In this official NASA picture the mare Crisium, Tranquility and Fertility can be seen.
The W.A.S.P. is the official publication of the Warren Astronomical Society and is available free to all club members. Requests by other clubs to receive the W.A.S.P. and all other correspondence should be addressed to the editor. Articles should be submitted at least one week prior to the general meeting.

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Warren Astronomical Society
P.O. Box 474
East Detroit, MI 48021

President: Frank McCullough 254-1786
1st V.P.: Roger Tanner 981-0134
2nd V.P.: Ken Strom 977-9489
Secretary: Ken Kelly 839-7250
Treasurer: Bob Lennox 689-6139
Librarian: John Wetzel 882-6816

The Warren Astronomical Society is a local, non-profit organization of amateur astronomers. The Society holds meetings on the first and third Thursdays of each month. The meeting locations are as follows:

1st Thursday – Cranbrook Institute of Science
500 Lone Pine Road
Bloomfield Hills, MI

3rd Thursday – Macomb County Community College – South Campus
K Building (Student Activities), 14500 Twelve Mile Rd., Warren, MI

Membership is open to those interested in astronomy and its related fields. Dues are as follows and include a year’s subscription to Sky and Telescope.

<table>
<thead>
<tr>
<th>Membership Type</th>
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<tr>
<td>Student</td>
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Stargate Observatory Chairman: Ken Strom 977-9489

Stargate Observatory is owned and operated by the Warren Astronomical Society in conjunction with Rotary International. Located on the grounds of Camp Rotary, Stargate features a 12½" club-built Cassegrainian telescope under an aluminum dome. The observatory is open to all club members in accordance with the “Stargate Observatory Code of Conduct”.

Lectures are given at Stargate Observatory each weekend. The lecture will be either Friday or Saturday night, depending on the weather and the lecturer's personal schedule. If you cannot lecture on your scheduled weekend, please call the Chairman as early as possible or contact an alternative lecturer. Those wishing to use Stargate must call by 7:00 p.m. on the evening of the observing session. The lecturers for the coming month are:

Apr 1/2 ........ Stephen Franks ............... 255-7215
Apr 8/9 ........ Frank McCullough ............. 254-1786
Apr 15/16 .... Ron Vogt .......................... 545-7309
Apr 22/23 .... Alan Rothenberg .................. 355-8844
Apr 19/30 .... Doug Bock .......................... 533-0898

May 4/5 ...... Ken Strom .......................... 977-9489
May 11/12 .... John Root .......................... 464-7908
May 18/19 .... Stephen Franks .................... 255-7215
May 25/26 .... Frank McCullough .............. 254-1786

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What do you get when you cross an astronomer with an astrologer? The answer: a great debate, of course. That’s exactly what took place this past March 8 at Schoolcraft College. Hosted by the Livonia Astronomical Society, the Great Debate was comprised of a panel of three astronomers—Peter Keefe, Frank Galea, & Larry Kalinowski—and three astrologers—Paul Hudson, Jane Nugent, & Mary Kay Fiorento. An attentive audience of sixty was on hand to witness the wonders that were before their eyes. But there were no wonders. And there were very few surprises. As there was no one specific debate question, this debate was more in the form of presentations they were.

The astronomers touched on the facts that astronomy is science and has a definite pattern of cause and effect and that scientific methods reaffirm this. The astrologers defined professional astrology as the symbolic representation of forces affecting nature and they claimed that astrology goes beyond the physical space of astronomy and into the inner man and his nature.

What most of us should realize is that this debate didn’t attempt to answer one side as being superior over the other. It simply laid down the ideas and facts for both and let the individual think as he will.

--Judy Butcher
April 2 - Executive meeting, beginning at 5:00 p.m., at Frank McCullough's. All membership is welcome. Following this is the Deep Sky subgroup meeting. If clear it'll be held at Stargate. If cloudy there'll be a planned program indoors.

April 7 - Meeting at Cranbrook at 7:30 p.m. Star Bowl Warmup! Bring your questions on a 3x5 card. Past Star Bowl participants to be judges.

April 9 - Star Bowl in E. Lansing!

April 16-17 - Chicago Trip! Those interested contact Alan Rothenberg 355-5844.

April 21 - Meeting at Macomb County Community College. Meeting room to be announced. Talk on telescope construction will be given by Jack Brisbin, President Detroit Astronomical Society.

April 23 - Astronomy Day begins at noon at Cranbrook Institute of Science. We need volunteers! If you can help, contact Frank, 254-1786.

