I & I News

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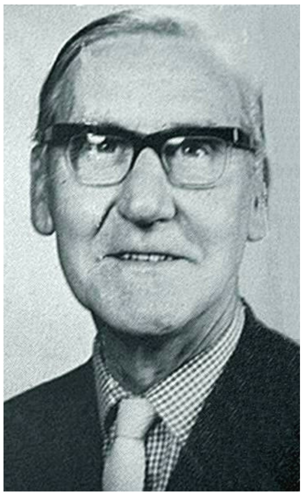


I was recently contacted by Mrs Alicia Giambarresi, who had been trying to trace the 12-inch Newtonian reflector that once belonged to her father, Henry Brinton. He had presented it to the Bayfordbury Observatory at Hatfield in 1975, and in 2008 it was moved to a location in West Sussex. Two days later she confirmed that it is in use at Slindon College, near Arundel, though she makes no claims to the instrument. She has simply said: 'My sister Julie and I grew up with this telescope in our garden at Selsey, and want to recapture some happy memories of my father's life and work.' She also sent me three photographs, the first of which was taken during filming for *The Sky at Night.* Henry Brinton appeared on several editions of the programme, and I therefore consulted Martin Mobberley, who concluded that the photograph was taken in June 1971, prior to the broadcast of 1 July. The other photographs are of Henry's radio telescope and an aerial view of the house and observatory. Henry had acquired the reflector from Robert Barker, the eminent lunar observer, and when he presented it to Hatfield Polytechnic it was set up by Iain Nicolson and J. C. D. (Lou) Marsh, to be used for teaching and research. The following reminiscences by Alicia, John Vetterlein, Iain Nicolson, and Bob Forrest (formerly Principal Technical Officer at Bayfordbury Observatory) are accompanied by three of Henry Brinton's published articles.

Bob Marriott, *Director*

Some memories

Alicia Giambarresi

We lived at The Old Mill House in Selsey, which was why Patrick moved there. Indeed, I actually found Farthings, which was not listed with any estate agents, but I spotted it from the car whilst we drove around searching. Patrick was staying with us at the time, and the idea was that they work together and share telescope facilities. In those days, a road name was not used because Selsey was a very small village and The Old Mill House was well known, prominently standing on the peninsular. It was 2 Woodland Road, and after the 1987 storms my mother had to admit defeat and sell what was left. Sadly, it was developed into about six houses, and only the old gatepost remains. Dad died in 1977, aged 75, and is buried at Church Norton, just north of Selsey, overlooking Pagham Harbour. My mother lived until 2000 – latterly with me. John Vetterlein has been very helpful in my efforts to locate the telescope. I remember him when he stayed with us when we were children: my sister and I called him 'Spiderman' because of the type of work he was doing at the time. My father built a radio telescope as well. It is featured in one of his books, *Measuring the Universe*, and also in the *Look and Learn* magazine for children.

Memories of the Brintons

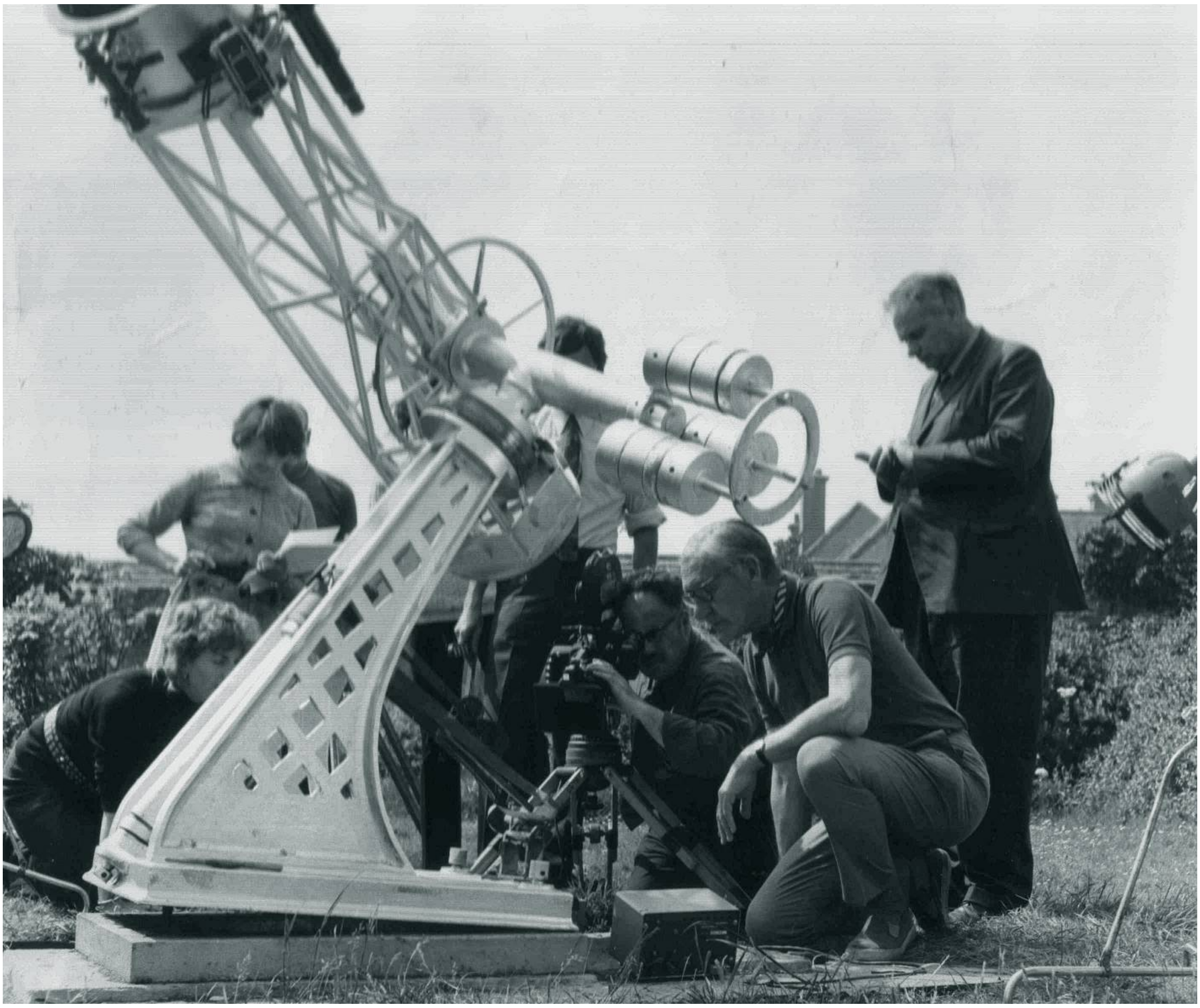
John C. Vetterlein

Henry and his wife Ailee lived with their two adopted daughters, Alicia and Julie, at The Old Mill House, Woodland Road, Selsey, close to the sea. I came to know Henry through a mutual friend, Patrick Moore. I had known Patrick since 1951, but only really got to know him well in the summer of 1959, when I was resident in East Grinstead and lived about a mile from his house in Worsted Lane. Henry invited me down to Selsey for a weekend in the early summer of 1960. He was a writer of fiction, as I am myself, and we both had an interest in astronomy. My memories of that time are necessarily somewhat limited, but I can recall walking the beach, which lay at the end of the back garden, on the Saturday morning.

