Periodic comet Swift-Tuttle (1992) has been recovered by T. Kuchih after 130 years. Perihelion will occur in December and should be an easy sight for northern observers. It'll be a sixth magnitude object during that month. Here's the orbital elements from IAU circular no. 5620:

- \( T: 1992 \text{ Dec 12.391} \)
- \( e: 0.96362 \)
- \( q: 0.95876 \)
- \( \text{Peri: 152.979} \)
- \( \text{Node: 139.430} \)
- \( \text{Absolute Mag.: 5.95} \)
- \( \text{Magnitude Coeff.: 10.0} \)
- \( \text{Epoch: 2000} \)

I don't know if you noticed or not but there were monitor stands mounted to the walls in room K209 during the last Macomb Community College meeting. It means the IBM PS2 model 55s are about to be installed in our meeting room. I guess the rumors were true ....

A new object has been spotted beyond Pluto's orbit. It's been designated 1992 QB 1. It's about 4.4 billion miles from the Sun and may be a comet or minor planet. The size has been estimated to be 200 kilometers in diameter.

AutoCAD, V12, is out on the market. Rumor has it that some accessory programs that are supposed to run with V11 aren't running with V12.

For the last month or so I've been working on a graphic program about the Messier objects. It's titled "The L.F.K. Messier Observer's Guide." It's not ready for distribution yet, but soon will be. I'm releasing it as shareware. The main feature of the guide is its ability to show the observer what he or she really can see through his or her eyepiece - not the long-exposure photos that are usually published in computer programs. I promise it's going to be a program every amateur astronomer will want in his library. Version 1.0 will contain graphics for M1 through M25, version 2.0 will have M26 through M50, etc. You can catch a preview of my program at the next Computer Group meeting.

The next meeting of the Computer Group will be on October 22, 1992. The meetings will be moved back to my house, starting time 8:00 p.m. Call me at 776-9720 if you have any further questions. Clear skies.

---

1992 Holiday Banquet
December 17, 1992
7:00 p.m. Social Hour
Cocktails and hot appetizers
8:00 p.m. Dinner
- 'Beef Tenderloin au jus
- Gourmet chicken and sauce
- Vegetarian plate
Non-smoking section available.
$16.75 per person.
For more information, call 790-9656.

---

Star Party at Imlay City Site
Friday, October 23 or Saturday, October 24
6:30 p.m. - 8:00 a.m.

All club members and their guests who wish to attend are welcome to join us at our first Star Party at the Imlay City observing site. No sign-up sheet is necessary for this site. Be sure to get a map from Jeff Bondono. Come out and help evaluate this potential observatory site while enjoying the fall skies. The Star Party will be held on whichever of the two listed nights looks most promising once weather predictions are available. To find out which night will be chosen, call Jeff Bondono at 731-4706 anytime after 5:30 p.m. on Thursday, October 22, 1992. There will be a recorded message if Jeff is not home.
The WASP
Volume 24, Number 11 — November 1992

Published by:
Warren Astronomical Society, Inc.
P.O. Box 1505
Warren, Michigan 48090-1505

1991 OFFICERS
President: Robert Halsall 781-6784
1st Vice President: Frank McCullough 790-9655
2nd Vice President: Jeff Bondono 731-4700
Secretary: Kathy Charla 334-5406
Treasurer: Ed Cressman 643-1837
Librarian: Don Mick 779-2784

The Warren Astronomical Society, Inc. is a local, non-profit organization of amateur astronomers. The Society holds meetings on the first and third Thursdays of each month, starting at 7:30 p.m.

