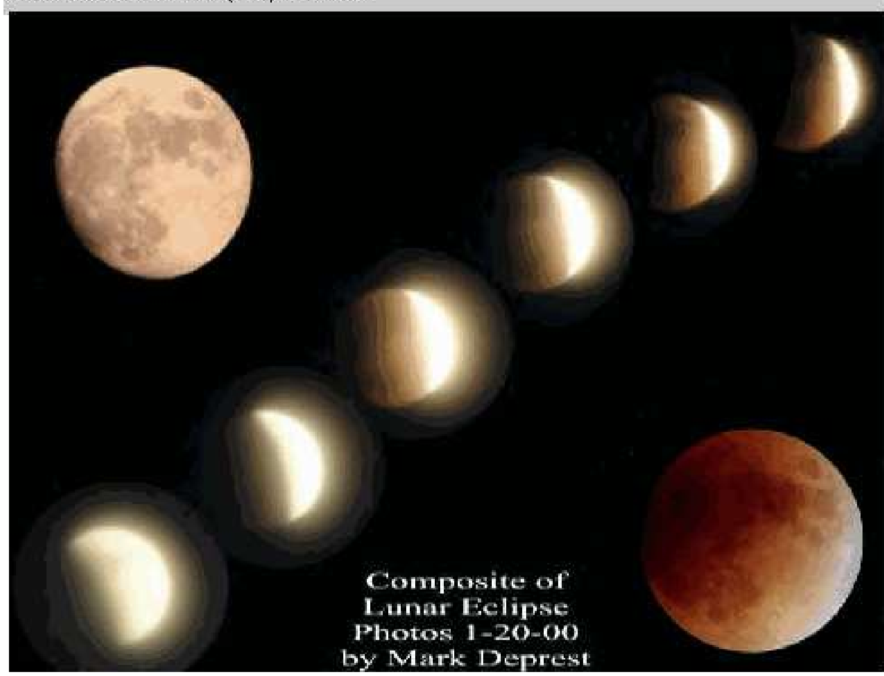
University Lowbrow Astronomers
Ann Arbor, Michigan

REFLECTIONS REFRACTIONS

of the University Lowbrow Astronomers

February, 2000

The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 807). Meetings begin at 7:30 pm and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party is canceled if it's cloudy or very cold at sunset. For further information call (313)480-4514.



Composite: Lunar eclipse of January 20-21, 2000 and full Moon of January 29, 1999. This is a composite of eight photographs, was all taken by Mark Deprest.

- The diagonal six photographs of the Moon taken at different times during the lunar eclipse of January 20-21, 2000 at Peach Mountain. They were taken with a Pentax 35mm camera at prime focus through a 5" f/5 refractor. All were 1 second exposures using Kodak Max 800 film. The fuzziness is due to the precipitation of H20 in its solid form.
- At the lower right a photograph of the Moon taken January 21, 2000 at Peach Mountain during totality.
- At the upper left a photograph of the full Moon taken January 29, 1999, at Peach Mountain.

This Month:

February 18 - Meeting at 130 Dennison - Come out and hear former Lowbrow Mark Vincent (aka: rocket scientist) "spin a few yarns" on life as a Hi-brow (a real professional astronomer).

Next Month:

March 4 - Public Star Party at Peach Mountain Observatory – First of two prime Messier Marathon weekends (the next is April 11th).

March 11 - Public Star Party at Peach Mountain Observatory – Last official winter observing session for this winter. Come on out and freeze while you still can. Summer is just around the corner.

March 17 - Meeting at 807 Dennison - Who knows what our topic of discussion will be tonight I know I don't. Not to worry. We'll inform you in next month's REFLECTIONS.

March 11, 18, 25 – Saturday Morning Physics, 170 Dennison Bldg. – "Nuclear Magnets: From Atomic Clocks to Medical Imaging" by Professor Timothy Chupp.

This popular public lecture series kicks off its spring session at 10:30 am in the large auditorium.

Physics or What Everything is Made Of?

by Dave Snyder

Regular readers of *REFLECTIONS* know that the University of Michigan Physics Department holds a series of multimedia presentations aimed at the general public called "Saturday Morning Physics." They have become very popular. This fall these presentations covered gamma ray bursts, particle physics and galaxies. In this article I will give an overview of the particle physics presentations given by Dr. Ken Bloom.

