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AN INTRODUCTION TO THE R. F. T.

-- by John L. Brown

I have a small 3 inch reflector which is designed along the lines of an R. F. T. (Richest-Field Telescope). Wherever I carry it there are usually some questions which arise as to why it is so small, why it has a certain power and focal ratio, etc. It might be interesting to see just why the telescope is made as it is.

The Richest-Field Telescope is, as the name implies, a telescope designed to give a field of view rich in stars; a greater number of stars may be seen in the field at one time than in any other telescope. There are many factors involved in the choice of constants to go with a telescope. One would naturally think that the larger the telescope the more stars can be seen with it; this is true as far as the total number is concerned, but as the telescope gets larger the field of view gets smaller. The larger telescope has a greater light gathering power and can reach farther down the magnitude scale. However, the rate at which the star field density increases is not constant; there will be an optimum combination of aperture and focal length which will yield the largest field and the greatest number of stars.

Once we have determined the proper aperture and focal length the telescope must be fitted to the observer's eye. The cone of light issuing from the eyepiece of any telescope has a definite diameter depending upon the objective aperture and the focal length of the eyepiece. With high powers this cone is very small; in fact we often have difficulty finding it when at the telescope. With low power eyepieces the cone diameter, or exit pupil, is much larger. To exact the greatest efficiency in image brightness from the telescope this cone should exactly fit the pupil of the observer's eye. This is a hard matter to determine precisely; the pupillary diameter varies considerably with the lighting conditions and with different persons. As a representative average the figure is considered to be about 1/3 of an inch or 7 millimeters. This is under dark-night observing conditions. Some observers have experimented on enlarging the pupil of the eye artificially with a drug such as atropine. In some cases the pupil has measured as large as 11 milimeters. This is rather painful when returning to a lighted area, however.

While there is only one particular R. F. T. which will give the best results, any telescope may be converted into a type of R. F. T. The primary requirement is to have the cone of light fit the pupil; there is a certain low power which will do this. It may be found by dividing the mirror or object glass aperture in inches by 1/3. Try this on your own telescope and look at the milky way in the Cygnus or Sagittarius region. This should convince you that magnification is not the only benefit to be derived from a telescope. It is interesting to note that the North American nebula is visible to the eye only in an R. F. T. Even the largest telescopes cannot show the entire nebula to the eye.

Specific details have been omitted. If you are interested in building an R. F. T. see Amateur Telescope Making- Advanced. The subject is covered thoroughly.

IT TAKES GRIT TO MAKE A MIRROR

-- by Crawford Jackson

As abrasives are the means by which the lens maker is enabled to fashion lenses and mirrors of various types and sizes, it is not uncommon that the amateur telescope maker should desire to know more about their properties. Upon closer inspection, but without resorting to abstract mathematics or formulae, the lens grinder will discover that he need concern himself with only three specific properties of abrasives: namely, uniformity, size and hardness.

Obviously, in any precision operation such as optical work, only chaos can result from working with mixed sized grits, except in gross work like the cutting of glass discs from slabs. An operation of this nature can be performed with any low grade or mixed abrasive that one has available, since extreme accurracy is not demanded.

Diameter of grain or particle size is probably the most familiar and best understood property of abrasives as far as the lens maker is concerned. Common sense dictates, and a few hours at the grinding stand will impressively verify the fact, that the speed of cutting is proportional to the diameter of the grain or simply, the coarsest grit cuts the fastest.

The average worker is probably well versed in the first two properties of abrasives but is perhaps a bit uncertain as to the implications of the last. In fact hardness is not a single property, but a compound of several properties: resistance to abrasion (scratching), deformation, and penetration. For our purposes we may well confine ourselves to the first named.

In attempting to understand hardness, one needs a frame of reference from which to start. The most satisfactory frame of reference is known as Moh's Hardness Scale and dates back to about 1820. This table is qualitative rather than quantitative; that is to say, a substance with a hardness of 4 is harder than one of 2, but not necessarily twice as hard. Indeed, it may be 6 or 8 times as hard as a substance with a number 2. The Moh's Scale runs from 1, which is hardness of talc to 10, the hardness of a diamond which is not exceeded by any other known substance. Ordinary glass on this scale is located at about the 5.5 mark.

Having understood this as a working basis, one begins to get insight into the relationships between hardness and lens work. Generally, the first step in fashioning a glass is the choice of a suitable abrasive for rough grinding the curve. A number of years ago the choice would have invariably been emery or natural corundum, a crystallized oxide of aluminum with a hardness of 9. This is an excellent agent for the task, but since the advent of cheap carborundum or Silicon carbide, this has largely been replaced. This has not been altogether a matter of economy as Silicon Carbide is harder

still than emery but not quite 10 on Moh's Scale. Even fused quartz which has a hardness of 7 is readily cut by Silicon Carbide or "Carbo" as it is referred to in the parlance of the telescope maker.

