, on the 8th instant, a pendulum watch in a Tortoise-shell Case, with a steel Chain and 2 Swiffles; made by Samuel Gascoigne" (*London Gazette*, July 14–18, 1692); C.C., 1676.

Gass, David, and Co., 42, Oxford Street, 1810–1823.

Gathercole, John, London, maker of a bracket clock, silvered arch dial, about 1780.

Gaudron, à Paris, clockmaker of repute, spoken of as an authority by Lepaute, 1710–1730.

Gaunt, William, 2, Bridgewater Gardens, 1840–1842.

Gavelle, James (alien), maker of a clock with square dial, boy and crown corners, "James Gavelle, Londini, fecit," on circle; admitted as a brother, C.C., 1683; 1683–1700.

Gaze, Samuel B., a well-known clockmaker, 26, Princes Street, Spitalfields, 1820–1842.

——, **Peter**, Liverpool Road, son of the above, died 1882, aged 73.

Gefael, U., 28, Langley Place, Commercial Road, 1835–1842.

Gells, Thomas, admitted C.C., 1720.

George, Richard, C.C., 1681.

Gernon, Bernard, apprenticed to Solomon Wagson, of Bristol; admitted C.C., 1659.

Gibbard, Thomas, Quakers' Buildings, 1780–1785.

Gibbons, Richard, C.C., 1730.

——, **Benjamin**, C.C., 1750–1770.

——, **Joshua**, 45, White Street, Borough, 1810–1815.

——, **John**, King Street, Clerkenwell, 1815–1823; 64, Hatton Garden, 1836–1842.

Gibbs, Walter, admitted C.C., 1648.

——, **Thomas**, admitted C.C., 1681; master, 1711; 1681–1712.

——, **William**, admitted C.C., 1707; maker of a pair-case verge watch, repoussé case, 1707–1720.

Gibbs, Thomas, 11, Nichol Square, Aldersgate Street, 1825.

——, **George**, 38, Banner Street, 1835–1842.

Gibson, James, admitted as a brother, C.C., 1670.

—— **and Faust**, 5, Charlotte Street, Rathbone Place, 1800.

——, **Edward**, livery, C.C., 1787; master, 1802; 1780–1803.

——, **John**, Whalebone Court, Lothbury, 1761–1813.

——, **C.**, 71, Bishopsgate Within, 1830.

Gideon, Robert, admitted C.C., 1691.

Gifford, Thomas, C.C., 1693.

Gilbert, Faustin, C.C., 1661.

——, **William**, admitted C.C., 1695.

——, **Charles**, admitted C.C., 1700.

——, **Philip**, 20, Cockspur Street, 1820; 5, St. James's Square, 1830; 1820–1830.

Gildchrist, Archibald, C.C., 1729.

——, **Sterling**, Lombard Street, 1755–1765.

Gilkes, Richard, C.C., 1686.

Gill, John, admitted C.C., 1707.

——, **John**, Gracechurch Street, 1760–1765.

Giller, C., Berne, maker of an oval watch, about 1650.

Gilpin, Edmund, petitioner for incorporation of C.C., 1630–1665.

Gingner, Anthony (French), admitted as a brother, C.C., 1687.

Ginn, William, freeman, C.C., 1699.

Girod, Gasper, an astronomical watch by him in B.M., about 1610.

——, **James** (French), admitted C.C., 1693.

Gladstone, Thomas, C.C., 1703.

Glanville, Richard, Strand, 1775.

Glass, Alexander, 306, High Holborn, 1783.

Glazier, William, C.C., 1666.

Gleave, Matthew, a watch by him in Guildhall Museum, 1700.

Glenny, —, watch-case maker, 20, Red Lion Street, Clerkenwell, 1810.

——, **Joseph**, livery, C.C., 1810; 1800–1811.

Glover, Samuel, admitted C.C., 1694.

——, **Daniel**, admitted C.C., 1699.

——, **John**, admitted C.C., 1700.

——, **Richard**, admitted C.C., 1703.

Glover, Boyer, died while serving as senior warden, C.C., 1740-1768.
——, —, watch-spring maker, 81, Aldersgate Street, 1800-1805.
——, **J.**, 9, May's Buildings, St. Martin's Lane, 1835.
Glynn, Richard, admitted C.C., 1705.
Gobert, Peter (French), admitted as a brother, C.C., 1687.
Godbed, William, Lombard Street, maker of a watch at the B.M., about 1640.
Goddard, John, Hounsditch (from Paris), described as a Papist who resided with and worked for Isaac Sunes in Hounsditch, 1615-1618.
——, **Benjamin,** admitted C.C., 1701.
——, **Nicholas,** Newark, maker of lantern clocks, 1700-1720.
——, **Benjamin,** admitted C.C., 1727.
——, **F.**, 6, Rathbone Place, 1794-1825.
——, **T.**, 20, New Gloucester Street, Hoxton, 1835.
Godfrey, Henry, admitted as a brother, C.C., 1685. "A pretty large sized Pendulum-watch in a Tortoiseshell-Case; it shews the Hours and Minutes with a Sun and Moon Dial Plate, made by Henry Godfrey, London" (*London Gazette*, October 7-10, 1700).
——, **George,** 22, Charterhouse Street, 1835.
Godney, J., 4, St. James's Street, 1825.
Godwin, John, 161, Strand, 1800-1805; 304, Holborn, 1820-1842.
Gold, John, 118, Fleet Street, 1806-1813.
Golding, J., 55, Cornhill, 1775.
Goldsmith, John, C.C., 1681.
——, **William,** admitted C.C., 1719.
——, **John,** admitted C.C., 1720.
Golledge, Richard, Stratford, 1835.
Gom, David, Lyons, maker of a watch cased in jacinths, about 1650.
Gont, William, 6, Norman Street, Old Street, 1790-1795.
Gooch and Harper, 12, Red Lion Street, Clerkenwell, 1810-1813.
——, **Albert,** 13, Red Lion Street, Clerkenwell, 1825.
——, **H.**, 25, Coppice Row, Clerkenwell, 1830.
Good, John, author of "The Art of Shadows; or, Universal Dialling," 2nd edition, London, 1711; admitted C.C., 1678.
Good, John, 305, High Holborn, 1780-1785.
Goodchild, John, admitted C.C., 1726.
Goode, Charles, admitted as a brother C.C., 1686.
Goodhugh, R. and B., 2, Welbeck Street, Cavendish Square, 1825-1835.
——, **William,** 126, Regent Street, 1825.
——, **Richard,** 32, Edward Street, Portman Square, from 2, Welbeck Street, Cavendish Square, 1840-1842.
Goodlad, Richard, admitted as a brother, C.C., 1689.
Goodman, J., and Son, 1, New Chappel Place, Kentish Town, 1840-1842.
Goodrich, Simon, received a reward from the Society of Arts, in 1799, for an improved escapement, 1790-1800.
Goodwin, John, 70, Strand, 1770-1775.
——, **James,** watch and clock enameller, 37, Red Lion Street, Clerkenwell, 1810-1840.
Goodyear, John, admitted C.C., 1722.
——, **Joseph,** admitted C.C., 1732.
Gordon, John, admitted C.C., 1698; maker of a bracket clock, black case, arch dial inscribed "John Gordon, London," on oval silvered plate, 1698-1712.
——, **William,** 15, Cross Street, Islington, 1794-1805.
——, **Theodore,** Great James Street, Bedford Row; born at Barbadoes, apprenticed in Aberdeen; horizontal and duplex escapement maker, also assistant of B. L. Vulliamy, sometime editor of the *Horological Journal;* died 1870, aged 81.
Gorham, James, 5, High Street, Kensington, 1835-1842.
Gosling, Richard, and Son, 55, Cornhill, 1765-1775.
——, **Joseph,** 55, Cornhill, 1780-1785.
——, **Robert,** 160, Fenchurch Street, 1770-1785.
Goss, Jeremiah, admitted C.C., 1667.
Goubert, James, admitted as a brother, C.C., 1890.

Gough, William, London, a watch by him in the Guildhall Museum, about 1760.

Gougy, Pierre Frederick, patented in 1839 (No. 8308) a supplementary second hand, so adjusted by mechanism that it may be stopped while the other second hand is going, and on being set free will recover its original position, and rotate as before along with the other, 1839.

Goujon, Samuel, 42, Newgate Street, master, C.C., 1760; 1752–1788.

Gould, Christopher, admitted as a brother, C.C., 1682. "Supposed to be drop'd in a Hackney coach on the 4th inst., a gold watch in a black shagreen case, made by C. Gold, the word 'Friendship' graved on the Movement" (*London Gazette*, March 18-21, 1694).

——, **Abel,** admitted C.C., 1683. "Lost on the 28th inst., a gold watch with two movements, having a black filagreen case studded like shells, made by Abel Gold" (*London Gazette*, March 26–30, 1691).

Goulon, à Paris. *See* Crofts.

Gout, Ralph, 6, Norman Street, Old Street, 1770–1772; 122, Birchin Lane, 1815. He patented in 1799 (No. 2351) apparatus for recording the paces made by man or horse, also an application of the invention for recording the revolutions made by the wheels of a carriage.

——, **David Ralph,** 122, Bunhill Row, 1830–1842.

Gowerth, John, Oxford, 1701.

Gowland, James, 11, Leathersellers' Buildings, London Wall, 1835; London Wall, 1860. In 1837 he patented (No. 7456) a device for communicating motion to a balance through the balance spring.

——, **Thomas,** 15, Bishopsgate Without, 1834; Leadenhall Street, 1838; 1834–1842.

Grafton, John (*alias* **Solomons**). In 1831, on the passing of an Act of Common Council, permitting the admission of Jews to the freedom, C.C., withdrew opposition to his election.

Grafton, J. and E., 42, Coleman Street, 1834; 81, Fleet Street, 1838; 1834–1842.

——, **Henry,** 18, Barbican, 1840.

Graham, George, "Honest George Graham," a most eminent clock and watchmaker (see pp. 89–97); 1694–1751.

——, **James,** 85, Piccadilly, 1800–1805.

Grand, John, 3, Cockspur Street, 1800.

Granger, Richard, C.C., 1695.

Grant, John, 75, Fleet Street; apprenticed to Alexander Cumming, whose nephew he was. Hon. freeman, C.C., 1781; warden, 1810. Several specimens of his work are in the Guildhall Museum; 1770–1810.

——, **John,** 75, Fleet Street, son of the preceding, and an equally celebrated maker; admitted C.C., 1817; master five times, 1838–1867; 1810–1870.

——, **Jesse,** 16, Woodstock Street, 1830.

—— **and Terry,** 35, Prince's Street, 1840.

——, **Henry,** 9, Finch Lane, 1835.

——, **William,** 36, Haymarket, 1835.

Grape, John, London, a watch by him in the Guildhall Museum, 1737.

Grave, G., 271, Whitechapel Road, 1835–1842.

Gravell and Tolkein, 49, St. John Street, 1790–1820.

——, **William, and Son,** 49, St. John Street, 1820; 29, Charterhouse Square; W. Gravell, master, C.C., 1840; 1835–1850.

Graves, Henry, 25, Goswell Terrace, 1835.

——, **Benjamin,** admitted as a brother, C.C., 1676; master, 1705; 1670–1706.

Gray, Timothy, admitted as a brother, C.C., 1633.

——, **Benjamin,** Pall Mall, clockmaker to George II. (see p. 133). In the Guildhall Museum is a gold repeating watch by him, which was made for Sir Peter Somes in 1732; 1720–1760.

—— **and Vulliamy,** Pall Mall (see p. 133), 1746–1760.

Gray, Thomas, 25, Strand, 1780–1785.
—— **T. J. and G.,** 25, Strand, 1800–1805.
——, **William,** 13, New Bond Street, 1800–1813.
——, **G. and W.,** 114, Fleet Street, 1830.
Graye, —, subscribed £2 10*s.* for incorporation of C.C., 1630.
Grayhurst, P. and M., 65, Strand, 1785–1800.
—— **and Harvey,** 65, Strand, 1810–1830.
——, **Harvey, Denton, and Co.,** 64, Strand, and 128, Regent Street, 1835–1840.
Greatorex, Henry, admitted C.C., 1711. In the *Postman*, 1710, is an advertisement for a silver pendulum watch, lost in White Conduit Fields, for which Mr. Greatorex at Bushby's Folly offers a guinea reward, 1710–1711.
Greatrex, Ralph, admitted C.C., 1653.
Greaves, Samuel, London, maker of marqueterie long-case clock, square dial, about 1720.
Green, James, admitted C.C., 1664; maker of lantern clock with handsomely chased dial, 1664–1682.
——, **Joseph,** admitted C.C., 1723.
——, **Margaret,** St. Martin's Court, Leicester Square, 1765–1771.
—— **and Aldridge,** 62, St. Martin's Le Grand, 1765–1785.
—— **and Bentley,** makers of a very complicated long-case musical and astronomical clock, about 1790.
——, **James,** 5, Fenchurch Street, 1775; master of C.C., 1784; 8, Philpot Lane, 1794.
——, **Samuel,** 112, Bunhill Row, 1794–1800.
——, **Ward, and Green,** Pall Mall, 1830.
——, **J., and Son,** 94, Hatton Garden, 1830.
——, **Henry,** 10, Quebec Street, 1835–1842.
——, **Thomas,** 30, Rahere Street, 1835; 9, Lower Ashby Street, Northampton Square, 1842; 1835–1842.
Greenaway, Richard, C.C., 1718.
——, **John,** 54, Bath Street, St. Luke's, 1842.
Greenaway, John, 4, St. John's Square, 1842.
Greene, James, admitted C.C., 1685.
——, **John,** admitted C.C., 1711.
Greenhill, Joseph, 36, Strand, 1775–1800.
——, **Charles,** watch-key maker, 12, Great Sutton Street, 1842.
Gregg, Francis, apprenticed to John Clowes, 1691. In the Guildhall Museum is a bell repeating watch by him, silver cap, 1698–1710.
Gregory, Jeremie, at y^e^ Royal Exchange, admitted C.C., 1652; master, 1665, 1676; died 1685; a good maker of lantern clocks. In the *London Gazette*, October 13, 1678, he advertises for a Nester Holmes, aged 18, a runaway apprentice, 1652–1685. "A silver watch with a String, made by Jeremiah Gregory, showing the days of the month; the Box engraven with the King's Picture in the bottom" (*London Gazette*, March 29, April 1, 1680).
——, **Thomas,** admitted C.C., 1671.
——, **Robert,** admitted C.C., 1678.
——, **Jeremiah,** admitted C.C., 1694.
Gregson, —, Paris, Horloger du Roy, maker of a watch, case finely enamelled, medallion with figure painting in centre, surrounded by a border of royal blue, 1780–1790.
——, **John,** watchmaker to the Prince of Wales, 36, Bruton Street, Hanover Square, 1794–1800.
—— **and Jefferson,** 36, Bruton Street, 1800–1805.
Grendon, Henry, at y^e^ Royal Exchange; a crystal case irregular octagon-shaped watch by him in the S.K.M., about 1660.
Grennell, Richard, maker of a fine long-case clock, about 1750.
Gretton, William, of Black Fryers, probably a relative of Charles Gretton, C.C., 1671; 1671–1695.
——, **Charles,** Ship, Fleet Street, 1697, apprenticed to Lionel Wythe in 1662; master of C.C. in 1701; an eminent maker; example, a lantern clock, balance escapement, dolphin frets, one hand. To him was apprenticed the celebrated Henry Sully, about 1694; 1671–1701.

Grey, John, 68, Leadenhall Street, 1830.

Gribelin, A., Blois. In the B.M. is a watch by him, dated 1600.

Grice, Thomas, admitted C.C., 1675.

Griffin, John, admitted C.C., 1720.

—— and Adams, 70, Strand, 1800–1805.

——, G., 30, King Street, Clerkenwell, 1835.

——, F., 25, Gloucester Street, Clerkenwell, 1835.

Griffith, Robert, admitted C.C., 1706.

——, George, admitted C.C., 1720.

——, J. W., 15, Wentworth Place, Mile End Road, 1840–1842.

Griffiths, Edward, livery, C.C., 1810; 1800–1811.

—— and Son, 1, Ireland Row, Mile End Road, 1835.

Grignion, Daniel and Thomas, makers of a fine repeating watch with beautifully enamelled case, about 1700.

——, Thomas, 7, Great Russell Street, Covent Garden (see p. 191); a watch by him with a repoussé case in S.K.M., 1740–1784.

—— and Son, Russell Street, Covent Garden, 1775.

——, T., 7, Great Russell Street, Covent Garden, 1825.

Grimalde, Peter, 431, Strand, a celebrated chronometer maker, 1800–1810.

—— and Johnson, 431, Strand, 1815–1825.

Grimes, Thomas, admitted as a brother, C.C., 1671.

——, William, admitted C.C., 1682.

Grimley, William, C.C., 1694.

Grimshaw, William, senior, 130, Goswell Street; died 1851, aged 80.

——, James, 146, Goswell Street; died 1846, aged 43.

——, William, eldest son of W. Grimshaw, senior, Goswell Road; died 1853, aged 54.

——, Frederick, Goswell Road, (Grimshaw and Baxter), died 1893, aged 77.

Grimstead, Thomas, St. Paul's Churchyard, 1757–1763.

Grindley, William, 32, Crown Street, Moorfield, 1820.

Grinken, Robert, admitted C.C., 1632; master, 1648, 1654. In the B.M. are specimens of his work, one an oval watch with outer case of leather piqué. He died 1660; 1620–1660.

Grizell, John, admitted C.C., 1687.

Grohe, James, 40, Wigmore Street, 1834; 7, Wigmore Street, 1840; 1834–1842.

Grollier de Serviere, Nicholas, born at Lyons in 1596, maker of many curious clocks and automata (see p. 158), 1618–1688.

Grose, Richard, admitted C.C., 1632.

Grosrey, Calestin, 25, Newgate Street, 1840–1842.

Grossmann, Moritz, Glashütte, Saxony; winner of the prize offered in 1863 by the British Horological Institute for the best essay on the lever escapement. A very capable horologist, died 1885; 1850–1885.

Grosvenor and Jone, 85, Wardour Street, 1815.

Grout, William, admitted C.C., 1660.

Grove, Thomas, admitted C.C., 1715.

——, George, admitted C.C., 1715.

——, Richard, 93, Wood Street; livery, C.C., 1757; 1770–1815.

Groves, George, 105, Bishopsgate Street, 1790–1795.

Gruet, —, a Swiss, inventor of fusee chain, 1664.

Guerint, Francis, Geneva, said to have inveuted engine turning, about 1790.

Guillaume, George, 16, Myddleton Square, 1842.

Gullock, Philip, 31, Minories, 1790–1795.

Gunter, R., Queen Street, May Fair, 1790–1795.

Gurden, Benjamin, and Son, 144, Wood Street, 1775.

Gutch, John, admitted C.C., 1673.

Gutheridge, William, C.C., 1728.

Gutteridge, John, 54, Coppice Row, Clerkenwell, 1835.

Guy, Henry, admitted C.C., 1702.

——, Charles, admitted C.C., 1714.

——, Samuel, London, maker of a fine long-case clock, decorated with Oriental lacquer work, about 1730.

——, Edward, 49, Rahere Street, Goswell Street, 1835; 19, Powell

Street, King's Square, 1842; 1835–1842.

Guye, Auguste, a pioneer of machine watchmaking in England; born 1835, died 1893.

Gwillim, Eli, admitted as a brother, C.C., 1648.

Gwinnell, J., 34, London Road, 1812–1815.

Habart, James, admitted as a brother, C.C., 1682.

Habrecht, Isaac, maker of the second Strasburg clock, and an elaborate clock now in the B.M. (see p.149), 1570–1589.

Hackett, Simon, Royal Exchange; admitted C.C., 1632; master, 1646, 1660. A specimen of his production is a watch with a movement one inch in diameter, pierced square pillars, gut to connect fusee and barrel, small and light balance, and no balance spring. The dial of metal with a raised hour-band, whose extreme diameter is three-quarters of an inch; outside of it an engraved border with the figure of a cherubim over the XII. Inside the hour-circle a view of Old London Bridge, tolerably well engraved. The case ornamented in high relief, and enclosed in an outer case of shagreen. The execution of the movement exceedingly rough, and on the top plate, partly hidden by the balance cock, an inscription, "Simon Hackett, of the Royall Exchannge, fecit," the form of the letters being as fanciful as the spelling; 1632–1665.

Hagger, James, Grove Hall Lane, maker of a square bracket-clock, Japanese case, cherub corners to dial, pull repeater, style about 1700.

Haines, Francis, admitted C.C., 1706.

——, **J.,** 49, Northampton Street, Clerkenwell, 1835.

Hair, George B., 129, High Street, Borough, 1835–1842.

Hale and Broadhurst, 81, Cheapside, 1800–1805.

Haley, Charles, 7, Wigmore Street; a celebrated maker, patentee of a remontoire escapement for chronometers (1796, No. 2132). He was one of the experts appointed by the select committee of the House of Commons to report on Mudge's chronometers in 1793; 1785–1800.

Haley and Milner, 7, Wigmore Street, Cavendish Square, 1800–1815.

—— **and Son,** 7, Wigmore Street, Cavendish Square, 1830.

Halked, Thomas, admitted C.C., 1702.

Halksworth, William, 58, Fleet Street, 1840–1842.

Hall, Ralph, admitted as a brother, C.C., 1638.

——, **Peter,** admitted as a brother, C.C., 1648.

——, **Edward,** admitted C.C., 1710.

——, **John,** maker of long-case clock, about 1730.

——, **C.,** 118, Chancery Lane, 1820.

——, **Charles,** 84½, Edgware Road, 1840.

Hallam, E., 15, Bateman's Row, Shoreditch, 1835.

Hallifax, John, Fleet Street, maker of chime clocks, 1760.

Halsey, George, admitted C.C., 1687.

Halstead, Richard, C.C., 1669.

——, **Charles,** admitted C.C., 1677.

——, **John,** admitted C.C., 1698.

——, **William,** admitted C.C., 1715.

Halsted, Robert, Fleet Street, C.C., 1668; master, 1699; 1688–1700.

Ham, John, 47, Skinner Street, Snowhill, 1820; 126, Newgate Street, 1835; 1820–1842.

Hambleton, George, C.C., 1669.

Hamilton, Richard, C.C., 1712.

Hamlet, T., 1 and 2, Prince's Street, Soho, maker of a gold horizontal watch for the Duke of Sussex, 1825–1830.

Hamley, J. O., 1, Warwick Place, Bedford Row, 1804–1810.

——, **J. O., and Son,** 284, Holborn, 1815.

——, **O.,** 22, Duke Street, St. James's Square, 1815.

——, **J. O.,** 24, Red Lion Street, Holborn, 1820–1840.

Hammon, J., 9, Northampton Square, Clerkenwell, 1840–1860.

Hammond, John, admitted C.C., 1680.

——, **and Co.,** 45, St. Martin's-le-Grand, 1768.

Hampton, W., and Sons, 77, Theobold's Road, 1842.
Hancock, Thomas, 17, Bond Street, 1830–1835
Hancorne, Thomas, admitted C.C., 1658; elected warden, 1683, but excused on paying a fine; 1658–1683.
——, **William,** admitted C.C., 1676.
Handcock, Edward, 23, Queen Street, Clerkenwell, 1842
Hande, Thomas. In the B.M. is an oval tulip-shaped watch by Thos. Hande, about 1700.
Handley and Moore, 39, Clerkenwell Close, 1800–1810.
Hanet, John and George, Porter Street, Leicester Fields, 1768.
Hanks, Benjamin, Litchfield, Connecticut, U.S.A., patentee of self-winding clock with air vanes, 1783.
Hannet, Samuel Stephen, London, maker of long-case clocks, about 1780.
Hansard, William, watch-spring maker, 6, King's Head Court, Holborn, 1790.
Hanslapp, Robert, C.C., 1653.
——, **William,** admitted C.C., 1603.
Hanson, Charles, 160, High Holborn, 1840–1842.
Hanush, —, maker of a clock for Prague Town Hall, about 1497.
Hanwell, Zachariah, admitted C.C., 1694, maker of a fine marqueterie long-case clock, straight pillars, square dial, cherub corners, "Z. Hanwell, Londini," on circle.
Happock, London, a maker of watches, about 1700.
Harbert, William, C.C., 1670.
Harbottle, Cornelius, C.C., 1667.
Harbud, J., watch-movement maker, 2, Green Terrace, 1835.
Harcourte, —, maker or repairer of clocks, near Westminster Abbey, 1469.
Harden, Charles, 120, Fleet Street, 1822–1825.
Harding, John, admitted as a brother, C.C., 1685.
——, **Francis,** admitted C.C., 1687.
——, **John,** admitted C.C., 1721.
——, **Robert,** London, 1753.
——, **Thomas, and Co.,** 43, Minories, 1760–1800.
Harding, Henry, 1 Holles Street, Cavendish Square, 1840.
Hardwidge, William, 53, Wapping, 1823.
Hardy, John, 8, Bridgewater Square, livery, C.C., 1776; 1760–1790.
——, **Joseph,** 26, Clement's Lane, Lombard Street, 1800.
——, **Thomas,** watch-case maker, 14, Rosoman Street, Clerkenwell, 1820.
——, **William,** 5, Wood Street, Coppice Row, Coldbath Square, Clerkenwell. A clockmaker of repute. Among other inventions he devised an escapement for clocks for which he in 1820 received from the Society of Arts the gold medal and fifty guineas (see p. 258), and a compensation balance (see p. 222), 1800–1830.
Hare, Alexander, 17, Grenville Street, Hatton Garden; a verge metal watch by him in the Guildhall Museum; 1794–1815.
Harker, George, master, C.C., 1852.
Harland, Theodore, Norwich, Conn., U.S.A.; to him was apprenticed Ely Terry in 1786.
Harlock, James, 7, Horseferry Road, Westminster, 1842.
Harlow, Samuel, Bolton, in 1789 patented (No. 1708) the Breguet or tipsy watch-key, in which the upper and lower portions are connected by means of a ratchet clutch kept in gear by a spring, so that the upper part will turn the lower part in the proper direction for winding, but if the upper part is turned in the opposite direction, the ratchet clutch slips without moving or straining the lower part of the key.
Harman, John, "watchmaker and astrologer," of Bloomsbury, 1753.
——, **George,** High Wycomb, maker of the chimes of Cripplegate Church, 1792.
Harmer, Jasper, near Smithfield Bars, cited by C.C. for exercising the art of clockmaker without having served seven years, 1685.
Harold, Richard, admitted C.C., 1690.
Harper, Henry, Cornhill, admitted C C., 1664. In 1688 at the Mayor's

Court some watch or pocket clock chains of steel belonging to him, and seized by C.C., were declared to be insufficient, and broken. He was the maker of a clock which stood in the hall of the Ironmongers' Company from about 1689 to 1889; another example is a long-case clock going for twenty-eight days; a gold watch by him mentioned in *London Gazette*, January 11–14, 1691; 1664–1708.

Harper, Thomas, assistant C.C., 1761, maker of a fine eight-day clock, Chippendale style of case, also of a watch in the Guildhall Museum, 1750–1761.

——, **John,** 1, Pear Tree Street, Goswell Street, 1810; 16, St. John Street, 1815; 78, Goswell Road, 1825; 1810–1825.

——, **Thomas,** 207, Fleet Street, 1800–1830.

Harrache, Thomas, Pall Mall, 1765–1775.

Harris, John, one of the first assistants, C.C., 1631; master, 1641; 1631–1655.

——, **John,** admitted C.C., 1659.

——, **Richard,** said to have been the maker of a pendulum clock for St. Paul's Church, Covent Garden, in 1641 (see p. 191); 1641.

——, **Thomas,** in y[e] Strand, maker of a good lantern clock, one hand, fret Fig. 104, inscribed, "Thomas Harris, in y[e] Strand," about 1680.

——, **John,** admitted as a brother, C.C., 1677; master, 1688; 1670–1689.

——, **Anthony,** admitted as a brother, C.C., 1683; known as a maker of lantern clocks, 1670–1690.

——, **John,** admitted as a brother, C.C., 1690.

——, **Francis William,** admitted C.C., 1702.

——, **Samuel,** admitted C.C., 1708.

——, **Christopher,** Lombard Street, admitted C.C., 1695; 1695–1720.

——, **Henry,** admitted C.C., 1711, maker of silver verge watch, silver dial, 1711–1720.

——, **William,** Temple Bar, liveryman, C.C., 1776.

——, **William,** 27, Goswell Street, master, C.C., 1830, 1832; 1790–1833.

Harris, Richard, 27, Old Jewry, 1790–1810.

——, **John,** 27, Old Jewry, 1800–1808.

——, **L.,** 9, Brown Lane, Spitalfields, 1810.

——, **H.,** 6, Susannah Place, Curtain Road, 1825.

——, **John,** 22, Gloucester Street, Clerkenwell, 1835.

——, **William,** watch-case maker, 21, Red Lion Street, Clerkenwell, 1835.

——, **Clement,** 76, Cornhill, 1825–1842.

——, **John James,** 11, Upper East Smithfield, 1840–1842.

Harrison, George, apprenticed to Johana May and Thomas Tompion, admitted C.C., 1698.

——, **William,** admitted C.C., 1699.

——, **Anthony,** Birchin Lane, admitted C.C., 1701. In 1721 appeared an advertisement respecting a small gold watch made by Anthony Harrison, and lost between Leadenhall and "Spittelfields" markets. The finder was offered nine guineas reward, and no questions asked, if the watch were restored to Mr. John Chadwell, goldsmith, Castle Alley, Birchin Lane, 1701–1720.

——, **John,** born 1693; died in Red Lion Square, and buried in Hampstead churchyard in 1776 (see p. 115).

——, **James,** Barrow, brother of the preceding; a long-case clock by him is in the Guildhall Museum, 1720–1750.

——, **William,** 48, Fetter Lane, 1790.

——, **Thomas,** 68, Fetter Lane, 1804.

——, **James,** Barton-on-Humber, a clockmaker of some celebrity, made a fine clock for Christ Church, Hull, 1810–1830.

——, **James,** Waterbury, Conn., U.S.A., founder of the Connecticut wooden clock industry, 1790–1830.

——, **Francis,** 91, Broad Street, Ratcliff, 1835–1841.

Harrys (Harris), Thomas, Water Lane, maker of the celebrated clock with figures on the front of Old St. Dunstan's Church, Fleet Street (see p. 138), 1671.

Harshell, D., 12, Bevis Marks, 1830.

Hart, Noe, admitted C.C., 1695.

——, **John**, admitted C.C., 1720.

——, **Henry**, admitted C.C., 1720.

——, **S. and M.**, 52, Prescot Street, Goodman's Fields, 1804–1810.

—— **and Harvey**, 5, King's Street, Finsbury, 1825.

——, **Napthali and Son**, 5, King's Street, 1835–1842.

——, **Maurice**, 6, Haydon Square, Minories, 1842.

Hartley, —, New Street, Shoe Lane, cited by the C.C. for trading in watches and clocks without having served seven years to the trade, 1680.

——, —, George Court, Red Lion Street, 1790.

Hartmans, John George, watchmaker to the University of Halle, 1756.

Hartnup, John, superintendent of Liverpool Observatory, Birkenhead. He invented a compensation balance, with an oblique rim (see p. 223), and tabulated the errors arising from the change of temperature in ordinary chronometers, 1840–1880.

Hartung, 61, St. Martin's Lane, 1840.

Harvey, Samuel, admitted C.C., 1696.

——, **Alexander**, admitted C.C., 1726.

——, **John**, 16, Fenchurch Street, 1798–1800; 3, Falcon Street, Falcon Square, 1815; 1798–1815.

—— **and Co.**, 2, King's Street, Finsbury, 1830.

——, **George**, 110, High Street, Whitechapel, 1830; 22, Cannon Street Road, 1840; 142, Ratcliff Highway, 1842; 1830–1842.

Harward, Robert, C.C., 1730.

Haskins, William, 79, Quadrant, Regent's Street, 1830.

Hasleden, Charles, 20, Waterloo Street, 1840.

Hassenius, James (alien), admitted as a brother, C.C., 1682.

Haswell, Alex, 10, Clifford Street, New Bond Street, 1790.

——, **A.**, 13, Skinner Street, Clerkenwell, 1835.

Haswell, A., 8, Woodbridge Street, Clerkenwell, 1840–1842.

——, **Robert**, 12, Upper Ashby Street, 1842, afterwards at 49, Spencer Street, Clerkenwell; died 1874, aged 58.

Hatch, John, admitted C.C., 1693.

Hatchman, James, C.C., 1680.

Hatton, Thomas, Lombard Street, watchmaker, and author of "Introduction to the Mechanical Part of Clock and Watch Work," published 1773; 1760–1774.

——, **James**, 45, St. Michael's Alley; livery, C.C., 1810; 1800–1812.

——, **Joseph York**, 40, Tooley Street; livery, C.C., 1800; St. Magnus, London Bridge, 1830.

—— **and Harris**, St. Michael's Alley, Cornhill, 1820.

——, **J.**, 15, Store Street, Bedford Square, 1835.

Hautefeuille, John (The Abbé), Paris, born 1647, died 1724. He is said to have invented, about 1722, the rack lever escapement, which was patented in England by Peter Litherland in 1794. Huygens, endeavouring to obtain a French patent for the balance spring, was successfully opposed by the Abbé, who claimed to be the prior inventor of it. 1668–1724.

Havelland and Stephens, 32, Aldgate High Street, 1794.

Hawes, John, 31, New Bond Street, 1775.

Hawkesbee, Benjamin, C.C., 1709.

Hawkesworth, John, C.C., 1709.

Hawkins, James, C.C., 1730.

——, **Thomas**, 6, Castle Alley, Cornhill, 1788–1810.

Hawley, John, 56, Frith Street, Soho, 1842.

Hay, Peter, 20, Davies Street, Berkeley Square, 1805–1840.

Hayden, William, C.C., 1717.

——, **John**, Deptford, maker of a long-case clock, about 1710.

