

THE EARNSHAW CLOCK

M. DUCKWORTH

In a paper given at a B.A.A. Provincial Meeting on 1967 September 16 and later presented in this *Journal*¹ an account was given by myself of the life and work of Lawrence Earnshaw of Mottram-in-Longdendale, Cheshire, with special reference to his remarkable astronomical clock. This astronomical clock was said to have passed into the Lonsdale family¹ via the Earl of Bute who had purchased it for the sum of £150. However, the clock is no longer in the possession of the Lonsdale family, neither is there any record of such a clock being in their hands. Another clock was said to have been kept at Poynton Hall, Cheshire^{1,2}, being lost when the Hall was sold in 1823.

Since publication of the paper, the author received a letter from a Mr P. Thornton of Great Haywood, Stafford, who has been of great assistance to him in tracing the present whereabouts of the clock. It now seems that the clock at Poynton Hall was in fact the one described by Beckwith³, given in the *Gentleman's Magazine* in 1795 and reprinted in my paper¹. Poynton Hall was a seventeenth century manor house situated some three miles from Stockport, Cheshire, and was the seat of the Warren family. Sir George Warren, K.B., was in possession of the Hall in 1795. In 1802 Lord Vernon of Sudbury Hall, Derbyshire, married into the Warren family. At the death of Viscountess Bulkeley, the only daughter of Sir George Warren in 1837, the estate passed to the Vernons, who assumed the surname of Warren by Royal licence.

Poynton Hall was demolished following the death of Viscountess Bulkeley and it was at this point that my own researches ended. As my source of information² stated, the clock was not listed in the sale of articles from the Hall in 1823, the reason being quite simply that the clock had been removed to the home of the Vernons in Derbyshire. At Sudbury Hall the clock was stored in a large box, evidently having been removed from the desk and bookcase cabinet described by Beckwith³. The box bore the date 1800, the clock perhaps having been purchased in this box at some time to be assembled in the cabinet at a later date. According to Mr Thornton, the clock seems to have first reappeared in the hands of a Mr F. N. Howard of University College, Exeter.

In 1931 October the Curator of the University College Library wrote to a Mr J. J. Hall and asked his assistance in restoring the clock to its original condition, as the instrument was now in a poor state of repair; Mr Howard, the owner of the clock, intended to present the clock to the University following its restoration. The restoration was carried out by Mr Thornton under the direction of Mr Hall, who later gave a detailed account of the clock's mechanism in the *Horological Journal*^{4,5}. The clock, now fully restored, is still at the

University of Exeter in the care of Mr L. J. Lloyd, and below are figures and photographs taken during its restoration.

Figure 1 represents as follows: (A) the terrestrial globe, (B) the celestial globe. In the top right-hand dial shown in figure 2, marked (C) in figure 1, are given the cycle of the Sun and Dominical letter (D and E), also the Roman Indiction (F). The four outer concentric circles of this dial give first, the months of the year with the number of days; secondly, the days of the month; then the declination of the Sun and finally the Sun's position along the ecliptic.

It is interesting to note that the clock's framework is of oak to which are affixed the brass bearing plates which house the globes. These also provide support for the degree and compass point silvered circles. (G) and (H) are rods which drive first the celestial, then the terrestrial globe. What is most surprising is the small size of the movement (I) in relation to the clock itself and it is obvious that much ingenuity was called for to overcome the many difficulties involved in using such a movement. The escapement was provided by a one-second pendulum (J).

To read the time of day to the nearest minute the upper dial (K) was added with an inset circle (L) to give the difference between apparent and true time, and a small moving picture to illustrate the time of day and the phases of the Moon (M).

