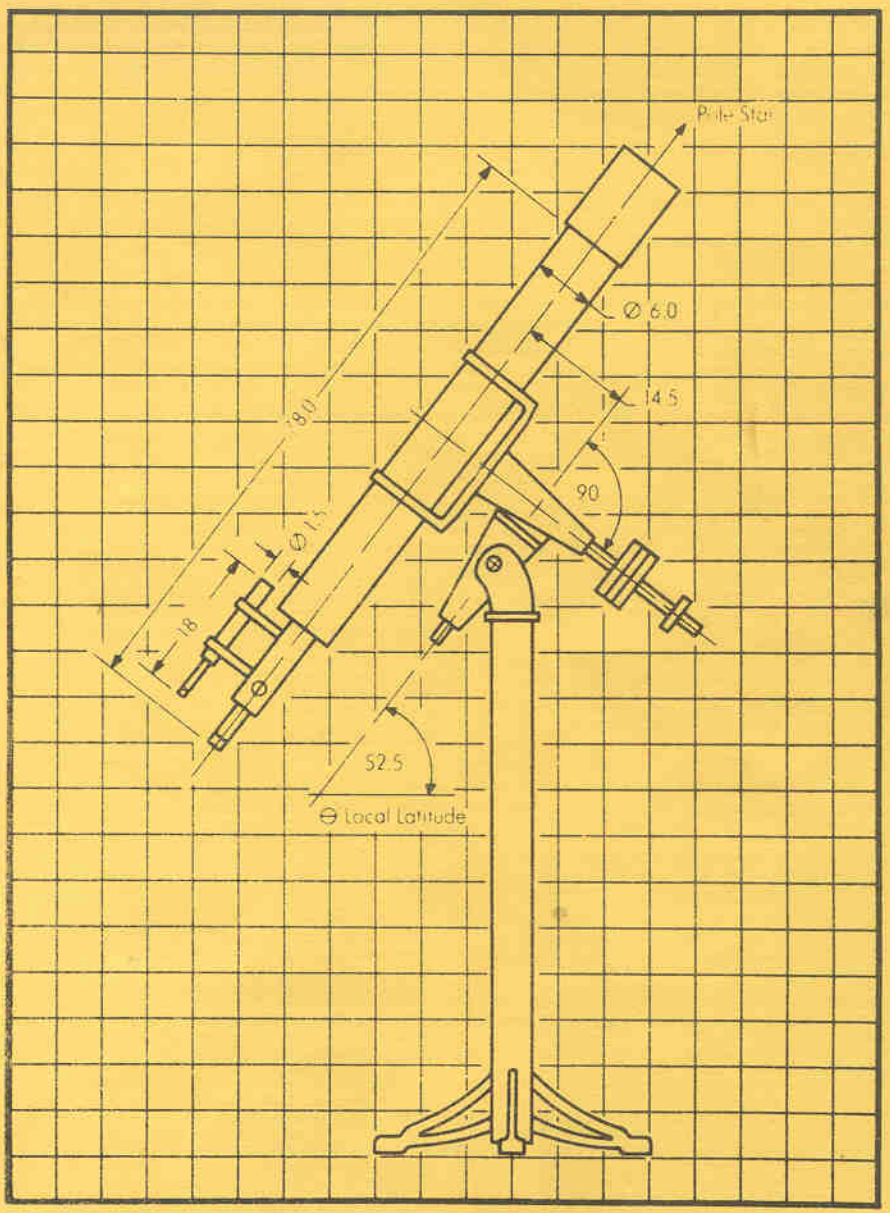
Broadhurst Clarkson & Fuller

1785-1985

WITH 200 YEARS BEHIND US - WERE LIGHT YEARS AHEAD



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CONTENTS

The bold marginal references throughout the catalogue, and indicated in this index, cross-reference those in the accompanying Price List. The letter "U" indicates Universal accessories

		Page
Introduction by Dudley Fuller		1
Astronomy in the Space Age		2
What is a good Telescope?		3
Which Telescope shall I choose?		4
Types of Reflecting Telescope		5
Collimating a Newtonian		6
What to expect from any Telescope		7
Mountings		8
Mounting Accessories		9
Setting up an Equatorial Mounting		10
Accurate Setting (con)		11
Setting Circles		12
Using the R.A. Setting Circle		13
Mirrors, Mirror Kits	A, U1	14
Lenses, Aluminising	U2, 3	15
Telescope Tubes	B, C	16
Mirror Cells	D	17
Spiders & Flat Supports	E, F	18
Focussing Mounts	F, U4, U4a	19
Eyepieces	P, U5a	20
Eyepieces (con)	P, U5b	21
Barlows, Star/Sun Diags, Sunscreen	P, U6-8	22
Finders, Guidescopes, Camera Adaptors & Brackets	G1, 2, U9-11	23
Celestial Photography		24
Equatorial Mountings	H	25
Mk II Equatorial	H	26
Mk III Equatorial	H, U12, 13	27
Mounting Accessories	I, J, K, L, L1, M, U14	28
Mounting Access. (con)	N, O, U12, 15, 19	29
Mk IV Equatorial	Q, R, S, T, V, U16, 17, 18	30
Mk IV Accessories	W, X0, 1, 2, Y1, 2, U19	31
Fullerscopes Unit Purchase Plan		32
4-in (114mm) Newtonian		33
6-in (152mm) Newtonian		34
6-in (152mm) Export Newtonian		35
8½-in (216mm) Newtonian		36
8½-in (216mm) Export Newtonain		37
10-in (254mm) and 11¼-in (298mm) Newton.		38
10-in Export Newtonian		39
Cassegrains		40
Export Cassegrains		41
3-in (76mm) Refractors		42
4-in (102mm) Refractors		43
6-in (154mm) Refractors		44
Professional and Semi-professional Telescopes		45
Fullerscopes 24-in (62cm) Cassegrain/Newtonian		46
24-in (62mm) (con)		47
Helios Planetarium		48
Globes, Atlases, Charts, Books, etc.		49

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Introduction

by Dudley Fuller

Firstly, thank you for your enquiry. Please accept my apologies for not writing you a personal letter, but because of the large number of these catalogues sent out every week, this is not possible. The catalogue you now have in your hand is most comprehensive; in its pages you will find virtually everything you require in connection with your hobby. If by chance you cannot find at once exactly what you need, or if you require special equipment, Fullerscopes will willingly undertake to produce or supply it for you *on receipt of an SAE* detailing your problem. In spite of our surprisingly low prices, all Fullerscopes equipment is of exceedingly high quality. No doubt you will have other telescope manufacturers' catalogues beside you, and so you will have noticed almost immediately how competitive Fullerscopes' prices are. The reason for this is simple.

Here at Fullerscopes we make Mirrors, Flats and Lenses, machine our own castings, cut our own gears and even make our own brass tube (we have one of the last remaining 'hand-made' tube plants in the country). We manufacture over 90% of our telescopes and accessories from start to finish in our own workshops. Each item is individually made and assembled by craftsmen. We do not 'mass-produce' anything, thus we are able to offer such high-quality equipment at such a realistic and reasonable price.

Every item in this catalogue is described, dimensioned and depicted accurately, also the relative merits and functions of each of the items concerned are shown. The inexperienced client will therefore know exactly what the object he is buying is for, where it fits into the overall scheme of things, and what it does. Newcomers to the hobby of Astronomy will also find a lot of useful information contained in the pages of this catalogue, which may help them choose their telescope. Throughout the following pages I have endeavoured, where practical, to include data and formulae which I believe will be of general value to all clients, expert and novice alike. Those readers visiting London or living within easy reach are cordially invited to visit Fullerscopes' Shop and Works.

Despite being Britain's leading Astronomical Telescope Manufacturers, we are a small firm; staffed by a handful of friendly, qualified and helpful people. (We try not to make mistakes but if we do, a 'phone call will put things right. **Please quote your reference number.)**

It should be noted that the stock position varies daily, and clients wishing to see specific items or requiring my personal attention, should telephone first to avoid disappointment – remember nearly all telescopes etc. are made-to-order.

In conclusion, please look carefully through the catalogue for what you require, compare it in all respects with others, then buy reliability and quality, by buying FULLERSCOPES.



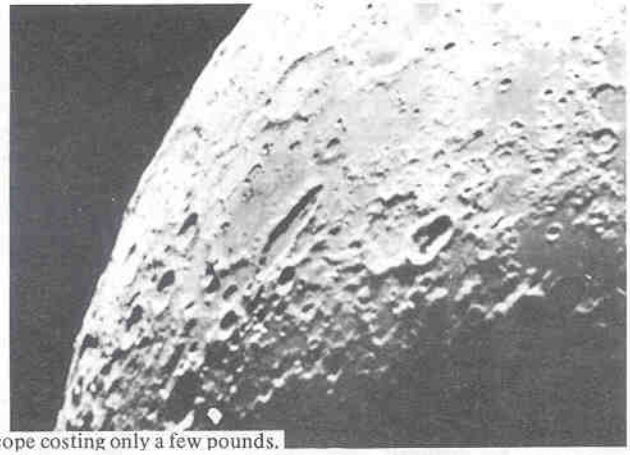
Yours sincerely,

Dudley K. M. Fuller, F.Sc., F.R.A.S.

P.S. Fullerscopes have acquired the telescope business of **Broadhurst Clarkson & Co.** This greatly increases our manufacturing capacity.

P.P.S. For Sanity's sake, let's all refer to a Metric Mirror" or an "Imperial speculum". (B.A.A. and R.A.S. *please* note!!)

ASTRONOMY IN THE SPACE AGE—Ever since the dawn of history Man has studied the stars and wondered over the ever-changing movement of the heavenly bodies. In the 16th and 17th centuries, speculation and myth gradually gave way to real scientific method, and when Galileo turned his primitive telescope on the night sky in the year 1609, theories which have been held with religious zeal for close on two thousand years came tumbling down. To Galileo were revealed for the first time to any man, the phases of Venus, the mountains of the Moon, the satellites of Jupiter and the rings of Saturn—observations which today can be made by a child using a telescope costing only a few pounds.

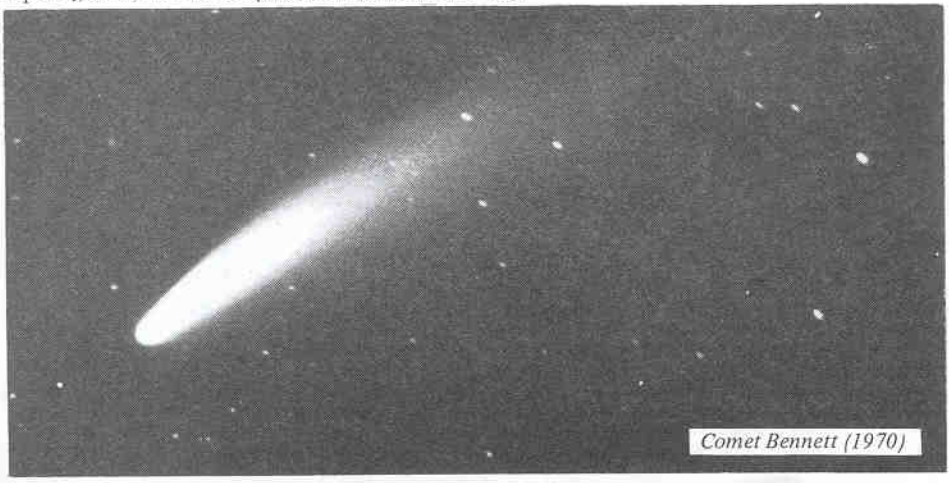


In our own day, astronomy has taken another great leap forward. To the power of giant optical and radio telescopes has been added the knowledge gained from instruments sent out into space to explore not only the immediate vicinity of our planet, but the Moon, Venus and Mars.

Man himself has set foot on the Moon and plans are already in hand for human expeditions to the planets. Astronomy has now taken on a new vitality and a new urgency. It is now an officially authorised subject in school curricular. So although astronomy may be one of the most complex and advanced of the sciences, it can also be a most fascinating hobby which can be entered upon and enjoyed from the first moment when one buys a small telescope and repeats for oneself the thrill of discovery which Galileo must have experienced three and a half centuries ago. It is a pastime which cannot fail to appeal to anyone with a sense of awe or a spirit of curiosity and adventure, whether they be aged eight or eighty.

With the most modest instrument there is so much that can be seen. The phases of Venus; the waxing and waning of the polar caps of Mars, changing colours of what may be its vegetation. the nightly motions of Jupiter's moons; the wonderful rings of Saturn; and, of course, the Moon itself, with its craters and its mountain chains, its vast flat plains or 'seas' and the mysterious domes. Then there are the strange visitors to our solar system called Comets. You might even gain fame and immortality by discovering one for yourself, as more than one amateur has done in the past, with the aid of nothing but patience and a small telescope. Further away, beyond our solar system, are the stars with their beautiful colourings, clusters, double systems and sometimes variability. Further still, unbelievable distances away, there are the great star systems, or galaxies, each with about a hundred thousand million stars.

There is so much to see, observe and record, that the task is beyond the capacity of all the professional observatories put together. For this reason, Astronomy is the one science where amateurs have always played, and may still play, a most significant part. Once possessed of a telescope you may give yourself many hours of individual excitement and pleasure, or you may with a little practice join the ranks of the thousands of amateurs around the world who have become infected with the fever of discovery and are practical contributors to the advance of human knowledge. A telescope is a welcome present to an inquiring child, and a valued possession to the old and wise.



Comet Bennett (1970)

WHAT IS A GOOD TELESCOPE?

Most newcomers to the hobby of Astronomy, on looking at a telescope ask, 'What magnification does it give?' Strangely enough, there is no definite answer, because magnification depends upon the ratio of the mirror focal length (in the case of a reflector) to the eyepiece focal length, and this ratio can be made to assume any value we please–simply by the choice of an appropriately short focus eyepiece.

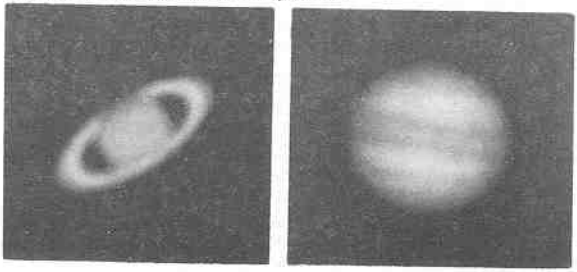
A much more important question than that would be, 'What is the greatest power that can be satisfactorily utilised on this telescope?' The answer this time is much more definite, and depends upon two qualities in the telescope, both concerned with the size of the mirror or object glass. First is the ability of the telescope to gather light, and this is clearly a function of the size of the mirror. The larger the mirror, the brighter the image appears at its focal plane; and thus the fainter the objects which can be made to appear at all. Second, and more important, is what is called the resolving power of the telescope. This must not be confused with magnification. Unless our primary mirror is large enough to separate, for example, a close pair of stars at its focal plane, no amount of magnification (by the use of short focus eyepieces) will do anything to enhance the single image actually obtained. The ability to resolve close stars, detail on the Moon or Planets, and so on, is a function of the size of the mirror or object glass. So we see that definition and hence mirror aperture is much more important than mere magnification. An amateur's 12-in (305mm) reflector can be made to give as much magnification as the 200-in (5080mm) Palomar reflector; but the 200-in (5080mm) with its great light gathering and resolving abilities, will be able to see much further into space and divide close doubles many times beyond the capabilities of the 12-in (305mm). But for most purposes, even size need not be so important. The effects of atmospheric turbulence, for instance, can limit the 200-in (5080mm) to a photograph of the Moon which is not all that much superior to a photograph taken by the 12-in (305mm). So don't be led astray by the many advertisements one sees describing telescopes in terms of *magnification*. The questions that anyone intending to buy a telescope should ask are, 'How big a telescope can I afford to buy?' and 'How accurate an optical system shall I get for the money?" Some idea of the accuracy required of



E. Elliott fashioning fine, hand-shaped brasswork for telescopes in the old, traditional manner.

an astronomical telescope can be gauged from the fact that a good mirror is accurate to anything from a quarter to one-twentieth of the wavelength of light–a figure that makes a millionth of an inch appear as wide as the M1! If the accuracy is not within these limits the telescope will be useless, and the use of high powers will only make it worse. Fullerscopes specialise in producing telescopes and their component parts supplied with first-class optics, and which can be used with the greatest magnifications possible within the resolving capabilities of the size of the instrument. That many of the claims put forward for magnification are absurd can be judged from the fact that the accepted formula for the greatest useful magnfication that a telescope will give (and this assumes the very best optical components) is 50 times the diameter of the mirror or lens in inches. Thus, for a 3-in (76mm) telescope, the useful limit is 150 magnifications; for a 12-in (305mm), it is 600 magnifications, and so on. In practice, weather conditions and the nature of the object being observed, make the useful magnifications obtainable substantially lower than these figures.

The optics used throughout Fullerscopes are, in common with the rest of our equipment, made by experts and craftsmen in this highly specialised field. To cater for a wide range of requirements we supply optics figured to varying degrees of accuracy. Thus Fullerscopes can provide optics at a low price, which are adequate for the person who simply wishes to 'star-gaze' and for the more discerning amateur, universities, research establishments, etc. Fullerscopes can offer the very best quality optics available anywhere.



Saturn and Jupiter taken with 11¾" (295mm) F.S. Reflector

WHICH TELESCOPE SHALL I CHOOSE?

There are two basic forms of telescopes from which to make your choice. The REFRACTOR which uses a lens to collect and focus light from distant objects (Fig.1) and the REFLECTOR which uses a Parabolic mirror for the same purpose (Fig.2). Whichever you choose, the first and primary consideration must be that concerned with the optical accuracy of the mirror or lens. The second consideration should be the focal ratio of the system. Formula:

$$\text{Focal Ratio} = \frac{\text{Focal Length}}{\text{Aperture}}$$

So it can be seen that a 6-in. (152mm) f.8 mirror would have a focal length of 48-in. (1218mm) etc. Short focal lengths provide a 'fast' system for photography, and a wide available field of view. However, the cost of production is greater, and aberrations may be induced. A long focal length provides better images and high available magnifications, but housing and mounting problems arise. Whatever your choice, for top quality optics, you can depend on Fullerscopes.

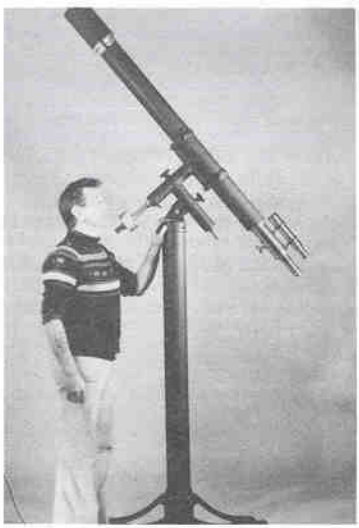
THE REFRACTOR Due to the fact that the Refracting telescope is a closed system without obstruction in the tube, it will perform about one and a half times as well as a reflector *of the same aperture and similar quality.*

There is, however, always a certain amount of false colour present in the observed image, though with a high grade compound lens this can be reduced to negligible proportions. The upkeep and maintenance of a refractor is simple and trouble-free, and once set up it should never need realigning.

Most Refractors have an f.15 lens which necessitates a long tube; a 6-in. (152mm) Refractor, for example, would require a tube of the order of 7ft 6in (2376mm) in length, a fact which can cause some housing and mounting problems to arise. Because Refractor lenses are made up from specially selected glasses and have four surfaces to be worked in their manufacture, they cost very much more than a Reflector of similar light grasp, and making them is usually beyond the capabilities of the average amateur.



Fig. 1


4in (102mm) Refractor

THE REFLECTOR Most amateurs choose a reflecting telescope because it is possible to become the owner of quite a large Reflector for the price of quite a small Refractor. The Reflector is entirely free from false colours, (if a good eyepiece is used and atmospheric conditions are good), and so is ideal for the true assessment of star colours, particularly when double star and star clusters are being observed. Being usually between f4.5 and f.8 the Reflector represents a 'fast' system, ideal for photography and rich-field (wide-angle) work. This shorter focal length range also allows for a wide choice of powers from very low to very high.

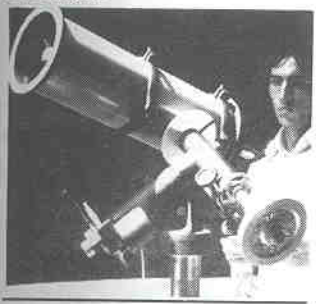
Reflectors do require rather more upkeep than Refractors; the system must be checked for alignment regularly–quite a simple matter–and every year or so, depending on conditions, the mirror and flat may need re-aluminising. This is not expensive, however, and is yet another Fullerscope service.

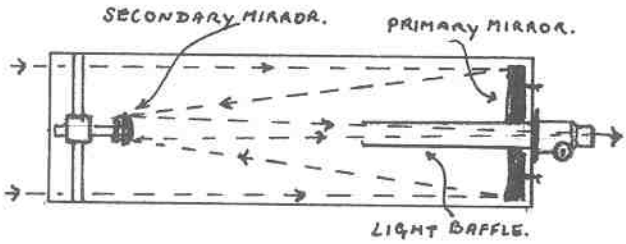
Fullerscopes manufacture or supply all the necessary optics and component parts for both the above forms of telescope. In the main, however, we find that most amateurs choose a reflecting telescope, taking full advantage of the unique Fullerscopes Unit Purchase Plan described later. Granting the selection of the best quality optics, size is next in order of importance, and you can have a far larger Reflector than Refractor for a given price. Remember, the light gathering power of any telescope increases by the square of its lens (or mirror) diameter.


10in (254mm) Reflector

TYPES OF REFLECTING TELESCOPE Although there are several designs of telescope utilising mirrors in place of objective lenses, there are only two types readily available in this country. The NEWTONIAN, by far the most popular instrument–and the CASSEGRAIN which, whilst having many advantages over the Newtonian, is not in such demand as it tends to be relatively expensive. Other more sophisticated telescopes, hybrids of lens/mirror systems, called Catadioptrics, such as the Schmidt, Maksutov, etc., because of their complexity, are usually very expensive.

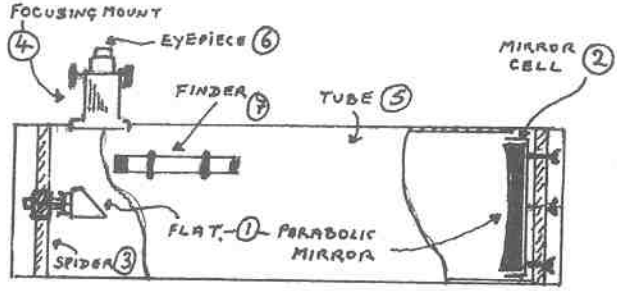
THE CASSEGRAIN Although first produced in the same year as the Newtonian, the Cassegrain telescope has never really gained the popularity it deserves, probably because the optics are difficult for the amateur to make, and the commercially built instrument is relatively highly priced.
The chief advantages of a Cassegrain are: it has a long focal length, usually about F20 (a third or more longer than the average refractor) contained in a tube about half the length of a normal Newtonian reflector; it provides a large image-scale; it has greatly reduced coma.
The mechanical and optical layout is shown in Fig.2. The traditional Cassegrain optics consist of a short focus centrally perforated parabolical primary mirror, usually f.4 or f.5, which has the same function as that of the Newtonian, and a hyperbolic secondary mirror placed in the telescope tube approximately in the position normally occupied by the flat of a Newtonian. This secondary reflects the light from the main mirror back down the tube, through the hole in the primary mirror where it comes to a focus, and is viewed and magnified by an eyepiece. The hyperbolic secondary has a negative focal length and so it acts in a similar fashion to a Barlow lens, amplifying the focal length of the primary four or five times, depending upon design, without physically increasing the tube length, thus providing a final focal ration between f.20 and f.25. With the traditional Cassegrain, it is possible to convert the system to a Richfield Newtonian, by substituting a flat for the secondary, thus making the telescope a highly versatile instrument.

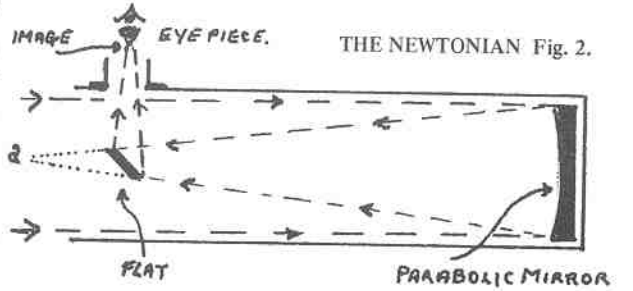




THE CASSEGRAIN Fig. 1.

