GEORGE CALVER—EAST ANGLIAN TELESCOPE MAKER

H. E. DALL

Nearly a century after William Herschel constructed his first reflecting telescope with a mirror made from speculum metal (an alloy of copper and tin) the much superior "silver on glass" mirror became popular among the few amateur telescope makers of the day. Among these, G. H. With of Hereford began producing excellent mirrors in the late fifties of last century; they are distinguished not only by his signature and by inscriptions indicating quality, but by the polished edges of the mirror. With was a science professor at local colleges and remained an amateur mirror maker, producing in his lifetime perhaps 200 mirrors, some of which were mounted by Browning. Glass mirrors are very durable and many have survived and given excellent service for over a century. The much larger number of mirrors and complete telescopes made by George Calver must mean that some will be in use well into the next century and Calver's fame as a maker of first-class mirrors has eclipsed that of With and others, professional as well as amateurs, of the last century. Much of our knowledge of Calver and his work comes from the voluminous 'letters to the Editor' of the famous *English Mechanic and World of Science*, a weekly journal founded when With and Calver began practising their hobby. The original Editor exercised great tact in controlling this always interesting, though often heated and argumentative, correspondence over a period of about 60 years. For those interested in the old mirror makers, the now scarce volumes of the old '*EM*' are fascinating indeed. Fortunately, David Barcroft of Madera, California, acquired 50 volumes of the '*EM*' and spent much time in copying those letters, obituaries, etc., of the astronomical mirror making fraternity. David passed these on to his friend Tom Cave of Long Beach and to Albert Ingalls of the *Scientific American*, editor of the three classical *Amateur Telescope Making* books, thence to the writer. David Barcroft and Tom Cave are keen and very well known astronomical observers and BAA members, and they are responsible for considerable research into the history of the "Amazing Mr Calver". This is, in fact, the title Mr Cave has given to his lectures and papers on this subject; and Mr Cave now owns the 50 volumes of *English Mechanic* referred to above.

The writer's first sizeable telescope was a 215 mm Newtonian, made and signed by G. Calver in 1877, and acquired in 1920 from William Porthouse, who in turn obtained it from N. E. Green. The writer also corresponded with Calver in 1923 and has naturally been much interested in his life's work; 25 years after Calver's death, he visited the village of Walpole in Suffolk, where Calver was born and died. The old workshop where many mirrors were made still survived, and notes on the progress of telescopes built early in the century were still marked on wall panels, while elderly inhabitants of the village contributed useful details of Calver's early life not otherwise recorded.

Calver was born in Walpole in 1834 July; his father was a farm labourer and both parents died when he was very young. He went to Bulcham Union and, while there, he was apprenticed to a shoemaker at Walpole and apparently wielded this craft after moving to Yarmouth (Norfolk) about 1850. Calver became interested in astronomy during his stay in Yarmouth and he met the Rev. Matthews who had a telescope with a mirror by G. H. With. Matthews challenged Calver to make a mirror of equal quality. Hence it appears that George Calver was already interested in mirror making at this period (probably 1862), and at the end of this decade was becoming a professional mirror maker and known to the fraternity of the *English Mechanic* correspondents.

He was soon contributing to this correspondence, firstly seeking advice and information and later contributing sound and serious advice to others, interspersed with requests for optical information when he had orders for less familiar telescopes, e.g. Cassegrains of larger size. One of his earliest telescopes was a 254 mm Newtonian which he used himself, and he became a good observer. As a professional he moved to Widford near Chelmsford (Essex) and many telescopes were completed there. Although he designed the stands, these were made by a small firm, T. Lepard and Sons, of Yarmouth. Calver used machines for grinding and polishing his mirrors but the vital figuring was hand work—as it remains for the best today. Testing was by pinhole/knife edge/eyepiece in the workshop, supplemented by the virtual image of the Sun seen in a black glass ball at a distance of more than 100 metres. (G. H. With was the first to use this device.) Final tests were made on stars at night, using eyepieces of high power—a test which Calver always correctly insisted was the most crucial. The writer has tested a number of Calver's mirrors; all had fine smooth zone-free figures. Most had slight under-correction of an amount compatible with a normal mild cooling gradient when observing in the evenings, which, as is well known, tends to increase the mirror correction. Figuring to a solar image reflected in a polished ball at finite distance also gives some under-correction; Calver was aware of this but he favoured the use of some under-correction.