Do you have any questions or problems that you can never seem to get a sufficient answer to at meetings? If so be sure to attend the workshop subgroup meeting at Doug Bock's on April 14.
**Greek Alphabet**

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BOARD OF DIRECTORS MEETING

January 15, 1983

The meeting was called to order at 5:00 P.M.

The first order of business was to pass a bank resolution and sign signature cards for the Co-America Bank account.

The next board meeting is scheduled for Feb. 12 at 5:00 P.M. at Frank's apartment. All members are welcome to attend.

The President read the duties of each of the officers.

It was recommended that the Secretary tape record the business section of the General meetings at M.C.C.C. and print up the minutes for the WASP; also all Board of Directors meetings. The Secretary was directed to send a list of all new officers to the Astronomical League.

We discussed different programs which we could put on. We also discussed the operation of the observatory.

John Wetzel was appointed to be the new Librarian. The library is presently located at Dave Harrington's house.

The President was notified that the M.C.C.C. now wants our meetings to start at 7:00 P.M. and end by 9:00 P.M. Future meetings will be held in the 'K' Building (Student Union Building). Bob Lennox and Frank will notify the membership.

The membership dues have increased by $3.00 per member on January 1 due to an increase in Sky & Telescope rates. The bank balance was $353.61 as of the present date.

We are now making preparations for National Astronomy Day on April 23.

Alan Rothenberg volunteered to do Public Relations work, and to try to get more publicity on radio stations. He said that public service announcements have been made on station WQRS.

A tour of the Jackson Space Center is scheduled for Jan. 23. We meet at Doug Bock's house at 1:00 P.M.

The meeting ended at about 8:00 P.M., at which time the Deep Sky Observers session began. After this, a long discussion ensued about improving the observatory.

Respectfully Submitted,
Kenneth Kelly,
Secretary.
GENERAL MEETING

January 20, 1983

The meeting was called to order at 7:55 P.M.

The President introduced himself and the other officers for 1983, also Judy Butcher, editor of the WASP.

Paul Strong has been very kind to make the arrangements for our meetings at M.C.C.C. We will now start our meetings at 7:00 P.M. in the 'K' Building. Also, they do not want us to have any refreshments in the building. Our meetings have to end by 9:00 P.M.

The Treasurer’s Report:
This report covers the period Dec. 29, 1982 thru Jan. 19, 1983. When the Treasurer took office, the books were audited and there was a balance of $388.70. There were receipts of $20.00 and expenses of $55.09. The balance on hand Jan. 19 was $353.61.

We have a field trip scheduled to the Jackson Space Center coming up on Jan. 23. We would like to have everybody come. We had an Executive meeting and we tried to notify as many members as possible at the Cranbrook meeting. Basically, we were just getting things in gear and taking care of functions. We are having another one on the 12th of February at 5:00 P.M. We are preparing to put our Logo on T-shirts and sweatshirts and start a few other projects.

We are trying to get the observatory back in shape. The electronics are out of condition right now.

There will be an astro-fest in Ann Arbor on Feb. 11. The University Low-Brows are having their first annual “Low-Brow Freeze-out” on Feb. 19. It will be an all day convention with Ann Cowley and Dr. Molner speaking. There will also be a tour of the Detroit Observatory, which has a 12½ inch refractor. There will be a swap shop and observing at night if it is clear.

The business meeting ended at 8:15 P.M.

Respectfully Submitted,
Kenneth Kelly,
Secretary.
A night at Duck Lake
by Steve Franks

Last February 12th, Mother Nature blessed us with a most unusual event. A Saturday, a new Moon and a clear sky—all on the same date! Considering Michigan's moods, Jon Warren and I decided that the occasion was too precious to let slip by. After a last minute bout with an obstinate computer we finally coaxed it into giving the elongation and transit times for Polaris. Figures in hand we at last settled into the long ride up to Duck Lake for a promising night of observing. As Venus slowly set in the west we at last arrived.

After five courageous starts up the hill and four slides back down, we at last set up our home for the next six hours. With the telescopes erected and cooling in the brisk night air, we lit the stove, red lanterns and reviewed our observing program. The sky was clear, calm and inviting.

Majestic Orion was naturally our first target. M-42, the Great Nebula, became the first object of Jon's 10-inch reflector with me quickly following suit with my 4-inch refractor. With both instruments the nebula proved large and well detailed under medium powers. The Trapezium was crisp and easily split. After comparing contrasts with nebular filters we began searching for new and less familiar sights. Still in Orion, we trained in on NGC-2169, a loose cluster of about 15 stars, the brightest being about 8 magnitudes. The cluster bore the shape of a bow tie and the eastern half of the cluster was identical in configuration to the Hyades. A personal count of 16 stars was made with the 4-inch refractor at 12mm, while Jon counted 17 with the 10-inch reflector also at 12mm.