THE NEWTONIAN Originally conceived by Sir Isaac Newton in 1672, the Newtonian telescope has, for many years, been the favourite instrument of the amateur. Because of its relatively simple design, even a large Newtonian is comparatively cheap to buy or make. Many amateurs own a 12-in. (305mm) Newtonian Reflector but a 12-in. (305mm) Refractor would be considered a major financial outlay even for a university.
The mechanical and optical layout of a Newtonian telescope is shown in Fig.2. The parabolical mirror gathers light from distant objects and brings it to a focus at 'a'. Obviously the image formed here could not be examined in this position, so a small mirror called a flat is placed at 45° inside the cone of light; this bends the light through 90° and brings the focus point outside the tube, where the image may be examined and magnified by an eyepiece. The purpose and function of each of the items shown in Fig.2 is fully described in the pages following.

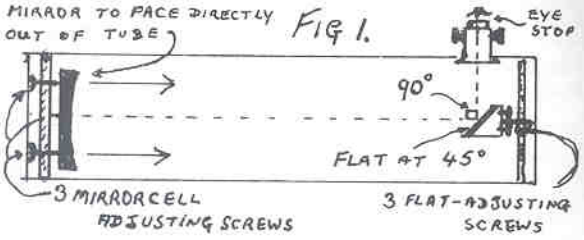




THE NEWTONIAN Fig. 2.

COLLIMATING A NEWTONIAN

The optical elements of a telescope must be correctly positioned relative to each other if the instrument is to perform to the optimum. Basically, both mirror and flat should be centrally placed in the tube. The optical axis of the mirror should face directly out of the tube. The flat should be positioned on to the optical axis so that the light rays are deviated through exactly 90° to pass through the centre of the focusing mount (Fig.1). The process of aligning the optical train is called collimation and it is far easier to do than to describe. There are two simple things to make before starting collimation:–



1) The exact centre of the mirror should be determined and marked; the best way to do this is to stick a ½-in (12mm) diameter piece of white paper, with a central ¼-in (6mm) dot or cross, in the middle of the mirror. (This will in no way affect the performance of the mirror since the central part of the mirror is shielded from incoming light by the shadow of the flat holder). If a piece of paper, the size of the mirror, with a 1-in (25mm) central hole in it is placed on the mirror first it will enable the spot to be exactly positioned and also protect the mirror from fingermarks during the operation (Fig.2).



2) An 'eye locater' should be made in order to be able to place the eye directly over the centre point of the focusing mount. This can be a simple card disc with a one-eighth inch (3mm) central hole or an old sawn off cotton reel. Anything, in fact, that will make the eye look through the centre of the focusing mount (Fig. 3a).



To Collimate the Newtonian Telescope

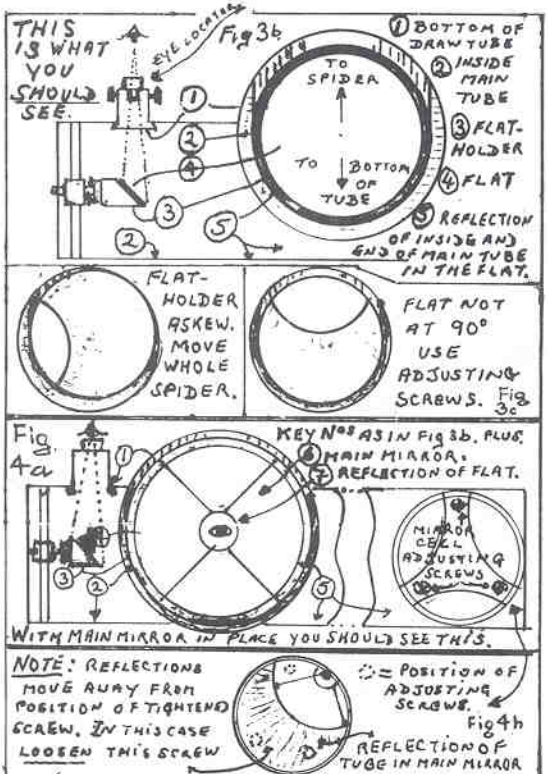
1) Place the eye stop in the focusing mount.

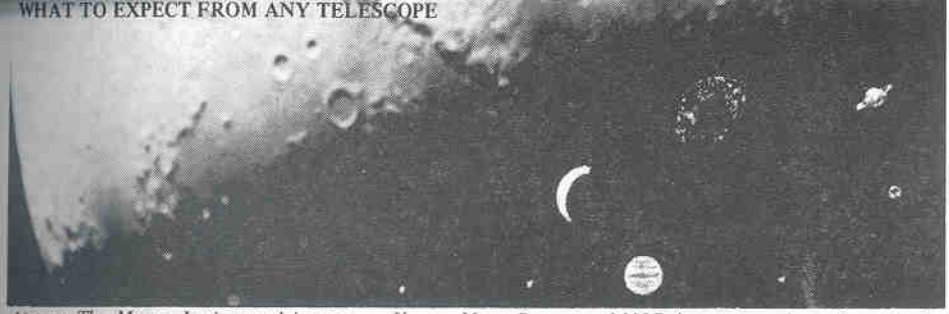
2) With the flat in position look through the eye hole and centre the flat holder with the bottom end of the focusing mount by moving it forwards or backwards or revolving it within the spider (Fig.3b).

3) Bring the image of the bottom end of the telescope tube central in the flat with the three adjusting screws on the flat holder (Fig.3c).

4)Place main mirror and cell in the tube and with the three adjusting screws of the mirror cell bring the reflection of the spider central with the mirror. (Fig.4a/4b). The central dot on the mirror should now form the centre point of a series of concentric circles (Fig.4a). If this is so, then the telescope is correctly collimated.

For the very short focus mirrors the flat should be offset. There appear to be two schools of thought on this matter. Sectional Notes of the B.A.A. (No.2) say that the flat should be offset away from the main mirror. Contributors to *Sky and Telescope* say that the flat should be offset in two planes, (a) towards the main mirror, (b) away from the eyepiece. Fullerscopes use the second method.





Above: The Moon, Jupiter and its moons, Venus, Mars, Saturn and M57 shown to scale as they would appear at 100x magnification.

APERTURE		AREA	DAWS	WORKING	FAINTEST	BEST MAGNIFICATION RANGE.						
D."	D. MM	Sq. INS.	LIMIT°	VALUE°	STARS	GENERAL VIEWING – AVERAGE USEFUL POWER	MOON	PLANETS	CLUSTERS	DOUBLE STARS	NEBULAE	VARIABLE STARS	LOWEST POSS. MAG.
3"	76	7·06	1·5	2·7	11·2	60x	20x – 200x	50x – 150x	20x-50x	40x-100x	50x-80x	LOW MAG.	12x
4"	101	12·56	1·1	2·0	11·8	80x	30x – 250x	50x – 250x	20x-80x	40x-120x	50x-80x	"	15x
6"	152	28·94	·8	1·3	12·7	120x	40x – 400x	70x – 265x	50x-100x	50x-130x	50x-125x	"	22x
8½"	216	56·94	·6	1·0	13·3	180x	50x – 500x	60x – 280x	50x-150x	50x-200x	55x-140x	"	33x
10"	254	78·54	·5	·8	13·8	200x	50x – 650x	60x – 350x	50x-160x	50x-200x	55x-180x	"	38x
11¾"	298	108·43	·4	·7	14·0	240x	50x – 750	60x – 375x	50x-160x	50x-225	55x-185x	"	45x

In Any Telescope

$$\text{Magnification} = \frac{\text{Focal length of Mirror/O.G.}}{\text{Focal length of eyepiece}} \qquad \text{Focal Ratio} = \frac{\text{Focal length of O.G./mirror}}{\text{Diameter of O.G./Mirror}}$$

$$\text{Prime focus image size} = \frac{\text{Focal length x Angular size of object in seconds of arc}}{206265 \text{ (200000 is near enough)}}$$

The maximum magnification = 30 x Diameter
The minimum magnification = 3 x D
The minimum magnification required to exploit a mirror's resolving power is equal to its radius in mm.

To find the true field of a telescope allow a star to trail across the field of the eyepiece and time it as accurately as possible. Divide this figure by 4 and the result is the field in degrees, or multiply by 15 to get the result in degrees and seconds.
The sun and moon are each approx. ½° in diameter.
½-in (12.55mm) at arms length = 1° (finger tip?)
12 inches (305mm) at arms length = 15° (a ruler?)
The knuckles of a clenched fist at an arms length are each approximately 3° from tip to tip.

Do let your eyes adapt to the dark – why not go outside and do a bit of naked eye astronomy for *at least* 10 minutes before starting to observe.
Do not use a bright torch to read setting circles, star charts, or to hunt for eyepieces! – Use a fairly dim red light.

Do experiment during the day with the various movements of the equatorial.
When viewing South it's straight forward – the further North the more complex it becomes.

Do not look directly at a faint object, nebulae, etc. You will get better results if you look just to one side of it (it is hard to do because instinct makes you want to look directly at it!)

DO allow your telescope mirror to cool to the outside temperature before using it – anything from 5 minutes to 3 hours depending on where it is kept. **DO NOT keep it in a centrally heated room (better a garden shed or its own observatory).**

CLEANING A MIRROR—It is obviously better to prevent a mirror from getting dirty in the first place! When the telescope is not in use, keep the mirrors covered, or at least, cover both ends of the telescope tube and also leave an eyepiece in the focusing mount to prevent dust from entering the draw-tube. If the mirror gets dusty, this can be blown off with a hair dryer. If a mirror dews up during or after viewing, the mirror cell should be removed and the mirror dried off with a hair dryer
Never try to remove dust or moisture with a cloth.
If the mirror is dirty and requires proper cleaning, immerse mirror in luke-warm water with fully dissolved Omo, and leave to soak for a while. Rinse off under tap and re-immerse in luke-warm water with Omo and *VERY CAREFULLY* swab the surface with a nap-free cloth. Remove from water and rinse mirror in *chemist's distilled water* (this is very important, as ordinary water contains impurities which will mark the surface of the mirror). Stand mirror on edge and let the water run off. If the mirror is clean, only a few small drops of water will remain, and these can be 'picked off' with blotting paper. If a lot of water remains on the mirror repeat the process. (see also p.15)

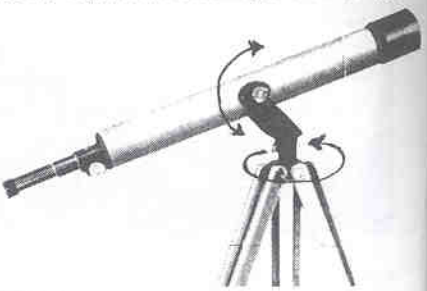
NEVER LOOK DIRECTLY AT OR NEAR THE SUN WITH *ANY* OPTICAL INSTRUMENT!!

MOUNTINGS

There are two main types of mounting for astronomical telescopes; the ALTAZIMUTH and the EQUATORIAL. By comparison it will be appreciated that the Equatorial mounting should be the automatic choice of the amateur astronomer.

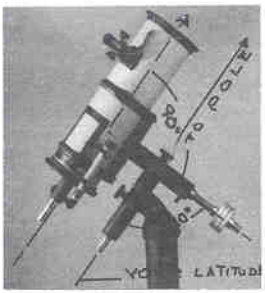
THE ALTAZIMUTH

An altazimuth mounted telescope can be moved in both the horizontal and vertical planes and so may be directed at any point in the sky. However, it is not very suitable for serious astronomical work as the apparent motion of a star across the sky is a curved line, and in order to keep the star in the field of view it is necessary continuously to move the telescope in both planes simultaneously, a difficult operation. Slow motion following is therefore unnecessarily complicated, motor drives are out of the question, and long exposure photography impractical, also the image rotates as the telescope is moved in azimuth.



THE EQUATORIAL MOUNTING

The Equatorial mounting has been devised especially for astronomical use. There are again two axes involved, but this time the main or Polar Axis can be tilted and set parallel to the Earth's axis: (Fig.1). This is an angle to the horizon equal to the latitude of the observer. It points, in other words, to the Celestial Pole. The second axis is placed at right angles to the Polar Axis, and enables the telescope to be aligned in declination, that is, to the apparent height of a star above the observer's horizon. Since the declination of a star varies only to an extremely small degree during its apparent motion from East to West, it is only necessary to move the telescope around the Polar Axis at or near sidereal rate, that is, one complete revolution in 23 hours 56 minutes, to keep the star firmly in the field of view.



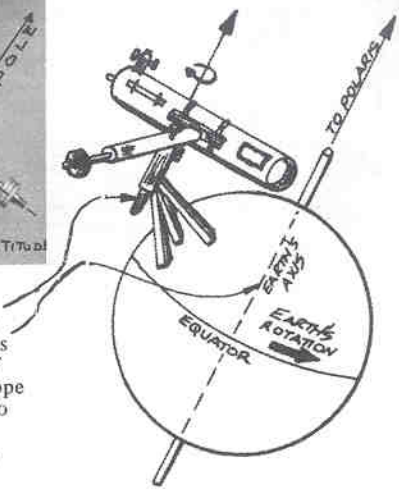
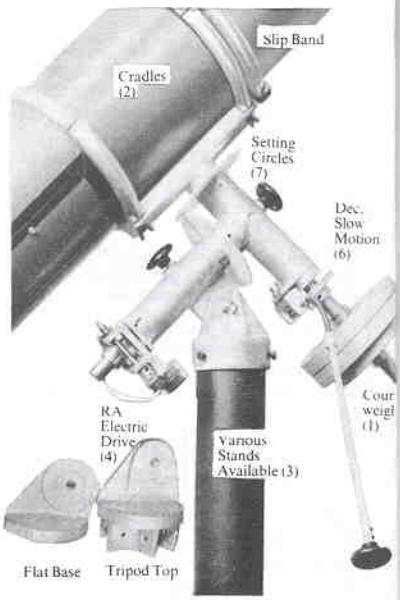


Fig. 1.

The Polar Axis is set parallel to the Earth's Axis, (the latitude of the observer) Telescope is turned East-West to counteract Earth's West to East motion.

These two movements correspond to the grid system of all star atlas, and thus the addition of setting circles and slow motion drives enables the observer to find and track any desired sky object. If the Polar Axis slow motion (called Right Ascension or R.A.) is driven by a synchronous electric motor, long period tracking is possible so permitting not only comfort in observing but also long exposure photography of faint objects as well.

What then should one expect from a first class mounting. Well, the mounting should be stable and robust enough to carry the weight of the proposed telescope, and under this load each axis must operate smoothly and evenly. The bearing and thrust surfaces must therefore be accurately machined, and the polar and declination axis must be at exactly 90° to each other. The Polar Axis housing should be fully adjustable for latitude and provision made for the easy attachment of slow motion gearing to each axis. The gear ratio of the R.A. slow motion should be such that when driven by a small synchronous, or other suitable motor, the Polar Axis will turn at, or near, sidereal rate. Accurately divided setting circles should be available and the mounting should be capable of accepting a range of tube sizes. All FULLERSCOPE mountings have been specially designed and developed to fulfil all these varied requirements. Bearing in mind the great importance of stability, each mounting in the FULLERSCOPE range has been listed with both its recommended and maximum carrying capacity. No mount, remember, can ever be TOO rigid.



MOUNTING ACCESSORIES

1) Counterweights

Because of its design the German type equatorial mounting requires counter-balance weights on the end of the declination axis to bring the telescope into equilibrium. The cast iron weights are normally attached to the shaft by collars, and can be moved anywhere along the declination shaft to ensure perfect balance. The declination shafts of the Mk.III & Mk.IV Equatorials are threaded and the weights traverse the threads, thus enabling quick positioning, no collars being necessary.

2) Cradles

It is possible to bolt the telescope directly to the saddle plate of the equatorial heads, but special cradles can be provided offering the following advantages: The tube can be turned round within the cradles thus avoiding awkward observing positions. The telescope can quickly be released from the cradles for easy storage. The centre of gravity of the tube can be altered at will to preserve perfect balance. Cradles give added rigidity to the telescope.

2a Slip Band

This is a cast ring which is clamped into position around the telescope tube above the cradles when the point of balance of the telescope has been established. The cradles may then be loosened off and the telescope tube easily revolved without the telescope tube slipping down through the cradles and thus becoming out of balance.

3) Pedestal Stands and Tripods

It is of little use possessing a highly stable mounting if it is not adequately supported. Ideally a mounting should be securely bolted to a permanent pillar which should be of concrete, or a heavy iron pipe set in, and filled with, concrete. Such piping can be supplied by Fullerscopes, a suitable size to use being shown with each mounting. However, it is not always possible or convenient to have a permanent stand made up in this manner, so Fullerscopes have developed a range of heavy duty rigid pedestals which, whilst providing the required stability for the equatorial may also be readily dismantled for storage. For those requiring maximum portability coupled with strength there is also available a selection of sturdily braced wood tripods; it must, however, always be remembered that a tripod will permit flexure regardless of its strength.

4) The R.A. Slow Motion

As discussed on the previous page, provided that the telescope is turned at a steady rate around the polar axis of a correctly set up equatorial mounting a star will remain in the field of view indefinitely once located. The reason for this is quite simply explained and was probably clear from what has been said already. The Earth revolves on its own axis from West to East once in 23 hours 56 minutes 4.09 seconds after which time a particular star returns to the same position in the sky, with respect to the observer, as it occupied previously. This is known as sidereal rate, or star rate. It follows, therefore, that if the telescope is turned from East to West (or in Right Ascension, as it is called) at or very close to this rate, the motion of the Earth and hence the apparent motion of the star is counteracted, and so the star appears stationary in the field of view. Fullerscopes R.A. worm and wheel slow motion gear units enable the observer to carry out the necessary tracking movement of the telescope smoothly and easily by hand, or because of the high degree of accuracy of Fullerscopes gears, by synchronous electric motor drive, in which case the following is entirely automatic. The driving rate of the large gear systems is accurate to within 0.004% per day

5) Electronic Guidance Control Systems (V.F.O.)

Hand guided tracking of celestial objects can become very tedious over a period of time, particularly at high powers, and for this reason Fullerscopes have developed a range of solid state electronic control units, which will enable the observer to keep any object in sight with a minimum of effort or attention.
For photography, such a drive control is absolutely essential if the best results are to be obtained, and it is, in fact, desirable at all times for the serious observer.

The Sky Tracker electronic control units regulate the speed of the normal synchronous motor drive not only to keep perfect star time, but also to follow the movement of the Moon and Planets (which are not regular as are the stars), and to permit compensation for the effects of atmospheric refraction. In short, with these unique units Fullerscopes solve all your problems of guidance and following as well as adding ease and comfort to observations.

6) Slow Motion Declination

Although the Right Ascension slow motion movement takes care of the following of stars it does not fully compensate for the movement of the Moon and Planets so for accurate guiding it is advantageous to have a slow motion control for the declination axis. The value of this worm and wheel gear unit also becomes apparent when centering a celestial object in the field of view of a high power eyepiece, and when compensating for the diffraction effect caused by the atmosphere. The declination slow motion may also be electrically driven if required.

7) Setting Circles

The addition of setting circles to a *properly set up* Equatorial mounting will greatly increase the usefulness of the telescope by making possible the finding of celestial objects with the aid of a star atlas, and enabling the location of bright sky objects–say Venus– during the day. Besides which, they are fun to use.

SETTING UP AN EQUATORIAL MOUNTING

ROUGH SETTING (for normal viewing with or without drives)

An equatorially mounted telescope can be simply and quickly set up, provided that the Pole Star is visible from the observation site. Proceed as follows:

1) Adjust the Polar axis of the mounting to your latitude (Fig.1).
2) Set up the mounting, *with the base perfectly level* so that the Polar Axis points at the Pole Star.
3) Bring the telescope into position over the mounting and tighten the R.A. and Dec. locking knobs, slightly slacken the large adjusting bolt of the Polar Axis and sighting up the telescope tube, adjust the Polar Axis until the telescope is pointing at the Pole Star (Fig.2).
4) Look through the finder or the telescope itself, using a low power eyepiece, and then by moving the entire mount bodily left or right, and by further adjusting the up and down movement of the Polar axis, bring the Pole Star into the field of view. (During this operation DO NOT move the telescope on the mounting bearings).

When this is done the telescope is quite adequately adjusted for casual observing, and if a drive is used, sky objects will remain in the field of view for reasonably long periods.

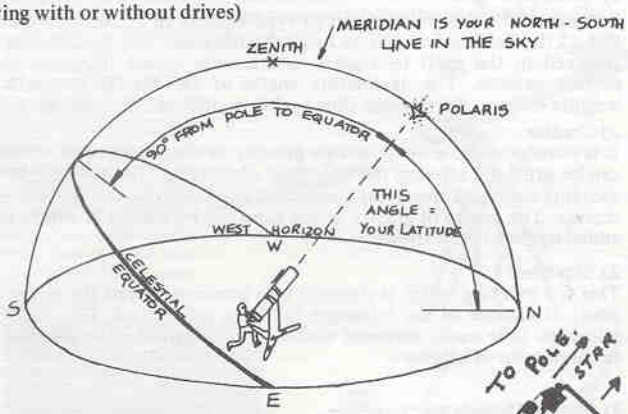
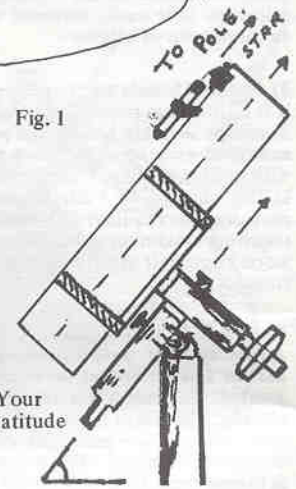


Fig. 1

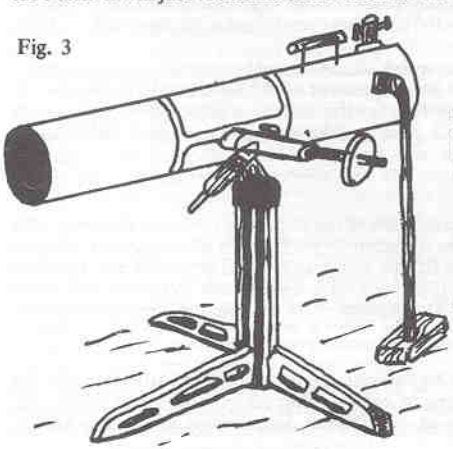


Fig. 2



If the telescope is to be used for serious work, photography etc. and if full use is to be made of setting circles, then the mounting must be very precisely aligned on the celestial pole. Before commencing accurate alignment, it is important to ensure that the telescope is exactly at 90° to the declination axis, and that the telescope is correctly collimated (see Page 8). To check that the telescope is at 90° to the Dec. axis turn the tube around the Polar Axis so that it is parallel to the ground (use a spirit level) and clamp the R.A. axis. Set up a post or stick vertially so that it just touches the side of the tube near one end (Fig.3). Rotate the telescope around the declination axis to point in the opposite direction (Fig.3a). If there is a contact difference between the tube and the stick, place cardboard or felt shims under the cradles of the tube until it will just touch the stick when the telescope is turned around the declination axis.

Fig. 3



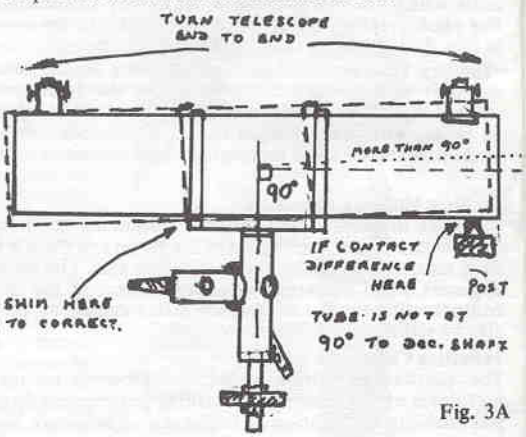


Fig. 3A

ACCURATE SETTING (continued)

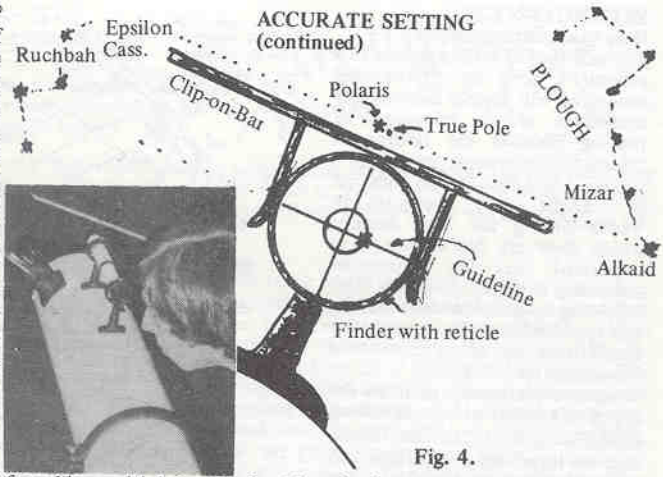


Fig. 4.