The two girls would have been aged around eight and ten, and both showed an interest in what I had to say about my work on binary stars. I explained how I mounted spider webs into the filar micrometer used for measuring position at the telescope. I kept a spider in two biscuit tins joined together with a hole in the 'party wall' to enable the spider to move about in both boxes. There I had a gantry of twigs so that the spider could leave threads for my personal use! I went into some detail, all of which appeared to amuse and interest the girls greatly: henceforth I became known as the 'Spiderman'.

It was a very friendly house – that I *do* remember. Henry and I had extended discussions on a range of topics, as one might expect when two authors get together. Thereafter we saw little of one another, but I had details from time to time through Patrick. Sadly, Henry died in 1977.

Alicia wrote me in an e-mail in June this year: 'Dad inspired me in so many ways – I was "Daddy's girl" and went everywhere with him. So much of his life has disappeared from memory: rescuing the Basque children, founding the Council for Civil Liberties in Jamaica, campaigning for civil rights worldwide, he wrote books on religion, socialism, war, politics, history, geography, science, astronomy, as well as fictional thrillers. He was elected County Councillor for West Sussex, worked on problems of adolescence, the Great Education Debate, criminality, and was a member of the South West Regional Hospital Board and the Police Committee. However, he always considered himself "a failure".' This latter remark did not surprise me. Henry was modesty itself and, again like me, I think he felt he was never quite getting across to the world what meant most to him. Alicia continued: 'Henry and Ailee were wonderful parents and we were very privileged to have been adopted by them.' Her mother Ailee, who died in 2000, was a magistrate, a social worker for the Family Fund and the Thalidomide Trust, a bereavement counsellor, and a member of the Samaritans.



The Henry Brinton Telescope at Bayfordbury Observatory

Iain Nicolson

I was introduced to Henry Brinton in the early 1960s by his close friend Patrick Moore. I think it was in 1963 that I first went down to Selsey, with Patrick, to visit Henry at The Old Mill House, and to see his remarkable 12-inch Newtonian reflector. With its rotating head, and a very solid and stylish German mounting, it was driven by a worm that coupled to a short arc which, as I recall, could drive the instrument continuously for at most a couple of hours before having to be disengaged and reset.

Henry was a delightful, engaging character, with a wide range of interests and a powerful intellect, yet endowed with practical skills that he used to great effect, for example, in the construction of his run-off shed observatory, and his radio telescope. He was a first-rate observer, particularly skilled in the use of the filar micrometer† with which he made a long series of measurements of the phases of Venus. He was great company and, because he refused to accept anything without delving into its logical consistency, would often engage in detailed discussions of physical principles, which were a joy (and a challenge!).

In 1976, when Henry came to the reluctant conclusion that he was no longer able to make good use of his telescope, he was determined that it should be passed on to some person or institution that would make good use of it. He talked this through with Patrick Moore, and decided to approach me to see if I could either take on the telescope myself or come up with a good suggestion as to where it could go. Much as I would have been delighted to take custody of this marvellous instrument, I knew I was not in a position myself to provide it with a proper home at a good observing site. Instead, I suggested that perhaps Henry might be willing to donate it to the then Hatfield Polytechnic Observatory at Bayfordbury in Hertfordshire (now the Bayfordbury Observatory of the University of Hertfordshire).

Henry readily and enthusiastically agreed to this suggestion. Accordingly, three of us drove to Selsey to dismantle the telescope and transport it back to Bayfordbury. We anticipated having considerable difficulty taking the mounting apart after it had spent decades in the run-off shed in Henry's garden, within 100 yards of the sea and subject to the vagaries of gales and a salt-laden atmosphere. Not a bit of it. Thanks to Henry's meticulous maintenance (and his pre-treating of all nuts and bolts with penetrating oil) the entire instrument and mounting came apart with considerable ease, and reassembling it back at Bayfordbury was a fairly straightforward operation.

The telescope was initially housed in a run-off shed and subsequently within a fibreglass dome, where it remained until, together with two other domes, it was destroyed in the great storm of January 1990. The defunct fibreglass dome was replaced by a steel Ash-Dome, within which the telescope remained – perched on top of a new concrete plinth bearing a brass plaque with the legend 'The Henry Brinton Telescope' – until 2008.

During the three decades for which the Henry Brinton Telescope was in commission at Bayfordbury Observatory, it was used for visual observations, photography, and photometry in a wide variety of ways: for student practicals, public open nights, short courses, and, notably, for a significant series of variable-star observations. The presence of this instrument, as part of the suite of telescopes at the observatory, helped to ensure that students encountered a wide range of different telescope types and provided an opportunity to experience the challenges, and rewards, of operating a Newtonian instrument with a rotating head and an intriguing drive mechanism.

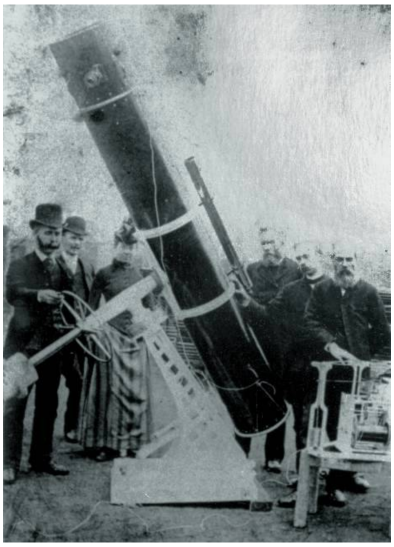
Eventually, though, it made sense to replace this historic instrument with a modern Schmidt–Cassegrain telescope – a 16-inch Meade LX200 – which now forms part of the suite of similar instruments (five 16-inch fully automated robotic LX200s plus a 14-inch LX200) that, together with the 20-inch Cassegrain 'Marsh Telescope', comprise the major optical telescopes at the observatory.

The time had come for the Henry Brinton Telescope to be handed on to new custodians, and it was particularly appropriate that the instrument should return to West Sussex. The telescope was collected by John Mason and delivered to Slindon College in Arundel, where it was recommissioned in 2009 and where it is now in regular use by students and, on open evenings, by the general public.