Calver's earlier mirrors were usually 140 mm to 216 mm diameter and about f/9, but soon he was accepting orders for 254 mm, 318 mm and then 456 mm and 610 mm. One of Calver's earlier friends was the famous astronomer Dr Common, and Calver made a second 610 mm telescope for him in 1876. The performance so pleased Dr Common that he ordered a 940 mm mirror from Calver in 1879 and a further 940 mm a few years later. One of these 940 mm mirrors is in use today as the Crossley reflector at Lick Observatory and has been acclaimed as of "truly amazing" performance.

The list of Calver's customers was extensive and worldwide. Cave estimates a total of nearly 4000 mirrors, made or refigured, an astonishing output for a small country workshop with two or three assistants. However, the Widford workshop was on a dusty main road, and Calver moved back to his old village of Walpole near Halesworth, Suffolk, in 1904. His home and workshop there was at "The Manse" which the writer visited in 1952. The photograph of a

CHRISTMAS SUPPLEMENT

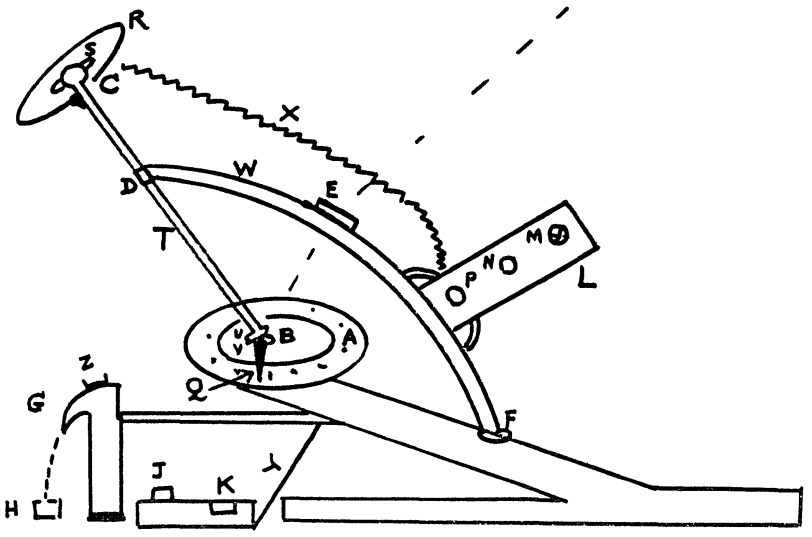
AN IMPROVED COSMODIAL FOR THE ROYAL OBSERVATORY

R. T. FISHALL

The new sundial at the Royal Greenwich Observatory, Herstmonceux, is of revolutionary design. The calculations needed to set it daily are easily worked out on a modern computer, and the position of the Sun can be calculated for centuries ahead if need be. When all the refinements have been taken into account, the dial is accurate to within a quarter of an hour, and this in itself is a major achievement.

Unfortunately the dial, like so many others, suffers from one major defect: it depends on the Sun. When the Sun is below the horizon, or is concealed by cloud, mist, fog, smog, haze or any other medium, the dial will not work. In the timekeeping centre of the world, this is unsatisfactory, and the new Cosmodial design submitted here is an attempt to remedy this deficiency.

The dial itself (A) is graduated into the usual temporal divisions, allowance being made for the equation of time and the Common Market. From the centre (B) there extends a gnomon (T). The jointing at B is achieved by rotatable gunge-pins, each of which has its own individual set of whimples (U, V). On the gnomon (T) there is fixed a queech-valve (D) which controls the arcuate arm (W) which is itself graduated into temporal divisions, and is attached to the main support by a snudger (F). The heart of the design is the artificial sun (C), which, since it is fixed to the gnomon, provides illumination when the real Sun is not available, and enables the cosmodial to work under any conditions of cloud or lighting.