The Celestial Pole is nearly 1° away from the Pole Star itself (actually 0°.51 min.) and the Polar axis of the mounting has to point precisely to this invisible place in space in order to be accurately aligned. There are several methods of performing this operation but most are quite complicated and take a considerable time to execute. An ingenious, simple method was described in *A.T.M.* and *Sky and Telescope* a few years ago and the following development of the idea is not only accurate but also quick and quite simple to do. All that is required is a finder with a modified reticle and a clip-on bar. The reticle may be made from a piece of clear plastic on which is scratched a central circle (Fig.4). The radius of the circle is found by multiplying the focal length of the finder OG by 0.015. This circle when seen through the finder eyepiece is 1°42' in the sky and if drawn accurately will be the path that the Pole Star takes around the Pole when the mounting is fully aligned.

The 'bar' (Fig.4a) can be a foot rule fixed to a terry clip which in turn is clipped to OG end of the finder. This is used for lining up the cross-hairs of the finder on one of two selected stars which are themselves in line with the Pole. The most accurately positioned stars are Delta Cass. (Ruchbah) in the 'W' of Cassiopeia, and Mizar, in the 'tail' of the Plough. We have shown Epsilon Cass. and Alkaid which are nearly as accurate and easier to use. When seen through an inverting finder Polaris will be on the Plough side of the Celestial Pole. Assuming that the mounting has been roughly aligned on the Pole Star as per Nos.1-4, p.10, and that the telescope itself has been collimated and aligned with the adapted finder proceed as follows: 1) Bring the telescope directly over the mounting and lock the RA axis (Fig.5). (2) Turn the bar on the finder so that it appears to point to Mizar or Alkaid on one side and Ruchbah or Epsilon on the other. Turn the eyepiece of the finder, or the finder itself, so that the guide line is parallel to the bar (Fig.4). (3) By using the East/West movement of the *Dec. axis only*, bring the Pole Star in line with the point where the circle intersects the guide line (5b). (4) Slightly loosen the Polar axis nut 'x' (Fig.5d) and by altering the angle of the polar axis up or down bring the Pole Star to the point where the guide line crosses the circle (5c). Then re-tighten the nut. (5) Bring the telescope on to the Meridian (E or W) of the mounting. Clamp R.A. axis. Re-align finder (as per (2) above). Get Polaris anywhere in the field by use of the North/South movement of the *Dec. axis only*, and by moving the whole mounting left or right (a light, crafty 'kick' at one of the pedestal feet often works!!) (6a). (7) Use the North/South movement of the Dec. axis to bring Polaris in line with the circle and guide line (6b). (8) By moving the whole mounting left or right around the pedestal (see No.6a) bring Polaris on to the circle at the intersection point (6c). (9) Turn the telescope around the R.A. axis slowly (looking through the finder) and the Pole Star should revolve around the circle on the reticle. If it does so then the mounting is correctly set up and aligned.



Fig.5

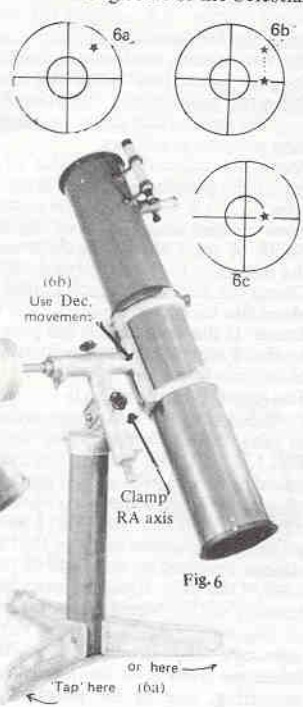
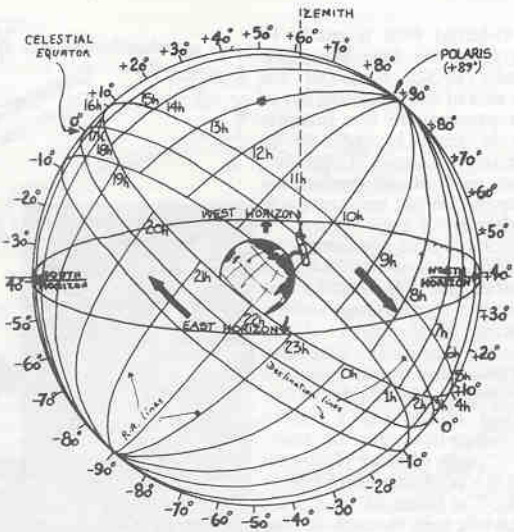


Fig. 6

SETTING CIRCLES

How to use Setting Circles



The addition of setting circles to a *properly set up* Equatorial mounting will greatly increase the usefulness of the telescope by making possible the finding of celestial objects with the aid of a star atlas, and enabling the location of bright sky objects–say Venus–during the day. Besides which they are fun to use. It is important that the Equatorial mounting is set up correctly. The following instructions are based on this assumption. (See section on the Setting up of an Equatorial Mounting (pp.10–11).

Imagine a stationary earth in the centre of a spherical cage, revolving from East to West. The 'bars' of the cage are layed out like latitude and longitude lines on a globe of the world. The stars being fixed relative to the 'bars'. The lines on a star map are called declination (latitude) and right ascension (longitude) and each star has been accurately plotted within the grid formed by these lines. (Some of the RA lines of Fig.1. have been omitted to avoid confusion.) The declination setting circle pointers indicate where the telescope is pointing North or South of the celestial equator; conversely, if the telescope is moved in altitude to the declination co-ordinates of a star, shown in a star atlas, then the telescope will be set to the correct 'height' of the star above the Horizon.

Using the Declination Circle.

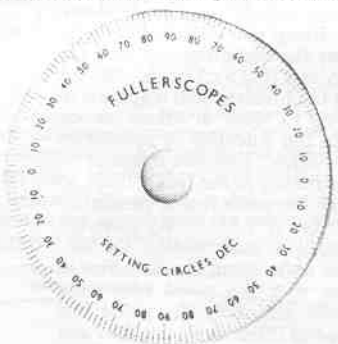
The declination circle is usually marked 0°–90°–0°–90° and is mounted on the declination axis so that the pointer reads 0° when the telescope itself is pointing to the Celestial equator, in other words, reads 90° when pointing to the pole–Polaris is actually 89°8'. It is possible to find celestial objects by using only the declination circle, and beginners sometimes find it easier to use this method. Set up the mounting then proceed as follows:

Point the telescope to a star of known declination and adjust the pointer or circle for the exact reading as per the atlas.

Look up the declination of the star to be found (+ means North of the Celestial equator and – means South). Turn the telescope to the required declination reading.

Clamp the declination lock knob.

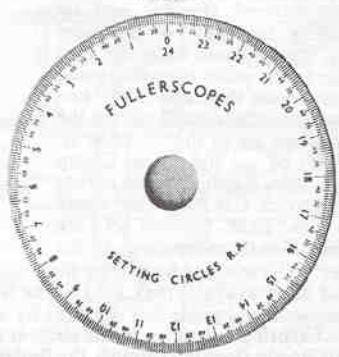
Move the telescope slowly in RA until the desired object is found. If the telescope is not permanently sighted, it is best to check and adjust the declination circle before moving on to another object.



The Right Ascension Circle

Provided that the R.A. circle is calibrated from 0–24 hours in an anti-clockwise direction, as is the case with FULLERSCOPES setting circles, it can be used for direct indexing–by far the easiest method to employ. The circle is attached either to the R.A. housing or, if an electric drive is used, directly to the R.A. gear wheel. In either case provision should be made so that the circle's position can be altered by hand to any desired reading. Three pointers are used. One is a fixed pointer located on the Polar Axis housing on the Meridian line–centre position North-South of the mounting. The other two pointers move with the telescope and should be positioned so that when the telescope itself is on the Meridian either East or West of the mounting, one of the pointers coincides with the fixed Meridian pointer.

The two R.A. pointers indicate the position of stars in hours and minutes, one East and the other West of the Meridian (your North/South line). 'O'-hour is at the time when Vernal equinox is on the Meridian–sidereal time is the 'sky time' or R.A. on your Meridian now!



USING THE R.A. SETTING CIRCLE

If the telescope has neither an electric drive nor driven RA circle, then it is necessary to have an 'observatory clock' so that you know what sidereal time it is. (A sidereal day has 23 hrs 56 mins 4.09 secs instead of the usual 24 hours).



Fig. 1A

It is possible for you to make your own observatory clock by adapting an old alarm clock. The dial should be re-marked to read 24 hours as shown and the regulator should be set to 'FAST' or '+' since a sidereal clock gains about 4 minutes per day on standard time. Having obtained your observatory clock proceed as per instructions and figs. below.

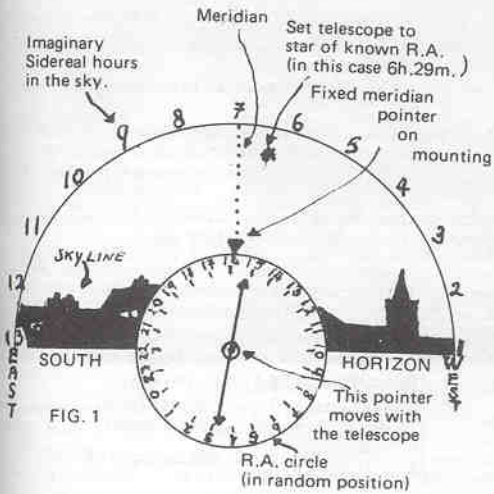


FIG. 1

Look for a bright star high up somewhere near the meridian and find its RA from a good star atlas. Using a low power eyepiece (40mm–1½in) get the star in the field of your telescope (Fig.1). When you have done this, carefully slip the RA setting circle so that the moving pointer of the mounting indicates the RA of the known star. (Check that the star is still in the telescope field). Now set your 'observatory clock' to read the time shown by the fixed meridian pointer, since this now indicates your local sidereal time (Fig.2).

(Fig.3): To find any other object during the rest of the evening's observing you (1) Using the star atlas look up the co-ordinates of the required object–in this example the faint, open cluster M67–RA 8h 48.5m, Dec.+12°. (2) Point the telescope in declination to +12° and clamp the declination axis. (3) Slip the RA setting circle so that the fixed meridian pointer indicates the time shown on the 'observatory clock'! (4) Turn the telescope in RA until the moving pointer indicates 8h 48.5m. M67 should now be in the field of a low power eyepiece.

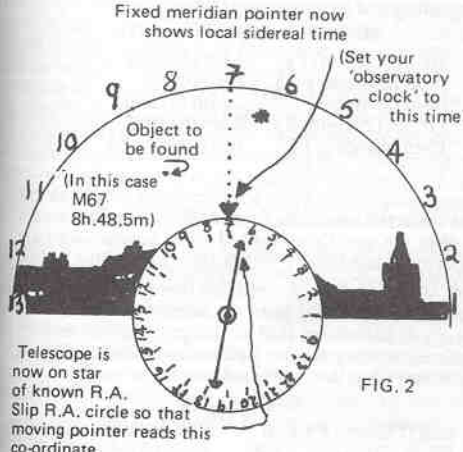


FIG. 2

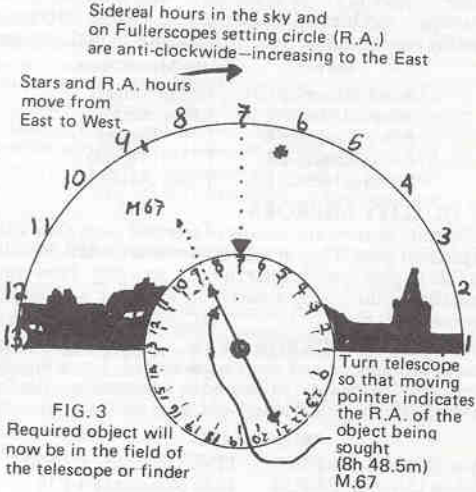


FIG. 3
Required object will now be in the field of the telescope or finder

DRIVEN R.A. CIRCLE

If the telescope has an electric drive then the R.A. circle can be mounted directly onto the R.A. Gear Wheel, and the ease of direct indexing can be enjoyed. Proceed as follows:
(1) Start the R.A. drive motor. (2) Point the telescope to a star of known R.A. (3) Keeping your telescope on the star, slip the R.A. circle by hand so that the nearest pointer reads the R.A. of the star. the fixed Meridian pointer will now read sidereal time, and the telescope can be pointed directly to the R.A. of any required star in the sky for the rest of the observing period, without further adjustment to the Circle.

FULLERSCOPE MIRRORS

A telescope is a scientific instrument and its performance as such depends *entirely* upon the quality of the optics used. When one considers the great accuracy to which the mirror has to be figured, and couples this to the fact that a great part of the work has to be done by hand, and a skilled hand, it must be obvious that while one is able to buy a good mirror or a cheap mirror, it is extremely unlikely that one will be able to obtain a good cheap mirror. If a mirror is cheap, its quality must be in doubt. Let us be realistic – there are cheap mirrors which will give quite reasonable results, and the beginner will probably be quite contented with his buy, until he has the opportunity of viewing with really superb optics. It is then that he is able to see the fine planetary and lunar detail which will reveal itself on nights of good seeing. This is where good optics come into their own.

Personal comment: It has been brought to my notice that some very poor quality mirrors are coming onto the market, advertised as being 1/8th and 1/10th or even 1/20th wave, when in point of fact they are not even a quarter wave; or, as we say – diabolical rather than parabolical!!

To me (and many others) 'wave rating' of a mirror doesn't mean very much except 'sales talk'! Experience has shown that basically there are four 'grades' of optics: Excellent, Good, Fair, and Poor-to-useless! Fullerscopes optics are: A—Excellent, B—Good, C—Reasonable. D. F.

NOTE: Where wave lengths are shown, these indicate a quality comparison to other available optics, both here and abroad.

It is impossible to tell by looking at a mirror what its quality is, and without experience it is virtually impossible for the amateur to tell exactly how good or bad his mirror is. It is unfortunate that there is no independent body in the country (with the exception of the N.P.L. who are expensive for this type of work) who can give unbiased and accurate test reports.

We strongly advise that if you are in any doubt about your source of optics, that you consult the RAS, BAA, JAS, or seek the advice of your local astronomical society who should be pleased to help you.

'A' QUALITY MIRRORS AND FLATS

'A' quality mirrors are made from low expansion (Pyrex type) glass and are aluminised and double coated. The accuracy of these mirrors is better than 1/10th wave. They are suitable for professional and advanced amateur work and we believe they are equal to, or better than, any other mirrors on the market.

Mirrors	Flats - Minor Axis	Mirrors	Flats - Minor Axis
6-in (152mm) F8	1.4in (36mm)	10-in (254mm) F6.5	2in (50mm)
6-in (152mm) F6	1.4in (36mm)	10-in (254mm) F5	2.25in (57mm)
6-in (152mm) F4	1.75in (44mm)	11¾-in (298mm) F5	2.5in (63mm)
8½-in (216mm) F8	1.75in (44mm)	16-in (406mm) F5	size as required
8½-in (216mm) F6	1.9in (48mm)	24-in (608mm) F5	

'B' QUALITY MIRRORS

'B' quality mirrors are also made from low expansion glass and are aluminised and coated. The accuracy of these mirrors is above 1/8th wave, and their performance leaves little to be desired for the study of fine planetary and lunar detail, resolving of close doubles, etc. We find that most of our clients choose the 'B' quality optics, and we have no hesitation in both recommending and guaranteeing them.

Mirrors	Flats-Minor Axis	Mirrors.	Flats-Minor Axis
4-in (102mm) F10	1in (24.5mm)	8½-in (216mm) F6	1.9in (48mm)
4½-in (114mm) F10	1.1in (28mm)	10-in (254mm) F6.5	2in (50mm)
6-in (152mm) F8	1.4in (36mm)	10-in (254mm) F5	2.25in (57mm)
6-in (152mm) F4	1.75in (44mm)	11¾-in (298mm) F5	2.5in (63mm)
8½-in (216mm) F8	1.75in (44mm)	16-in (406mm) F5	size as required

'C' QUALITY MIRRORS

'C' quality mirrors are usually of selected plate glass although depending upon supplies these may be in low expansion glass. They are silvered or aluminised. Because these mirrors come from various suppliers we are unable to give specific guarantee of accuracy. However, they are usually about 1/4 wave accuracy and are suitable for the young amateur or for those who wish to view occasionally rather than pursue the hobby seriously. *SIZES AS AVAILABLE IN PRICELIST* suitable flats supplied

CASSEGRAIN MIRROR SETS – Consisting of a matched perforated primary mirror and secondary mirror aluminised and silica hard-coated. These mirrors are so calculated that the primary mirror may be used as a Newtonian if so desired by substituting a flat for the secondary mirror. Fullerscopes Cassegrain sets have an effective focal length of f.20 at the Cassegrain focus and f.5 at the Newtonian focus.

'A' QUALITY		'B' QUALITY	
6-in (152mm) F4-F16	11¾-in (298mm F5-F20	6-in (152mm) F4-F16	11¾-in (298mm) F5-F20
8½-in (216mm) F5-F20	16-in (406mm) F4-F16	8½-in (216mm) F5-F20	16-in (406mm) F4-F16
10-in (254mm) F5-F20	24-in (608mm) F4-F16	10-in (254mm) F5-F20	24-in (608mm) F4-F16

MIRROR MAKING KITS

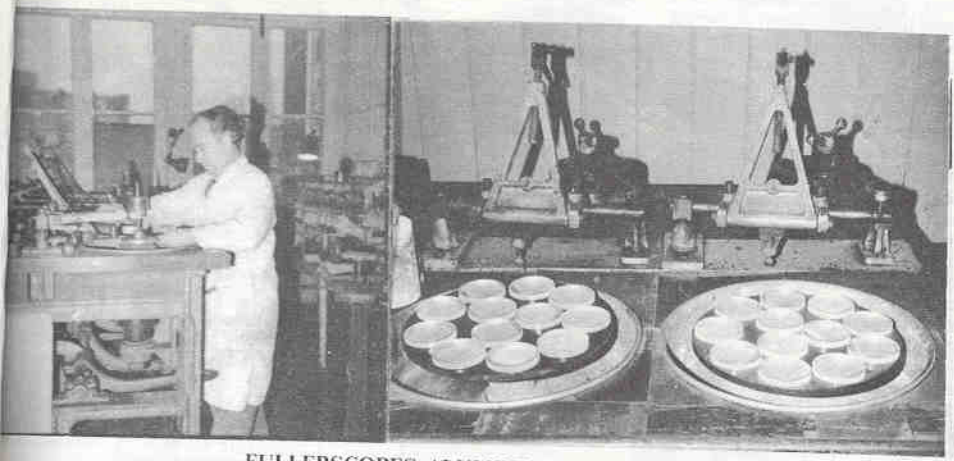
Fullerscopes can now provide in kit form, the materials necessary to make mirrors. Each kit contains a low expansion mirror blank pre-curved to eliminate time consuming grinding, and a matching glass tool. Only two grades of smoothing powder are required and these are supplied together with a polishing agent, pitch, netting and an elliptical diagonal blank. Full instructions are included. See price list for available sizes and cost. Recommended pre-reading "Howards Book of the Telescope" by N. E. Howard or Amateur Telescope Making Book 1 (Ed. Ingalls) obtainable from your local library (under section 522.2).

ACHROMATIC OBJECTIVE LENSES

Because of the difficulties we have been experiencing in obtaining astronomical quality achromatic objective lenses we have re-opened our lens making department. This is operated by a small staff, one of whom has been an optical craftsman for over forty years. The achromatic pairs of lenses are carefully made and matched by hand to the original 'Broadhurst Clarkson' specifications, which have been world renowned for nearly two centuries.

U2

3" (76mm)	5" (127mm)
4" (102mm)	6" (152mm)



FULLERSCOPES ALUMINISING SERVICE

U3

The aluminising equipment used has been built for surface coating mirrors and is not employed for any other purpose. Each mirror is chemically cleaned, aluminised and hard coated to protect the delicate surface. Double coating and hard surface can be provided at extra cost and is advised when mirrors are subject to adverse environmental or atmospheric polution conditions (near the sea, local factories etc). Whilst the greatest care is taken to obtain best results in coating mirrors, since we have no control over their application, use, or how they are looked after, we are unable to guarantee how long the coating or double coating will last. In the U.K. the surface of a WELL CARED FOR mirror will probably require coating annually. All mirrors have "pin holes". MIRRORS MUST BE KEPT DRY AT ALL TIMES. *Immediately after use they must be covered by a warm dry absorbent material (such as blotting paper) suspended a few millimetres above the mirror surface* – a hair dryer used with care will remove dust and condensation.

A mirror should not be washed for at least six weeks after aluminising and under NO circumstances should a mirror be wiped when dry, this leaves a large amount of small scratches. (See p.7 for hints on cleaning a mirror.) Sometimes the surface of a mirror does deteriorate rather quickly and if clients feel this should be our responsibility after reading the following notes, please return the mirror to us for inspection (very well packed and by registered post). Normally we can tell at once if the mirror has a faulty coating, in which case we will re-aluminise it and refund the post charges. In the unlikely event of a dispute we will be pleased to submit the mirror to any other professional body for evaluation – loser pays the cost!!!

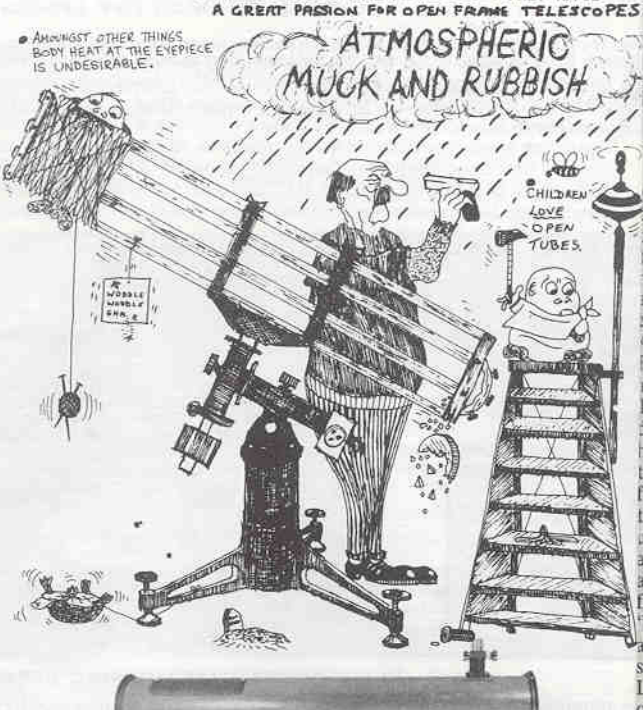
COMMON ALUMINISING DEFECTS AND THEIR CAUSES

If a mirror is breathed upon, any marks due to previous condensation, water drips from diagonal, fingering and other defects on the surface can be seen. A mass of white corruded spots indicate corrosion due to condensation and deposits from polluted atmosphere. Dendritic (moss-like) etched marks, especially at the edge of the mirror (which may be bald) indicate a foreign body such as sulphorous grit or metalic particles, having fallen on or having come into contact with the surface. Any small pit in the surface of the mirror will inevitably form a focus of corrosion. If the mirror is washed when the surface is aged (see p.7) the coat may come off in places where the liquid penetrates. Washing or rubbing will probably alter the colour of the overcoat, but this will affect performance only to a very small degree.

We cannot be held responsible for the faults described above. We are, however, prepared to consider for re-coating mirrors which:-

a) Have been surfaced by us not more than one month previously.
b) Have not been cleaned in any way.
c) Do not show "Water Marks" or other foreign mark with the breath test.
d) Do not pass the following test for adhesion of coat:
A strip of adhesive sellotape (scotch tape) a ½ x 3 inches is pressed firmly across the mirror, avoiding an external or internal edge. This tape is pulled off slowly. No metal should be apparent on the tape, (but there may be a smudge of adhesive on the mirror, or the colour of the overcoat may have changed where the tape was applied: both these effects are normal).

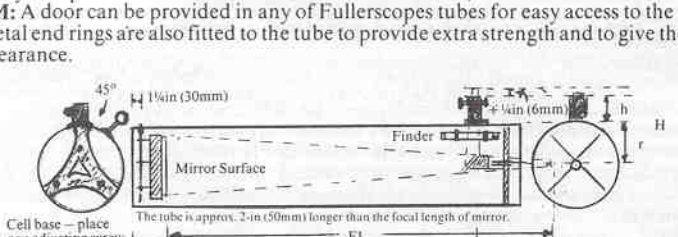
TELESCOPE TUBES—There are two main types of tube used for reflecting astronomical telescopes: the normal tube of metal, plastic or fibreglass; or the fabricated type of open network or 'skeleton' tube. The type of tube used in practice is really only a matter of personal preference, though Fullerscopes believe that the advantages of a normal tube system vastly outweigh those of the 'open' type. Besides considerations of general appearance, a real tube may be readily turned on its mounting to avoid awkward observing angles, and it may also be easily positioned to give a correct lateral balance. Further, one is not bothered by stray light creeping through the tube side, the mirror and flat are protected from dust etc. blown by the wind, and, probably most important of all, the observer's body heat and breath does not flow across the light path of the optical system to disturb and ruin the image, as is frequently the case with an open framework tube (Cartoon by W. Dillon). Glass fibre, rigid plastic or insulated metal tubes, in that order, are considered to be the best materials for reflecting telescopes, providing that the mirror end of the tube is ventilated, as it is in all Fullerscope designs.