Haydon, William, Croydon, admitted C.C., 1687.

Hayes, Walter, admitted C.C., 1654; master, 1680; 1654–1684.

——, **Edmond**, admitted C.C., 1682.

Hayford, Henry, 2, Star Alley, Fenchurch Street, 1842.

Hayley, William, 38, Great Marylebone Street, 1788–1793.
Haynes, John, admitted as a brother, C.C., 1676.
—— **and Kentish,** 18, Cornhill, 1804–1810.
Hayward, William, C.C., 1720.
——, **John,** 22, Bush Lane, Cannon Street, 1820.
——, **R. H.,** Thornton Street, Bermondsey, 1835.
——, **J.,** 2, Summers Court, Bishopsgate Without, 1835–1842.
Head, Thomas Cartwright, apprenticed to Christopher Gould in 1693; 1700.
Headworth, P., 55, John's Street, 1825–1842.
Heady, George, admitted C.C., 1682.
Heap, Richard, 5, King Street, Covent Garden, 1800–1304.
——, **Richard,** 1, Maiden Lane, Covent Garden, 1825.
Heathcock, Timothy, admitted as a brother. C.C., 1698.
Hebert, Anthony, "Moorefields, nere London," 1630.
Hebting, F., wooden clockmaker, 19, Moor Street, Soho, 1835.
Heckstetter, Joseph, admitted C.C., 1694.
Hedge, Nathaniel, Colchester, maker of lantern clocks, about 1740; also of a fine long-case clock, about 1780.
—— **and Banister,** Colchester, known as makers of long-case and other clocks, about 1800.
Hedger, George, 40, Great Sutton Street, 1835.
——, **George,** 10, St. John's Row, St. Luke's, 1842.
Hedges, John, 4, St. James's Walk, Clerkenwell, 1800.
Heffer, W., 2, George Street, Grosvenor Square, 1835.
Heitzman, F., and Co., 40, Norton Folgate, 1840.
Heizman, Matthew, 1, Charles Street, Soho Square, 1840.
Helden, Onesiphorus, admitted C.C.; warden, 1648; did not become master, 1630–1649.
Hele, Peter, Nuremberg, inventor of the mainspring (see p. 34); 1500.
Hellam, James, admitted C.C., 1689.
Heming, Thomas, 31, New Bond Street, 1769–1775.
——, **Artis,** Shadwell, liveryman, C.C., 1776.
—— **and Crawner,** New Bond Street, 1780–1790.
Hemmen, Edward, on verge watch, period about 1750.
Henche, Uldrich. Payment to him of £100 for a clock "in manner of a branch," made by him and set up at Whitehall, 1605.
Henderson, John, 13, Broad Street, Exchange, 1775; 21, Cornhill, 1783–1800.
——, **R.,** 18, Bridgewater Square, 1800–1805.
Hendricks, Aaron, Devonshire Street, 1760–1768.
Hennon, William, admitted C.C., 1674.
Henry, W. and S., 44, Taylor's Buildings, Islington, 1804.
——, **S.,** 59, Lower Brook Street, Grosvenor Square, 1810.
——, **S.,** 70, Leman Street, Goodman's Fields, 1830.
——, **Stephen,** 3, Berkeley Square, 1835–1840.
Henshaw, Walter, admitted C.C., 1670; master, 1695; 1670–1696.
——, **John,** admitted C.C., 1696.
Herant, Brothers, and Son, Berlin, makers of an enamelled watch, S.K.M., about 1680.
Herbert, Edward, C.C., 1664.
——, **Thomas,** Whitehall, C.C., 1676.
——, **Evan,** admitted C.C., 1691.
——, **Cornelius,** London Bridge, admitted C.C., 1699; master, 1727; 1699–1728.
——, **Edward,** admitted C.C., 1710.
——, **Henry,** admitted C.C., 1713.
Herman, Ignaz, 13, Compton Street, Clerkenwell, 1840.
Herring (Herren), Joshua, 38, Cornhill, known as a maker of bracket clocks, 1758–1775.
——, **John,** free, C.C., by redemption, 1770.
Hertford, John, admitted C.C., 1632.
Hesk, William, Horseferry Road, Westminster, 1835.
Hester, Henry, admitted C.C., 1670.
——, **Henry,** admitted C.C., 1687. "Lost in Whitehall, on Sunday,

the 26th past, a Gold Watch with a plain Outside Case, made by . . Hester, of West minster, with a ribbon tied to it of Changeable Purple and Gold, and upon that two Seals, the one an Onyx with a Head cut in it, set with small Diamonds; and the other Seal a Stone set with rubies. Whoever brings the said Watch, etc., to Mr. Snagg, Goldsmith, in Lombard St., shall have 5 guineas reward" (*London Gazette*, May 30, August 3, 1691).

Hewitt, Thomas, 12, Upper Ashby Street, and 10, King Street, Tower Hill, a chronometer maker who devised different forms of compensation balances; born 1812, died 1869.

——, **Benjamin,** admitted C.C., 1724.

——, **Alexander,** admitted C.C., 1725.

Hewkley, John, admitted C.C., 1732.

Heywood, William, 12, King Street, Covent Garden, 1807–1810.

——, **William,** 35, Goodge Street, Tottenham Court Road, 1835–1842.

Heyworth, John, 218, Tottenham Court Road, 1823.

Hibbert, John, 7, Jewry Street, Aldgate, 1840.

Hickling, John, 122, St. John's Street, Clerkenwell, 1835–1842.

Hickman, Joseph, 20, Bridgewater Square, 1779.

——, **W.,** 89, Borough, 1825.

Hicks, Thomas, admitted C.C., 1664. "Lost Sep. 21, betwixt Ingerstone and Rumford, a watch with a silver-pinned Case, showing the day of the month, the hour of the day, made by *Thomas Hicks, Londini*, with a blue taffety ribon fastened to the key thereof. Whoever will give notice thereof to Mr. Christopher Maynard, watchmaker at the Royal Exchange, London, shall have 40*s*. reward" (*London Gazette*, September 23–27, 1675).

——, **Thomas,** admitted C.C., 1666.

——, **John,** admitted C.C., 1694.

——, **James,** 112, Whitechapel, 1804–1815.

——, **Charles,** 112, Whitechapel, 1810.

Hickson, Thomas, C.C., 1690.

Higgins, Banger, C.C., 1724.

Higginson, Henry, C.C., 1662.

——, **Samuel,** admitted C.C., 1697. Hatton speaks of the splendid polish of the work of Higginson Brothers, watch finishers.

——, **John,** 27, Strand, 1790; 38, Southampton Street, Strand, 1798–1815.

Higgs, John, admitted C.C., 1661.

—— **Thomas,** admitted C.C., 1716.

——, **Robert and Peter,** 7, Sweeting's Alley; Peter Higgs was master, C.C., in 1767; 1750–1769.

—— **and Evans,** 7, Sweeting's Alley, Cornhill; a verge watch movement by them, with curious pillars, in the Guildhall Museum, 1786–1815.

Highfield, Josiah, 55, Rosoman Street, 1790.

Highmare, Edward, C.C., 1687.

Highmore, Jacob, 52, Aldersgate Street, 1790.

Hill, John, petitioner for incorporation of C.C., 1630.

——, **Benjamin,** admitted as a brother, C.C., 1641; master, 1657. In the B.M. are specimens of his work, one a watch with outer case of shagreen. He died 1670; 1640–1670.

——, **Francis,** admitted C.C., 1679.

——, **Thomas,** Fleet Street. His name was engraved, in conjunction with that of Henry Harper, on a long-case clock which stood in the hall of the Ironmongers' Company from about 1689 to 1889. There was also on the clock the further inscription, "The gift of John Woolfe, member of the Company."

——, **Edward,** admitted C.C., 1698.

——, **John,** admitted C.C., 1705.

——, **John,** Fleet Street, admitted C.C., 1731; 1731–1760.

——, **Thomas,** Aldersgate St., 1777–1786. Thomas Hill was the maker of a gold verge watch, embossed case, said to have belonged to Captain Cook.

——, **S. C.,** 5, Ball Alley, Lombard Street, 1800–1810.

—— **John,** 15, James Street, Covent Garden, 1820.

——, **Leonard,** 61, Fleet Street, 1823.

——, **Samuel,** 13, Hooper Street, Clerkenwell, 1842.

Hillcoat, William, 33, Queen Street, Cheapside, 1790.
Hilliard, G., 35, Queen Street, Cheapside, 1820.
Hillier, James, watch-glass maker, 12, Church Street, Spitalfields, 1790.
——, **James,** watch-glass maker, 11, Church Street, Spitalfields, 1804–1810.
Hills, Fleet Street, 1774.
Hillyard, William, C.C., 1679.
Hilton, John, apprenticed to Tompion, admitted C.C., 1698.
Hind, —, 96, Spa Road, 1790.
Hinde, Benjamin, musical clockmaker, 20, Banner Street, Clerkenwell, 1835–1840.
Hindley, John, maker of a clock at York Cathedral, 1752.
——, **Henry,** York, a clever clock and watchmaker, credited with the invention of the dividing plate for wheel-cutting engines, 1722–1771.
Hine, —, Fleet Street, 1774.
——, **John,** 68, Red Lion Street, Clerkenwell, 1790.
Hinton, J., 20, Tabernacle Row, Finsbury, 1835.
Hiorne, John, admitted C.C., 1707; master, 1744; 1707–1745.
Hiscocks, T., 9, Princes Street, Drury Lane, 1835.
——, **Zachariah,** 7, Little Russell Street, Covent Garden, 1840–1842.
Hislop, Robert, 53, Rosoman Street, Clerkenwell, 1840–1842.
——, **William,** 15, Rosoman Street, Clerkenwell, 1820; 96, St. John's Street Road, 1835–1872; he was some time hon. sec. and an active member of the governing body of the Horological Institute; he died in 1876; 1820–1876.
Hitchen, John, admitted C.C., 1720.
Hitchins, Joseph, Brown's Buildings, St. Mary Axé, 1779–1790.
Hobbs, James, Lambeth, 1830.
——, **James,** 142, Great Surrey Street, 1830.
Hobler, Paul, Porter Street, hon. freeman, C.C., 1781; 1780–1790.
Hobson, John, petitioner for incorporation of C.C., 1630.
——, **James,** 21, James Street, Oxford Street, 1835.
Hock, C., wooden clockmaker, 40, Charles Street, Hatton Garden, 1840.
Hochicorn, Isaac, C.C., 1728.
Hocker, John, admitted C.C., 1729.
Hoddle, John, admitted C.C., 1705.
Hodges, Nathaniel, in "Wine Office Courte, Fleete Street;" admitted as a brother, C.C., 1681; known as a maker of bracket clocks, 1680–1700.
——, **William,** admitted C.C., 1719.
——, **J.,** Beauvoir Place, Kingsland Road, 1835.
Hodgkin, Sarah, admitted C.C., 1699.
——, **Robert,** maker of an eight-day square dial clock, Queen Anne period, fine movement, inscribed, "Rob. Hodgkin, Londini," about 1805.
Hodsoll, William, 31, Primrose Street, Bishopsgate, 1800–1808.
——, **William,** 20, Ratcliff Row, City Road, 1842.
Hogan, J., watch-movement maker, 6, Badgers Yard, St. John's Street, 1820.
—— **and Smith,** watch-movement makers, 15, King Street, Clerkenwell, 1835.
Holdway, George, 302, Strand, 1779.
Hole, Henry, 11, Lisle Street, Leicester Square, 1810; 12, Kingsgate Street, Holborn, 1820–1823.
Holeyard, Samuel, admitted C.C., 1705.
Holland, George, petitioner for incorporation of C.C., 1630–1655
——, **Thomas,** admitted C.C., 1632; master, 1656; 1651.
——, **Thomas,** admitted C.C., 1658.
——, **Lewis,** admitted C.C., 1699.
——, **John,** 5, Bishopsgate Street Without, 1765–1775.
Hollier, Jonathan, Skinner Street, liveryman, C.C., 1776.
Holloway, Robert, admitted C.C., 1632.
——, **Edward,** admitted as a brother, C.C., 1650.
——, **William,** Cullum Street, admitted as a brother, C.C., 1697; 1695–1710.
Holmden, John, musical clockmaker, 50, King Street, Goswell Road, 1840.

Holmes, John, admitted C.C., 1697.
——, **John,** 156, Strand, near Somerset House, one of the experts appointed by the select committee of the House of Commons in 1763, to report on Mudge's timekeepers. In 1779 he made a clock for Greenwich Hospital: 1763-1810.
——, **Edward,** 9, Foster Lane, Cheapside, 1783–1788.
——, **William,** 12, Clerkenwell Green, 1783.
——, **M.,** 10, Shoemakers Row, Blackfriars, 1835-1842.
Honison, J., 5, Charlton Place, Islington Green, 1835.
Honeybone, Thomas, Old Brentford, 1840.
Hooke, A., maker of a silver gilt watch in the Fellows Collection at the B.M., inscribed, "A. Hooke, 1661."
——, **Robert,** born 1635, died 1703; invented the balance spring for watches and the anchor escapement for clocks (see p. 103).
——, **John,** admitted C.C., 1698.
Hope, Edward, Bridge Street, Strand, 1775; 97, Oxford Street, 1783; 1775-1785.
Hopgood, T. B., 202, Bishopsgate Without, 1823.
Hopkins, John, admitted C.C., 1641.
——, **John,** Fleet Street, 1753-1756.
——, **A.,** 32, Aldgate, 1823.
Hornblower, William. admitted C.C., 1713; maker of a long-case clock, Japanese decoration, arch dial, style about 1740; 1713-1750.
——, **William H.** (possibly a son of William), was beadle of C.C., 1779.
——, **William,** 9, Powell Street, King's Square, 1842.
Horne, Samuel, admitted C.C., 1654; master, 1672, 1673; 1654-1685.
——, **George Henry,** C.C., 1718.
——, **Henry,** master, C.C., 1750, 1768; 1750-1776.
——, **William,** 114, Ratcliffe Highway, 1835-1842.
Horseman, Stephen, was apprenticed to Daniel Quare, 1702, admitted C.C., 1709; Quare, prior to his death, seems to have taken Horseman into partnership, judging from examples with their joint names, including repeating clock watches, and a thirty-day clock, 1724-1740.
Hoskins and Bird, 11, St. John's Square, Clerkenwell, 1830.
——, **Jonah,** 6, Hatton Garden, 1840.
——, **George,** 75, Old Broad Street, 1842.
Houghman, Charles, C.C., 1680.
Houghton, Richard, C.C., 1690.
——, **James,** 198, Tooley Street, 1790.
——, **James,** Ormskirk, assistant of William Garrat, and afterwards maker of watches with Debaufre's dead-beat escapement, with two escape wheels as modified by Sully, known in Lancashire as the club-footed verge, 1800-1820.
——, **William,** Lever Street, died 1890, aged 75.
Houriet, Frederick Locle, clever horologist and maker of spherical balance springs, 1810-1825.
House, J., Gray's Inn Lane, maker of a pair-case silver verge, showing day and night by means of a revolving plate, serving as hour hand, minutes shown in the usual way, period 1700; 1672-1700.
——, **Robert,** 32, Upper Moorfields, 1790.
How, Benjamin, admitted C.C., 1691.
——, **William,** admitted C.C., 1697.
—— **and Masterton,** White Hart Court, Gracechurch Street, 1758-1760.
Howard, John, admitted C.C., 1694.
——, **Richard,** admitted C.C., 1718.
——, **John Jarvis,** 68, Aldersgate Street, 1790-1794.
——, **Edward,** 6, Kirby Street, Hatton Garden, 1778-1804.
Howe, Samuel, admitted C.C., 1712.
——, **Ephraim,** apprenticed to Graham, admitted C.C., 1729.
——, **Samuel,** 173, High Holborn, 1840.
Howell, Benjamin, C.C., 1699.
——, **Joseph,** admitted C.C., 1721.
——, **John,** Bull's Head Court, Newgate Street, admitted C.C., 1724; 1724-1730.
Howells, William, Kennington, one of the experts appointed by the select committee of the House of Commons to examine Mudge's timekeepers, 1780-1810.

Howlett, John, London, known as a maker of good watches, about 1730.
Hows, Thomas, The Sun, Pope's Head Alley; admitted C.C., 1632; known as a maker of watches, 1630–1640.
Howse, John, Croydon, C.C., 1687.
——, **Joseph,** admitted C.C., 1698.
——, **John,** admitted C.C., 1706.
——, **William,** 13, Fleet Street, admitted C.C., 1731; master, 1777; 1731–1780.
——, **Charles,** 5, Great Tower Street, master, C.C., 1787; 1768–1794.
Howson, John, admitted C.C., 1699.
Huand le Puisné excelled as a figure painter in enamel for watch cases, about 1650.
Hubbard, John, admitted C.C., 1722.
——, **Joseph,** watch gold hand maker, St. John's Square, 1790.
——, **E.,** musical clockmaker, 33, Gibson Street, Waterloo Road, 1840.
Hubberd, C., watch-case maker, 9, Peerless Row, City Road, 1835.
Hubert, Neil, Rouen, maker of an oval silver watch, about 1650.
——, **Estienne,** Rouen, maker of a watch said to have belonged to Mary, Queen of Scots. "Lost upon New-years-day, above stairs in Whitehall, a gold watch with a plain shapen case; the watch was made at Rouen, maker's name Hubert. Whoever brings it to her Royal Highness the Princess of Denmark's porter at the Cockpit, shall have two guineas reward" (*London Gazette*, December 30, January 2, 1689); 1655–1720.
——, **James.** Charlotte Hubert was apprenticed to him and Elizabeth his wife in 1725; and in 1730 Catherine Cext was also apprenticed to them; 1725–1730.
——, **David,** Strand, master, C.C., 1743; maker of a repeating watch, silver case engraved and pierced, enamel dial, Roman hour numerals, Arabic figures outside for minutes, the plate covered with engraving, and inscribed "Dav. Hubert, London." Another specimen of his work is a bracket clock repeating the quarters on six bells by pulling a cord, which winds up the quarter repeating train, brass arched dial, strike-silent, day of the month, verge escapement; 1735–1748.
Huchason, Richard, C.C., 1702.
Hudson, John, St. Martin's Churchyard, 1780–1785.
——, **William,** Griffin Street, Shadwell, 1835.
Hues, Pierry (Peter), admitted C.C., 1632; 1660.
Huggerford, Ignatius, admitted as a brother, C.C., 1671; a watch by him played a prominent part in respect of the petition of Facio and Debaufre for extension of their watch jewel patent (see p. 231), 1671–1705.
Hughes, John, admitted C.C., 1703.
——, **Thomas,** admitted C.C., 1712.
——, **S.,** Gracechurch Street, 1774.
——, **William,** 119, High Holborn, hon. freeman, C.C., 1781; centre seconds watch by him in the Guildhall Museum, 1776–1790.
——, **Thomas,** 25, Broad Street Buildings, liveryman, C.C., 1776; 1769–1783.
——, **John,** 92, Minories, 1800.
——, **David,** 30, Frith Street, Soho, 1835–1842.
Huguenin, A., 67, Great Russell Street, 1830–1835.
Hulbert, William, Castle Green, Bristol, 1708.
Hull, —, a celebrated cylinder escapement maker, who worked for Ellicott and other celebrated makers, 1750–1780.
Hulst, Jacob, admitted C.C., 1646.
Hulton, John, admitted C.C., 1724.
Humphrey, W. H., 17, Great Surrey Street, 1830–1835.
Humphrys, William, C.C., 1699.
Humphreys, Samuel, C.C., 1728.
Humphries, J., London, known as a maker of mantel clocks, about 1750.
Hunot, Samuel, 28, Rathbone Place, 1842.
Hunt, John, admitted C.C., 1671.
——, **Edward,** admitted C.C., 1684; maker of a watch movement with tulip pillars, in the Guildhall Museum. "Lost the 17 past, out of Mrs. Man's Lodgings in Sohoe, a gold minute pendulum watch,

with a gold-studded case, the inward box marked E.H. and a coronet, made by Edw. Hunt" (*London Gazette*, September 15-19, 1692); 1684-1700.

Hunt, James, admitted C.C., 1708.

——, **William**, Ludgate Street, 1753-1756.

——, **Hiram**, Robbinston, Maine, U.S.A., was said to have been the original "Sam Slick" of Haliburton. He died at an advanced age; 1830-1886.

——, **Thomas**, 151, Tottenham Court Road, 1835.

——, **William**, 4, Stafford Street, Bond Street, 1835.

——, **Samuel**, 18, Buttesland Street, Hoxton, 1842.

Hunter, T., 43, Lombard Street, 1768; 156, Fenchurch Street, 1754; liveryman, C.C., 1768; 1754-1780.

——, **Thomas, junior**, 156, Fenchurch Street, 1781-1800.

——, **William**, 51, Lombard Street, 1768-1783.

——, **Thomas**, 54, Goswell Road, 1788-1790.

——, **William**, 156, Fenchurch Street, 1804.

—— **and Son**, 156, Fenchurch Street, 1810-1815.

—— **and Edwards**, 43, Cornhill, 1840-1842.

Huon, Jacques, Paris, maker of a splendidly enamelled watch, in S.K.M., about 1650.

Hurland, Henry, admitted C.C., 1654.

Hurley, Isaac, 68, Red Lion Street, Clerkenwell, 1790.

Hurst, Isaac, admitted C.C., 1677.

——, **W.**, 9, Lambeth Walk, 1835-1842.

——, **Henry**, Ludgate Hill, 1750-1756.

Hussey, Joseph, admitted C.C., 1685.

Hutchin, Joshua, admitted C.C., 1682. In the B.M. is a watch by him, handsome silver dial with a semicircular slit above the centre, through which appears blue sky, the sun in the day and the moon at night pointing to the hour; 1670-1700.

——, **Joseph**, admitted C.C., 1697.

——, **Joseph**, admitted C.C., 1703.

Hutchin, John, admitted C.C., 1703.

Hutchinson, John, petitioned Parliament to grant a longer period than usually covered by a patent for his improved watch, which would be wound without any aperture in the case. Successfully opposed by C.C., Mr. Charles Goode producing to the committee of the House of Commons a watch made fourteen years previously, which Mr. Hutchinson confessed was made as his; 1712.

——, **Richard**, C.C., 1702-1736.

Hutton, Patrick, 83, Cannon Street, 1790.

——, **John**, Mark Lane, chronometer maker, 1840-1868.

Hux, John, 41, Percival Street, Clerkenwell, 1840-1842.

——, **R. R.**, Spencer Street, Clerkenwell, a well-known watchmaker, 1849-1869.

Hyams, Joshua, 32, Leman Street, Goodman's Fields, 1840-1842.

Hyde, Thomas, 33, Gutter Lane, 1783.

——, **James**, 38, Gutter Lane, 1783.

Hynam, Robert, 4, Clement's Lane, liveryman, C.C., 1769-1780.

Hyon, à Paris, on a watch, S.K.M., about 1740.

Ibel, Thomas, watch-spring maker, Featherstone Street, 1790.

Imhof, N., 24, Curtain Road, 1842.

Inglish, James, 36, Watling Street, 1790.

——, **Adam**, wooden clockmaker, 39, St. John's Square, 1840.

Ingold, Pierre Frederick, born at Bienne, 1787, a clever mechanician, who devised machinery for duplicating parts of watches. He visited Paris about 1830. In 1841 he was in London; in 1842 and 1843 he took out various patents for protecting the tools to be used by the British Watch Company; visited New York in 1845, and afterwards returned to Switzerland.

Ingram, Thomas, admitted C C., 1695.

——, **William**, admitted C.C., 1730.

——, **William**, 40, Goswell Street, 1842.

Inkpen, John, Horsham, maker of long-case clocks, about 1770.

Innocent, Robert, 16, Gwynn's Place, Hackney Road, 1835.
Inwood, S., London, maker of a watch, green leather case piqué, about 1700.
Ireland, Henry, Lothbury; admitted as a brother, C.C., 1654; maker of lantern clocks, 1650-1675.
——, **Francis**, admitted C.C., 1668.
——, **John**, 21, Maiden Lane, 1779.
Ironside and Belchier, Lombard Street, 1737-1740.
Irvin, Jean, 32, Kirby Street, Hatton Garden, 1825.
Irvine, J., watch-movement maker, 23, Rahere Street, 1835.
Irving, Alexander, C C., 1695.
Isaac, Daniel, assistant, C C., 1670; 1660-1670.
Isaacs, Levy, 57, Mansell Street, 1769-1783.
——, **Lewis**, 23, Houndsditch, 1830-1842.
Israel, John, 180, Whitechapel, 1783.
Ive, G. H., 10, Finsbury Place, 1835.
Ivery, John, repairer of the clock of St. Margaret's, Westminster, 1548.
Ives, Francis, admitted C.C., 1790; maker of a thirty-hour clock, hour hand only, inscribed "Fra. Ives, fecit for Thos. Sclater, Gentl."
Izod, William, admitted C.C., 1649.

Jaccard, David, 26, Percival Street, Clerkenwell, 1840-1842.
Jackman, Joseph, "On London Brydge," maker of a large verge watch movement in the Guildhall Museum, period about 1690.
Jackson, Richard, C.C., 1632.
——, **Joseph**, admitted C.C., 1648.
——, **Edward**, admitted C.C., 1669.
——, **Edward**, admitted C.C., 1680.
——, **John**, admitted C.C., 1682.
——, **Thomas**, admitted C.C., 1688.
——, **James**, admitted C.C., 1689.
——, **Matthew**, admitted C.C., 1730.
——, **Martin**, admitted a brother, C.C., 1697; master, 1721; maker of a bell top, ebony case, pull-repeater clock, brass arch dial, 1697-1721.
——, **John**, 37, Basinghall Street, 1759-1774.
——, **William**, Broad Street, afterwards Tower Street; liveryman, C.C., 1776; known as a maker of long-case clocks, 1740-1776.
Jackson, John, 2, Bridgewater Square; livery, C.C., 1776; master, 1796; 1769-1800.
——, **John, junior**, Bridgewater Square; master, C.C., 1822; 1800-1830.
——, **Henry**, 29, St. Martin's Lane, 1790.
——, **Thomas**, 52, Upper East Smithfield, 1790; 53, Red Lion Street, Clerkenwell, 1810.
——, **Isaac**, 145, St. John's Street, 1804.
——, **W.**, 31, Cowcross Street, 1820.
——, **G.**, 82, Charlotte Street, Rathbone Place, 1825.
——, **John**, watch-case maker, 10, Norman Street, St. Luke's, 1835.
——, **William**, 6, Brunswick Place, Brompton, 1835.
——, **Henry, and Son**, 66, Red Lion Street. Clerkenwell, 1835-1842.
——, **William**, 29, Exeter Street, Sloane Street, 1835.
——, **John**, 72, Hackney Road, 1842.
——, **William**, 6, Brunswick Place, Brompton, 1842.
Jacob, Benjamin, admitted C.C., 1706.
——, **Benjamin**, admitted C C., 1718.
——, **Dennis**, Cockspur Street, 1775-1800.
Jacobs, Judah, Whitecross Street, 1779; 1, Little Mitre Court, Fenchurch Street, 1771.
——, **E.**, 86, York Street, Westminster, 1820; 25, Bevis Marks, 1825-1835.
——, **Edward**, 29, Eare Street, Westminster, 1835.
Jacques, William, admitted C.C., 1687; master, 1716; 1687-1717.
Jaggar, Edward, admitted C C., 1702.
Jakeman, —. *See* Jackman.
James, John, admitted C.C., 1662.
——, **Joseph**, admitted C.C., 1689.
——, **Robert**, 23, White Street, Borough, 1835.
Jamison, George, 33, Charing Cross, 1800-1805.
Jammet, —, admitted C.C., 1704.
Janvier, Antide, born at St. Claude in the Jura, settled in Besançon, and became an authority on horological construction. His "Essai

sur les Horloges," was published at Paris in 1811; 1772-1835.
Japy, Frederic, Beaucourt, France, in 1799 patented a series of machines for producing parts of watches by unskilled labour. This appears to be the first attempt to manufacture watches on the factory system.
Jaques, William, C.C., 1724.
——, **Augustus,** 4, President Street, West, 1842.
Jardin, John, admitted hon. freeman, C.C., 1781; maker of a repeating watch in shagreen case, style 1745; 1745-1781.
Jarman, John, admitted C.C., 1728.
—— **and Co.,** 33, St. James's Street, 1825.
——, **John B.,** 25, Strand, 1823.
Jarrett, Richard, master, C.C., 1685; 1660-1686.
——, **Bernard,** livery, C.C., 1786.
——, **John W.,** livery, C.C., 1786; 1770-1786.
—— **and Sons,** watch-case engravers, Albemarle Street, St. John's Square, 1790.
Jarvis, George, admitted C.C., 1728.
——, **John,** Aldersgate Street, 1775-1790.
Jayne, John, admitted C.C., 1687.
Jeanin, A., 28, Cranbourne Street, 1842.
Jefferies, John, admitted as a brother, 1639.
Jefferson, Samuel, 31, Bruton Street, 1807-1842.
——, **Reed, and Walton,** 38, Fetter Lane, 1820-1825.
——, **Matthew,** 236, High Street, Shadwell, 1835-1842.
Jeffery, William Knight, C.C., 1712.
——, **Thomas, and Jones,** Cockspur Street, Charing Cross, 1769-1788.
Jefferys, Nathaniel, Strand, 1771.
——, **Nathaniel, junior,** Piccadilly, 1780-1785.
——, **Thomas,** Cockspur St., 1771.
——, **H.,** 49, Salisbury Square, Fleet Street, 1798-1804.
——, **G.,** 86, New Bond Street, 1800.
—— **and Gilbert,** Cockspur Street, 1800.
——, **Nathaniel,** 22, Queen Street, Mayfair, 1768-1804.
—— **and Ham,** 49, Salisbury Square, Fleet Street, 1810-1815; 46, Skinner Street, 1825.
Jeffreys, John, admitted C.C., 1726.
Jeffs, John, admitted C.C., 1697.
——, **Benjamin,** admitted C.C., 1702.
Jelf, William, admitted C.C., 1717.
Jenkins, Thomas, admitted C.C., 1678.
——, **Cornelius,** admitted C.C., 1678.
——, **James,** admitted C.C., 1692.
——, —, Cheapside, 1774.
——, **Henry,** 68, Aldersgate Street, known as a maker of curious astronomical and other clocks, 1756-1783 (see p. 136).
——, **F.,** 7, Tyler Street, Regent Street, 1835.
Jennings, Robert, C.C., 1703.
——, **Thomas,** admitted C.C., 1721.
——, **Charles,** admitted C.C., 1725.
Jernegan, Edward, Great Russell Street, 1737-1740; Featherstone Buildings, 1750-1759.
Jerome, Chauncey, pupil of Eli Terry, maker of American clocks, 1800.
Jessop, Josias, 38, Southampton Street, Covent Garden, 1781-1790.
Jevon, May, admitted C.C., 1706.
Job, Robert, 25, Charlton Street, Somers Town, 1835; 7, Park Terrace, Camden Town, 1842.
——, **Frederick,** 25, Sherrard Street, Golden Square, 1835; 17, Tichborne Street, Haymarket, 1842.
Jodin, Jean, author of "Les Echappemens à repos comparés aux échappemens à recul," Paris, 1766.
Johnson, Roger, petitioner for incorporation of C.C., 1630.
——, **Jery,** Exchange Alley. In the B.M. is a small watch of his make in an irregular octagonal-shaped case with a faceted crystal over the dial, 1620-1625.
——, **George,** admitted C.C., 1649.
——, **John,** admitted C.C., 1678.
——, **John,** admitted C.C., 1680.
——, **Michael,** admitted C.C., 1687.
——, **John,** Fleet Lane, 1701.
——, **Jeremiah,** Exchange Alley, admitted C.C., 1668; 1668-1690.
——, **Cornelius,** admitted C.C., 1694.
——, **Thomas,** admitted C.C., 1700.
——, **John,** admitted C.C., 1701.
——, **Isaac,** admitted C.C., 1705.
——, **James,** admitted C.C., 1706.