After a short warm-up break in the van, we began a search for NGC-2194 in Orion. After a long while, Jon found it. Even with a 10-inch light bucket, the globular cluster was barely visible. No sooner had we convinced each other of seeing it, it seemed to disappear completely.

Moving on, we located M-41, a galactic cluster in Canis Majoris and M-35 in Gemini. I thought M-35 one of the most impressive open clusters I've seen in the 4-inch refractor. M41 as a whole was circular with the brightest members forming a butterfly pattern. Most striking was the 6.9 magnitude red, variable star at the centre known as Espin's Star. Certainly worthy of future study.

The temperature was now dipping to 22 degrees at 22:00 hours. Jon and I repaired to the van for hot tea and vittles. As we relaxed and listened to Bach's Brandenburg Concertos, we talked shop and updated our notes.

In spite of the welcomed warmth, we braved the night again to find M-45 and M-47. Barely 2 degrees apart these two clusters lie in Puppis. M-46, 5400 light years distant, rates as a 6th magnitude object but was not bright. In the northern edge of the cluster is the planetary nebula NGC-2438. The planetary was difficult to locate and best seen with medium to high powers. M-47, on the other hand, was loose and bright containing about 50 stars, the brightest star, 5.7 magnitude. M-47 is often called the "missing" Messier object due to a position entry error in his now famous catalogue. With the 4-inch refractor many color stars were seen in low powers. Jon's 10-inch,
with his larger field, of view, made it all the more spectacular. M-47 also contained a binary star both of 7.9 magnitude near its centre. The primary star-E1121 (Struve) and its companion are separated by 7.4 seconds of arc at 305 degrees of position angle.

M-3 in Canis Vanatici gave us a real run for our money being located half way between Cor Coroli and Arcturus. After half an hour and 11 degrees of sky, we both came on it at the same moment. At long last Jon’s greater aperture put me to shame and provided a grand sight! A tight swarm of over 44,000 stars in a globular cluster some 30,000 light years distant. With averted vision many stars resolved into view. As my eye adapted, direct viewing in no way diminished what I saw. In fact, a peculiar feeling of falling toward it began to be disarmingly felt the longer I looked. Unforgettable.

Now determined to put Jon in his place, I challenged him to split Eta Orion, a very close binary of 1.4 seconds arc. At 6mm the 4-inch refractor easily split it with dark sky between them. After minutes of mumbling and juggling eyepieces, Jon quietly gave up. My honour having been restored I suggested a truce over hot tea.

At 02:00 hours Saturn rose high enough over the trees in the southeast to offer itself as our final object of the evening. Though “swimming” on the unsteady horizon the rings were stark and well tipped to the south, exposing one lonely equatorial band on the planet’s surface. Titan was well off to the northwest in the eyepiece.

Cold, tired, but well satisfied, we limbered up and headed for home.

Escape Velocity Part II

Bruce Johnston

Now that we have seen a formula for calculating escape velocity, I could rest the case at this point and say that the equation:

\[ V(\text{esc}) = \sqrt{2GR} \]

is all we need to calculate the escape velocity for any planet or star. Well, it’s true that the equation will give us the proper answer, but frankly, I happen to find it a pain in the neck for anything other than on the surface of the Earth itself. Why? For one thing, most charts of the statistics of the Solar System refer to mass, surface gravity, etc. compared to Earth. i.e., Jupiter’s mass will be given in Earth-masses, its surface gravity in earth-ratios, etc.

If this is to be the case, then it would be more beneficial for us to develop an equation or two which is based on these ratios. I’ll work toward my preferred equation in a round-about way, so as to show how we get there.

It’s perfectly acceptable to express a planet’s surface gravity in “Earth-ratios” so long as we know what the surface gravity for Earth happens to be. Likewise, if we know Earth’s radius, we can accept “Earth ratio” radii as well. We can even incorporate these ratios into our equation for Escape velocity and, hopefully, come up with the Escape velocity for any planet. Let’s use Mars as an example.

Mars has approximately .538 “earth-radii” for a radius. It also has a surface gravity of about .4 “Earth gravities”.