PLASTIC TUBES—Fullerscopes lightweight rigid plastic tubes are recommended for the amateur's reflecting telescope. They keep tube air currents to a minimum, are particularly easy to cut and drill, and all Fullerscopes accessories are designed to fit them. The tubes are supplied individually cut to suit the focal length of a client's mirror, so it is *important to let us know the exact focal length* when ordering a tube separately (tubes ordered with Fullerscopes optics, or as complete telescope, are automatically cut to the correct length). "Utility" tubes are self colour grey. "Standard" are finished matt black interior, self colour grey exterior "De Luxe" tubes have a high gloss white exterior, matt black interior. Tubes are available in a variety of sizes from Fullerscopes. The tube sizes I use for my own telescopes are as follows: for a 4in (102mm) telescope, a 4in (104mm) tube; for a 4½in (114mm) telescope, a 5in (127mm) tube; for a 6in (152mm) telescope, an 8in (202mm) tube; for an 8½in (216mm) telescope, a 10in (254mm) tube; for a 10in (254mm) telescope, a 12in (305mm) tube; and for an 11¾in (298mm) telescope, a 14in 365mm) tube.

GLASS FIBRE TUBES are the ultimate material for telescopes. They have a high gloss white exterior and matt black interior. Usually they have two seams down the length of the tube. I hope to be able to provide seamless tubes shortly (see price list for information, available sizes, etc.).

DOOR/END TRIM: A door can be provided in any of Fullerscopes tubes for easy access to the main mirror for covering etc. Metal end rings are also fitted to the tube to provide extra strength and to give the telescope a more aesthetic appearance.



TUBE DATA

The positioning of the Mirror Cell, Focussing Mount, Finder etc., is quite straightforward, as can be seen from the diagram and photograph. The tube should be approximately 2-in (50mm) or more, longer than the focal length of the mirror. The screws holding the Mirror Cell in the tube should be about 1¼-in (32mm) up from the bottom. The Finder should be positioned at 45° to and level with the Focussing Mount. The hole for the focussing mount (at distance 'D') should be 1¼-in (32mm) to 2¼-in (56mm) in diameter, depending upon the size of the focussing mount used. (see also p.18).

D

NEWTONIAN MIRROR CELLS



6" (152mm) Cell

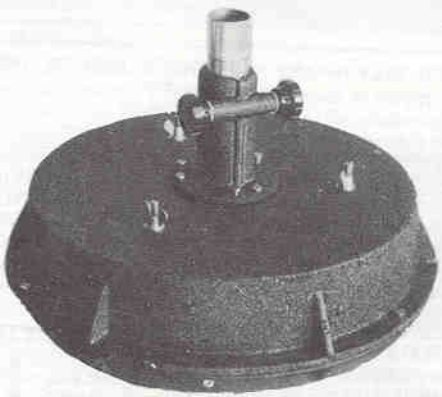


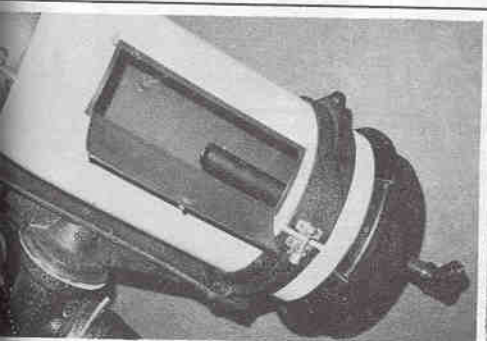
8½" (202mm) Cell

As the name implies, the mirror cell contains the main mirror and holds it centrally in position in the telescope tube. It must be so designed that the mirror can be easily collimated–that is, aligned so that the optical axis faces exactly out of the centre of the tube. Although comparatively low in price, Fullerscopes mirror cells have all the advantages of more expensive models. The mirror rests on three mathematically determined points within the cell and is held safely in place without pressure by three clips. The all-metal cell itself is fully adjustable in relation to its base by three spring loaded wing nuts. The whole unit can easily be removed from the tube and replaced without disturbing the alignment of the mirror. The cell is finished in matt black, as standard 'Utility' cells are unpainted. (Note: 10-in and larger cells may be of a different specification from those illustrated.)
Larger or specialist cells can be made to order. Please enclose s.a.e. for quotation.

CASSEGRAIN MIRROR CELLS

Fullerscopes Cassegrain mirror cells, besides affording correct support and full collimation facilities for the mirror, also incorporate an independently adjustable Rack Focusing Mount and an easily detachable light baffle tube. Collimation is effected by six push-pull screws between the main cell and the fixing ring. The Rack Mount is likewise fully adjustable in relation to the tube and the mirror cell.



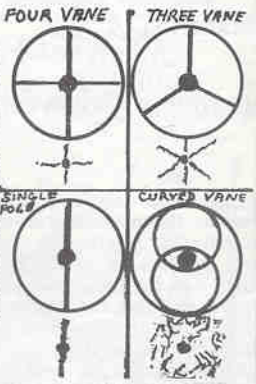


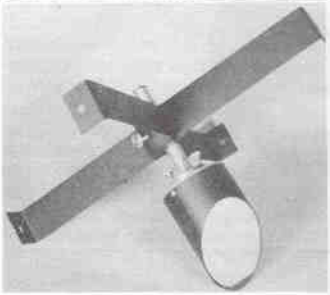


ote–If the optical system is NOT being pplied by Fullerscopes, in order that we ay supply the correct sized light baffle it essential that we have the following formation: (1) Diameter of primary irror; (2) Diameter of secondary mirror; (3) Distance between primary and secondary; (4) Distance of focal point behind the mirror (as measured from the primary mirror surface).
Larger or specialist cells can be made to order. Please enclose s.a.e. for quotation.

SPIDERS & FLAT SUPPORTS

The spider is the most difficult mechanical part of a telescope to produce commercially at a low cost. It is an important piece of equipment, since its function is to hold the optical flat in the centre of the tube, at the same time obstructing as little incoming light as possible; and there must of course be full facilities for correctly collimating the flat in the optical train. There are basically four types of spider: the conventional model which has four thin vanes; the three-vane spider, which tends to give a six-lined diffraction pattern on bright stars; the single pole support which, because of its necessary thickness, obstructs quite a lot of light and gives a 'skewered' appearance to stars and planets alike and spiders with various shaped curved vanes all of which tend to spread the diffraction pattern over the whole of the image—not really a desirable situation, because of the loss of contrast over the field. Fullerscopes manufacture three of the better known designs and the choice is, of course, up to the client.



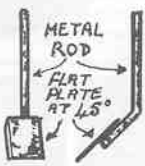


SPIDER SUPPORT Mk.I:
Although not cheap, the Mk.I spider and flat support comes nearest to the optimum in design. The Spider itself consists of four thin vanes and a central casting. The flat is supported firmly yet without tension in a brass cell. This in turn is fully adjustable, by means of three knurled screws, enabling rapid and accurate adjustment for collimation. Besides the standard size of spider/-flat holders listed in the price list, we can provide any size required to suit clients' flats. NOTE: A charge is made for fitting clients' own flats to Fullerscope spiders.

SPIDER AND SECONDARY SUPPORT (CASSEGRAIN)
The spider support is identical to the Mk.I Spider described above. The secondary cell safely retains the small mirror without flexure and at the same time acts as a light baffle. Collimation is effected by means of three knurled-headed screws. The holder is so designed that it can be easily removed from and replaced in the spider without disturbing the collimation. Available for secondaries of cassegrain systems of: 6in (152mm); 8½in (216mm); 10in (254mm); 11¾in (298mm). Other sizes can be quoted for — please enclose S.A.E. for reply.
The holders shown here and above do **NOT** include the price of the flats or secondaries.



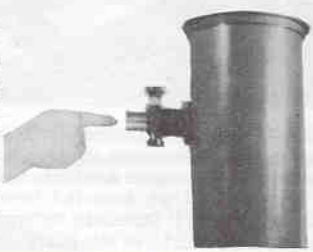
SINGLE POLE SUPPORT - As its name suggests, this comprises ¼-in (6mm) rod with a metal plate set at 45° for holding the flat. (The best adhesive to use is black Bostic, which being rubberoid does not cause flexure. Available for 4in (102mm); 4½in (114mm); 6in (152mm) and 8½in (216mm) telescopes only. **NOT** recommended for use with top quality optics.



FOCUSSING MOUNTS

Because the position of the focal plane of different eyepieces varies it is necessary to have a means of accurately adjusting their position relative to the focal plane of the telescope itself. Fullerscopes focusing mounts will effectively perform this function. They will accept any 1¼-in (32mm) diameter eyepiece (including those with RAS threads) the tubes being slotted to provide for slight eyepiece diameter variation. Adaptors can be provided to suit any eyepiece size. (See pp. 21-23).

The Fullerscopes range of focussing mounts shown on the opposite page cater for telescopes of all types and sizes. Reflectors larger than 8½" (216mm) should be provided with a 2" diameter focussing mount especially if wide field astro photography is envisaged - although it is, of course, permissible to use any of the other units shown. Where clients are constructing their own telescopes, it should be borne in mind that when calculating the position of the focussing mount on the telescope tube, allowance should be made for the focal plane to be ¼in + (6-9mm) outside the draw tube: (when the focussing mount is in its fully down or 'closed' position). This ensures that any types of eyepiece or Barlow lens and eyepiece combination can be brought to a focus. (see also p.16).



FULLERSCOPE FOCUSSING MOUNTS

DRAW TUBES We have standardised on 1¼in (32mm) push fit draw tubes. RAS threaded and other sizes can be supplied (Pic. shows RAS type) – see Price List and p.21.

F

THE PUSH FOCUSER is a cheap yet practical focusing device consisting of a machined casting and a simple tube which is slotted to provide friction on the draw tube. Focusing is performed by gently turning, pushing or pulling the draw tube. Very precise focusing is thus made possible.





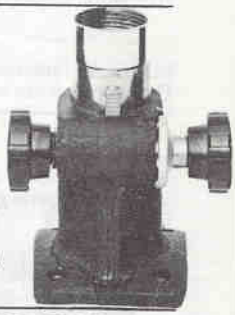


U4

THE Mk.I RACK MOUNT has been designed specially for the amateur telescope maker and is one of our most popular lines. Focusing is by means of a smooth rack and pinion gear system controlled by two knobs with variable tension. It enables precise and quick focusing. The finish is black wrinkle stove enamel with brass tubes.
The Mk.I R/P may not be exactly as illustrated.

THE Mk.II AND Mk.IIa RACK MOUNTS operate on the same principle as the Mk.I unit but have longer castings and tubes. The Mk.II unit (illustrated) is designed for refractors. The Mk. IIa unit for Cassegrains. The base is flat, and has push-pull adjusting screws for collimation. An integral light baffle tube can be supplied at an extra cost but we **MUST** be provided with full optical data of the proposed instrument.

THE Mk.III MICRO-FOCUSING RACK MOUNT is the first of its type on the British market. The mount has two knobs, one giving normal coarse focusing, and the other providing ultra slow-motion. This model is ideal where high powers are used and for short focus reflectors where focusing is critical. Although the cost of this unit is relatively high it will be found that the extra outlay is well worth while. The slow-motion action is incredibly smooth and extremely precise focusing can be achieved with great ease.



U4A

THE MkIIIA RACKMOUNT, not illustrated, has 2in (50mm) diameter tubes and is recommended for telescopes larger than 8½in (216mm).

The MkIIIA Photographic model is a specially adapted version of the above unit. It is very short and is fitted with a pentax thread. Normally it is mounted *opposite* to the main rack mount and is used *solely* for prime focus photography, in conjunction with a pentax threaded S.L.R. camera.

BRASS RACK MOUNT
with finder attached





1¼-in (32mm) Adaptor

Mk.IV RACK MOUNT has been designed primarily for telescopes from 10-in (254mm) to 24-in (700mm). It represents the ultimate in rack mount design and performance. The precisely cut matched *helical rack* mechanism provides smooth focusing action over the full 2½-in (63mm) travel. The bore diameter is 2-in (50mm). A reducing adaptor is provided for standard 1¼-in (32mm) eyepieces. The main body is of die-cast aluminium alloy and the rack tube is heavy walled polished chrome plated brass. We believe the Mk.IV Rack Mount to be the finest available for the larger telescope.

Besides the standard focusing mounts FULLERSCOPES also manufacture a wide variety of extra large all brass focusers. These units are made to order only and are suitable for large refractors and reflectors to 1 metre.

Clients requiring a large focusing mount should write giving full details – type of telescope, field required etc. – and enclosing an S.A.E. for reply.

The model illustrated (with a Mk.IV rack mount for comparison) is used on the 4-in (102mm) export refractors.

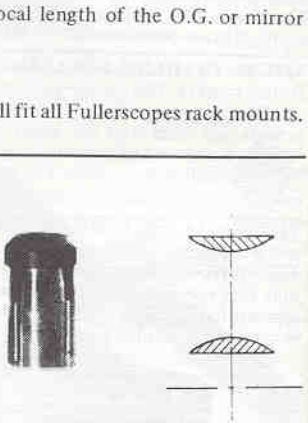
EYEPIECES—The purpose of an eyepiece is to examine and magnify the image formed by the objective or mirror of a telescope. It is therefore false economy to use cheap eyepieces with really good quality telescope optics. Conversely, the best eyepiece in the world will not improve the performance of a poor quality objective. There is quite a large selection of eyepieces available on the British market, but always bear in mind that good eyepieces are never cheap, and as a rule, cheap eyepieces do not perform well. In the lower price range, the *Ramsden* can be used quite satisfactorily on reflectors for all powers if used with poor or mediocre optics, but are NOT recommended for anything but low powers with good quality optics, since they do tend to introduce false colour, as well as other aberrations. The *Huygenian* should never be used with reflectors, but can be used quite successfuly with refractors. Most other types of eyepieces are good quality being highly corrected for both colour and distortion, and so can be used on any telescope with good results. The ideal selection of eyepieces for a telescope would consist of the following focal lengths: 1½-in (40mm), 1-in. (25mm), ½-in. (12mm), ¼-in. (6mm), and a Barlow lens.
The latter will increase the magnification given by these eyepieces by a factor of 2 to 3 times. The suggested order of purchase (depending on finances) is recommended as a 1-in. (25mm) eyepiece and a Barlow lens followed by a ½-in. (12mm), 1½-in. (40mm) and ¼-in. (6mm), and then specialist eyepieces such as the Erfle, Tolles, etc.
Most amateurs start off by being what we call 'Power Crazy' and want to use the highest magnification attainable, regardless of atmospheric conditions, object being viewed or size of telescope. The normal *maximum* useful power for a telescope is 50x per inch of aperture. Magnification beyond this only results in a deterioration of the image. The *lowest* usable power is 4x per inch of aperture—at powers below this the exit pupil becomes too large to enter the eye and a loss of field and light results. As a rough guide, at approx. 15x per inch of aperture an image can be compared with a good snapshot photograph. At 30x per inch of aperture definition would be equivalent to the photographs in this catalogue. At 40x per inch of aperture the image quality would be similar to the photographs seen in a newspaper. After 50x per inch of aperture the image starts getting weak and fuzzy. These figures do not necessarily apply to the splitting of close double stars, where far greater magnification may be used provided that atmospheric conditions are good.
The magnification provided by any eyepiece is determined by the focal length of the O.G. or mirror divided by the focal length of the eyepiece being used:

$$M = \frac{F}{f}$$

NOTE: All Fullerscopes eyepieces are 1¼-in. (32mm) push fit. These will fit all Fullerscopes rack mounts. The eyepieces can be supplied with an RAS thread

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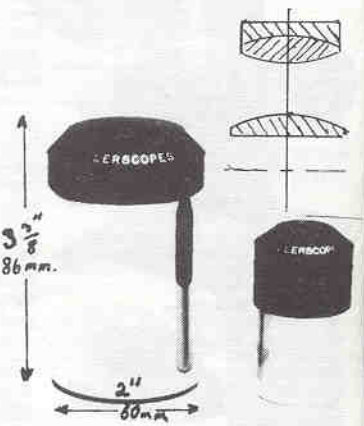
RAMSDEN—The Ramsden is a reasonably priced eyepiece which gives quite good images. The apparent field is 30° to 40° and it has fair eye relief, although it is not all that well colour corrected.



Sizes available:

1½in (40mm)	**½in (12.5mm)**
1in (25mm)	**⅜in (9mm)**
¾in (18mm)	**¼in (6mm)**

KELNER—The Kelner eyepiece has a wide apparent field of between 40° to 50°, with good eye relief. The latest design now supplied by Fullerscopes has greatly improved colour correction and is bloomed to increase light transmission and largely to eliminate ghosting.



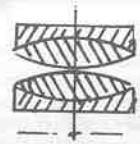
Sizes available:

1½in (40mm)	**½in (12.5mm)**
1in (25mm)	**⅜in (9mm)**
¾in (18mm)	**¼in (6mm)**

WIDE ANGLE KELNER—The Two and three-eighths inch (60mm) Focal length Kelner low power extra wide field eyepiece. This magnificent bloomed Kelner is the first of its type on the British market. Being over 2-in (50mm) in diameter it requires an adaptor (£3,extra) for use with the smaller rack mounts. It is primarily designed for 10-in and larger telescopes using the Mk.III and Mk.IV rack mounts. It is a perfect eyepiece for low power work—Star clusters, comet seeking, etc.

SYMMETRICAL—Symmetrical eyepieces are usually not supplied new, and are normally ex-WD. They are frequently advertised as being Orthoscopics – they're not! They are, however, quite well corrected eyepieces, having an apparent field of between 25° and 40°. They are usually only available in low powers.

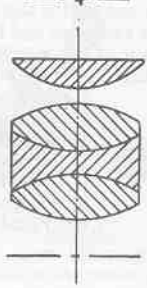




P

ORTHOSCOPIC—The traditional type Orthoscopic consisting of a specially computed triplet lens and a Plano-convex lens, may be considered to be the Rolls-Royce of eyepieces. They have a wide apparent field of between 45° to 50° with excellent eye relief, useful to spectacle wearers. They are fully corrected for distortion and have excellent colour correction. They provide a wide, flat, dark field. The fully bloomed lenses provide maximum light transmission. Genuine Orthoscopics are the finest telescope eyepieces available. (See note on Symmetrical eyepieces).



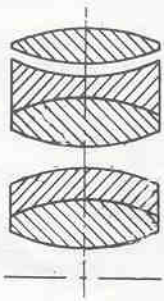


Sizes available:

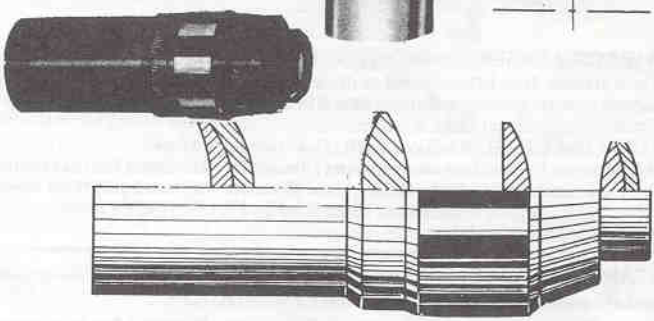
½in (12.5mm)	1½in (40mm)
⅜in (9mm)	1in (25mm)
¼in (6mm)	¾in (18mm)

ERFLE—The Erfle eyepiece has a huge apparent field of 60° to 70°, and excellent eye relief. Up till now only ex-WD Erfles have been available. Because of the great demand for this superb eyepiece, Fullerscopes are having them manufactured. This latest design is a great improvement on the original model, having a focal length of ¾-in (20mm). It is fully bloomed to give maximum light transmission, and is also corrected for distortion as well as being highly colour corrected. The Erfle will give spectacular views of the Moon, when used in conjunction with a Barlow lens, and is also a magnificent eyepiece for Starfields, clusters, Nebulae and for variable star work. Altogether it is an ideal eyepiece.





ZOOM LENS—3/8 in (8mm) – 1in (25mm). This highly corrected zoom eyepiece (bloomed for maximum light transmission) will provide a full range of powers between a focal length of 3/8th in (8mm) and 1in (25mm) by simply twisting a knurled ring. Once set up on maximum magnification the zoom action will not affect the focusing position throughout the entire range.



EYEPIECE ADAPTORS

U5

There are basically three standard eyepiece bodies currently available. Japanese 24.5mm push fit, American 1¼" push fit, and British 1¼" R.A.S. thread (16 T.P.I. Whitworth form). In order that the amateur can obtain the maximum use from his telescope, Fullerscopes provide a range of eyepiece adaptors to suit these oculars. It is worth noting that R.A.S. threaded eyepieces can be used in 1¼" push fit devices (Rackmounts, Sun Diagonals, Adaptors, etc.) as the R.A.S. thread is based upon 1¼" o.d. (nominal sellotape packing might be deemed necessary, but it can save the price of extra adaptors).

For converting Japanese 24.5mm push fit eyepieces to R.A.S. thread.
Japanese 24.5mm push fit eyepieces to 1¼-in (32mm) push fit.
R.A.S. threaded eyepieces to 1¼-in (32mm) push fit.







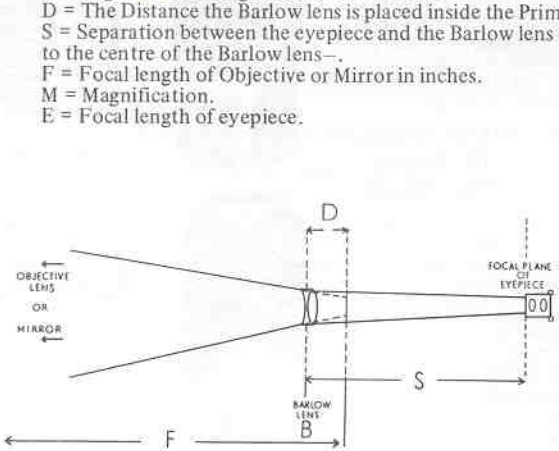




Typical 24.5mm Eyepiece with R.A.S. Adaptor Compare size with Fullerscopes Eyepieces

P **BARLOW LENSES**–A Barlow lens is a negative achromat which, when placed a little inside the focal plane of an Objective lens or Parabolic mirror, increases its effective focal length by up to three times the original value. Thus the use of a Barlow lens and a medium power eyepiece results in high magnification. The eye relief of the eyepiece being used is unaffected, as is the apparent field of view. This in my opinion outweighs the slight loss of light due to the extra air-glass surfaces. The increase in effective focal length of the telescope can be varied by altering the position of the Barlow in relation to the eyepiece and the focal plane of the objective. The diagram and formulae below show how this works:

Where: A = Amplification given by the Barlow lens.
B = Negative focal length of the Barlow lens.
D = The Distance the Barlow lens is placed inside the Prime focus of the Objective.
S = Separation between the eyepiece and the Barlow lens (measure from the stop on the eyepiece to the centre of the Barlow lens–.
F = Focal length of Objective or Mirror in inches.
M = Magnification.
E = Focal length of eyepiece.



$$A = \frac{S + B}{B}$$

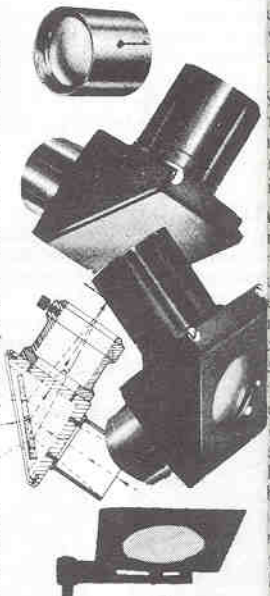
$$D = \frac{(A \times B) - B}{A}$$

$$S = B\,(A-1)$$

$$M = \frac{A \times F}{E}$$

BARLOW LENSES (for non-technically minded):
Place Barlow lens in lower end of draw tube and eyepiece in the opposite end. Place assembly back in rack mount ensuring that the Barlow lens is inside the focal plane of the mirror or objective, by a small amount. Focus in the normal fashion.

FULLERSCOPE BARLOW LENS (F-2") for Reflectors
Achromatic Barlow lens almost ¾-in (18mm) dia. (bloomed for maximum light transmission) which will increase the effective focal length of your telescope by up to three times when used in FULLERSCOPES standard 3½-in (89mm) draw tube.