Other branches of physics study collections of matter such as rocks or planets, but particle physics studies the smallest parts of matter. Even so, particle physics can contribute to the study of larger objects. For example, the problem of dark matter (see "Dark Matter", by Lorna Simmons, *REFLECTIONS* December 1999) might be solved by better understanding of particle physics. Also particle physics is necessary to understand how stars emit energy, how stars evolve over time and how cosmic ray particles travel through the galaxy.

Dr. Bloom began with a history of the development of particle physics. The ancient Greeks believed that all matter was composed of four elements, earth, water, air and fire. This idea persisted until 1808 when Thomas Dalton demonstrated that matter was made of atoms. Chemists were able to identify approximately 90 different types of atoms called elements. In time, these elements were organized into a pattern we now call the periodic table. Initially there was no explanation for why the periodic table worked; this would have to wait until the internal structure of the atom was determined.

Clues to this structure emerged in 1897, when Thomson discovered the electron. It is possible to detect charged particles, such as the electron, by creating a magnetic field. Charged particles passing through the magnetic field travel along curved paths. The exact shape of the path tells us the ratio of the electric charge to the mass. This led to a model of the hydrogen atom: negatively charged electrons distributed within a sea of positive charge similar to the distribution of plums in plum pudding.

The plum pudding model was shown to be incorrect by Thomas Rutherford. Rutherford sent alpha particles (a particle observed near radioactive materials) through a thin gold foil. Alpha particles appeared on the other side. A few were deflected at large angles, but most were not deflected at all. This was not consistent with the plum pudding model, but was consistent with another model. Electrons are in "orbit" around another particle called the nucleus. Sending small probes like alpha particles have become the standard technique for studying particle physics. The electron has about 1/1800 the mass of a hydrogen nucleus. By measuring the mass of different atoms, it is possible to guess that the nucleus is made of two particles, the proton and the neutron. Different kinds of atoms have different numbers of protons and of neutrons. The hydrogen atom consists of one proton; the alpha particle consists of two protons and two neutrons and so on. This leaves one question. Protons repel each other, so why don't atoms fall apart? We will answer this later.

Soon other particles were discovered. Cosmic rays are particles that enter the earth's atmosphere from space. Dr. Bloom demonstrated a device called a scintillation detector, whenever a particle passes through this device, a flash of light appears. If we measure the charge/mass ratios

of cosmic rays, we find that some are pro tons, but we find new particles with names like muon, kaon, pion, omega, and so on. The particles with the highest energies detected so far have been from cosmic rays.

In the late 1920s, quantum mechanics predicted that there must be a particle that has the opposite charge to the electron, which we now call a positron. The positron was discovered in 1931. Almost all particles have an antiparticle with equal mass and opposite charge. All particle reactions can occur with antiparticles. Also when a particle and an antiparticle collide, they release energy that is carried off by two photons.

Understanding how particles interact has been a major preoccupation of particle physics. After studying many objects, physicists have concluded all interactions operate within two constraints, the conservation of energy and the conservation of momentum. If you measure the energy of a closed system before and after a particle interaction, you get the same value. This is also true of momentum. These laws have been used to understand subatomic particles. For example, early observations showed the neutron decaying into two particles, a proton and an electron. However this does not comply with the conservation of momentum. Therefore either the conservation laws are wrong or there is an additional unseen particle. Physicists soon were able to observe such a particle, called a neutrino. It has very little mass, perhaps no mass, and zero electric charge. Neutrinos rarely interact with matter, and can pass through many light years of lead. A similar reasoning process has been used to predict the existence of several new particles.

We now have a zoo of different particles, why are they so many? To answer this, we first categorize the particles into groups. The leptons consist of six particles and six antiparticles in three families, the electron family, the muon family, and the tau family. Note that there are three different types of neutrinos and they are all leptons. The bosons consist of the photon and a few related particles. The remaining particles are referred to as hadrons and are the most unmanageable group; a way organizing hadrons into patterns, reminiscent of the periodic table, was developed. This was called the eight-fold way and made valid predictions for hadron properties. This worked, except there was an empty space where there should have been a particle. Sure enough, a particle called omega-minus, was discovered which fit into this space.

