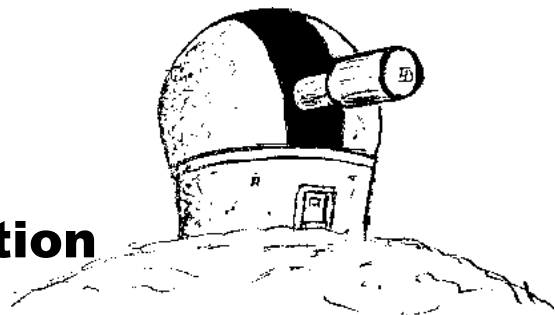


SDAA

San Diego Astronomy Association

Promising the Sun, the Moon and the Stars... and Delivering!



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Observatory (619) 766-9118
A Non-Profit Educational Association
WWW – <http://www.sdaa.org>
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**SDAA BUSINESS MEETING
WILL BE HELD AT
SKF CONDITION MONITORING
4141 RUFFIN ROAD
SAN DIEGO CA 92123-1841**

**DON'T forget to mail in
your invitation RSVP.
The invitations were
mailed out late.**

**So PLEASE Mail
your check and
invitations as soon as
possible.**

*SDAA 2001 Banquet
This year's banquet is going to
held at the Hanalei Hotel on
February 9th.*

*Look for your invitations in
this issue. All information
will be on the invitation.*

**Our speaker will be
Terence Dickinson.**

CONTENTS

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The Rainbows _____	2-3
SkyWatch _____	4
Business Meeting _____	5
E-mails/phone numbers _____	5

News and Notes

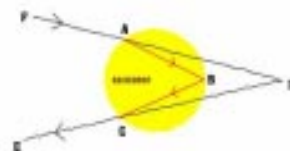
January 2002

Did you ever wonder how a rainbow was formed or what makes the bow?



What is a rainbow? The rainbow is one of the more spectacular light shows observed on earth. The traditional rainbow is sunlight spread out into its spectrum of colors and diverted to the eye of the observer by water droplets. The "bow" part of the word refers to the fact that the rainbow is a group of nearly circular arcs of color all having a common center. Typically, we only see a portion of the entire circle, leading to the bow shape.

What makes the bow? To understand how the bow is formed we need to consider the path of a ray of sunlight through single round raindrop. As light enters the raindrop, it is refracted (the path of the light is bent to a different angle), and some of the light is reflected by the internal, curved, mirror-like surface of the raindrop, and finally is refracted back out the raindrop toward the observer.



This schematic represents the path of one light ray entering a raindrop at point A. As the light beam enters the surface of the rain drop, it is bent (refracted) a little and instead of continuing to point D, strikes the inside wall of the raindrop at point B, where it is reflected back to point C. As it emerges from the raindrop, it is refracted (bent) again into the direction E. The angle created at point D is 42°. The ray drawn here is significant because it represents the ray that has the smallest angle of deviation of all the rays that can enter the raindrop. This means that much of the sunlight that is refracted and reflected through the raindrop is focused along this path. This is known as the *rainbow ray*.

Since the raindrop is circular, the reflection it creates is also circular. We don't see a full circular rainbow however, because the earth gets in the way. The lower the sun is to the horizon, the more of the circle we see. At sunset, we would see a full semi-circle of the rainbow with the top of the arch 42° above the horizon. The higher the sun is in the sky, the smaller the arch of the rainbow above the horizon. If the sun is more than 42° above the horizon, no rainbow will be visible. So, the main ingredients to see a rainbow are the following:

- You need to be standing with the sun to your back and the rain in front of you.
- The sun needs to be less than 42° above the horizon.
- The sun's rays must be hitting the raindrops to create the rainbow.