Johnson, Thomas, admitted C.C., 1713.
——, **Isaac,** admitted C.C., 1723.
——, **William,** admitted C.C., 1702, maker of a bracket clock, bell-top ebony case, with handle, brass dial, bob pendulum, style 1725, strike-silent, 1703–1725.
——, **Thomas,** 9, Gray's Inn Passage, about 1730.
——, **James,** New Road, St. George's East, 1790.
——, **John,** 9, Gray's Inn Passage, 1770–1799.
——, **John,** 5, Elm Street, Gray's Inn Lane, 1790–1820.
——, **E.,** 7, Sweeting's Alley, 1823.
——, **Leond,** 19, Bartlett's Buildings, Holborn, 1825.
——, **J. and W.,** 19, Cross Street, Hatton Garden, 1825.
——, **James,** 18, Paddington Street, 1835–1842.
——, **William,** 50, Strand, 1835–1842.
——, **Edward Daniel,** 9, Wilmington Square, a leading watch manufacturer, formerly with James Stoddart; retired from business 1879, died at Highbury, 1889, aged 73.
Johnston, G., 7, Queen Street, Northampton Square, 1835.
——, **J.,** 2, Elm Street, Gray's Inn Lane, 1835.
Jolly, Joseph, 11, Dean Street, Fetter Lane, 1790.
Joly, Jacques, London; in the B.M. is a watch by him, 1620–1630.
Jones, Evan, admitted as a brother, C.C., 1648.
——, **William,** admitted C.C., 1663.
——, **Thomas,** admitted C.C., 1679.
——, **Jonathan,** admitted C.C., 1687.
——, **David,** admitted C.C., 1687.
——, **Henry,** admitted C.C., 1697.
——, **Valentine,** admitted C.C., 1704.
——, **John,** admitted C.C., 1716.
——, **Henry,** Inner Temple Gate, master, C.C., 1691; an eminent maker (see p. 81); 1663–1693.
——, **John,** master, C.C., 1762; 1748–1763.
——, **Jenkin,** 61, St. James's Street, 1775–1783.
——, **Owen,** Little George Street, livery, C.C., 1786; 1780–1790.
——, **William,** livery, C.C., 1786; 1778–1786.
Jones, David, watch-pendant maker, 69, Bunhill Row, 1790.
——, **William,** 27, Barbican, 1790; 31, Little Moorfields, 1810; 1790–1810.
——, **Robert,** 49, Little Bartholomew Close, 1800.
——, **James,** 65, Banner Street, Bunhill Row, 1795–1810.
——, **William,** White Cross Street, 1810–1815.
——, **John,** 338, Strand, 1821; succeeded by his son, John Jones, a man of high attainments and successful manufacturer; vice-president of the British Horological Institute; he retired from business in 1885.
——, **F.,** 62, Cornhill, 1825.
——, **Sam,** 78, Cheapside, 1825.
——, **W.,** 132, Holborn Hill, 1825.
——, **John and Timothy,** 20, Red Lion Street, Clerkenwell, 1825–1830.
——, **Timothy,** 18, Ludgate Street, 1830–1840.
Jordan, Timothy, 40, Snow Hill, maker of a tall mahogany-case clock, brass dial, period 1780; 1769–1780.
Jourdain, A., 6, Wheeler Street, Spitalfields, 1790.
——, **William,** London, maker of a timepiece with crown wheel escapement, short pendulum with pear-shaped bob, and 8-inch silvered dial. Through a short circular slit in the upper part of the dial is shown a small silvered star, which, as it vibrates along with the pendulum, shows when the timepiece is going; 1670–1710.
Jourdan, R., 29, Marshall Street, Golden Square, 1835.
Joyce, George, admitted C.C., 1692.
——, **Stephen,** Moor Street, Soho, 1769.
——, **Samuel and C.,** 38, Lombard Street, 1790–1842.
——, **James,** Whitchurch, a well-known clockmaker, died 1883, aged 62.
Judson, Thomas, sent a letter to C.C., relative to watches seized, 1790.
Julian, Gregory, admitted C.C., 1664.
Jullion, John, Brentford, 1730.

Jullion and Son, New Brentford, 1771.

Julliott, Solomon, London, verge watch by him in the Guildhall Museum, date on mainspring, 1738.

Jurgensen, Urban, born 1776, died 1830; an eminent Danish watchmaker. Author of "The Higher Horological Art," and "Principes de la Mesure du Temps." Jurgensen was associated with the leading men of his day. He experimented with compensation balances made of brass and platinum, and strongly advocated the use of gold springs for marine chronometers. He made many excellent chronometers for the Danish navy, and very successful metallic thermometers.

——, **Louis Urban,** Copenhagen, son and successor of the foregoing, 1828–1867.

Just, George, 22, Anderson's Buildings, City Road, 1840.

Justis and Comp, Well Yard, St. Bartholomew Hospital, 1769.

Kaiser, Kleyser, and Co., wooden clockmakers, 4, Broad Street, 1840.

Kallenback and Fuller, 77, Blackman Street, 1840–1842.

Kammerer, Joseph, wooden clockmaker, 51, King Street, Borough, 1840.

Kangiesser, S., 24, Southampton Street, Strand, 1825.

Kanns, John, admitted C.C., 1712.

Kater, Captain Henry, F.R.S., conducted experiments for determining the length of the seconds pendulum in the latitude of London, 1817.

Keat, Joseph, 19, Cock Hill, Ratcliff, 1810.

——, **Edward,** 69, Banner Street, St. Luke's, 1830–1840.

——, **Mrs. Mary Anne,** 19, Broad Street, 1840.

——, **Sophia,** 60, Banner Street, St. Luke's, 1842.

Keates, William, 135, Fleet Street, 1783–1800.

Keating, A., 114, Strand, 1807–1815.

Keddon, Daniel, admitted C.C, 1717.

Keef, Thomas, 22, Rosoman Street, Clerkenwell, 1835.

Keeling, George, musical clockmaker, Webber Street, Blackfriars Road, 1840.

Keely, W., gilder, Orange Court, Clement's Lane, 1790.

Kefford, Thomas, Royston, maker of long Oriental lacquer-case clock, about 1760.

Kelme, —, London, maker of a small timepiece on a horse, in the Massey - Mainwaring Collection, 1670.

Kelton, Simon, admitted C.C., 1723.

Kemp, Charles, admitted C.C., 1688.

——, **Richard,** admitted C.C., 1701.

——, **William,** livery, C.C., 1786.

——, **Joseph,** Curtain Road, Shoreditch, 1790.

Kemps, Matthew, C.C., 1670.

Kendall, Larcum, 20, Wood Street, Cheapside, apprenticed to John Harrison, and one of the judges appointed to report on Harrison's timekeeper in 1765. He agreed to make a duplicate for the Commissioners of Longitude, undertaking to faithfully reproduce the various parts without being held responsible for the performance, and stipulated that the price, £400, should be paid in advance. The date on this instrument is 1769; it must have been at least three years in hand. Kendall afterwards made a much simpler instrument than Harrison's, without the remontoire action, and with an ordinary seconds hand; the date on this is 1771. It is in the possession of the Royal United Service Institute. There is a fine watch with a remontoire escapement by him in the Guildhall Museum, 1740–1780.

——, —, watch finisher, 17, St. John's Square, 1790.

Kendrick, John, admitted C.C., 1719.

——, **John,** admitted C.C., 1726.

Keney, Vincent, received £19 16s. 8*d.* from Henry VIII. for "xj clocks and dialls," 1530.

Kenney, William, threatened with prosecution by C.C. for exercising the art, not being admitted, 1682.

Kenning, William, admitted as a brother, C.C., 1684.

Kent, Henry, admitted C.C., 1650.
——, **Joseph,** 19, Cock Hill, Ratcliff, 1806–1815.
——, **John,** 19, Broad Street, Ratcliff, 1822–1835.
Kentish, John, Pope's Head Alley, 1758–1761.
——, **John, and Haynes,** 18, Cornhill, 1769–1788.
Kenton, Joseph, admitted C.C, 1686.
Kerby, Thomas F., London, known as a maker of clocks about 1760.
Kershaw, George, Tyler's Court, Cornaby Market, 1790.
Kersill, William, 21, Aldersgate Street, 1775.
Keys, David, Craven Street, Strand, a well-known manufacturer of watches; died 1887, aged 74.
Keyzor, Louis, 16, Tottenham Court Road, 1835–1840.
Kidder, John, 6, Strand, 1823.
Kilminster, Henry, C.C., 1677.
Kimbell, Thomas, 214, Tottenham Court Road, 1842.
King, Jonathan, admitted C.C., 1689.
——, **Thomas,** admitted C.C., 1669; maker of a marqueterie long-case square dial clock, 1669–1690.
——, **John,** admitted C.C., 1715.
——, **John,** admitted C.C., 1729.
——, **Isaac,** Moorfields, 1730.
——, **William John,** admitted C.C., 1720. In the B.M. is a watch by him with repoussé case, 1730.
——, **Henry,** Lincoln's Inn, admitted C.C., 1720; 1720–1745.
——, **John,** Gough Square, 1758–1761.
——, **Thomas and Benjamin,** 82, Upper East Smithfield, 1804–1825.
——, **W.,** 34, High Holborn, 1830.
——, **Thomas,** 130, Minories, 1835–1842.
Kingman, James, 104, Leadenhall Street, 1783.
Kingsmill, George, C.C., 1667.
Kinnear, Charles, 33, Frith Street, Soho, 1830.
Kinning, John, admitted C.C., 1701. A specimen of his work in the B.M. is a watch the works of which are encased in glass, 1720–1730.
Kipling, William, Broad Street, near Ratcliff Cross, maker of oak long-case clock, square dial, period Queen Anne, 1705–1737.
Kirby, Robert, admitted C.C., 1722.
Kirk, John, admitted C.C., 1677.
Kirkton, R., enameller, Red Lion Street, 1790.
Kissor, Samuel, admitted C.C., 1712.
Kitchen, B., 32, Compton street, 1842.
Kitching, Joshua, 14, Dover Street, Piccadilly, 1823.
Klaftenberger, C. J., a skilful watchmaker, sometime vice-president of the Horological Institute; died 1874, aged 79.
Kleyser, J., wood case-maker, 90, Holborn, 1790.
——, **George, and Co.,** wood case-makers, 3, Little Tower Hill, 1790.
—— **and Kaltenback,** wooden case-maker, 196, High Street, Borough, 1810–1825.
—— **and Fritschler,** 405, Oxford Street, 1835–1842.
——, **T. and J.,** 191, High Holborn, 1810–1830.
——, **J., and Co.,** wooden case-maker, 4, Goswell Street, 1840.
——, **John,** wooden case-maker, 66, Borough High Street, 1840.
Knibb, Samuel, admitted C.C., 1663.
——, **Joseph,** Oxon., admitted C.C., 1670. He made a clock for Windsor Castle in 1677. He issued a token, having on the obverse: "Ioseph Knibb, Clockmaker in Oxon.;" reverse, I.K., a clock face and hands. In the Camden Society's "Secret Services of Charles II. and James II." are various accounts of payments on behalf of King Charles. In the account up to July 3rd, 1682, is an item, paid "To Mr. Knibb by his said Ma'tie's comand upon a bill for Clockwork, 141*l*." He appears to have at one time had a business in London; on a bracket clock, with curious striking part, ornamented on the back-plate, is the inscription, "Joseph Knibb, Londini, fecit."

"Lost, on the 26th inst., near the Ferry Place, Putney, a gold Pendulum Chain Minute-watch, made by Joseph Knibb, of London, in a shagreen case, studded, with a Gold Knob, and marked with 48 on the inside of the case. Whoever will give notice of it to Mr. Joseph Knibb, watchmaker in Fleet Street, shall have 2 guineas and charges; or if pawned or sold, their money again and a good gratuity" (*London Gazette*, April 30, May 4, 1691).

"Left in a coach or drop'd, the 12th inst., a Gold Out-Case of a striking watch, engraven. Whoever shall bring it to Joseph Knibb, clockmaker, at the Dyal, near Sergeants-Inn, in Fleet Street, shall receive 40*s* reward" (*London Gazette*, January 11-14, 1691).

"At the Clock Dyal, in Suffolk Street, near Charing Cross, on Friday, the 23rd inst., will begin the sale of a great Parcel of very good Pendulum Clocks, some do go a year, some a quarter of a year, some a month, some a week, and some 30 hours; some are Table Clocks, some repeat themselves, and some, by pulling, repeat the hours and quarters; made and sold by Joseph Knibb, at his House at the Dyal, in Suffolk Street aforementioned. There are also some watches to be then and there sold" (*London Gazette*, April 15-19, 1697).

Knibb, Peter, admitted C.C., 1677.

——, **John**, Oxon., maker of a verge watch movement, with curiously wrought pillars, in the Guildhall Museum, style 1690.

Knifeton, Thomas, at Ye Cross Keys, in Lothebury, 1690-1700.

Knight, Michael, apprenticed to Tompion, admitted C.C., 1677.

——, **Richard**, admitted C.C., 1682.

——, **Charles**, admitted C.C., 1685.

——, **Henry**, admitted C.C., 1723.

——, **John**, 6, Carpenters' Buildings, London Wall, 1768.

——, **Benjamin**, New Street, Dockhead, 1790.

——, **Valentine**, engine turner, first president of the British Horological Institute; born 1793, died 1867.

Knottesford, William, admitted C.C., 1664, maker of a circular silver watch in the B.M., also of a repeater in S.K.M., hall mark, 1684; 1650-1685.

Knowles, James, 2, Hospital Row, Chelsea, 1835-1840.

Kullberg, Victor, born at Gothland, Sweden, 1824. In 1851 he came to London, where he died, in 1890. One of the most brilliant and successful horologists of the present century. Inventor of a compensation balance (see p. 223).

Kyezor, Louis, 46A, Edgware Road, 16, Tottenham Court Road, and 3, Great Turnstile, 1842.

Kynvyn, James, maker of a clock belonging to the Earl of Essex, 1593.

Lacey, Charles, 12, Ludgate Street, 1783.

Lacour, Daniel, New Street, Covent Garden, 1825.

Ladd, Ladd, admitted C.C., 1709.

——, **J.**, 35, Cornhill, 1823.

Lafosse, William, 32, Old Broad Street, 1738-1788.

Laidlau, Thomas, hon. freeman, C.C., 1770-1781.

Lainy, John, admitted C.C., 1720.

Lake, Bryan, admitted C.C., 1674.

Lamb, Thomas, Union Street, Spitalfields, 1790.

——, **Benjamin**, 21, St. John's Square, 1769-1779.

—— **and Webb**, 21, St. John's Square, Clerkenwell, 1780-1795.

——, **Sarah**, 2, Lower Queen's Row, Pentonville, 1842.

Lambe, Thomas, admitted C.C., 1632.

——, **Edmund**, admitted C.C., 1675.

——, **John**, 29, Fetter Lane, 1800.

Lambert, John, 2, Tichborne Street, 1775-1810.

——, **Henry**, 93, Piccadilly, 1840.

——, **Henry**, 119, Cheapside, 1842.

Lamp, John, admitted C.C., 1713.

Lampe, John, Henrietta Street, admitted C.C., 1713; Chippendale long-case clock, large hood and gallery round the top, inscription on disc, "John Lampe, London;" 1713-1715.

Landlen, Thomas, 16, Salisbury Court, 1794.

Langcroft, Richard, C.C., 1718.
L'Ange, A., 51, Cornhill, 1835.
Lange, Adolf Ferdinand, apprentice of Winnerl, Paris; an excellent and progressive watchmaker; Glashutte, Saxony; died 1873, aged 60.
Langford, Goring, admitted as a brother, C.C., 1652.
Langhorne, Thomas, Threadneedle Street; liveryman, C.C., 1776.
Langley, Thomas, admitted C.C., 1664.
——, **Cornelius,** admitted C.C., 1706.
Larard, James, 7, New Bridge Street, 1842.
Larçay, —, an eminent French horologist, period 1725.
Large, Augustus, 51, Cornhill, 1840.
Laroch, John, 18, High Street, Bloomsbury, 1822–1825.
Lasarus, Abraham, Gun Yard, 1760–1765.
Lashbrook, Henry, admitted C.C., 1715.
Lasoffe, William, 52, Old Broad Street, 1765–1770.
Lasseter, William, Arundel, maker of long-case clocks, about 1770.
Latham, John, admitted C.C., 1700; maker of a watch with gold repoussé case, in S.K.M., 1700–1720.
Latour, René, admitted C.C., 1730.
Lauriere, J., 62, St. James's Street, 1822–1830.
Laver, Benjamin, 4, Bruton Street, Berkeley Square, 1800.
Law, Thomas, 27, Thomas Street, Southwark, 1790.
——, **Anthony,** 68, Borough High Street, 1840–1842.
Lawell, Paul, admitted as a brother, C.C., 1653.
Lawley, Bernhard, 253, Borough High Street, 1840–1842.
Lawrence, James, 13, Bolingbroke Row, Walworth Road, 1835.
——, **G.,** 74, Paradise Street, Rotherhithe, 1835–1842.
—— **and Son,** 171, Tooley Street, 1835.
Lawson, John Edward, 58, Bishopsgate Within, 1800–1825.
Laxton, Thomas, admitted as a brother, C.C., 1642.
——, **Thomas,** admitted C.C., 1653.
Layton, John, admitted as a brother, 1653.
Layton, Francis, admitted C.C., 1726.
——, **Thomas,** Dean Street, liveryman, C.C., 1776.
Lazarus, H., 112, Upper East Smithfield, 1815.
——, **J.,** 15, Carter Street, Houndsditch, 1825; 39, Minories, 1830; 1825–1830.
——, **J.,** 13, Oakley Street, Lambeth, 1835.
——, **H. L.,** 3, Bury Street, St. Mary Axe, 1835.
——, **E., and Son,** 3, Bury Street, St. Mary Axe, 1840–1842.
Lazenby, R., Knightsbridge, on a small clock, with sunk seconds and day of the month circles, about 1750.
Lea, Thomas, Old Jewry, master, C.C., 1782; 1760–1783.
Leach, Thomas, Lombard Street, 1753–1760.
Leadbetter, William, Cross Keys Court, Little Britain, 1785–1790.
Leah, Samuel Henry, 29, Bath Street, City Road, 1830–1842.
——, **Samuel Henry, junior,** Mare Street, Hackney, 1835; 79, Shoreditch, 1842; 1835–1842.
Leake, Faith, admitted C.C., 1685.
——, **George,** admitted C.C., 1693.
Leaver, William, 45, Great Sutton Street, 1830.
Lecomte (Lecount), Daniel, admitted as a brother, C.C., 1676. "Taken from Mr. Robert Murrel, on the 5th inst., by Foot Pads, near Newington, a Pendulum Watch made by Daniel Lecount" (*London Gazette*, August 4–8, 1692).
——, **James,** admitted as a brother, C.C., 1687.
——, **J. R.,** 60, Dean Street, Soho, 1763–1783.
Lecount, Peter, livery, C.C., 1810; 1800–1811.
Ledeur, —, London, maker of a hexagonal table clock in the Massey-Mainwaring Collection, about 1600.
Lee, Cuthbert, admitted C.C., 1676.
——, **Samuel,** admitted C.C., 1694.
——, **John,** admitted C.C., 1719.
——, **George,** Lombard Street, 1737–1740.
——, **John,** 31, Noble Street, Foster Lane, 1800–1804.

Lee, Isaac, 10, Devonshire Buildings, Great Dover Street, 1840–1842.

Leekey, Gabriel, 15, Basinghall Street (*see* Cabrier), 1769–1815.

Leeming, W., watch-case maker, 8, Little Britain, 1790.

Leeson, William, Coleshill, Birmingham, well known as a maker of turret clocks throughout the Midland Counties; died 1886, aged 77.

Le Feburg, Charles (French), admitted C.C., 1687.

Leffin, Thomas, admitted C.C., 1720.

Lefosse, William, 52, Old Broad Street, 1769–1772.

Legeips, John, London; in the B.M. a very large repeating watch with silver case decorated in repoussé, 1720–1730.

Legg, John, admitted C.C., 1724.

Le Grand, James, admitted as a brother, C.C., 1641.

——, **Francis**, admitted as a brother, C.C., 1647.

Legrand, James, junior, C.C., 1664.

Leigh, Thomas, admitted C.C., 1730.

—— **and Phillips**, 40, Mansell Street, 1840.

Leignes, Charles, Northumberland Street, Strand, 1790.

Lello, James, admitted C.C. as a brother, in 1656, on producing his masterpiece with his name, its genuineness being attested by Samuel Betts, 1656.

Lemaitre, Paul, watch tool maker, 28, Grafton Street, 1790–1810.

Lemandre, Nicholas, Blois, 1630.

Lemmon, Henry, 19, Grenville Street, Hatton Garden, 1835; 6, Upper North Place, Gray's Inn, 1842.

Lens, William, admitted C.C., 1711.

Leon, George Isaac, 56, Great Prescot Street, 1842.

Lepaute, J. A., born 1709, died 1789. He was a French clockmaker, and the inventor of the pin-wheel escapement. Lepaute constructed several fine turret clocks and clocks for the Louvre at Paris, wound by means of an air current and fan, a method re-invented recently. He made many curious timepieces (equation, one-wheel clocks, etc.), and was the author of an excellent "Traité d'Horlogerie" (Paris, 1760), revised and augmented, says Moinet, by the celebrated Lalande. In the second edition of this work appears Lalande's treatise on "perfect pitching."

Lepine, —, a French watchmaker (Horloger du Roy), who introduced bars for carrying the upper pivots of a watch train instead of a top plate, 1770.

Leplastrier, John, 138, Upper Shadwell, 1790; 125, Minories, 1815; 1790–1815.

——, **Louis**, 142, High Street, Shadwell, 1804–1815.

—— **and Son**, 142, High Street, Shadwell, 1820–1828.

——, **Isaac**, 17, King William Street, Strand, 1840; 21, Holles Street, Cavendish Square, 1840–1842.

——, **Louis**, 50, Alfred Street, City Road, 1842.

—— **and Son**, 20, Ludgate Hill, 1835.

Leroux, Alexander, C.C., 1706.

——, **John**, 8, Charing Cross; hon. freeman, C.C., 1781. There is a fine watch by him in the Guildhall Museum; 1770–1800.

Le Roy, Julien, a scientific French watchmaker, born 1686, died 1759. He devised a form of repeating mechanism much used in French watches, and substituted springs for the bell in use before.

——, **Pierre**, son of Julien Le Roy, born 1717, died 1785. Among his conceptions was a form of duplex escapement and an escapement on which the present chronometer escapement is founded; 1738–1785.

Lesage, Augustus, Cockspur Street, 1775; St. James's, Haymarket, 1788.

Leschot, Georges Auguste, Geneva, in 1840 designed a series of machines for watchmaking on the factory system.

Leslie, James, 6, Maiden Lane, Covent Garden, 1788; 5, Parliament Street, 1790; 1788–1790.

——, **Robert**, patentee of pumping keyless work (No. 1920); 1793.

Lester, Thomas, admitted as a brother, C.C., 1697.

——, —, Lombard Street, 1774.

Lestourgen, David, admitted C.C., 1721; 1721-1751.
——, **David,** admitted as a brother, C.C., 1698; maker of a verge watch with finely pierced cock and pillars. Another specimen of his work is in the Guildhall Museum; 1690-1731.
Lestourgeon, Thomas, known as a maker of long-case clocks, 1760.
L'Estrange, David, admitted as a brother, C.C., 1697.
Letwitch, William, 42, Lombard Street, 1769-1772.
Levens, John, Shoemakers' Row, Blackfriars, 1790.
Levin, Moses, 7, Cook's Court, Carey Street, 1790.
——, **Lewis,** 63, Prescot Street, 1804; 51, Mansell Street, 1815; 123, Leadenhall Street, 1830; 1804-1830.
Levy, Joseph, New Round Court, Strand, 1780-1785.
——, **Lyon,** 121, Whitechapel High Street, 1780-1785.
——, **Hyam,** 121, Whitechapel High Street, 1780-1785.
——, **M. and C.,** 19, Maiden Lane, Covent Garden, 1790.
——, **Philip,** 30, Jewry Street, Aldgate, 1798-1803.
——, **Jonas,** 18, Somerset Street, 1800; 135, Whitechapel, 1810; 38, Minories, 1820; 1800-1820.
——, **J.,** Coventry Street, Haymarket, 1815.
——, **B.,** High Street, Whitechapel, 1820.
——, **J., and Son,** 49, Tooley Street, 1820.
—— **and Co.,** 408, Strand, 1825.
——, **A.,** 17, Camomile Street, 1825-1835.
——, **S.,** 19, Crutched Friars, 1830.
——, **A.,** 183, Ratcliffe Highway, 1835.
——, **Jonas,** 13, Bevis Marks, admitted C.C., 1831; 1820-1842.
——, **Abraham,** 36, Trinity Square, Tower Hill, 1840-1842.
—— **and Moss,** 1, Liverpool Buildings, Bishopsgate, 1842.
Levyson, Montague, 125, Pall Mall, 1840.
Lewin, William, admitted C.C., 1731.
Lewis, John, admitted C.C., 1705.
——, **Ambrose,** admitted C.C., 1725.
——, **Joseph,** 38, Foster Lane, 1783.
—— **and Alston,** 30, Bishopsgate Within, 1825.
Ley, William, admitted C.C., 1711.
L'Hospital, J., 13, Oxendon Street, Haymarket, 1842.
Liddiard, Thomas, 54, St. Paul's Churchyard, 1775-1783.
Light, John, admitted as a brother, C.C., 1648.
Lightfoot, Peter, a monk, maker of the Glastonbury and Wimborne clocks (see p. 23), 1335.
Like, George, 29, Butcher's Row, 1785-1790.
Lillie, Charles, corner of Beaufort Buildings, Strand; "a seller of watches, &c.," 1710.
Limonière, Stephen, admitted as a brother, C.C., 1712.
Limpard, John, a watch by him in the B.M., about 1630-1635.
Lind, N., 4, Norman Street, Old Street, 1788-1825.
Lindesay, G., watchmaker to George II., a verge movement by him in the Guildhall Museum.
Lindley, —, 10, St. Martin's Court, Old Street, 1810.
Lindsey, John, 69, Banner Street, 1825.
Linford, Thomas, London, maker of watches, 1626.
Linnet, John, 9, Cursitor Street, Chancery Lane, 1825.
Linney, John, watch-case maker and liner, Leatherstone Street, 1790.
Lipp, Nicholas, Basle, maker of a remarkable clock at Lyons, 1598.
Liptrop, Peter, a well-known wheel cutter; born in Prescot, 1793; died in London, 1879; 1814-1879.
Litherland, Peter, patentee of the rack lever escapement (No. 1830, Oct., 1794); 1790-1800.
Little, Joseph, 179, Strand, 1800.
Littlemore, Whitestone, apprenticed to Tompion, admitted C.C., 1698.
Littlewort, George, 34, Cannon Street, maker of watches for the use of the guards of the Royal Mail coaches, 1816-1832.
Livermore, Edward, 30, Tokenhouse Yard, Lothbury, and 3, Cross Street, Islington, 1798-1810.

Lloyd, William, admitted C C., 1668.
——, **William,** admitted C.C., 1670.
——, **Joseph,** admitted C.C., 1673.
——, **David,** admitted C.C., 1677.
——, **Richard,** admitted C.C., 1681.
——, **Charles,** admitted C.C., 1691.
——, **James,** admitted C.C., 1700.
——, **James,** Sheep Pens, Smithfield, admitted C.C., 1722.
——, **John,** 21, Aldgate Within, 1790–1794.
——, **William,** 6, Britannia Row, Hoxton, 1842.
Lochard, John, admitted C.C., 1655; maker of a thick round silver watch, gut to fusee, engraved dial, serrated trident hand, inscribed, "John Lochard, fecit," 1655–1670.
Loddington, Isaac. Anna Maria Shaw was apprenticed to him and to Elizabeth his wife, 1733.
Lodowick, Peter, admitted C.C., 1689.
Long, Thomas, admitted C.C., 1653.
——, **John,** admitted as a brother, C.C., 1677.
——, **John,** admitted C.C., 1698.
——, **Henry,** 200, High Holborn, 1770–1780.
—— **and Drew,** enamellers, 5, Red Lion Street, Clerkenwell, 1794–1810.
Longford, Ellis, admitted C.C., 1672.
——, **Thomas,** hon. freeman, C.C., 1781; 1770–1781.
Longland, John, admitted as a brother C.C., 1677.
Loomes, Thomas, at y^{e} Mermayd in Lothebury, admitted C.C, 1649, a celebrated maker. Example, a small lantern clock, frets Fig. 103, inscription, "Thomas Loomes, at y^{e} Mermayd in Lothebury, fecit, 1674;" 1630–1674.
Lord, Richard, admitted C C., 1632.
Lorimer and Edwards, 17, Shoreditch, 1810–1823.
——, **David and Edwards,** 17, Shoreditch, 1825.
——, **William,** 24, Crown Street, Finsbury, 1830; 93, Wood Street, Cheapside, 1835; 1830–1840.
Lormier, Isaac, London, long-case clock, about 1740.
Loseby, Edward Thomas, inventor of a compensation balance which acted by the expansion and contraction of mercury in a curved glass tube fixed at each end of the laminated rim, which was shorter than usual (Patent 1011, December, 1852), (see p. 224); 1146–1890.
Louarth, Jasper, admitted as a brother. C.C., 1641.
Loudan, William, 149, Great Surrey Street, 1825; 228, Blackfriars Road, 1840; 1825–1840.
Loughton, William, admitted as a brother, C.C., 1683.
Loundes, Isaac, admitted as a brother, C.C., 1682.
——, **Charles,** Pall Mall, maker of a long-case clock belonging to the Bishop of Chester, 1700–1726.
Lounde (Lowndes), Jonathan, in Pall Mall, admitted C.C., 1680; steward, 1696; a celebrated maker. Examples, a square black basket-top bracket clock, and a walnut inlaid long-case one, 1680–1700. "Lost on the 19 past, from a gentlewoman's side, a gold pendulum watch with 2 gold cases, the outer case engraved; made by J. Lowndes, in Pall Mall, London. Whoever brings it to Mr. Lowndes, at the Dyal, in Pall Mall, shall have 3 guineas reward; or if bought, their money again with content" (*London Gazette*, October 1–5, 1691).

"Lost on the 10 instant, in a Hackney Coach, between Covent Garden and Jermyn Street, a Gold Pendulum Watch, the maker's name Lowndes, the Chrystal crack'd; with 2 Steel Seals tyed to it, the Coat of Arms, 10 Crosses and a Baron's Coronet, and a small Famble (*sic*), made up of 2 little Diamonds and 4 or 5 Rubies. Whoever brings them to St. Francis Child, Goldsmith, within Temple Bar, shall have 2 guineas reward" (*London Gazette*, November 16–19, 1691).
Love, James, 23, Aldgate, High Street, 1780–1790.
——, **Christopher,** 6, Old Bond Street, 1822–1825.
Lovelace, Jacob, Exeter, maker of a famous clock (see pp. 161–163).
Loveles, W., 14, Charles Street, Hoxton, 1796.

Lovell, Paul, 1630–1633.
Lovett, William, admitted C.C., 1702.
Lowry, Morgan, Holborn, 1700.
Lowther, Thomas, clock-case maker, 58, Red Lion Street, Clerkenwell, 1822–1830.
Lucas, William, admitted C.C., 1669.
——, **Edward,** admitted C.C., 1727.
——, **Henry,** admitted C.C., 1731.
——, **John,** Pear Tree Street, 1800–1810.
Lucie, John, admitted C.C , 1663.
Ludlam, William, one of the judges of Harrison's chronometer, 1765.
Ludlow, Samuel, C.C., 1706.
Luke, William, shagreen and morocco case-maker, 147, Aldersgate Street, 1810.
Lum, Joseph, Spittlefields, 1700.
Lumb, John, 16, Southampton Buildings, 1790.
Lumpkin, Thomas, admitted C.C., 1694; maker of a walnut marqueterie long-case clock, centre engraved; over day of month circle G. R. and three crowns; 1694–1715.
Lund, John Richard, Hatton Garden, and afterwards 41, Cornhill; apprenticed to John Pennington, senior, for some time partner in the well-known firm of Barraud and Lund; died 1868, aged 63; 1828–1869.
Lupton and Gillam, 23, St. Martin's Lane, 1825.
Lushbrook, —, admitted C.C., 1701.
Luttman, William, C.C., 1720.
Lutwiche, —, Fenchurch Street, 1775.
Lynaker, Samuel, one of the first assistants of the C.C., 1630–1649.
Lynch, Robert, admitted C.C., 1670.
Lyndon, G., 30, Gerrard Street, Soho, 1825–1830.
Lyne, William, admitted C.C., 1703.
Lyon, Lewis, 64, Gray's Inn Lane, 1840.
Lyons, Richard, master, C.C., 1683; 1670–1684.
Lysney, Sebastian, clockmaker to Edward VI., 1548.

Maberly, John, master, C.C., 1738; 1718–1739.
McCabe, —. This house was much esteemed for fine watches and clocks, especially in India. James McCabe, 11, Bell's Buildings, Fleet Street, in 1779; 34, King Street, Cheapside, in 1783; 8, King Street, Cheapside, in 1788; 97, Cornhill, in 1804. He was hon. freeman, C.C., 1781; livery, 1786; warden, 1811, when he died. McCabe and Son, 99, Cornhill, till 1820; McCabe and Strahan to 1825. J. McCabe, 97, Cornhill, till 1838. Then J. McCabe, 32, Cornhill. Robert McCabe, who succeeded his father at 32, Cornhill, retired in 1880, when he closed the shop, declining all offers to purchase the business.
McDowall, Charles, Church Street, Kensington, 1836; 8, Victoria Road, Pimlico, 1839; 2, Mall, Kensington, 1840; Jermyn Street, 1858. A clever horologist, born in Wakefield; he patented the single-pin escapement, 1851. Example of his work, a beautifully made thirty-day skeleton clock, with Hooke's helix or twisted teeth; died 1872, aged 82; 1811–1872.
Macgregor, J., 14, Charterhouse Street, 1830.
Macham, Samuel, London, maker of a repeating bracket clock, about 1750.
Mackarsie, G., 14, Gt. Queen Street, 1820.
Mackarthy, James, 47, Holborn, 1790.
Mackdonald, Peter, New Compton Street, 1790.
MacKenny, G., 8, Lower Ashby Street, 1840–1842.
Mackie, James, Banner Street, Bunhill Row, 1810–1835.
—— **and Son,** 54, City Road, 1825.
——, **James and George,** 31, City Road, 1835–1842.
——, **James,** 4, White Rose Court, Coleman Street, 1830–1842.
McLachlan, Hugh, 17, Upper East Smithfield, 1820–1840.
MacLennan, John, a watch and chronometer maker of the front rank, who worked for McCabes; born at Dingwall, died in London, 1886, aged 72.