At first there was no explanation for why the eight-fold way works. An experiment similar to the Rutherford experiment was devised were protons were bombarded with high-energy electrons. Most electrons were not deflected but a few were deflected by large angles (reminiscent of the Rutherford experiment). Protons are apparently mostly empty space and are composed of objects less than 1/1000 its size. These particles have the name "quarks." The quarks are organized into families, each of which has two members: Family 1 with the up and down quarks. These two quarks plus with the electron are all that is needed to make most things we normally encounter. The other quarks only occur in exotic matter that is rarely seen under normal conditions. Family 2 has the strange and charmed quarks. Family 3 contains the bottom and top quarks. All these quarks have fractional electric charge (either +2/3 or -1/3). The top quark is the heaviest and this fact meant it was only recently that particle physicists were able to prove its existence. Current theory suggests it is impossible to observe a free quark. Any attempt to free a quark would release just enough energy to create a quark and anti-quark pair. One member of this pair would bind to the quaarks that remain and the other member would bind to the other fragment. Instead of creating a free quark, all you have accomplished is splitting a hadron into two hadrons. All eight-fold way particles, all hadrons, are believed to be composed of quarks. Hadrons are divided into two groups, baryons which are composed of three quarks and mesons which are composed of a quark and the corresponding anti-quark.

Whenever two particles interact, we assume a "force" acts between them. Before the twentieth century, there were three known forces, namely gravity, electricity and magnetism. When physicists started experimenting, they discovered electricity and magnetism were related. Dr. Bloom gave several demonstrations, which showed that a changing electric field generates a magnetic field, a changing magnetic field generates an electric field and an electric field exerts a force on a changing magnetic field. There is a single electromagnetic force (EM force) which explains both electric and magnetic phenomenon. Physicists have since added two new forces, the strong force and the weak force.

Each of these forces has different characteristics. A particle interaction occurs through the exchange of particles and the particles exchanged depend on which force is involved. In any given situation, one of these forces tends to dominate. Gravity is the most important player on the scale of solar systems, globular clusters, galaxies and so on. It can operate over large distances but is much weaker than the other three forces. It operates by the exchange of particles which have never been observed called gravitons. The weak and strong forces don't have the needed range and EM fields tend to cancel out over large distances and thus cannot compete with gravity. EM is the most important player within the human scale. Gravity is a player, but not as important as EM. EM holds most objects together more strongly than gravity. EM interactions involve the exchange of photons. Within an atomic nucleus, the strong force dominates. It is stronger than any of the other forces, without the strong force the protons within a nucleus would fly very short distances, and when neither the strong or electromagnetic forces apply weak interactions always involve neutrinos, the only particle that responds to neither the strong nor EM force. Weak interactions involve the exchange of particles known as vector bosons. Weak interactions occur in some forms of radioactive decay and contribute to energy production in some stars.

When physicists attempted to describe the strong interaction, they found that they found some problems. It is possible to map particle interactions using special diagrams called Feynman diagrams. A single diagram describes up to four different particle interactions with the same mathematical formula. These descriptions frequently involved infinite quantities since quantum mechanics allows so-called virtual particles to be created and destroyed anywhere and accounting for virtual particles is not easy. Dr. Bloom showed examples of Feynman diagrams for the EM, strong and weak interactions. He also showed a Feynman diagram representing the experiment that proved the existence of the top quark.

As much progress as physicists have made, there are still unanswered questions that keep physicists busy. Among these questions: Why do quarks and leptons have different properties? Why do the different particles have the masses they do? There does not appear to be any pattern to particle masses. Why are there three families of quarks, three families of leptons and not four or five? Are quarks made up of anything smaller?