General meeting on first Thursdays:
Cranbrook Institute of Science
500 Lone Pine Road
Bloomfield Hills, Michigan

Business meeting on third Thursdays:
Macomb Community College
South Campus, Building B, Room 209
14500 Twelve Mile Road
Warren Michigan

MEMBERSHIP AND DUES
Membership in the Society is open to all. Annual dues are:
Student $12.00
College $17.00
Individual $25.00
Additional Family members $ 5.00 per person
Senior Citizen $17.00

Among the many benefits of membership are:
- Discount magazine subscriptions:
  Astronomy $16.00 (12 monthly issues)
  Sky and Telescope $18.00 (12 monthly issues)
- Free copy of each WASP newsletter.
- Free use of Stargate Observatory.
- Special interest subgroups. (See subgroup chairpersons.)
- Call list - don't miss unexpected events.
- Free membership in Astronomical League.
- Free copy of Reflector (Astronomical League newsletter).
- Free use of W.A.S. library. (See Librarian.)
- Rental telescopes. (See Observatory Chairperson.)

Send membership applications and dues to:
Ed Cressman 645-1837
30540 Pierce Road
Southfield, Michigan 48076

WARREN ASTRONOMICAL SOCIETY PAPER
The WASP is the official monthly publication of the Society. Each new issue of the WASP is made available at the Macomb meeting on the third Thursday. Non-members will be charged $1.00 for each new issue. Back issues, when available, are free. Requests by other clubs to receive the WASP and other correspondence should be addressed to the editor.

Articles for inclusion in the WASP are strongly encouraged and should be submitted to the editor on or before the first Thursday of each month. For further information on contribution, see the "Instructions for Authors" box on page 4 of Volume 23, Number 5.

Send articles to the editor:
Douglas E. Goudie 680-0434
2420 Alexander
Troy, Michigan 48083-2405

Disclaimer: The articles presented herein represent the opinions of their authors and are not necessarily the opinions of the Warren Astronomical Society or this editor.

STARGATE OBSERVATORY
The observatory is owned and operated by the Society in conjunction with Rotary International. Located on the grounds of Camp Rotary on 29 Mile Road, 1.8 miles east of Romeo Plank Road, Stargate features a 12.5 inch f/17 club-built Cassegrainian telescope under a steel dome. The observatory is open to all club members in accordance to the "Stargate Observatory Rules:" Those wishing to use the observatory must call the Observatory Chairperson (2nd Vice President) by 7:00 p.m. on the evening of the session.

LIBRARY
The Society maintains a library of astronomy-related books and periodicals at the Macomb County Community College meeting room. See the Librarian for rules or to check out a book.

SUBGROUPS
Special interest subgroups exist for those interested in specialized areas of astronomy. Contact the chairperson of each subgroup for more information on that group.

Computers: Larry Kalinowski 776-9720
Cosmology: Mike O'Dowd 268-7125
Deep Sky: Doug Bock 750-0273
Lunar / Planetary: Riyad Matti 548-7511
Solar: Ed Cressman 643-1837
Telescope making: Jim Houser 294-1952

CALL LIST
The Call List is a list of people who wish to be alerted of spectacular and unexpected astronomical events. Anyone who notices such an event calls the next person on the call list. That person in turn calls the next person, etc. A call list member can restrict callings to certain available times. Any Society member is welcome to join the call list.

To join the call list, please notify Marty Kunz at 477-0546.
Hubble Space Telescope's First 18 Months in Orbit Report

"From our home on the Earth, we look out into the distances and strive to imagine the sort of world into which we are born. Today we have reached far out into space. Our immediate neighborhood we know rather intimately. But with increasing distance our knowledge fades rapidly, until at the last dim horizon we search among ghostly errors of observations for landmarks that are scarcely more substantial. The search will continue. The urge is older than history. It is not satisfied and it will not be suppressed."
— Edwin P. Hubble (1889-1953)

The First 18 Months

More than 1,900 observations of nearly 900 astronomical objects have already been carried out by HST. Observations began with imaging but now include spectroscopy. Scientists obtain information on the temperature, composition, and motion of an object by analyzing the spectrum of radiation emitted or absorbed by the object. Observing time is in great demand by astronomers worldwide.

I Thought It Was Broken

Pluto and its close satellite Charon, barely distinguishable as separate bodies in a ground-based image are clearly separated in the HST image. Because Charon is half the size of Pluto, this system is often called the "double planet." A ring of gas around Supernova 1987A, as shown in a HST image, was ejected many thousands of years prior to its location in space permits HST to observe ultraviolet radiation that does not penetrate the atmosphere.