Maclennan, Kenneth, May's Buildings, St. Martin's Lane, 1781–1825.
——, **R. and W.**, 9, Great May's Buildings, St. Martin's Lane, 1825.
McPhail, C., 14, Regent's Street, Pall Mall, 1830.
Macure, Thomas, musical clockmaker, 7, Great New Street, Gough Square, 1788.
Macy, Benjamin, C.C., 1712.
Madell, Charles, 1, Waterloo Place, Clerkenwell Close, 1835.
Maggs, William, claimed to be successor to D. Quare, 1724–1730.
Maginie, Samuel, Duke's Row, Pimlico, and 9, Prince's Street, Westminster, 1835.
Magniac, "Colonel," St. John's Square, Clerkenwell, a manufacturer of complicated clocks and automata, 1770.
Magnus, N., 7, James Court, St. Martin's Lane, 1823.
Maillett, Henry, 16, Bartlett's Buildings, 1790.
Maillingley, Robert, 135, Goswell Road, 1790.
Maisonneuve, Benjamin, Craven Street, Strand, 1769–1772.
Makepeace, Robert, 6, Serle Street, Lincoln's Inn, 1775–1788.
Malden, Samuel Rain, Essex, maker of lantern clocks, about 1725.
Malleson, Thomas, 62, Cornhill, 1769–1783.
Malpas, J., 91, Wood Street, 1753–1775.
Manaviere, —, Smithfield, 1774.
Manby, H., maker of repoussé watch cases, 1660–1690.
Manchester, John, C.C., 1700.
Maniglier, John, 4, Frith Street, Soho, 1840–1842.
Manley, Daniel, watch by him, *London Gazette*, September 21–25, 1693.
Mann, Percivall, Charlotte Street, Oxford Street, 1790.
—— **and Muddell**, 114, Leadenhall Street, 1830.
Mansell, William, watch-case maker, 1800, Rosoman Street, Clerkenwell; fined £15 by C.C. in 1813, for refusing to take up the livery; 26, Spencer Street, 1826; 1800–1835.
Mansir, R., watch-case maker, Northampton Square, 1835.
Mantir, G., 71, Snow Hill, 1830.
Manwaring, Thomas, C.C., 1694.
Marchant, Samuel, admitted C.C., 1700; warden, 1704; did not serve as master, 1700–1705.
——, —, Prince's Street, Leicester Fields, nephew of — Archambo, 1750.
——, **William**, 255, High Holborn, 1775–1783.
——, **M.**, 350, Oxford Street, 1823.
Marchet, Richard, Fulwood Rents, Holborn, 1790.
Marder, Henry and William, 20, Artillery Place, Finsbury, 1842.
Marduit, Isaac, admitted C.C., 1724.
Margary, —, 4, Wallbrook, 1790.
Margetts, George, 21, King Street, Cheapside, 1785; 3, Cheapside, 1804; a celebrated maker, admitted C.C., 1779; livery, 1799. In the B.M. is a superb watch movement by him. It shows ordinary time, the month, day of the month, north and south declination, time of high water and the constellations. Another example of his work is a timepiece named on dial, "Margett's eight-days timepiece, 202," and on plate, "Geo. Margetts, London, Invt. et fecit, eight-day nautical chronometer." It is the size of a small two-day, with fusee and chain, great wheel running next top plate, spring detent, escape wheel of sixteen teeth, measuring ·470, and impulse roller a quarter the size of wheel, 1779-1810.
Margot, D., 19, Arlington Street, Clerkenwell, 1835.
Markham, Robert, behind the Exchange, 1737–1740.
——, **John**, London, known as a maker of watches for the Dutch market, 1760–1780.
Marks, L., 127, Jermyn Street, St. James's, 1830–1835.
——, **Lewis**, 59, Prince's Street, Leicester Square, 1840–1842.
Markwick, James, Royal Exchange, 1675; apprenticed to Edward Gilpin, C.C., 1666. "Dropt the 3rd

instant between the Cross-Keys in Holborn, and the Temple Gate, a Gold Pendulum Minute watch, made by Jacobus Markwick, London. Whoever brings it to Mr. Wilkinson at the Black Boy against St. Dunstan's Church, in Fleet Street, shall have 3*l* reward" (*London Gazette*, July 6–9, 1691).

Markwick, James, admitted C.C., 1692; master, 1720; 1692–1721.

——, **James**, London; several specimens of his work in the B.M. One, in very large silver cases, is inscribed, "Made for F.B., M.D.," another, a clock-watch of a slightly later period; 1760–1780.

——, **Markham**, behind the Royal Exchange, maker of a watch movement in the Guildhall Museum, rolling verge, balance wheel teeth cut the reverse way; another with elaborate pillars; also known as a maker of long-case clocks; 1720–1740.

Marquet, —. "That divers Watches and Pocket Clocks which were Mr. Samuel *Betts*, deceased, are to be sold at his late shop, now the shop of Mr. Marquet, watchmaker, on the backside of the Royal Exchange" (*London Gazette*, February 28, March 2, 1675).

Marriott, John, admitted C.C., 1715.

——, **W.**, 10, Fetter Lane, about 1760.

——, **John**, musical clockmaker, 10, Fleet Lane, 1782; 175, Fleet Street, 1790; master, C.C., 1799; 1782–1800.

——, **J.**, 148, Aldersgate Street, 1806–1810.

——, **William and J.**, 27, Fenchurch Street, 1823–1830.

Marsden, John, admitted C.C., 1698; master, 1731; 1698–1732.

——, **Samuel**, 4, Leathersellers' Buildings, 1820.

——, **Samuel**, 23, Great Winchester Street, 1835–1842.

Marsh, Anthony, at y^{e} dial opposite Bank of England, C.C., 1724.

——, **Jacob**, 78, Lombard Street, 1754–1768.

——, **James and Samuel**, 79, Broad Street, Ratcliff, 1790–1810.

Marsh, James, watch movement maker, 22, Tysoe Street, Clerkenwell, 1835.

——, **J.**, watch-case maker, 35, Clerkenwell Green, 1835.

——, **Edward and John**, 61, Whiskin Street, Clerkenwell, 1840.

——, **H.**, 20, Down Street, Piccadilly, 1840, 1842.

Marshall, Benjamin, C.C., 1680.

——, **John**, Rainbow Coffee House, Cornhill, apprenticed to D. Quare; admitted C.C., 1689.

——, **Samuel**, admitted C.C., 1689.

——, **Samuel**, admitted C.C., 1718.

——, **John**, Newark, maker of long-case calendar clocks, cast dial plates, about 1730.

——, **E.**, 61, Cannon Street, 1825–1830.

——, **William**, 3, Corporation Lane, 1823; 6, Percival Street, 1830–1835.

Marster, W. J., 26, Bartlett's Buildings, Holborn, 1825.

Marston, William, admitted C.C., 1669.

——, **John**, 4, Oxenden Street, Haymarket, 1842.

Marten, Henry and William, 20, Bunhill Row, 1840.

Martin, John, White Gate Alley, admitted C.C., 1679; threatened in 1682 with prosecution by C.C. for undue taking of apprentices, 1679–1686.

——, **Abraham**, engraver, C.C., 1682.

——, **Jeremiah**, apprenticed to Tompion and Dent; C.C., 1687.

——, **Richard**, Northampton, maker of lantern clocks, about 1695

——, **Thomas**, Royal Exchange, admitted C.C., 1699.

——, **William**, Bristol, maker of lantern clocks, about 1700.

——, **William**, admitted C.C., 1709.

——, **John**, 16, Brownlow Street, Bedford Row, 1763–1769.

——, **Benjamin**, maker of a curious table clock, 1770.

——, **Thomas**, 27, Cornhill, 1778–1781; St. Michael's Alley, 1788; 1781–1790.

——, **Edmund**, 44, Queen Street, Cheapside, 1790.

——, **J. F.**, 26, High Street, Marylebone, 1810.

Martin, G., 13, Church Lane, Whitechapel, 1835.

——, **H.**, Bunhill Row, Chiswell Street, 1835.

——, **James**, 26, Hanway Street, 1835.

——, **M.**, 18, Aylesbury Street, Clerkenwell, 1835.

——, **William**, 75, King Street, Westminster, 1810–1840.

—— **and Mosse**, 8, Charing Cross, 1835.

Martineau, Joseph, St. Martin's Court, maker of gold repoussé watches, 1770; 65, Red Lion Street, Clerkenwell, 1790.

Martinot, Barnaby, Farringdon Within, 1618. "A four-square Gold Watch, made at Paris by Monsieur Martinot. Information to be given to Mr. East, watchmaker, at Charing Cross" (*London Gazette*, June 4–7, 1677).

Mascarone, Gio. Batt., said to be the maker of a padlock-shaped watch, shown on p. 56, about 1635.

Masey, Thomas, mended St. Mary's Clock, Oxon., 1550.

Mason, Richard, admitted C.C., 1632.

——, **William**, admitted C.C., 1688.

——, **Samuel**, admitted C.C., 1712.

——, **John**, admitted C.C., 1712; maker of a lantern clock, square dial, cherub corners, bob pendulum; 1712–1720.

——, **Henry**, admitted C.C., 1715.

——, **John**, C.C., 1718; maker of long-case clocks, 1718–1730.

——, **William**, near East Lane, Rotherhithe Wall, 1760–1769; Dockhead, Southwark, 1781–1783.

——, **Robert**, 11, Strand. In 1790 he sent a letter to the Clockmakers' Company respecting watches seized on his premises; 1788–1790.

——, **John**, 3, Helmet Row, Old Street, 1820.

——, **John**, 1, Jubilee Street, Mile End, 1840.

Masquerier, Lewis, 12, Coventry Street, 1780–1785.

——, **William**, Gerrard Street, Soho, 1790.

—— **and Perigal**, Coventry Street, 1775.

Masse, James, Broad Street, 1753–1760.

Massey, Edmund, C.C., 1682.

——, **Henry**, Charles Street, near St. James's Square, 1707; admitted as a brother C.C., 1692; maker of a thick round silver verge, silver dial, showing day of the month, elaborately pierced movement; 1692–1696.

——, **Nicholas**, Cranbourne Street, near Leicester Fields; admitted as a brother, C.C., 1693; a watch movement by him with an index on top of the cock in the Guildhall Museum. "Lost the 17 instant, between the Haymarket and Temple Bar, a new Silver Pendulum Watch made by Nich. Massy, with a tortoise-shell studded case, the studs wrought, and the case lined with red sattin; and 2 seals" (*London Gazette*, Nov. 24–28, 1692); 1690–1700.

——, **Jacob**, Leicester Fields; admitted as a brother, C.C., 1785; maker of a black arch bracket clock, 1715–1725.

——, **John**, 40, Bridge Road, Lambeth, 1820.

——, **Benjamin**, 116, Leadenhall Street, 1823–1826.

——, **Edward**, 28, King Street, Clerkenwell, a Staffordshire watchmaker who settled in London. Inventor of a form of lever escapement called the crank roller (see p. 262), and forms of keyless winding for watches (see p. 241). He died in 1852, aged 82, and was buried at St. John's, Duncan Terrace, Islington.

——, **John**, 40, Bridge Road, 1830; 89, Strand, 1840.

——, **E. J.**, 3, Tysoe Street, Spafields, 1835.

——, **C.**, 40, Bridge Road, Lambeth, 1823-1835.

——, **F. J.**, 17, Chadwell Street, 1840-1842.

——, **T.**, 32, Wilmington Square, 1835–1840.

——, **Thomas**, 4, Birchin Lane, 1840–1842.

——, **Edmund**, 89, Strand, 1842.

——, **Edward, James**, 78, Cornhill, 1842.

Massy, Nicholas (French), C.C., 1682.

Massy and Windham, 4, Birchin Lane, 1835.

Master, W. J., 26, Bartlett's Buildings, 1823.

Masterman, J., White Hart Court, Gracechurch Street, 1769–1773.

Masters, William, admitted C.C., 1701.

——, **James**, livery, C.C., 1810; 1800–1811.

Masterton, Richard, at the Royal Exchange; admitted as a brother, C.C., 1633; master, 1642; died 1653. In the Guildhall Museum is an oval watch by him, cockle-shell case, plain silver dial, hour hand only, catgut; 1618–1653.

Matchett, John, Covent Garden, admitted C.C., 1648; signed a petition against the company's oppression, 1656; assistant, 1670, but suspended, as well known to be a popish recusant, 1678. "Lost on the 11th inst. about Lincoln's-Inn-Fields or Covent Garden, a silver watch ingraven with several Figures, made by John Machett, a studded case with silver Pins" (*London Gazette*, June 12–15, 1676); 1648–1680.

Matham, Robert, 66, Newgate Street, 1783.

Mather, Samuel, admitted C.C., 1691.

Mathew, Francis, admitted C.C., 1656.

Mathews and Thorp, 10, Artillery Place, 1840–1842.

Matthew, John, admitted C.C., 1731; maker of long oak-case clock, with day of the month circle; 1731–1740.

Matthews, William, 27, Fleet Street, admitted C.C., 1731; livery, 1766; one of the examiners of Harrison's timekeeper in 1765; 1731–1766.

——, **John**, 36, Goswell Road, 1840.

Mattocks, John, summoned to livery C.C., 1786; 1780–1787.

Maude, Benjamin, 53, St. Martin's-le-Grand, 1783–1790.

——, **Edward**, 53, St. Martin's-le-Grand, 1800–1808.

Maurer, Johann, in Fiessna. In the B.M. is a small skull-watch by him, 1650–1660.

May, William, admitted C.C., 1679.

May, John (Dutch), admitted as a brother, C.C., 1692.

——, **Samuel**, 51, Myddleton Street, Clerkenwell; an expert watch and chronometer springer; died 1871, aged 58; 1840–1871.

Mayes, John, 8, Lower Charles Street, Goswell Road, 1842.

Mayland, Thomas, admitted C.C., 1698.

Maynard, Christopher, apprenticed to Hacket, admitted C.C., 1667.

Mayo, Joseph, Craven Street, Strand, 1769.

——, —, Coventry, about 1780–1790.

Mayson, John, admitted C.C., 1704.

Mead, William, 1, Corporation Lane, Clerkenwell, 1835.

Meade, Garrett, admitted C.C., 1703.

Meades, Thomas, admitted C.C., 1687.

Meak, John, musical clock and watchmaker, 7, Worship Street, Shoreditch, 1825.

Meanley, —, maker of a pair-case verge watch, with an engraving on the back representing the Queen of Sheba before Solomon; about 1770.

Mears, watch engraver, 48, Cloth Fair, 1790.

Measure, A., 420, Strand, 1815–1820.

Medhurst, Richard, Croydon, admitted as a brother, C.C., 1687.

Meigh, Moses, admitted C.C., 1712.

Mellin, Gui., Blackfriars, maker of an oval watch in the B.M., glass over the dial, 1600–1620.

Melville, John, hon. freeman, C.C., 1781; 1770–1782.

—— **and Stoddart**, 61, Red Lion Street, Clerkenwell, 1804–1810.

——, **Robert**, 40, King Street, Clerkenwell, 1835.

Menessie, Elisha, Aldersgate Street, 1790–1795.

Meniall, James (French), threatened with prosecution by C.C. for exercising the art, not being admitted, paid costs and was admitted forthwith, 1682.

Menzies, John, 4, Charles Street, Northampton Square, 1840–1842.

Mercer, John, Hythe, maker of long-case clocks, about 1720.

—— **Brothers**, Coventry, about 1770–1790.

Merchant, Samuel, C.C., 1677.

Meredith, Lancelot, signed a petition against the tyranny of C.C., 1656.
——, **John,** admitted C.C., 1664.
Merigeot, John, livery, C.C., 1766.
Meriton, Samuel, 18, Foster Lane, Cheapside, 1800.
Merny, Charles, Spitalfields, liveryman, C.C., 1776.
Merrick, Joseph, 28, Paul Street, Finsbury, 1835-1842.
Merrill, Charles, livery, C.C., 1810; 1800-1811.
——, **H.,** Hill Street, Richmond, 1840.
Merriman, Benjamin, admitted as a brother, C.C., 1682.
Merrin, Henry, 100, High Street, Shadwell, 1840-1842.
Merry, Charles, master, C.C., 1768; 1755-1769.
Merryman, Henry, C.C., 1674.
Merttins, George, Cornhill, goldsmith and watchmaker, succeeded to the business of his father; admitted C.C., 1688; master, 1713; knighted, 1713; Lord Mayor, 1724; died 1727; 1688-1727.
Mesniel, James (French), admitted as a brother, C.C., 1682.
Mestager, Henry, C.C., 1712.
Mesure, A., 420, Strand, 1823.
Metcalf, George Marmaduke, Round Court, St. Martin's-le-Grand, admitted C.C., 1781; summoned to livery, 1786; 122, Newgate Street, 1794; 1781-1825.
——, **J.,** 146, Oxford Street, 1830.
Methem, Robert, 66, Newgate Street, 1775.
Micabius, John. C.C. ordered him to be sued for failing to pay a promised contribution towards incorporation, 1632.
Michant, Daniel, 28, Greek Street, 1794.
Michells, 63, St. Mary Axe, 1830.
Micklewright, Erasmus, C.C., 1673.
——, —, admitted C.C., 1708.
Middleditch, John, 156, High Street, Shadwell, 1835-1842.
Middleton, William T., 10, Grenada Terrace, Commercial Road, 1835-1842.
Midnall, John, in Fleet Street, one of the first assistants, C.C.; maker of a small oval watch said to have belonged to Oliver Cromwell; also a silver watch with flowers engraved on the outer case; 1625-1633.
Milborne, John, admitted C.C., 1698.
Miles and Morgan, 32, Ludgate Street, 1790.
——, **Septimus,** 32, Ludgate Street, 1794; livery, C.C., 1810; 8, Little Carter Lane, Doctors' Commons, 1825; 1794-1842.
Mill, David, admitted as a brother, C.C., 1655-1659.
Miller, John, admitted C.C., 1674.
——, **Peter,** admitted C.C., 1681.
——, **Ralph,** admitted C.C., 1697.
——, **Joseph,** admitted C.C., 1728.
——, —, Lurgan, Ireland, maker of a curious clock in which the hour was uttered by a human figure, as appears from the journal of the Rev. John Wesley, in a clear articulate voice, 1762.
——, **T.,** maker of a pair-case watch, outer case tortoiseshell, painted dial, hall-mark, 1777.
——, **Charles,** 29, Aldgate Within, 1823-1825.
——, **R.,** 2, George Street, Commercial Road, 1835.
——, **F., and Co.,** 10, Broad Street, Bloomsbury, 1835-1840.
——, **James,** 262, High Street, Poplar, 1842.
——, **Robert,** 4, Upton Place, Commercial Road, 1842.
Millet, William, admitted C.C., 1714.
Millett, Edward, admitted C.C., 1680.
Millington, Thomas, 31, Gutter Lane, Cheapside, 1760-1769.
——, **Thomas,** 33, Wapping, 1790.
Million, William, Blackfriars, admitted C.C., 1671.
Mills, Thomas, in Shoe Lane, admitted as a brother, C.C., 1652; maker of lantern clock with Dolphin frets; another example inscribed "Tho. Mills, Soe Lane, Londini," 1648-1660.
——, **Ralph,** admitted C.C., 1697.
——, **Robert,** 141, Ratcliff Highway, 1790.
——, **Septimus,** 32, Ludgate Hill, 1804-1808.
——, **Thomas, and Son,** 91, Bishopsgate Without, 1823.

Mills, George, 141, Goswell Street, 1825.

Milner, Thomas, London, maker of long-case clocks, about 1780.

——, **Henry**, 7, Vere Street, Oxford Street, 1815.

Milward, George, 2, Little Brook Street, 1806–1815.

Minchinale, William, C.C., 1701.

Misplace, R., about 1760.

Mitchell, Myles, admitted as a brother, C.C., 1640.

——, **John**, St. James's Street, admitted C.C., 1712.

——, **Robert**, livery, C.C., 1766; 1712–1776.

——, **Samuel**, St. James's Street, maker of a repeating watch, hall mark, 1776; 1776.

——, **V.**, 6, Cornhill, 1768–1788.

—— **and French**, 5, Clerkenwell Close, 1825.

Mitchelson, James, Throgmorton Street, 1753–1756.

——, **Alexander**, 45, Michael's Alley, Cornhill, 1769–1772.

——, **Walter**, 3, Helmet Row, Old Street, 1780–1800.

Mitford, John, apprenticed to St. George Mertins, of Cornhill, whose daughter he married in 1714, when he was 19 years old. £200 stock of the Exchange Assurance Association standing in his name, which, with interest, had accumulated to £6600 in 1883, was then ordered by Mr. Justice Williams to be paid to his nearest relatives; 1714–1738.

——, **Robert**, Cornhill, liveryman, C.C., 1776.

Moginie, Samuel, 1, Prince Row, Pimlico, 1830–1842.

Moinet, M. L., author of "Nouveau Traité Général Astronomique et Civil d'Horlogerie Théorique et Pratique;" Paris, 1848.

Molee, P., 44, Great Sutton Street, Clerkenwell, 1835.

Molens, Charles, admitted C.C., 1709.

Molleson, Thomas, 62, Cornhill, 1788.

Molyneux, Robert, a chronometer maker who carried on business at 44, Devonshire Street, Queen's Square, and afterwards in King Street, Holborn; inventor of a compensation balance with auxiliary (Patent No. 8418, March, 1840). (See p. 221.)

Molyneux, R., and Sons, 30, Southampton Row, Russell Square, 1835–1842.

Moncas, John, 75, Myddelton Street, Spitalfields, 1835.

Monday, Joseph, admitted C.C., 1654.

Monkhouse, Thomas, Duke Street, fecit, anno 1759, inscription on the barrel of a fine 8-day long-case clock with high numbered train, end pieces, and all the repeating work pivoted with cocks. On the dial the name Curteen, 1759.

Monnier, John, 38, Southampton Street, Strand, 1820–1823.

Monro, Benjamin, 13, Moor Street, Soho Square, 1830–1842.

Moodie, David, admitted C.C., 1649.

Moody, Charles, 45, Rupert Street, Piccadilly, 1825.

Moon and Co., 4, Holborn Bars, 1790.

——, **Christopher**, 4, Lower Holborn, 1810.

——, **William**, 4, Lower Holborn, 1815–1842.

Moor, William, admitted C.C., 1701.

Mooran, Andrew, London, maker of clocks, about 1760.

Moore, Peter, 15, Sweeting's Alley, maker of verge watch, square pillars, in the Guildhall Museum, 1808–1814.

——, **Joseph**, admitted C.C., 1690.

——, **Daniel**, admitted C.C., 1697.

——, **E.**, 37, Gracechurch Street, 1775.

——, **John**, 118, Fleet Street, 1769–1775.

——, **William**, 55, Paternoster Row, 1783.

—— **and Gearing**, 55, Paternoster Row, 1783.

—— **and Starkey**, 89, St. Martin's Lane, 1823.

——, **Patrick**, 15, Sweeting's Alley, 1806–1810.

——, **E. T.**, 37, Clement's Lane, 1823; 8, Prospect Place, Kingsland, 1835.

——, **George**, 23, Percival Street, Clerkenwell, 1840–1842.

—— **and Sons**, Clerkenwell Close, 1810–1842.

Moran, Andrew, Earl Street, St.

Giles. This name appears on the disc at the top of an arch-dial eight-day long-case clock at the Crown, Harlesden, where it is stated to have been since 1740.
More, Charles, 19, Holywell Row, Shoreditch, 1840-1842.
Morgan, Richard, petitioner to Charles I. for incorporation of C.C., and one of the first assistants of C.C., 1629-1649.
——, **Robert**, admitted as a brother, C.C., 1639.
——, **Jude**, admitted as a brother, C.C., 1654.
——, **Thomas**, admitted C.C., 1658.
——, **William**, Southwark, 1696.
——, **John**, admitted C.C., 1703.
—— **and Mills**, 32, Ludgate Hill, 1790.
Morice, David, and Son, Fenchurch Street, 1804-1823; 86, Cornhill, 1835.
Moriffet, R. and C., 22, Denmark Street, Soho, 1783.
Morland, William, Red Cross Street, 1780-1785.
Morlière, born at Orleans, excelled as a watch-case enameller at Blois, about 1650.
Morris, Henry, 82, Fleet Street, 1753-1775.
——, **John**, admitted C.C., 1799.
——, **T.**, 68, Bell Dock, Wapping, 1794.
Morrison, Richard, 15, Cheapside, 1769-1783.
——, **William N.**, 33, Ludgate Hill, 1840.
——, **John**, Packington Street, a well-known clockmaker, died 1893, aged 77.
Morse, Richard, 8, Charing Cross, 1840-1842.
Morson and Stephenson, 98, Fleet Street, 1760-1772.
——, **Richard**, 12, Ludgate Street, 1775.
Mortland, William, 17, Redcross Street, 1790.
Morton, Samuel, 210, Borough, 1775.
Moseley, William, C.C., 1680.
Mosely, Elinor. Elizabeth Askell was bound apprentice to her in 1734; C.C., 1726-1734.
——, **M.**, 28, Goulston Square, Whitechapel, 1804; 6, Bevis Marks, 1815-1835.
Mosely, Ephraim, 48, Leadenhall Street, 1840-1842.
——, **Moses**, 26, Bury Street, 1840-1842.
——, **Robert, and Son**, 113, Fetter Lane, 1840-1842.
Moser, George Michael, *temp.* Geo. I., II., maker of fine repoussé watch-cases, 1716-1730.
Moses, Ephraim, 135, Whitechapel, 1790.
Moss, Thomas, 24, Ludgate Street; livery, C.C., 1775-1823.
——, **John**, 106, Holborn Hill, 1825.
——, **B.**, Tabernacle Walk, 1835.
Motley, Richard, admitted C.C., 1682.
Mott, William, 91, Bishopsgate Street Without, 1830.
Motteux, Samuel, C.C., 1697.
Mottram, John, Warden Court, Clerkenwell Close, 1790.
Mottu Brothers, 11, Richmond Buildings, Soho Square, 1840-1842.
Mouline, A., and Co., 29, Percy Street, Tottenham Court Road, 1842.
Moulton, Henry, admitted C.C., 1685.
——, **Samuel**, 210, Borough, 1800.
Mount, William, admitted C.C., 1692.
Mountford, Zachariah, St. Albans; admitted C.C., 1684.
Mowlton, Conan, admitted C.C., 1700.
——, **Henry**, admitted C.C., 1715.
Moysant, —, Blois, maker of a watch in the Massey-Mainwaring Collection, case finely painted in enamel (see p. 53).
Moyse, —, Blois, maker of skull watch (see p. 51), 1587.
Muckarsce, James, 47, High Holborn, 1794.
Mudge, Thomas, Fleet Street, a celebrated maker; admitted C.C., 1730 (see pp. 124-127), 1730-1794.
—— **and Dutton**, 148, Fleet Street, 1780-1794.
Mulford, John, died while warden C.C., 1748; 1730-1748.
Muller and Thum, 40, King Street, Soho, 1842.
Munden, Francis, admitted as a brother, C.C., 1653.
——, **Francis**, admitted C.C., 1670.
Murray and Strahan, Cornhill, 1825.

Murray, James, 30, Cornhill, 1829-1842.

Mussard, Daniel (Genevese), admitted as a brother, C.C., 1686; maker of a watch in the Hamilton Collection, bought by Lord Moray at the auction sale in 1882, for £154 10s. Portraits of the Stuart family were enamelled thereon; 1670-1690.

Muston, George, Red Lion Street, Clerkenwell, 1835-1842.

Myddleton, Timothy, C.C., 1687.

Myers, John, 255, High Holborn, 1790.

——, **John**, 255, Borough, 1783-1804.

——, **Henry**, 164, Ratcliff Highway, 1804.

——, **Moses**, 152, Regent Street, 1830.

——, **Abraham**, 79, Leman Street, 1840-1842.

Mylne, G. E., Upper Chadwell Street, maker of high-class watches, sometime hon. secretary to the Horological Institute, 1835-1868.

Myson, Jeremiah, C.C., 1698.

Nadauld, William, 129, Hounsditch, 1804-1820.

——, **W. R.**, White Hart Court, Lombard Street, 1819-1823.

Naizon, Francis, 42, Poultry, 1780-1785.

Nash, Thomas, admitted C.C., 1717.

——, **Samuel**, 11, Broadway, Blackfriars, 1790.

Nathan, Henry, Ratcliff Highway; admitted C.C., 1673; maker of long-case clocks, 1673-1700.

——, **Phineas**, 9, Magdalen Row, 1840-1842.

Nau, Richard, admitted C.C., 1661.

——, **George**, admitted C.C., 1675.

Naudey, Francis, 59, Dean Street, Soho, 1842.

Neale, John, Leadenhall Street, 1753-1759.

Needham, Benjamin, C.C., 1709.

——, **Charles**, 55, Piccadilly, 1825.

Neighbour, William, C.C., 1685.

Neild, James, St. James's Street, 1755; 4, Upper Thames Street, 1788.

Nelmes, Robert, admitted C.C., 1717.

——, **Robert**, 38, Upper King Street, Bloomsbury, 1842.

Nelson, James, apprenticed to Oswald Durant, 1638; admitted C.C., 1645; maker of an astronomical watch in Guildhall Museum.

Nelson, Robert, admitted C.C., 1697.

——, **John**, 15, Hayfield Place, Mile End, 1842.

——, **Thomas**, London, chronometer maker, 1850-1882.

Nemes, John, admitted C.C., 1724.

Neuens, Peter, 32, Bread Street, 1840-1842.

Neuren, D. D., London, known as a maker of verge watches, about 1790.

Neuwers, Michael, makes a clock for the Earl of Shrewsbury (see p. 47), 1599.

Neville, J., London, a maker of watches, about 1704.

Newbrough, Jeremiah, London, maker of long-case clocks, about 1700.

Newby, John, 3, Judd Street, Brunswick Square, 1825.

Newell, William, livery, C.C., 1810.

Newman, Joseph, 30, Great Alie Street, 1790.

——, **John**, 49, Lombard Street, 1775-1783.

——, **John**, 17, Piccadilly, livery, C.C., 1804-1825.

——, **Robert**, livery, C.C., 1810.

——, **William**, 109, Golden Square, 1840-1842.

Newnham, Nathaniel, C.C., 1703.

Newsam, Bartholomew, Strand. He was appointed, in 1572, clockmaker to Queen Elizabeth, in succession to Nicholas Urseau (see p. 62), 1570-1590.

Newton, George, London, about 1680.

——, **William**, admitted C.C., 1685.

——, **Thomas**, Fenchurch Street, 1753-1856.

——, **John**, 76, Lamb's Conduit Street, 1788; 10, Great Ormond Street, 1788-1715.

——, **Alexander, Levi, and Co.**, 4, Bury Street, St. Mary Axe, 1839-1842.

Nicasius, John, admitted C.C., 1632; several times fined for abuse and disrespect, and in 1679 was suspended from being assistant; master, 1653-1655; 1632-1680.

Nichol, Isaac, admitted C.C., 1681.

Nicholas, W., 158, Tooley Street, 1825.

Nicholas, Samuel, and Son, 158, Tooley Street, 1835–1840.

Nicholls, Roger, admitted C.C., 1667.

——, **Thomas,** admitted C.C., 1707.

——, **John,** clock-case maker, 6, Red Lion Street, Clerkenwell, 1804–1810.

Nichols, Thomas, apprenticed to Edward East; admitted C.C., 1720.

Nicholson, John, 53, Cornhill, 1822–1830.

Nickisson, S., Ashby Street, 1815–1840; 33, Northampton Square, 1842.

Nicole, John, keeper of the great clock within the palace of Westminster in 1731, his wages being sixpence a day; 1371.

Nicoll, William, 117, Great Portland Street, Oxford Street, 1790–1835.

——, **John,** 117, Great Portland Street, Oxford Street, 1840–1842.

Nightingale, William, Red Lion Street; liveryman, C.C., 1776–1790.

Niloe, Hans (Dutch), maker of a musical clock for James I. In August, 1609, Sir Julius Cæsar writes to the Clerks of the Signet to the effect that Niloe is pressing for the £300 due to him for the clock; 1609.

Noades, J., Strand, 1775.

Noakes and Nylder, 129, Houndsditch, 1790–1794.

——, **James,** watch movement maker, 34, Charterhouse Street; livery, C.C., 1776; 1790.

——, **James,** 126, Houndsditch, 1800; 24, Bishopsgate Street Within, 1810; 1800–1815.

Noble, William, 2, Cow Cross Street, 1804.

—— **and Harrison,** 35, Fetter Lane, 1822–1825.

——, **C.,** 211, Strand, 1830.

Nobson, John, apprenticed to Daniel Quare; admitted C.C., 1697.

Nodes, John, Strand, 1770–1775.

——, **William,** 126, New Bond Street. In 1790 he wrote to C.C. respecting watches seized on his premises; 1783–1790.

Noel, Aymé, maker of a watch, B.M., crystal case, dial and outer case of silver, about 1620.

Noon, —, seller of lamp clocks at the White Hart, in the Poultry, 1731.

Nor, P. H., maker of a clock at S.K.M., 1505.

Norcot, John, admitted C.C., 1681.

Norgate, John, admitted C.C., 1712.

Norman, Samuel, 50 and 51, Prince's Street, Leicester Square, 1825.

Norris, Joseph, admitted C.C., 1670.

——, **Edward,** at the Cross Keys in Bethlem; admitted C.C., 1658; master, 1658; maker of full-size lantern clock, balance escapements, dolphin frets, inscribed, "Edward Norris, at the Cross Keys in Bethlem, Londini," 1658–1686.

——, **Charles,** admitted C.C., 1687.

——, **Charles,** 18, Gracechurch Street, 1783.

North, William, admitted as a brother, C.C., 1639; maker of an oval watch, silver case, B.M. (see p. 66), 1620–1639.

——, **John,** admitted C.C., 1650.

——, **John,** admitted C.C., 1720.

——, **William,** White Hart Yard, Drury Lane, 1790.

——, **Richard,** 44, Lombard Street, 1772–1800.

——, **Thomas,** 2, Old Compton Street, 1820.

Northam, G., musical clockmaker, Tabernacle Square, Finsbury, 1825.

—— **and Son,** 49, Greek Street, Soho, 1825.

Northcote, Samuel, elder brother of James Northcote the artist, was sent to London to Mudge to be instructed in watchmaking, 1766.

Northley, J., 181, Brick Lane, 1790.

Norton, Thomas, admitted C.C., 1720.

——, **Samuel,** Fish Street Hill; liveryman, C.C., 1776; 1770–1780.