Seeing the Deep Sky
by Fred Schaff

a book review by Paul Walkowski

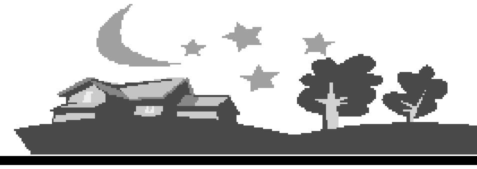
This book is great fun, I really mean this. I have star hopping books that are so dry they can suck all the dew off of the ground and still leave a dry spot in your throat large enough for Arizona. They jump into lengthy tables of star spectra without a hint of explanation, parsec this, pontificate that, prognosticate the other thing and pretty soon I am sure that I am a woodworker with a telescope and not an amateur astronomer. Enter Fred Schaff. He wrote this book with fire, charisma, and the story telling ability of Garrison Keelor (It was a quiet week in Lake Wobegone...). I had not the slightest interest in splitting binaries and the color of stars before this book, and now I want to buy the book just to work through the wonderful experiments, tables, and explanations. Like a tall iced tea after a long summer's day of splitting wood, I could not put the book down. It was written at an advanced high school to middle college level, but each chapter was a story that started out with a bit of verse, a pep talk to build your enthusiasm for the subject matter, a teaching section where he conversationally introduced the essential vocabulary as well as the subject matter, a table of where to find lots of things just like he was talking about in the sky, one paragraph explaining the significance of each entry in the table, and then an assignment to have at it: "Go out and ambush a turquoise and ruby binary pair, and keep it in your journal." Each chapter is a 20-30 minute read, and the exercise proposed can take that long again or all night, if you'd like. The book progresses through things like near and far away stars and objects, the colors of stars and binaries, and on through galactic (open) and globular clusters, ending in galaxies and clusters thereof. My criticisms of the book are few: the book was too short, and too interesting-- I sometimes read for 3 hours without putting it down leaving no time to actually look at stars, and there was an absence of star maps that would have made it a better stand alone field guide. But since everyone I know has such strong opinions on star atlases, maybe he was right to leave them out. So if you're looking for a book to rekindle your astro fire, engage a new amateur, or are just plain tired of looking at the same old 20 familiar objects at a star party, buy the book. I have the only library copy and won't be giving it back for at least 59 more days.

Oh yes, this is really the second volume of a 2 volume set, the first being about the sun, planets, comets, and asteroids.

The Abrams Planetarium *Sky Calendar* and Star Chart on the following pages are reprinted with permission of Abrams Planetarium. A full-year subscription is $9.00. To subscribe send name and address to:

Sky Calendar
Abrams Planetarium
Michigan State University
East Lansing, MI 48824

Be sure and check out their web site at: http://www.pa.msu.edu/abrams/



Saturday Morning Physics

Multimedia Presentations for the Passionately Curious

Spring 2000

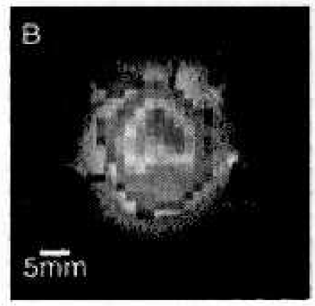
Ann Arbor
170 Dennison Bldg.
Church Street between N. and S. University Avenues
Saturdays, 10:30 to 11:30 AM
Refreshments will be served.

Admission is Free

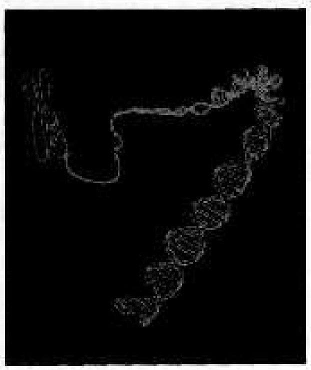
Supported in part by public donations.

Nuclear Magnets: From Atomic Clocks to Medical Imaging

March 11, 18, and 25 Professor Tim Chupp



The atomic nucleus is a tiny magnet whose effects can be measured and used in many ways. Nuclear magnets are sensitive to forces that only mattered in the very early universe, but are so important that they produced the matter from which galaxies, stars, planets, and everything on this Earth are made. Nuclear magnets in the atoms of our bodies are sensitive to their environment in a way that allows imaging of the body with a technique called MRI. Professor Chupp will describe nuclear magnetism, how it is detected and controlled, and how it is utilized: from probing elementary particle interactions to probing the human body and brain.