† From 1963 he used a micrometer which had been presented to the Association by Will Hay in 1947 – *Director.*

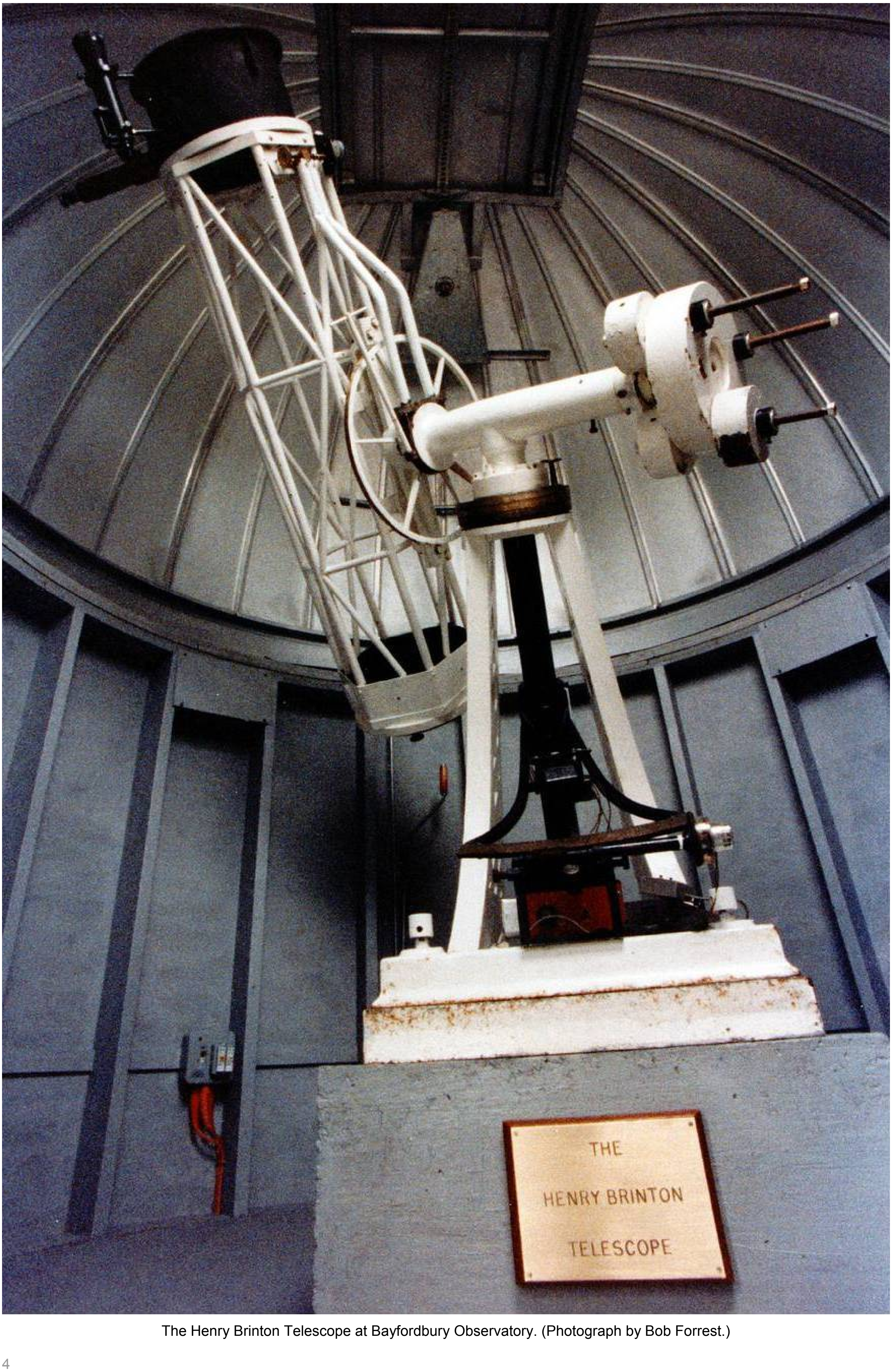
The Henry Brinton Telescope and its twin

Bob Forrest



The Henry Brinton Telescope was used for many purposes while it was installed at the Hatfield Polytechnic/University of Hertfordshire observatory. In its early years it catered for visiting parties and was also used for visual observation of variable stars (cataclysmic variables, if I remember correctly). Later, after being rehoused in the more user-friendly Ash-Dome, it was a workhorse instrument used for practicals. Photometric exercises and short-exposure photography of a variety of objects were routinely carried out both by undergraduate students and participants on public short courses. The telescope was also employed for practise in the use of CCDs as they came into wider use. Below is a CCD image of the Sombrero galaxy that I took with the instrument on 11 March 1994 – an unguided total exposure of 10 min (60 x 10s). By chance, asteroid 111 Ate was nearby and is the tilted streak above and to the right of the galaxy.

In a purpose-built observatory atop the former High School in Stirling there is a telescope with a mount, drive, and rotatable head carrying the secondary mirror and eyepiece, which is very similar to the Henry Brinton Telescope, though the instrument has a wooden tube. Purchased by generous benefactors in 1889, the observatory saw considerable use by school pupils and the public for a few years thereafter, but then fell into disuse. During the early 1970s it was carefully restored, and is now used and maintained by Stirling Astronomical Society.



The Henry Brinton Telescope at Bayfordbury Observatory. (Photograph by Bob Forrest.)

A run-off observatory

Henry Brinton

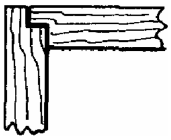
The problem of housing a medium-sized telescope presents something of a challenge to those who are neither rich nor gifted with the natural genius of the handyman. I am a fit person to write on the subject, because I am the owner of a 12-inch reflector, and I am neither affluent nor dexterous. It is broadly true that if I can solve the problem, anyone can.

The simple answer for those incapable of building a revolving dome – and those who have such skill will not need advice – is the run-off shed. Very little craftsmanship is needed to make one which will fulfil the three requirements of this form of protection for a valuable telescope. It must give adequate cover, be easy to remove, and cheap to build.

In my view, there is everything to be said for using tempered hardboard for the principal material. It is cheap to buy, costing only ninepence a square foot, and will stand up to the weather well. My own telescope is housed in a sunken garden within a hundred yards of the open sea, with nothing but a hedge to keep off the winds, or more usually gales, which come straight from South America, laden with corrosive brine and abrasive sand. With a single outside coat of bitumenous aluminium paint, the board shows no signs whatsoever of yielding to these challenging conditions.

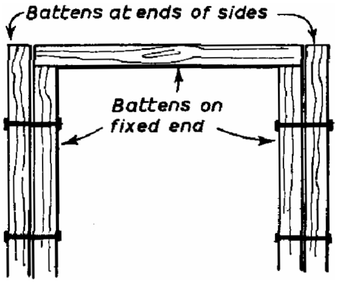
Another prime advantage for the clumsy-of-hand in using hardboard is that each wall of the shed is semi-rigid in itself by the mere process of cutting it out to the right size. If weather-boarding is used, rigidity is secured only by accurate and sturdy fastening.