——, **Eardley,** 49, St. John's Street, Clerkenwell, a well-known maker of musical and astronomical clocks. In 1771 he patented (No. 987) "a clock which strikes the hours and parts upon a principle entirely new; and a watch which repeats the hours and parts, so concisely contrived and disposed as to admit of being conveniently contained not only in a watch but also in its appendage, such as a key, seal, or trinket." There is in Buckingham Palace an astronomical clock with four dials he made for George III. Another example of his work is a splendid four-train, repeating, and musical clock in the possession of Mr. J. E. Whiting, Andover, Mass., U.S.A., and formerly the property of Mr. Edward Savage, Mr. Whiting's grandfather. It is 28 in. high, chimes the quarters on 8 bells, and plays on 16 bells one of 11 tunes every three hours; 1770–1790.

Norton, Graham, maker of a clock, about 1790.

——, **B.,** watch-case maker, 59, Banner Street, 1835.

Nourse, Thomas, livery, C.C., 1766.

Nouwen, Michaell, London. In the B.M. is a watch with an irregular octagonal-shaped crystal case, the plates are enamelled, a choice specimen of the period; 1600–1620.

Nowroe, Thomas, 22, Beech Lane, 1790.

Nurse, John, admitted C.C., 1718.

Oakes, Richard, shagreen case maker, 86, Snow Hill, 1775.

——, **John,** Grub Street, 1775–1780.

Oakley, William, 4, High Street, St. Giles, 1804–1820.

Ogden, Thomas, admitted C.C., 1659.

Okeham, Thomas, admitted C.C., 1632.

Oliver, Thomas, 17, Fleet Street, 1780; 2, Brook Street, Hanover Square, 1790–1800.

Ordson, William. In the Guildhall Museum is a verge watch by him, square pillars, enamel dial, the hours represented by letters forming the name "James Newman *," about 1720.

Orford, Robert, 71, Oxford Street, 1795–1810.

Orpwood, Richard, 7, Worship Street, Finsbury.

——, **G.,** 58, Bishopsgate Within, 1830–1840.

Orr, P., 17, Myddelton Square, Clerkenwell, 1840.

Orton, Edward, admitted C.C., 1687.

——, **William F.,** 5, York Road, 1835.

Osborn, William, admitted C.C., 1700.

Osmont, Jean B., 41, Strand, 1840; 6, Victoria Road, Pimlico, 1842.

Otley, Thomas, 55, Piccadilly, 1823.

Oughtred, Benjamin, admitted as a brother, C.C., 1639; author of several books on mathematics, including "Clavis Mathematicæ." Derham speaks of him with admiration; 1639–1680.

Overbury, Thomas, admitted as a brother, C.C., 1688.

Overzee, Gerard, Isleworth (naturalized), admitted as a brother, C.C., 1678; known as a maker of lantern and other clocks, 1670–1690.

Owen, Ben, London, completed his apprenticeship, 1694; maker of long-case clocks, 1694–1740.

——, **William,** Cheapside, 1737–1740.

——, **Joseph,** 10, Helmet Row, Old Street, 1800; 243, St. Margaret's Hill, 1810.

Pace, Thomas, at the Crown in Fleet Street, maker of several small-sized lantern clocks, originally with balances, frets Fig. 103; 1630–1660.

——, **Jno.,** 19, Cock Hill, Ratcliff, 1790.

——, **Thomas,** 128, Whitechapel, a well-known maker of bracket and long-case clocks, 1788–1840.

——, **Edmund,** 21, Thavies Inn, Holborn, 1840–1842.

——, **Charles,** 128, Whitechapel High Street, 1842.

——, **Henry,** 11, Green Terrace, Clerkenwell, 1842.

Pacificus, Archdeacon, Verona, one of those to whom the invention of wheel and weight clocks is ascribed. Claim disputed by Ditmar; 850.

Pack, Richard, admitted C.C., 1712.

Packer, William, 376, Oxford Street, 1840.

Page, Joseph, admitted C.C., 1683.

——, **Henry,** admitted C.C., 1713.

——, **John,** 129, Strand, 1790.

Paget, Ambrose, admitted C.C., 1728.

Pagnes, William, Butcher's Row, East Smithfield; maker of lantern clocks, about 1690.

Pain, William, admitted C.C., 1729.

——, **Thomas,** known as a maker of long-case clocks, about 1780.

Paine and Balleston, 5, Banner Street, 1840.

——, **John P.,** 33, High Street, St.

Giles's; received in 1826 a silver medal from the Society of Arts for a method of illuminating dials; 1826–1840.
Palfrey, John, admitted C.C., 1654.
Palmer, Robert, liveryman, C.C., 1776.
——, **Thomas,** Fetter Lane, liveryman, C.C., 1776.
——, **William,** Shoe Lane, liveryman, C.C., 1776.
——, **Thomas,** 132, Lower Holborn, 1783–1810.
——, **Samuel,** gold watch-case maker, 2, Red Lion Street, 1790–1810.
——, **B.,** 21, King Street, Covent Garden, 1830.
——, **John,** 58, Great Marylebone Street, 1825–1835.
——, **Robert,** 24, White Hart Place, Kennington, 1835–1842.
——, **Henry,** 25, Buttesland Street, Hoxton, 1842.
Pamphillon, William, C.C., 1725.
Panchard, David, 202, Oxford Street, 1790.
—— **and Cummin,** 202, Oxford Street, 1810.
Pantin, Lewis, 45, Fleet Street, 1770-1775.
——, **Lewis,** 62, St. Martin's-le-Grand, 1800.
Papanoine, Isaac (French), Duke's Court; admitted as a brother, C.C., 1687; maker of long-case clocks, 1680–1710.
Papworth, John, admitted C.C., 1688.
Paradise, John, admitted C.C., 1716.
——, **John,** 13, Newcastle Street, Strand, 1823.
Parbury. This name is on a very fine repoussé gold watch case in the Mainwaring Collection.
Paris, John, watch engraver, 7, Dean Street, Fetter Lane, 1790.
Parish, Simon, admitted C.C., 1723.
Park, Nicholas, admitted as a brother, C.C., 1641.
Parker, Thomas, "in St. Ann's Lane, neere Aldersgate, fecit," inscribed on a lantern clock of ordinary make; admitted C.C., 1669; 1669–1675.
——, **John,** admitted C.C., 1674.
——, **John,** admitted C.C., 1678.
——, **Robert,** apprenticed to J. Markwick; admitted C.C., 1698.
Parker, John, admitted C.C., 1706.
—— **and Wakeling,** Panton Street, 1760–1775.
——, **John,** 55, St. Paul's Churchyard, 1775.
——, **Thomas,** 15, Wilderness Row, 1788.
—— **and Birketts,** 16, Prince's Street, 1804.
——, **John,** 2, Rathbone Place, 1804.
——, **James,** 17, King Street, Clerkenwell, 1835.
Parkington, W., 52, Paddington Street, 1840.
Parkinson, James, 4, Cross Street, Goswell Road, 1820.
——, **Henry,** 50, Great Sutton Street, 1835; 21, Red Lion Street, Clerkenwell, 1842.
—— **and Frodsham,** 4, Change Alley, 1806–1840.
——, **James,** 70, Red Lion Street, Clerkenwell, 1842.
Parnell, Thomas, High Street, Bow, 1835–1842.
Parr, William, author of a "Treatise on Pocket Watches," London, 1804.
——, **Thomas,** 27, Cheapside, 1735–1775.
Parsons, Richard, 54, Goswell Street, admitted C.C., 1690; maker of bracket and other clocks, 1690–1720.
——, **John,** admitted C.C., 1696.
——, **John,** 8, St. Martin's Court, 1775.
—— **and Horne,** Castle Street, Holborn, 1825.
Parten, William, admitted C.C., 1720.
Parter, William, admitted C.C., 1692.
——, **Francis,** admitted C.C., 1730.
Partington, J., High Street, Marylebone, 1790.
——, **William,** 53, Paddington Street, 1825–1842.
Partridge, Joseph, Bartholomew Close, 1760-1763.
——, **C.,** 13, Wentworth Place, Mile End Road, 1840–1842.
Pascal, Claude, à la Haye, on a splendidly decorated watch, about 1650.
Pashler, —, Bishopsgate Street, 1774.
Passanine, Isaac, Duke's Head Court, Cannon Street, maker of long-case clocks, about 1770.

Passement, —, maker of equation clocks, about 1700.
Patching, Elisha, C.C., 1728.
Paten, Wm., maker of a verge watch movement in the Guildhall Museum, enamel dial, period about 1760.
Patmore, Peter, Ludgate Hill, C.C., 1813.
Patric, John, admitted as a brother, C.C., 1712.
Pattee, Thomas, livery, C.C., 1810; 1800–1811.
Patterson, Robert, C.C., 1668.
——, **George**, 16, King Street, Seven Dials, 1835.
Paul, Nowell, alien, threatened with prosecution for working as clockmaker within the liberties of C.C., 1668.
——, **Thomas**, admitted C.C., 1670.
Paulet, —. London, maker of a watch at S.K.M., 1703.
Paulin, Lewis, 45, Fleet Street, 1772.
Paull, P., 15, Cleveland Street, Fitzroy Square, 1810–1823.
——, **George**, 15, Cleveland Street, Fitzroy Square, 1830–1835.
Payn, John, Southwold, a smith, received 6*s.* 8*d.* for a new clock from the churchwardens of Walberswick, Suffolk, 1451.
Payne, H. and John, 44, Cheapside, 1753–1775.
——, **Southern**, Bridgewater Square, livery, C.C.; master, 1778; 1766–1779.
——, **J.**, 17, Foster Lane, 1794; 18, St. Ann's Lane, Aldersgate, 1800–1825.
——, **W.**, 62, South Moulton Street, 1820; 39, High Street, Bloomsbury, 1825.
——, **William**, 163, New Bond Street, 1830.
Payton, —, watch-case maker, 3, Addle Street, Wood Street, 1790.
Peachy, William, admitted C.C., 1727.
Peachey, Newman, Dean Street, liveryman, C.C., 1776; 1766–1778.
Peacock, George, 65, Threadneedle Street, 1769–1775.
——, **George**, 4, Sweeting's Alley, Cornhill, 1778–1781.
Pearce, Adam, admitted C.C., 1664.
—— **and Newton**, Newgate Street, 1760–1763.
Pearce, William, master, C.C., 1804; 1800–1804.
——, **John**, 101, Great Peter Street, Westminster, 1835–1840.
Pearkes, F., 15, St. Martin's Court, 1823.
Pearse, John, Newgate Street, 1753–1760.
Pearson, Mary, 31, Fleet Street, 1772–1775.
——, **the Rev. W., LL.D., F.R.S.**, author of the splendid treatise on horology which appeared in Rees' "Cyclopædia," published in 1819.
—— **and Price**, 11, Great Sutton Street, 1830.
Peatting, Thomas, C.C., 1682.
Peck, George, admitted C.C., 1725.
Peckett, John, admitted C.C., 1691.
——, **Henry**, Compton Street, Soho, bequeathed an old table clock by Zech to the Society of Antiquaries, 1770–1808.
Peckover, Richard, Change Alley, Cornhill, known as a maker of long-case clocks, 1737–1756.
Peere, —, admitted C.C., 1654.
Peirson, Worthy, 92, Whitechapel High Street, 1840.
Pelleter, Solomon, 14, Broad Street, 1775.
Penfold, Joshua, admitted C.C., 1695.
——, **Miles**, 115, Newgate Street, 1769–1775.
Penkethman, Thomas, C.C., 1692.
Pennington, Robert, chronometer maker, Camberwell; invented an improved form of sector, 1780–1816.
——, **Robert, and Son**, 11, Portland Row, Camberwell, 1832–1842.
Pennock, John, Lothbury, C.C., 1638; master, 1660; 1638–1670.
Penny, Richard, London, maker of verge watches, about 1690.
Penton, Charles, Upper Moorfields, 1770–1775.
Pepper, Thomas, livery, C.C., 1787; 1776–1788.
Pepys, Richard, admitted C.C., 1674.
——, **John**, admitted C.C., 1680; master, 1707. There is a watch by him in the B.M.; other examples are occasionally met with, 1680–1707.
——, **John, junior**, Fleet Street, ad-

mitted C.C., 1715; master, 1739; 1715-1748.
Pepys, William, admitted C.C., 1723.
Perchard, Matthew, Cannon Street, 1753-1759.
Percherd, Peter, 15, Abchurch Lane, 1760-1772.
Percival, N., 36, Old Bond Street, 1798-1800.
——, **Thomas**, 36, Old Bond Street, 1804.
Peres, Mark, admitted C.C., 1680.
Perigal, Francis, 9, Threadneedle Street, the first of a family of able horologists. Excellent watches and clocks of their make are to be met with, 1769-1745.
——, **Francis**, 9, Royal Exchange, master, C.C., 1775; 1745-1780.
——, **Francis, junior**, Royal Exchange, 1780-1790.
——, **Francis and Son**, 9, Royal Exchange (Francis Perigal, junior, master, C.C., 1806), 1790-1808.
——, **Francis**, watchmaker to the king, 37, New Bond Street, 1790-1794.
——, **John**, 12, Coventry Street, Haymarket, 1783-1800.
—— **and Browne**, 11, Coventry Street, Piccadilly, 1794-1800.
—— **and Duterrau**, 62, New Bond Street, 1810-1840.
——, **John**, 55, Prince's Street, Soho, 1810.
Perinot, Abraham, known as a maker of long-case clocks, about 1780.
Perins, John, 193, Strand, 1772-1790.
Perkins, Eysum, of "Redcriffe, the end of Love Lane," threatened with prosecution by C.C. for exercising the art not being admitted; he promised to take up his freedom at the next quarterly court, 1682.
——, **James**, admitted C.C., 1730.
—— **and Spencer**, 44, Snow Hill, 1769-1774.
Perremond, F., 192, Brick Lane, Whitechapel, 1810.
Perrier, Peter, maker of a silver watch, the back plate covered with representation of crucifixion, about 1680.
Perring, H., 179, Great Surrey Street, 1830.
Perringham, Francis, back of Exchange, 1790.
Perron, Richard, 7, Worship Street, 1790.
Perry, Henry, admitted C.C., 1691.
——, **John**, 40, Oxford Street, 1840-1842.
Peterkin, John, 25, Cleveland Street, 1810-1840.
Petit, Guillaume, petitioner for incorporation of C.C., 1630-1632.
——, **William**, admitted C.C., 1632.
Petter, Christopher, C.C., 1730.
Pettit, —, 54, Bethnal Green Road, 1835.
——, **Isaac**, 22, Fieldgate Street, Whitechapel, 1835.
——, **Eliza**, 22, Fielding Street, Whitechapel, 1840-1842.
——, **William**, 7, New Rutland Street, 1840.
Petty, William, admitted C.C., 1646.
Pewtress, Thomas, Gracechurch Street, 1753-1756.
Phelps, Richard, founder of the great bell for Bradley's St. Paul's clock (see p. 208), 1716.
Philcox, George, 24, Great Dover Street, Borough, 1835; 22, Southwark Square, 1842. He spent his life in endeavouring to improve timekeepers by various inventions in connection with escapements and compensation, 1830-1870.
Philip, Robert, musical clockmak r, 6, New Court, St. John Street, 1779.
Phillips, Philip, 10, St. John's Square, 1790-1800.
——, **Joel**, 35, Norton Folgate, 1820.
——, **P.**, 19, Crown Street, Finsbury, 1830.
——, **Abraham**, 33, City Road, 1835.
——, **John**, 91, Goswell Street, 1835.
——, **Joseph**, 55, Belvedere Place, Borough Road, 1835.
——, **Brothers**, 31, Cockspur Street, 1840-1842.
——, **James and Charles**, 25, Coppice Row, Clerkenwell, 1835-1840.
——, **P.**, 15, Bury Street, 1840-1842.
——, **P.**, 3, Steward Street, Spitalfields, 1840-1842.
Philp, Robert, musical clockmaker, 6, New Court, St. John Street, 1781-1788.
Phipps, James, 40, Gutter Lane, 1783.
Phylander, Sylvanus, maker of a pair-

case silver calendar watch, hall mark, 1772.

Pickett and Rundell, 32, Ludgate Hill, 1775–1783.

——, **William,** 32, Ludgate Hill, 1769–1772.

Pickman, William, 79, Dean Street, Soho, 1825.

——, **W.,** 6, Albany Street, Regent's Park, 1835.

Pierre, Le Queux, clockmaker to the Duke of Orleans, 1396.

——, **Pasquier,** admitted as a brother, C.C., 1648.

Pigott, Henry, admitted C.C., 1687.

Pike, John, steward, C.C., 1838; verge watch movement by him in the Guildhall Museum, 1830–1840.

—— **and Green,** Bunhill Row, 1806; 10, Bartholomew Square, 1823–1830.

Pilkington, J., Woolwich, 1815.

Pinard, Paul, 2, New Street, Covent Garden, 1775.

Pinchbeck, Christopher, Clerkenwell and Fleet Street, a clever maker of musical clocks and of watches; inventor of Pinchbeck alloy (see p. 121); 1690–1732.

——, **Edward,** Fleet Street, son and successor of the above (see p. 123); 1732–1766.

Pine, Philip, 20, Aldgate, 1779.

Pinfold, M., 115, Newgate Street, 1775.

Pinkerton and Miller, 20, Percival Street, 1842.

Piolaine and Co., 67, Great Russell Street, Bloomsbury, 1825.

Pipes, John, London, known as a maker of long-case clocks, about 1750.

Pistor, Edward, 116, Leadenhall Street, and 105, Strand, 1774–1790.

——, **Messrs.,** 116, Leadenhall Street, musical clock and organ makers, 1798.

Piton, James, admitted C.C., 1710.

Pitcher, John, admitted as a brother, C.C., 1689.

Pitkin, H., Hartford, Connecticut, U.S.A. Watches by him, engraved with the American flag, were made in 1838.

Pitman, John, admitted C.C., 1714.

Pitt, Thyar, 24, Bush Lane, livery, C.C., 1787; maker of a musical clock playing every three hours; 1770–1790.

——, **William,** livery, C.C., 1787; 1778–1789.

——, **Caleb,** 292, Oxford Street, 1790; 43, Duke Street, 1800–1830.

——, **Charles,** 152, Sloane Street, 1835–1840.

——, **John,** 37, Crown Street, Finsbury, 1840–1842.

——, **W. G.,** 25, Thyar Street, Manchester Square, 1840–1842.

——, **J.,** Kingsland Road, 1842.

Pittney, Thomas, Featherstone Street, 1769–1772.

Planck, Anthony, Fleet Street, 1760–1772.

Planner, Thomas, C.C., 1701; 1730.

——, **Thomas,** admitted C.C., 1730. The Planners were known as makers of long-case clocks; 1730–1745.

Plant, Edward, admitted C.C., 1664.

Plate, Richard, 58, Carey Street, Lincoln's Inn, 1835.

Platt, Edward, 33½, Wilderness Row, Clerkenwell, 1835.

Player, Thomas, admitted C.C., 1672. "A silver watch in the form of 5 crowns, a Flower-de-Lis under each crown, with a Knot, in the middle the name *Thomas Plaire, Londini;* the hours engraven in a six-square, with a chain and 5 wheels" (*London Gazette*, March 29, April 1, 1680).

——, **Robert,** admitted C.C., 1700; maker of a walnut long-case clock, arch dial, 1700–1740.

——, **H. J.,** 2, North Place, Gray's Inn Lane, 1820–1840.

Pleverie, Isaac, admitted as a brother, C.C., 1652.

Pluett, Anthony, admitted C.C., 1697.

Plumbly, J., 26, New Cavendish Street, 1830–1835.

——, **and Parr,** 16, New Cavendish Street, 1840–1842.

——, **William,** 43, Ludgate Hill, master, C.C., 1779, 1801; 1769-1825.

——, **C.,** 231, Strand, 1835–1840.

Plunkeld, Richard, 8, Fieldgate Street, Whitechapel, 1820.

Pohlmann, Peter, Leadenhall Street, maker of long-case clocks, 1760–1775.
Poidevin, F., 16, Brewer Street, Golden Square, 1830.
Poisson, Henry, maker of a long-case marqueterie scroll-work clock in S.K.M., period Queen Anne; also of a silver pendulum watch of a slightly later date; 1705–1720.
Pomeroy, Joseph, admitted C.C., 1728; maker of a horn-covered pair-case verge, inscribed "Joseph Pomeroy," 1728–1738.
Poney, Abraham, 82, Wells Street, Oxford Street, 1840–1842.
Pool, J. C., St. Anne's Lane; made a clock for the Mayor of Kendal as a gift to that town. On the dial was the motto, "Time runneth. Your work is before you," 1654.
Poole, Robert, Aldersgate Street, master, C.C., 1781; 1770–1781.
—— **and Bickerlo,** 88, Bartholomew Close, 1769–1775.
——, **George,** 88, Bartholomew Close, 1783–1785.
——, **John,** 36, Charles Street, City Road, 1822; 7, Brunswick Terrace, Commercial Road, 1835–1840.
——, **John,** born 1818, died 1867; 7, Brunswick Terrace, Commercial Road, in 1842, afterwards in Fenchurch Street. A clever chronometer maker, and inventor of an auxiliary compensation (see p. 221).
Pools, Edmonde, admitted C.C., 1722.
Portal and Coyle, Ludgate Hill, 1760–1763.
——, **Abraham, and Gearing,** 34, Ludgate Hill, 1769–1775.
Porter, Charles, 227, Bermondsey Street, 1835–1840.
Porthouse, Thomas, High Street, Poplar, 1822–1830; 10, Northampton Square, Clerkenwell, 1840–1842.
Post, William, 42, Fish Street Hill, liveryman, C.C., 1776; 1772–1776.
Potter, George, watchmaker, and Mayor of Coventry, 1727.
——, **Harry,** 5, Well Street, Aldersgate, master, C.C., 1795, and again in 1812, when he died before the expiration of his year of office; 1775–1812.
Potter, James, livery, C.C., 1810; 1800–1811.
Poulton, R., 2, Mayfield Place, High Street, Kennington, 1840–1842.
Powell, Bartholomew, C.C., 1668.
——, **Robert,** admitted C.C., 1710.
——, **James,** 7, Prince's Street, Leicester Square, 1835.
Powis, Richard, 36, Rosoman Street, Clerkenwell, 1806–1823.
Poy, Godfrie, maker of a very fine quarter repeater, inner case pierced and repoussé, hall mark 1729, outer case shagreen; another of his productions is a black, pull-chime bracket clock; 1720–1729.
——, **Godfrey,** 78, Mortimer Street, 1790.
Pratt, C., 30, Camden Street, Islington, 1835.
Prentis, Daniel, 25, Charterhouse Lane, 1788.
—— **and Son,** 25, Charterhouse Lane, 1804–1807.
Prerie, Humphrey, C.C., 1653.
Presbury and Son, 9, New Street, Covent Garden, 1804.
Presciot, —, New Rents, St. Martin's-le-Grand, 1790.
Prest, —, Fleet Street, 1774.
——, **Thomas,** patentee of keyless action for watches (No. 4501, 1820). Prest was foreman to J. R. Arnold (see p. 242).
Prestige, Bartholomew, C.C., 1703.
Preston, Edward, C.C., 1721.
Prestwood, Joseph, admitted C.C., 1703; maker of long-case clocks, 1703–1720.
Prevost, Adolphe, 20, King Street, Soho, 1840–1842.
Price, George, St. Martin's Churchyard, 1788.
——, **George,** 89, Oxford Street, 1800–1804.
——, **W.,** 17, Maiden Lane, Wood Street, 1825.
Priddith, John, admitted C.C., 1639.
Prideau, Edmund, 31, Hatton Garden, 1790.
Pridham, William, Great Alie Street, Goodmans Fields, 1760–1763.
Priest, Thomas, admitted C.C., 1729.
——, **W. and James,** 30, White Cross Street, 1768–1772.
——, **—,** Fleet Street, 1774.

Prigg, John, Bethlehem, liveryman, C.C., 1776; 1766–1777.
——, **Ansell,** clock and watch-spring maker, Middle Moore Fields, 1781–1790.
Prime, Abraham, admitted C.C., 1672.
Prince, Richard, admitted C.C., 1680.
Print, Richard, admitted C.C., 1698.
Prior, George, 31, Prescot Street, Goodman's Fields, 1769–1788.
——, **George,** 5, George Yard, Lombard Street, 1798–1810.
——, **J.,** Newington Causeway, 1830.
Prosser, William, Strand, 1769–1772.
——, **John,** 61, Piccadilly, 1822–1830.
Pryme, Andrew, admitted as a brother, C.C., 1647.
Pryor, Robert, 254, Tottenham Court Road, 1835–1840.
Puckridge, Charles, Goldsmiths' Street, Shoe Lane, 1790.
——, **T.,** 72, Snow Hill, 1790–1815.
——, **J.,** 73, Snow Hill, 1730–1740.
——, **Alfred,** 7, Orange Street, Bloomsbury, 1840–1842.
Pugh, Ellis, Cockspur Street, 1780–1785.
——, **Benjamin,** watch gilder, 34, Jewin Street, 1790.
Puller, Jonathan, admitted C.C., 1683; assistant, 1705; 1683–1705.
Purfe, William, 336, Strand, 1804.
——, **George,** 487, Strand, 1804.
Purnell, J., 106, Upper Seymour Street, 1842.
Purrier, Richard, admitted C.C., 1705.
Purse, G., 487, Strand, 1825.
Purvis, Alexander, 4, North Audley Street, 1835–1840.
Putley, F., 40, Newington Causeway, 1806–1842.
Puzzy, Isaac, London, maker of an old twelve-hour lantern clock, about 1625.
Pyke, John, watch motion maker, Bedford Row, 1700–1720.
Pyne, Nathaniel, admitted C.C., 1677.
Pyons, William, 66, Threadneedle Street, 1790.

Quare, Daniel, at the Plow and Harrow in Cornhill, and afterwards at the King's Arms, Exchange Alley; admitted C.C., 1670; master, 1708; a celebrated maker, inventor of the repeating watch (see p. 97), 1660–1724. "Lost, the 2nd inst., a Silver Pendulum Watch, the name Daniel Quare London; it had but 6 hours upon the Dial-plate, with 6 small Cipher figures within every hour; the hand going round every 6 hours, which shows also the minutes between every hour. Whoever gives notice of it to Daniel Quare, Clockmaker at the King's Arms, in Exchange Alley, London, shall have a guinea reward" (*London Gazette,* March 25–29, 1686).

"Lost, between Firle and Shoram Ferry, in Sussex, a gold watch made by D. Quare in a black Shagreen Case with a Cypher J. C. Whoever brings it to Mr. Shelly, Goldsmith, in Panton Street, near the Haymarket, shall have 2 guineas reward" (*London Gazette,* May 16–19, 1691).

"Lost, April 25, a Gold Minute Pendulum Clock, the name on the upper plate D. Quare, London, 726 engraven on it, and a Shagrine case. Whoever gives notice of it to Daniel Quare, Clockmaker at the King's Arms in Exchange Alley, shall have 3 guineas reward; or if already bought, their money returned again with content" (*London Gazette,* May 96–30, 1692).

"Lost, on the road between Hungerford and Marlborough, a Gold Repeating Watch, made by Quare and Horseman, with an old Gold Chain, and several seals hanging to it. Whosoever will bring them to Mr. Horseman, at Mr. Quare's, in Exchange Alley, shall have 20 guineas reward and no questions asked" (*London Gazette,* August 9–12, 1718).

Quare and Horseman, at the King's Arms, Exchange Alley, 1700–1724.
Quelch, John, admitted C.C., 1646; known as a maker of lantern clocks, 1646–1666.
Quin, T. D., 18A, Great Titchfield Street, 1840.
Quinton, Stephen, London, maker of long-case clocks, about 1750.

Radford, Henry, admitted C.C., 1721.

Ragsdale, George, 25, New Bond Street, 1769-1783.

Raiment, Thomas, C.C., 1719.

Raines (Raynes), William, Butcher Row, East Smithfield, admitted C.C., 1660; maker of lantern clocks, 1660-1665.

Rainier, John, livery, C.C., 1787; 1780–1788.

Rainsford, Francis, Charing Cross, admitted C.C., 1689.

Raitt, Alexander, London, known as a maker of long-case clocks, with striking rack between the plates, 1690–1720.

Raker, P., 95, Bishopsgate Street, 1775.

Rambley, William, 407, Oxford Street, 1775.

Ramier, John, summoned to livery, C.C., 1786.

Ramsay, David, near Temple Bar, watchmaker to James I., first master of the C.C. (see p. 67), 1600-1650.

Ramsden, Thomas, admitted as a brother, C.C., 1648.

Ranceford, Bernard, C.C., 1677.

Randall, John, Wine Office Court, Fleet Street, 1790.

Ransom, George, 18, King Street, Soho, 1825.

Rant, John, admitted C.C., 1687.

——, **Jonathan**, admitted C.C., 1687.

Ranzonet, The Sieur, Nancy, said by Wood to have made a musical watch in 1770.

Ratcliffe, J., 45, Clerkenwell Close, 1835.

Ratherain, C., 25, Cursitor Street, Chancery Lane, 1825.

Raven, Crispin, London, maker of long solid walnut-case clock, about 1780.

Rawford, James, 75, Gray's Inn Lane, 1790.

Rawlings, Charles, Brook Street, Holborn, C.C., 1818–1860.

——, **George**, 88, Whitechapel, 1790.

Rawlins, Henry, admitted C.C., 1706.

——, **James**, livery, C.C., 1787.

Ray and Montague, 22, Denmark Street, Soho, 1804.

——, **Samuel**, 35, Great Castle Street, Oxford Street, 1830.

Ray, H., 3, Commercial Place, City Road, 1835.

——, **Henry**, 22, Great Russell Street, Covent Garden, 1840.

Raymond, —, Leadenhall Street, 1774.

Rayner, John, admitted C.C., 1697.

Raynesford, Benjamin, C.C., 1709.

Read, George, Old Square, Lincoln's Inn, 1820.

——, **William**, Newcastle Place, Clerkenwell, 1820.

——, **George**, 10, Rotherhithe Street, 1825.

——, **William**, 84, Jermyn Street, Piccadilly, 1825.

Recordon, Louis, Cockspur Street, Charing Cross. In 1780 he patented (No. 1249) a pedometer-winding for watches (see p. 246), 1778–1810.

Reed, Alexander, admitted C.C., 1706.

Reeve, Thomas, in Pope's Head Alley, admitted C.C., 1648; assistant, 1655; 1648–1655.

——, **Henry**, admitted C.C., 1682.

——, **John**, admitted C.C., 1712.

——, **Jarvis**, admitted C.C., 1731.

——, **William**, 24, Ludgate Street, 1830.

——, **William**, 13, Vigo Street, Regent Street, 1835.

——, **William**, 37, Newington Causeway, 1835–1842.

Reeves, Richard, 208, High Street, Shoreditch, 1820–1842.

Regard, Reymond, clockmaker at the upper end of Russell Street, near Drury Lane; admitted as a brother, C.C., 1677; mentioned in *London Gazette*, January 25–28, 1691.

Reid and Auld, Edinburgh, makers of a fine regulator at the Horological Institute, 1800–1820.

——, **William**, 32, Rosoman Street, Clerkenwell, 1820.

——, **Adam**, Clerkenwell, inventor of an adjustment for Graham's pendulum (see p. 197), 1779–1836.

——, **Thomas**, born 1750, died 1834, a celebrated Edinburgh clockmaker, author of "Treatise on Clock and Watchmaking," published in 1826.

Reilly, J. C., 12, Middle Row, Holborn, 1825.
Reith, James, admitted C.C., 1705.
Relph, E., 182, Tooley Street, 1835.
Renshaw, Thomas, Ship Alley, Wellclose Square, 1825.
Rentzsch, Sigismund, 2, George Street, St. James's Square. He patented in 1813 an automatic timekeeper somewhat similar to Hortsman's (see p. 190), 1813–1842.
Rewalling, Thomas, C.C., 1715.
Rex, Thomas, 96, Broad Street, Ratcliff, 1842.
Reyner, Stephen, at y[e] Dial, Bishopsgate Within, admitted as a brother, C.C., 1691.
Reynolds, Joseph, admitted C.C., 1691.
——, **Thomas**, admitted C.C., 1705.
——, **Francis**, Kensington, about 1776.
——, **Thomas, and Son**, 1, Sparrow Corner, Minories, 1783–1788.
——, **T.** (materials), 2, St. Martin's-le-Grand; a verge watch by him in the Guildhall Museum, tortoise-shell case, 1800–1810.
——, **G.**, 10, Gough Square, 1830.
——, **T.**, 25, Coppice Row, Clerkenwell, 1835.
Richard, Peter, admitted as a brother, C.C., 1679.
Richards, Luke, admitted as a brother, C.C., 1648.
——, **Henry**, admitted C.C., 1699.
——, **Hugh**, master, C.C, 1735; 1720–1735.
——, **Thomas**, 114, Strand, 1770–1772.
——, **William**, Albemarle Street, Clerkenwell; liveryman, C.C., 1776.
——, **William**, 43, Brick Lane, Old Street, 1794.
——, **Thomas**, 17, Bridgewater Square, Barbican, 1804; 96, Shoreditch, 1830.
Richardson, Richard, C.C., 1675.
——, —, of London, "a good wheel cutter" (Hatton), 1750.
——, **James**, master, C.C., 1788; 1762–1789.
——, **John**, Racquet Court, liveryman, C.C., 1810; 1798–1811.
Rickman, W., 35, Great Pulteney Street, 1820.
Ricord, Richard, admitted as a brother, C.C., 1649.
Riddlesdon, Samuel, C.C., 1766.
——, **J.**, watch-spring maker, Red Cross Square, 1790.
Rider, John, Camberwell Green, 1835.
Ridgette, R., maker of an oval watch, S.K.M., about 1600.
Ridley, Josiah, admitted C.C., 1685.
——, **Thomas**, 14, Waterloo Road, 1842.
——, **Joseph**, received a reward of 20 guineas from the Society of Arts for a sector and depthing tool, 1788.
Riesle, E., wooden and musical clock-maker, 2, Garden Row, London Road, 1840.
Rigby, Joshua, 5, Berkeley Street, Clerkenwell, hon. freeman, C.C., 1781; spoken of by Hatton; maker of a repeater watch for the Duke of Sussex; 1770–1800.
——, **E., and Son**, 6, Berkeley Street, Clerkenwell, 1795–1800.
——, **James**, 35, Rosoman Street, Clerkenwell, 1804.
——, **Joshua**, 8, King Street, Goswell Road, 1820.
——, **J.**, watch-movement maker, Nelson Terrace, City Road, 1820.
——, **James**, 8, Charing Cross, 1806–1830.
Rimbault, Stephen, 7, Great St. Andrew Street, 1760–1781.
——, **Paul**, 9, Denmark Street, St. Giles's, 1679–1785.
Ring, Joseph, admitted C.C., 1693.
Rippin, William, Holbeach, Lincolnshire, worked at his trade as watch and clock repairer for thirty years after he lost his sight, vouched for by his daughter and many other persons; he died in 1857.
Rippon, R., 46, King's Street, Seven Dials, 1820.
Risbridger, William, Dorking, maker of thirty-hour long-case clocks, about 1700.
Ritherdon, Robert, 3, Aldgate Within, 1758–1800.
Rivers, David, 3, Sweeting's Alley; master, C.C., 1773; 1760–1783.
——, **David**, 3, Bridgewater Square, 1753–1775.
——, **William**, master, C.C., 1794; 1780–1795.