Human Genetics: The Human Genome Project, Evolution and Health; Genetics and Aging

April 1 and 8 Professor David Burke (U-M Medical School)

Professor Burke will present an overview of the ongoing global effort to map (through DNA sequencing) the complete set of genetic instructions for our species, *Homo sapiens*. Because of the intimate connection of the human genome to that of other species, several other species are being sequenced as part of the project. The first talk (on April 1) will explore the evolutionary connections that give us insight into fundamental biological questions, the future impact of the Human Genome Project on health care, and new microfabrication technologies for bringing genome information into the clinical setting. On April 8, Burke will ask why organisms age, what the nature of the aging process is, and how we can understand the evolutionary basis of aging.

Physicists and the Bomb: From the Nucleus to the Test Ban Treaty

April 15 and 22 Professor Michael Sanders

Since the realization that a nuclear chain reaction could occur, physicists have played key roles related to the Bomb, serving as scientists, technologists/engineers, lobbyists/advocates, advisers, and strategic planners. Professor Sanders will discuss these activities, the science, and the people around the world before, during, and after World War II.

www.physics.lsa.umich.edu/saturday * University of Michigan Physics
(734) 764-4437

***Shrinking gathering of evening planets:* Jupiter,** brightest evening "star," is in WSW to W at dusk, sinking lower as month progresses. **Saturn** is 10° to 6½° upper left of Jupiter. **Mars** closes from 19° to within 3° lower right of Jupiter this month. The three bright outer planets take up 25° on March 6, 20° on March 13 & 14, 15° on March 21 & 22, 10° on March 29 & 30. Each clear evening an hour after sunset, check on the changing arrangement of Mars-Jupiter-Saturn. At same time, **Moon** can be followed for 14 consecutive evenings, March 7-20. (The very young Moon setting earlier in bright twilight on March 6 is easiest from SW U.S. and Hawaii.) Watch the young waxing crescent Moon climb past the three bright outer planets March 7-10. As shown on this calendar, the Moon pulls alongside Mars on March 8, alongside Jupiter March 9, and climbs to upper left of Saturn on March 10. Continue following Moon as it shifts farther east nightly against zodiacal backdrop: Moon approaches Aldebaran, eye of Taurus, on March 11. On March 14, gibbous Moon passes south of the Gemini twins, Pollux and Castor. On March 17 Moon is near Regulus, heart of Leo, the Lion. On March 19, see Moon and Sun simultaneously just above opposite horizons about 10-15 minutes before sunset. Moon is Full later that evening, at 11:44 p.m. EST. On March 20 the Moon rises due east about 40 minutes after sunset; this is final day of the fortnight when the Moon can be seen an hour after sunset. On March 21 & 22, the gathering of three bright outer planets is 15° long, with Jupiter shining midway between Mars and Saturn. The gathering will become even more impressive next month, shrinking to only 5° across in mid-April. That'll be the most compact visible gathering of these three planets over a 179-year interval, from December 1901 until November 2080. The April *Sky Calendar* will highlight this rare trio.

Morning: Venus rises in ESE to E in twilight, one hour before sunrise on March 1, to 35 minutes before sunrise on March 31, from lat. 40° N. So Venus becomes harder to see, but remains easy to spot from southern U.S. where it rises earlier. **Mercury** passes above Venus at midmonth; see calendar.