We can then, if we so desire, figure the Escape velocity for Mars by modifying the original equation accordingly.

\[ V(\text{esc}) = \sqrt{2 \cdot G \cdot \text{(Earth-ratio “G”s) \cdot R \cdot \text{(Earth-ratio Radius)}}} \]

Let’s see if this somewhat cumbersome equation even works before we set about simplifying it.

\[ V(\text{esc}) = \sqrt{2 \cdot 9.80665(10^{-3}) \cdot .4 \cdot 6378 \cdot .538} = 5.2 \]

Escape velocity for Mars, then, is about 5.2 Km/Sec. If you look the answer up, you’ll find that this is within 3% of the accepted figures (depending on which reference book you use). The reason for the error is because (1.) Our numbers for Earth-ratios are not exactly accurate, and (2.) We’re assuming Mars to be a non-rotating, perfect sphere. (I’ll leave the oblateness of the planets and the centrifugal effects from their rotations to those who wish to go more deeply than me.)

At any rate, my point is made; the equation DOES work. Now, how to simplify it?

We can re-write the above equation in the following form, if we so desire.
\[ V(\text{esc}) = \sqrt{2} \cdot \sqrt{G} \cdot \sqrt{R} \cdot \sqrt{\text{Earth-ratio } \text{"G"}} \cdot \sqrt{\text{Earth-radius}} \]

But why bother? All I did was put each part under its own radical sign, and, in the process, re-arrange their order. (Bear with me, please. I promise I'm heading toward a simpler equation!)

Now I can combine the first three radicals and the last two, like this (If I don't run out of room.)

\[ V(\text{esc}) = \sqrt{2} \cdot G \cdot R \cdot \sqrt{\text{Earth-ratio } \text{"G"}} \cdot \text{Earth-ratio radius} \]

You'll recall from part I of this discussion that:

\[ \sqrt{2} \cdot G \cdot R = 11.2 \text{ Km/Sec.} \] (I rounded it off a bit.)

Why not just substitute the number, so long as they're equal? If we do this, we come up with:

\[ V(\text{esc}) = 11.2 \sqrt{\text{Earth-ratio } \text{"G"}} \cdot \text{Earth-ratio radius} \]

Finally, I'll shorten the two terms under the radical. Instead of “Earth-ratio ‘G’”, I'll just call it “G”. (Remember, in this equation, “G” will stand for “Earth-ratio ‘G’” and NOT the actual “G”.

Likewise, I'll replace the long term “Earth-ratio radius” with just the letter “R”. Again, don’t confuse it with the ACTUAL radius of a planet, it represents the “Earth-ratio radius”.

Our final equation, then, is:

\[ V(\text{esc}) = 11.2 \sqrt{G \cdot R} \text{ Km/Sec.} \]

Let’s apply it to the planet Uranus to see what we get.

The “Earth-ratio ‘G’” for Uranus equals 1.00 (Lucky us) The “Earth-ratio radius” is about 4.186

Using the equation, we get:

\[ V(\text{esc}) = 11.2 \sqrt{1 \cdot 4.186} = 22.91 \text{ Km/Sec.} \]

About a 6% error, compared to my reference book. Not bad, with our simplifications in place.

We can then use the above equation for any planet or moon, in order to calculate its Escape velocity.

I'm not satisfied.

The equation, like our first one DOES work, but what if the “Earth-ratio surface gravity” can’t be found in the table you're using? Or, more to the point, what if you want to figure the escape velocity for an object that isn't on the surface of a planet or
moon, but rather, an object in orbit some distance ABOVE the planet? The “Earth-ratio ‘G’” could be calculated, but it’s an unnecessary pain.

Fortunately there are, on most charts for the statistics of the Solar System, at least two facts given; the Planet’s mass and its radius (Both, generally, in Earth-ratios). We’ll just have to modify our last equation again, so as to be dealing with mass and radius, rather than gravity and radius.

(Off I go on another tangent.)

You’ll recall from our first discussion that I said the acceleration of an object under the influence of gravity depends on the mass of the planet (solely) divided by the square of the distance between the objects. (The distance, we can assume to be the radius of the planet, if we’re talking about Escape velocity from the surface of the planet.)

\[ A = \frac{M}{D^2} \]

Since the acceleration we’re referring to is the acceleration under the force of gravity, we can simply say:

\[ G = \frac{M}{D^2} \]

This means that we can interchange the terms. We can also interchange the “G” which represents “Earth-ratio ‘G’” for “Earth-ratio mass” divided by “Earth-ratio Radius” squared. That being the case, we can write our latest equation for Escape velocity.

\[ V(esc) = 11.2 \sqrt{G \cdot R} = 11.2 \sqrt{\frac{M}{R^2} \cdot R} \]

The values under the radical, when simplified, become: \( \frac{M}{R} \)

Our final equation for Escape velocity then becomes:

\[ V(esc) = 11.2 \sqrt{\frac{M}{R}} \text{ Km/Sec.} \]

One final reminder: the values under the radical are “Earth ratio” values. Don’t forget it; it’s very important when using this short-cut equation.