The artificial sun is surrounded by a solar screen (S) and a second screen (R) which is transparent and therefore dispensible. From S, a cable (X) runs to the motivating mechanism which provides the energy to allow the artificial sun to radiate. This is an atomic nudivator (L), controlled in its turn by a caesium clock (M) which can be used to set the dial in the first instance. Of the remaining dials of the nudivator, the upper (N) provides hot milk and the lower (P) turns on Radio Three.

When the Sun is not shining, operating the main controls (J, K), which are joined to the main instrument by a boodler cable (Y), turns on the artificial sun (C), and the shadow (Q) cast on to the cosmodial provides the reading. Of the remaining equipment, G is designed to collect rainwater during showers; the water is decanted into a can (H), while the upper attachment (Z) is designed to hold the operator's waterproof hat.

To bring the dial into action, all that need be done is to set the nudivator, operate the queech-valve, oil the gunge-pins, count ten, and retire immediately. If the dial then fails to work, the only course is to set light to it and consult one's pocket watch.

The design has been submitted to the Patent Office, and a reply has already been received instructing the inventor as to what to do with it.

UP PERISCOPE!

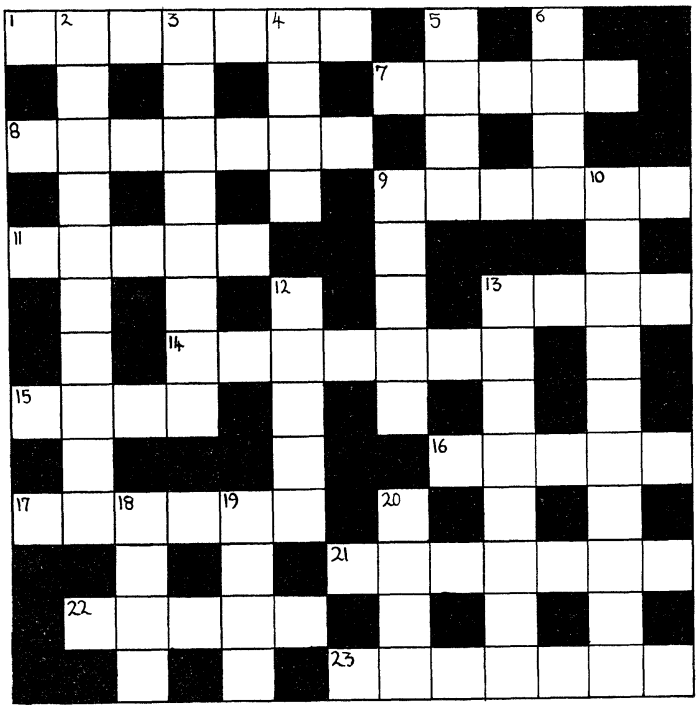
From a travel brochure (Pontinental) for 1974:

"St Lucia daily Hours Sunshine 13 (in October)"

St Lucia is an island in a latitude of N 14°. Readers may care to calculate the height of the mountain (to the nearest kilometre) on St Lucia from which the interval of time from sunrise to sunset is 13 hours on October 15, assuming a sea horizon, and neglecting refraction. The answer is given at the end of this Supplement. (*Submitted by Mr Gordon E. Taylor.*)

CROSSWORD

Compiled by C. S. Williams



Across

1 Crater in Altai Scarp. (7)
7 A month consisting of 29·53059 days. (5)
8 Baade and —— put forward suggestions of colliding galaxies. (7)
9 What have the asteroids Isis, Ariadne, Hestia, Asia, in common? (6)
11 —— Freres is a third quadrant crater. (5)
13 Mountain range of no degrees east or west. (4)
14 Variable satellite of Saturn. (7)
15 Has P. Moore run off with this Observatory? (4)
16 This meter was constructed for the Königsberg Observatory by Franhofer. (5)
17 In what constellation can I find the star Sadir? (6)
21 Professor who in 1846 at Cambridge Observatory began his search for the planet Neptune? (7)
22 Shepherd in Cepheus. (5)
23 He discovered Saturn's second satellite. (7)