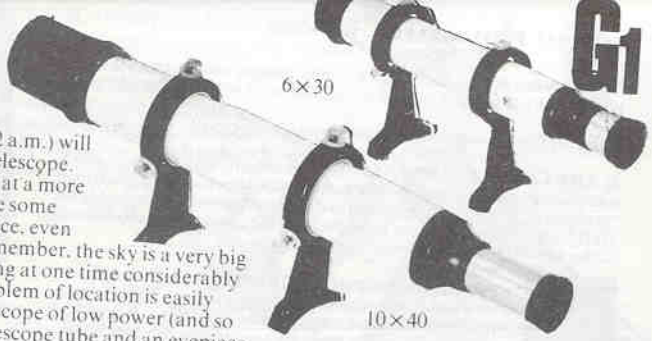


U6 **STAR DIAGONALS**–Fullerscopes star diagonals are ideal for Cassegrains and are essential for comfortable viewing with refractors.
They consist of an optically precise 90° prism, bloomed for maximum light transmission mounted in a special holder (as illustrated) which will accept either 1¼-in (32mm) push fit eyepieces or those with a standard RAS thread.

U7 **SUN DIAGONAL**–Fullerscopes Herschel solar wedge type sun diagonal is intended for use in conjunction with stopped down reflectors or refractors up to 3-in (76mm). The Hertschel prism will reflect only 5% of the sun's heat, thus avoiding cracked eyepieces or filters. A sun filter should be used in conjunction with the sun prism to ensure maximum safety. The unit will accept either 1¼-in (32mm) push fit eyepieces or those with a standard RAS thread
(If the sun or star diagonal is required to fit an RAS thread add 75p and stipulate this when ordering)..

U8 **FULLERSCOPES SUN PROJECTION SCREEN** (for Reflectors) This unit consists of a flat screen 7-in (178mm) square perforated at each corner and supplied with clips to hold a standard sun sheet. This is mounted, as illustrated, on a specially designed bracket which allows the sun screen to be positioned as required over the eyepiece. The unit may be removed from the telescope without trouble when not in use. By removing the screen only the unit may be used as a camera bracket. Once again almost any camera may be accurately placed for eyepiece projection photography

INDERS – Those observers who have
nelt on damp grass, their backbone
id neck joint trying to equal
e performance of high class universal
intings, squinting along a
escope tube set to the zenith (and all at 2 a.m.) will
preciate the necessity of a good finder telescope.
en under less contorting conditions and at a more
ceptable hour, it can be difficult to locate some
estial objects directly in the main eyepiece, even
en low powers are being employed. Remember, the sky is a very big
ce and your field of view may be covering at one time considerably
s than one-millionth of its area. The problem of location is easily
ercome, however, by having a small telescope of low power (and so
h a wide field) mounted on the main telescope tube and an eyepiece
h a wide apparent field of view and crosswires or a reticle at its focal plane, for precisely centring the
ect within the field. A typical finder might have a field of view of 10°. Since the field of a 6-in (152mm)
telescope, using a 1-in (25mm) Ramsden eyepiece, is about 0.5°, it will be apparent that with the use of a
der the location and centre-positioning of stars, etc. in the field of view of the main telescope will become
nparatively easy.



G1

LLERSCOPES finders all have achromatic objectives and are provided with wide-field eyepieces and
sswires. Each finder is also provided with mounting rings which enable the instrument to be accurately
gned with main telescope. Finder rings supplied separately to suit clients finders (see price list).

ESTIAL PHOTOGRAPHY.

almost inevitable that the amateur astronomer will eventually wish to use his telescope for Astro-Pho-
aphy. A short dissertation on the various methods possible is given on the next page.
erscopes provide the following accessories which have been designed especially to enable
mateur to employ his telescope to its full advantage as an astro-camera.
e is going to undertake
stial photography,
der to get the best
ts, it is necessary to keep
bject being photographed
nary in the field of view. Even with an electrically driven, properly set up equatorial mounting, 'drifting'
s due to atmospheric refraction.



GUIDE TELESCOPE.

LLERSCOPES 4-in (102mm) GUIDE SCOPE is a Newtonian telescope which can be mounted on the
telescope. To preserve equilibrium the guide 'scope is normally mounted directly opposite to the
nation axis. The special cradles permit the guide 'scope to be correctly aligned with the main telescope
types are available. Universal rings which may be bolted directly to the telescope tube, or rings
ned to bolt to the slotted lugs on Fullerscope cradles. (State which type are required)
in (32mm) push fit eyepiece with crosshairs is provided and additional eyepieces are obtainable.
ct extra eyepieces from Page 20/21 and add £1 to cost specifying "crosshairs to be added")
the telescope and guide 'scope are aligned on the object being photographed, this being centred on
osshairs. The image may be enlarged by slightly defocusing the guide 'scope eyepiece thus making it
to keep on the 'wires'. Constant, accurate guiding is then possible either manually or electronically
he Sky Tracker V.F.O.

G2
U9

RA ADAPTORS.

single lens reflex cameras offer the widest advantages
stial photography. Fullerscopes have a series of
s for coupling such cameras to various types of
e. These adaptors permit prime focus, eyepiece or
projection photography to be undertaken (it may be
y to move the main mirror 2½ins (60mm) up the
e tube for prime focus photography). The adaptors
ble for any 35mm S.L.R. camera with a pentax
or reflex cameras not having this thread, special
nay be purchased from almost any camera dealer.
ptor consists of three parts: a 2in (50mm) long spacer
tax thread, an eyepiece and Barlow holder, and a
lon to fit the telescope draw tube. Extra spacer rings
pplied if required.
dering clients should state the diameter of eyepieces
d and the fittings of the focusing mount (1¼in push
, thread etc.)





U 10

MERA BRACKET is used for positioning any camera accurately over the eyepiece of a reflecting telescope for
otography. The bracket may be removed from telescope when not in use. Specification is as for Sun Projection
ithout screen) – see opp. page. **MkII CAMERA BRACKET** may be used with almost any camera for photo-
star trails and star fields. This unit fixes to the end of the declination shaft (*please state diameter when ordering*)
camera to be pointed at any part of the sky.

U11



Obviously it is not possible to give comprehensive instructions for Astro-photography here but I hope that the following information will prove useful.
There are five photographic methods which can be used.

1) THE CAMERA ALONE. Any type of camera may be employed to take photographs of star trails. The camera should be mounted on a tripod, "propped up" on a wall or attached to the telescope with either the MkI or MkII Camera brackets. Once set in position the camera/telescope should not be moved until after completion of the exposure.



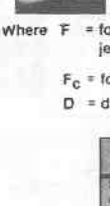
2) PRIME FOCUS PHOTOGRAPHY. Remove lens from camera and couple camera body to telescope with Fullerscope camera adaptor. (no eyepiece or Barlow). It may be necessary to move the main mirror 2½-3ins (60-80mm) up the tube. Alternatively, employ Fullerscopes Mk.IIIA photographic focus mount (p.19). Nebulae and star fields need long exposures. A guide scope and slow motions are normally required.



3) AFOCAL PHOTOGRAPHY. Any camera can be used. Set at infinity, focus the telescope and, using a Fullerscope camera bracket, locate the camera with its lens centred over and nearly touching the eyepiece.

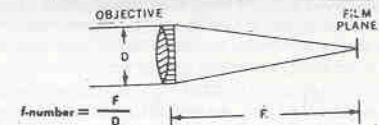


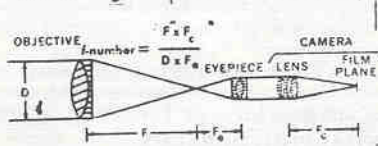
4) EYEPIECE PROJECTION. Remove lens from camera and, using a Fullerscope camera adaptor with an eyepiece in situ, (and spacer rings if greater amplification is required) couple the assembly to the camera. Focus object to be photographed, viewing through the reflex system.

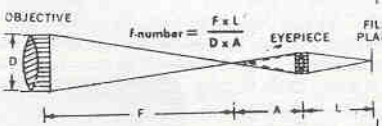


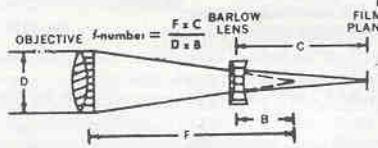
5) BARLOW PROJECTION. This method is similar to No.4 above but instead of an eyepiece a Barlow lens is used. Barlow lens projection is considered best for Lunar and Planetary photography since it is the most compact system. The image scale (magnification) may be varied by employing additional spacer rings.











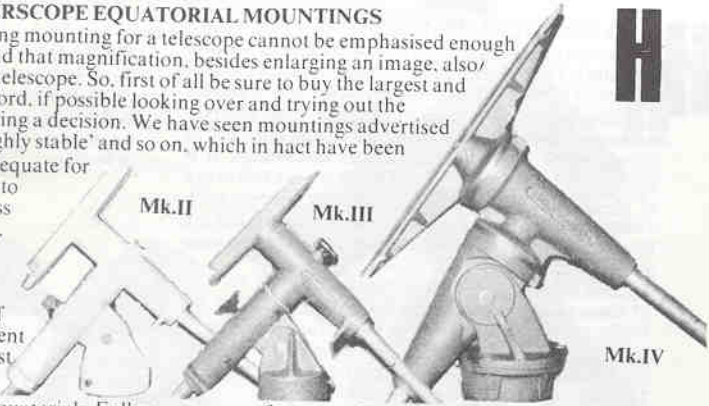
Where F = focal length of the telescope objective
F_e = focal length of the eyepiece
L = distance of eyepiece from the film
F_c = focal length of the camera lens
C = distance of Barlow lens from film
A = distance of eyepiece from normal focus of the telescope objective (eyepiece-projection system only)
D = diameter of the telescope objective
B = distance of Barlow lens from normal focus of telescope objective

SUBJECT	INSTRUMENT	MOUNT	OBJECTIVE	f-NUMBER	FILMS and PLATES	EXPOSURE
Star Trails and Comets	Camera with time exposure	Rigid support	Any lens	Wide open	Fast, B & W and color	Up to 30 min or more
Meteors	Camera with time exposure	Rigid support	Good lens	f/6.3 or wider	Fast, B & W and color	10 to 30 min
Aurorae	Camera with time exposure and fast lens	Rigid support	Fast lens	f/4.5 or wider	Fast, B & W and color	1 sec to 2 min
Man-Made Satellites	Camera with time exposure and fast lens	Rigid support	Fast lens	f/4.5 or wider	Fast, B & W and color	Hold shutter open for duration of pass
Moon*	Camera, or camera with telescope	Rigid, or equatorial with or without drive	1" diameter or larger	About f/11	Medium speed, B & W and color	1/125 sec to 10 sec
Stars and Comets	Camera, or camera with telescope	Equatorial with guiding sights	1" diameter or larger	f/6.3 or wider	Fast, B & W and color	10 min to 1 hr
Star Clusters, Nebulae, and Galaxies	Camera, or camera with telescope	Equatorial with sights and drive	1" diameter or larger	About f/6.3	Fast, B & W and color	10 min to 1 hr
Planets	Camera with telescope	Equatorial preferably with drive	1" diameter or larger for detail, 6" and up	Use f-number determined by your system	Fast, B & W and color	1/2 to 15 sec
Sun* (Never look at the sun through any optical device without adequate protection!)	Camera, or camera with telescope	Rigid, or equatorial with or without drive	Neutral Density Filters 4.00-6.00 over 1" or larger, main objective	f/11-f/32	Slow, B & W and color	1/30 to 1/1000 sec with Neutral Density Filters 4.00-6.00 over main optical objective (not the eyepiece!)

FULLERSCOPE EQUATORIAL MOUNTINGS

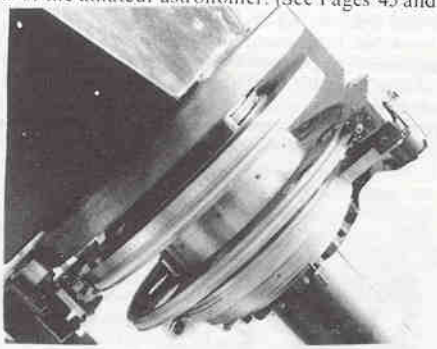
H

The importance of a good strong mounting for a telescope cannot be emphasised enough It must always be borne in mind that magnification, besides enlarging an image, also amplifies any vibration in the telescope. So, first of all be sure to buy the largest and heaviest mounting you can afford, if possible looking over and trying out the various assemblies before making a decision. We have seen mountings advertised as 'massive', 'wobble-free', 'highly stable' and so on, which in hact have been pitifully small and totally inadequate for the job intended. It is difficult to indicate the size and ruggedness of a mounting in a photograph, so where possible we have included a person or some standard object in the illustrations for the purposes of comparison as well as a statement of the dimensions and the fullest information.



Besides our standard range of equatorials, Fullerscopes manufacture various types and sizes of prefabricated mountings suitable for Observatory instruments from 12" to 36". These include German Cross-axis, Fork and Dual telescope mountings, all based on Fullerscopes unique modular design drive unit. Observe the large diameter differential sidereal and slewing gear wheels. Please note the prices of the large special mountings are highly competitive in comparison with other manufacturers of professional systems, but are normally beyond the means or requirements of the amateur astronomer. (See Pages 45 and 47 for further details).





The 23" (59cm) diameter 718 toothed Right Ascension drive and slewing gears shown above act as a large differential, thus permitting accurate guiding without disturbing the accuracy of the sidereal drive or the direct reading R.A. Setting Circle mounted on it. The Declination gear wheel (not shown) is of similar diameter.

FULLERSCOPES FORK MOUNTING

This massive prefabricated steel equatorial was designed by Boris V. Barlow for Fullerscopes 24" (62cm) Cassegrain/Newtonian instrument fully described on P.47 It is capable of carrying telescopes up to 1 metre diameter.



DUAL TELESCOPE MOUNTING

Specially designed to carry an 8½" (205mm) Cassegrain with large twin Astro Cameras on opposite side of the Declination axis (36cm) 14" diameter gears. Driven direct reading R.A. Setting Circles, etc.



GERMAN EQUATORIAL. Based on the Fullerscopes modular system with 14" (36cm) diameter R.A. gear and slewing drives. The Declination slow motion has a similar sized sector tangent arm with control rod to eyepiece position (see also page 45).

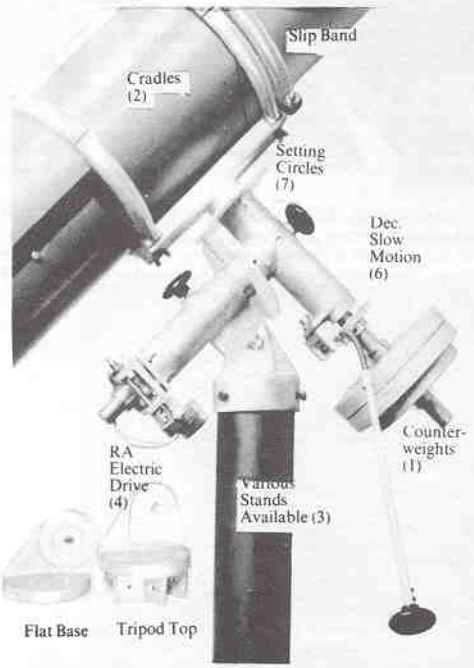
Mk.II EQUATORIAL MOUNTING – Suitable for Refractors up to 3-in (76mm) and Reflectors up to 8-in (203mm). The Mk.II Equatorial mounting is a utility version of the Mk.III mounting which is renowned for its stability and elegance. In order to keep the cost down the Mk.II is supplied unpainted and unplated as standard. As with all Fullerscopes mountings, it is adjustable for latitude setting and there is a full range of accessories available (slow motions, circles, etc.). These can easily be fitted by the client himself; but are fitted free by Fullerscopes if ordered at the same time as the mounting.

Specification:– Cast alloy housings, each 9-in (230mm) × 2½-in (63mm) diameter: Solid steel shafts 1-in (25mm) diameter: Precision machined bearings lubricated with Kilopoise: Friction clamps to each axis: Channel shaped saddle plate 12-in (305mm) × 2½-in (63mm).

Maximum Loading:– 4½-in (114mm) Refractor; 8½-in (216mm) Newtonian or 10-in (254mm) Cassegrain.

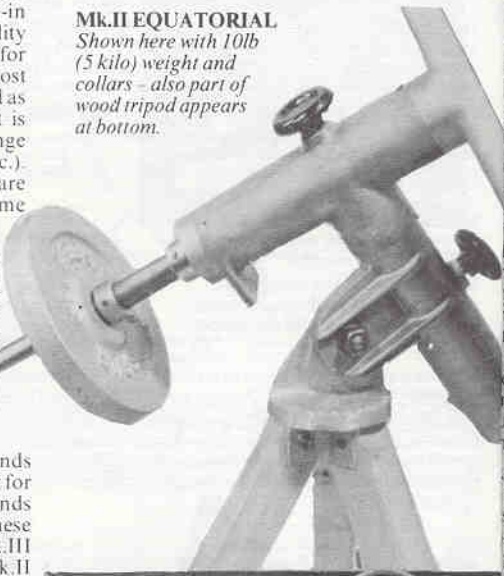
ACCESSORIES FOR Mk.II EQUATORIAL

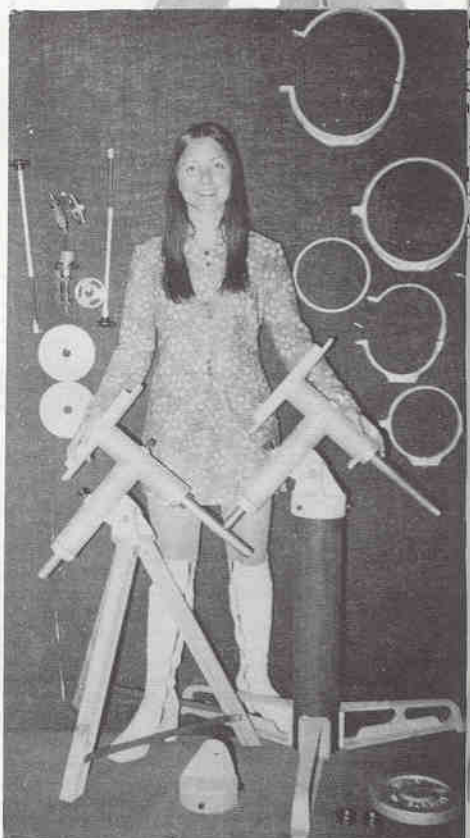
Counterweights and collars; cradles and slip-bands for all standard sizes of tubes; slow motion gears for R.A. and Dec; setting circles and a full range of stands are available. Full description and illustration of these accessories is to be found under the heading Mk.III Mounting Accessories. The accessories for the Mk.II Mountings are in a utility finish, i.e. unpainted and unplated. The utility cradles and slip bands are unlined and unpainted.



NOTE: For maximum stability any Equatorial mounting should be permanently sited, and with this aspect in view there is a choice of three bases from which the client can select one suitable for his requirements. Where portability coupled with rigidity is required, Fullerscopes can supply the Mk.II Equatorial heads fitted to a metal braced wood tripod or an all metal pedestal stand.

Mk.II EQUATORIAL
Shown here with 10lb (5 kilo) weight and collars – also part of wood tripod appears at bottom.

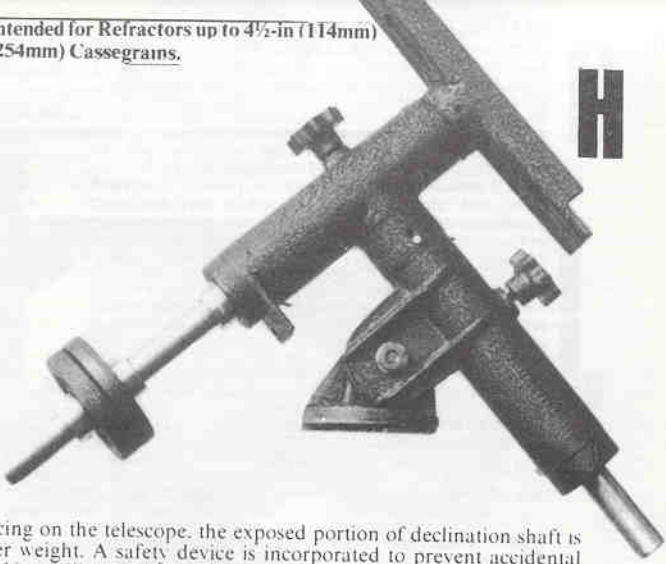




Mk.II Equatorials on 2ft (61cm) Tripod and Pedestal. All accessories shown at rear. 'Pot' base & weights at foot.

Mk.III EQUATORIAL MOUNTING **Intended for Refractors up to 4½-in (114mm) ½-in (216mm) Newtonians; up to 10-in (254mm) Cassegrains.**

Fullerscopes Mk.III Equatorial head has been designed especially for the amateur who requires a really sturdy and sophisticated unit at a realistic cost. It is, in our opinion, the most stable mounting on the market at anywhere near the price we ask, and customer reaction on seeing this Equatorial is one of most agreeable surprise at its robust yet aesthetic appearance, size and mass. The elegantly styled castings of heat treated aluminium alloy are precision machined on special jigs to ensure an axes alignment of exactly 90° to each other. The 1-in (25mm) diameter solid steel shafts run in accurately machined bearings lubricated with Kilopoise, and each axis has P.T.F.E. thrust surfaces affording an absolutely smooth and snatch-free operation.



H

To facilitate accurate and positive balancing on the telescope, the exposed portion of declination shaft is threaded to take a quick-traverse counter weight. A safety device is incorporated to prevent accidental displacement. This is a new innovation and is not illustrated.

The saddle plate is ribbed for strength and channel shaped in cross section to accept a wide range of telescope tube diameters as well as the specially designed cradles. The mounting is, of course, adjustable for latitude. Large friction knobs are provided for each axis. The finish is black wrinkle stove enamel paint. Weight approximately 17lbs (7.711kg). Although the mounting is suitable for Refractors up to 4½-in (114mm) Newtonians up to 8½-in (216mm) and Cassegrains up to 10-in (254mm), the maximum loading capacity for the Mk.III is 6-in (152mm) Refractors, 10-in (254mm) (short focus) Newtonians and 11¾-in (298mm) Cassegrains. The Mk.III Mounting is designed to accept the full range of accessories. When these are purchased by the client at the same time as the mounting, they are fitted free by Fullerscopes. They may, however, be easily fitted by the client himself if purchased at a later date. Only household tools are necessary.

Mk.III Equatorial on 5ft (152cm) Wood Tripod

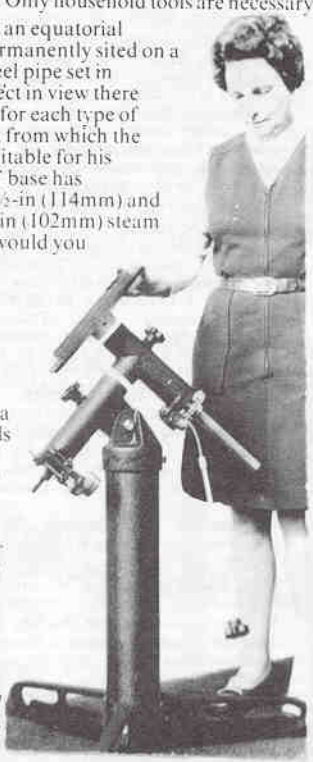
Mk.III Equatorial on 5ft (152cm) Standard Pedestal



For maximum stability an equatorial mounting should be permanently sited on a concrete pier or on a steel pipe set in concrete. With this aspect in view there is a choice of two bases for each type of Fullerscope equatorial, from which the client may select one suitable for his requirements. The 'Pot' base has an inside diameter of 4½-in (114mm) and will fit over standard 4-in (102mm) steam pipe. The Flat base is (would you believe it!) flat underneath, with four holes for bolting to a suitably solid flat surface.

Where portability and stability are prime considerations, there is a choice of pedestal stands or tripods which have been designed specially for Fullerscopes equatorials. These are shown on the next page.

We also supply suitable heavy gauge steel pipe for clients who wish to build their own permanent piers – sold pro-rata per foot.



U12

See P.29

U13

Mk.III Equatorial on 2ft (61cm) Standard Pedestal

ACCESSORIES FOR MK III EQUATORIAL

The attachments for the Mk III Mounting described and illustrated here are also used for the Mk II equatorials except that they are unpainted or "utility" versions. When ordering accessories *at the same time as the mounting* no extra carriage or insu charges are incurred. Mountings and their acce ies are also depicted throughout the catalogu also P.9.

Counterweights – The weights are designed to run on the threaded declination shaft of the Mk.III mountings. They may be quickly traversed along the shaft to be clamped in any required position. (Note: This system is a recent innovation and is not shown in any illustrations.)

Cradles– Designed to fit the tube sizes mentioned, the all metal felt-lined cradles attach directly to the saddle plate of the mounting by means of wing nuts for easy fitting. The cradles for reflectors are hinged so that telescopes can be quickly removed from the mounting. The finish is black wrinkle stove enamel paint (Cradles for Mk II mountings are unpainted).