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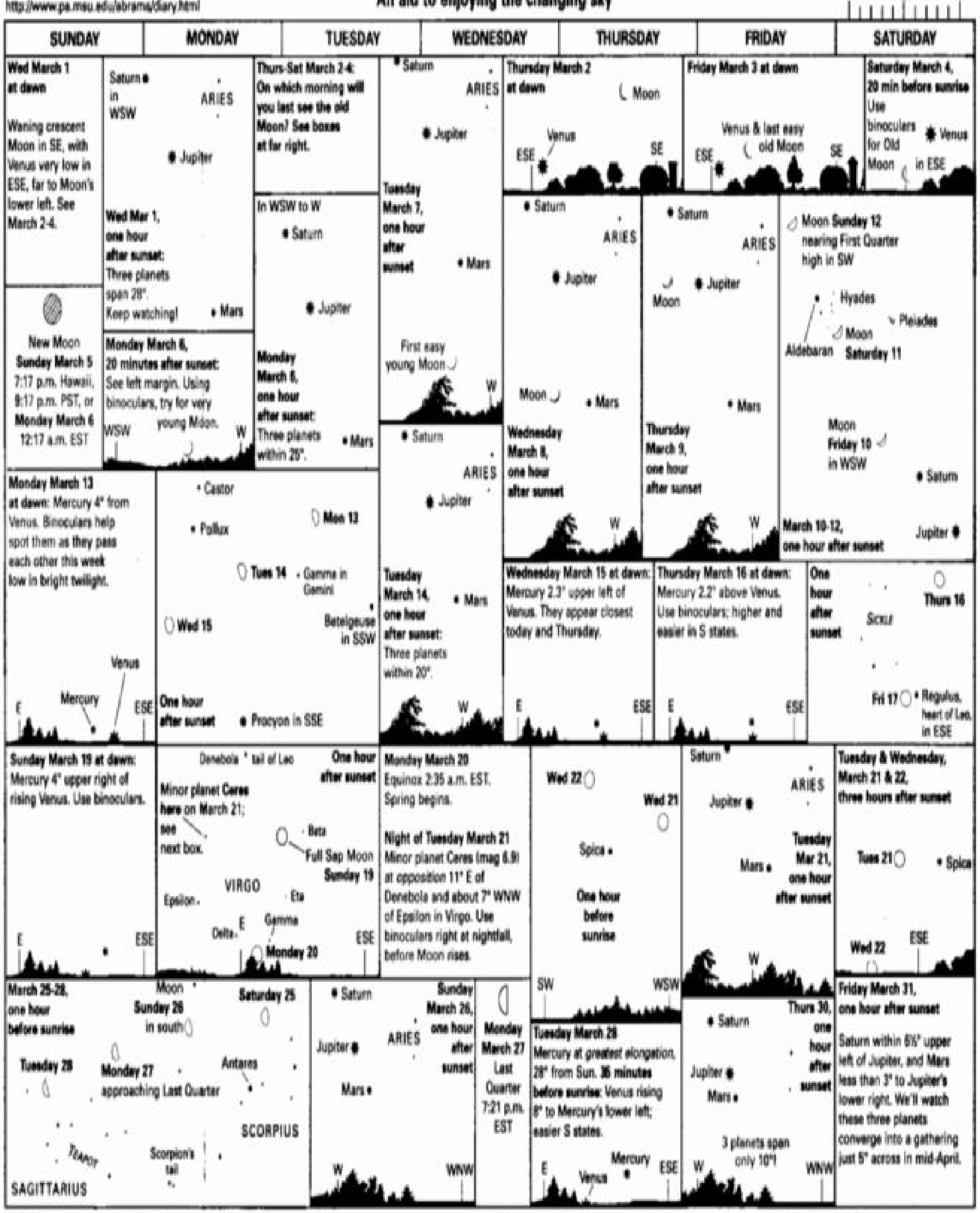
SKY CALENDAR MARCH 2000

An aid to enjoying the changing sky

Planetarium business office: (517) 355-4676
Skywatcher's Diary on World Wide Web: http://www.pa.msu.edu/abrams/diary.html

Use this scale to measure angular distances between objects on diagrams below.



Robert C. Victor, Patti Toivonen, Elissa Sanset
ISSN 0733-6314

Subscription: $9.00 per year, starting anytime, from *Sky Calendar*, Abrams Planetarium, Michigan State University, East Lansing, MI 48824