For a 12-inch or larger telescope, the board should be fixed on 2 x 2-inch sawn joinery softwood along all the edges, crossed, if necessary with 2 x 1-inch for extra rigidity. For smaller telescopes, 2 x 1-inch may be strong enough throughout. It is as well to creosote the wood after cutting, but before joining and nailing or screwing on. As the wood is liable to go first at the joins, treating at this stage will protect the most vital parts.

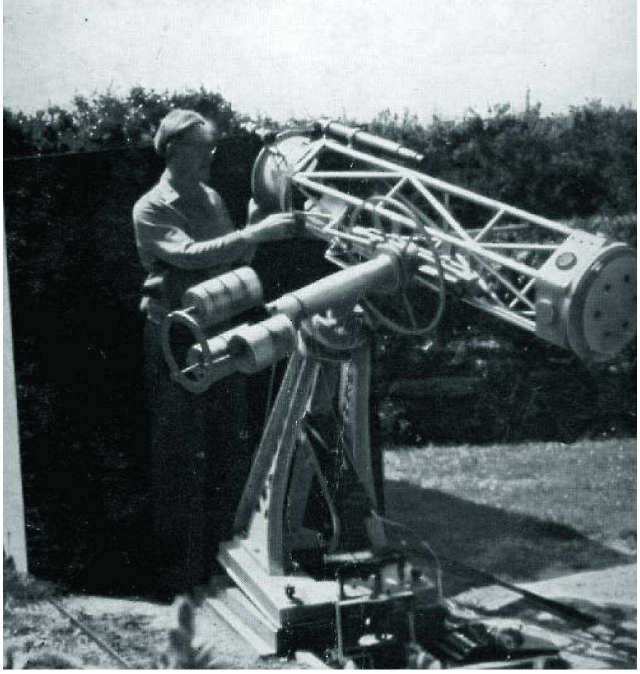


Because the wood is principally there for the purposes of giving extra rigidity and joining the sides, there is no need for neat joints; the board being nailed or screwed onto the wood will keep the battens in place. A simple joint for joining the top and end supports can be made by cutting out half the thickness of the batten at each end, and then nailing one over the other to fit flush.

It is impossible to suggest actual dimensions, because each instrument has its own, often odd, shape. The only essential is that the roof should be sloped sufficiently to allow the rain to run off easily; 15° is quite sufficient.

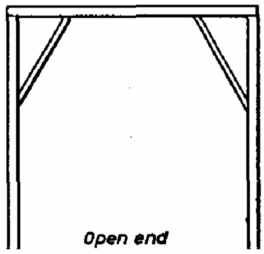


The hardboard comes in sheets 12 x 4 feet, and it is therefore necessary to have joins. Needless to say, it is most important to fix a batten behind the joins; but, for the roof particularly, just nailing the board to the wood is not sufficient. Before putting the batten in place for nailing, it should be laid with a strip of sealing compound to come immediately under the join. Silastic, or almost any of the other proprietary seals, will make a good, waterproof join, if applied in this way. Otherwise it is miraculous how the water will find its way through.



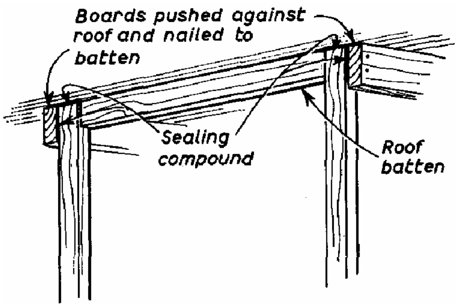
The run-off shed consists essentially of three fixed sides, a roof, and a door. The simplest way of going about the construction is to make and erect the three fixed sides first. Each side will consist of a sheet of hardboard, fixed on battens, as described. One side is, of course, lower than the other, to allow for the pitch of the roof, and the fixed end has to be tailored to fit the two sides. The actual design and method of fastening will have to be decided in the light of the dimensions of the individual telescope.

The fixed end can be fastened onto the sides in a number of different ways. One simple one is to make the battens of the fixed end fit snugly inside the battens of the two sides, and then bolt or nail the two sets together. This, though fairly firm, will not be quite firm enough for larger sheds. For these, small diagonal pieces can be fixed across the corners at top and bottom, their size being dependent upon the amount of clearance in any individual ease.



The open end, where the door is to be hung, presents a less easy problem, since, by its nature, it can have no support whatsoever across the bottom. If it were not that the rails, to which we will come presently, prevent the sides splaying outward, a run-off shed for anything but a small telescope would be impracticable. As it is, it is necessary to design the whole shed to allow sufficient clearance to permit small diagonal supports across the corners from the sides to the roof.

The roof itself is a critical part of the construction, since it must be absolutely waterproof both in itself and where it joins the walls. If it is to be more than 4 feet wide, the joint should be most carefully made, and the board nailed closely over well-applied sealing compound. Unless the shed is very large, the board can be fastened straight to the battens running along the tops of the three fixed sides, with its own battens cut to fit closely inside these. A couple of inches at least of overlap of the roof board should be left all round. When it has been fixed, flat pieces of board, 3 x 1-inch or 2½ x ¾-inch, should be pushed up tight against the overlap of the roof and nailed onto the battens of the sides with sealing compound in the joint.

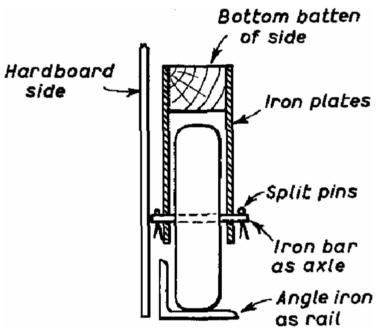


The door is largely a matter of choice. There is little or nothing to be said for hingeing it. Whether or not it is divided, a hinged door will only flap and swing and get in the way when the shed is pushed back. Much the best plan is a door which will simply lift off, though, if it is big, it can be a nuisance in a wind, acting as a sail which will suddenly carry off the observer if he is unwary. On the other hand, few of us have telescopes rigid enough to be much use in a high wind.

A door which lifts off can be made like the lid of a box. The top and side battens of the shed can be flush with the board, and the door can have battens which fit outside these, like the rim of a box lid. Better, I think, is to let the boards of the shed stick out beyond the battens and let the door fit inside, with its own battens lying up against the battens of the shed. Any form of fastening can then be made, either round the outside or through the two pairs of battens.

So much for the shed itself. The next question is the method of running off. The essentials are, naturally, some wheels and rails. Wheels are fairly easily come by, made of some hardened rubber compound, 5 inches in diameter with 1-inch axles, intended for fitting on trolleys, They can be bought at most large ironmongers.