Deluxe Cradles for Refractors:
3in (76mm):
4in (102mm):
5in (127mm)

Deluxe Cradles for Reflectors:
4in (102mm)
8in (202mm):
10in (254mm)
12in (305mm)





Mk III Equatorial with 'pot' base shown here plete with electric drive R.A.; Manual Slow M Declination; Setting Circles Mk I; and 25lbs (1 Counterweights.

2a) Deluxe Slip Bands – These all metal felt rings are placed on the telescope tube above cradles enabling easy rotation of the tube with slipping out of balance. The finish is black w stove enamel paint (Mk II slip bands are unpai Sizes available as for cradles

R.A. Slow Motion Manual – Comprising a helical worm wheel gear system with a precise number of teeth. The bronze gear wheel is keyed to the shaft by means of an adjustable nylon pad which acts as a friction clutch. This makes it impossible to damage the gear and permits telescope to be slewed by hand without having to disengage worm. The worm unit is fully adjustable to eliminate any trace of backlash and the worm bracket easily attached to the mounting. A flexible manual drive is provided.

R.A. Electric Drive – The R.A. Slow Motion Unit described above may be fitted with a small but very powerful synchronous electric motor (1.739ins/lbs-2cm/kgs). This will drive the telescope at 1 revolution in 24 hrs which is ideal for normal visual work. The electric motor is powered from normal mains supply. IN THE INTERESTS OF SAFETY IT IS ESSENTIAL THAT THE UNIT IS PROPERLY EARTHED.

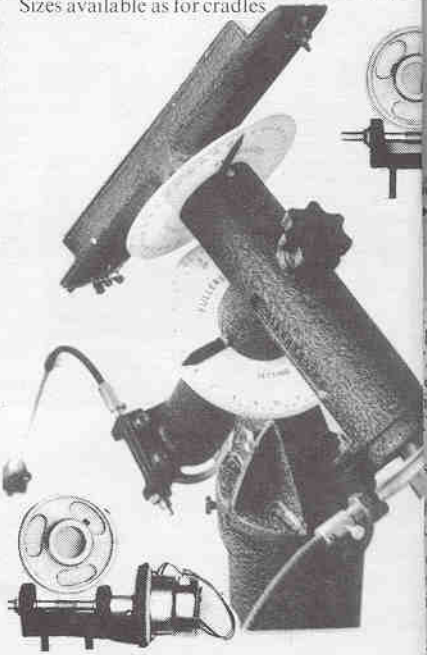
R.A. Electric/Manual Drive – Basically this unit is the same as L2 above, but has the addition of an ingenious system enabling manual correction of about 15° to be made by means of a flexible cable over-riding the electric drive. This unit is not necessary if a Sky Tracker control is to be used.

Declination Slow Motion – This unit has similar specification to the R.A. Manual Drive described above.

Dec. Electric Drive – MI units as above powered by a 1rpm reversible motor and remote push-button switch (or via the Sky tracker).

Electric/Manual Drive – (See L3). This unit is not necessary if a Sky Tracker control is to be used.

Flexible Cables – As illustrated (left) 18in (45cm) long. Will fit worm sizes up to 3/8-in. (9mm) dia. Special lengths and diameters can be quoted for on receipt of s.a.e.



Mk III Equatorial with manual Slow Motion on and Declination axes and Mk I Setting Circles. show R.A. electrical drive unit and (top R) M unit.

CCESSORIES FOR Mk.III (continued)

n Setting Circles Mk.I. – The master plate for mak-ng these circles was machine divided with great ac-racy, and the resulting 6-in (152mm) diameter early calibrated scales are equally accurate. Made om 1/8-in (3mm) thick white translucent rigid plas-. they may easily be rear illuminated. Declination rcle reads 0°–90°–0°–90°. R.A. Circle calibrated 0 24 hrs. as illustrated. Complete with pointers.

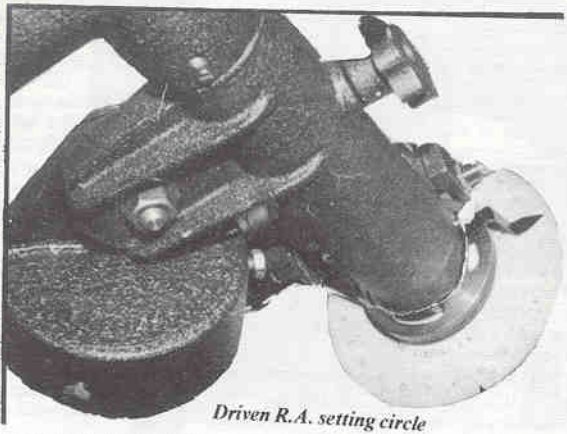




N

SETTING CIRCLES Mk.II

his item is probably the most useful ac-ssory which can be added to the equator-l mounting of an astronomical telescope. he circles are calibrated in the same man-er as the Mk.I series described and epicted above, but the method of use of he R.A. circle is entirely different. The eclination circle is fitted to the equatorial exactly the same manner as for the Mk.I rcles. The R.A. circle however has to be pecially machined and fitted to the elec-ically driven R.A. gear wheel. A different ype of pointer is used and these also must e made individually for the mounting oncerned. The great advantage of the Mk.II R.A. setting circle lies in the fact that is constantly being driven by the R.A. ear wheel. One of the pointers provided ndicates local sidereal time to within a few



Driven R.A. setting circle

seconds per hour. The other two pointers are used to indicate the time position of the telescope when it is East r West of the mounting. The locating of sky objects is thus greatly simplified and the potential usefulness of the telescope is vastly increased. The procedure for using driven circles is given on p.13. **This unit must be fitted by Fullerscopes and can only be supplied when the mounting is fitted with an R.A. Electric Drive.**

VARIABLE FREQUENCY CONTROL UNIT



As illustrated the unit consists of two parts. The power amplifier operates from any 12 volt D.C. battery and consumes approximately 2 amps when operating. The output to the Synchronous Motor is 220/240v AC providing a variable frequency range from 47HZ to approx. 80HZ. The small hand held control box can be used at the viewing position. The speed of the telescope drive may be regulated with great precision to match the apparent motions of the Moon and Planets and to give accurate sidereal rate and diffraction compensation by means of a pointer knob, to vary the frequency between 47HZ and 53HZ. Also on the hand held control unit are two buttons. These are for accurately centring an object in the field of view. One button moves the telescope Eastwards at +50% to the drive rate. The other button interrupts the telescope drive causing the object being viewed to trail Westward.

O U15 & U19

H1

EDESTAL STANDS AND TRIPODS

llerscopes offer the following Pedestal Stands and Tripods for the Mk.II and Mk.III Mountings.

TANDARD PEDESTAL—This consists of a 4½" (11.4cm) diameter heavy steel pipe to which are bolted ree rugged aluminium feet spaced at 120° finished in black wrinkle stove enamel paint tility pedestals are unpainted). Illustrated on pages 26-27.

XTRA HEAVY PEDESTAL—The specification is similar to that of the tandard Pedestal but larger cast iron feet are used thus providing stly greater stability. Both the above models e available either 2ft (61cm) high for eflectors or 5ft (152cm) high for Re-ctors.

TRIPODS

he Fullerscopes White Wood Tripods e probably the strongest and most nd of their kind. The 2ft (61cm) ipods for Reflectors are permanently ed and braced at their base with three el straps to ensure maximum rigidity. e 5ft (152cm) Tripods for Refractors e likewise braced but the steel straps y be easily removed and the tripod ded flat.



Mk.III Equatorials on 5ft and 2ft (152cm and 61cm) Extra Heavy Pedestals

U12

SEE P.27

Q

Mk.IV EQUATORIAL MOUNTING—Massive in construction (the head alone weighs 50lbs (22.680 k yet finger light in action, this impressively elegant mounting has been developed to provide the maxim stability for the larger telescope. While retaining graceful and sweeping lines, the Mk.IV has b scientifically designed to alleviate all the usual 'bottle-necks' and flexure points which are features of poo produced mountings. The thrust surfaces are 6-in (152mm) diameter and the heavy shafts are carefu lapped into phosphor-bronze bearings lubricated with Kilopoise. As a finishing touch heavy gauge PT thrust surfaces are employed, providing that extra light, almost frictionless movement, to each axis so mak the Mk.IV in our opinion the finest mounting available at the price. Study the photograph, read specification below and then compare it with other available mounts. The Mk.IV mounting is intended Newtonians up to 12¾-in (324mm). Cassegrains up to 14-in (356mm). Refractors up to 8-in (203mm). It nightly use with telescopes at universities, schools and by many amateur astronomers throughout the wo

Specification:—Heavy heat-treated alloy castings: Kilopoise lubricated phosphor-bronze bearings: (152mm) dia. PTFE thrust surfaces to each axis; 1¼-in (32mm) dia. solid steel shafts; flat saddle pl webbed for extra strength; 24-in long (610mm) by 5½-in wide (140mm) reinforced fork-type base (229mm) × 6-in (152mm). Polar axis can be adjusted for latitude (overseas clients should quote t latitude, as near-Equatorial regions require a special base). Finish: black wrinkle stove enamel paint.

The declination shaft is threaded enabling fast positioning of the specially designed counterweights illustrated).

R U16 S

COUNTERWEIGHTS & COLLARS — For balancing the telescope in R.A., a series of specially designed weights are available. These are threaded on to the shaft and may be swiftly and accurately positioned and located with precision anywhere along the Declination shaft.

CRADLES—The saddle plate of the Mk.IV and Mk.V mountings is flat so it becomes necessary to have cradles if a round tube is used. Being spaced 2ft (610mm) apart, these cradles add extra support for the telescope. The construction is all metal, felt lined and hinged, so that the tube may also be positioned by turning for ease of viewing. Lugs are provided to take the guide or tracking telescope brackets.

T

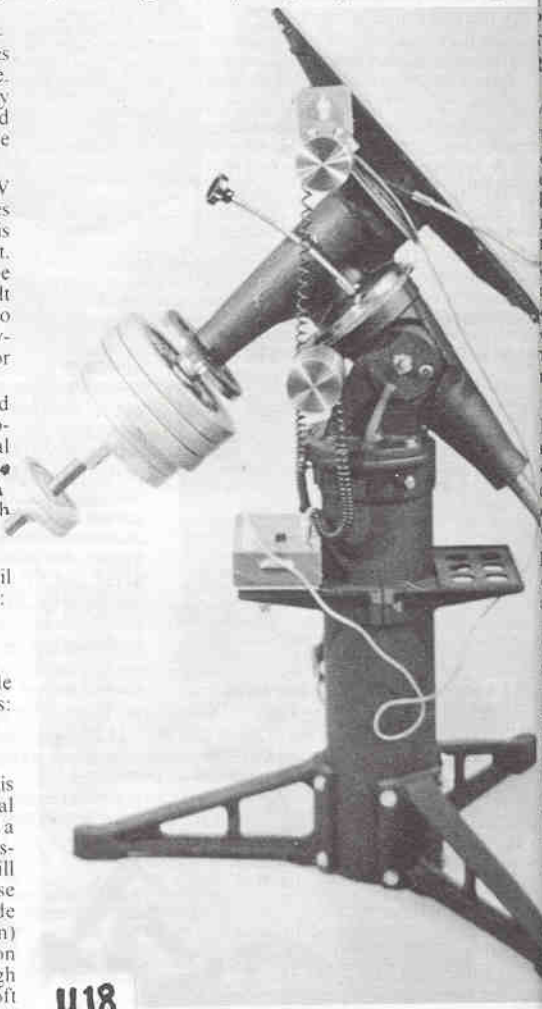
SLIP BANDS—As with the Mk.II and Mk.III Equatorials, Fullerscopes can supply a series of Slip Bands. These all metal felt-lined rings are placed on the telescope tube above the cradles enabling easy rotation of the tube without it slipping. Finish black wrinkle stove enamel paint.

CRADLES AND SLIPBANDS are available for the following Reflector tube sizes:
10ins (253mm) 12ins (305mm)
14ins (356mm)

REFRACTOR CRADLES are available for a large range of models. Standard sizes:
4ins (102mm) 5ins (127mm)
6ins (152mm) 8ins (203mm)

V U17

PEDESTALS—The Mk.IV mounting is strictly too massive for a normal pedestal support and is perhaps better built on to a concrete plinth. However, if this is not possible, the Fullerscope pedestal stand will provide the really sturdy and robust base necessary for this massive mounting. Made from 6½in (165mm) diameter ¼in (6mm) wall steel pipe with three heavy cast iron feet. Standard sizes 2ft (610mm) high pedestals for Newtonians. Up to 6ft (1.830mm) high for Refractors & Cassegrains. We can also supply 6½in (165mm) diameter steel pipe cut to any required length, for clients wishing to site their telescopes permanently.



U18

ACCESSORY RACK—This unit comprises a pair of alloy trays, as illustrated, 5ins (127mm) × 7ins (175m which bolt to the pedestal stand. They are used for hol electronic control units, eyepieces etc.

Mk.IV SETTING CIRCLES—Plastic Circles – These are similar to those used on the Mk.II and Mk.III Equatorials illustrated on Page 29. The declination circle attaches directly to the dec. axis of the mounting. The RA circle is supplied with a clip collar which fixes to the RA housing thus permitting direct indexing. Pointers are supplied.

ENGRAVED BRASS CIRCLES—For the deluxe sophisticated telescope we now provide these elegant brass circles. The 6ins (152mm) Declination circle is in brass with contrasting black. It is engraved on the edge and calibrated 0° - 90° - 0° - 90° in 2° intervals. The R.A. Circle is mounted directly on to the R.A. gear wheel and is driven by it to provide direct indexing. The R.A. circle is divided in hours, sub-divided into 20 and 40 minutes, and further divided into 4 minute intervals. Pointers are provided. **This unit must be fitted by Fullerscopes and can only be supplied where an R.A. electric drive is fitted to the equatorial.**



W

Xo

MANUAL OVERRIDE UNIT—This ingenious device (illustrated above) may be built into an electrically driven R.A. or Declination gear system, enabling rapid manual override of the electric drive for accurate centring etc. **If required, this unit must be supplied and fitted at the same time as the mounting and electric drive.**

X1

Y1

SLOW MOTION UNITS FOR R.A. AND DEC.—The slow motion gear systems for the Mk.IV mountings consist of 7-in (178mm) dia. precision cut gunmetal gear wheels. A clutch is provided so that the telescope can be moved without any danger of stripping the teeth. This mechanism may be disengaged so that the telescope becomes completely free-moving, thus facilitating precise balancing. The worms for each unit run smoothly in ballraces. The worm housings are hard rubber mounted; this allows perfect meshing between the worms and wheels, ensuring smooth operation and eliminating any possibility of backlash. A flexible manual drive is provided for the manually operated systems.

X2

ELECTRIC DRIVE (for R.A. unit)—The number of teeth in the gear wheels has been so computed that when the R.A. gear system is driven by the small, but powerful 8in/lbs (9.216cm/kg) synchronous motor, the R.A. axis of the telescope turns at 1 rev. in 23 hours 56 minutes. The motor is supplied complete in a housing which bolts directly to the R.A. worm unit. The motor can be easily disconnected from the worm when it is desirable to use the manual control only. The electric motor is powered from normal mains supply. **IN THE INTERESTS OF SAFETY IT IS ESSENTIAL THAT THE UNIT IS PROPERLY EARTHED.**

Y2

ELECTRIC DRIVE (for Dec. unit)—The declination axis can also be motorised, thus permitting full electronic control of the telescope for precise centring of objects in the field of view. The specification is as for the R.A. electric unit above except that the motor is reversible and a press button control box is supplied. (If a Knightmaster unit is employed, the control box is unnecessary and clients should deduct £3.00 from the price.) The electric motor is powered from the normal mains supply. **IN THE INTERESTS OF SAFETY IT IS ESSENTIAL THAT THE UNIT IS PROPERLY EARTHED.**

Z

U19

The SKY TRACKER MK.IV. Designed by Mike Barker, this sophisticated solid statement unit provides electronic guiding for a dual-drive telescope. The power amplifier which may hand on the pedestal or be free standing) operates from standard 240.50HZ mains supply & consumes less than 50 watts. The mains input & motor outputs are protected by fuses & have neon lights for quick location in case of failure. The output plugs to the motors may be locked to avoid accidental displacement. The Dec. motor feed has an extensible cable. The hand-held control paddle is fully isolated from the mains by relays & may safely be used at the telescope. This remote control unit has the following facilities:- The R.A. output is continuously variable from 45-55HZ by a knurled wheel to alter the telescope drive for Solar, Luna or sidereal rates. An overriding switch, with an l.e.d. warning light, locks the frequency to 50HZ when desired. An audible phase indicator which may be turned off when not required) enables the operator to approximate the variable frequency selected relative to the 50HZ mains. Drive corrections & centering are made by means of four buttons arranged in a cross South, North, East, West coloured l.e.d. lights, likewise placed, indicate the slew direction. A red light, operated by a push-button switch, is provided for map & setting circle reading etc.



FULLERSCOPES UNIT PURCHASE PLAN

Even with the extremely moderate Fullerscope charges found throughout the accompanying price list, astronomy may well still prove a little expensive for some; so, to cater for those who must budget their outgoings carefully, be they private individuals, clubs, schools or universities, I devised a system called "**FULLERSCOPES UNIT PURCHASE PLAN**". Time has shown that this scheme, together with the high quality of our components, is the main reason why Fullerscopes is Britain's leading telescope manufacturer for the amateur and semi-professional astronomer.

Basically, this means that, with the exception of Export Telescopes (where the scheme would not be practicable) Fullerscopes do *not* have a standard range of telescopes standing in the shop waiting patiently to be bought! Instead, every telescope is made up individually to customer requirements within a large range of sizes and component alternatives from which you, the client, are able to select those best suited to your needs and pocket! By permutation, there are literally hundreds of models from which to choose.

I have now revised and extended the "**Unit Purchase Plan**" to make it even more versatile and, I hope, easier for my clients to use. Every item in the price list is cross-referenced with the catalogue page numbers, and the items in the catalogue are coded to show their position in the price list. The main section of the price list is laid out in grid format. There is a column devoted to each size (diameter) and type of telescope within the Fullerscope range. This lists, in "boxes", the various components required for the telescope. There are several alternatives to most of the components required for the telescope. There are several alternatives to most of the components. Adjacent columns show the individual prices, also the carriage and insurance (C & I) charges. A separate blank column is provided for the client's calculations.

The "**UNIT PURCHASE PLAN**" is remarkably versatile and flexible. The permutations of possible telescope assemblies are enormous and clients should find little difficulty in selecting the Fullerscope of their choice. Remember: *you* choose the parts — we build the telescope from those parts for you **free of charge!** A unique service, second to none. Clients making their own telescopes may order any parts they require from the relevant "Telescope size" column or from the "Common Accessory Section". Full instructions are given in the price list for its use.

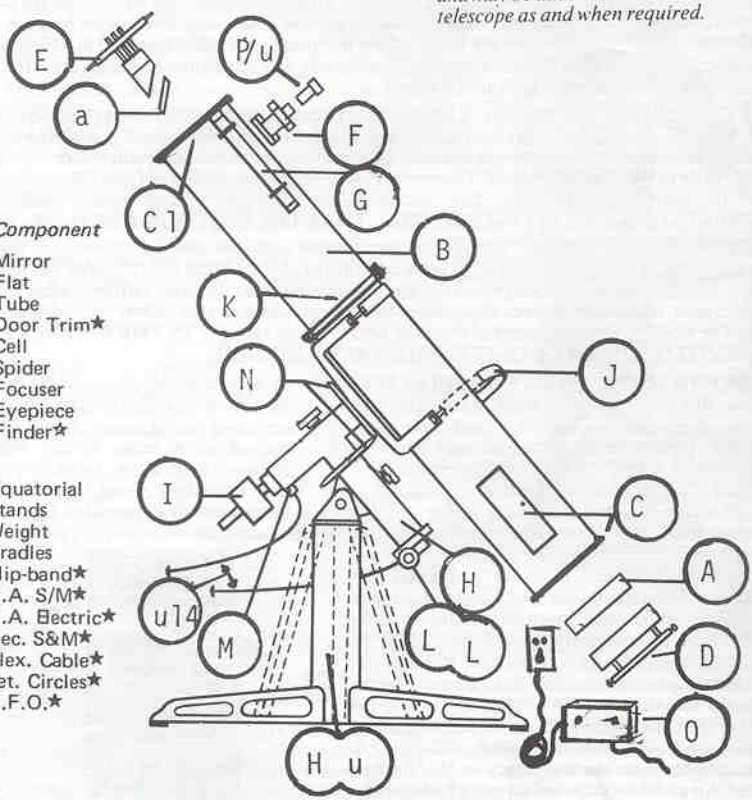
Finally, have fun! and please, *please*, **add the wretched V.A.T. charges** at the current rate **to the total price including C&I** charges. Remember, too, that books and maps are at the moment exempt from V.A.T., as is the postage on them.

The drawing below shows a typical Newtonian telescope on Mk.II or Mk.III Equatorial with all possible components indicated with the identification chart alongside.

"FULLERSCOPE" IDENTIFICATION CHART

*Items marked * are not essentials and may be added to the telescope as and when required.*

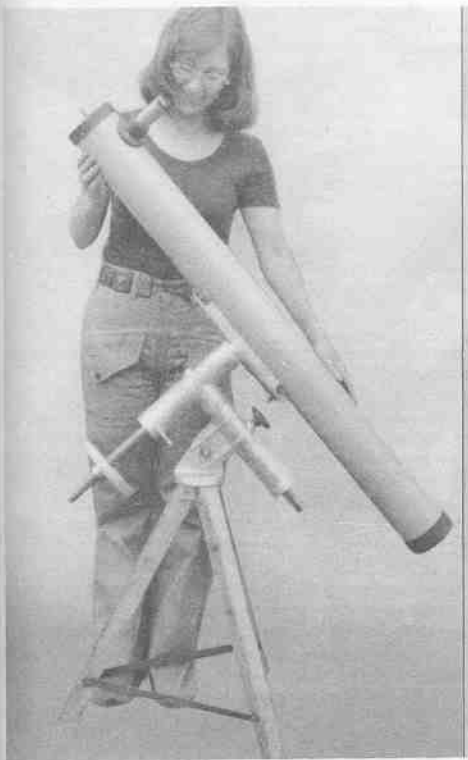
	Part Code	Cat. Page	Component
TELESCOPE	A1	14	Mirror
	A2	14	Flat
	B	16	Tube
	C	16	Door Trim★
	D	17	Cell
	E	18	Spider
	F	19	Focuser
	P/U	20/21	Eyepiece
	G	23	Finder☆
MOUNTING	H	27	Equatorial
	H/U	27/29	Stands
	I	28	Weight
	J	28	Cradles
	K	28	Slip-band★
	L	28	R.A. S/M★
	L1	28	R.A. Electric★
	M	28	Dec. S&M★
	U14	28	Flex. Cable★
	N	29	Set. Circles★
	O1	29	V.F.O.★

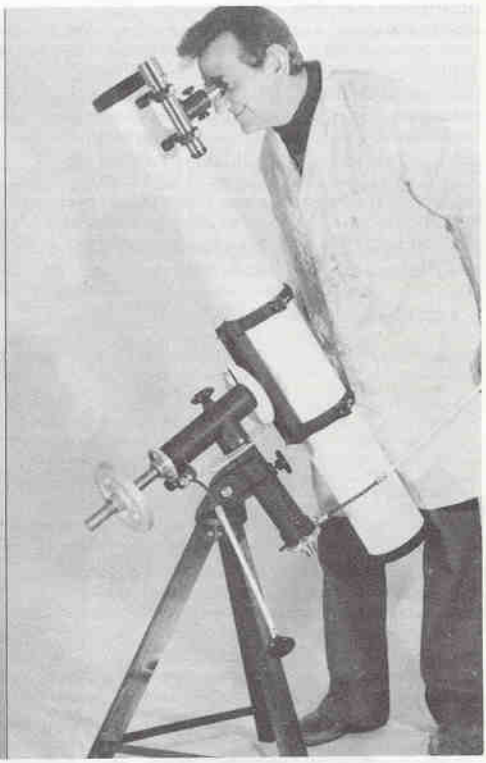


FULLERSCOPES 4in (102mm) and 4½in (114mm) EXPORT NEWTONIAN

For years now the world market has been flooded with small Newtonian Telescopes which appear, at first sight, to be the answer to the young astronomer's dream. Gleaming white tube, a sophisticated looking equatorial mounting and an impressive battery of eyepieces – all complete and 'ready-to-go' at a mouthwateringly low price. The illusion is far too often shattered when the mounting is found, in use, to be so unstable that it is impossible to focus the telescope with the absurdly high powered eyepieces provided. The young astronomer is thus unable to see for himself just what poor images his main optics provide! It is an unfortunate fact that about 90% of these telescopes are of use for looking at the moon and very little else. The odd 10% which are of reasonable quality optically are usually priced higher than our 6ins (152mm) telescopes! – Look at it logically. Like everybody else in business, we at Fullerscopes like to 'earn-a-crust' and yet, despite the larger than usual profit to be made on these imported telescopes, we don't sell them. The reason is simple. We know that if we provide good instruments right from the start, as our clients grow, so do their orders for larger and more sophisticated telescopes!

