the spectrum

APRIL 1966 THE BUFFALO ASTRONOMICAL ASSOCIATION B. COOK EDITOR
~~R. ZYGMUNT PUBL.~~

NEXT MEETING APRIL 15 th

The next regular meeting of the BAA will be held on Friday April 15th, 1966 at the Buffalo Museum of Science. Please note that this month's meeting date is set for third Friday rather than the regular second Friday to prevent a conflict with the Easter weekend. The speakers will be our four Fellow members who will present individual topics:

"Activity on the Sun" -Ernst Both.

"Completion of my Rich Field Telescope" - Walter Semereau.

"Construction of Eyepieces" - Rudolph Buecking.

"Observatories of the Northeastern United States" - Ed Lindberg.

This should certainly be one of our most outstanding meetings. Don't miss it.

EYEPIECES AND OCULARS

This issue of the Spectrum includes the concluding article, "Eyepieces and Oculars", written by Mr. Darwin P. Christy, Jr.

ADVANCED STUDY SECTION

The Advanced Study Section, under the guidance of Mr. Ron Clippinger, will meet on April 29, 1966 at 7:30 PM at the Buffalo Museum of Science.

SPECIAL ** THE HALE GIANT BINOCULAR

In the "Gleanings for ATMs" section of the February 1966 issue of Sky & Telescope magazine (pp. 106-110), Mr. Arthur H. Hale wrote an article describing the construction of his giant binocular. Since many inquiries have been made concerning this article, Mr. Hale has been kind enough to expand his article and make it available to various astronomical societies. In this issue, we are including a reprint of Mr. Hale's expanded explanation. We hope you will file this article with your "Gleanings" since it was so generously reproduced in multilith.

RAFFLE ???

Last month's raffle was cancelled at the last moment because the raffle item, the moonwatch Telescope, was loaned out and no one knows to whom. We are requesting anyone who knows of it whereabouts to please notify Ron Clippinger whereupon it will be raffled.

NEW MEMBERS

We would like to take this opportunity to welcome several new members to our organization and introduce them to the membership:

Mr. Darl Washburn
Mr. David O. Larson
Mr. Robert Ziegler Jr.
Mr. Daniel Zeller
Mr. Anthony Oswald
Mr. Clinton I. Baxter
Mr. David H. Alman
Mr. John Riggs, Sr.
Mr. John Riggs, Jr.

OCULARS & EYEPIECES (cont'd.)

Having reached the climax of oculars others are the Coddington (fig. 10), Tolles (fig. 11), Hastings (fig. 12), Airy (fig.13), Mittenswey (fig.14), Monocentric (fig. 15) Erfle (fig. 16) and last but not least the Barlow or Multiplier (fig.17). There may be others but I could find no others in my research.

The Erfle, otherwise known as a wide field ocular, is similar to the Orthoscopic. It is free of aberations and ghosts because of the close placement of the aschromats in the system. The field it produces is an exceptional 65 to 75 degrees. This to is an expensive ocular duetto the number of cemented achromats and corrections made in manufacture.

Two of the listed oculars, Airy and Mittenswey, are actually modifications of the Huygenian ocular. The field lens of the Airy is a converging Meniscus of long focal length and the eyelens is double convex. The convex surfaces of the eyelens are different. The outer curvature is about one sixth of the inner curvature. The commoner of the two oculars is the Mittenswey. This is actually an improvement over the Airy because the field lens is less concaved which makes it shorter in focal length thus eliminating field curvature. The eyelens is again different only in that it is a plano-convex lens. The field produced is broader, from 45 degrees in the Airy to 50 degrees

Finally we come to the solid oculars. The first known was the Coddington. It's construction was of a ball or sphere of polished glass ground away at it's equator to fit a lens barrel. After itwas ground down a groove was cut into it centrally leaving a diameter of less than half. This was to eliminate stray rays of light within the sphere. The Tolles is quite similar but the convex surfaces are not that of a sphere within it's solidity as is the Coddington. The eye end has been tapered down to help lessen stray light rays. It is said that this ocular is a Huygenian in solid form because of it's length. An adaptation of the Tolles is the Hastings. By taking the Tolles,hHastings added a diverging lens of flint to the eye end. This eliminated the slight chromatic effects of the Tolles. It also had a tendancy to flatten the field.