Rivers and Son, 38, Cornhill, 1790–1810.
——, **William**, 33, Cornhill, 1820.
Riviere, S. N., 63, New Bond Street, 1804.
Robbin, Fabian, London, maker of a walnut marqueterie long-case month clock, square dial, bull's-eye in front of pendulum bob, about 1690.
Robbins, J., 24, Percival Street, Clerkenwell, 1842.
Roberts, H., admitted C.C., 1664; in the B.M. is a large astronomical watch by him; 1630–1670.
——, **Gideon**, Bristol, Conn., U.S.A., maker of American clocks, 1790.
——, **J.**, St. James's Market, 1790.
——, **W.**, St. James's Market, 1806; 5, St. Alban's Place, Pall Mall, 1820–1830.
——, **George**, 27, Marchmont Street, Brunswick Square, 1820.
——, **James**, 87, Union Street, Boro', 1842.
Robertson, Benjamin, 14, Jewin St., 1783.
Robin, —, Paris, 1794.
Robins, John, 67, Aldersgate Street, 1783.
——, **William**, 13, Fleet Street, 1783–1804.
——, —, New Lisle Street, 1794.
——, **John**, 13, Clerkenwell Green, 1800–1804.
——, **John**, 13, Frith Street, Soho Square, 1823–1830.
Robinson, Robert, C.C., 1652.
——, **William**, admitted C.C., 1667.
——, **Thomas**, admitted C.C., 1703.
——. **Francis**, apprenticed to Thomas Williamson, 1672; master, C.C., 1725; maker of a repeating watch movement in the Guildhall Museum, silver case, inscribed, "Servant to his Royal Highness," 1679–1726.
——, **Ruhamer**, admitted C.C., 1713.
——, **William**, apprenticed to Daniel Delander; admitted C.C., 1720.
——, **Philip**, Fleet Street, 1737–1740.
——, **James**, at the Dial in Grace's Alley, Well Close Square, known as a maker of long-case clocks, 1730–1760.
Robinson, Richard, watch-chain maker, 4, Goldsmith Row, 1790.
——, **M.**, watch-movement maker, 8, Charterhouse Street, 1790.
——, **Owen**, an escapement maker who worked for Arnold, mentioned by Reid as the maker of a double chronometer escapement, 1780–1810.
——, **Anthony**, 232, Strand, 1783.
——, **Richard**, watch-movement maker, 27, Key Street, Clerkenwell, 1835.
Robotham, Feis, High Street, Hampstead Road, 1840.
Robson, William, musical clockmaker, 48, Redcross Street, master, C.C., 1809; 1798–1810.
Roby, James, 2, Prince's Street, Leicester Square, 1800.
Rochat, Jules, 82, Dean Street, Soho, 1840–1842.
Rochford, M. F., 212, Piccadilly, 1804–1825.
——, **F.**, 29, Jermyn Street, 1830.
Rogers, William, admitted as a brother, C.C., 1641.
——, **John**, admitted C.C., 1731.
——, **William**, Broad Street Buildings, liveryman, C.C., 1776.
——, Fenchurch Street, 1774.
——, **Isaac**, White Hart Court, Gracechurch Street, a maker of good watches; a specimen in gold repoussé outer case is in the B.M.; did a good trade in foreign markets; 1750–1794.
——, **Isaac**, 4, White Hall Court, Gracechurch Street; admitted C.C., 1776; master, 1824; succeeded to his father's business, 1776.; removed to 24, Little Bell Alley, Coleman Street, in 1802; died 1839; 1776–1839.
——, **Thomas**, 63, Charing Cross, liveryman, C.C., 1810; 1800–1811.
——, **C.**, 59, Charlton Street, Somers Town, 1820.
Rogerson, William, Exchange, master, C.C., 1774; 1760–1775.
——, **Henry**, London, clockmaker; about 1800.
Rolf, Joseph, and Son, 17, Foster Lane, 1769–1788.
Rolfe, Robert, 29, St. John's Square, Clerkenwell, 1835.

Romback, J., 103, Regent Street, 1835.
Rome, William, 6, Shepperton Place, North Road, 1842.
Romer, Flack, admitted C.C., 1661.
Romeux, Lewis de, C.C., 1706.
Romilly, Peter, Frith Street, Soho Square, 1769–1775.
Romney, Joseph, admitted C.C., 1664.
Ronnizen, Adam, admitted C.C., 1687.
Roof, Daniel, admitted as a brother, C.C., 1676.
Rooke, John, 26, Berkeley Square, 1790.
Rooker, Richard, Chelsea, admitted C.C., 1728; maker of a large silver watch, silver chased dial, behind an aperture in which a pendulum swings; 1728–1740.
Rookes, Barlow, admitted C.C., 1667.
Rooksby. "Stolen on the 23rd instant, out of Mr. Jeffreys House in York, a gold pendulum watch with minutes and seconds, made by Mr. Rooksby, of Hull, with a gold studded case. Notice to be given to Mr. Hill, Goldsmith, in the Strand" (*London Gazette*, November 26–30, 1691).
Rose, Michael, admitted C.C., 1676.
——, **John, and Son**, 19, Foster Lane, 1768.
——, —, **junior**, St. Ann's Lane, 1774.
——, **Joseph, Son, and Payne**, 17, Foster Lane, 1771–1790.
——, **John**, 96, Fleet Market, 1830.
Roskell, Robert, the elder, Liverpool, introduced the rack lever patented by Litherland, and was a collector of curious horological specimens, 1805–1830.
Ross and Peckham, 41, Bedford Street, Covent Garden, 1810.
Rosse, Samuel, admitted C.C., 1679.
Rossi, W., 5, Blackman Street, Boro', 1830.
Rotheram, Thomas, C.C., 1662.
——, Coventry. *See* Vale.
Rotherodd, Benjamin, maker of a silver rose-shaped watch which was in the Bernal Collection seventeenth century work.
Rothwood, Robert, C.C., 1632.
——, **Robert**, admitted as a brother, C.C., 1648.
Roumieu, Adam, C.C., 1695.
——, **John**, admitted C.C., 1720.
——, **Adam**, admitted C.C., 1726.
Roumyen, James, admitted as a brother, C.C., 1692.
Rousseau, Jean, maker of a silver watch in the S.K.M., engraved with figures of the seasons and with flowers, also a crystal-cased watch in the form of a cross, in the Fellows Collection; his father also was a watchmaker; 1680–1700
Rowden, John, London; example of his work, verge watch, silver dial, with raised figures, square pillars, no jewel, about 1700.
Rowe, Thomas, admitted C.C., 1699.
——, **Benjamin**, admitted C.C., 1708.
——, **John**, St. Paul's Churchyard; liveryman, C.C., 1770–1780.
Rowland and Co., 8, Coventry Street, 1825.
Rowlands, William, and Son, 92, Quadrant, 1823.
——, **William**, Smith Street, Clerkenwell, watch-case maker; treasurer and a liberal supporter of the Clock and Watchmakers' Asylum; master, C.C., 1860; 1820–1864.
——, **C.**, 9, Coventry Street, 1835.
——, **R.**, watch-case maker, 35, Meredith Street, Clerkenwell, 1835.
——, **C.**, 33, Leadenhall Street, 1840.
Roy, David, admitted as a brother C.C., 1682.
——, **William**, 30, Bell Yard, Lincoln's Inn, 1804.
Roycroft, Thomas, admitted as a freeman, C.C., 1699.
Royer, William, 40, Gee Street, Goswell Road, 1820.
Roylands, William, watch-movement maker, 29, Chiswell Street, 1790.
Rudkin, Thomas, C.C., 1683.
Ruffel, Charles and Thomas, 18, Barbican, 1804.
Rugendas, Nicholas, Augsburg, 1550.
Rugg and Thaine, 15, Cheapside; a watch by them, S.K.M., 1769–1788.
Rugless, G., 43, Ratcliff Highway, 1820–1825.

Rugless, T., 3, Cannon Street, St. George's East, 1842.
Rundell and Bridge, 32, Ludgate Hill, 1788-1823.
Rush, Samuel, 16, Ludgate Hill, 1759-1790.
Russel, Thomas, watch-case maker, 18, Barbican, 1775.
——, **Charles**, 18, Barbican, 1790.
Russell, Nicholas, apprenticed to William Rogers in 1653; master, C.C., 1692. "A plain hour watch goes but 24 hours, the name on it is Nicolus Russell, Londoni, fecit" (*London Gazette*, December 22-27, 1697). 1663-1700.
——, **Thomas**, Barbican, liveryman, C.C., 1776.
——, **Charles and Thomas**, 18, Barbican, 1787-1815.
——, **T.**, 50, Great Sutton Street, 1842.
Rutland, Jonathan, 114, Oxford Street, 1800-1804.
——, **James**, 83, Oxford Street, 1822-1830.
Ruttiven, William, maker of a lantern clock, 1630.
Ryder, Thomas, admitted C.C., 1698.
——, **Thomas**, admitted C.C, 1712.
Ryler, William, admitted C.C., 1712.
Ryley, Thomas, admitted C.C., 1704.

Sacheverell, Benassir, apprenticed to Tompion, admitted as a brother, C.C., 1687.
Sadleir, Samuel, warden, C.C., 1723; 1720-1723.
Sadler, Stephen, 134, Bishopsgate Without, 1830.
Saer, Joseph, admitted as a brother, C.C., 1687; maker of a square-dial brass eight-day clock, two hands, inscription "Joseph Saer, in Penpool Lane, London," 1686-1700.
Saffory, John, 13, Tokenhouse Yard, 1760-1775.
Sainsbury, J. (tools), 2, Cowcross Street, 1806-1823.
——, **Richard**, 9, Wingrove Place, Clerkenwell, 1840-1842.
St. Leu. *See* De St. Leu.
Salmon, Henry, Coventry Street, Piccadilly, 1769-1772.
——, **Robert**, 49, Strand, 1790-1794.
Salmon, C. E., 151, Bishopsgate Without, 1823.
Salter, Edward, 20, Cannon Street, 1788.
——, **John**, 35, Strand, 1804; 73, Strand, 1825-1830.
Saltmarsh, Samuel, 74, Middleton Street, Clerkenwell, 1840.
Sambrook, John, C.C., 1680.
Samley, —, Gutter Lane, 1775.
Samon, John, admitted C.C., 1654.
Samson, Samuel, Westminster, maker of a silver repoussé pair-case watch, apparently for the Dutch market; hall-mark 1800; also a musical and mechanical bracket clock, 1798-1805.
——, **J.**, 11, Denmark Street, Soho, maker of a verge watch with engraving of the Crucifixion in white metal fastened above the balance wheel, and a semicircular piece of metal fastened below it, and decorated with doublet rubies, emeralds and topazes, 1800-1805.
—— **and Grandin**, Denmark Street, Soho, 1810.
Samuel, Humphrey, Panton Street, Haymarket, 1790.
——, **Abraham**, 11, Little Alie Street, Goodman's Fields, 1820-1825.
——, **J.**, 142, High Street, Shadwell, 1835.
——, **Abraham, and Son**, 11, Little Alie Street, Goodman's Fields, 1840-1842.
Sanders, Daniel, admitted C.C., 1632.
——, **George**, 57, Lion Gardens, Aldermanbury, 1790.
——, **James**, 46, St. John Street, 1790.
——, **John**, 3, Holborn Hill, 1810-1815.
——, **George**, 8, Gee Street, Goswell Road, 1820.
Sanderson, Robert, Strand, admitted C.C., 1703; afterwards Sanderson and Son. Hatton in 1773 speaks of the late Mr. Sanderson as an improver of calendar work, and the son as clever, 1703-1750.
——, **George**, patentee of tools for duplicating parts of watches (1761, No. 763), also a lunar and calendar watch-key (1762, No. 777), 1761, 1762.

Sanderson, Henry, 301, Strand, 1778–1781.
——, **Thomas,** 105, Bishopsgate Within, 1815.
——, **Samuel.** 63, Mark Lane, 1840.
Sandford, William, 15, Conduit Street, 1800–1825.
Sands, John, St. Dunstan's Alley, 1790.
Saplin, P., 42, Whitcomb Street, Haymarket, 1835–1842.
——, **T.,** 17, East Road, Hoxton, 1842.
Sarbitt, John, 11, St. Martin's Court, Leicester Square, 1804.
Sargeant, B., 40, Garden Row, London Road, 1835.
——, **H.,** 10, Wells Street, Oxford Street, 1835.
Sargent, Robert, admitted C.C., 1720.
——, **Benjamin,** 133, Fleet Street, 1769–1788.
——, **J.,** 106, Jermyn Street, 1794–1810.
Sarl, J., 18, Cornhill, 1842.
Satchabell, Thomas, 9, Bridgewater Square, 1804.
Sattell, C., watch-case maker, 36, Clerkenwell Green, 1795–1800.
Saunders, John, admitted C.C., 1721.
——, **John,** admitted C.C., 1730.
——, **Joshua,** Cripplegate Buildings, 1765–1770.
——, **D.,** Parkside, Knightsbridge, 1820–1840.
Savage and Vincent, 60, Red Lion Street, 1800–1815.
——, **Thomas,** 3, Red Lion Street, 1820–1840.
——, **W.,** 8, Chapel Street, Bedford Row, 1820–1825.
——, **Samuel,** 8, Red Lion Street, Clerkenwell, 1825.
——, **D.,** 7, Queen Street, Northampton Square, 1835.
——, **Thomas,** 21, Sidney Street, Goswell Road, 1842.
——, **George,** a watchmaker who, in the early part of this century, did much to perfect the lever escapement, besides inventing the two-pin variety. He spent the early part of his life in Clerkenwell, but in his old days emigrated to Canada, and founded a flourishing retail business in Montreal, where he died, 1800–1855.
Savage, Thomas. "Stolen out of the house of John Shorren, Esq., Norfolk Street, a gold watch made by Thomas Savage of London" (*London Gazette*, September 10–14, 1691).
Saville, John, admitted C.C., 1656; assistant, 1675; died 1679; maker of a watch reputed to have belonged to William of Orange, dated 1656, tortoiseshell case decorated with silver; 1656–1679.
——, **John,** admitted C.C., 1678. There was a brass lantern clock of his production at Blackburn in 1887; 1678–1680.
Savory, Andrew, admitted C.C., 1676; known as a maker of lantern and bracket clocks, 1676–1700.
——, **Joshua,** 48, Cheapside, 1788.
—— **and Co.,** 48, Cheapside, 1810.
——, **A.,** 54, Cheapside, 1825.
——, **Adey B., and Son,** 9 and 14, Cornhill, and 5, Finsbury Place, 1840–1842.
Sawyer, Paul, admitted C.C., 1718.
——, **John,** 1, Poultry, 1804.
Say, Nehemiah, admitted C.C., 1654.
Scafe, William, King Street, admitted C.C., 1720; master in 1749; 1720–1750.
Scale, Henry. Of him was bought Huggerford's watch with false jewelling used as evidence against Facio (see p. 231), 1705.
——, **G.,** musical clockmaker, 15, Wellington Street, Goswell Street, 1840.
Scales, Edward, 33, Strand, 1775–1780.
Scantlebury, W., 17, Golden Lane, 1780–1792.
Scherer, George F., 227, Regent's Street, 1835–1840.
Schilsky, Joseph, 90, Houndsditch, 1840–1845.
Schlott, Hanns. In the B.M. is a clock in the form of a ship by him, said to have been made for the Emperor Rudolph II.; 1578–1581.
Schmidt, John, patentee of mysterious clock (1808, No. 3185), (see p. 159), 1800–1810.
Schofield, W., 35, Cheyne Walk, Chelsea, maker of long-case clocks, 1815–1825.

Schofield, William, 2, Clerkenwell Close, 1830–1835.
Scholefield, James, London, maker of long-case clocks, about 1800.
Schuler, M. and J., 16, Commercial Place, London Road, 1835–1842.
Schutt, Jasper, admitted as a brother, C.C., 1648.
Schwilgue, J. B., restored Strasburg clock (see p. 145), 1838.
Science, John, admitted C.C., 1724.
Scolding, John, 7, Great Prescot Street, 1794–1810.
Scotchford, Thomas Charles, London, a good maker of lever pallets, 1830–1876.
Scott, Daniel, admitted C.C., 1697.
——, —, Gracechurch Street, 1770–1775.
——, **James,** apprenticed to John Jackson, 1752; admitted C.C., 1766.
——, **John,** 40, Gloucester Street, Red Lion Square, hon. freeman, C.C., 1781; 1770–1794.
——, **William,** 79, Dartmouth Street, 1790.
——, **Thomas,** 65, Charing Cross, 1810–1820.
——, **A., and Co.,** 64, West Smithfield, 1828–1832.
——, **William,** 40, Skinner Street, Clerkenwell, 1830–1842.
——, **Jesse,** 45, King Square, St. Luke's, 1835; 1835–1842.
——, **Robert,** 20, Bell Yard, Temple Bar, 1835–1840.
——, **Wing and Co.,** 59 and 60, Red Lion Street, Holborn, 1840–1842.
Sea, Frederick, 18, Bartholomew Close, 1820–1830.
Seaborne, James, C.C., 1648–1650.
Seagrave, Matthew, C.C., 1730.
——, **Robert,** 35, Gutter Lane, 1790.
Searle, George, 15, Wellington Street, Goswell Road, 1830–1840.
Seddon, James, in St. James's, admitted C.C., 1662.
——, **Nathaniel,** admitted as a brother, C.C., 1691.
——, **Humphrey,** Southwark, about 1730.
Sedwell, Edward, C.C., 1664.
Seignior, Robert, an eminent maker in his day; received, in 1682, £20 for a clock set up in the Treasury Chambers, 1670–1682. "A silver Pendulum watch, with a Tortoiseshell case inlaid with silver, made by Mr. Seignoir, Exchange Alley" (*London Gazette,* December 16–19, 1695).
Sellars, John, warden, C.C., 1692; excused from serving as master in 1696, on account of ill health; 1685–1696.
Sellers, William, Long Acre, 1740.
Selwood, William, ye Mermaid, in Lothbury; admitted as a brother, C.C., 1633; an early maker of lantern clocks, 1620–1636.
——, **John,** admitted as a brother, C.C., 1641.
Sens, William, admitted C.C., 1711.
Sergeant, Nathaniel, 224, Wapping, master, C.C., 1783; 1784–1769.
——, **Benjamin,** 133, Fleet Street, 1754–1768.
Servant, H., 68, Salisbury Court, 1775.
Sewell, George, 47, Blackman Street, 1790.
Sexty, R., 71, Carlisle Street, Lambeth, 1830–1840.
Seymore, John, admitted C.C., 1710.
Seymour, William, maker of a mahogany-case bracket clock, handle on top, brass dial, style 1740.
Shalcross, Josiah, maker of cylinder escapements with ruby cylinders, and of duplex escapements; for many years in the employ of McCabes; born 1800, died 1866.
Sharp, J., 20, Little Tower Street, 1794–1808.
——, **John,** 30, Fish Street, Holborn, 1810–1825.
——, **and Son,** 30, Fish Street, Holborn (John Sharp, master, C.C., 1833 and 1835); 1830–1840.
——, **George,** 9, Postern Row, Tower Hill, 1822–1825.
Sharpe, William, admitted C.C., 1681.
Sharpwell, James, Charing Cross, 1775.
Shaw, John, in Holborn, admitted C.C., 1682; master in 1712; maker of a splendid marqueterie-case clock; 1682–1712.
——, **William,** 22, Wood Street, Cheapside, 1760–1772.

Shayler, Richard, Ball Alley, Lombard Street, 1753–1756.
——, **William**, 44, Lombard Street, 1755–1775.
Sheate, William, 16, Bell Alley, Coleman Square, 1790.
Shearer, James, 23, Devonshire Street, Queen Square. The Duke of Sussex had a skeleton-movement astronomical clock by him; 1830–1842.
Sheldrick, Edward, 48, Cheapside, 1798–1803.
Shelly, Joseph, admitted C.C., 1717.
—— **and King**, 149, Shoreditch, 1772–1775.
——, **Samuel**, 61, St. Paul's Churchyard, 1775.
Shelton, Samson, member of the Blacksmiths' Company; active in obtaining the charter of the C.C., of which he was one of the first wardens in 1631; died 1649, leaving £50 to the C.C.; 1629–1649.
——, **John**, Shoe Lane, C.C., 1720; livery, 1766; 1720–1766.
Shepherd, Henry, 4, Pope's Head Alley, Cornhill, 1760–1775.
——, **W.**, 199, Strand, 1822–1825.
Sheppard, Samuel, 1, Hanover Street, Hanover Square, 1830.
Shepperd, Thomas, C.C., 1632.
——, **Sarah**, 199, Strand, 1830.
——, **Charles**, 7, Chadwell Street, 1840–1842.
Sheraton, Thomas (see p. 184), 1803.
Sherbird, J., Turk's Street, Bethnal Green, 1820.
Sherborn, Thomas, 6, Strand, 1800.
Shere, Henry, and Arnold, 46, Lombard Street, 1753–1768.
Sherwood, William, apprenticed to James Delander; admitted C.C., 1695; 1695–1721.
——, **William**, admitted C.C., 1720; master in 1740; 1720–1740.
Shick, William, 43, Brick Lane, Old Street, 1820.
Shields, John, 19, Bridge Street, Lambeth, 1835.
——, **John**, 33, Great Marylebone Street, 1840–1842.
Shindler, Thomas, Canterbury, known as a maker of long-case clocks, about 1720.
Shirley, John, admitted C.C., 1720; in 1724 paid £20 to be transferred to the Vintners' Company; 1720–1725.
Shirt, W., 10, City Road, 1835.
Short, Joshua, admitted C.C., 1665.
——, —, Surrey Street, Strand. Harrison's son, before starting on his voyage to Barbadoes, in 1764, set his chronometer by Mr. Short's regulator; 1750–1770.
Shorter, E., 4, Bridge Road, Southwark, 1830.
Shrapnell, James, 36, Ludgate Street, 1761–1770; 60, Charing Cross, 1788.
Shuckburg, Charles, C.C., 1719.
Shuttleworth, Henry, C.C., 1669.
——, **F.**, 23, Duke Street, Piccadilly, 1806–1810.
Sibbald, William, 4, Cannon Street Road, 1835.
Sidey, Benjamin, 5, Moorfields, admitted C.C., 1730; master, 1761 and 1789; known as a good watchmaker, and active in matters affecting the interests of the trade, 1730–1790.
Sidley, John, admitted C.C., 1701.
——, **Benjamin**, admitted C.C., 1710.
Sills, William, a marine chronometer finisher of surpassing merit; born 1812, died 1884; he worked for Robert and Henry Molyneux and other eminent makers, 1832–1884.
Silver, Frederick, livery, 1810; 1800–1811.
——, **J. and J.**, 28, Hatton Garden, 1825–1830.
Simcox, William, admitted C.C., 1682.
——, **Samuel**, admitted C.C., 1708.
Simkin, Ben, 16, High Street, Boro', 1788–1793.
Simmons, John, Fleet Street, 1753–1756.
——, **E.**, 1, Pavement, Moorfields, 1820.
——, **Ebenezer**, 26, Coleman Street, 1840–1842.
——, **George**, 49, King Square, Goswell Road, 1840–1842.
——, **Morrice**, 40, Great Prescot Street, 1842.
Simonds, Thomas, Fleet Street, admitted C.C., 1661; maker of a lantern clock, frets Fig. 100, balance escapement; 1661–1670.

Simonds, J. L., 19, Holborn Hill, 1820–1830.
Simons, John, watch-case coverer, Sutton Street, Clerkenwell, 1790–1793.
——, **G.**, 49, King's Square, 1840–1842.
Simpkins, Thomas, C.C., 1710.
——, **Benjamin**, 35, Frith Street, Soho, 1800.
Simpkinson, Roger, 41, Fleet Street, 1758–1775.
Simpson, John, admitted C.C., 1700–1710.
——, **John**, admitted C.C., 1723.
—— **and Ward**, Fleet Street, 1737–1740.
——, **William E.**, hon. freeman, C.C., 1770–1781.
——, **Archibald**, 10, Prince's Street, Leicester Square, 1790–1794.
——, **Hector**, 127, Pall Mall, 1788–1792.
——, **R.**, 19, Albion Buildings, 1790–1795; 481, Strand, 1805–1815.
——, **John**, 6, Middle Row, Holborn, 1825–1840.
——, **Robert**, 55, Park Street, Dorset Square, 1835–1840; 15, New Street, 1842.
——, **Robert, junior**, 11, Great Castle Street, Regent Street, 1840.
——, **Thomas**, Oxford Street, 1835–1842.
Sims, John, 64, Lombard Street, 1773–1778.
——, **Henry**, Canterbury, maker of long-case clocks, about 1780.
Sinclair, Charles, 69, Old Street, 1835–1842.
Sinderby, Francis H., Devereux Court, Strand, 1790; livery, C.C., 1810; 18, Bull and Mouth Street, 1830; 1790–1840.
Sindry, Lawrence, C.C., 1661.
Skeggs, L., 355, Rotherhithe Street, 1788–1810.
——, **William**, 355, Rotherhithe Street, 1820–1840.
Skerry, W., Dartmouth Street, Westminster, 1835–1842.
Skinner, Matthew, master, C.C., 1746; 1730–1747.
——, **Charles**, 23, Pool Terrace, City Road, 1840.
Slack, Joseph, admitted C.C., 1723.
Slater, W., 13. Ship Alley, Wellclose Square, 1835.
Sloagh, William, C.C., 1687.
Sloper, Jeremiah, C.C., 1726.
Sly, Robert, admitted C.C., 1720.
Smalle, Lewis, received payments for "keping the clocke" of Lambeth parish church, 1585–1605.
Smalley, Thomas, admitted C.C., 1687; maker of a clock at Battle Abbey, Sussex; 1687–1700.
Smart, John, admitted C.C., 1682.
——, **Orpheus**, 1750.
——, **Benjamin**, 35, Frith Street, Soho, 1800.
——, **Thomas**, 4, Little Ryder Street, St. James's, 1825–1830.
——, **Samuel**, 198, South Audley Street, 1835.
——, **Alexander**, 70, South Audley Street, 1835–1840.
Smeaton, John, York. In the B.M. is a circular rather large silver watch by him silver dial, outer case of leather piqué, about 1640.
Smeed, George, 17, Chapel Street, Edgware Road, 1835–1842.
Smith, John, petitioner for incorporation of C.C., and one of the first assistants, 1630–1649.
——, **George**, admitted C.C, 1632.
——, **Walter**, admitted as a brother, C.C., 1641.
——, **Robert**, admitted as a brother, C.C., 1648; warden in 1650, and died during his year of office, 1640–1651.
——, **John**, admitted C.C., 1654.
——, **John**, admitted C.C., 1656.
——, **David**, admitted C.C., 1662.
——, **Robert**, admitted as a brother, C.C., 1695; on the disc of a long walnut-case clock appeared the inscription, "Robert Smith, Dunstable;" 1680–1700.
——, **John**, admitted C.C., 1674, clockmaker and author of "Horological Disquisitions," 12mo., published in 1694, second edition, 1708. This was probably the first English book on clock and watch making; he also published "Horological Dialogues," in 1675; 1670–1708.
——, **Thomas**, admitted C.C., 1700.
——, **Morris**, admitted C.C., 1702.

Smith, Henry, admitted C.C., 1703.
——, **John**, admitted C.C., 1703; maker of the turret clock at Westminster Abbey, 1730. The movement of this clock was replaced by a modern one in 1860; 1703–1740.
——, **Tudor**, admitted C.C., 1717.
——, **Thomas**, admitted C.C., 1718.
——, **Obadiah**, admitted C.C., 1725.
——, **Joseph**, Chester, maker of bracket clock, about 1740.
——, **Maurice**, Royal Exchange, 1728–1732.
——, **Edward**, Bury, maker of lantern clocks, about 1730.
——, **James**, Chiswell Street, 1758–1760.
——, **James**, White Horse Court, hon. freeman, C.C., 1790.
——, Bishopsgate Street, 1775.
——, **George**, 110, Wood Street, 1770–1776.
——, **James**, 115, Fleet Street, 1760–1780.
——, **William**, 32, Cornhill, 1769–1780.
—— **and Sharp**, 14, Bartholemew Close, 1780–1785.
——, **Richard**, Cloak Lane, 1780–1785.
——, **Joseph**, 49, Lombard Street, 1783–1790.
——, **George**, 4, Huggin Lane, Wood Street, 1783–1790.
—— **James and Son**, 118, Bunhill Row, 1769–1790.
—— **and Wareham**, Davies Street, Berkeley Square, 1790.
——, **Jabez**, 16, Fenchurch Street, 1790.
——, **Charles**, 118, Bunhill Row, 1790–1823.
——, **James** (clockmaker to George III.), Jermyn Street, 1790.
——, **John**, 143, Houndsditch; livery, C.C., 1776–1790.
——, **William**, 170, Wapping, 1800–1804.
——, **William**, 3, Bridgewater Square, 1803–1810.
——, **James**, 98, Oxford Street, 1790–1815.
——, **Samuel**, patented (1812, No. 3620) a vertical escape wheel with five teeth. Several watches were made on this plan; 1800–1820.

Smith, George, Charlotte Terrace, New Cut, 1820.
——, **William**, 35, Poultry, 1823.
——, **John**, 27, Cornhill, 1825.
—— **and Co.**, Piccadilly, 1825.
——, **T. W.**, 27, Fenchurch Street, 1820–1830.
——, **B.**, 12, Duke Street, Lincoln's Inn Fields, 1830.
——, **G.**, 11, St. Martin's Churchyard, 1823–1830.
——, **J.**, 256, Borough, 1825–1830.
——, **H.** (watch-movement maker), 12, Berkeley Street, Clerkenwell, 1825–1835.
——, **Thomas**, 17, John Street, Oxford Street, 1823–1835.
——, **J., and Son**, St. John's Square, Clerkenwell, 1835-1842.
——, **John**, 70, Charlotte Street, Fitzroy Square, 1842.
——, **Joseph**, 18, Bride Lane, Fleet Street, 1842.
Smitton, Peter, 12, Crown Street, Russell Square, 1820–1835.
Snell, George, admitted C.C., 1688; maker of long-case clocks, 1688–1700.
Snelling, Thomas, C.C., 1680.
——, **James**, Poultry, admitted C.C., 1712; master in 1736; a watch by him in B.M.; 1712–1748.
——, **Henry**, Ball Alley, Lombard Street, 1769–1775.
Snosswell, William, 24, Farringdon Street, 1835–1842.
Snow, John, Sarum. "A watch the hours in the form of Diamonds, the Out-case holes with bizels for the sound of the Bell" (*London Gazette*, March 29, April 1, 1680).
Soar, James, 5, Paradise Street, Finsbury, 1842.
Soffleur, Thomas, London, 1680.
Solomon, Henry, Coventry Street, 1775.
——, **S. C.**, 13, St. Mary Axe, 1794–1804.
——, **Moses**, King Street, 1810; Bevis Marks, 1820; Great Alie Street, 1830.
——, **Henry**, 46, Duke Street, Aldgate, 1835.
——, **Henry, and Co.**, 31, Houndsditch, 1840–1842.
——, **P.**, 26, Mansell Street, 1840-1842.