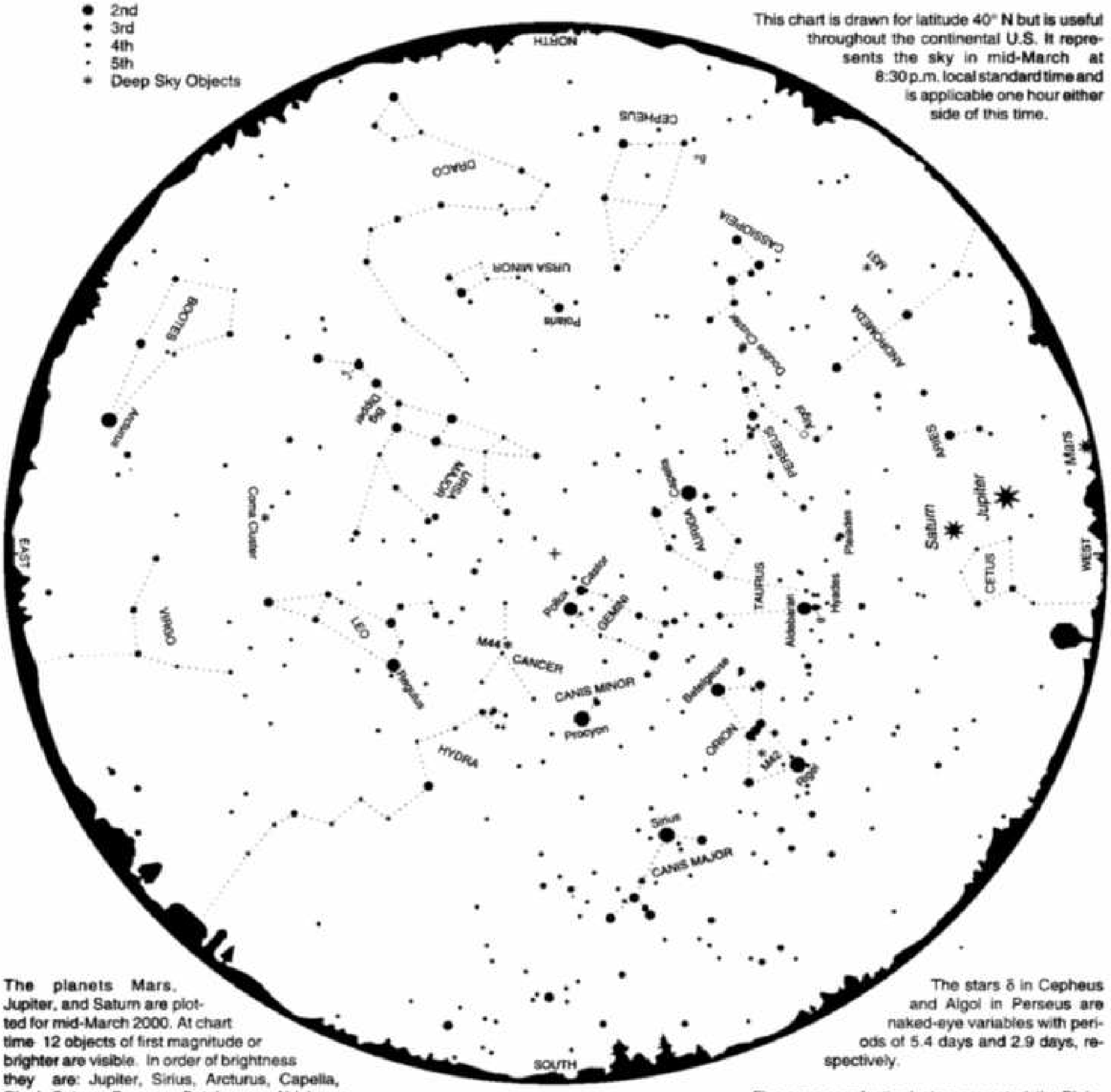
March Evening Skies

LEGEND
Star Magnitudes

- Zero or brighter
- 1st
- 2nd
- 3rd
- 4th
- 5th
- Deep Sky Objects

Subscription: $9.00 per year, from ***Sky Calendar***, Abrams Planetarium, Michigan State University, East Lansing, MI 48824-1324.

This chart is drawn for latitude 40° **N but is useful** throughout the continental U.S. **It represents** the sky in mid-**March at** 8:30 p.m. **local standard time and** is applicable one hour **either** side of this time.



The planets Mars, Jupiter, and Saturn are plotted for mid-March 2000. At chart time 12 objects of first magnitude or **brighter are visible**. In order of brightness **they are**: Jupiter, Sirius, Arcturus, **Capella, Rigel, Saturn**, Procyon, **Betelgeuse, Aldebaran, Pollux, Regulus**, and Mars.

The stars δ in Cepheus and Algol in Perseus are naked-eye variables with periods of 5.4 days and 2.9 days, respectively.