Fullerscopes 4in (102mm) and 4½in (114mm) export telescopes provide a firm base (pun intended!) on which the young astronomer can build. These two instruments have excellent optics which will give good images at sensible magnifications. The equatorial mountings are, if anything, oversized (an excellent 'fault') and are capable of carrying far larger instruments. They are also made to take a variety of useful accessories, when finances permit, thus enabling the young astronomer to advance his hobby along with his experience.





FULLERSCOPES 4in (102mm) NEWTONIAN

The telescope illustrated has a standard tube, special spider and de luxe cell (neither illustrated in the catalogue), push focusser & Mk.II Mount on wood tripod. This scope is ideal for youngsters but is *not* suitable for adults unless required for casual use as its size limits serious observing. Conversely, it is useful to anyone undecided about the hobby. Should they become keen, a larger telescope may be bought and fitted to the existing mount. The 4-in (102mm) being part-exchanged or kept as a "guide scope" (see p.23). If interest passes, the telescope can be sold and little will be lost.

FULLERSCOPES EXPORT 4½in (114mm)

The F.10 spherical mirror and flat are made and individually tested in our own optical shop. Under best observing conditions diffraction limited viewing is available. A fully adjustable mirror cell and spider are provided together with a full size precision rack and pinion focusing mount and 8 × 30 finder telescope. The massive Mk.III Equatorial has hinged cradles, a slipband, setting circles and slow motions on each axis and is mounted on an exceptionally rugged non-folding wooden tripod. Two eyepieces and a Barlow lens are supplied as standard. The tube is finished high gloss white. The mounting and fittings are black wrinkle and brass.

6in (152mm) FULLERSCOPES

Obviously, with Fullerscopes unit purchase plan, there is a wide variety of telescopes available, and it is impossible to illustrate all of them here.

A 6in (152mm) telescope will show stars down to 12.7 magnitude and resolve 'double' stars to about 1.3 sec of arc providing that seeing conditions are first class. The usable magnification range is between 24× and 300× depending on the focal ratio and the eyepieces chosen. The picture right shows a fairly basic 6in (152mm) telescope (with slipband, end trim and finder). It is mounted on a Mk.II equatorial with utility pedestal.



Bottom left is a 6in (152mm) F.8 basic Newtonian on Mk.II equatorial with plain wood tripod.

Centre, is a fully equipped 6in (152mm) F.8 instrument complete with almost everything except an electric drive. The deluxe tube has end trim, a door and slipband. An 8× finder is also shown. The Mk.III equatorial on pedestal stand has manual slow motions to each axis and setting circles. The F.6 telescope, bottom right, is classified as a rich field instrument. Used at its lowest magnification – about 24× – it will provide breathtaking views of star clusters and the Milky Way etc. Much higher powers are obtainable with the use of a short focus eyepiece and Barlow lens. It is shown here with finder and slipband. The Mk.III Equatorial is on a deluxe wood tripod.





FULLERSCOPES EXPORT 6" (152mm) NEWTONIAN

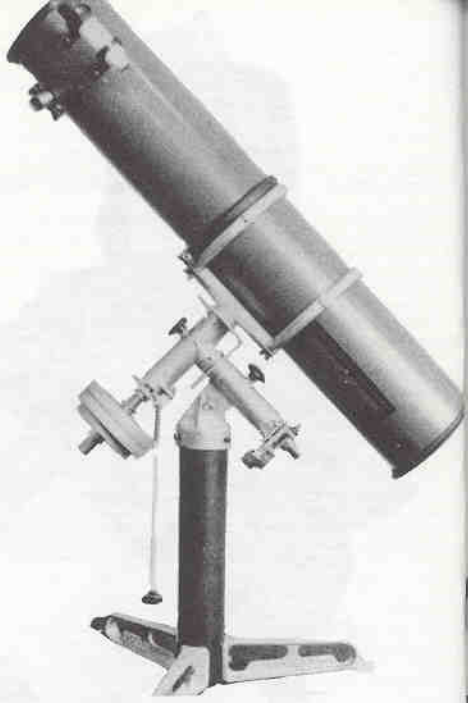
All export telescopes are finished to the highest possible standards with high gloss white tubes and metal doors and end trims. The various screws and draw tubes are of polished brass. Only 'A' quality optics are used – ensuring maximum resolution and first class images (under optimum seeing conditions). The telescopes are complete with finder telescope, setting circles, electric drive in Right Ascension, manual slow motion in Declination and two, quality eyepieces. These 6" (152mm) Export Newtonians are unsurpassed for value and are now available in limited quantities for the British market; with a choice of focal lengths F8, F6 or F4 rich field. These models are *not* available under the unit purchase plan. Optional accessories:- Driven Circle, Electronic Control Unit, extra Eyepieces (p.20/21) Sun Screen, Camera Adaptors, etc.

FULLERSCOPES 8½" (216mm) NEWTONIANS

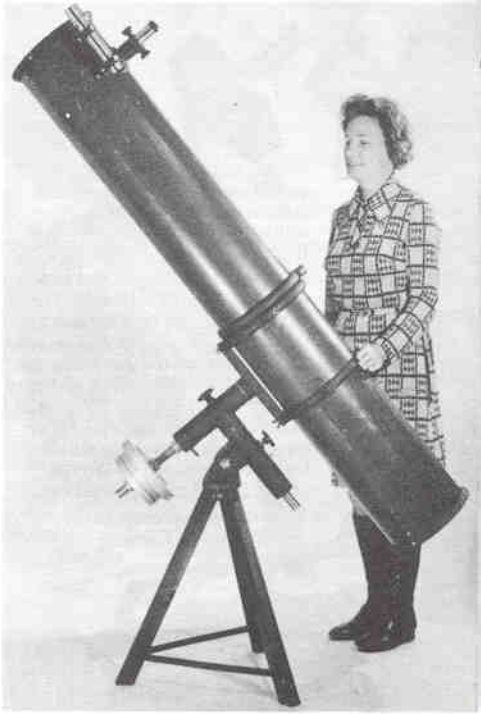
An 8½in (216mm) reflector has a much greater light gathering power than the 6in (152mm) telescope. It will, under first class conditions, enable stars to be seen down to about 13.4 magnitude and in similar circumstances resolve 'double' stars with a separation of only 1.0 of a second of arc. Usable magnifications are somewhere between 30× and 500× depending upon the focal ratio of the primary mirror and the focal length of the eyepieces used. It is not, of course, possible to illustrate the complete range of available 8½in (216mm) telescopes here. The final appearance of the instrument will depend upon the components selected from those listed in the price list under the Unit Purchase Plan.

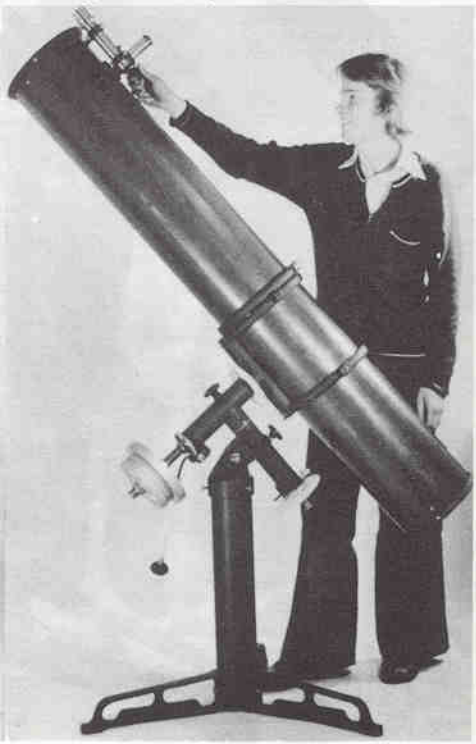
The telescope shown right has a focal ratio of approx. F6. Experience shows this to be the ratio most frequently selected by our clients. With its shorter tube it is more portable and a lower range of magnifications is possible as well as the higher powers. The telescope illustrated has a 'deluxe' tube with door and end trim — a finder and slip band are also shown. It is mounted on a Mk.II Equatorial (Utility Pedestal) and is shown complete with electric drive in R.A. Setting Circles and a manual slow motion in Dec.

Bottom left is an F.8 Fullerscope with finder and slip band. The mounting is the Mk.III Equatorial on Deluxe, metal-braced, wood tripod. The picture lower right is an 8½in (216mm) F.8 telescope with 'deluxe' tube with door, end trim, slip band and finder. It is mounted on a fully equipped Mk.III Equatorial complete with 'deluxe' pedestal Electric drive in R.A. and driven R.A. Setting circle. The Declination axis has a manual slow motion and, of course, dec. setting circle.



NOTE: It is better policy to use the extra heavy pedestal stand (not illustrated here) as this provides much greater stability.





FULLERSCOPES 8½" (216mm) EXPORT NEWTONIAN

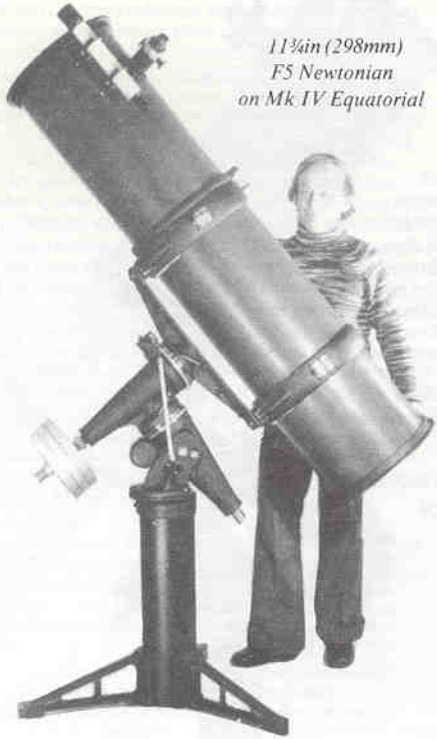
Recently released for the British market in small quantities, the 8½" (216mm) Export model is rapidly becoming the most popular telescope for the amateur astronomer in Europe. Although priced well below other telescopes of similar size, the quality of the optics and equatorial mounting surpasses that of any other make we've seen. The 'A' quality Mirror & Flat (choose either F7.5 or F6) are figured to an accuracy which will give the finest resolution possible on nights of 'good seeing' conditions. The main telescope tube is high gloss white with black crackle end trim and door. All screws and draw tubes are polished brass. The heavy duty equatorial mounting on sturdy steel pedestal is smooth in operation and extremely stable. The electrically driven Right Ascension axis and manual slow motion in Declination provide comfortable prolonged viewing and the addition of the Knight Master electronic control unit (optional extra) enables the amateur to take up celestial photography. A finder telescope, Setting Circles and two Eyepieces are included as standard. Optional extras:- Driven Circle, Electronic Control Unit, extra Eyepieces (p.20/21) Sun Screen, Camera Adaptors.

FULLERSCOPES 8½" (216mm) "PHOTOGRAPHIC" EXPORT NEWTONIAN

(F6 or F7.5)



For the amateur and semi-professional astronomer who wishes seriously to undertake celestial photography, the 8½" (216mm) photographic model is the ultimate in small telescopes. The gloss white of the tube contrasted with the black crackle metal end trim, door and fittings, all with polished brass screws, give elegance and "class" to an instrument which is optically and mechanically the finest available value for money. The primary mirror & flat are hand corrected to exacting tolerances and are guaranteed to perform, under the best seeing conditions, equal to, or better than, any others of similar size obtainable anywhere. The Rack & Pinion eyepiece unit has dual controls, coarse and ultra fine, providing precise focussing action. Also included is a camera adaptor for Pentax thread cameras. The massive equatorial and steel pedestal with iron feet provides incredible stability. Both Right Ascension and Declination are electrically driven and controlled by a mains operational control unit (see p.31 for details). The R.A. Setting Circle in brass is direct reading being driven by the main 359 threaded R.A. gear wheel. A large finder and 4" (102mm) F.10 Newtonian guide scope is provided. The latter being mounted directly to the cradles of the mounting to ensure perfect balance. The guide scope eyepiece is 1¼" push fit and is interchangeable with the two eyepieces supplied with the main telescope.



11¾in (298mm) F5 Newtonian on Mk IV Equatorial

FULLERSCOPES 10" (254mm) F6.5 and 11¾" (298mm) F5 NEWTONIANS

There is very little in *outward* appearance to distinguish the 10in (254mm) Newtonian from the 11¾in (298mm). In performance, however, the difference is very appreciable. The 11¾in telescope has far greater light gathering power and resolution. Both sizes are illustrated here. It is possible, as illustrated, to employ a 10in (254mm) short focus instrument on the Mk.III Equatorial with extra heavy pedestal stand, but, if finances permit, this size of telescope should be mounted on the Mk.IV Equatorial which is far more suitable and provides vastly greater stability.

THE 10" (254mm) F6.5 and 11¾" (298mm) F5 EXPORT NEWTONIANS

These instruments are the finest of their genre in the Fullerscope range. The page opposite shows a 10" (254mm) Export Newtonian.

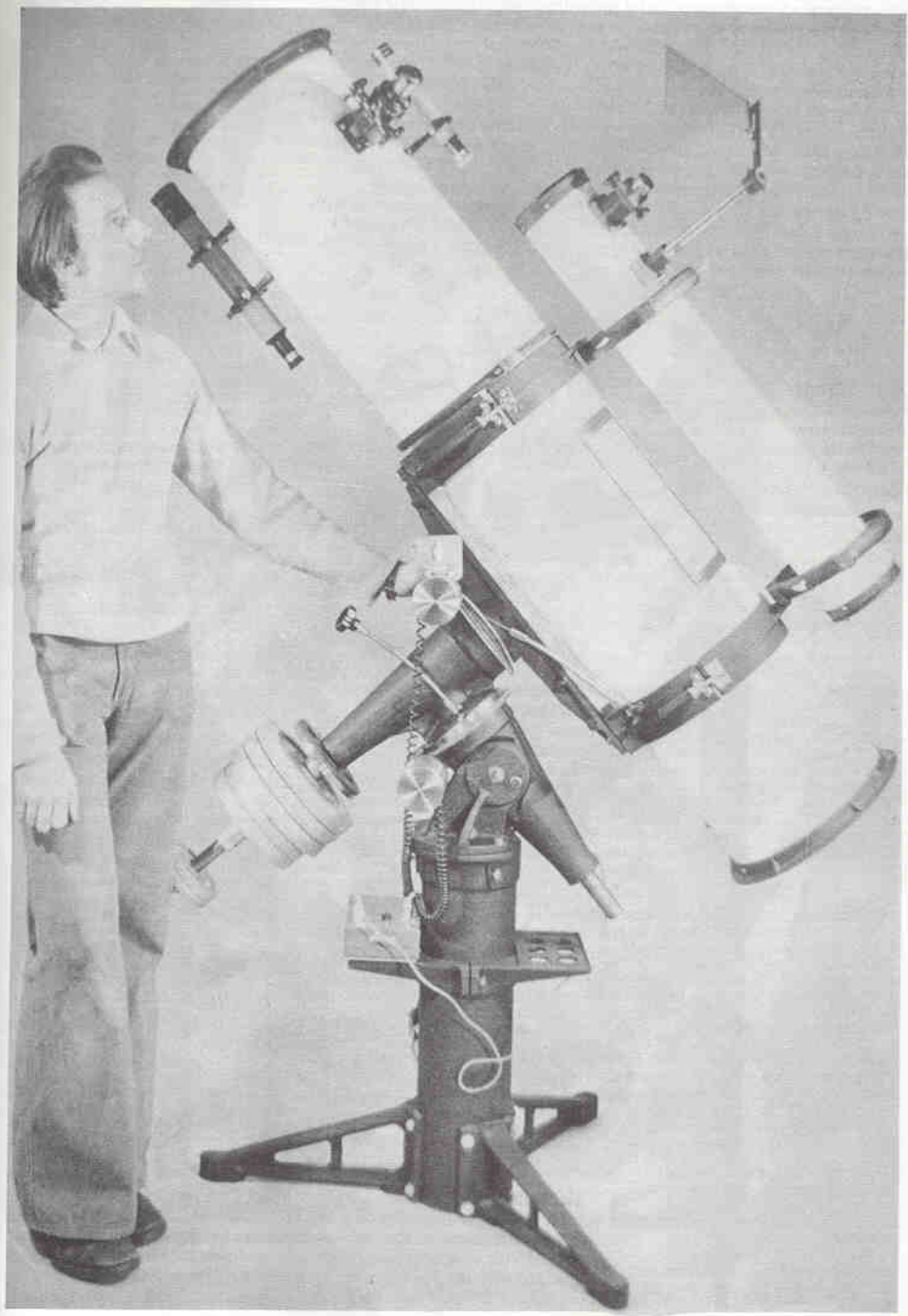
The Mk IV Equatorial is supplied as illustrated, complete with brass setting circles, electric drives in both right ascension and declination, operated by an electronic control unit. The extra heavy iron and steel pedestal stand has an accessory rack fitted. The tube is in high gloss white complete with door, black end trim, dual speed rack and pinion mount for ultra precise focussing and a 10 × 40 finder telescope is also supplied. The 4" (102mm) guide telescope is mounted directly to the cradles and is fully adjustable for colimation with the main telescope. A separate counterweight is provided to counterpoise the additional weight. Other accessories supplied are two high quality eyepieces, a Barlow lens and a pentax threaded camera adaptor. The sun screen illustrated is available as an optional extra. The complete telescope is finished to extremely high standards.



10in (254mm) on Mk III Equatorial with extra heavy pedestal



10in (254mm) on Mk IV Equatorial



FULLERSCOPES CASSEGRAIN AND CASSEGRAIN/NEWTONIAN TELESCOPES

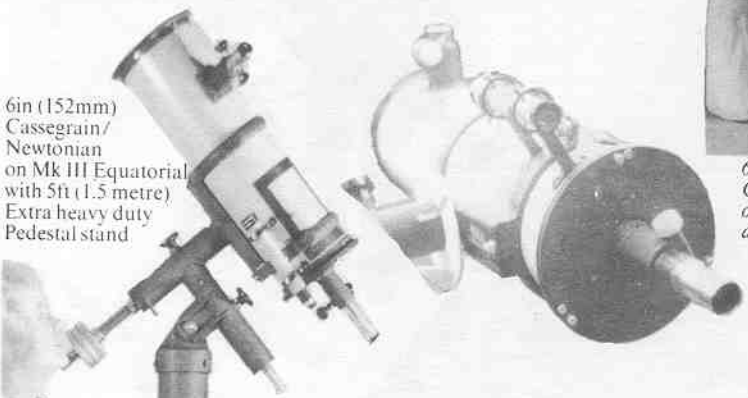
By primarily using the well tried Dall Kirkham optical system, Fullerscopes have drastically reduced the price of their Cassegrain telescopes, and these are now becoming increasingly popular. The great advantage of a Cassegrain is that it provides a large image scale with excellent resolution and yet has a far shorter tube than the average Newtonian. By substituting a flat and an additional rackmount, the telescope can easily be converted to a short focus richfield Newtonian for use at low powers. The Cassegrain Newtonian is probably the most versatile and useful astronomical telescope.

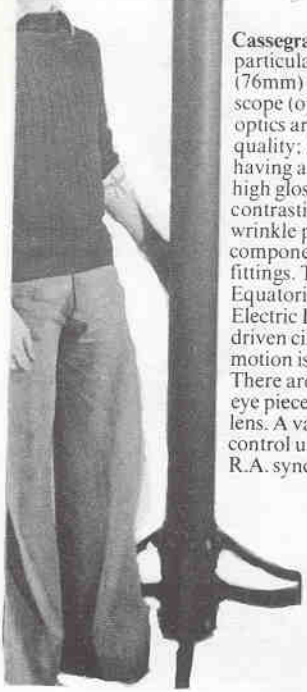
Fullerscopes Cassegrain telescopes are all available under the Unit Purchase Plan and the required components may be selected from that section of the price list. The large number of possible permutations makes it impossible to illustrate them all here. The 6in (152mm) Cassegrain-Newtonian – right – is mounted on a Mk III Equatorial with extra heavy duty 1 metre (medium height) pedestal stand. The inset photo shows the cell end of a Cassegrain. Note the push-pull collimation screws.



6-in (152mm) Cassegrain Newtonian on 3ft (1m) heavy duty pedestal

6in (152mm) Cassegrain/ Newtonian on Mk III Equatorial with 5ft (1.5 metre) Extra heavy duty Pedestal stand





Cassegrain-Newtonian. This particular model has a 3in (76mm) refractor guide scope (optional extra). The optics are of the highest quality; the whole telescope having an export finish of high gloss white tube contrasting with the black wrinkle painted components and brass fittings. The Mk III Equatorial is complete with Electric Drive in R.A. and driven circle; a manual slow motion is provided in dec. There are two finders, two eye pieces and a Barlow lens. A variable frequency control unit operates the R.A. synchronous motor.



The 8½in (216mm) Photographic Export Cassegrain-Newtonian is a similar telescope mounted on a Mk IV Equatorial. This has brass circles and electric drives to each axis with an electronic unit controlling the two drives. A 4in (102mm) Newtonian guide scope is provided as standard with the Photographic model Cassegrain. See opposite page for full mounting and accessory specification.

FULLERSCOPES 10in (254mm) & 11¾in (298mm) EXPORT CASSEGRAIN-NEWTONIANS

Primarily intended for the export market these fine instruments are complete in every respect. Possessing the finest optics available in the U.K. they will perform to the limit of their apertures. Each telescope is individually made and is tested under working conditions both optically and mechanically. The Cassegrains are supplied with one finder (the guide scope is an optional extra).
Cassegrain-Newtonians however are supplied with two finders, a 4in (102mm) Newtonian guide telescope and a camera adaptor.
All 10in (254mm) and 11¾in (298mm) models have two eyepieces and a Barlow lens and are supplied on the Mk IV Equatorial which may have either a 3ft or 5ft (1 metre or 1.5 metre) heavy duty pedestal.
Finish: High gloss white tube; black wrinkle components and brass fittings.



Fullerscopes 10in (254mm) Export Cassegrain.



Each of these telescopes has the Mk IV Equatorial mounting complete with electric drives to each axis; brass setting circles (driven RA); variable frequency electronic unit controlling both axies; counterweights; and a long or short heavy duty pedestal stand with accessory rack.

Fullerscopes 11¾in (298mm) Export Cassegrain-Newtonian.



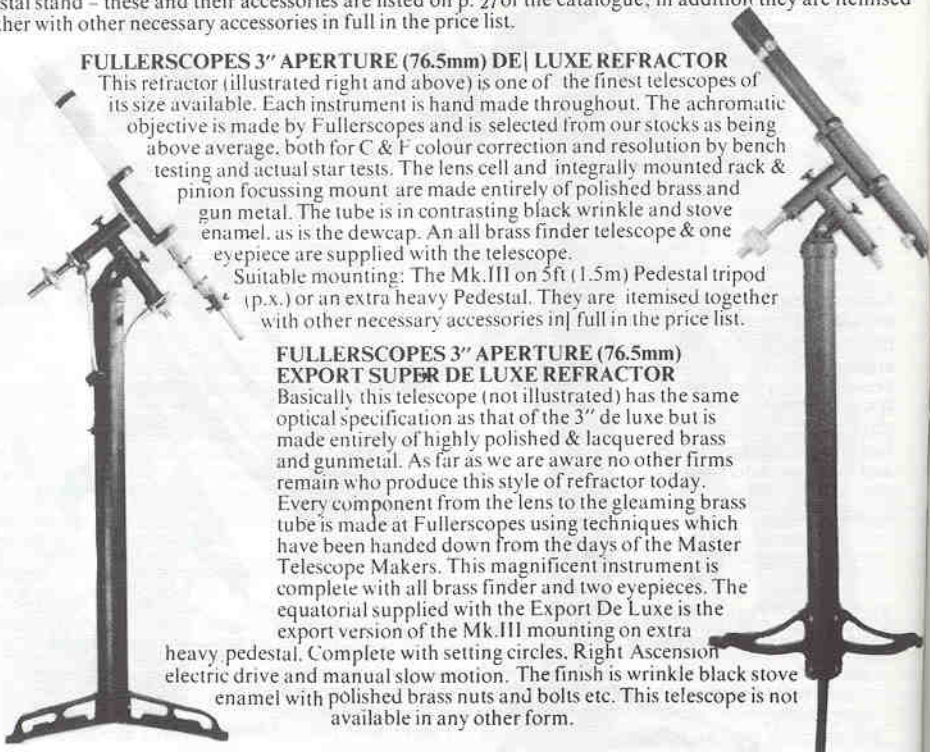
Fullerscopes 10in (254mm) Export Cassegrain-Newtonian.