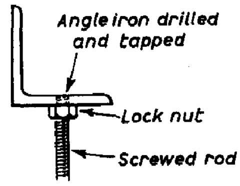
A simple way of fitting the wheels onto the bottom of the sides of the shed is to have pairs of plates cut and drilled by a blacksmith. Through two holes in the top, the plates can be bolted on either side of the 2 x 2-inch running along the bottoms of the sides of the shed. One-inch holes, drilled



opposite one another in the bottoms of the plates, can take a simple piece of steel bar to form axles for the wheels. The axles can themselves be held in place by drilling small holes through the ends of the bars and inserting split-pins when the wheels are in place.

It remains to provide rails. Builders' merchants can sometimes produce rails intended for sliding garage doors; but these are not easy to find, because most garage doors are now hung, or else roll. In any case, the rails tend to be expensive. A simple solution is to use ordinary l¼-inch angle-iron, which makes excellent rails and is as cheap as possible.

Naturally, the rails need fixing, the strength and closeness of the fasteners depending upon the nature of the ground. The easiest method, if you have a friendly blacksmith close at hand, is to get him to weld a number of rods or strips along the bottoms of the angles. The perfect way of laying is to sink each of these in a concrete pocket, in which case spiral strips should be used. If the ground is firm clay, it is enough to have rods 6 inches long pushed into the clay. Most builders' merchants can now provide ready-mixed cement in small bags, so that laying the cement pockets is an easy matter. In either case, the most essential matter is to make sure, by using a gauge, easily made of wood, that the rails are truly parallel and the right distance apart.



If a blacksmith is not available, simple fasteners can be made with threaded steel rods, which are very easily bought. This involves drilling and tapping a number of holes along the rails. When this is done the rods must be screwed to the underside of the rails, so that the tops of the rods are flush with the surface of the rails. Lock-nuts must then be pulled up tight on the underside.

It goes almost without saying that the boards of the sides are continued down beyond the 2 x 2-inch battens which carry the wheels. Hardboard is quite rigid enough for this; but slots will have to be cut to allow the axles to protrude slightly. In addition to this, it is very desirable to screw or bolt on both sides a single piece of iron strip to the 2 x 2-inch on the outside and bend it inwards slightly, so that it will just rub the edge of the rail. In this way, the unsupported front ends are prevented by the wheels from splaying outward and by the strips from splaying inwards.

One last point may need to be taken care of. If the shed is narrow in relation to its height and length, there may be danger of it blowing over in a high side wind. My own shed is broad, and has shown no signs of yielding to even a furious gale; but narrower ones may be less secure. There are many easy ways of dealing with the problem; but the first consideration is that any fastening should be quick to release. There are enough things to fiddle with in preparing the telescope without wantonly adding to the number. A very easy solution is to sink a metal rod, with a loop or ring on top, in the ground on each side. If hooks are then fastened to the sides of the shed, they can be so arranged that they will slide into the rings automatically, and so anchor the shed without the need for any action.

A run-off shed can be made easily and cheaply in this way. When it is time to use the telescope, the door is unfastened and lifted away by handles screwed to the outside; a push, and the shed rolls away – and the telescope is all ready to be used. When observing is over, a simple push; the door lifted on and clipped; and the instrument is snugly and safely housed for any length of time and in any weather.

This article was published in *Yearbook of Astronomy 1963*, ed. Patrick Moore. London: Eyre & Spottiswoode, 1962, pp. 137–43. The photograph of Henry Brinton and his telescope appears on the front cover.

Telescope drives

Henry Brinton

Among the many irritating tricks by which celestial bodies seek to avoid observation by the amateur astronomer, when he first takes up his hobby, is their apparent movement – which quite baffles the observer equipped with a 3-inch refractor mounted upon a wobbly altazimuth stand.

With the highest power on my own telescope (a 12-inch reflector), a star moves right across the field in a matter of 20 seconds. When giving children their first look through a real telescope, I find that letting them observe this rapid drift is a highly dramatic demonstration of the Earth's movement.

When buying a new telescope, the question of a drive presents few problems. Manufacturers offer a number of alternatives, and it is only a question of balancing cost against the required accuracy. The difficulty arises when converting an instrument which has not previously had any driving mechanism.

The first thing is to be clear of the purpose for which the drive is required. For visual observers, who do not intend to go in for photography, no great accuracy is needed. If planetary and lunar photography is intended, accuracy becomes a serious factor – though, even so, the need is less than is commonly supposed. It is only when very long exposures are needed for such objects as galaxies that very great accuracy is essential.

Motive power presents no difficulty. My own telescope, which was built by Calver in 1889, was driven by weights when it came into my possession. The system was simple and satisfactory, except that at crucial moments the weights always needed winding up. Nearly all telescopes are now driven by electric motors of one sort or another. Motors of all types and sizes are readily available, many of them for very small sums of money. The main problem is one of reduction gear.

Since the telescope has to turn once in just under 24 hours, the drive has to be very slow indeed. A large reduction is provided by the usual practice of worm and wheel, with the latter on the main axis. This, however, still needs the worm to turn very slowly indeed, whereas most available motors have a speed up to 1,500 rpm. This calls for a total reduction of the order of 2 million to 1.