The familiar red rouge, universally used polishing agent for glass, boasts an average hardness of about 6, the same as its lesser known cousin, Magnetite, or "black rouge". The important aspect of cleanliness in carrying out the grinding and polishing procedures must not be taken lightly. It requires no stretch of the imagination to see the havoc that could be wreaked by a few grains of Silica dust or sandy material on a optical surface during polishing or late stages of fine grinding. As a note of caution, ____ basements are likely places for harboring this particular type of dust.

An interesting side light concerning hardness is the types of laps employed in optical work. The orthodox procedure is the use of the time-honored pitch lap which despite some short comings is probably the most foolproof device for amateur telescope makers. Being resilient and of a semi-solid nature, it frequently engulfs stray particles of grit before extensive damage has resulted to the lens. Extremes in hardness of the pitch lap may easily be altered by treatment which is one advantage not to be overlooked. On the other hand, the cloth lap, having a hardness of about 1, is inflexible in that aspect, as is also the paper lap. The two last named laps together with the rarely used brass lap (of hardness 3.5) and the lead lap, which is softer still, constitute mere curiousities for the majority of lens grinders.

In late years, a number of workers grinding relatively large aperture telescope mirrors, have used tools of concrete faced with tile, ratherthan use glass tools. This accomplishes the job rather nicely as porcelain tile averages about 5 on Moh's Scale, being very near glass. Of course different types of glass will vary in hardness, but those interested in pursuing the problem further will find plenty of material for study and ample tabular data on the book shelves.

Moh's Scale of Hardness

1 - Talc, Cloth
3 - Copper
5 - Tile (porcelain)
5.5 - Glass (window, plate)
6 - Rouge (red), Magnetite ("black rouge")
7 - Quartz, sand, silic dust
9 - Emery
9.8 - Silicon carbide (Carborundum)
10 - Diamond

A DEVICE FOR USE WITH A "SKY-SCOPE"

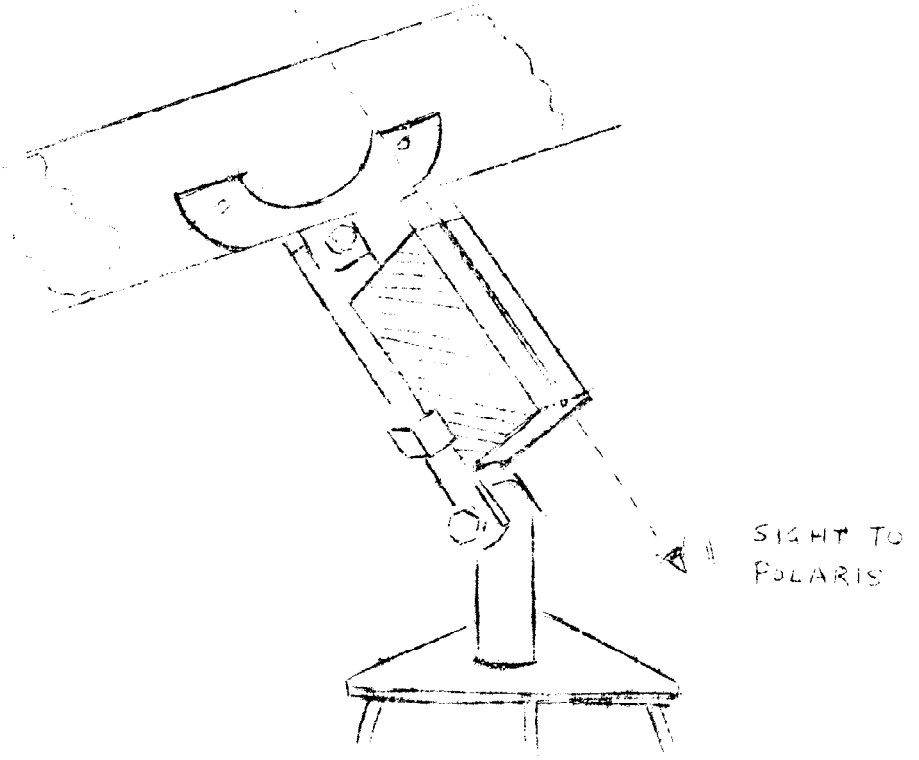
-- by R. H. Mitchell

For many amateurs, the Sky-Scope is a convenient and satisfactory telescope since it is easily portable and since it has an equatorial mounting. The suggested method of determining the angle at which this mounting should be set for satisfactory use, is by pointing it at the North Star and fastening it in that position.