Two other ocularsaare of the triplet type. These are the Monocentric, which Seinheil worked with, and the Orthoscopic without an eyelens. The Monocentric gives a flat field and has been proved to be an excellent camera lens. The single triplet of the Orthoscopic was used alone before the eyelens was added and proved to be a boon to eye piece making. The largest objection to all of these solid and single oculars is that the field of view is only about 20 to 30 degrees a with a fringed edge.

There is one more ocular I have not memtioned because i can find no information about it. The Plossl ocular must be new or it is one which has never been marketed for the public to see. It is for sale though, in surplus stores and is a rather expensive item. It must be a good one as its price is beyond that of the orthoscopics. See fig. 19 and note.

After all these oculars have been briefly gone over we now come to an all important lens, the Barlow (fig. 17) or Multiplier. There are, as far as I know, three types: the plane Barlow, the achromatic and the corrected Barlow. The Barlow lens magnifies an image by lengthening the cone of light (fig.18) to the ocular. It is placed ahead of the focus and by diverging the light rays, increases the objective focal length. This aids in decreasing the chromatic aberation of the oculars as well as giving increased magnification. Combining a Barlow with a longer focal length ocular gives better resolving power than with an ocular with a shorter length equal to the Barlow combination. The plain Barlow gives some Chromatic aberation but is satisfactory and easy to make. The achromatic Barlow eliminates the chromatic aberation and is the one most used by observers. Another was introduced in which a correcting lens was installed with a slight air gap. This showed a little improvement over the achromatic but the cost also rose. The Barlow increases magnification to a given ocular and at the same time keeps the image sharp and retains brightness. It also provides greater eye relief in the high powers. This lens is not fixed in its case so it can be moved in or out to increase or decrease its multiplying factor. The multiplying factor is from 2x to 3x usually and has proved its merits to.me.

This article is not to be thought of as complete. I have only touched on oculars in a small way by giving the highlights of the advantages or disadvantages of as many as I could find in reference to write upon. This is open to criticism and additions. Even so, if it is satisfactory I might attempt to write a small article on the basic math of oculars.

Darwin P. Christy, Jr.

References used for this article:-
Standard Handbook for Telescope Making: by N.E. Howard
Amateur Telescope Making: by Albert G. Ingalls, ed. Scientific American
The Telescope: by Louis Bell, Ph.D.
Edmunton Scientific Catalogue
Jaeger's Scientific Catalogue
Encyclopedia Americana