Down

2 Flemish inventor of the Dutch Trunk. (10)
3 Piazzi discovered one in 1801. (8)
4 Praesepe could be the cluster we are looking for. (4)
5 Discovered by Harding of Göttingen in 1804. (4)
6 Where could I find 'Electris'? (4)
9 Discovered in the constellation of Gemini by Clyde Tombough. (5)
10 The Moon is said to be syzygy when in this. (10)
12 Could be related to the Wilson Effect. (5)
13 —— Borealis, Gamma in Cancer. (8)
18 Dr once Director of Royal Observatory Cape of Good Hope. (4)
19 Moon mountains. (4)
20 Satellite named after the daughter of Uranus and Gaia in Greek mythology. (4)

UP PERISCOPE!

The answer to the problem given earlier in the Supplement is 25 km. St Lucia is a volcanic island—perhaps the travel firm, which advertises a "drive-in volcano", was predicting a gigantic eruption before October!

SOLUTION TO CROSSWORD

Across	*Down*
1 Almanom	2 Lippershey
7 Lunar	3 Asteroid
8 Spitzer	4 Open
9 Pogson	5 Juno
11 Henry	6 Mars
13 Alps	9 Pluto
14 Iapetus	10 Opposition
15 Shed	12 Spots
16 Helio	13 Ascellus
17 Cygnus	18 Gill
21 Challis	19 Ural
22 Alrai	20 Rhea
23 Cassini	

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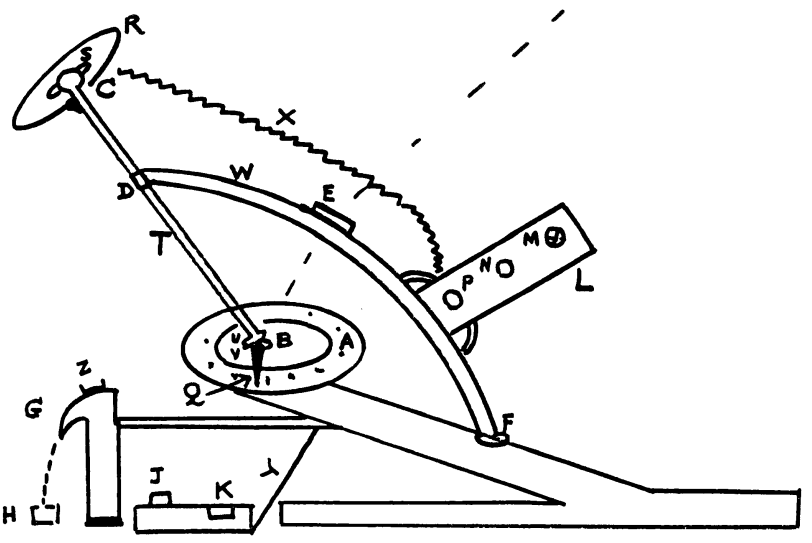

claimed that the 1·27 m was perfect when tested in all orientations—doubtless this was the spherical surface under test and not the Bessemer modification. No doubt Calver would have produced an excellent 1·27 m mirror by his normal techniques and he was not daunted by mere size. He surprised the optical world by quoting for a 2·45 m mirror when Mr James Lick was offering a prize for one of record size.

Among the larger mirrors made by Calver early this century was a 762 mm for a Mr Esterre, a 103 mm for a Mr Chetwood and a 610 mm for Edinburgh Observatory. A Mr Finch became an assistant to Calver from 1894 until his death in 1927. The writer visited Mr Finch in 1953 (then living in Skegness) and learned interesting details of this period and of Calver's excellent relations with his colleagues. Unfortunately, Finch could throw no light on the mystery of the 1·27 m Bessemer mirror of 1884.

No satisfactorily reproducible photograph of George Calver appears to exist, but one published in '*EM*' shows an elderly white-bearded figure, seated, and holding a 254 mm mirror, believed to be the one made for the Rev. Mackinnon of Newport, Isle of Wight, who took the photograph about 1914. The Rev. McKinnon died in 1940.

Calver died on 1927 July 4, within weeks of his 93rd birthday; his wife died a year later aged 95. They had no children. The tombstone in Walpole Churchyard does not refer to his life's work, but says "Kind to the poor and little children".