In trying to set the mounting by pointing it at Polaris, a difficulty arises in that the tube of the telescope obstructs the view of the star in sighting along the barrel of the mounting.

An easy method of overcoming this difficulty is by the use of a small piece of wood, properly machined, that will provide a "sight" over the telescope tube. It has been found that a piece of plywood approximately 2-3/4 by 1-3/4 inches and 3/4 of an inch thick serves the purpose nicely. One of the 2-3/4 inch edges should be grooved (V shape) along its entire length to provide the "sight". The opposite 2-3/4 inch edge should be rounded out along its length so that it will be steady when placed on the mounting. The latter edge will need a notch about 1/2 inch long and a 1/4 inch in depth so that it will fit over the hex-nut on the equatorial mounting.

By the use of a piece of wood as described, the proper angle can be set quickly. It would be useful to some one on vacation or traveling who changes his latitude and needs to change the angle of the mounting. And, since the best location for observing is not always level and since the mounting is on a tripod, the use of the "sighting block" would obtain the proper angle even though it differed because of the uneven ground, from the angle for the latitude.



UNFORGETTABLE

-- by Kathleen Ann Stout

Ever since I can remember, I have loved to sit and watch the sea. I have seen it in all its moods and enjoyed each one to the full That is why I was always particularly delighted when we elected to spend our summer holidays in Shetland, the group of islands to the northeast of Scotland. It was while holidaying on a lighthouse on the Mainland, as the main island of the group is called, in the summer of 1949 that I had an experience which I shall never forget.

The coast around the lighthouse was admirably suited to my occupation of sea-watching since it was open to the Atlantic, and all the time I could see these huge breakers rolling in, crashing against the cliffs, flinging clouds of spray into the air and subsiding in boiling, frothy waves. The cliffs and rocks of this volcanic land seemed to be all lava in which we found embedded beautiful specimens of rock quartz and even a few of amethyst. The cliffs were about a hundred feet high and very irregularly formed in ravines and inlets so that there were many points of vantage for watching the suicide of the rollers as they dashed themselves against the hard volcanic rocks.

The constant lashing of the sea had created many strange phenomena along the coast, one of my favorites being only a few minutes' walk from the lighthouse. Certain softer parts of the rock had been worn away by the waters through time. At my spot, this wearing had made an underwater cave which was completely covered at high tide, but which was connected to another cave above high water mark, the mouth of which was circular and about the size of a large dinner plate. During certain conditions of tide and wind the water would surge into the lower cave and out of the upper one with a sound like the boom of a gun; hence it got the local name of The Cannon.

One day, I settled myself comfortably in a sheltered corner out of the wind, but in the sun which was shining brightly for once, and prepared to sea-watch for a while. I was watching the Cannon which was acting very well and shooting water out sometimes for about a hundred feet or more over the sea before it dropped. All of a sudden I saw it--the most vivid rainbow! It lasted for such a short time that I wondered if I had really seen it; but I know, now that I have started to study astronomy, that it is possible for the angle of the sun and height of the water to have combined in the correct degree to produce the beautiful prismatic effect of the rainbow, and I didn't imagine it after all.

PLANET NOTES FOR MARCH 1951

-- by P. O. Parker

The Sun, during March moves from Aquarius into Pisces and its declination changes from 7 degrees South, to 3 degrees North and the length of the day increases from 11h 27m to 12h 31m. At 5:26AM on the 21st the sun crosses the celestial equator, enters the northern hemisphere and "Spring Begins."

There will be a partial eclipse of the Sun - 34% in this vicinity, on March 7th -

Eclipse begins	- 4:55PM EST
Mid eclipse	- 5:45
Eclipse ends	- 6:32
Sunset at	- 6:39

It will require a clear western horizon to observe this eclipse.

Mercury moves through Aquarius and into Pisces. It is in superior conjunction with the Sun on the 11th, after which it passes into the evening sky. By the end of the month it may be seen very low in the western sky just after sunset. Magnitude 1, distance 95 million miles.

Venus is an evening star moving from Pisces into Aries. It is becoming a very prominent object in the western sky. Magnitude -3.4, diameter 11", distance 137 million miles. Sets about 8:30PM.

Mars is still in the evening sky but faint and difficult to locate. Sets about 7:20PM.

Jupiter is in Aquarius. It is in conjunction with the Sun on the 11th after which it will pass into the morning sky. Too close to the Sun all month to be observable.