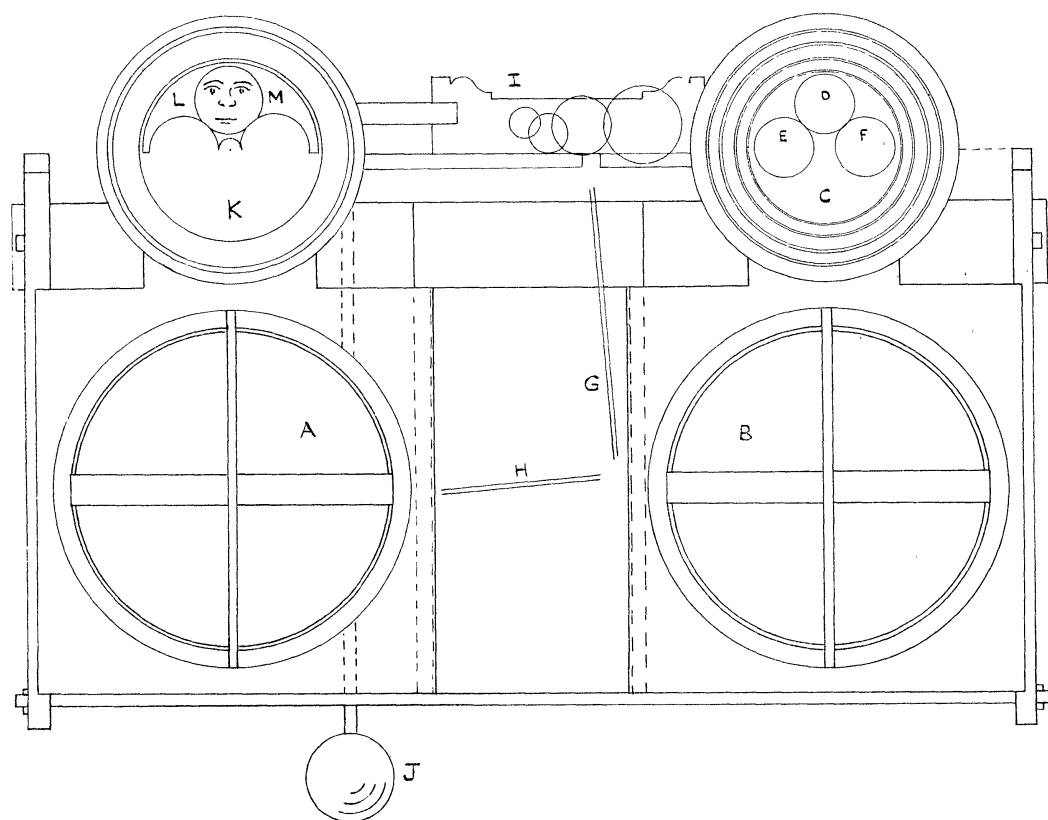


FIGURE 1. Diagram of general arrangement of the clock.

Beckwith³ says that Earnshaw performed the complete execution of the clock's manufacture. However, the globes were signed by Senex of London being made of papier mâché—these Earnshaw had specially adapted for his own particular use. In his article Hall^{4,5} pointed out that parts of the clock seem to have been mislaid and I quote the following:

“In the 1787 description of Earnshaw's clock mention has been made of ‘the climates’ engraved on the terrestrial globe bearing plate; the ‘flow of tides’, too, is mentioned on Earnshaw's monument. Some details of the clock are manifestly missing and it will be found extremely difficult to supply them. There is no accommodation on the G.M.T. dial, for example, to carry a rising and falling plate (or horizon) on the one hand which should indicate high and low water. And yet, as regards ‘climate’ an ellipse is squared and pinned to the arbour of wheels F.G. [these letters refer to a diagram in the article] which performs one revolution in 525,950 minutes, which is only 19 out in the length of a Sidereal Year expressed