Let’s see how the new equation works for the planet Saturn. Saturn has an “Earth-ratio” radius of about 9.45 (On the average, since Saturn is very elliptical in shape). It also has an “Earth ratio” mass of 94.1. Plugging these numbers into the latest equation we get:

\[ V(esc) = 11.2 \cdot \sqrt{\frac{94.1}{9.45}} = 35.3 \text{ km/sec} \]
This figure comes out to be within .2% of the published figures for Saturn. Pretty doggoned good!!

Another example we might try would be to see what the Escape velocity would be for an object orbiting the Earth at the same (average) distance as the Moon. Since the distance to the Moon from the center of the Earth is about 60.58 “Earth-radii”, then the Escape velocity would be:

\[ V(esc) = 11.2 \cdot \sqrt{\frac{1}{60.58}} = 1.44 \text{ km/sec.} \]

Since the velocity of the Moon in its orbit is, on the average, pretty close to 1 Km/sec., this tells us that if we could somehow increase the velocity of the Moon about 44% it would escape the Earth. (This number, although only approximate, is by no means arbitrary. We will eventually see --- but not in this discussion --- that if we were to increase almost ANY planet or moon in the Solar System --- with the sole possible exception of Pluto --- by about 44%, it would escape its parent body.)

The discussion about the Moon escaping the Earth just naturally leads me to wonder about the Escape velocity of the Moon itself.

The Moon has about .01228 Earth-masses and about .27 Earth radius. The Escape velocity for the Moon, then, is:

\[ V(esc) = 11.2 \cdot \sqrt{\frac{.01228}{.27}} = 2.38 \text{ km/sec.} \]

Just as if I didn’t have some ulterior motive, I next innocently suggest that we find the Escape velocity for an object orbiting the Sun at a distance from the Sun equal to that of Earth. The mass of the Sun is 329,390 Earth-masses and the distance from the Earth from the Sun is 23,362 Earth-radii, so the Escape velocity for an object way out here near Earth is:

\[ V(esc) = 11.2 \cdot \sqrt{\frac{329,390}{23,362}} = 42 \text{ km/sec.} \]

So what? Is it just another example of Escape velocity? Yes and no. It is, but it also shows that, even on the very surface of the Earth, the Escape velocity from the Sun is greater than it is from the Earth itself. This means that, just because we reach Earth’s Escape velocity and escape the Earth, we WON’T escape the Sun, but will instead fall into an orbit around the Sun.

This isn’t true for Jupiter, Saturn, Uranus, or Neptune, but it is for Mars and all the planets from there into and including Mercury.

Although I won’t go into detail about it at this time, it is worth pointing out that, by using the equation we’ve been using, we could re-arrange the equation and even find out some interesting facts about black holes. We could, for instance find the size we’d
need to shrink the Earth or the Sun down to in order to make it into a black hole. How? Simply by re-arranging the equation to solve for “D”, and see what the radius need be in order to have an Escape velocity of 300,000,000 meters/sec.----- the velocity of light. At that exact radius, the planet or Sun would then become a black hole, by definition.

One final point that is unique about Escape velocity. If we were to leave Earth at 11.2 km/sec. and we were then to calculate our velocity at various distances from Earth, we’d find that we’d be moving at exactly the Escape velocity for that distance from Earth (again assuming that only we and the Earth were alone in the universe).

In other words, once an object is moving at Escape velocity, it will remain at Escape velocity forever!

See? I told you that Escape velocity was Special. Maybe next time you’ll believe me when I tell you something!!
This month we will finish our discussion of the micrometre with our second and final installment.

The outside diameter of the dial can be of any convenient size, but the inside must fit snugly to the adapted tube. It may be made of wood or cardboard; it should be either shellacked or painted, and it is then divided into degrees. In marking the degrees, you have to remember that there are 360 degrees in every circle and to the circumference of the dial accordingly. Rub-on transfers make a neat job for the numbers.

To determine its position, refer to figure 61B and note the distance from the eyepiece at which it is placed in order to allow the observer to put his eye to the lines. A collar placed in back of the dial around the circumference of the telescope tube will serve to keep the dial in place.