FULLERSCOPES REFRACTORS For a variety of reasons, many of our clients prefer to choose a small or medium sized refractor of high quality than the larger reflector which could be obtained for the same price. The refractor is, of course, an ideal instrument for the flat dweller who must necessarily have an easily transportable telescope; and in parts of the country where for atmospheric conditions, seeing is normally poor, the small aperture of the refractor will often out-perform that of an open tube larger reflector. To meet the increasing demand for guaranteed quality refractors, FULLERSCOPES are now manufacturing a selection of these instruments in popular sizes, catering, as usual, for our client's budget and other requirements, mountings may be selected from the range of Fullerscope equatorials. In this way, clients are offered a very wide selection of possible instruments. There are a great many refractors available on the market these days, in the main imported Japanese models, and we are continuously being asked about the quality of these instruments. A short answer to this question lies in the fact that whilst a great many firms stock these instruments, very few will accept them in part exchange. The small hand telescopes are generally good value for money, and the higher priced astronomical eyepieces are excellent quality. The Japanese astronomical refractors of 3-inch and 4-inch aperture are of variable quality. Some have excellent optics, whilst others of the same make and size are found to be exceptionally poor. Further, in nearly all cases, the mountings, whilst being well designed, are far too small and badly machined. The finish of all Japanese work is excellent and herein lies the trap for the unsuspecting amateur. The instruments look very attractive and of high quality in a shop window, and the discerning and knowledgeable amateur will usually agree that this is the best place for them.



FULLERSCOPES 3" APERTURE)76mm) REFRACTOR This instrument is an ideal moderately priced high quality telescope for the amateur astronomer. The air spaced achromatic lens, made in our own lens shop, is 3⅛" (79mm) diameter for maximum light gathering power.Each lens is star tested for resolution and C and F colour correction. The dural telescope tube is fitted with internal glare stops, objective lens cell, dewcap and external rack & pinion focussing mount complete with draw tube. The telescope has a high gloss white tube with black wrinkle cell, rack mount and fittings. One eyepiece is supplied with the telescope. Suitable Mounting: Mk.II or Mk.III equatorial on either 5ft (1.5m) wooden tripod or 5ft pedestal stand – these and their accessories are listed on p. 27 of the catalogue; in addition they are itemised together with other necessary accessories in full in the price list.

FULLERSCOPES 3" APERTURE (76.5mm) DE| LUXE REFRACTOR
This refractor (illustrated right and above) is one of the finest telescopes of its size available. Each instrument is hand made throughout. The achromatic objective is made by Fullerscopes and is selected from our stocks as being above average, both for C & F colour correction and resolution by bench testing and actual star tests. The lens cell and integrally mounted rack & pinion focussing mount are made entirely of polished brass and gun metal. The tube is in contrasting black wrinkle and stove enamel, as is the dewcap. An all brass finder telescope & one eyepiece are supplied with the telescope.
Suitable mounting: The Mk.III on 5ft (1.5m) Pedestal tripod (p.x.) or an extra heavy Pedestal. They are itemised together with other necessary accessories in| full in the price list.



FULLERSCOPES 3" APERTURE (76.5mm) EXPORT SUPER DE LUXE REFRACTOR
Basically this telescope (not illustrated) has the same optical specification as that of the 3" de luxe but is made entirely of highly polished & lacquered brass and gunmetal. As far as we are aware no other firms remain who produce this style of refractor today. Every component from the lens to the gleaming brass tube is made at Fullerscopes using techniques which have been handed down from the days of the Master Telescope Makers. This magnificent instrument is complete with all brass finder and two eyepieces. The equatorial supplied with the Export De Luxe is the export version of the Mk.III mounting on extra heavy pedestal. Complete with setting circles, Right Ascension electric drive and manual slow motion. The finish is wrinkle black stove enamel with polished brass nuts and bolts etc. This telescope is not available in any other form.

FULLERSCOPES 4" Aperture (102mm) Refractor

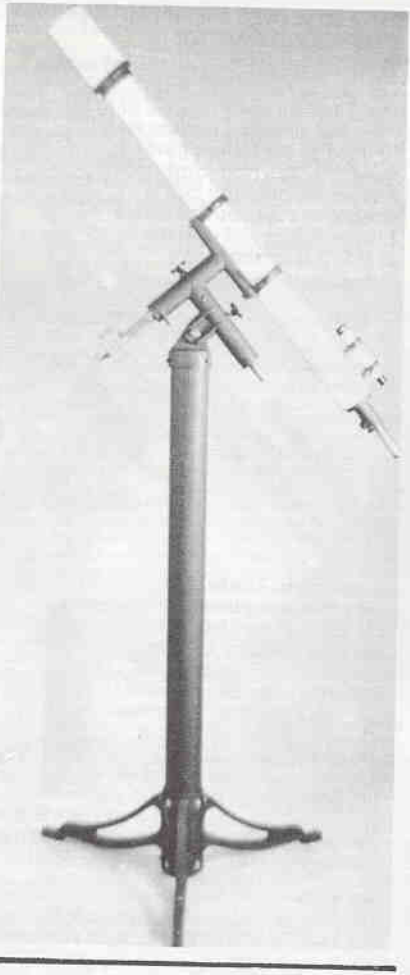
One of three models, the 4" aperture refractor (shown right) is, we believe, the lowest priced instrument of its size and quality on the world market to-day. The air spaced achromatic objective lens is well corrected in the C & F colour range and will resolve to Daws limits under good seeing conditions. The white stove enamelled tube has contrasting black wrinkle external rack and pinion focussing mount and fully adjustable lens cell, complete with dew cap.

The telescope comes complete with 6 × 30 finder telescope and one eyepiece.

Suitable equatorial mountings Mk II or Mk III on 5ft pedestal or possibly a wooden tripod (the extra heavy pedestal stand is to be recommended if maximum stability is to be obtained). A 7½lb (1½K) weight and collars are necessary, also 4" (102mm) cradles. (see (p.26-29).

Other accessories are optional and may be selected as required from the catalogue.





FULLERSCOPES 4" Aperture (102mm) De Luxe Refractor

The air spaced achromatic objective lens is selected for excellence from our standard stock of lenses. It is finely C & F colour corrected and will resolve on 'nights of good seeing' to the limit of its aperture. The lens is housed in a cell which is contained in a fully adjustable countercell, permitting perfect collimation. The cells are turned from gunmetal castings polished and lacquered. The tube contains the necessary glare stops and a polished brass and gunmetal large external rack and pinion focussing mount. The finish is black wrinkle stove enamel, as is the dewcap. An all brass finder is supplied together with one quality eyepiece.

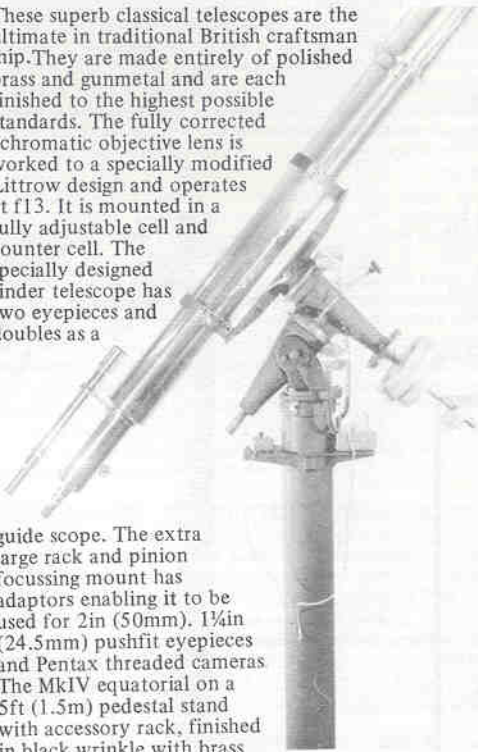
Recommended mounting:- Mk III equatorial on extra heavy pedestal stand. A 10lb (2K) counterweight and collars are necessary. Also 4" (102mm) cradles. (other equatorials may of course be chosen – see p.27-29.

FULLERSCOPES 4" Aperture (192mm) Export Super De Luxe Refractor

The basic specification of this classic instrument (not illustrated) is the same as that of the 4" de luxe (left). The tube however, together with all fittings, if of highly polished lacquered brass and gunmetal. The whole telescope is hand finished to the highest possible standards by skilled artisans. We feel that this refractor is unsurpassed and is surely a modern day "collector's item" as well as being a superb scientific instrument. The export Mk III equatorial comes complete on extra heavy pedestal stand with electric drive in right ascension. Declination slow motion manual and setting circles. The mounting is finished with black wrinkle stove enamel offset by polished brass nuts and bolts etc. This telescope is not available in any other form.

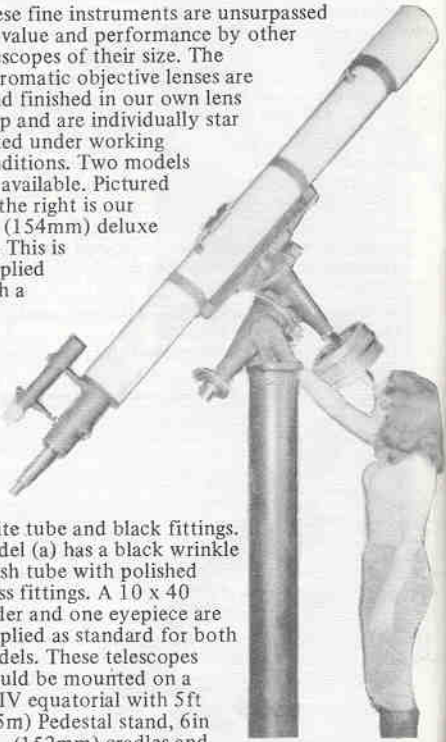
FULLERSCOPES 6-in APERTURE (154mm) EXPORT REFRACTOR

These superb classical telescopes are the ultimate in traditional British craftsmanship. They are made entirely of polished brass and gunmetal and are each finished to the highest possible standards. The fully corrected achromatic objective lens is worked to a specially modified Littrow design and operates at f13. It is mounted in a fully adjustable cell and counter cell. The specially designed finder telescope has two eyepieces and doubles as a guide scope. The extra large rack and pinion focussing mount has adaptors enabling it to be used for 2in (50mm). 1¼in (24.5mm) pushfit eyepieces and Pentax threaded cameras. The MkIV equatorial on a 5ft (1.5m) pedestal stand with accessory rack, finished in black wrinkle with brass fittings is fully equipped with electric drives to each axis, bronze (driven) setting circles and an electronic control unit. Two eyepieces and a Barlow lens are included.



FULLERSCOPES 6-in APERTURE (154mm) REFRACTORS

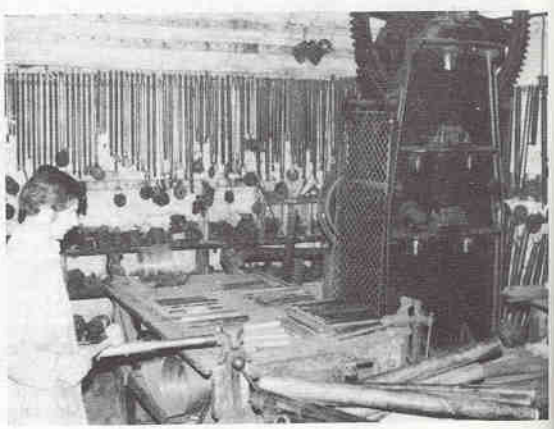
These fine instruments are unsurpassed for value and performance by other telescopes of their size. The achromatic objective lenses are hand finished in our own lens shop and are individually star tested under working conditions. Two models are available. Pictured on the right is our 6in (154mm) deluxe (a). This is supplied with a white tube and black fittings. Model (a) has a black wrinkle finish tube with polished brass fittings. A 10 x 40 finder and one eyepiece are supplied as standard for both models. These telescopes should be mounted on a MkIV equatorial with 5ft (1.5m) Pedestal stand, 6in (152mm) cradles and 20 kilo weights. (see p.30-31 for complete mounting specification)



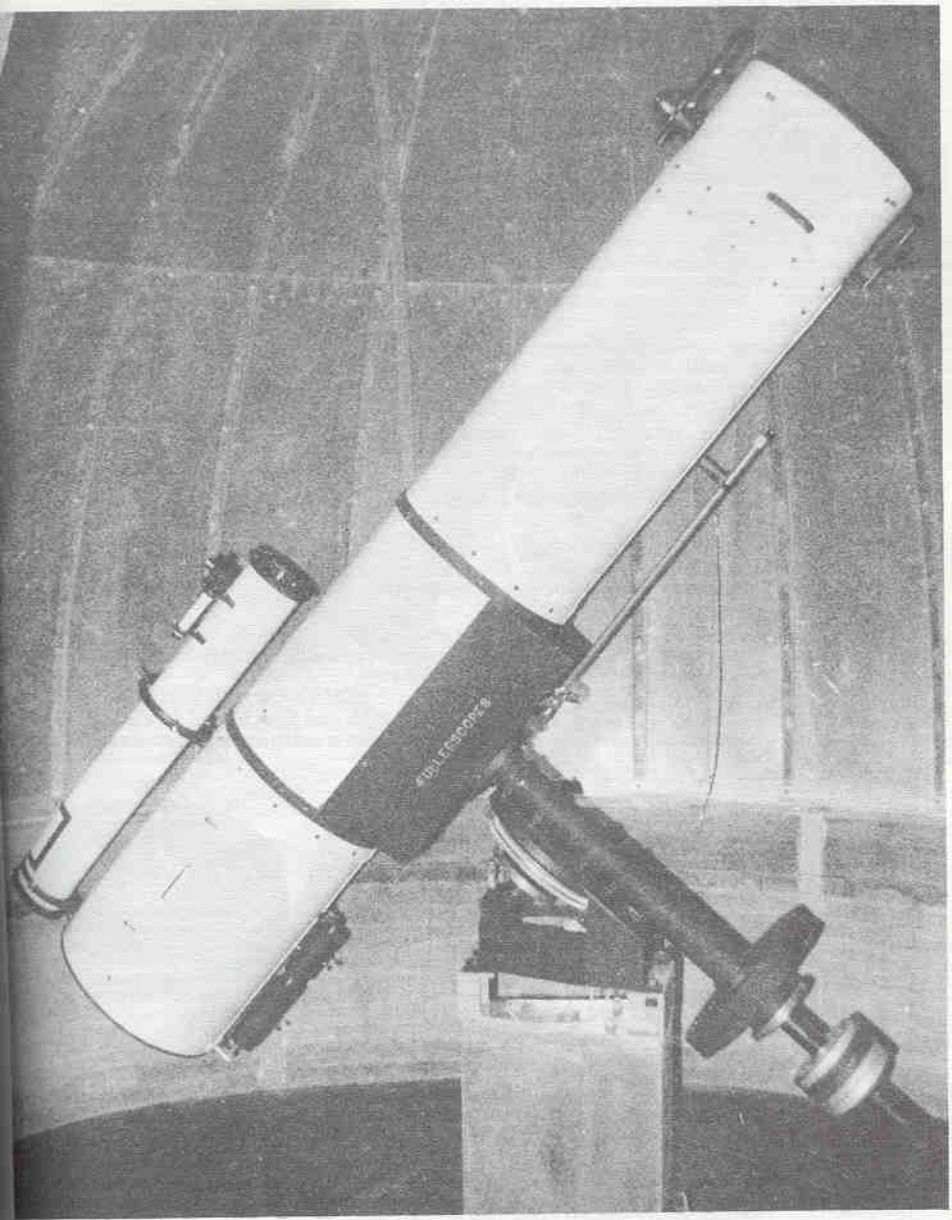
FULLERSCOPES BRASS TUBE PLANT

Most of our refractors are still produced today in the old traditional fashion, using the identical methods employed by the great telescope makers of old: Thomas Cooke, Alvin Clarke, Dollond, James Short etc., right up to the comparatively recent times of Broadhurst Clarkson, Ottoway & Ross. Some of the old moulds are still used, and most of the machining is performed with hand-tools on "Hob-and-Drag" lathes (see p.3). Nearly all Fullerscopes brass work is done by hand in artisan style. Pictured below is our brass shop, with Gerald Morris, a budding craftsman, hand fashioning brass tube. The process is as follows: Brass, or German Silver (supplied in rolls of various gauges from 10G to 25G) is marked out to the required size, utilising the original patterns, The metal is then trimmed by a hand-operated guillotine, the resulting rectangles being chamfered by file, bent by hand over suitable mandrils and beaten with wooden mallets (some nearly 100 years old) until approximately round. They are then bound with wire so that the seams meet and are subsequently brazed. After being immersed in dilute acid to clean them, these raw tubes are placed over appropriately sized mandrills and pulled individually through matching holes in iron discs which are fitted to a large, powerful pulling machine—We have two of these, one being over 150 years old!

We can produce over 200 sizes of intersliding tube in this fashion, in a range of diameters from ¼in-6in. Tapered brass tubing is also made, being created manually from start to finish. Despite the apparently primitive methods, production is cheaper and, we believe, tolerances more accurate, than commercially mass-produced tubing!

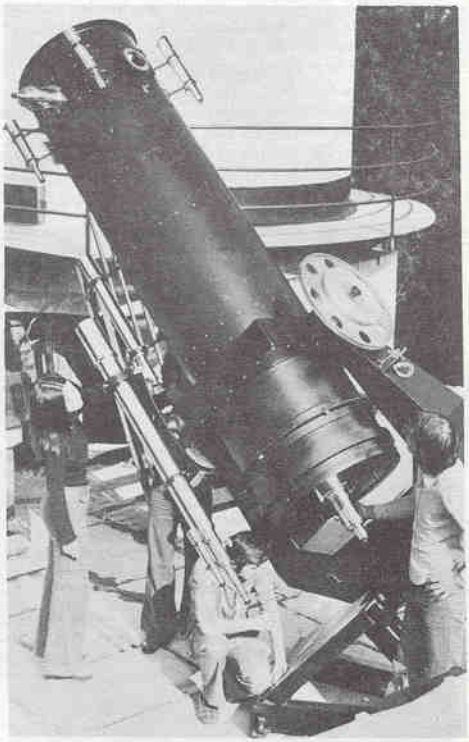


ewtonians or Cassegrains to clients' individual specification and available budget. Frequently pleasantly
rprising them with the highly competitive cost and exceeding their expectations for quality and perfor-
ance. Below is illustrated an 18" (45.4cm) Newtonian complete with 6" (15.2cm) Newtonian guide scope.
he massive German type equatorial based on our modular system, has a 14" (30.5cm) dia. right ascension
ear wheel providing sidereal rate drive with a matching slewing gear wheel. The 10" (25.5cm) dia. setting
rcle R.A. is driven by the R.A. gear, providing a direct index sidereal read out facility. Slow motion in
eclination is by means of a large tangent arm. The metal tube is thermally insulated and has a fully rotating
ead for ease in observing. Finder telescopes are provided.
his particular instrument is currently in use in a teaching observatory at Charterhouse in Somerset.



FULLERSCOPES 24in (62cm) CASSEGRAIN-NEWTONIAN

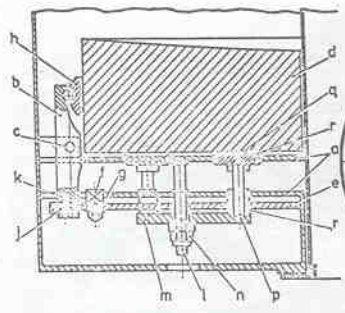
This is one of the largest Astronomical telescopes we produce. Because this size of instrument is normally only required by Universities and Professional Observatories, each telescope is custom made to suit individual requirements and may be supplied with either a Seurrier Truss open tube or a closed tube. The equatorial may be of almost any design required.
The following is a brief specification:

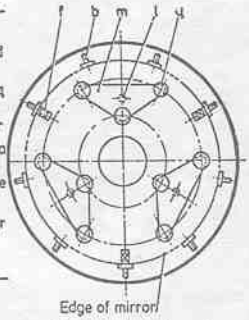


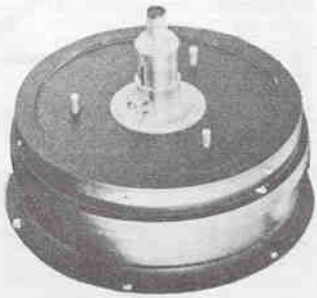
Optical System: The 24⅜" (62cm) primary mirror was produced from a Duradur Blank (having a linear expansion coefficient of 32×10^{-7}) to a tolerance of 1/20 wave. The matching Secondary was made from Duran 50 to a similar tolerance. The optics were designed for a classical cassegrain configuration which, with the exceedingly high quality flat, provides focal ratios of f5/f20. A 2° field being obtainable at the prime focus, and a ½° field at the cassegrain focus.

Tube: The tube is made from rolled dural sheet thermally insulated to alleviate tube currents. A door is sited at the lower end of the tube to enable the primary mirror to be covered and to provide access to the interchangeable light baffle. (This baffle also houses the mounting for the large penta prism which is used to deflect the light path to the Naysmith viewing position). There are four Newtonian viewing positions each with a 2½" (63mm) all brass finder telescope. A quick release mechanism is provided for changing the position of the large brass rack & pinion focussing mount. This is designed to accept a selection of eyepieces of various diameters as well as a camera for prime focus photography. Mounted on the centre section of the tube is a 4" aperture (10.5cm) all brass refractor Guide Scope. Two 3" aperture (80mm) finder telescopes are also provided, one at the cassegrain position and one for use at the Naysmith focus of the telescope.

Mirror Cell: Designed by Boris V. Barlow the mirror cell is fully temperature compensated by an ingenious method. The length and contact points of the nine, edge suspension levers, (b) were mathematically computed so that the dissimilar co-efficients of expansion of the dural anulus (e), the steel plate (a) of the mirror cell construction, and the low expansion glass of the mirror (d), cancel each other out. The floating pads (h) thus keep a uniform pressure on the edge of the mirror regardless of changes in the ambient temperature or the position of the mirror. Three pegs (f) spaced at 120° around the alloy anulus (e) ride in expansion slots (g) to eliminate lateral movement of the mirror.
The mirror (d) is supported without flexure or strain on nine pads (g) which are part of the fully adjustable flotation system (l.m.n.p). Rubber sleeves (r) centralise the pads and push rods in the clearance holes of the cell. The light baffle which also carries the Naysmith pentaprism is independently adjustable.







The secondary mirror and flat holders are designed so that the mirrors may be collimated by tilting them in any direction without deviating from the centre of the optical axis. This is especially important in the case of the flat which is rotatable to the four Newtonian positions and because the short focal length of the primary mirror makes it necessary to offset the flat in two planes. The secondary is moved up and down along the optical axis by a small electric motor, for focussing, this is operated from the main, hand held, control paddle

EQUATORIAL MOUNTING

The large prefabricated fork mounting was also designed by Boris V. Barlow. It is made from welded sheet metal sections which were stress relieved before machining. It has pre-loaded Timkin roller thrust bearings in the tynes of the fork for the Declination axis. The North bearing consists of a 25" (64cm) fly wheel riding on four gimble mounted self aligning cam-follower bearings. The South bearing is a large Timkin thrust roller bearing which is flexibly mounted. The Declination slow motion is powered by a d.c. motor driving a 22" (56cm) diameter bronze wheel and stainless steel ground worm unit. The Right Ascension drive and slewing system consists of twin 22" (56cm) diameter bronze gears each having 718 teeth. One is driven by the synchronous motor and carries the direct reading 22" (56cm) diameter R.A. setting circle, the other being driven by a d.c. motor for slewing (see also p.25 for illustration of this gear system).
All the controls for the drives are brought to the viewing positions of the telescope by a hand held paddle flexibly connected to the main control unit which is described at the bottom of the page.



ELECTRONIC CONTROL UNIT

Developed by Mike Barker

The V.F.O. power pack and hand held control paddle provide a high degree of sophistication. Fed by 240v mains 50 cps the power unit has outputs of 6v, 12v and 24v DC and a fully adjustable frequency range of 40 – 100 cps at 240v AC. Relays avoid direct mains voltage at the hand-held unit. The wiring harness, from the power pack, is led, in flexible trunking, to the hand paddle. This is usable at all six observing positions. The hand paddle and control unit are illustrated in the inset photo right.

The slewing motors for North-South, and East-West axes are controlled by two pointer knobs at the base of the unit. These smoothly move the telescope, at controllable speed, to the desired position, twin l.e.d.s. providing visual direction indication. The central button, at the bottom, illuminates the panel and provides a 'wander-light' for eyepiece indentification etc. The switch, top left, lights the setting circles on the equatorial. The centre-biased toggle switch, top right, controls the focusing of the cassegrain – twin l.e.d.s. indicating 'in or out'. The main drive of the telescope is controlled by the buttons on the centre panel of the unit and the North/South drive, guide correcting buttons are on either side of it. This panel has variable frequency control pointer knob and phasing light indicating sidereal rate. A 'phase-lock' switch returns the output to 50 cps when required. Overriding press button controls provide guiding facilities N/S and E/W.