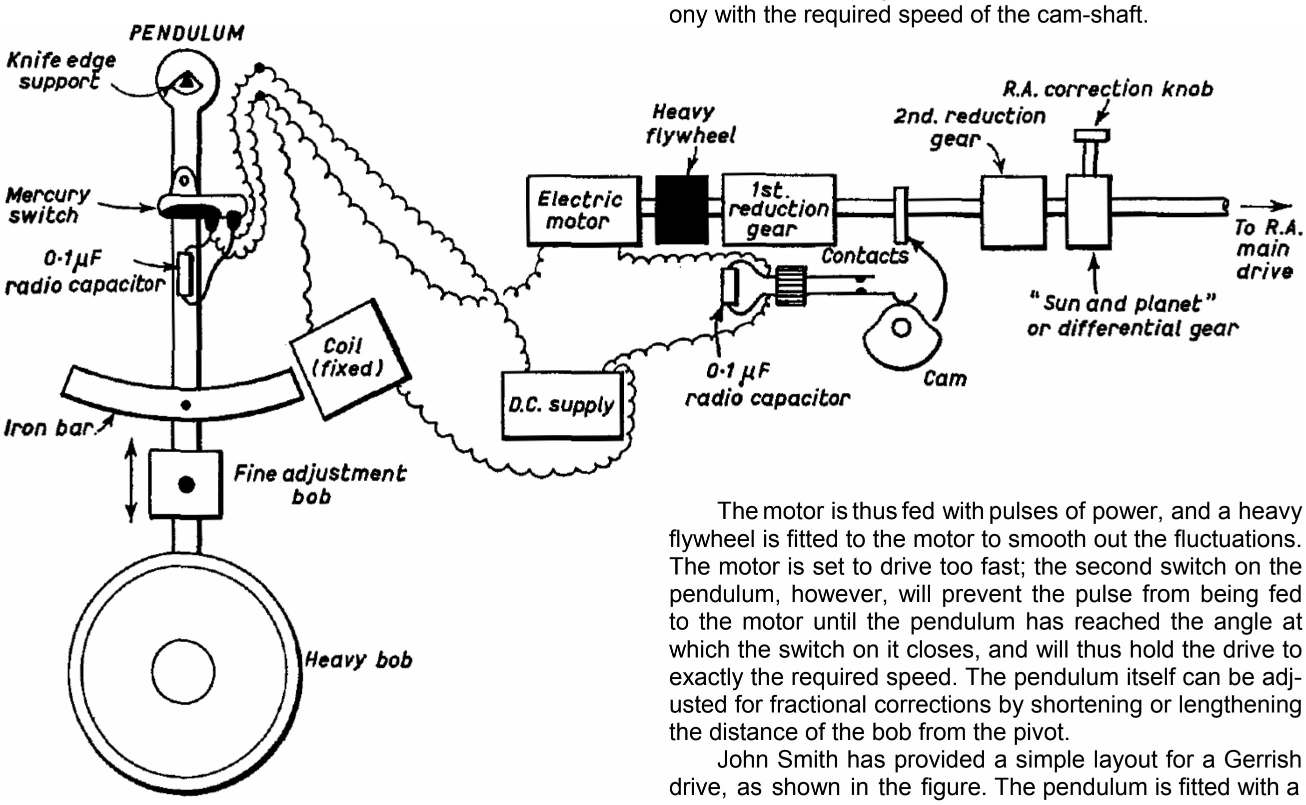
Gearing is very expensive to make, and calls for skill and patience to make for oneself. There used to be ex-government bomb-sights on the market very cheaply, which contained large and accurate reduction trains; but these are now hard to come by. Series of radio-tuning slow-motion drives have also been used.

If the drive is for convenience only, a simple way out of the difficulty is to use windscreen-wiper motors. These are sturdy, cheap, and need a minimum of extra reduction. At break-up yards they can be bought for a few shillings. They have the added attraction of being battery-driven, or driven from a simple charger, thereby avoiding the risk involved in having mains voltage in a damp garden. With either source of power, they will give a surprisingly steady drive. Fitted with a rheostat, they will be accurate enough, over short periods, for planetary photography.

For greater accuracy, a synchronous motor is generally used. At times of heavy load, the frequency may vary by perhaps 2%, and the generating station is apt to make up the difference late at night, just when one is using the telescope. Otherwise, a synchronous motor is accurate enough for most purposes. Even with the normal variations of frequency, it will serve for planetary work – for anything, indeed, except very long exposures.

Synchronous motors with reduction can be bought cheaply, with powers of a few inch/ounces. There are, of course, clock motors, and switch motors which will serve excellently if the power required is small enough. Unfortunately the power available is marginal, depending upon how finely balanced the telescope is. A typical switch motor will give about 6 inch/ounces at 4 rpm.

Another method of controlling the drive speed is with the Gerrish drive. This system provides a free-swinging pendulum to give continuous corrections to the motor speed. A cam is fitted to a suitable point on the reduction gearing from the electric motor so that it will close a set of contact points at intervals of, say, once a second. The pendulum is fitted with a second set of points, in series with those on the cam, and is of a length which will produce a period in harmony with the required speed of the cam-shaft.



The motor is thus fed with pulses of power, and a heavy flywheel is fitted to the motor to smooth out the fluctuations. The motor is set to drive too fast; the second switch on the pendulum, however, will prevent the pulse from being fed to the motor until the pendulum has reached the angle at which the switch on it closes, and will thus hold the drive to exactly the required speed. The pendulum itself can be adjusted for fractional corrections by shortening or lengthening the distance of the bob from the pivot.

John Smith has provided a simple layout for a Gerrish drive, as shown in the figure. The pendulum is fitted with a mercury switch, and is maintained by the use of a stationary solenoid acting on a curved iron bar attached to the pendulum rod. A slight 'slopping' of the mercury keeps the current flowing slightly longer on the return than on the up-swing, and so imparts the necessary impulse. In this system the cam-shaft should rotate once every 2 seconds if a seconds pendulum is used. The mercury switch closes on the left-hand stroke only.

A rather more refined version, also suggested by John Smith, makes use of an artificial gravity for fine adjustments of the pendulum, which is fitted with an iron block at the bottom. Underneath is fitted a small adjustable solenoid to control the rate of the swing. A further refinement is to provide buttons, one of which will cut out the current altogether, while the other will by-pass the contacts and provide a continuous current. These will permit movements of the image in small steps.

Another problem which has to be overcome is the slow-motion adjustment in right ascension. A simple and inexpensive way of dealing with this is to make the main drive through a drill-chuck reduction gear, with a reduction of 4 to 1. For normal drive, the gear-case is locked. For slow-motion, the casing can be driven by a secondary reversing motor, for which purpose almost any motor with a large reduction will serve. A windscreen-wiper motor is excellent for the purpose. The reversing switch is fixed near the eyepiece, or held on a long flex in the hand.

A further method of securing the slow-motion and, at the same time, providing a flexible control of the main drive speed is to use one of the frequency-generating devices now obtainable, complete with a reversing switch. The range of frequencies available is sufficient to adjust the image by increasing the frequency to maximum for forward adjustment, and to use the reverse for backward movement. The frequency control, which is kept at a predetermined norm for following a star, can also be adjusted slightly to match the movement in right ascension of the Moon or a comet.

There has been space here to mention only a very few of the points about drives in what might be called the 'middle ranges'. My own reflector is still driven through the ancient and ponderous brass governor designed by Calver, though the motive power is now a wiper-motor. At the other extreme, professional telescopes are controlled by electronic devices beyond the range of the amateur. (Not, perhaps, the more versatile amateur, but those in such a class will not need instructions which are condensed into a single paragraph!)

As with so much else, where telescopes are concerned, each instrument has to be considered on its own terms. Popular though astronomy has become, we have not yet reached the era of the mass-produced telescope of larger size than a toy.

This article was published in *Yearbook of Astronomy 1966*, ed. Patrick Moore. London: Eyre & Spottiswoode, 1965, pp. 100–4.

Observatories and observatory equipment

Henry Brinton

For the amateur observer with a small or medium-sized telescope, the problem of providing an observatory may be almost as important as obtaining the telescope itself. The first question to be decided is whether an observatory is necessary, and, if so, what type it shall be.

