MACARTHUR ASTRONOMICAL SOCIETY

MAS Newsletter

Volume 1 Issue 7 **JULY 1996**

PRESIDENT
PHIL AINSWORTH
(02) 605 6174

SECRETARY
DAVID MCBEAN
(046) 559725

TREASURER
ROBBIE CHARLTON
(047) 749 331

EDITOR
BOB BEE
(046) 251623

PRESIDENT'S REPORT

Hello and welcome to all our members and guests.

It's official. We are now Macarthur Astronomical Society Incorporated. And insured. We have only to gain approval from the Department of Gaming and Racing to become a charitable organisation.

Thank you to those who wrote articles and participated in helping to make our Newsletter one of the biggest and best throughout the NSW Societies. It is greatly appreciated by Bob and myself.

Our last star night was a reasonably good success. Despite the atrocious weather in Campbelltown, our site was cloudy at first but with some patience, a lot of us enjoyed starry skies from 7.30 to 10pm. I realise some people didn't want to gamble with the suspicious looking clouds.

The main highlight for me, other than seeing Jupiter and the Small Magellanic Cloud, was comet Hale-Bopp. It kind of makes up for missing Hyakutake. Hale-Bopp is going to be much brighter around May 1997 and should be worth the wait.

Gazing at the stars was not the only form of entertainment that night. Some of us decided to play detectives and investigate some remains of a deposit of stolen goods. We reported it to the police and returned most of the important items to the Picton police station. Our investigators were Dave, Diana and myself.

GUEST SPEAKERS

As most of you already know, Bob is talking tonight on Measuring the Distances to the Stars and Beyond.

Next month Peter Druery will educate us on the use of planetspheres (star wheels) and star charts. This would also be a great chance to have some practical experience in finding out where to locate stars and constellations in the sky if members all have their own star wheel. The only way this is possible is for members wanting cheaper wheels to write their name down on the list on the Notice Board. I must know by this July meeting so as to order wheels for approx. $5 each. If I cannot order 20, the cost will be $7.95. Sky and Space need 3 weeks to get in enough. It would be great to have at least one star wheel between two members at the August meeting.

Speakers are required for September and November I do have one speaker lined up with a date to confirm. Please let me know if you can talk on a topic of your choice (astronomy) or have contact with someone whom you think would like to address us this year or next. I also have some guest lecturers with no confirmed dates who are coming to our society.

PRESIDENTS REPORT (Cont'd)

SPACE FRONTIER CONFERENCE

Please see me if you are interested in going. It's up in Brisbane on the weekend of 19th July. Cost $40 for the weekend, not including transport and accommodation.

LATEST NEWS

The Space Shuttle Columbia has just spent 16 days in orbit, the longest to date. During the mission the seven astronauts did many Microbiology, Human Physiological, Biological, Neurological experiments to learn about the effects of long term space missions and how to cope for up to 6 to 12 months in the International Space Station Alpha.

LIBRARIAN'S REPORT

Once again, thanks for the patronage. I'm sorry I forgot the books last month. Could any magazines or items borrowed for over one month please be returned to the Library so other members can enjoy the benefits of the material.

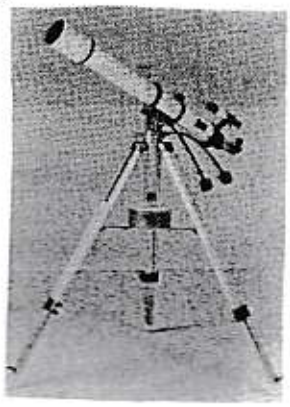
I also must confess to still not being able to obtain 'date due' slips. Hopefully next month.

I am pleased to announce our first book has arrived for the Library. Dr Ragbir Bhathal's 'Australian Astronomers'. I have had the pleasure to glance through it and find the book very interesting. Thanks to the good Dr. for writing and making your book available for us to purchase. The book will be on Reference for 6 months for all members to browse. Please see me if you want to buy a copy, although we did have pamphlets about it two months ago.

TELESCOPE FOR SALE

Time to buy your first telescope? This is a pre-loved (but little used) TASCO 60mm refractor for only $150. It comes with a finderscope, 2 eyepieces, 1 Barlow lens, 1 alt-azimuth mounting and stand plus an instruction book.

Contact Mr and Mrs Houseman at Camden on (046) 55-8317.



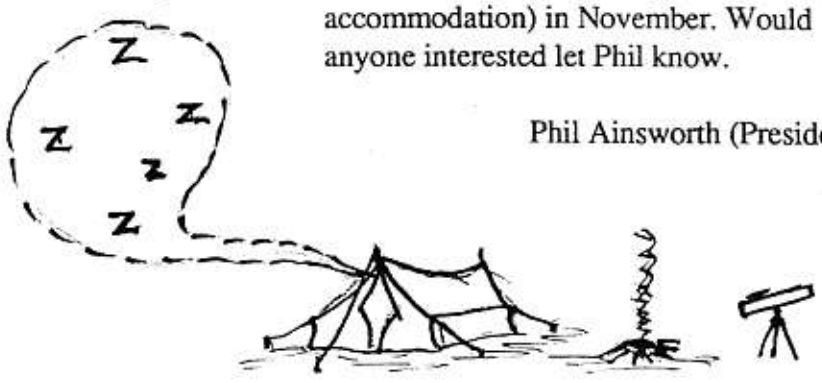
CHRISTMAS PARTY

The Committee has discussed the possibility of a Christmas Party with the presentation of appropriate merit awards. It would possibly be on the 2nd Saturday in December Details to be confirmed.