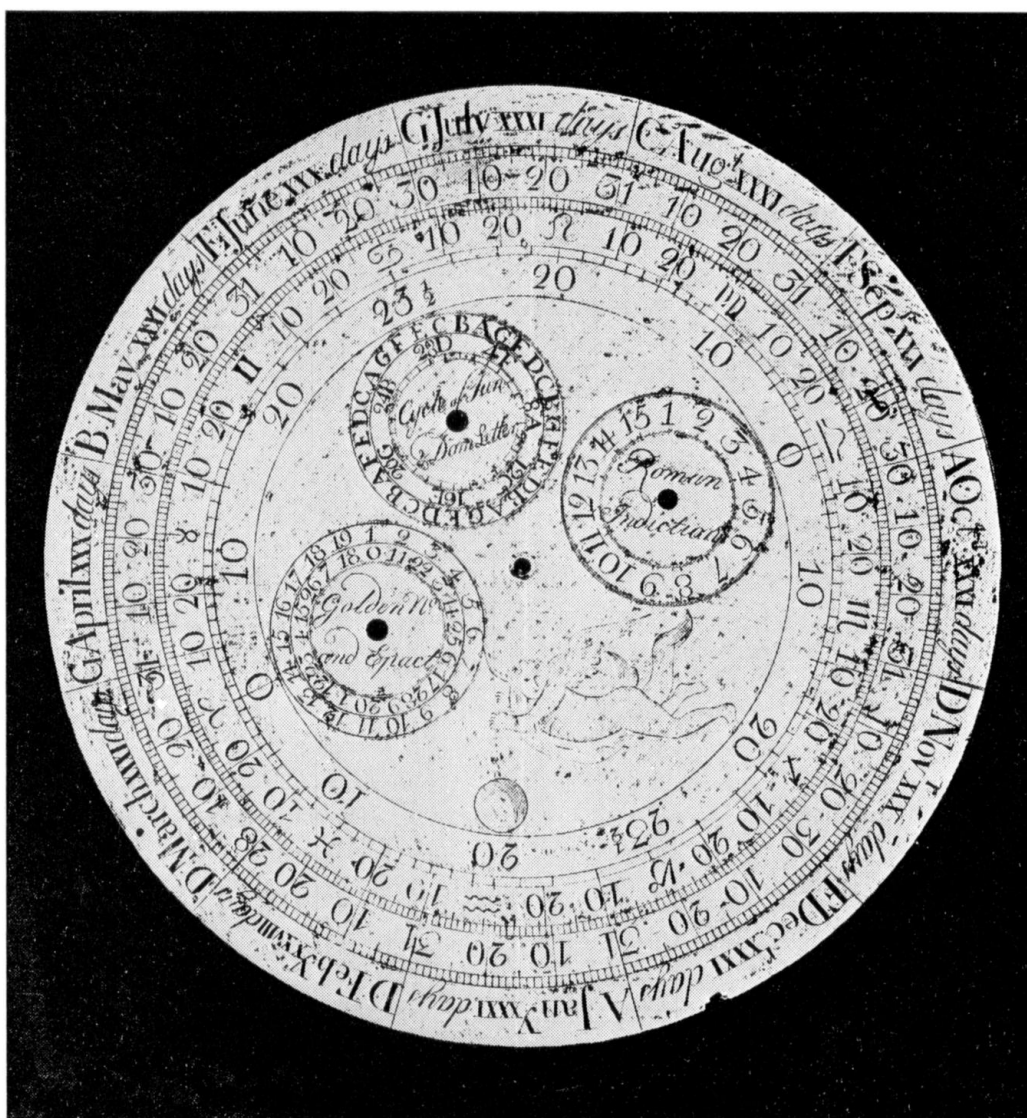


FIGURE 2. Details of right-hand dial.