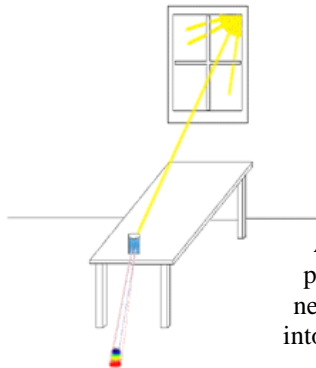
(cont'd on pg 2.)

What makes a double rainbow?

CHECK OUT THIS WEBSITE:
<http://nimbo.wrh.noaa.gov/Flagstaff/science/>

by Steve Beeson, *Arizona State University*

Sometimes we see two rainbows at once. What causes this? We have followed the path of a ray of light as it enters and is reflected inside the raindrop. But, not all of the energy of the ray escapes the raindrop after it is reflected once. A part of the ray is reflected again, and travels along a different path inside the drop to emerge from the drop at a different angle. The rainbow we normally see is called the **primary** rainbow and is produced from one internal reflection. The **secondary** rainbow arises from two internal reflections and the rays exit the drop the second time at an angle of around 50° , rather than the 42° for the primary rainbow. This effect produces the secondary rainbow, with the colors *reversed* from the primary rainbow. It is possible for light to be reflected more than twice within a raindrop, but these additional rainbows are typically never seen under normal circumstances.



Everyone has seen a rainbow. They are arguably one of the most beautiful displays of nature, and they seem to come in many different sizes, situations, and settings. But what is a rainbow? If you ask, most people will say that a rainbow is “light going through raindrops” or something to that effect. That is correct, but it’s not the complete answer. In this lesson we will learn how and why rainbows form and how you can make one yourself in the classroom.

At home, put a glass filled with water near the edge of a table that is bathed in sunlight or some other parallel light source. As in the drawing below, a “rainbow”, or spectrum, should appear on the floor near the glass. In this case, the glass of water is acting like a prism and is dispersing the white light into its many colors

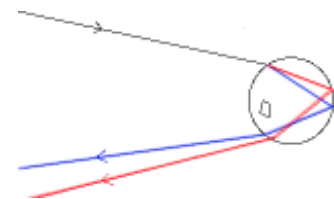
What causes rainbows?

Did you try making a rainbow with the water-filled flask? If you haven’t, please attempt this exercise now. If you have tried, but you couldn’t make a rainbow, think about what the water can do besides **refract** light. What is the white posterboard used for? If you have figured it out, why did the rainbow appear where it did?

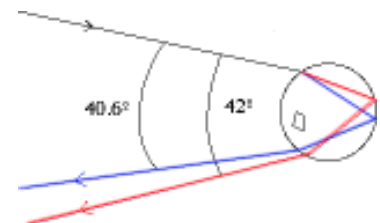
Think back for a second to the last time you saw a rainbow. Where were you standing relative to the sun? Were you looking **toward** the sun or **away** from it? Most likely **away** from it. In fact, it was directly behind you, as you looked at the rainbow. And the rain was probably somewhere in front of you. So the light must have been bouncing off the raindrops and reflecting back into your eye. OK, the sun was reflecting off the

raindrops.....but why do we see colors? The colors are present because the sun is not only **reflecting** off the raindrops, it is also **refracting** in the raindrops (see the drawing below). Notice in the drawing how the raindrop acts like a **prism**, splitting the white light from the sun (on the left) into its component colors. For simplification, I have only shown the red and the blue beams. But notice also how the raindrop acts like a **mirror**, in that it reflects (some of) the refracted light back toward the sun. These **reflected** rays are the ones that you see as a rainbow.

When the white light from the sun hits the raindrop, the light is first **refracted** as it enters the raindrop, much like we observed in Submodule 2 with the prisms. The separate colors are then **reflected** from the backside of the raindrop and exit, where they refract



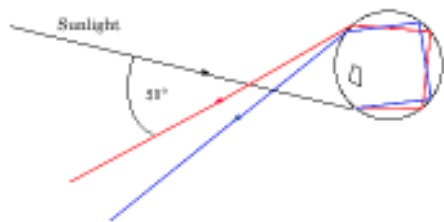
once again, due to the change of index of refraction between the water and the air. The angles at which each color emerges is obviously different (or else you wouldn’t see different colors!): red light emerges at 42° and blue light emerges at 40.6° relative to the incoming ray of sunlight.