Used with the dial, the eyepiece pointer helps to give the exact position. It may be made of aluminum strap, and one end should be attached to the eyepiece cap, but since the exact method of installation depends upon the nature of the eyepiece this procedure should be determined by the individual. The completed instrument is shown in figure 61B, and a careful study of this diagram will make the construction and arrangement of the parts clear.

When the instrument is completed, it is essential to determine the distances separating the parallel hairs. To do so, direct the telescope at a star that is as close as possible to the celestial equator and near the meridian.

Adjust the eyepiece so that the vertical hair is parallel to the equator, and move the telescope back and forth from east to west. This will cause the star selected to make a fine trail of light from one side of the field to the other. The vertical hair will, of course, also be parallel to this line of sight. Now move the telescope until the star is at the extreme eastern side of the field, and let it remain so. As the star advances toward the west, it crosses each hair.

Make a note of the time intervals between these crossings. The distance between each crossing is equal to the separation of the hairs in seconds of time. To convert this reading into seconds of arc, multiply the number of time seconds by 15.

Figure 52A shows an example of how the micrometre may be put to use. The diagram shows the planet Jupiter; a nearby star is also in the field.

The first problem is to find the position angle, or line of Jupiter’s declination to the star. The horizontal wire is adjusted to run through the Planet, and the eyepiece is turned until, as the planet moves from east to west, it is bisected always by that wire. The base line is thus established, and now the dial is turned, the eyepiece remaining fixed, until the mark 270 is indicated on the eyepiece pointer. Leaving the dial fixed, the eyepiece is now turned until the central horizontal hair (“H.H.”) bisects the star and the planet. The reading of the dial at this point is equal to the angle X in Figure 62A, in this case about 25 degrees.
A double star in the inverted field of view of a position micrometre. The fixed and moveable wires (a and m) are set on the components stars to measure their distance apart. The parallel wires indicate position angle, which here is about 310°. The arrow shows the direction in which the star drifts when the driving clock is stopped; therefore is west.

A bi-filar micrometre with crosswires

Position angle dial
Use of a position micrometre to measure Jupiter's position relative to a nearby star.  

A. Vertical hair north-south.  
B. Vertical hair adjusted position angle.
After this, the next observation is to determine the distance from Jupiter to the star in units of arc. The eyepiece is turned until the vertical hair bisects the star and the planet. The horizontal hairs being used as a micrometre (Fig. 62B); the planet is bisected by the prime horizontal hair, and distance to star is judged in relation to the separation of the two hairs.

In the drawing, the star is about 0.75 of the distance between the cross hairs; we have but to multiply 0.75 by that value to obtain the distance from the comparison star. The other hair can be used in the same way.

Having two position observations (angle and distance between planet and star) it is an easy matter to plot the planet’s motion with a ruler and protractor as in figure 62C.

For those who can afford to buy it, Meade makes a 12-millimetre illuminated eyepiece with a micrometre reticle. This is what I am presently using in conjunction with the dial and pointer. With it closer and more exact distances can be obtained. For the truly dedicated (and rich), a bi-filar micrometre can be purchased from Ron Darbinian, 2546 Arroyo Grande, CA 93420. Prices start at 239.00.

Some excellent books for those interested in binaries that I would recommend are: Burnham’s Celestial Handbook by Robert Burnham, Celestial Objects for Common Telescopes by Rev. T.W. Webb, Observing Visual Double Stars by Paul Couteau. If anyone has other books or ideas in mind, let me know.
This month’s formula is one of the most fundamental and useful to the amateur astronomer - the formula for Dawes’ limit. W. R. Dawes was a famous 19th Century English astronomer. One of his most renowned accomplishments was the empirical derivation of a formula for calculating the resolving power of a telescope. Resolving power is the ability of a telescope to distinguish fine details (e.g. seeing fine markings on a planet or resolving a close double star). Dawes’ limit formula allows you to calculate the smallest separation of a double star that a given telescope aperture will resolve. All you need do is plug the diameter of the telescope's objective in inches into the following formula:

\[ R = \frac{4.56}{D} \]

Where “R” is the resolution limit in seconds of arc (60 seconds of arc = 1 minute of arc and 60 minutes of arc = 1 degree) and “D” is the diameter of the telescope objective in inches.

Bear in mind that Dawes’ limit will only be reached under ideal seeing conditions, with ideal optics by an observer with good eyesight. Also, the formula assumes that each component of the double star is of the same approximate magnitude and that neither is dazzlingly bright. Both of these latter conditions will reduce resolution.