Our usual monthly maps are designed for stargazers just beginning to find their way around the sky. **This month's map** is useful for serious stargazing **from dark locations**. It contains many more stars, inclusive to magnitude 4.5, and some fainter stars as needed to complete patterns or assist in locating special objects.

A selection of double stars (labeled with Greek letters) and "deep sky objects" is also plotted. **All** are visible with modest equipment; most are within the range of the unaided eye or binoculars.

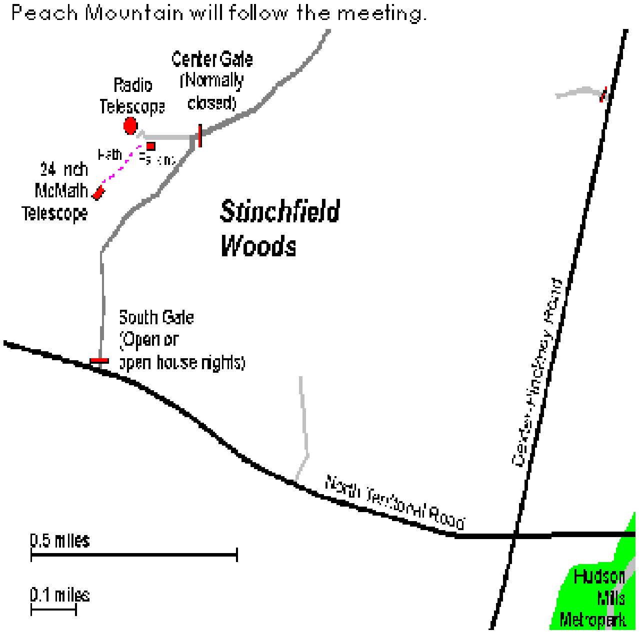
The double stars, in order of decreasing angular separation, are ζ in Ursa Major, and θ in Taurus.

Five open or galactic clusters are noted: the Pleiades or Seven Sisters, and the Hyades, both in Taurus; the Double Cluster in Perseus; M44, the Beehive or Praesepe, in Cancer; and the Coma Cluster, a loose group of naked-eye stars.

M42 is the famous Orion Nebula, a gas cloud out of which stars are forming. M31 is the Andromeda Galaxy, a collection of 300 billion stars located 2 million light years from Earth.

Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 807. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMath 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pickney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly!

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMath telescope (after some training). Dues can be paid to the club treasurer Doug Scobel at the monthly meeting or by mail at this address:

1426 Wedgewood Drive
Saline, MI 48176

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $29.95 / year
Astronomy: $29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Bernard Friberg (743)761-1875 Bfriberg@aol.com
Chris Sarnecki (734)426-5772 chrisandi@aol.com

to discuss length and format. Announcements and articles are due by the first Friday of each month.

Telephone Numbers:

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Vice Presidents: Lorna Simmons (734)525-5731
Dave Snyder (734)747-6537
Paul Walkowski (734)662-0145
Treasurer: Doug Scobel (734)429-4954
Observatory Director: Bernard Friberg (734)761-1875
Newsletter Editors: Chris Sarnecki (734)426-5772
Bernard Friberg (734)761-1875
Keyholders: Fred Schebor (734)426-2363
Mark Deprest (734)662-5719

Lowbrow's Home Page:

http://www.astro.lsa.umich.edu/lowbrows.html
Dave Snyder, webmaster
http://www-personal.umich.edu/~dgs/lowbrows/

Monthly Meeting
February 18, 2000 7:30 pm
Room 130 Dennison Hall
Physics & Astronomy Building
The University of Michigan

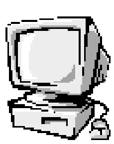
Mark Vincent, Ph.D.,
Lowbrow President, Emeritus

Presents

Escapades of a Post Doc in "Seeing Land"

The Moon and Venus – Photograph taken by Mark Deprest on February 2, 2000 from his backyard. The Moon is illuminated by "earthshine" or reflected light from Earth.

UNIVERSITY LOWBROW
ASTRONOMERS
3684 Middleton Drive
Ann Arbor, Michigan 48105



Lowbrow's WWW Home Page:
www.astro.lsa.umich.edu/lowbrows.html

Check your membership expiration date on the mailing label !