Q: What is the long-range future of Hubble Space Telescope?
A: Bright. Through Shuttle servicing missions, which were planned from the beginning, we can achieve the capabilities intended for HST early in the observatory's 15-year mission lifetime. Over this period, HST should be able to achieve its original scientific objectives.

IN FACT, Hubble Space Telescope is the most powerful optical telescope in the world today; it offers unmatched ability to image fine detail and to study ultraviolet radiation from astronomical objects.

Achievements Amid Challenges

Star Regeneration in 47 Tucanae

In the cores of old globular clusters like 47 Tucanae, thousands of stars are crowded into a region less than one lightyear across. Could these ancient stars ever be regenerated by stellar mergers or collisions? Ground-based telescopes have not been able to answer this question; their images of such cluster cores are smeared out by atmospheric turbulence. But in the core of 47 Tucanae, HST's clear view from space has revealed dozens of hot blue luminous stars radiating away energy so rapidly that they cannot have survived since the birth of the cluster itself. These observations provide the first convincing evidence of recent star regeneration in old clusters.

HST images of Saturn, recorded at quarterly intervals of the planet's 10-hour rotation show successive quadrants of the surface. Hundreds of such images, computer processed to bring out fine detail, were assembled into a 1991 film to illustrate the progress of a giant storm across Saturn's turbulent atmosphere.

Q: Have you had to meet other challenges, besides the mirror?
A: Yes - which is not surprising for a complex system with 400,000 different parts. For example, the solar power arrays supplied by the European Space Agency make HST "jitter" or shake, every time the spacecraft orbits into and out of daylight. But we have fixed most of the problem by writing special computer programs for the HST pointing system.

Q: Is HST especially vulnerable to malfunctions?
A: Quite the opposite. HST, as well as being serviceable in space, was designed to provide high redundancy and extensive backup capabilities. For example, two gyroscopes used for pointing control have stopped functioning; but we've activated two spare gyroscopes for the HST

(Continued on page 4)
First 18 Months...
(Continued from page 3)
continue normal operation, and another space is still available. Overall, very few of HST’s reserve capabilities have been needed so far.

Q: So the capability for forefront science remains high?
A: Yes. Consider scientific papers presented at the January 1992 meeting of the American Astronomical Society. Of the papers reporting space science observations which represented 25 percent of all the observational papers - one out of four described HST results. And demand for observing time remains strong. In 1991, some 450 scientific groups submitted new proposals to use the telescope.

A storm was revealed in September 1990 by ground-based observations. The HST observing schedule was quickly modified to permit HST to track the disturbance, which by November had spread to cover most of the plant. White areas detected in images of the storm are believed to be immense clouds of ammonia ice crystals, lofted to high altitudes by violent winds.

Breakthroughs in Technology
Hubble Space Telescope, the creation of ten thousand people over two decades of inspired effort, is by far the most complex and advanced space observatory ever built. The HST project team produced major technological breakthroughs in order to meet the most demanding observing requirements in space-science history.

Support Structure: Constructed of lightweight, low-expansion, hand-formed graphite-epoxy tubes, the structure holds HST optical components aligned within 1/10,000 of an inch during two abrupt temperature changes every 96 minutes as HST orbits into and out of sunlight.

Pointing Control System: The most accurate ever devised for astronomy, incorporating unique, high-spin-rate gyroscopes shielded against vibration and electromagnetic disturbances caused by space radiation and solar flares - reduces pointing instability to an angle less than the width of a dime seen 200 miles away.

Ultraviolet Performance: The ultraviolet optical system is the most capable ever launched for astronomical observations in this region of the electromagnetic spectrum. It has reflecting surfaces of unprecedented cleanliness and smoothness to maximize the amount of ultraviolet radiation available for imaging and spectroscopic analysis. Serviceability: This is the first NASA space mission designed for regular Space Shuttle maintenance and upgrading over a planned 15-year mission lifetime. Forty-nine types of key components, including gyroscopes, are accessible and readily replaceable on orbit to maintain and expand HST capabilities.