Solomon, J., 24, Great Prescot Street, 1842.
Somerfall, Richard, Finsbury Place, Moorfields, 1788; 1798-1804.
Somersal, John, admitted C.C., 1708.
Somersall, George, Leadenhall Street, 1750; Finsbury, Moorfields, 1779.
——, **Richard**, summoned to livery, C.C., 1786; 1776-1787.
Sones, Thomas, watch-case maker, 6, Lillypot Alley, 1790.
South, Joseph, admitted C.C., 1709.
Southan, Samuel, 28, Red Lion Street, 1790.
Southwarth, John, C.C., 1689.
Southworth, Peter, C.C., 1664.
Sowerby, Thomas, 79, Chiswell Street, 1830.
——, **Thomas**, 124, Long Acre, 1830.
Sowter, John, admitted C.C., 1683.
Sparkes, Nicholas, presented C.C. with a piece of plate in lieu of serving as steward, 1659.
Sparrow, Thomas, 113, Leadenhall Street, 1790-1794.
Speakman, Thomas, C.C., 1685.
——, **Edward**, admitted C.C., 1691.
——, **John, junior**, C.C., 1706.
——, **William**, master, C.C., 1701; 1690-1715.
Spear, Jacob, musical clockmaker, 39, Myddelton Street, 1835.
Spence, John, London. In the B.M. is a round silver watch by him, dated 1650, silver dial, matted ground with Roman hour numerals engraved on polished lozenge-shaped plaques, day of the month shown on outer circle, glass over dial; 1650-1670.
Spencer, Thomas, Strand, threatened with prosecution by C.C. for undue taking of apprentices, 1682; admitted C.C., 1685; 1680-1686.
——, **Arthur**, admitted C.C., 1732.
—— **and Perkin**, 44, Snow Hill, 1775-1794.
——, **J.**, 20, Red Lion Street, Clerkenwell, 1820-1830.
Spiegalhalter, G., musical clockmaker, 6, Mount Place, Whitechapel, 1835-1842.
Spink, M., 8, Gracechurch Street, 1828-1830.
Spittle, Richard, admitted C.C., 1699; maker of a tall walnut long-case clock, brass dial, with arch riveted on, containing Father Time on wing, with the words, "Tempus fugit," 1699-1720.
Spurrier, John, admitted C.C., 1684.
Spyer, J., and Solomon, 26, Prescot Street, 1804; 20, Leman Street, 1825.
Stables, Thomas, admitted C.C., 1685.
Stacey, John, admitted C.C., 1683.
——, **William**, maker of a bell-top mahogany-case bracket clock, period 1750.
Stafford, John, admitted C.C., 1708.
Stainsburg, Robert, Chippenham. "A silver watch with a black Fish-Skin case, studded with silver, Robert Stainsburg, Chippenham, engraven on the Dial Plate" (*London Gazette*, August 29, September 1, 1698).
Stainton, Matthew, 1, Aldermanbury, 1772.
Stamp, J., 86, Cheapside, 1775.
Stamper, Francis, at "ye Golden Ball in Lumbard Streete," a good maker; admitted C.C., 1682. In 1687 ordered by the C.C. to be prosecuted for refusing to admit to his workroom master and wardens when they were upon a search, but he submitted himself to the court, and was fined 20*s.*; maker of a clock with square dial on a lantern movement; 1682-1700.
——, **John**, 148, Fleet Street, 1772.
Stanbury, Henry, admitted C.C., 1709; maker of a thirty-hour long-case clock; 1709-1720.
Standish, William, C.C., 1668.
Stanes, Jeffery, admitted C.C., 1686.
Stanger, Hugh, 46, Old Street Road, 1835-1840.
Stanley, John, admitted C.C., 1732.
Stanton, John, admitted C.C., 1692.
——, **Edward**, admitted C.C., 1662; master, 1696; 1662-1697.
——, **Joseph**, admitted C.C., 1703.
——, **Samuel**, admitted C.C., 1714.
Staples, James, 7, Rosoman Street, Clerkenwell, 1788-1792.
Stapleton, Thomas, C.C., 1694.
Staptoe, William, Charing Cross, admitted C.C., 1703; 1703-1710.
Starey, John, 4, Sweeting's Alley,

Cornhill; livery, C.C., 1787; 1770–1794.
Starkey, Joseph, admitted C.C., 1706.
Stauffer, Robert, and Co., 43, Skinner Street, Clerkenwell, 1842.
——, **Robert, Son, and Co.,** Snow Hill, 1840–1842.
——, **Julius,** 43, Skinner Street, 1840–1842.
Staunton, Edward, Leadenhall Street, "a new Gold Clock-Watch graved with a cypher, on the back Edward Staunton, maker" (*London Gazette*, November 16–19, 1696).
Stayne, Thomas, admitted C.C., 1654.
Stedman, J., Red Lion Street, 1790.
Steele, F., 71, Oxford Street, 1825–1833.
Stegar, John, admitted C.C., 1699.
Steinmann, Daniel, 29, North Audley Street, 1840–1842.
Stephens, Francis, C.C., 1632.
——, **Joseph,** Whitechapel, admitted C.C., 1721; master, 1752; 1721–1766.
——, **Joseph,** 32, Aldgate, master, C.C., 1776; 1760–1790.
——, **Thomas,** 93, Strand, 1823.
Stephenson, Benjamin, 5, Ludgate Hill, 1774–1777.
——, **Thomas Samuel,** livery, C.C., 1810.
——, **D. W.,** 27, Lombard Street, 1820–1830.
Sterck, William, Portugal Street, Lincoln's Inn, 1760–1768.
—— (**Sterk**), **William,** Cockspur Street, 1772–1790.
Sterens, Samuel, 26, Whitechapel, 1790.
Steuart, James, 8, Green Street, Leicester Square, 1790.
Stevens, Samuel, Grub Street, admitted C.C., 1680; threatened in 1682 with prosecution by C.C. for undue taking of apprentices, 1680–1682.
——, **Daniel,** admitted C.C., 1661.
——, **George,** admitted C.C., 1673.
——, **Thomas,** admitted C.C., 1700.
——, **Nathaniel,** admitted C.C., 1702.
——, **Samuel,** admitted C.C., 1706; maker of a square dial lantern clock, cherub corners, inscribed "Sam. Stevens, Londini, fecit," on circle; 1706–1718.
Stevens, Richard, C.C., 1715.
——, **Joseph,** 32, Aldgate Without; master, C.C., 1752 and 1756; 1745–1777.
——, **W.,** 31, Ironmonger Lane, Old Street, 1835.
——, **Ezek.,** 49, King Terrace, New North Road, 1840–1842.
——, **William, junior,** 11, Ironmonger Street, 1840–1842.
——, **William,** 14, Bartholomew Square, St. Luke's, 1840–1842.
——, **D.,** 5, New Gloster Street, Hoxton, 1842.
Stevenson, Adam, summoned to livery, C.C., 1786.
——, **J.,** Bethnal Green Road, 1835.
Stewart, Joseph, 61, Red Lion Street, 1842.
Stiebel, B., 5, Chandos Street, 1823.
Stiles, John, admitted C.C., 1704.
——, **Nathaniel,** Wood Street, admitted C.C., 1725; master, 1751; 1725–1770.
——, **Richard,** probably son of the above; master, C.C., 1790; 1770–1790.
——, **William,** 28, Tottenham Court Road, 1835.
Still, Francis, admitted C.C., 1699.
Stirling, John, 38, Abchurch Lane, 1788.
Stirrup, Thomas, publisher "Hoometer; or, Complete Dialist," in 1652.
Stock, Jabez, Whitechapel, maker of a long black narrow-case clock, with Japanese decoration down the front, and a small circular glass in the door, about 1700. In the panel is—

> "I labour here with all my might,
> To tell the time by day and night;
> In thy devotion copy me,
> And serve thy God as I serve thee."

Stoddart, Robert, 61, Red Lion Street, Clerkenwell, 1815–1842.
——, **J.,** 7, Charles Street, Northampton Square, 1835–1840.
——, **James,** 13, Red Lion Street, 1842; died at Hastings, 1886, aged 80.
Stogden (Stockten), Matthew, admitted C.C., 1716; inventor of improved repeating motion (see p.

247); died in abject poverty; 1716–1770.

Stokes, Henry, Turnmill Street, Clerkenwell, bequeathed his best clock to Robert Stokes, 1586.

Stone, Andrew, admitted C.C., 1699.

——, **William,** admitted C.C., 1700.

——, **Roger,** admitted C.C., 1710.

——, **Samuel,** 8, London Road, Obelisk, 1820.

Stones, Thomas, Lothbury, admitted C.C., 1692; master, 1730; 1692–1731.

Storer, Robert, and Son, 11, Berkeley Court, Clerkenwell, 1788–1798.

——, **C.,** 11, Berkeley Court, Clerkenwell, 1790–1800.

——, **J.,** 64, Wynyat Street, Goswell Road, 1835.

——, **W.,** 5, Felix Terrace, Islington, 1840–1842.

Storey, James, admitted C.C., 1703.

——, **Charles,** Sidney Alley, Leicester Fields, 1758–1760.

——, **J.,** 176, Regent's Street, 1830.

Storr, Marmaduke, 20, Lombard Street, 1760–1774.

——, **William,** 44, St. James's Street, hon. freeman, C.C., 1781–1794.

Story, William, Red Lion Street, Clerkenwell, 1769–1772.

——, **Henry,** 7, Charterhouse Lane, 1820.

Stracey, John, 34, Prince's Street, Lothbury, 1790.

Strachan, Andrew, a Scotsman; to avoid prosecution for practising his art in the city of London he bound himself apprentice to Thomas Warden; the Chamberlain ordered the indenture to be cancelled, as Strachan was between thirty and forty years old, 1691.

——, **A. and J.,** 125, Long Acre, 1830.

Straiton, Alexander, 146, Leadenhall Street, 1825; 15, Little Knightrider Street, 1842; died 1873, aged 83.

Stram, Alfred, Ashby Street, Clerkenwell; born in Switzerland, died 1893, aged 80. An excellent watch-case maker.

Stratford, George, admitted C.C., 1704.

Stratton, Richard, C.C., 1720.

——, **John,** 133, Bunhill Row, 1820–1825.

Stratton, Joseph, Church Street, Hackney, 1830–1835.

Street, Richard, admitted as a brother, C.C., 1687; warden, 1715; maker of a clock costing £50, which was presented by Sir Isaac Newton to Dr. Bradley, Master of Trinity College, Cambridge, in 1708; 1680–1816.

Strelly, Francis, admitted C.C., 1665.

Stretton, Sarah, admitted C.C., 1710.

Stribling, Benjamin, Stowmarket, known as a maker of lantern clocks, about 1700.

Strigel, William, St. James's Street, 1760–1775.

——, **George Philip,** Stafford Row, near Buckingham Court, 1760–1788.

Strigner, —. In the B.M. is a watch by him in an outer case of carnelian. It was made for James II., and by him given to his daughter, Catherine, Countess of Anglesey and Duchess of Buckingham, about 1687.

Strongfellow, John, C.C., 1691.

Storr and Mortimer, 13, New Bond Street, 1830.

Stroud, Elizabeth, 5, Henry Street, Pentonville, 1840.

Stubbs, Gabriel, admitted C.C., 1675; described as a small clockmaker (watchmaker?) and a celebrated member of the Company; 1675–1677.

——, **J.,** 28, Penton Street, Haymarket, 1830.

——, —, Prince's Street, Leicester Square, maker of a gold chronometer half-quarter repeater, gold dial, raised numerals, 1817.

Stuk, William, Cockspur Street, 1781.

Style, Richard, 3, Carey Lane, Foster Lane; master, C.C., 1790; 1780–1796.

——, **Nathaniel,** Wood Street, admitted C.C., 1725; master, 1751; 1725–1770.

Sudbury, John, admitted C.C., 1686.

Sully, Henry, apprenticed to Charles Gretton, admitted C.C., 1704; an eminent man who settled in France (see p. 110); 1704–1728.

Summer, William, C.C., 1662.

——, **Francis,** 26, Greek Street, Soho, 1790.

Supple, John, Vigo Lane, Piccadilly, 1783.
Sutton, Isaac, admitted C.C., 1662.
Swale, Jaques (alien), threatened with prosecution for working as clock-maker in liberties of C.C., 1668.
Swannell and Co., Staples Inn, Holborn, 1790.
Swannick, G., 38, Banner Street, Bunhill Row, 1820.
Swanson, Robert, admitted C.C., 1730.
——, **William,** 5, Banner Street, Bunhill Row, 1790.
Swearer and Sons, wooden clock-makers, 7, Upper Street, Smithfield, 1820.
——, **J.,** 30, Park Terrace, Regent's Park, 1840–1842.
Sweeby, John, admitted C.C., 1671; maker of a fine long inlaid-case clock, period William III., 1671–1700.
Swift, Thomas, Essex Street, Islington, lever pallet maker, 1825–1867.
Swindells, Jasper, watch-case maker, Salmon and Ball Court, Bunhill Row, 1800–1813.
Sydenham, H. and J., 126, New Bond Street, 1800–1804.
——, **J.,** 126, Bond Street, 1823.
Sylvester, John, admitted C.C., 1693.
Symonds, Thomas, 27, Cheapside, 1770–1775; 20, Fleet Street, 1775–1788.

Taber, Thomas, 29, Compton Street, Clerkenwell, 1825.
Tallibart, Louis, 48, Rathbone Place, 1842.
Tallis, Aaron, admitted C.C., 1722.
Tanner, Joseph, admitted C.C., 1682.
——, —, clock engraver and varnisher, Fleet Street, 1790.
Tapp, Francis, 85, Strand, 1775–1785.
Tarman, J. B., 34, Regent Street, Piccadilly, 1825.
Tate, Ruth, East Sheen, on an oak long-case clock, about 1790.
Taylor, a well-known family among the London watchmakers from 1640 till past the middle of the present century.
——, **Thomas,** admitted C.C., 1646; master, 1668; 1646–1670.
——, **Richard,** admitted C.C., 1655.
——, **Abraham,** admitted C.C., 1668.
Taylor, William, admitted C.C., 1682.
——, **Thomas,** Holborn, at the end of Fetter Lane, admitted C.C., 1685; master, 1710; maker of a fine pair-case repoussé repeating watch, gold dial, 1685–1715.
——, **John,** admitted C.C., 1687. "Lost between Pickadilly and St. James Street, a gold watch made fast in a gold studded case, with high pins at each hour; made by Mr. Taylor, at the Upper End of Fetter Lane, in Holborn. Whoever brings it to Mr. Harrison, Goldsmith, etc., the Three Flower-de-Luces, in the Strand, shall have a guinea reward" (*London Gazette*, February 9–12, 1692).
——, **Jasper,** in Gray's Inn, admitted C.C., 1694. On a pair-case copper verge watch, outside case of leather, with many small rivets, lock-spring projecting through the dial, is the inscription, "Jasper Taylor, in Holbourn."
——, **John,** admitted C.C., 1702.
——, **George,** admitted C.C., 1703. To him and his wife Lucy, Rebecca Fisher was bound apprentice in 1715; 1703–1715.
——, **Charles,** admitted C.C., 1723.
——, **Richard,** admitted C.C., 1724.
——, **Jasper,** of Barnard's Inn, admitted C.C., 1729; took an active part in the affairs of the Company; was master in 1754, and clerk from 1760 to 1770; 1729–1770.
——, **Edward,** livery, C.C., 1810. In the B.M. is a curious watch of his, with symbolical figures and texts of Scripture in the enamel on the dial and case, 1800–1830.
——, **Samuel,** 10, Bell Alley, Lombard Street; master, C.C., 1807; 1788–1810.
——, **Edward,** 25, Leadenhall Street, 1825.
——, **Joseph,** 2, Bouverie Street, Fleet Street, 1825.
——, **John,** 8, Wilderness Row, Clerkenwell, 1810–1840.
——, **Kennard, and Co.,** 3, Crescent, Jewin Street, 1830.
——, **David,** 27, Northampton Square, 1842. Between 1850 and 1860 he

did a large trade with the American market.
Taylor, James, 3, Corporation Lane, Clerkenwell, 1835.
——, **Robert,** 47, William Street, Regent Street, 1835.
——, **Charles,** 62, John Street, Fitzroy Square, 1840.
Team, John, 25, Redcross Square, 1790.
Tebball, Benjamin, C.C., 1683.
Tebbatt, Benoni, Little Old Bailey, C.C. seized at his shop a gold watch-case, both for that it was of coarse and unwarrantable gold, and also so extremely thin that it was insufficient in strength. William Brafield, who made the case, admitted his fault, and was fined 5s., the case being broken up; 1688.
Temple, Thomas, admitted C.C., 1720.
Templer, Charles, admitted C.C., 1673.
Tenant, Leonard, paid £37 for a new clock and chimes for St. Margaret's Church, Westminster, 1617.
Tennant, Thomas, C.C., 1668.
Terold, Henry, Ipswich, maker of a round silver watch-case with interlacing bands, silver dial, Fellows Collection, about 1670.
Terrier, James, admitted C.C., 1694.
——, **Thomas,** admitted C.C., 1694.
——, **Mary,** admitted C.C., 1713.
Terry, Eli, Plymouth, Lichfield County, Connecticut, U.S.A.; maker of American clocks, and patentee of equation clock in 1797; 1791–1845.
——, **Isaac,** 15, King Street, Clerkenwell, 1835.
——, **Isaac,** 35, Prince's Street, Leicester Square, 1842.
Thacke, Philip, admitted C.C., 1685; maker of marqueterie long-case clock, square dial, 1685–1700.
Thead and Pickett, Ludgate Hill, 1758–1765.
Thiout, l'Aine, a clever French watchmaker, inventor of many ingenious forms of repeating work, curious clocks, etc., described in his "Traité d'Horlogerie," Paris, 1741; 1730–1745.
Thitchener, W., 36, High Street, Shadwell, 1835–1840.
Thitchener, J., 14, Maiden Lane, Covent Garden, 1835.
——, **Thomas,** 18, High Row, Knightsbridge, 1840–1842.
Thomaque, Abraham, C.C., 1675.
——, **Isaac,** maker of a silver repeating watch, about 1729.
Thomas, John, 55, St. James's Street, verge watch movement by him in Guildhall Museum, 1800–1804.
——, **Richard,** 3, Strand, 1804.
——, **Thomas,** 314, Borough, 1825.
—— **and Son,** 3, Strand, 1825–1830.
——, **F. L. and J. W.,** 153, New Bond Street, 1823–1830.
——, **John,** New Road, St. George's East, 1835.
Thomegay, Mark, Moorfields, 1768.
Thompson, John, admitted C.C., 1662.
——, **Robert,** admitted C.C., 1681.
——, **Isaac,** admitted C.C., 1699.
——, **William,** admitted C.C., 1708.
——, **John,** admitted C.C., 1720.
——, **Troughton,** admitted C.C., 1731.
——, **Ann, and Son,** Red Lion Street, Clerkenwell, 1790.
——, **James,** Bride Lane, Fleet Street, 1790.
——, **John,** 10, Red Lion Street, Clerkenwell, 1765–1790.
——, **W.,** Skinner Street, Clerkenwell, 1790.
——, **E.,** 32, Exeter Street, Sloane Street, 1835–1840.
——, **J.,** 19, Red Lion Street, Clerkenwell, 1835.
——, **William,** 5, Great Tower Street, 1840–1842.
——, **Edward J.,** 43, Windsor Terrace, 1842.
Thomson, Philip, and Son, 11, Exeter Court, Strand, 1769.
——, **Adam,** 25, New Bond Street. A very able man; published "Time and Timekeepers" in 1843; 1842–1860.
Thorn, Thomas, 23, Wood Street, Cheapside, 1758–1769.
——, **Robert,** 12, Wood Street, Cheapside, 1760–1768.
Thorne, John, 56, Whitechapel, 1790–1815.
——, **John, and Son,** 56, Whitechapel, 1820.
——, **James,** Limekiln Hill, Limehouse, 1835–1842.

Thorne, John, 49, Rahere Street, 1842.
Thornton, Henry, C.C., 1699.
——, **John**, admitted C.C., 1731.
Thorogood, John, admitted C.C., 1660.
——, **William**, admitted C.C., 1660.
——, **Richard**, 175, Fenchurch Street, 1783.
Thorowgood, L., London, a maker of long-case clocks, about 1770.
Threlkeld, William, London, 1780. "A silver watch with an engraved Case and a Cipher, G. K., in the middle, the Dial Plate having Flower-de-luces at the half-hours, the Maker's name, W. Threlkeld, London" (*London Gazette*, May 12-15, 1701).
Thuret, —, Paris, maker of a clock at S.K.M., about 1750.
Thwaites, Ainsworth, Rosoman Street, Clerkenwell; made the Horse Guards clock, 1756; 1740–1780.
——, **James**, Ratcliff Highway, 1770–1790.
——, **John**, 4, Rosoman Street, Clerkenwell; master, C.C., three times, 1815, 1819, 1820; presented to the C.C. Sully's timekeeper; 1780–1816.
—— **and Reed**, 4, Rosoman Street, Clerkenwell, 1817–1842.
Tidbury and Son, 206, Oxford Street, 1825.
Tiesse, J., London, maker of an oval watch, about 1650.
Tilly, Joseph, admitted C.C., 1703; maker of a walnut long-case clock, square dial, 1703–1720.
Tipping, George, C.C., 1674.
Tobias, Morris, 68, Bell Dock Yard, Wapping, 1798–1800.
——, **Morris, and Co.**, 68, Bell Dock Yard, Wapping, 1804. In 1812 Messrs. Tobias patented (No. 3584) a binnacle timepiece, to show the time by "bells," as watches are kept on board ship.
——, **Morris, and Co.**, 31, Minories, 1830–1842.
Tolby, Charles, admitted C.C., 1720.
Tolkin and Dancer, 148, St. John Street, 1807.
Tolkien, George, 145, St. John Street, 1810.
Tolley, Charles, admitted C.C., 1683.
Tollison, John, admitted C.C., 1714.
Tomkins, William, 11, Winchester Street, 1768–1772.
Tomkinson, Humphry, Maiden Lane, Covent Garden, 1768–1775.
Tomlin, Edward, 69, Threadneedle Street, 1772–1788.
Tomlinson, Thomas, admitted as a brother, C.C., 1647.
——, **William**, admitted C.C., 1699; master in 1733. There is a watch by him in S.K.M., hall mark 1719; 1699–1734.
Tomlyns, Nicholas, C.C., 1647.
Tompion, Thomas, "father of English watchmaking" (see p. 83); admitted C.C., 1671–1713. "Lost out of a gentleman's Pocket, the 19th past, betwixt Lyme St. end in Fenchurch St., and the end of the Minories, an indifferent small size gold pendulum watch, going without string or chain, showing the hours of the day, and day of the month, the name Tompion, in a shagreen case, pinned with a Cypher in the bottom of the case, wound up on the dial plate, at the hour of 12, a straight key with a Steel Nose. Whoever brings it to Mr. Tompion, Clockmaker, at Water Lane, and in Fleet St., shall have one guinea reward, or, if bought, their money again with reasonable profit" (*London Gazette*, November 10–13, 1690).

"Lost, the 3rd inst., betwixt the Sun-Dial, in St. James Park, and Man's Coffee House, a silver Minute Pendulum watch, made by Tho. Tompion, in a Shagreen studded case, on the bottom of the inner case the number 458; with a gold Ring hanging upon the silver chain, with the Effigies of their Present Majesties" (*London Gazette*, March 3 to 7, 1691).

"Lost on the 24 instant, about Kingston-on-Thames, a Gold Minute and Second Chain Pendulum watch, with a Stop, the hours seen through a hole in the Dial Plate, and in a plain Shagreen Out-Case, the name Tho. Tompion, London, a number in the bottom of the Box, 0201. Whoever gives notice of it to Mr. Tho. Tompion, Clockmaker, at the corner of Water Lane, in Fleet St., shall have 3 guineas reward; or if bought already, your money again with reasonable profit" (*London Gazette*, June 25–29, 1691).

"Lost, some time in November last, at Oxon, a Gold Minute Pendulum watch in a plain gold case; the names on the upper peak, Tho. Tompion, Edwd. Banger, London; and on the Dial Plate, Tompion, Banger, London, with this number, 3428, on the bottom of the Box within side, and likewise upon the upper plate. Whoever give notice of it (so as it may be had again) to the Reverend Dr. King, of Christ Church College, at Oxon, or to Tho. Tompion, Clockmaker, at the Dial and Three Crowns, at the Corner of Water Lane, Fleet St., London, shall have three guineas reward; or if bought or pawned, your money again with reasonable profit" (*London Gazette*, December 4–7, 1704).

Tompion, Thomas, junior, apprenticed to Charles Kemp, 1694; admitted C.C., 1702.

—— **T., and Banger, E.,** inscribed on some watches. *See* Banger.

Tompson, J., 9, Hooper Court, Clerkenwell, 1842.

Toms, T. E., 7, Swan Street, Minories, 1820.

Topham, J., 9, Basing Lane, 1788–1800.

Torado, Francis, Gray's Inn, admitted as a brother, C.C., 1633; maker of an oval watch in Guildhall Museum. His widow became a pensioner of C.C. in 1690; 1633–1675.

Torin, James Lewis, 30, Throgmorton Street, 1738–1780.

Torkler, Peter, 9, Red Lion Street, Clerkenwell, 1785–1790.

Tothaker, William, C.C., 1703.

Toulmin, Samuel, 27, Strand, maker of a centre seconds watch, beating full seconds, in the Guildhall Museum, cylinder escapement; 1766–1783.

Toutin, Jean, Château Surr, celebrated enamel painter (see p. 71).

——, **Henry,** Blois (brother of Jean), (see p. 72).

Tovey, William, watch and clock spring-maker, 64, Red Lion Street, Clerkenwell, 1798.

——, **William,** watch and clock spring-maker, 53, Upper Moorfields, 1804.

Townsend, Samuel, C.C., 1702.

——, **Elizabeth and John,** 61, St. Paul's Churchyard, 1760–1769.

——, **Elizabeth,** 119, Fetter Lane, 1804.

——, **William,** 99, Guildford Place, Spafield, 1842.

Trail, Edwin, 68, Old Broad Street, 1835.

——, **Edwin,** Edgware Road, 1842.

Travers, William, Red Lion Street, Clerkenwell, 1788–1810.

——, **Adam,** 9, Red Lion Street, Clerkenwell, 1783–1790.

——, **Mathew,** watch-case maker, 12, Great Sutton Street, 1810.

Tregent, James, 35, Strand, 1775; 29, Cranbourne Street, Leicester Square, 1780; watchmaker to the Prince of Wales; hon. freeman, C.C., 1781. A celebrated French maker, who settled in London, and was intimate with Garrick, Sheridan, and other notabilities of the theatre. The Duke of Sussex paid him £400 for a repeater and alarum travelling watch; 1770–1804.

Trelegon, James, Strand, 1775.

Trenholm, —, admitted C.C., 1728.

Trewinnard, Joseph and James, 16, Rotherhithe Wall, 1790–1842.

——, **Joshua,** 40, Strand, 1807–1810.

——, **Edward,** Grange Road, Bermondsey, 1825.

——, **James,** 32, London Road, 1835.

——, **Joseph,** 23, Grange Road, 1835.

——, **George,** Kingsland Place, 1835.

Trigg, Thomas, admitted C.C., 1701.

Triggs, Thomas, admitted C.C., 1708.

Tringham, George, 15, Golden Lane, 1835–1842.

Tripp, Job, Bridge Street, 1772.

Trippett, Robert, admitted C.C., 1700.

Trippitt, William, C.C., 1706.

Tritschler and Co., wooden and musical clockmaker, 191, High Holborn, 1835-1840.
Troughton, Bryan, 35, Fenchurch Street, 1760-1775.
Troup, J., 233, Tooley Street, 1822; 120, Cheapside, 1835-1842.
Trowe, Gilbert, admitted C.C., 1722.
Trubshaw, John, admitted C C., 1686; a gilt metal-cased repeating watch by him S.K.M., 1686-1700.
Tubet, Edward, Fenchurch Street, liveryman, C.C., 1776.
Tuck, J. and L., 8, Haymarket, 1804-1830.
Tudman, James, The Crown, Lombard Street, 1697-1710.
Tuite, William, 41, Great Queen Street, 1769-1775.
Tulet, Edward, 13, Fenchurch Street, 1765-1770.
Tunnell, J., 18, Fleet Street, 1825.
Tupling, B., 191, Strand, 1820.
Tupman, G., 6, Charles Street, Grosvenor Square, 1806-1830.
——, **James,** Great Russell Street, Bloomsbury, 1820-1842.
Turges, Josiah, 23, Smithfields, 1768-1772.
Turner, Joseph, admitted C.C., 1717.
——, **William,** Church Street, Spitalfields, 1768-1772.
——, **John,** 10, London Wall, 1788.
——, **William,** Fenchurch Street, 1825-1835.
——, **J. and Charles,** 58 and 59, New Bond Street, 1830.
Turpin, Benjamin, 65, Banner Street, St. Luke's, 1835-1842.
Turvee, Jarrett, admitted as a brother, C.C., 1688.
Tutet, Edward, 10, Fenchurch Street, livery, C.C., 1766; master, 1786; 1766-1790.
Tuttell, Thomas, admitted C.C., 1695.
Twhing, James, admitted C.C., 1688.
Twycross, S., and Son, 8, Haymarket, 1804.
Twyford, Robert, 40, Strand, hon. freeman, C.C., 1781; 1770-1782.
——, **Robert, and Co.,** 9, Finch Lane, Cornhill, 1790; 10, Salisbury Street, Strand, 1800; 1790-1810.
Tyas, J. A., watch-case maker, 77, Rahere Street, Goswell Road, 1835.
Tyas, W. T., Thavies Inn, Holborn, 1830-1835.
Tyler, George, Pope's Head Alley, maker of a bracket clock, Japanese tortoiseshell case, 1687.
——, **James Henry,** 24½, Northampton Street, 1835.
Tymms, A., 6, Rennington Lane, 1820.
——, **M.,** 5, Rennington Lane, 1820.
Tyrer, Thomas, patented in 1782 (No. 1311) the duplex escapement. His specification says, "Horizontal scapement for a watch to act with two wheels," 1780-1783.
——, **H.,** 32, Northampton Street, Clerkenwell, 1806-1830.
——, **James,** 65, Red Lion Street, 1842.

Udall, J., 5, Great New Street, Shoe Lane, 1819-1822.
Ulrich, John Gottleib, 26, Nicholas Lane, in 1835; he devised and patented several methods of compensating chronometers, 1830-1874.
Underhill, Cave, admitted as a brother, C.C., 1655.
Underwood, John, and Sons, Foster Lane, 1758-1760.
——, **John,** 36, Noble Street, Cheapside, 1754-1775.
——, **Robert,** 3, Falcon Street, 1769-1804.
——, **Cæsar,** 3, Panton Street, 1798-1800; 9, Ranelagh Street, Pimlico, 1820.
Uneman, John and William, Dutch clockmakers in England (see p. 23), 1368.
Unwin, Edward, 30, Upper Lisson Street, Paddington, 1820.
Upjohn, James, Threadneedle Street, 1760-1763; Lombard Street, 1774.
——, **James, and Wirgman,** 18, Red Lion Street, Clerkenwell, 1769-1781.
——, **Francis,** 1, Bridgewater Square, livery, C.C., 1786; suggested distinctive marks on foreign watches, 1780-1787.
——, **J.,** 11, St. John's Square, Clerkenwell, 1815-1820.
——, **Peter,** 11, Red Lion Street, 1783-1835.
——, **J. and T.,** 5, Chandos Street, Covent Garden, 1835.

Upjohn and Bright, 5, King William Street, Strand, 1842.

Urseau, Nicholas. There is an entry of a payment to him as a clockmaker in 1553, and on New Year's Day, 1556, he presented a clock to Queen Elizabeth, 1553–1556.

——, **Nicholas**, probably a son of the preceding, clockmaker to Queen Elizabeth, 1572–1590.

Usherwood, William, 19, Strand, 1830.

Vale, Samuel, Coventry, 1747.

——, **Howlett, and Carr**, Coventry, 1754–1790.

—— **and Rotherham** (R. K. Rotherham apprenticed to Vale, Howlett, and Carr), 1790–1840.

——, **William**, 12, Bunhill Row, 1781–1790.

——, **William**, musical clockmaker, 32, Paul Street, Finsbury, 1820–1840.

Valentine, Charles D. F., livery, C.C., 1810; 1800–1811.

Vallance, Thomas, 5, Wilderness Row, Goswell Street, 1820.

Van Ceulen, John, Hague, maker of a clock on Huygens' plan (see p. 107), about 1660.

Vandenburg, John, 8, Owen's Row, Clerkenwell, 1830.

Vangnion, Daniel, Spring Gardens, Charing Cross, 1790.

Vanham, Leonard, Addle Street, 1737–1740.

Vanscolina, Richard, 70, Charlotte Terrace, New Cut, 1842.

Vantroleyer, James, one of the first assistants, C.C., 1631–1649.

Vardon, Samuel and Thomas, 29, Frith Street, Soho, 1783.

Vaslet, Andrew, admitted C.C., 1717.

Vaucher, Fritz, 27, Gerrard Street, Soho, 1842.

Vaultrollier, James, one of the first assistants of the C.C., 1630–1649.

Vautyer, —, Blois, maker of a handsome octagonal watch, B.M., case decorated with filigree work and jewels, 1620.

Vecue, Thomas, admitted C.C., 1632.

Vere, John Henry, 48, Lombard Street, 1769.

Vernon, Christopher, in "ye Great Turnstyle, Holborne," maker of lantern clocks, about 1650.

Vernon, Samuel, admitted as a brother, C.C., 1649; master in 1679; 1645–1680.

——, —, admitted C.C., 1685.

——, **Thomas**, maker of a verge watch, repoussé case, about 1700.

Vesper, J., Fore Street, Limehouse, 1820.

——, **T. and W.**, 4, Grosvenor Place, Commercial Road, 1835.

——, **Thomas**, 5, Wellington Place, Commercial Road, 1842.

——, **William**, 12, Sidney Place, Commercial Road, 1842.

Vevers, Richard, 2, Cateaton Street, 1825–1830.

Vial, Charles, 1685. "Silver pendulum watch made by Charles Vial, with a tortoise-shell case inlaid" (*London Gazette*, January 17–20, 1697).

Vick, Richard, in the Strand, admitted C.C., 1702; maker of a repeating watch inscribed "Richard Vick, watchmaker to his late Majesty."

Viel, George, 29, King Street, Soho, 1842.

Viet, Claude. His daughter Marianne was bound apprentice to him in 1715; C.C., 1698–1715.

Vieyres, Anthony, 40, Pall Mall, 1842.

Vigne, James, 2, Strand, hon. freeman, C.C., 1781; 1775–1794.

Villiscun, Stephen, Church Abbey, Basinghall Street, 1780–1785.

Vincent, John, 157, Drury Lane, 1842.

Vine, James, 2, Charing Cross, 1790.

——, **James**, 5, Staining Lane, 1825.

Viner, Charles, and Hopkins, 235, Regent Street, and 8, Sweeting's Alley, 1830–1842.

——, **Charles Edward**, 19, Sackville Street, 1840; Pall Mall, 1855.

Vines, James, admitted C.C., 1708.

——, **C. E., and Co.**, 231, Regent Street, 1835.