It is clear that some sort of covering is required for almost any instrument which is not sufficiently portable to be put away in the dry after each occasion on which it has been used. Most refractors of 4-inch aperture and upwards, and reflectors of 6 inches and upwards, are too heavy and cumbersome to be moved about easily. When I had a 6-inch reflector I could and did move it often; but it was not easy, and there were occasions when I was tempted to take a risk in apparently good weather and leave it out uncovered. Assuming, therefore, that you own a telescope which is too large to move freely, and which needs some efficient form of covering, the immediate need is to decide what form that covering shall take.

Loose covers

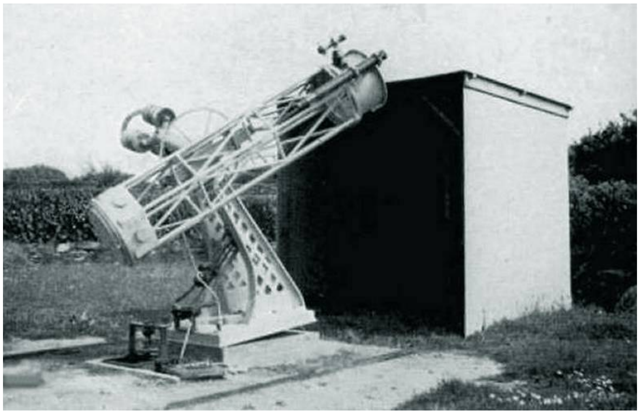
The simplest answer, of course, is some type of material such as a plastic sheet or car cover, but in my view this is most unsatisfactory. Plastic sheets always tend to tear; they lead to condensation, and, no matter how one lashes them, they appear to possess a fiendish capacity for coming loose in any strong wind. Moreover, a loose covering of such a kind will not cost much less than the materials needed for a really satisfactory form of cover. This means, in effect, building an observatory, and the two most common forms are the run-off shed and the dome.

Run-off sheds

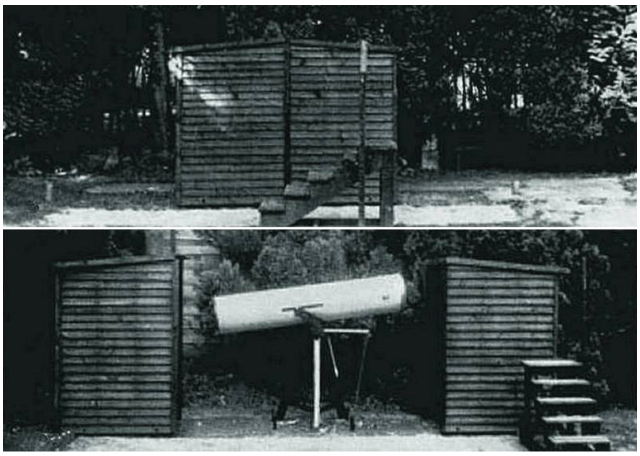
[This section is omitted here, as it is a shorter version of the previous article; see illustrations – *Director*.]

Fixed observatories

Some people will prefer a fixed structure which has, at least,



Henry Brinton's run-off shed.



Patrick Moore's run-off shed.

the advantage of giving some protection against the wind when the telescope is being used. First, there is the building with a roof which may either be slid back, hinged back, or else removed completely.

In my opinion there is nothing at all to be said for the latter type. It offers no advantage, or no substantial advantage, over the run-off shed, but it has serious drawbacks. Unless the instrument is very small (in which case it will presumably be portable), a roof which has to be taken off is horribly cumbersome. One type of building has a roof which hinges back on itself; another has a roof which is lifted off like the lid of a dustbin. A variation, which is slightly better, is to make the roof slide back on to a support. I do not propose to describe any of these in detail, if for no other reason than that I regard them as unsatisfactory. The least objectionable variety appears to be the hinged roof which can be lifted or lowered by a rope and pulley attached to a pole.

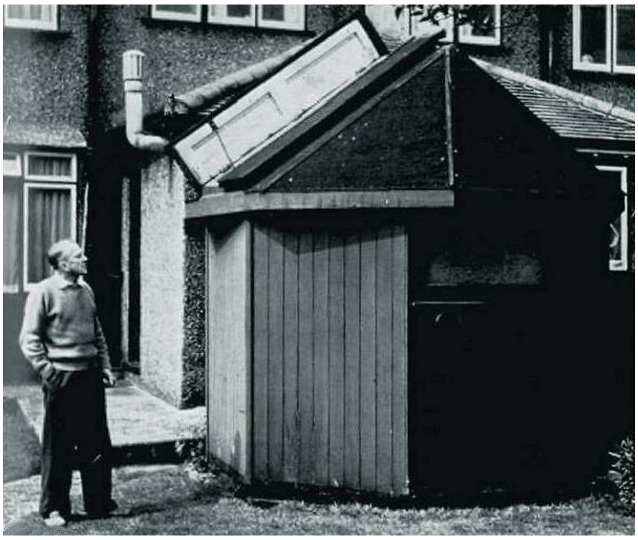
Let us now turn to the observatory with a roof, which either revolves or else has removable panels. Despite the high cost of construction, this sort of observatory is clearly the best of all, since the telescope is kept in a closed room with a small opening only when required. The simplest form is one with a hexagonal or octagonal roof, each section of which can be opened independently. The disadvantage, of course, is that the struts which support the panels cannot be moved; and though they may be slender, they will invariably obscure whatever object one wishes to observe, precisely at the moment when one wants to look at it! It seems, then, that if this kind of observatory is contemplated, it will be worthwhile to be slightly more ambitious and have an observatory which has a revolving dome.

It is, of course, possible to have an observatory which has one removable panel, and which is completely revolvable. It can be built of wood on a central pivot set in concrete, with wheels around the periphery running on a concrete track, after the manner of certain summerhouses. It may even be possible to buy such a summerhouse and adapt it. Once again, however, I would advise against anything of the sort. Pushing the whole arrangement around is not easy, and the observatory is too apt to jam at the crucial moment.

We are left, then, with the proper rotating dome, as is used in almost all professional observatories. I do not propose to describe this in as much detail as I have done for the run-off shed; those who are rich enough to have one built, or sufficiently experienced to make one for themselves, will not need design instructions, and few others will have telescopes big enough to warrant such an ambitious observatory. However, a few notes may be useful, and two typical amateur domes are shown. The one belonging to W. M. Baxter is wooden, and houses a 4-inch refractor used by its owner for his studies of the Sun. It is octagonal, and the viewing panel hinges back against the roof itself. It was constructed by a professional builder at moderate cost – but this was a good many years ago, when labour was much cheaper than it is now.