Current Capabilities
Q: What was HST designed to do?
A: HST was designed to provide three capabilities:
1. High angular resolution — the ability to image fine detail;
2. Ultraviolet performance — the ability to produce ultraviolet images and spectra; and
3. High sensitivity — the ability to detect very faint objects.

Q: What can HST currently do?
A: HST currently provides the first two capabilities. First of all, for the brighter sources:
1. Computer processing can be used to bring out much finer image detail than can be provided by ground-based telescopes. In addition,
2. Corrective optics, to be provided by the first Shuttle servicing mission, will bring this scattered light back into focus, allowing HST to achieve its original design goal and reach very distant stars and galaxies.

High angular resolution of HST compared with a ground-based image of the globular cluster M14 and an image recorded by HST after computer processing show the ground-based image heavily blurred by atmospheric turbulence and unable to reveal individual stars in the cluster center.

Ultraviolet spectroscopy of the star Beta Pictoris by HST reveals streams of circumstellar gas (CS) falling into the star. From earlier optical and infrared observation, Beta Pictoris is known to be surrounded by an orbiting disk of matter that may be a planetary system in the process of formation. The HST ultraviolet observations probe the central regions of the system and provide new insights into its dynamics.

High sensitivity will be achieved through correction of spherical aberration by the first Shuttle servicing mission. The current HST image of a star is broadened by the effect of the aberration. The corrected stellar image will meet the HST design goal by concentrating 60 to 70 percent of the light within a small region near the image center, enabling HST to study much fainter objects.

Servicing Plan
Q: How does Shuttle servicing fit into your plans?
A: HST is designed to be serviced by Space Shuttle crews. It has 49 different types of key components readily replaceable in space, and 74 replacement parts are available right now. We have always planned servicing missions, at roughly three-year intervals, to maintain HST’s operational capability and to upgrade its scientific performance as new technologies become available.

Q: What will you do on the first mission?
A: Our current baseline planning calls for replacement of the solar arrays, correction of the spherical aberration, and replacement of other components as necessary for example, gyroscopes - in late 1993 or early 1994.

Q: And on later missions?
A: We'll replace remaining first-generation instruments, which represent earlier technology, with much more advanced second- and third-generation instruments to provide even greater capability, particularly for ultraviolet and infrared observations.

First Servicing Mission
(Continued on page 5)
First 18 Months...
(Continued from page 4)

- Replace Solar Arrays
- Correct Optics with WF/PC 11 and Costar
- Replace two gyroscopes
- Wide Field / Planetary Camera, workhorse of the
  HST observing program, will be replaced by an optically
  corrected camera by astronauts on the first Shuttle servic-
  ing mission in late 1993 or early 1994.

- Install second-generation instruments to broaden
  infrared and ultraviolet capabilities
- Install third-generation instruments to increase sensi-
  tivity and provide finer imaging and spectral detail.
- Boost HST spacecraft to higher altitude as required.
- Service other HST components as necessary.

The Great Observatories

Compton Gamma Ray Observatory launched in 1991, is
now investigating the most energetic systems and violent
events in the Universe. Compton has already shown that the
puzzling gamma-ray "bursts" observed by earlier satellites are
distributed uniformly across the sky, rather than concentrat-
ed toward the plane of our Galaxy - challenging current theo-
ries of burst origin in neutron stars and suggesting that some
other mechanism must be responsible. (In operation).

Advanced X-Ray Astrophysics Facility (AXAF) will use
specially designed mirrors to image X rays from supernova
remnants, high-temperature stellar atmospheres, galactic
'halos' and nuclei, and other high-energy objects. In Septem-
ber, 1991, the initial pair of AXAF mirrors passed a series of
stringent performance tests at NASA's Marshall Space Flight
Center. (In development).