Armed with Dawes’ limit you can look at a current table of double stars and immediately tell whether or not the double is easily resolvable, a close challenge, or clearly impossible to resolve with your telescope. Doubles near the Dawes’ limit are the most interesting. By trying to split them, you can find out: how good your optics are and/or how good the seeing is and/or how good your eyesight is. Repeated practice should tell you which one is which. Dawes’ limit also gives you a convenient method of comparing one telescope to another on paper (e.g. How much more resolution, theoretically, will a 12 inch telescope give you than the 8 inch you already have?)

One final note about Dawes’ limit: it’s not an absolute limit. Under unusually good seeing conditions, and/or with people having exceptional eyesight, Dawes’ limit can and has been exceeded.

As always, if you have questions or comments on this column send them to:
Ken Wilson, 1780 Clarkson, Apt. C, Richmond, VA 23224.

Happy calculating and observing!
Although you doubtless haven’t read about it in any of the popular Astronomy or Science journals, an amazing invention was recently developed by the Research department at Columbia University. Were it not for the fact that Mr. Lirpa just happens to have a cousin employed there in the Maintenance Department, I would never have learned of it and wouldn’t be able to relay the information on to you. What follows is the story behind the most exciting development in the field of Astronomy since the telescope … and its tragic demise.

As I’m sure you’re well aware, all objects -- stars, planets, dust, gas, etc. -- have some amount of mass and therefore develop gravitational fields, however small. It has been shown by theory that a gravitational field actually consists of sub-atomic particles being emitted (the particles are known as “Gravitons”), but detection of these particles has never been firmly established. That is, not until this past year.

In 1980 at Bell Laboratories, a new electronic component known as the “Scan Diode Matrix” (S.D.M.) was invented. This particular component was an offshoot of research being done in the area of new forms of computer memory devices. Exactly how the S.D.M. works is classified, but certain unexpected characteristics of the component were not lost on Dr. Helmut Angstrom and Dr. Leonardo Scaparelli at the Research center at Columbia University.

The researchers found that the S.D.M., when enclose in an environment of pure hydrogen, could not only detect Gravitons but could convert them one-for-one into photons. In short, Gravitons could be turned into visible light and could actually then be seen!

The first practical application of the principle came when their device (it never received a name) was attached to a 24 inch reflector telescope --- used to gather and focus the Gravitons in exactly the fashion it is used to collect and focus visible light --- and was turned to the skies. The Gravitons streamed into the telescope, were focused in the Graviton-converter, and a yellow light was emitted out the other side, just as had been predicted. The light was then viewed using a standard Erfle eyepiece.

What the two professors saw was an entirely different sky than had ever been seen before. Objects of large mass -- which generate many gravitons -- appeared as extremely bright points of light, regardless of how much visible light they emitted. Objects of small mass, on the other hand, appeared as very faint “stars”.

They found that there were no visible nebulae, for their mass was far too low. Likewise, they discovered that the pulsar in the Crab Nebula appeared as bright as would the star Vega to a visible light astronomer.

Many binary stars took on what appeared to be reverse rolls. As you know, many binaries consist of a bright giant red star and a dim, massive companion star. With their device the small, massive
star shone brilliantly, while the less massive giant reds dimmed to the point of being just barely visible, if at all.

But this is only the beginning of the story. Next, they modified the device by ionizing the Hydrogen gas which contained the S.D.M. and found that they could, with the use of magnetic fields, align the Hydrogen atoms. With the unique characteristics of the S.D.M. in a field of aligned Hydrogen atoms, they developed a new type of interferometer. This new device had completely different properties than the first one. With this one, they could detect SIZE rather than MASS but with a great difference. The SMALLER the object, the BRIGHTER it appeared, while LARGE objects appeared very DIM.

The first object they viewed with the new version of the device was the star Sirius. The bright star Sirius-a all but disappeared while the white dwarf Sirius-b shown brighter than does Sirius-a to a visual observer using a similar size telescope.

This second modification to their device was improved upon until there was virtually no object too small to be detected. In actual fact, an object as small as the nucleus of a carbon atom at a distance of four light-years was detectable (at least in theory, for no object with such a small angular size had as yet been observed. If it were, the light output would be almost unbelievably bright!)

Nebula could now be easily detected with the new modifications, for they were made up of dust particles as well as atoms of various gasses, while Betelgeuse was observed as a twelfth magnitude star. Our own Sun, by the way, appeared completely black, as did the Moon, for their size was comparatively gigantic, even as seen from Earth.