INDEX

VOLUME 79

- Accounts, Annual, for the Session 1968–69, 437
- Allen, D. A., and C. J. Andrews, *The Last Word on Einstein* (Caramuel), 288
- Appleyard, A., *The Equatorial Zone of Saturn*, 40
- Barocas, V., *Jeremiah Horrocks*, 223
- Biographies:
- Horrocks, Jeremiah, V. Barocas, 175, 223, 405
- Phillips, T. E. R., W. E. Fox, 14
- Bispham, K., and H. Hill, *Observations of Polar Faculae*, 200
- Book Reviews:
- ABC of Astronomy*, A. Weigert and H. Zimmermann, 79
- The Amateur Astronomer's Photographic Lunar Atlas*, H. Hatfield, 163
- Apollo and the Universe*, ed. S. T. Butler, 250
- Astronomy*, P. Moore, 163
- Astrophysics and Space Science*, ed. Z. Kopal, 330
- Atlas Stellarum 1950.0*, H. Vehrenberg, 164
- Basic Astronomy*, P. Moore, 248
- The Basis of Modern Physics*, J. M. Irvine, 248
- Collins' Concise Encyclopedia of Astronautics*, 332
- The Earth in Space*, ed. H. Odishaw, 329
- Earth, Moon and Planets*, F. L. Whipple, 409
- The Encyclopaedia of Atmospheric Sciences and Astrogeology*, ed. R. W. Fairbridge, 412
- Exploration of the Moon by Spacecraft*, Z. Kopal, 330
- The Exploration of the Universe*, G. Abetti, 413
- Highlights of Astronomy*, I.A.U., ed. L. Perek, 414
- Homage to Galileo*, ed. M. F. Kaplan, 330
- Intelligence in the Universe*, R. A. MacGowan and F. I. Ordway, 81
- The Interior Planets*, V. A. Firsoff, 248
- Book Reviews (*cont'd.*):
- An Introduction to Astronomy*, R. H. Baker and L. W. Fredrick, 80
- John Harrison, the Man Who Found Longitude*, H. Quill, 500
- Lunar Atlas*, ed. D. Alter, 80
- Man in Space*, H. Brinton, 415
- Man Is Not Lost*, H.M.S.O., 332
- The Moon (A Map)*, H. Schwarzenbach, 415
- Nebulae and Interstellar Matter*, ed. B. M. Middlehurst and L. H. Aller, 412
- The New Space Encyclopaedia*, ed. M. T. Bizony, 500
- The Penguin Dictionary of Astronomy*, A. Wallenquist, 250
- Planetary Nebulae*, I.A.U. Symposium, 411
- Proceedings of the Thirteenth I.A.U. General Assembly, Prague*, 414
- The Promise of Space*, A. C. Clarke, 409
- Reports on Astronomy*, I.A.U., 414
- Skysighting — Photography for Amateur Astronomers*, R. N. and M. W. Mayall, 249
- Solar Physics*, ed. J. Xanthakis, 331
- Some Mysteries of the Universe*, W. R. Corliss, 410
- Space*, P. Moore, 329
- Space Frontier*, W. von Braun, 331
- Stars, Planets and Life*, R. Jastrow, 415
- Statistical Communications and Processing*, E. A. Robinson, 332
- Der Sternhimmel—1969*, R. A. Naef, 329
- The Story of Jodrell Bank*, Sir Bernard Lovell, 79
- The Swan System of the C₂ Molecule; The Spectrum of the MgH Molecule*, J. G. Phillips and S. P. Davis, 413
- Telescopes in Space*, Z. Kopal, 249
- Variable Stars*, J. S. Glasby, 163
- Vistas in Astronomy*, Vols. 9 and 10, ed. A. Beer, 410
- Yearbook of Astronomy, 1969*, ed. P. Moore, 79
- Botley, C. M., *Astronomical Anniversaries 1968*, 44
- Botley, C. M., *The Aurora of 1366 January 12*, 231
- Botley, C. M., *Two Mysterious Stars*, 474

Comets:

- Brightness Variations of Comet Alcock 1963b and its Correlation with Solar Phenomena, I. R. Ferrin, 130

Computation:

- I.A.U. Central Bureau for Telegrams, B. Marsden, 11
- Some Aspects of the Computing Section, C. Dinwoodie, 259
- Star Finding with an Altazimuth Mounted Telescope, F. V. Davies, 467

Cosmology:

- New Information on the Age of the Universe, I. Shklovsky, 381

- Dall, H. E., Telescope Eyepieces, 349
- Daniel, C. St J., Gnomonics Discovered, 345
- Davies, F. V., Star Finding with an Altazimuth Mounted Telescope, 467
- Delano, K., Magnitude Variations of Saturn's Satellites, 124
- Dinwoodie, C., Some Aspects of the Computing Section, 259
- Doylerush, E., The Development of a Total Power Radiometer, 291