Hubble Space Telescope (HST), launched in 1990, is
already making discoveries at the forefront of science, includ-
ing clouds of high-velocity gas spiraling into the center of an
accretion disk around Beta Pictoris and a stellar "fountain of
youth" in the ancient globular cluster 47 Tucanae. HST will
receive upgrades through Shuttle servicing missions over its
15 year mission lifetime. (In operation).

Space Infrared Telescope Facility (SIRTF) will use optics
cooled to extremely low temperatures in order to detect mil-
ions of faint infrared sources across the sky. Particular tar-
gets include the dense, warm clouds of dust and gas that perv-
ade star-forming regions in our own and other galaxies.
SIRTF will build upon the extraordinary success of NASA's
Explorer-class Infrared Astronomical Satellite, which carried
out the first all-sky survey of infrared sources between 1983 and
1985. (Technology under development).

Hubble Space Telescope, launched in April 1990, is
now in routine operation, chalking up a succession of scient-
ific accomplishments despite a number of technical chal-
enges. The tracking of a rare, giant storm on Saturn, the
unexpected detection of numerous clouds of hydrogen gas
near our Galaxy, and the discovery of a stellar "fountain of
youth" in 47 Tucanae, together with the exciting spectroscopy
of Beta Pictoris, are only some of the triumphs recorded to
date.

HST's current scientific capabilities are outstanding, and
its future capabilities will be even better. The first Shuttle
servicing mission, in late 1993 or early 1994, will end the
"jitter" caused by the solar arrays and give HST the high sen-
sitivity needed to observe very distant stars and galaxies. Lat-
er servicing missions will install the powerful second- and
third-generation instruments that have been planned from
the start. With these scheduled performance enhancements,
HST will be able to achieve its original scientific goals over a
planned 15-year observing lifetime.

"The exploration of space ... is one of the great adven-
tures of all time, and no nation which expects to be the leader
of other nations can expect to stay behind ... ”
- President John F. Kennedy, September 12, 1962

NASA Spacecraft Begins Gravity
Mapping of Venus

By Michael Braukus, Headquarters,
Washington, D.C. and Jim Doyle, Jet
Propulsion Laboratory, Pasadena, California

September 15, 1992 — The Magellan spacecraft’s orbit at
its closest approach to Venus was lowered Monday and today it
began a full 243-day cycle of gravity mapping, project officials at
NASA’s Jet Propulsion Laboratory, Pasadena, California, said.

Magellan has now completed three cycles of mapping with its
radar, covering 99 percent of the surface of Venus. Monday,
controllers ordered a one-hour orbit adjustment burn to lower its
periapsis - closest approach to the planet - altitude from 160 miles
(258 kilometers) to 113 miles (182 kilometers).

The objective of cycle 4, which extends to May 15, 1993, is
to obtain a global map of the Venus gravity field from the ellipti-
cal orbit. The orbit apoaapsis, or furthest point from the planet,
remains the same, 5,296 miles (8,543 kilometers).

During this fourth cycle, variations in the gravitational pull
experienced by the spacecraft are being recorded by carefully
tracking the Doppler shift of a radio signal that Magellan will
constantly beam to the Deep Space Network tracking stations.

When Magellan passes over a dense region of Venus’ in-
terior, for example, the spacecraft accelerates in its orbit and the
location of the denser region is mapped.

Over the course of the 243-day cycle, one rotation of Ve-

Cus, variations in the planet’s density will be mapped at a resolu-
tion much higher than achieved by previous missions.

Looking at the interior with gravity observations is ex-
pected to provide an improved understanding of the forces of
tectonics and volcanism that shape the planet.  

Searching for Extraterrestrial Intelligence

"Are we alone?" This question has been a focus of philosophical speculation since humans first contemplated the cosmos. Within recent decades, it has also become a topic of legitimate scientific inquiry within the field of exobiology, the study of the origin, evolution and distribution of life in the universe. Current knowledge of the origin and nature of life, the process of the formation of stars and planets, and the evolution of intelligence and technology leads many scientists to speculate that there are millions of other potential "life sites" within the Milky Way galaxy. To test this hypothesis, NASA will inaugurate the Search for Extraterrestrial Intelligence (SETI) Microwave Observing Project (MOP) on October 12, 1992.