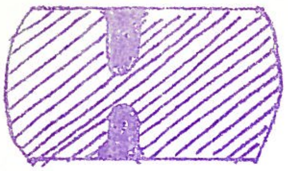


fig. 10

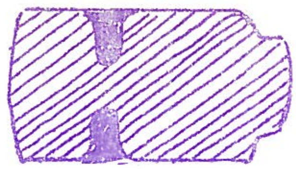


fig. 11

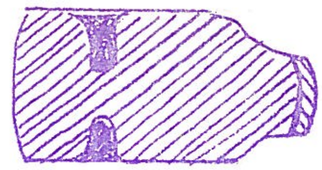


fig. 12

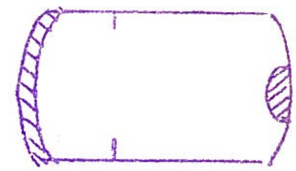


fig. 13

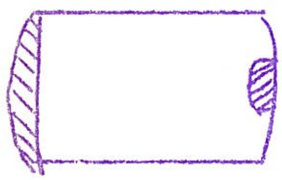


fig. 14

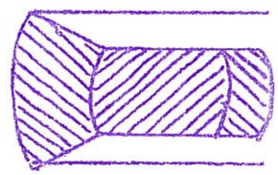


fig. 15

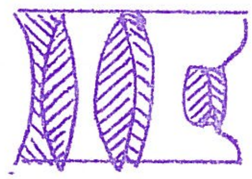


fig. 16

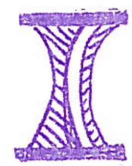


fig. 17

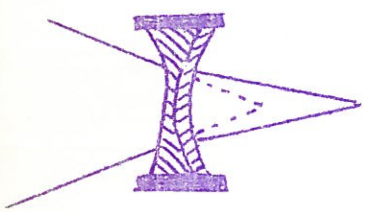


fig. 18

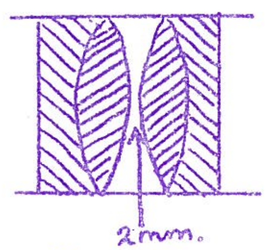


fig. 19

On looking for the Plossl, it is now noted that it is a long relief symetrical, using two identical achromats of a plano convex type. Each one, though, is of a crown and flint glass semented together. In their spacing in the ocular barrel they are within 2 mm. apart.

THE HALE OFF-AXIS GIANT BINOCULAR DESIGN

ADDENDA to "Gleanings for ATM'S" pp 106-110, "Sky & Telescope" magazine, Vol. XXXl #2, February 1966.

This new arrangement of the optics gives improved image contrast. The image cone is substantially created from incident light. A large portion of the rays created from inclined and wide angle light are eliminated from the image beam by the baffle (Fig. #3, S & T, also Figures 11 & 12 overleaf). Consequently, short FL mirrors, of wide aperture, could be used. The design is so efficient that the instrument shown (Fig. #1, S&T) gave a usable image without silver on the primaries.

A concave parabolized mirror can be figured to an accuracy of millionths of an inch. If the correct method is used to figure and saw the mirror in half, the figured surface of each half would be identical to within millionths of an inch. The D-shaped tube prevents some of the inclined and wide angle rays from reaching the primary mirror, and discourages air currents.

All of the angle light that normally crosses from one-half to the other half, in prior art, is eliminated in this design by the baffle which runs the full length of the tube. (See Fig. #10 overleaf)

The freedom to enlarge the secondary allows "b" of Fig. 2 (S & T) to be any desired spacing, at the same time permitting choice of any amplifying ratio. This great advantage introduces the convenience of viewing from a remote room.

I have designed a small model of a binocular equatorial mounting, together with an observing room. The instrument is mounted outside, and needs only a small cover for protection. Once the instrument has been collimated, any slight movement of the mirrors causing the image to split can be corrected instantly by slightly turning one or two of the control knobs of the primary cells while looking through the eye-pieces. Perfect alignment can be checked at a more convenient time.

This system gives ample light for use of short F.L. eye-pieces. Caution: no light from the D tube must be allowed to squeeze past the sawn edge of the primary mirror to enter the prism housing. If it does, the beam will be watered down.

Book 2 of Amateur Telescope Making states, at the bottom of page 415: "We all know that a parabolic mirror produces a perfect image when the incident light strikes it squarely." The incident light is the smallest volume which enters the tube. It is most important, therefore, to prevent as much as possible of the angled light from entering the image beam.

I have not mentioned aberration, adma, etc. It is my opinion this design gives a chromatically improved image. My interest has been concentrated on designing the optics in this instrument. I am sure much simpler methods could be used to hold these optics (than those which have been illustrated) without affecting the performance.

A.H.

INSTRUCTIONS TO AID THE AMATEUR IN CONSTRUCTION OF THE HALE GIANT BINOCULAR

The frame holding the primary cells is an old type car wheel rim, sawn in half, with pieces of the same type rim inserted to give the necessary eliptic width. Short pieces of light steel pipe 5" long are welded to the edge of the rim into which lengths of 2" light gauge aluminum pipe are fixed. At the open end of the tube the pipes are squeezed flat and bolted to a bicycle rim which has been suitably bent to eliptical shape and proper size. Thin aluminum tubing is used for bracing.