What is a secondary rainbow?

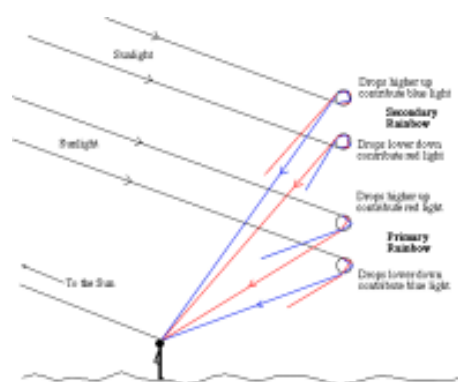
by Steve Beeson, *Arizona State University*

Every once in a long while, if you get lucky, you may see a **second** rainbow on the outside of the first, brighter rainbow. This is the “secondary rainbow” and occurs because of raindrops that are higher in the atmosphere than those causing the “primary rainbow”. The higher raindrops will internally reflect the sunlight **twice** rather than just once.



Notice that the sunlight hits the **bottom** of the raindrop to make the secondary rainbow. There is **still** sunlight hitting the other parts of the raindrop. However, some of the light is simply transmitted through the raindrop without reflecting, and some light is reflected and refracted, but not into our eyes. That light is for someone else’s rainbow.

Notice also that the red and blue lines are **switched** in comparison with the colors from the raindrops making the primary rainbow. What does this mean in regards to the colors of the secondary rainbow? What color is the innermost “bow”? What color is the outermost “bow”?



Examples of optics and light in nature are all around us—rainbows, glories, sundogs, iridescence on animals, halos, and the earth’s shadow. These are just a few examples of the myriad of natural optical phenomena that happen everyday, in your backyard or right over your head.





Promising you the Sun the Moon and the Stars and delivering...

Camp With The Stars by Michael Dietz



Eight members joined me, along with a couple of hundred campers, at Vallecito on November 17th to watch the Leonid meteor shower. The waves of high clouds made the viewing conditions less than perfect, but it was still quite a show. There were many bright bolides which were visible through the clouds, and many more meteors visible when the skies cleared. The shower peaked around 1:30 - 2:00 Sunday morning at which time we could see about one meteor every three seconds (1200 per hour). It was not uncommon to see 2 or 3 at the same time. It was a night I will never forget. There were far too many meteors to keep track of, but I would estimate that I saw several thousand over the entire night.

We will be in the desert at Vallecito Stage Station Campground on January 12th and February 16th for our Camp With The Stars Program. If you have a telescope that you can share with the campers you are welcome to join us and camp for free. If you like, you can come up on Friday and enjoy the

campground an extra day/night. Don't forget to bring a towel and swimsuit so you can take a dip in the pool at Agua Caliente Hot Springs at no charge. To reach Vallecito Stage Station take I-8 East to Ocotillo, and then take Hwy. S-2 North about 30 miles to the campground which is about 4 1/2 miles north of Agua Caliente Hot Springs. Those of you that are coming from the North County area can take Hwy. 78 through Julian to Scissors crossing. Turn right and head South on Hwy S-2 to the campground.

I hope to have the remaining dates and locations for the 2002 Camp With The Stars program set by next month's newsletter. They will most likely include Vallecito, William Heise, Borrego Palm Canyon, and Paso Picacho campgrounds with Lake Morena, Mission Trails, and Poway Lake also possible locations. It is going to be another fun-filled year for the Camp With The Stars program.