The NASA SETI MOP is the most comprehensive attempt ever undertaken to answer this compelling and enduring question. The SETI MOP will employ some of the world's largest and most sensitive radio telescopes and the advanced radio antennas belonging to NASA's Deep Space Network. Upon completion of its initial observing period (through 2001), the SETI MOP will have probed 10 billion times more search space than the sum of all previous searches, and at frequencies and sensitivities not previously obtainable. The project employs two complementary search strategies: a Targeted Search and a Sky Survey. The very high sensitivity Targeted Search will use the world's largest radio telescopes and will focus on 800 solar-type stars within 100 light years of Earth at frequencies between one and three gigahertz (GHz). The Sky Survey will perform a high-resolution search of the entire celestial sphere, including the 99.9 percent of the sky that the Targeted Search does not cover, at frequencies from one to 10 GHz. The Sky Survey will employ the 34-meter high efficiency radio antennas of the NASA Deep Space Network. The NASA Ames Research Center is the lead center for the project and is in charge of the Targeted Search. The Jet Propulsion Laboratory is in charge of developing and implementing the Sky Survey.

The interdisciplinary nature of SETI and the natural enthusiasm children show for the subject make SETI an exciting avenue to attract and retain student interest in science and engineering disciplines. Therefore, the SETI Program is developing several educational initiatives that are designed to introduce young students to science, mathematics, and engineering, and to help science teachers develop innovative classroom materials and become more familiar with the effective classroom presentation of space science, physics and astronomy; all to make science "tangible and enjoyable."  

Student Payload Successfully Launched on NASA Rocket

September 23, 1992 — The first student managed and built payload flown on a NASA sounding rocket was launched successfully Monday, September 21, from the NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia.

The pilot project, known as the Colorado Student Ozone Atmospheric Rocket (CSOAR), was developed to demonstrate the use of sounding rocket flight as a valuable educational tool for undergraduate and graduate students.

"This is like winning the Super Bowl the first time you try," said Elaine Hansen, Director of the Colorado Space Grant Consortium.

"It was amazing, beyond words," exclaimed Greg Essmeier, a student from Colorado State University at Fort Collins.

The payload, designed to measure ozone density in the atmosphere, was carried aloft by a NASA single stage Orion sounding rocket at 2:52 p.m. EDT. After reaching a 33.5 mile (53.9 kilometer) altitude in 116 seconds, the payload descended by parachute into the Atlantic Ocean where it was recovered by the U. S. Coast Guard from Chincoteague, Virginia.

The project was a joint venture between NASA and the Space Grant Consortiums in Colorado and Virginia.

"This mission was conducted in a very professional manner and will serve as a model for future projects of this type," according to Joseph McGooigan, Director of Suborbital Projects and Operations at Goddard Space Flight Center, Greenbelt, Maryland.

"It was a real team effort It wasn't just one person doing it," said Dan Shrosphire, a graduate student from the University of Colorado at Boulder, referring to the students working at seven different sites during the launch.

More than 50 students from six participating Colorado colleges and universities developed the CSOAR payload during the past two years. Virginia students provided public affairs support and also will provide post-flight data comparison.

The data will be analyzed and compared with data gathered by NASA's Earth Radiation Budget Satellite. Results are expected in about two months.

The CSOAR launch is supported by the overall NASA Sounding Rocket Program, managed at Wallops for NASA's Office of Space Science and Applications, Washington, D.C. The NASA program consists of approximately 30 sounding rockets launched each year from various worldwide locations.

For Sale

Equatorial mount for OS-16 (16-inch) telescope. Has setting circles, AC motor drive and levelers. Ideal for 10- to 14-inch scopes. Must sell. Asking $1000 or best offer.