- Eberst, R., Satellite Tracking from Scotland, 171
- Eiby, G. A., Centenary of the New Zealand Time Service, 489
- Ells, J. W., Estimate of Sub-Surface Martian Temperatures, 280

- Farrant, M., A Weightlifter's Mounting, 232
- Ferrin, I. R., Brightness Variations of Comet Alcock 1963b and its Correlation with Solar Phenomena, 130
- Ferris, G. A. J. (with S. W. Mathers), Aluminized Filters for Solar Photography, 376
- Ferris, G. A. J., Planetary Influences on Sunspots, 385
- Fillias, A. J., 'Perfect' Lunar Craters, 230
- Firsoff, V. A., On the Internal Structure of the Moon, 191
- Firsoff, V. A., On the Surface Temperature of Mars, 276
- Fos, W. E., Presidential Address 1968, 8, 14
- Friends, J., Hemispherical Inequality in the Distribution of Sunspots, 472

- Hatfield, H. R., Making Slides from Prints, 36
- Hewish, A., Pulsing Radio Sources, 178
- Hindley, K. B., The 11 Canis Minorid Meteor Stream, 138

Historical and Archaeological:

- The Aurora of 1366 January 12, C. M. Botley, 231
- Bicentenary of the Discovery of the Wilson Effect, 398
- Centenary of the New Zealand Time-Service, G. A. Eiby, 489
- Comets of 1618 and 1668 (Astronomical Anniversaries), C. M. Botley, 44
- Meteor Observations by John Flamsteed, 325
- The Search for the Nebulae, K. G. Jones, 19, 105, 213, 268, 357, 450

Historical and Archaeological (*cont'd.*):

- Solar Eclipses, 161
- Southern Constellations, 145
- Two Mysterious Stars, C. M. Botley, 474
- Uranometry of Al Sûfi, 318, 404
- Howse, H. D., The Old Observatory at Greenwich, 256

Instruments and Accessories, Manufacturing Processes, etc.:

- Aluminized Filters for Solar Photography, S. W. Mathers and G. A. J. Ferris, 376
- The Development of a Total Power Radiometer, E. Doylerush, 291
- Gnomonics Discovered, C. St J. Daniel, 345
- The Herschel Telescopes, 5, 340
- A Simplified Cross-Bar Micrometer, 162
- Telescope Eyepieces, H. E. Dall, 340, 349
- A Weightlifter's Mounting, M. Farrant, 232
- Instruments, List of, Belonging to the Association, 430

- Jeffries, A. J., The Suspected Phase Anomaly and Atmosphere of Mercury, 286
- Jones, K. G., The Search for the Nebulae, 19, 105, 213, 268, 357, 450

Jupiter:

- Apparitions 1966-67 and 1967-68, 255, 304

- Lomas, R. S., A Preliminary Statistical Survey of SS Cygni 1946-65, 227

Mars:

- Apparition 1967, 53
- Historical Drawings of Mars and Other Observations, 263, 347
- Space Probes to Mars, 264
- Sub-Surface Martian Temperatures, Estimate of, J. W. Ells, 280
- On the Surface Temperature of Mars, V. A. Firsoff, 276

- Marsden, B., I.A.U. Central Bureau for Telegrams, 11

- Mathers, S. W., and G. A. J. Ferris, Aluminized Filters for Solar Photography, 376

Meetings and Courses:

- Annual General, 7
- Exhibition, 447
- International Union of Amateur Astronomers, 341
- Keele University Summer School, 2
- Lunar Section, 46, 388
- Morley College Astronomy Courses, 503
- Ordinary General, 10, 87, 91, 171, 174, 255, 259, 340, 345
- Provincial, 4
- Winchester, King Alfred's College, Course, 348

- Membership Table 1968-69, 421

Mercury:

- Report 1967 February to 1968 February, 143
- The Suspected Phase Anomaly and Atmosphere of Mercury, A. J. Jeffries, 286

Meteorological and Atmospherical Phenomena:

Air Temperature Variations during a Recent Solar Eclipse, K. J. H. Phillips, 460

The Green Flash, 77, 240, 262

Objects Across the Moon, 48, 241

Meteors:

The 11 Canis Minorid Meteor Stream, K. B. Hindley, 138

Fireballs 1969, 347, 484

The Lyrid Meteor Streams, 68, 347, 477, 480

Meteor Notes, 68, 315, 475

Miles, H. G., NASA, The First Ten Years, 134

Miles, H. G., Space Probes to Venus and Mars 1969, 264

Moon:

Experiments on the Formation of Craters, 389

On the Internal Structure of the Moon, V. A. Firsoff, 191, 403

The Last Word on Einstein (Caramuel), D. A. Allen and C. J. Andrews, 288

Lunar Domes, 46

Origin of the Lunar Maria, 239

'Perfect' Lunar Craters, A. J. Fillias, 230

Project Moonhole, 176, 389

Ray Systems, 46, 390

Rock Fall in the Crater Vitello, 48

Satellite Reports, 93, 173, 174, 389

Transient Lunar Phenomena, 49

Moore, P., The Magnitudes of Saturn's Satellites, 121

Moseley, T. J. C. A., The Magnitude of Pluto, 129

Notes from Other Journals:

Astrophysical Journal, 165, 246, 334, 502

Notices (Non-Ephemeral):

Changes of Address, 254

Chelmsford and District Astronomical Society, 375

Election of New Members, 416, 417, 504

Erratum, 25

Movable Observatories—A Warning, 78

Officers and Council 1968–69, 82; Photograph, 342

The Planet Earth—A National Savings Poster, 161

Subscriptions for *Circulars*, 446

Obituaries:

Martin Davidson, 244

Kennet Pollock, 327

Observation:

Artificial Satellite Measurements, 176

Mercury and Venus, 13

Meteor Section Programme, 235, 391

Monthly Notes for Observers, 11, 90, 171, 259, 345

Reduction of Radio Telescope Flux Density Recordings, J. R. Smith, 371

Reporting of Fireballs and Re-Entry of Artificial Satellites, 337

Star Finding with an Altazimuth Mounted Telescope, F. V. Davies, 467

Variable Star Programme, 70

Observatories, Planetaria, Institutes, Museums, etc.:

Birr Castle, Earl of Rosse, 4

Greenwich Old Observatory, H. D. Howse, 256

Greenwich Planetarium, 172

Morley College Planetarium, J. L. White, 296

Page, A. and B., Multiple Exposure Techniques in Flare-Star Photography, 26, 242

Phillips, K. J. H., Air Temperature Variations during a Recent Solar Eclipse, 460

Phillips, K. J. H., Recent Latitude Measurements of Features on Saturn, 113

Photography:

Aluminized Filters for Solar Photography, S. W. Mathers and G. A. J. Ferris, 376

Making Slides from Prints, H. R. Hatfield, 36

Multiple Exposure Techniques in Flare-Star Photography, A. and B. Page, 26, 242

The Polaroid System for Astronomical Photography, H. L. Pugh, 94

Pluto:

The Magnitude of Pluto, T. J. C. A. Moseley, 129, 326, 498, 499

Presentations and Awards:

Goodacre Medal and Gift, 7, 345

Merlin Medal and Gift, 255, 340

Presidential Address 1968, W. E. Fox, 8, 14

Pugh, H. L., The Polaroid System for Astronomical Photography, 94

Satellites, Artificial, and Space Probes:

Experiments on Satellite Position Estimation, 177

Lunar Probe—Apollo 8, 93, 173, 174, 389

NASA—The First Ten Years, H. G. Miles, 134

Re-Entry of Cosmos 253 Rocket, 156

Satellite Tracking from Scotland, R. Eberst, 171

Space Probes to Venus and Mars 1969, H. G. Miles, 264, 348, 494

Saturn:

Apparition 1967–68, 60

The Equatorial Zone of Saturn, A. Appleyard, 40

The Magnitudes of Saturn's Satellites, P. Moore, 121

Magnitude Variations of Saturn's Satellites, K. Delano, 124

Recent Latitude Measurements of Features on Saturn, K. J. H. Phillips, 113, 243

White Spot on Saturn, 175

Schöve, D. J., Solar-Terrestrial Relationships, 384

Sections:

Annual Reports 1968–69, 422

Shklovsky, I., New Information on the Age of the Universe, 381

Smith, J. R., Reduction of Radio Telescope Flux Density Recordings, 371

Solar System:

Magnitudes of the Planets, 499

A Paradox Relating to Planetary Orbits, 323

Planetary Influences on Sunspots, G. A. J. Ferris, 385

Sowerby, P. L., Venus Atmosphere Experiment, 294

Stars and Nebulae:

Galactic Structure, 5

Pulsars, 91, 172

Pulsing Radio Sources, A. Hewish, 178

Quasars, 381

Sun:

Air Temperature Variations during a Recent Solar Eclipse, K. J. H. Phillips, 460

Bicentenary of the Discovery of the Wilson Effect, 398

Brightness Variations of Comet Alcock 1963b and its Correlation with Solar Phenomena, I. R. Ferrin, 130

Hemispherical Inequality in the Distribution of Sunspots, J. Friends, 472

Observations of Polar Faculae, K. Bispham and H. Hill, 200

Planetary Influences on Sunspots, G. A. J. Ferris, 385

Solar Activity 1968–69, 12, 73, 154, 171, 237, 261, 297, 319, 347, 399, 491, 496

Solar Flares, 78, 162

Sun (*cont'd.*):

Solar, Terrestrial and Lunar Phenomena, 261, 407

Solar-Terrestrial Relationships, D. J. Schove, 384

Total Solar Eclipse 1968 September 22, 5, 6 (photograph), 13, 87

Telescopes—see under Instruments, etc.

Variable Stars:

Multiple Exposure Techniques in Flare-Star Photography, A. and B. Page, 26, 242

SS Cygni: A Preliminary Statistical Survey 1946–65, R. S. Lomas, 227

SS Cygni: 1967 Report, 146

TZ Persei: 1967 Report, 149

Venus:

Dichotomy and Schröter's Effect, 176, 406, 497

Elongation 1967 November, 50

Photographs of Venus, 173

Space Probes to Venus, 264, 348, 494

Venus Atmosphere Experiment, P. L. Sowerby, 294

White, J. L., The Morley College Planetarium, 296

in solar minutes. This ellipse works a rocking or see-saw arm but what was at the other end I know not."

Mr Hall also points out that the clock had provision for adjustment of the parts "setting the globes, etc., by means of, say, the clock key or *winder*". This was also pointed out by Beckwith³:

"The diurnal and annual motions of the terrestrial globe were amazingly clever. By turning a winch he [Earnshaw] could accelerate the motion so as to make the whole machine perform a perfect revolution in a very little time, or could stop several parts of the motion at pleasure."

It is unusual to see wood used in the framework of the clock but perhaps this may have been used to suit the bookcase into which it was fitted. However, many provincial makers at this time used wood, perhaps because of the high