Acknowledgments by Michael Dietz

The club would like to thank Roy Ang, Don Beaman, Dean Belcher, Rich Bentley, Tim Boller, Carolyn Corless, Peter DeBaan, Richard Devine, Mike Dietz, Shawn Kelly,

Jose Magsaysay, Nick Marilao, Joe McGerald, Laurie Morin, Bob Nanz, Jennifer Pesqueira, Lin Robertson, Cindy and Terry Stewart, Bob Wetzell, and Bill Whalen for helping with the school star parties, Camp With The Stars, and Stars In The Park programs. Your efforts are greatly appreciated by the students, parents and teachers.

Wanted!

8" Couler telescope. Please contact Peter Shearer at 858-534-2260 (work), 858-450-1464 (home), or pshearer@ucsd.edu. *(Editor's note: the person who is trying to find this scope is one of this past year's Science Fair SDAA Award Winners! It is truly a pleasure to see one of SDAA's own students continue to pursue astronomy. If anyone can help out here, please let us know!! ddj)*

Past Board Meeting

Minutes of Past Board Meeting were not submitted for publication by the Secretary.

SkyWatch for January 2002

by John Mood



[Times PST] [* = Easy] [** = Moderate] [*** = Difficult]

Tues., 1 Jan. — Happy New Year! Sun., 13 Jan. — NEW MOON, 5:29 a.m.
Sat., 5 Jan. — STAR PARTY @ Tierra del Sol. Mon., 28 Jan. — FULL MOON 2:50 a.m.
Sat., 12 Jan. — STAR PARTY @ Tierra del Sol.

EVENING PLANETS: MERCURY [*½] has its usual very quick appearance the first half of this month; moving in Aquarius, it's highest in the sky on 11 Jan., but is virtually gone by the 19th. MARS [*] is still hanging in there in Pisces. The "stars" of the planetary apparitions this month are of course SATURN [*] near the Hyades in Taurus (its rings are as good as they get!!) & giant JUPITER [*] at Gemini's feet.

MORNING PLANETS: None! (When was the last time that happened?) Well, okay, Jupiter is up all night, so you early birds can view it, + you have a special treat on the morning of Thurs., the 17th, when its 4 Galilean satellites are in correct order off the eastern edge of the planet. In the '70s, when I was just starting out observing through a 4½" Newtonian reflector on the public pad at Tierra del Sol, I frequently set up my scope next to an old man by the name of Howard Wang, a long-time, interesting & well-traveled member of SDAA. (It turned out he had driven the length of Baja California in the '30s!). He had a cot & a 3½" reflector. He liked to take a nap at Tierra del Sol & then observe double stars, a passion which I came to share. The lovely variety of matched doubles, close doubles, unmatched doubles, color contrasts, triples, etc., some gravitationally related, some accidental line-of-sight, is endless. So this, the 1st of 4 articles (one each season) on doubles is dedicated to the memory of Howard Wang.

BEGINNING OBSERVERS (binocs & small scopes): Begin with Orion. The Trapezium (Theta Orionis) should show 3 stars in the smallest scope; maybe you can even spot the 4th. Sigma Orionis might yield 5 stars! Gamma Arietis is a gorgeous matched double, Epsilon Canis Majoris equally sweet unmatched. Castor (Alpha Geminorum) is also unmatched. For a stretch, try Rigel (Beta Orionis), a somewhat more difficult unmatched one. There are 100s more!

EXPERIENCED OBSERVERS (large scopes): Begin with Orion. The Trapezium (Theta Orionis) has 6 stars in your range, or if you have a really big scope, 2 more of 16th mag! Sigma Orionis has 9 stars (some very dim, not all gravitationally related). One of the doubles of Castor (Alpha Geminorum) is actually itself a close & more difficult double. Rigel (Beta Orionis) should be easy for you but it always gives a thrill. Now try for Struve 742 in Taurus ½° from the Crab (M-1), a fairly easy matched double. For a tough one, try 10 Arietis, 1.2" apart. There are thousands more!