——, **Joseph**, Newbury, Berks, maker of a curious astronomical clock, 1836.

Virgoe, Thomas, admitted C.C., 1682.

Voght, Auty, 26, Up. Cleveland Street, 1835.
——, **Charles Frederick,** 30, Wigmore Street, 1842.
Volant, Ely, admitted C.C., 1632.
Volk, P., 38, Goodge Street, Tottenham Court Road, 1835-1840.
Vossière, Thomas, C.C., 1698.
Voughan, Edward, C.C., 1715.
——, **Daniel,** Charing Cross, 1775.
——, **George,** 11, Granville Street, Hatton Garden, 1820.
Vouloire, Matthew, admitted as a brother, C.C., 1692.
Voyce, Gamaliel, admitted C.C., 1694; maker of an arch-top ebony bracket clock, pull quarters, original rise and fall, 1694-1700.
Vuicar, J. B., Zug, maker of a small round watch, silver dial, about 1610.
Vuille Brothers, 2, Easton Street, Spitalfields, 1840-1842.
Vulliamy, Justin, carried on business at Pall Mall, in partnership with Benjamin Gray, whose daughter he married, 1730-1775.
——, **Benjamin,** Pall Mall, son of Justin, and father of Benjamin Lewis; hon. freeman, C.C., 1781; 1775-1820.
——, **Benjamin Lewis,** 68, Pall Mall, an eminent maker (see p. 133), 1810-1854.
Vuolf, J. C. (Swiss), maker of a small skull watch in the B.M., 1600.

Wade, Henry, admitted C.C., 1728.
Wagdon, Stephen, C.C., 1724.
Wagstaff, Thomas, 33, Gracechurch Street, maker of a bracket clock playing four tunes at the hour, black wood case, 1769-1774.
——, **James,** 16, Brown's Lane, 1835.
Waine, —, Queen Street, 1774.
Wainwright, John, C.C., 1679.
Wait and Son, Wapping, 1772.
Wakefield, John, 3, South Street, Berkeley Square, 1835-1842.
——, **T.,** 5, Smith Street, Northampton Square, 1835.
Wakelin and Taylor, Panton Street, St. James's, 1788.
—— **and Garrard,** Panton Street, St. James's, 1800-1805.
Waker, Peter, admitted C.C., 1663.
Waldoe, John, admitted as a brother, C.C., 1677.
Waldron, John, 38, Cornhill, maker of a watch in the Massey-Mainwaring Collection, gold case, repoussé, 1760-1772.
Waldvogel, Anthony, 82, Ratcliff Highway, 1835-1840.
Walford, John, admitted C.C., 1717.
Walkden, Thomas, C.C., 1694.
Walker, John, admitted C.C., 1632.
——, **George,** admitted C.C., 1683.
——, **Jonadab,** admitted C.C., 1687.
——, **John,** Fleet Street, and afterwards at the White Horse and Bell, near Cheapside Conduit; admitted C.C., 1717; inventor of a lamp clock, 1710-1730.
——, **Ezekiel,** of Lynn, wrote an article in *Nicholson's Journal* on longitude and the use of chronometers, 1770-1804.
——, **Joseph,** 1, Warwick Street, Holborn, 1790.
——, **William,** 38, Fetter Lane, 1790.
——, **and Son,** 49, Red Lion Street, Clerkenwell, 1810.
——, **D., and Son,** 46, Clerkenwell Close, 1820.
——, **J.,** musical watchmaker, 7, Nassau Street, Soho, 1820.
——, **John,** 29, Gloucester Street, Queen's Square, 1825.
——, **Thomas, and Son,** 17, Castle Street, Oxford Street, 1825-1830.
——, **E.,** watch-case maker, 46, Whiskin Street, Clerkenwell, 1835.
—— **and Blundell,** 4, Red Lion Street, Clerkenwell, 1835-1840.
——, **William,** patented (1841, No. 8997) a wheel for lever escapement, in which the spaces between the teeth were portions of circles, so as to dispense with the necessity of banking pins.
Waller, J., 17, Shoreditch, 1790.
Wallis, William, admitted C.C., 1715.
——, **Peter,** Fleet Street, 1737-1740.
——, **Henry,** Red Lion Street, 1768.
——, **J.,** 14, Skinner Street, Bishopsgate, 1835-1840.
Wallitt, Richard, admitted C.C., 1693.
Walsh, Arthur Paul, a celebrated watch and chronometer maker and springer; apprenticed to T. F.

Cooper; carried on business as a tool dealer, at Frith Street, Soho, in partnership with Robert Oliphant, and afterwards settled in George Street, Euston Road; born 1815, died 1893.

Walter, Nicholas, maker of an oval watch in the B.M., about 1620.

Walton, Christopher, 24, Ludgate Street, 1823.

Warburton, William, C.C., 1693.

Ward, John, admitted C.C., 1731.

——, **Edward**, admitted C.C., 1731.

——, **John**, Barbican, liveryman, C.C., 1776.

——, **Robert**, 19, Abchurch Lane, Cannon Street, 1769–1785.

——, **Richard**, 18, Lower Street, 1790.

——, **Henry**, of Blandford, a well-known clockmaker, about 1770–1790.

——, **John**, 9, Fore Street, master C.C., 1797; 1775–1798.

——, **Benjamin**, 45, Upper Moorfields, 1790.

——, **John**, 39, Greek Street, Soho, 1790.

——, **Robert**, musical clockmaker, 20, Plumtree Street, Bloomsbury, 1790.

——, **Richard**, 27, Banner Street, 1835–1842.

Warden, Thomas, 1691.

Ware, Robert, admitted C.C., 1701.

Wareham, John, 18, Davies Street, Berkeley Square, 1820–1823.

Warfield, Alexander, C.C., 1692.

Warne, James, 7, Queen Street, Cheapside, 1760–1775.

Warner, John, admitted C.C., 1682.

——, **John**, admitted C.C., 1696.

——, **John**, 8, Trinity Row, Islington, 1835.

Warnes, Robert, 2, Leicester Square, 1825.

Warre, W. H., Skinner Street, Snow Hill; on the Court of C.C., 1863.

Warren, Richard, C.C., 1668.

Washboure, Thomas, Queen's Square, Bartholomew Close, 1754–1759.

Wassell, J., 9, Picket Street, Strand, 1830.

Waters, John, admitted C.C., 1646.

——, **John**, admitted C.C., 1683.

——, **Thomas**, admitted C.C., 1731.

Waters, John, 4, Cornhill, 1775.

Watkins, John, 9, Giltspur Street, Smithfield. Received £33 from Society of Arts for improvement in the spring detent escapement, 1804.

——, **Joseph**, 21, Coldbath Fields, 1810; 21, Great Warner Street, 1815.

Watson, William, C.C., 1691.

——, **Samuel**, Coventry, admitted C.C., 1692; inventor and maker of a curious piece of clockwork. In 1682 is mentioned a payment of £215 for a clock he sold to his late Majesty, Charles I. The clock "showes the rising and setting of the sun and many other motions" (*London Gazette*, September 4–8, 1690); 1670–1692.

——, **Walter**, admitted C.C., 1720. Hatton, in 1773, mentions the astronomical or complicated work of Mr. Watson as being rare; 1720–1773.

——, **John**, Michael's Alley, Cornhill, 1780–1785.

——, **Thomas**, 23, Aldersgate Street, 1785–1790.

——, **James**, 24, Arundel Street, Strand, 1788–1805.

——, **William**, 149, Strand, 1800–1805.

——, **W.**, 67, Red Lion Street, Clerkenwell, 1820.

——, **Edward**, 16, King Street, Cheapside, 1820–1842.

——, **William**, 25, North Audley Street, 1842.

Wattes, John, admitted C.C., 1664.

Watts, Richard, admitted C.C., 1680.

——, **Brouncker**, apprenticed to Joseph Knibb, 1684; admitted C.C., 1693; a repeating watch by him in the Guildhall Museum, engraved cap, gold dial, well engraved and pierced inner case. "Lost, on the 21st instant, in Gutter Lane, Cheapside, a Silver watch with Tortoise-shell Out-Case, with a Lion rampant and 3 oaken leaves for the coat, engraven on the Back-side, made by Bro. Watts; the movements are the hours, minutes, and seconds. Whoever brings it to the sign of the Goldsmiths' Hall in Gutter Lane, or to Bro.

Watts in Fleet Street, shall have a Guinea reward" (*London Gazette*, April 27-30, 1696).
Watts, John, admitted C.C., 1712.
——, **James,** admitted C.C., 1720.
——, **William,** 8, Cripplegate Buildings, 1770; 8, Fore Street, 1775.
Wayland, Henry, Stratford, 1835.
Waylett, John, 9, Bell Alley, Lombard Street, 1795-1810.
Weadon, William, C.C., 1695.
Weakman, William, C.C., 1661.
Weatherley and Roberts, 9, Poultry, 1804.
—— **and Son,** 9, Poultry, 1823.
Weaver, Cuthbert, admitted as a brother, C.C., 1682.
Webb, Charles, Cheapside, 1737-1740.
——, **Peter,** 28, Throgmorton Street, 1753-1768.
——, **Benjamin,** 21, St. John's Square, hon. freeman, C.C.. 1778-1790; 3, Red Lion Street, 1806-1810.
——, **Arthur,** 86, Portland Street, 1780-1885.
——, **Robert,** 14, Berkeley Street, St. John's Square, 1815.
——, **Edward,** 245, Tottenham Court Road, 1620.
——, **J.,** Seward Street, Goswell Road, 1820.
——, **William,** 19, Wilderness Row, Goswell Road, 1820.
——, **William,** 2, Northampton Terrace, City Road, 1840; afterwards at Pullen's Row, Islington; a noted watch and chronometer maker, died 1887, aged 78.
Webster. Many generations of this family have carried on business in the City of London from 1675.
——, **Robert,** admitted C.C., 1675.
——, **John,** admitted C.C., 1695.
——, **George,** admitted C.C., 1703.
——, **Henry,** admitted C.C., 1709.
——, **Thomas,** admitted C.C., 1709.
——, **William.** The following extract from the *London Gazette*, from November 24-28, 1713, respecting him, may be of interest: "On the 20th Instant, Mr. Tompion, noted for making of all Sorts of the best Clocks and Watches, departed this Life: This is to certify all Persons of whatever Quality or Distinction that William Webster, at the Dial and Three Crowns in Exchange-Alley, London, served his apprenticeship, and served as a Journeyman a considerable Time with the said Mr. Tompion, and by his Industry and Care, is fully acquainted with his secrets in the said Art." This William Webster was warden, C.C., 1734, and died in office, 1735.
Webster, William, 26, Change Alley; master, C.C., 1755; livery, 1766.
——, **Samuel,** livery, C.C., 1766.
—— **and Son,** 11, Change Alley, 1781-1800.
——, **Richard,** 26, Change Alley; livery, C.C., 1810; 1800-1830.
——, **Richard,** 43, Cornhill, and afterwards at No. 5, Queen Victoria Street, which he had built when the thoroughfare was formed; died in 1882, aged 62; an accomplished horologist.
——, **Charles,** 19, Broad Street, Long Acre, 1835; 24, Red Lion Street, Holborn, 1842.
Weekes, Thomas, admitted as a brother, C.C., 1688.
Weeks, Thomas, admitted as a brother, C.C., 1654.
——, **Charles,** admitted C.C., 1713.
——, **John,** clock-case maker, Great Sutton Street, 1810.
Welborne, William, Leather Lane, Holborn. In 1813 fined £15 by C.C. for refusing to take up the livery, 1800-1813.
Welch, E. N., founder of E. N. Welch Clock Co., Forestville, New England, U.S.A., died 1887, aged 78; 1840-1887.
Welcome, John, one of the first wardens of C.C., 1631-1649.
——, **John,** admitted C.C., 1705.
Welder, Thomas, 40, Foster Lane, 1780-1785.
Welle, Robert, 30, Red Lion Square, 1825.
Weller, John, admitted C.C., 1713.
Wellington, John, admitted C.C., 1726.
Wells, John, admitted C.C., 1682.
——, **John,** 4, Cheapside, 1758-1768.
——, **Matthew,** Russell Court, Covent Garden, 1755-1760.
Wescott, John, admitted C.C., 1703.
West, William, admitted C.C., 1697.

West, Thomas, London, 1704.

——, **Thomas**, completed his apprenticeship in 1694; maker of a large metal pair-case verge watch, elaborate dial and movement, inscribed "Thomas West, London," 1694–1710.

——, **Samue'**, Royal Exchange, livery, C.C.; example of his work, an eight-day bracket clock, with verge escapement, in black wood case, with brass mounts and brass dial silvered, has a landscape painted at the top, with two men in the foreground playing tennis, the ball being represented by a small brass button, attached by a wire to the staff of the verge, and working backwards and forwards in a slot cut in the dial; 1750–1767.

Westaway, John, 1, Gower Street, 1840.

Westbrook, William, London, maker of long-case clocks, about 1730.

Westlake, John, 33, High Street, Borough, 1820; 41, Castle Street, Borough, 1835–1842.

Westoby, John, admitted C.C., 1677.

Weston and Willis, enamellers, 23, Greenhill's Rents, Smithfield, 1810.

Westwood, Richard, admitted C.C., 1691; known as a maker of lantern clocks, 1691–1705.

——, **Robert**, patented (1829, No. 5850) an eight-day watch with large barrel extending over the train.

Wetherell and Janaway, 114, Cheapside, 1785–1790.

Weylett, J., 7, Mark Lane, 1790.

Whaley, J., 14, Mount Street, Lambeth, 1840–1842.

Wham, —, 13, Knightsbridge, 1820.

Wheatley, John, admitted C.C., 1668.

——, **William**, admitted C.C., 1698.

——, **John**, 18, Bull and Mouth Street, 1820–1825.

Wheatstone, Sir Charles, an eminent electrician, inventor of a system of synchronous clocks driven by magnetic-electric currents; died 1875, aged 73.

Wheeler, Thomas, admitted C.C., 1655; master, 1684; maker of a lantern clock, dolphin frets, altered balance escapements, inscribed "Thomas Wheeler, near the French Church in Londini;" died 1694; 1655–1694.

Wheeler, John, admitted C.C., 1680.

——, **John**, 17, Shoreditch, 1794.

Whichcote, Samuel, Crane Court, Fleet Street, admitted C.C., 1724; master in 1748; 1724–1752.

——, **Samuel**, 175, Fleet Street, master, C.C., 1764; livery, 1766; 1765–1772.

Whipple, G. M., superintendent of the Kew Observatory, Richmond. Initiated a system of watch rating in 1884; died 1893, aged 50.

Whiptan, Thomas, 61, Fleet Street, 1775.

Whitaker, —, Camberwell, maker of a watch at S.K.M., 1720.

——, **S.**, 12, Long Lane, 1830.

——, **William**, 8, High Street, Camberwell, 1835–1842.

White, John, admitted as a brother, C.C., 1648.

——, **Thomas**, admitted as a brother, C.C., 1683.

——, **John**, admitted C.C., 1692.

——, **Joseph**, admitted C.C., 1713.

——, **William**, 306, Oxford Street, 1830.

——, **John**, 3, Northampton Terrace, City Road, 1840–1842.

Whitear and Raves, 30, Fleet Street, 1790.

Whiteaves, Richard, 30, Fleet Street, 1804–1840.

Whitebread, William, C.C., 1728.

Whitehead, Richard, C.C., 1671.

——, **Robert**, 3, St. James's Street, Clerkenwell, 1810–1815.

Whitehear, Richard, admitted as a brother, C.C., 1648; seems to have settled at Reading. Example of his work, a lantern clock, dolphin frets, inscribed "Richard Whitheare, Reading, fecit;" 1648–1660.

Whitehurst, John, Derby, and afterwards of Bolt Court, Fleet Street, F.R.S. A well-known maker of turret and other clocks, inventor of tell-tale clocks; born at Congleton, 1713, died in London, 1788; 1735–1788.

Whitewick and Moss, 24, Ludgate Hill, 1790.

Whitfield, Henry, C.C., 1662.
Whitford, Thomas, 1, Smithfield Bars, 1790-1800.
—— **and Son,** 1, Smithfield Bars, 1810-1823.
——, **George,** 1, Smithfield Bars, 1830-1842.
Whittaker, Edward, C.C., 1711.
Whittey, John, 42, Wynyatt Street, Clerkenwell, 1842.
Whittingham, William, cited by C.C., he not having served seven years, 1688.
Whittle, Thomas, C.C., 1683.
Whitway, Samuel, Cheapside, 1735-1740.
Whitwell, Robert, C.C., 1648.
Wichell, Samuel, St. James's Street, maker of a marqueterie long-case clock, about 1710.
Wickes, John, 27, Cannon Street; summoned to livery, C.C., 1786; 1776-1790.
——, **John,** 8, Clement's Lane, 1804.
——, **W. G.,** 114, Leadenhall Street, 1823.
—— **and Son,** 8, Clement's Lane, 1810-1835.
——, **John Haughton,** 88, Lombard Street, livery, C.C., 1810; 1800-1820.
——, **W.,** 8, Skinner Street, Clerkenwell, 1835.
—— **and Netherton,** Panton Street, 1753-1760.
Wicks, William, London, maker of long-case clocks, about 1800.
—— **and Bishop,** 170, New Bond Street, 1825.
——, **William,** watch-case maker, 34, Percival Street, Clerkenwell, 1820.
——, **W. G.,** 120, Long Lane, 1836.
——, **Thomas,** 34, Union Street, Kingsland Road, 1835.
——, **Alfred,** 8, Clement's Lane, 1842.
Wicksteed, Edward, 9, Fore Street, Cripplegate, 1768; 114, Bunhill Row, 1795.
Widdowson, Joseph, 100, Fleet Street, 1830.
Wideham, Richard, 6, East Street, Clerkenwell, 1830; 13, Lombard Street, 1835.
—— **and Adams,** 13, Lombard Street, 1840-1842.
Wieland, William, 11, St. James's Walk, Clerkenwell, 1820.
——, **F.,** 25, Penton Street, Walworth, 1835.
——, **Charles,** 12, Workworth Place, Commercial Road, 1835-1842.
——, **R. and W.,** 7, Lower Street, Islington, 1835-1842.
——, **Frederick,** 14, Crosby Row, 1842.
Wiggins, Thomas, 129, High Street, Borough, 1835.
Wigginton, William, 11, St. James's Walk, Clerkenwell, 1806-1820.
Wight, James, 12, Union Street, Southwark, 1820.
Wightman, William, C.C., 1696.
——, **Thomas,** 95, St. Martin's Lane, 1798-1810.
Wightwick and Moss, 24, Ludgate Street (John Wightwick, hon. freeman, C.C.), 1775-1804.
Wigram, Thomas, 67, St. James's Street, 1804.
Wild, James, Frith Street, Soho, 1790.
——, **E.** (tools), 2, St. John's Square, Clerkenwell, 1798-1810.
Wilder, Richard, Richmond Buildings, Soho; liveryman, C.C., 1776.
Wildman, Watkinson, Cheapside, 1753-1760.
——, **Samuel,** 63, Cheapside, 1760-1783.
——, **Charles,** 6, Great Newport Street, 1800.
Wilkins, Robert, C.C., 1670.
——, **George,** 36, Frith Street, Soho, 1820-1825.
——, **Samuel,** 4, Norman Street, St. Luke's, 1835.
Wilkinson, William, C.C., 1718.
——, **T.,** 32, Piccadilly, 1825-1830.
——, **James,** 18, Castle Street, 1830; 19, Farringdon Street, 1835.
Willard, J., Boston, U.S.A., American clockmaker, 1800.
Willcocks, Richard, 46, Red Lion Street, Clerkenwell, 1790-1800.
Willerme, Pierre, admitted as a brother, C.C., 1648.
Willerton, Skull, and Green, 21, New Bond Street, 1783.
Williams, Joseph (Ireland), admitted as a brother, C.C., 1685

Williams, John, 11, Old Bond Street, 1769.
——, **J.,** 35, Goodge Street, 1794.
——, **John,** 168, Shoreditch, 1800–1804.
——, John, watch-case maker, 56, Great Sutton Street, Clerkenwell, 1820.
——, **E.,** 1, Albany, Saville Row, 1825.
——, **John,** 4, Amen Corner, 1821; 70, St. Paul's Churchyard, 1831.
——, **S.,** 16, John's Row, St. Luke's, 1842.
——, —, Baldwin Street, St. Luke's, 1848.
Williamson, William, C.C., 1664.
——, **Thomas,** admitted C.C., 1668. "Lost on the 19th day of August, from Mr. Will. Clinch's house at Epsom, a silver Minute Pendulum Watch with a scollop-shell case studded with silver, made by Thomas Williamson, London, with a silk string and a silver seal with a Coat of Arms. Whoever brings it to Mr. Robert Dingly, watchmaker in George Yard, Lombard Street, shall have 2 guineas Reward" (*London Gazette*, Sept. 5–8, 1692).
——, **John,** admitted C.C., 1682.
——, **Robert,** St. Bartholomew Lane, admitted C.C., 1666; master, 1698; maker of a watch with a Shagreen case in the B.M., 1666–1720.
——, **Edward,** apprenticed to Jonathan Puller for seven years ending 1694, maker of a long marqueterie case clock; 1694–1720.
——, **Joseph,** invented an equation clock in 1720; master of C.C., 1724, and died in office, 1725; 1700–1725.
——, **Timothy,** 196, Fleet Street, 1769–1775; 90, Great Russell Street, 1788.
——, **Christopher,** 24, Cornhill, 1840–1842.
Williamston, Ralph, C.C., 1706.
Willin, William, livery, C.C., 1800–1811.
Willis, M., 81, Bishopsgate Street Without, 1825.
Willmot, Stephen, C.C., 1674.
——, **Thomas,** admitted C.C., 1715.
Willmott, John, 86, St. Margaret's Hill, 1768–1775.
Willoughby, John, C.C., 1686.
Willoughby, Benjamin, High Cross, 1708.
Willowe, John, Fleet Street. In the B.M. is a watch by him in a fancy case of escallop shape, 1630–1640.
Willshire, James, Glasshouse Yard, Goswell Street, 1769.
——, **James,** 19, High Holborn, 1781.
Willson, Thomas, admitted C.C., 1659, as assistant, 1685.
——, **George,** admitted C.C., 1692.
——, **William,** C.C., 1693.
——, **John,** admitted C.C., 1714.
——, **G. V.,** 5, St. Alban's Place, St. James's, 1835.
Wilmot, George, admitted C.C., 1670.
——, **Stephen,** London, maker of 30-hour long-case clock, square dial, about 1730.
——, **Richard,** 1, Wilmington Square, 1842.
Wilson, Joshua, London, maker of a lantern clock, finely engraved dial, about 1700.
——, **James,** admitted C.C., 1723; Susannah Smith was apprenticed to his wife Hannah Wilson in 1747, C.C., 1723–1747.
——, **George,** admitted C.C., 1730.
——, **Alexander,** 132, Drury Lane, hon. freeman, C.C., maker of a verge watch, pair of brass cases, with outside case of tortoiseshell, on which are representations of ferns, 1783–1790.
——, **James,** 4, King Street, Westminster, 1790.
——, **James,** 27, Threadneedle Street, 1804; 53, Lombard Street, 1810; 1804–1810.
——, **G.,** 17, Craven Buildings, Drury Lane, 1820.
——, **W.,** 38, Southampton Street, Strand, 1830–1840.
Wilter, John, maker of a watch in the Guildhall Museum, silver dial, silver repoussé case; another example, a silver repoussé pair-case watch, Dutch style, 1760–1780.
Wilton, Clay, admitted C.C., 1697.
Wiltshire and Sons, 136, Cornhill, 1830.
Winch, Amos, admitted C.C., 1677.
Windham, James, 22, Birchin Lane, 1840.

Windmills, Joseph, St. Martin's-le-Grand, well known as a good maker of clocks and watches; admitted as a brother, C.C., 1671; master, 1702. In the B.M. is a handsome watch by him: silver dial, in which is a semicircular opening above the centre, through it appears a representation of blue sky, with the sun pointing to the hour by day, and the moon by night; tortoiseshell case. There is a similar watch by John Hutchin; 1658–1703.

——, **Thomas,** apprenticed to Joseph Windmills, 1686; admitted C.C., 1695; master, 1719. A repeating watch by him in the Guildhall Museum; 1695–1730.

——, **J. and T.,** Great Tower Street (Thomas Windmills, master, C.C., 1718); many excellent long-case clocks by them are to be met with, period 1700–1735.

Windon, Daniel, C.C., 1718.

Windsor, James, 99, Paul Street, Finsbury, 1835–1842.

Winerow, William, C.C., 1718.

Wing, Mark, 2, Goswell Street, 1822–1842.

Winnock, Joshua, C.C., 1672.

——, **Daniel,** admitted C.C., 1707.

Winsmore, John, admitted C.C., 1712.

Wint, —, Smithfield, 1774.

Winterhalter, J., 47, St. Andrew Street, 1840.

Wintle, Thomas, 9, Poultry, 1760–1788.

Wirgman, Peter, St. James's Street, 1775–1783.

——, **G. and G.,** 31, Castle Street, Holborn, 1804.

——, **Thomas,** 68, St. James's Street, 1823.

——, **G.,** Hewitt's Court, Strand, 1825.

——, **C.,** 5, George Street, 1830.

Wirrall, Copley, C.C., 1648.

Wise, Luke, Reading, 1686.

——, **or Wyse.** Several generations among the early makers.

——, **John,** admitted C.C., 1669.

——, **Richard,** admitted C.C., 1679.

——, **John,** admitted C.C., 1683.

——, **Thomas,** admitted C.C., 1686.

——, **Joseph,** admitted C.C., 1687.

Wise, Peter, son of John, admitted C.C., 1693; master in 1725; 1693–1726.

——, **Luke,** admitted C.C., 1694.

——, **Robert,** admitted C.C., 1694.

——, **John,** admitted C.C., 1710.

——, **Mark,** admitted C.C., 1719.

Wiseman, John, admitted C.C., 1647.

Wiswall, Thomas, 20, Ely Place, Holborn, 1800.

—— **and Co.,** 52, Red Lion Street, 1810.

Wither, John, admitted C.C., 1699; maker of long-case clocks, 1699–1720.

Witte, Samuel, admitted C.C., 1660.

Woerd, Charles V., born 1821, died 1888. A clever mechanician who did much to advance the art of machine watch-making by designing automatic tools for the Waltham Watch Company, of which he was mechanical superintendent, from 1875–1882.

Wolf, J., Wienne, maker of a book-shaped watch shown on p. 56, 1627.

——, **Joseph,** Mitre Court, near Aldgate, 1769–1772.

Wolverstone, Thomas, C.C., 1650.

——, **Benjamin,** apprenticed to R. Richards, 1647; admitted C.C., 1657; alarum watch by him in the Guildhall Museum, silver dial, one hand; 1657–1680.

Wolveston, Thomas, C.C., 1670.

Wontner, John, 125, Minories; livery, C.C., 1810; maker of a horn-covered, pair-cased verge watch; 1783–1812.

——, **John, and Son,** 125, Minories, 1804–1812.

Wood, Thomas, admitted C.C., 1691.

——, **Robert,** admitted C.C., 1670.

——, **John,** admitted C.C., 1701.

——, **Henry,** admitted C.C., 1720.

——, **Thomas,** admitted C.C., 1727.

——, **Robert,** Horse Shoe Alley, Moorfields, 1807.

——, **John,** 32, Minories, 1775.

——, **Thomas,** 86, Charlotte Street, Rathbone Place, 1825–1830.

——, **Robert,** 4, Hartley Place, Kent Road, 1820–1835.

Woodall, T. J., 3, Birchin Lane, 1804–1810.

Woodhill, Jabez, 63, St. Paul's Churchyard, 1830.
Woodman, Mary, 29, Paradise Row, Chelsea, 1835.
Woodruff and Son, 43, Kirby Street, Hatton Garden, 1823–1830.
Woods, Thomas, admitted C.C., 1713.
——, **C. R.,** 21, White Lion Street, Pentonville, 1842.
Woodward, J., 8, New Inn Yard, Shoreditch, 1835.
——, **Thomas,** 24, Curtain Road, 1835.
Woolard, John, 14, Bridge Road, Lambeth, 1810.
Woolverton, James, admitted as a brother, C.C., 1677.
——, **James,** admitted C.C., 1690.
Worboys, Arthur, 4, Wine Office Court, Fleet Street, 1769–1785.
——, **John,** 30, Ludgate Hill, 1780–1788.
Worrall, John, 71, Goswell Road, 1840–1842.
Worsley, Thomas, 22, Cheapside, 1783.
Worthington, John, C.C., 1721.
Wotton, Thomas, Fleet Street, maker of lantern clocks, 1690.
Wragg, Houblon, admitted C.C., 1724, known as a maker of long-case clocks, 1724–1740.
Wray, Hilton, Birchin Lane, master, C.C., 1785; 1770–1786.
Wren, John, 96, Bishopsgate Without, 1780–1785.
Wrench, Charles, 57, Bishopsgate Street Within, 1790; 25, Camomile Street, 1798; 29, Paternoster Row, 1810–1815.
Wrigg, Johannes, in Covent Garden, admitted C.C., 1661; part of a watch made by him in Guildhall Museum; 1661–1680.
Wright, John, maker of an oval watch, B.M., inscribed, "Wm. Heade, the owner," representation of the crucifixion engraved inside, about 1620.
——, **John,** admitted C.C., 1661.
——, **Benjamin,** watchmaker, Bell Alley, Coleman Street, C.C., 1685.
——, **John,** admitted C.C., 1696.
——, **Joseph,** admitted C.C., 1671.
——, **John,** admitted C.C., 1700.
Wright, John, admitted C.C., 1714.
——, **Thomas,** Duke's Street, St. Martin's Lane, Charing Cross, 1765–1775.
——, **Thomas,** 6, Poultry, "maker to the King," on a bracket clock; hon. freeman, C.C., 1760–1790.
——, **Charles,** 9, Avemary Lane, 1780; 76, Strand, 1788.
——, **T.,** watch-glass maker, Red Lion Street, Clerkenwell, 1798; 127, Bunhill Row, 1805; 1798–1820.
——, **S.,** 141, Ratcliff Highway, 1820.
——, **Elizabeth,** 141, Ratcliff Highway, 1825.
——, **James,** 181, Union Street, Borough, 1835.
——, **Thomas,** 22, Lisle Street, Leicester Square, 1835–1842.
——, **John,** 1, Batters Place, Pentonville, 1842.
——, **William,** 212, Tooley Street, 1840–1842.
Wrightman, James, C.C., 1670.
——, **Thomas,** admitted C.C., 1701.
Wrightmark, Mark, 49, Percy Street, Clerkenwell, 1840–1842.
Wrightson, Thomas, master, C.C., 1737; 1734–1738.
Wyatt, Anthony, 167, Oxford Street, 1800.
——, **Henry,** 46, South Audley Street, 1840.
Wych, David, next door to the Cross Keys Tavern, Strand; C.C., 1694.
Wycherley, John, born in 1718, at Prescot, Lancashire, where he founded the machine-made watch movement industry; died at Southport, 1891.
Wyeth, John, admitted as a brother, C.C., 1655.
Wyke, R., 2, Evelyn's Buildings, Oxford Street, 1825.
Wylder and Hall, 16, Sun Street, Bishopsgate Street, 1794.
Wymark, M., 5, Percival Street, Clerkenwell, 1830–1835.
Wynn, W. M., 135, Fleet Street, 1804.
——, **William,** 19, Dean Street, Soho, maker of an exceedingly fine clock for Boston (Lincolnshire) church, no dials, hours and quarters on bells. Is said to have died in Clerkenwell workhouse; 1810–1835.

Wynne, Henry, admitted C.C., 1662; master in 1690.

Wythe, Lionel, admitted C.C., 1646; a good maker. To him was apprenticed Charles Gretton, in 1662; 1646-1662.

Yarde, Thomas. A watch by him, B.M., about 1580.

Yardley, James, Bishop's Stortford, maker of a long-case clock, arch dial, date on back of day of month circle, 1763.

Yates, Samuel, admitted as a brother, C.C., 1648.

——, **Samuel**, admitted as a brother, C.C., 1685.

Yeatman, Andrew, maker of a silver verge watch, in the Guildhall Museum, about 1700.

Yelverton, William, 115, Portland Street, 1780-1785.

Yeomans, Ralph, C.C., 1722.

Yonge, George, 131, Strand, 1798. Yonge succeeded the celebrated Holmes. The shop was pulled down to make the entrance to Waterloo bridge in 1824.

——, **George and Walter**, 156, Strand, 1835-1842.

York, Thomas, admitted C.C., 1716.

——, **John**, 8, Nelson Street, City Road, 1840.

Young, William, admitted C.C., 1668; assistant, 1695; maker of a long oak-case clock, square dial, day of month circle; 1668-1696.

Young, Henry, near the Wine House in the Strand; admitted C.C., 1671. "A Gold Watch made by Mr. H. Young, that went with a chain, the Hour of the day and day of the Month. Having a studded Shagrine case, and the square in the inner case where the ring is riveted" (*London Gazette*, April 26, 29, 1680).

——, **Thomas**, admitted C.C., 1699.

——, **William**, admitted C.C., 1682; maker of a small-size walnut and ebony long-case clock, solid hood, spiral pillars, square dial, cherub corners; 1682-1700.

——, **Henry**, 89, Fleet Street, 1679-1775.

——, **James**, 32, Aldersgate Street, 1783, summoned to livery, C.C., 1786.

——, **Henry**, 18, Ludgate Street, 1783-1788.

——, **John**, 44, Russell Street, Bloomsbury, 1800-1807.

——, **J.**, 40, Old Gravel Lane, Wapping, 1820.

——, **William**, 15, Butcherthall Lane, 1825.

——, **James**, 34, Rosoman Street, 1835.

Zachary, John, admitted C.C., 1694.

Zech, Jacob, Prague. He invented the fusee in 1525; died in 1540 (see page 36); 1525-1540.

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