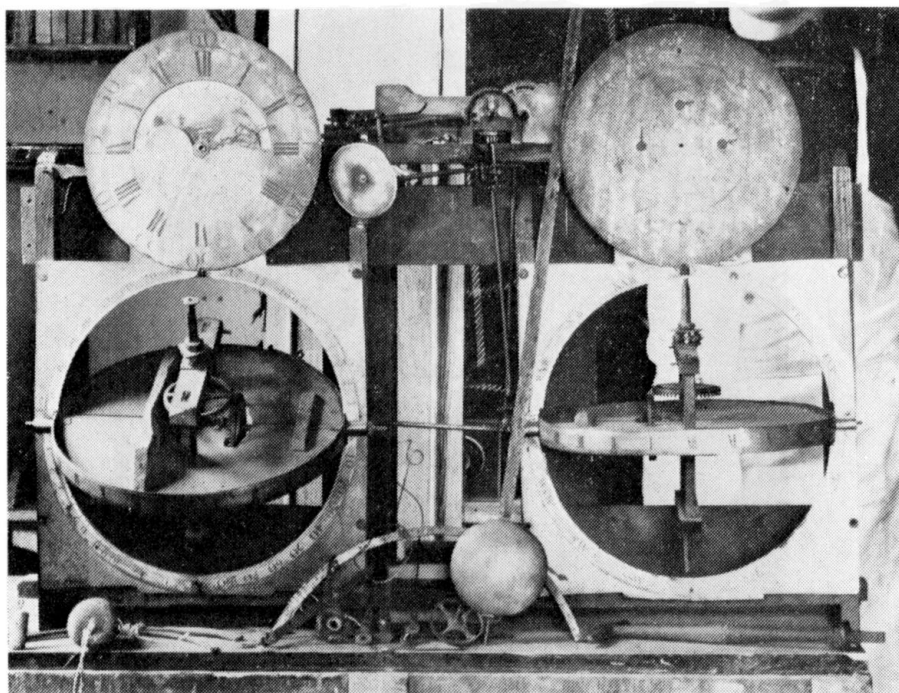


FIGURE 3. General view of clock during restoration.

cost of metal plates. John Harrison (1693–1776), the maker of the marine chronometer which won the Board of Longitude award, used wood in the manufacture of his early timepieces. The wheels of Harrison's clock being of wood were ingeniously jointed in segments to avoid their teeth breaking off and to cut down warping.

When Earnshaw's clock was fully restored a new case was constructed to house it at the University in which it is still displayed. However, I doubt if this is a good copy of the original case made by Earnshaw but as Mr Hall had only Beckwith's account and the general shape of the clock to work from, he did a very good job indeed to assimilate its earlier appearance. Indeed,

Mr Hall and Mr Thornton were to be congratulated on the fine work of restoration they carried out on this wonderful clock. In his article Mr Hall gave a full mathematical and mechanical description of the workings of the various movements. Anyone who may be interested in these and unable to consult Mr Hall's article, may have any information they require from me.

An interesting reference has since come to my notice in connection with a question asked at the B.A.A. meeting by Mr P. Moore¹ concerning a clock at Armagh. In my paper, the price of Earnshaw's clock was quoted as £150, having been purchased by the Earl of Bute¹. This may in the past have been



FIGURE 4. Celestial globe in place below right-hand dial.

confused with a clock made by Thomas Earnshaw whom I mentioned¹ may have been a close relative of Lawrence. We find that £150 was paid for a clock by the Archbishop of Armagh, the fifth son of John, the third Earl of Bute. This was a regulator timepiece despatched to Ireland following its trial at the Royal Observatory at Greenwich in 1792 February, twenty-five years after the death of Lawrence. Owing to the assumed close relationship between these two makers it is not unlikely that some confusion arose.

My thanks must be expressed to Father James, O.S.B., of Bath who kindly passed my paper on to Mr Thornton knowing of his connections with the clock. Mr Thornton kindly gave me permission to reproduce his photographs

and plate copy of the dial, and it is to him I am indebted for informing me of the clock's present whereabouts. My thanks are also expressed to Mr L. J. Lloyd of University College, Exeter, the British Horological Institute and the Manchester Central Library.

EDITORIAL NOTE: A clock of similar design, and possibly by Earnshaw, was on sale in London during the summer of 1968. The three small indicators of the right-hand dial were replaced by a date wheel.

References

- 1 Duckworth, M., *J. Brit. astr. Ass.*, **78** (1), 22 (1967).
- 2 Earwaker, J., *East Cheshire Past and Present*, **2**, 149, London, 1880.
- 3 Beckwith, J., and Holt, J., *The Gentleman's Magazine*, **57** (II), 665, 1165, 1795.
- 4 Hall, J. J., *Horological Journal*, **LXXIV**, 186, 1931–32.
- 5 Hall, J. J., *Horological Journal*, **LXXV**, 203, 1932–33.