Contact: Fred Judd (W.A.S. member) or call (313) 758-7458. If I am not available, leave a message.
Limiting Magnitudes

The larger the diameter of a telescope lens or mirror, the fainter the objects that may be seen through it. The magnitude of the faintest objects visible through a telescope is known as its limiting magnitude. The table below lists limiting magnitudes for many telescope diameters. This table is not absolute; under ideal conditions, limiting magnitudes can exceed the values given here.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Magnitude</th>
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<tbody>
<tr>
<td>Eye</td>
<td>6.0</td>
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<tr>
<td>2&quot;</td>
<td>9.7</td>
</tr>
<tr>
<td>3&quot;</td>
<td>10.3</td>
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<tr>
<td>4&quot;</td>
<td>11.3</td>
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<td>13.4</td>
</tr>
<tr>
<td>12&quot;</td>
<td>13.8</td>
</tr>
<tr>
<td>24&quot;</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Use these star charts to check the limiting magnitude of your instrument and the weather conditions for the night. At right is a detailed chart of the area including enough stars to "star-hop" to the really dim ones - down to about magnitude 15. Inset is a low-scale chart showing the general region of sky. Happy viewing.

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### November 1992

<table>
<thead>
<tr>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
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<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4 – First quarter Moon</td>
<td>Southern Taurid meteor shower peaks</td>
<td>18 – Moon is at apogee</td>
<td>16 – Mars is 5° south of Pollux</td>
<td>7:06 – 17:22</td>
<td>7:07 – 17:21</td>
<td>7:08 – 17:19</td>
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<td>8</td>
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<tr>
<td>7:15 – 17:13</td>
<td>7:16 – 17:12</td>
<td>7:17 – 17:11</td>
<td>9 – Mercury is stationary</td>
<td>Northern Taurid meteor shower peaks</td>
<td></td>
<td>19 – Pluto in conjunction with Sun</td>
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<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>7 – Moon is 5° south of Mars</td>
<td>23 – Juno is stationary</td>
<td>7 – Last quarter Moon Leonid meteor shower peaks</td>
<td>19 – Moon is at perigee</td>
<td></td>
<td>11 – Moon is 7° south of Jupiter</td>
<td>17 – Mercury in inferior conjunction</td>
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<tr>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
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<tr>
<td>4 – New Moon</td>
<td></td>
<td></td>
<td></td>
<td>7 – Venus is 1.9° south of Uranus</td>
<td></td>
<td>13 – Moon is 3° north of Uranus</td>
</tr>
<tr>
<td>29</td>
<td>30</td>
<td></td>
<td></td>
<td>16 – Moon is 5° north of Venus</td>
<td></td>
<td>11 – Mars is stationary</td>
</tr>
</tbody>
</table>

Eastern Standard Time. Sunrise and sunset data are based on the coordinates of the Hawthorn Hollow observing site, latitude 42° 52' 30" N., longitude 82° 37' 30" W. Times are reasonably accurate for the entire metropolitan Detroit area.
Warren Astronomical Society Calendar 1992

Sunday Afternoons

October 23 or 24  6:30 p.m.  Solar Group at Ed Cressman's house when the weather is clear.

October 23  6:30 p.m.  Star Party at the Imlay City observing site. Call Jeff Bondono at 731-4706 after 5:30 p.m. on Thursday, October 22, 1992 to find out which night has been chosen.

Thursday  November 5  7:30 p.m.  General meeting at Cranbrook Institute of Science.

November 6-7  8:30 p.m.  Open House at the 24-inch observatory of Michigan State University (East Lansing). For further information contact Kim Dyer

Thursday  November 19  7:30 p.m.  Business meeting at Macomb Community College. Officer elections will occur. Guest speaker: Dave Donofrio about his computerized telescope interface, "StarConnect"

Thursday  November 26  8:00 p.m.  Tentative Computer Group meeting. (Thanksgiving.) Call Larry to be sure.

Thursday  December 17  7:00 p.m.  Holiday Banquet at the Warren Chateau. Begins with Social Hour. No Macomb Community College meeting. Reservations are due by December 3, 1992.