Saturn is in Virgo. It reaches opposition on the 20th and is then at minimum distance, 789 million miles and is well placed for observation. Rises about 6:30PM, Ring diameter 44", Polar diameter 19", Magnitude 0.7, Ring system open only about 2¼ degrees.

Uranus is in Gemini, about a degree northeast of third magnitude star "Mu". It is well past opposition and sets about midnight.

Neptune is in Virgo, located some three degrees northwest of Spica, near fifth magmitude star "Theta."

The moon is new at 3:50PM on the 7th, full at 5:50AM on the 23rd. Nearest the Earth on the 2nd, 230.000 miles and on the 27th, 228,000 miles, and farthest on the 15th, 251,000 miles.

AN OPEN-BOOK QUIZ

This quiz is divided into four sections. Part I is designed for the amateur with a general interest in astronomy; Part II, for those interested in optics; Part III, for the mathematicians; and Part IV, for the experts. Answers will be available next month.

Part I

1. What is the nickname of the star Alpha Ursae Minoris?

   Discuss briefly how this star helps to determine position on the earth.

2. What are the main causes for the change of the seasons?

   At comparable sea levels and equal climatic conditions, why are the summers hotter and the winters colder in the Southern Hemisphere than in the Northern Hemisphere?

3. Beginning with Aries, name the constellations of the Zodiac in their proper order.

   How did the ancients determine the Zodiacal path?

4. Name andidentify by actual observing, the constellations appearing in the heavens in February.

5. What is the path of the ecliptic? Discuss briefly.

6. What is Universal Time?

   What is our latitude and longitude in Decatur, Ga.?

   If Universal Time is 14p.m., what time is it in Decatur?

Part II

7. Assuming that the average eye has a resolving power of 3 minutes of arc (20/20 vision), what focal length eye piece must be used on a 6 inch f 8 telescope in order to barely separate epsilon Lyrae (separation 3 seconds of arc)?

8. What focal length eyepiece would be required to convert the above telescope into an R. F. T. ?

Part III

9. A body is dropped from an elevation of 200 ft. at lat. 41 degrees North. Where will it strike the ground? Neglect air resistance.

10. What is the greatest possible number of Sundays in February?

11. The average radius of the earth is 6,371 kilometres and the average density is 5.5 gms per c.c. Find the mass of the earth.

12. In one second the earth travels 18.5 miles in its orbit around the sun. By how much is it deflected from a straight line in this time.

Part IV

13. Imagine two asteroids at the same distance from the sun. One is red, the other blue. Which is hotter?

14. Suppose you were on Venus whose atmosphere is opaque. Not being able to see out into space, it would be possible to detect daily rotation by Foucault pendulum! Would it be possible, by laboratory methods to determine that it revolves around another celestial body?

Some of you may develop some interesting theories for solving this last problem. If so, please let us have your answer before March 2 for publication in the next issue of the Report.

The cover for this issue shows the impressive array of the planets and crescent moon which many of us enjoyed seeing on Wednesday evening, Feb.7. Our editor, Bill Close, has made a beautiful drawing of the phenomenon as seen with his telescope. At the top is Mars apparently hovering over Jupiter and its moons. Beneath are Venus and the moon. Many thanks, Bill, for this attractive record of a memorable evening!

W.A.C.

OBSERVING PARTIES--PAST AND FUTURE

The star gazing parties being held at the Closes' home have been scheduled on Saturdays midway between regular club meeting nights in order to space our observing activities as evenly through the month as possible. However, lately that has been a date when the moon has been prominent in the sky; and while it is an interesting enough object in itself, it does limit the field of good observing of some of the other celestial attractions. On the night of January 20th, Uranus, which we had hoped to see, was lost in this moonglow. However, given a clear sky and a telescope or two, no astronomy enthusiast is ever completely disappointed, and this was definitely proven at the observing party of the 20th. There were over a score of us, several telescopes, and the clouds intermittently cooperated with observing plans, allowing us several extended periods of fine observing. When the clouds obscured the sky, we merely went indoors for coffee and what has been for many of us, one of the most enjoyable of social evenings together. Then when the skies cleared again, out we would go for more observing. All in all, it was a well balanced evening of observing and getting acquainted with each other.

As usual, the notices of the party had been given to the daily papers, but unfortunately did not appear in them. Our only guarantee that you will receive word of the extra observing get-to-gethers is to come to the club meetings and get your Report.

Another observing party will be held on Saturday, February 25, beginning at 8:30 p.m. at the home of Mr. and Mrs. W. H. Close, 225 Forkner Drive, Decatur. Please pass the word along to those of our group who are not here tonight so that as many as possible can make plans to come.