The final -- and fatal -- step was to combine the features of the two devices. The reasoning was that if they did so, they could detect only small, massive objects such as white dwarfs and Neutron stars. Hopefully such stars would be detected in abundance. Their reasoning was absolutely correct ... to a fault.

I have no information on how they overcame the technical problems but the characteristics were, indeed, combined and the new device was attached to the giant light-bucket at Mt. Palomar.

On the fateful evening of the initial test, the telescope began sweeping the western edge of the constellation Virgo and, as was predicted, white dwarfs and neutron stars of countless numbers were observed and charted for the first time. Some of the more massive and more distant Neutron stars were so brilliant that frosted glass had to be inserted between the eyepiece and the viewers eye, lest the brilliant light cause permanent damage to the viewers eyes.

Then the totally unexpected happened.

It is only with hindsight that the two professors were able to conclude what happened next, for suddenly everything seemed to happen at once.

Apparently, as the giant telescope was scanning an area in Virgo known as the “Realm of the Galaxies”, they happened across a Black Hole of almost unbelievable mass, which, in itself, would not be fatal, but would generate tremendous amounts of light. Unfortunately, it so happens that such a massive black hole would collapse down to NO physical size whatsoever! This particular black hole was still in the process of collapsing and just happened to have reached the lower limit of the devices’ detection, which resulted in maximum graviton-to-photon conversion (or, in common terminology, maximum possible light). Coupled with this minimum-size maximum light
was the original maximum-mass maximum light, both of which were Intensified a thousand fold by the sheer size of the giant telescope.

The final result of all this tremendous light production was heat. Inside the device the temperature instantly rose to an excess of ten million degrees Celsius. At such a temperature, hydrogen can and does fuse into helium. In short, several of the hydrogen atoms in the device became a miniature Hydrogen Bomb. The device turned into a fifteen inch high mushroom cloud and disappeared!

Fortunately the fusion reaction was of such a small scale that the telescope was undamaged and none of the observers was seriously hurt, although Dr. Angstrom did develop a rather severe case of sunburn.

Although the final test was a near-disaster, Drs. Angstrom and Scaparelli have begun assembly of another device which will again be put to a test, but with greater safeguards installed. What is the date for the planned test? You guessed it. April 1 !!!

Authors note: In the event that you still doubt the validity of this story, I suggest that you attempt to read the names of the authors ... backward!
17 March 1983 Ken Strom

The mirrors from the Stargate telescope were in need of a new coating. Since the last surface was BERAL and seemed to hold up longer than straight aluminum coatings, the mirrors were sent to P. A. Clausin Co., Skokie, Ill. on 7 Feb 1983 for a recoating with BERAL. The mirrors were received back on 11 Mar 1983 with a good looking surface and will be installed the weekend of 18 Mar 1983. I asked Clausin what caused the degrading of the coating. The reply was as follows:

“The coating on the 12.5” mirror had deteriorated due to moisture. Do not let frost or humidity condense on the mirror surface and remain there to dry. Some people have solved this problem by placing a light bulb in the telescope, using small heaters, or attaching heater wires to the back of the mirror. The main precaution is to keep the mirror surface dry and clean.”

We will have to devise some method of keeping our mirror dry, because it was covered with frost when it was removed from the telescope. One suggestion was to use a light bulb attached to the large dust cover which would be left on to warm the telescope. Another suggestion was to use a thermistor circuit to sense when the mirror was colder than the outside air, and then turn on a heater. The problem seems to be that the main mirror takes a long time to heat and cool, so it can be much colder than the air, and condense moisture from the air. We are open to all suggestions and are in need of some help to solve this problem.

It’s Time For Spring Cleanup-Fixup At Stargate

Mark your calendars this coming event at the observatory. The date is Saturday 16 April. We need help with the following projects;

1) Replace the ladder supports on the south side of the building
2) Fill in the holes and cracks in the walls of the building
3) Need a lettering expert to make UP some signs describing the operation of the telescope
4) Need someone with a drill for concrete to install picture hangers
5) Need to realign the telescope to the celestial pole.
6) evict the wasp family (yes, our mascots)

Special Projects include:

1) Installing new outdoor socket boxes and a ground fault interruptor
2) Devising a lighting system for the setting circles
3) Fixing the drive corrector oscillator circuit
4) Drawing the club logo on the north side of the building
5) Making a light box for reading charts
6) Making the devices for measuring binaries and variable stars

If you are interested in any of these special projects please contact me (575-3451 days 977-9489 nights). If you don’t, I’ll call on you. Let’s get together and make Stargate a good working observatory again.