At the back of the tube is a 3-ply wooden cover out of which an aperture is cut to permit the beams to enter the prism housing. Eye-pieces and prism housing are supported by two angle-irons welded to the rim (Fig. #1 S & T).

A brake drum sawn in half would serve to make the cells. Close the sawn side of the D-shape cells by welding pieces of steel plate at each end, but leave the center clear to allow the beams to pass close to the sawn mirror edge. The mirror is held tight against the flat side. The cells are slung in the frame, hinged at the bottom, and held at the side and top against spring pressure, by bolt and threaded control knob.

It would be easier to mount the secondaries on a dovetail slide-way than by the cylindrical methods, as shown in Fig. #8, in the article. A rod with a long thread gives control from the eyepieces.

The mounting for each secondary is made from two Chev pistons, cutting the surplus material away. See Fig. #8 (S & T) - use a mangifying glass for more detail. Lay the lower piston on its side and bolt to the base. Insert the wristpin and weld to it a short piece of flat iron. Force a valve spring between the side of the piston and the flat iron. Bore a hole in the side of the piston slightly larger than the 1/4 inch bolt or stud. A butterfly nut is used to control the wristpin motion.

A similar procedure is followed to adapt the piston which holds the mirror cell, however the piston itself should be shaped as shown in Fig. #8. A short length of rod is welded between the flat iron of the top assembly to the wristpin of the bottom assembly. The cell is made from one piece of 1/8 inch aluminum plate. This is bolted to the piston. The mirror tucks behind the sharp corners, and is held by two clips bolted to the piston. A small trap door at the open end of the tube gives access to the assembly. Take great care to set the cells and assembly square to the primaries before making the final welds.

A structure of three-ply is erected in the frame, Fig. #16, near the primary focus. Width of the structure is the spacing of the primary mirrors. Screw to the top and bottom of the structure an aluminum strap, slotted at both ends (slots simplify positioning). Bolt the structure to the frame. Across the open edge of the D apertures screw a short length of thin steel saw blade apprx. 3/4" wide. Fix a non-reflective baffle to the front side of the structure which passes between the secondary halves to isolate each system. The beams from the structure to the primary cells are boxed. A baffle runs full length down the center of the box, isolating each system. The prisms can all be fixed, and use of an eye-piece assembly containing Rhomboid prisms will give inter-ocular spacing. The addition of Penta prisms produce the eye-piece arrangement as shown in Fig. #1, S & T.

The half section Newtonian, (Fig. #13 & 14, as shown) allows the use of short F.L. Mirrors. The minimal light blackage is at the side, and the very small prism used for a 3 inch aperture is adaptable for any large size mirror of any F.L.

The half section of the Hale design binocular (Fig. #15) with the mirrors set at approximately 2-1/2" has the same light blockage as the conventional Newtonian, but this blockage lies at the side of the mirror, where I believe it has less adverse effect on the image.

COMMENT: Since the 16th century the monocular type of optics (telescope) has been the accepted means for high powered viewing, and the small binocular has been considered only in the field of low power. As recently as 1953, G. Dallas Hanna of the Academy of Sciences, San Francisco, stated:

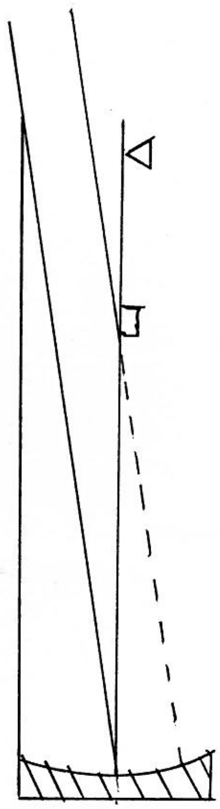
"It is believed that a 'good' binocular has not been made and it is doubtful whether one ever will be. This comes about through the impossibility of assembling two precisely similar optical systems and keeping them in some fixed relationship to each other, usually parallel." (Ref. page 218, Book III, Amateur Telescope Making)

I have spent many hours in experimenting and evaluating the greater benefits to be gained from binocular over monocular viewing. I am convinced that in the binocular viewing one has depth of perception and finer detail can be resolved. This is due to the weakness of one eye being compensated by using both eyes, thereby permitting the viewer to explore the image in comfort.