TIERRA DEL SOLLAT = 32° 36' 46" N (± 0.1"), LONG = 116° 19' 55" W (± 0.1"), ELEV = 3710' (± 5'), at the bathroom, as determined from USGS 7.5 min 1/24000 map. Send comments & questions to me by phone (619/225-9639), USPS (4538 Long Branch Av., San Diego, CA 92107) or e-mail (1happyalien@home.com).

¡HAPPY VIEWING!



Promising you the Sun the Moon and the Stars and delivering...

Star Wishing

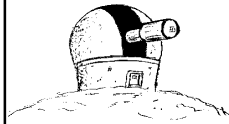


If you forgot someone of your xmas shopping list here is a very nice gift for that special person. Name a Star & add a special wish. Go to this website and find out about getting that special star. <http://www.starwishing.com/main.html>



Board Adopts Budget by Jim Potter, Treasurer

The Board of Directors adopted the following budget for calendar year 2002 at its regular Board meeting in December. This budget includes projects that will address our immediate growing pains such as the completion of new private pads and an addition to our public pad area. Also included are expenditures that will address our site needs such as the installation of the water tower and upgrading electrical functions. Increased funding was provided for educational programs, additions to the library and for club eyepieces. The Board will also be planning for the most efficient use of the remaining Tierra del Sol property and developing a time line for other



SDAA Business Meeting Agenda FOR JANUARY 2002

1. Agenda Overview
 - a. Reading of prior meeting minutes
 - b. Priority Issues
2. Standard Reports
 - a. Treasurer's Report
 - b. Private Pad Report
 - c. Observatory Report
 - d. Site Maintenance Report.
3. Old Business
4. New Business
5. Adjournment

SDAA BUDGET 2002

improvements.		Total Fixed Expenses	9,850
Budgeted Revenue		<i>Variable Expenses</i>	
Membership Dues	15,220	Education Fund	700
Interest Income	260	Library Fund	300
Private Pad Fees	<u>860</u>		
Total Budgeted Revenue	16,340	Picnic/Special Events	750
		Speaker Fund	<u>300</u>
BUDGETED EXPENDITURES		Total Variable Exp	\$ 2,050
<i>Fixed Expenses</i>		Site /Telescope Improvements	<u>\$ 3,900</u>
Astronomy Day	150	(Water Tower, Cement Projects, New Pads	
Banquet Door Prizes	250	Electrical and Gravel)	
Insurance	1,800	Total Budgeted Expenditures	<u>\$ 15,800</u>
Newsletter Exp:	3,000	Budget Balance – Contingency	<u>\$ 540</u>
Office Expenses:	1,960		
Taxes Net	750		
Science Fair Awards	240		
Site/Telescope Maintenance	700		
Utilities	<u>1,000</u>		

Clip and Save

2002 BOARD OF DIRECTORS & CHAIRPERSONS

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e-mail: scottb80@cts.com
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CALENDAR OF EVENTS

STARS IN THE PARK BALBOA PARK
January 2nd *First Wednesday of each month*
February 6th

STARS IN THE SITE
January 5th & January 12th

BOARD MEETING LOCATION

BUSINESS MEETING
SKF Condition Monitoring
4141 Ruffin Road
San Diego CA 92123-1841
Second Tuesday of each month
January 8th 2002

PROGRAM MEETING:
Third Friday of each month
January 18th

SCHOOL STAR PARTIES

January 1	Tecate Christian School
January 12	Vallecito Stage Station
January 15	Carlton Hills Elementary
January 15	San Diego Jewish Academy
January 16	Heritage Elementary
January 17	Village Elementary
January 18	Giegueno Middle School
January 23	Chesterton Elementary
February 6	Stars In The Park

**LOOK FOR YOUR
SDAA 2001
INVITATION**

**PLEASE Mail
our check and
inviations as
soon as possible.**

**Our speaker will be
Terence Dickinson.**

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