The other is the dome covering one of Patrick Moore's reflectors at East Grinstead. It, too, is octagonal. The wooden walls rest upon a concrete base. Inside, there is a circular rail, made out of an ordinary steel bar; it is this circular rail which probably presents the most difficult problem, since it must be very accurate. Eight bearings run along this rail, and the whole of the upper part of the observatory, including the window section, moves round. The removable panel is in two parts, and is hinged; the lower section is lifted over from the outside, and the upper section is pushed back with an attached rod. The roof is of plywood, covered with roofing felt. The window below the slit can, of course, be swung back on a conventional hinge.

(Note by Patrick Moore: The observatory was built entirely by my two cousins, R. A. Gulley and Brian Gulley. Neither is an astronomer in any sense of the word, and neither had previously built anything of the sort. On the other hand, it is fair to say that both are exceptionally skilful, and were able to make use of a very well-equipped amateur workshop; even so, the construction took an immense amount of time. The total cost of the materials was between £30 and £40, but if the construction had been tackled by a professional builder the labour cost would have been extremely high. The observatory has now been moved to Selsey, in Sussex.)



W. M. Baxter's fixed observatory.
(The observatory and the 4-inch Cooke refractor were bequeathed to the Association – *Director*.)

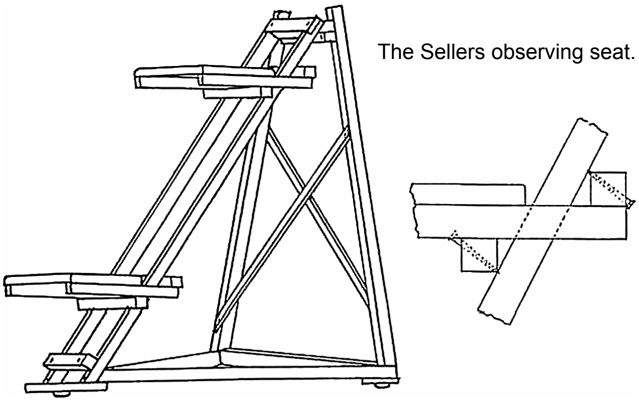
Patrick Moore's fixed observatory.

Considering how many small domes are built, and how excellent some of them are, I may have dismissed them too cursorily; yet those who feel that such an observatory is not beyond their skill or their pocket will be well advised to have one, with the qualification that it is better to be without it than to make it too small.

Equipment

Leaving the question of construction, we now turn to the matter of equipment. The most important item to most people will be the provision of a seat which can be so adjusted as to bring the eye to the desired height. There is no one arrangement which will meet every case, but a most ingenious and adaptable model has been described by the late F. J. Sellers. Sellers' arrangement consists in essence of a self-locking seat which slides up and down a pair of parallel uprights, sloping, and mounted on a triangular base. Such a chair, as shown in the figure, can easily be made out of 1½-inch or 2-inch square rough-sawn softwood, and is instantly adjustable to any height. In Sellers' model, the self-locking device is augmented by allowing the screws securing the two cross-battens to project slightly and catch in the uprights, but there are various alternatives, as, for instance, a series of notches in the uprights themselves, or, as Sellers suggested, rubber blocks fitted at the corners.

There can be one drawback to this or any other similar arrangement. With some mountings, as for example with my own German mounting, it is impossible, because of the stand, to bring the seat near enough to the eyepiece when viewing



The Sellers observing seat.

at a high altitude. The only way that I know out of this difficulty is to have a pair of step-ladders which can be set on either side of the mounting, with a plank placed between the ladders. This has the disadvantage not only that it is cumbersome, but that the height of the seat can be adjusted only by moving up or down one complete step. There is no one perfect answer.

Although, strictly speaking, it is a matter of telescope design and not of observatory equipment, it seems worth mentioning here that the difficulty does not occur in my case, as my telescope is equipped with a revolving end. I had the tube made in this way against the best professional advice, and have never regretted it. Of all the features which my telescope possesses, this is the one which I value most, apart from the excellent optics. In my opinion a well-made revolving end has almost everything to be said for it, except that it requires getting used to the fact that one constantly views celestial objects from different angles. Against this single disadvantage is the fact that with a twist of the wrist one can bring the eyepiece to exactly the spot where it is most convenient.

Other matters of observatory equipment are rather hard to write about, because the requirements of each observer are liable to be so different. One general idea which seems worth pursuing is that of the ‘observatory box’. Most of us need an almost endless series of odds and ends when we are at the telescope. Often we want them in a hurry; and they are usually difficult to find. I have fitted up a large wooden box so that it will take, in different compartments, the separate eyepieces and a filar micrometer. I have, as well, a rack for filters and a compartment for pens, pencils, torches, and papers.

Beyond such a general provision, there are one or two specific suggestions which may be useful. Most observers (or, at any rate, many of them) will make use of the knee-pad; but a valuable addition is the illuminated pencil or pen. Such devices may now be bought as a unit, which makes drawing at the telescope much easier.

For those who wear glasses, but prefer to observe without them, there is a great deal to be said for taking an old pair of spectacles and removing the lens from one eye. It takes a little while to get accustomed to using only a single eye for reading instruments or drawing; but once the habit has been acquired, a great deal of time and fumbling for spectacles can be obviated.

Despite my observing box, I still find that when I am at the eyepiece there seem to be an enormous number of gadgets to be parked; filters to be changed; pencils to be put down and picked up; eyepieces which have been discarded, or are awaiting use. As an alternative to losing them, or damaging them by rubbing together in one’s pockets, it is possible, at any rate with lattice-tubed telescopes, to make a simple, light tray to clip onto the instrument in a convenient place. Tubed telescopes are not so suitable for this, but a little ingenuity will generally come to the rescue.

Space does not allow me to write at length about arrangements for recording time; but it is worth mentioning the problem of sidereal time. Of course, if one has money to spare, it is very nice to have a sidereal chronometer; but, with time-signals so frequently and so readily available, this is little more than a luxury to most amateurs. A simple note, before one goes to the telescope, of the relation between one’s watch and the sidereal rime is all that is necessary. To go a step further, an ordinary cheap clock can be adjusted to run 4 minutes a day fast; and a single setting at leisure any time during the day from a time-signal will provide the sidereal time to at least as high a degree of accuracy as is warranted by the setting circles on most amateur telescopes.

Conclusion

Of necessity there are many aspects of my subject which I have not covered. Each telescope requires its own forms of covering and accessories, and there can be few fields in which ingenuity has wider scope. Yet unbridled ingenuity can defeat itself. The prime object of a telescope is to observe the celestial objects, not to provide an opportunity for ingenious adaptations. To those of us who have studied astronomical history, the lesson is very clear that it is not always those with the most elaborate observatories or equipment who produce the best results. A glance at drawings of some of the early large telescopes can only leave one wondering at the marvellous skill which enabled the observers to see anything at all, let alone to produce the magnificent results which are on record.

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The site of The Old Mill House, Selsey.

As it was ...