It is essential to bear in mind that the inherent drawbacks of the Gregorian design, such as the long focal length, etc. are eliminated in the Hale arrangement of the optics. With the Hale system it is now practical to use a binocular with high power.

Patents Pending
Arthur H. Hale
Narrative prepared
by Jean Lockwood
Galiano Island,
British Columbia, Canada.

Instructions to Aid the Amateur in Construction of the Hale Giant Binocular (continued)



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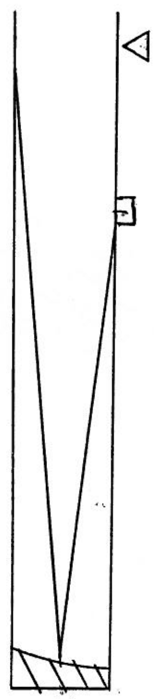

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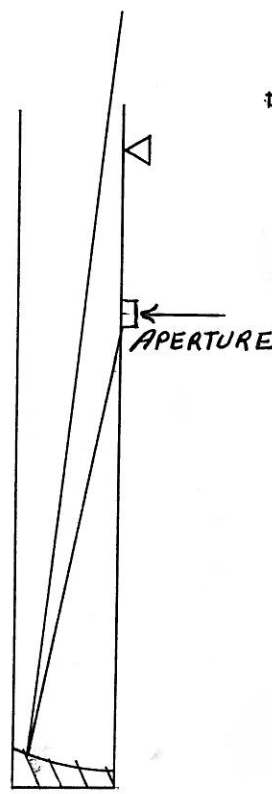

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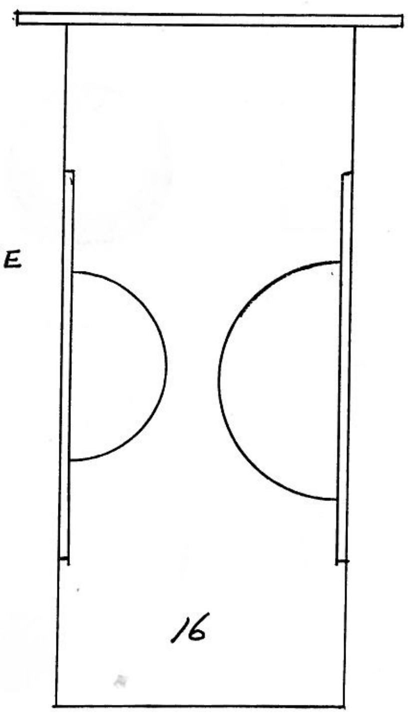

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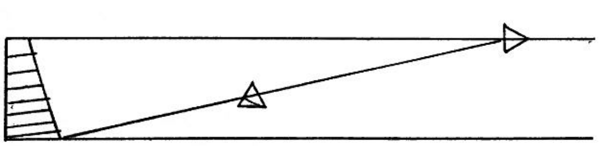

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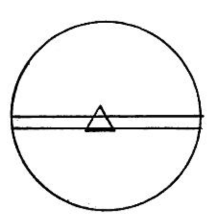

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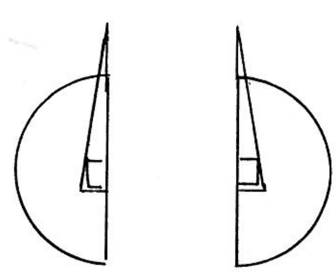

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