STAR CAMP

The Committee discussed the possibility of conducting a Star Camp (with overnight accommodation) in November. Would anyone interested let Phil know.

Phil Ainsworth (President)



REFLECTIONS

Astronomy...to question...to understand how the universe evolved from the Big Bang to its present form, and astronomers strive to capture even more minute flickers of light originating from galaxies billions of years ago.

Beginning December 18th, 1995, the Hubble Space telescope turned its eye towards a seemingly empty black patch of sky near the handle of the Big Dipper. After 100 hours and 342 separate frames in 4 different wavelengths, it revealed to us the deepest field image ever taken. Galaxies as faint as 30th Magnitude, millions of times dimmer than the dimmest stars the eye can see on a clear dark night, in their first stages of development. In late January, astronomers used the Keck telescope to measure red shifts of some of the galaxies by standard spectroscopy. They measured red shifts ranging from 2.6 to 3.3, and if you take the interim result of the Hubble Constant project of 72 (+/-10%)km/s/mpsc, that gives the universe an age of 8 to 13 billion years. Also, astronomers at the Siding Spring Observatory, using the Anglo-Australian Telescope, have discovered quasars with red shifts greater than 4.

After a disastrous beginning, and after astronauts installed the corrective optics into the Hubble ST in December 1993 (effectively a $10 million visit to the optometrist), astronomers had a 'perfect' view on space, 'as close to perfection as engineering can achieve and the laws of physics will allow...:" one astronomer said. But...as close to perfection it may be it is limited by the fact that its primary mirror is only 2.4 metres in diameter.

Today astronomers are spending millions of dollars and years of research to build bigger and better telescopes.

Radio astronomers have long been using a technique called interferometry, which by spacing two or more radio telescopes apart, they can achieve a resolution as if they had a telescope as large as the space between them.

Recently, a group of astronomers in England, using just three 16-inch telescopes spaced six metres apart took images of the binary star Capella, several times sharper than those achieved with the HST, and for the first time, both stars could be defined.

Once, the Mt Palomar observatory was King, 200-inches of raw reflection, but with today's 6.5 m Mt Hopkins, and the 10m Keck telescope (segmented), mirrors are just getting larger. As mirror size increases, problems come into the equations. Thick mirrors may resist physical deformation easily, but have a tendency to retain so much heat that it creates shimmering air which plays havoc with the astronomers' observations. Very thin mirrors, on the other hand, have ideal thermal properties but have a tendency to bend and wobble as if they are made of rubber. At the Uni. of Arizona, astronomers have solved that problem, to create a new family of massive mirrors.

With old methods, mirrors were cast as one large cylindrical block, and then many weeks were spent on grinding out tonnes of glass to give the mirror its parabolic shape. With the new method, the glass is placed onto a huge round ceramic mould. The glass is heated very slowly. When the glass reaches 750C, the oven spins, automatically giving the glass its parabolic shape. The glass continues to heat up, until it flows into the honeycomb mould. It is then cooled slowly, for 80 days, to prevent stress in the glass, which could later lead to cracking and deformation. Even after this, the glass must still be polished to perfect the shape. The average overall thickness of the mirror is only about 2.8 cm. The honey comb structure on the bottom of the mirror gives it its support, giving birth to a new generation of telescopes.

But, this technique is still being tested, and many new designs will be tested, and it will be many years before they come into play.

Until that day, us amateurs must stick with our 4-inch refractors or our homemade 6-inch Dobsonians, and the professionals their 4m reflectors, but there still remains the eternal question - How did it begin and how will it end?

Steve Manos

THE PLANETS

by Phil Ainsworth

I will briefly discuss basic information, past and present, on each of the planets in our Solar System. Please refer to Newsletter Vol. 1, Issue 4 for a short table on their diameters and distances from the Sun.

MERCURY

Mercury is the second smallest planet in our solar system. It takes only 87 days to orbit the Sun and has a 58 day rotation. It is only 4,878 km in diameter.

It is a small rocky body seared on one side (with temperatures reaching 350C) and a chilly -180C on the side not facing the Sun.

Some of us oldies will remember Mariner 10. It travelled to Mercury in the 60's and took 18 images. This was the first and only craft, to date, to visit Mercury. During its stay, a magnetic field was discovered mainly caused by Mercury's rich iron core. However, the planet showed little or no atmosphere.

The surface is also heavily cratered, just like or moon. Recently, water ice is believed to have been found on a polar cap which is shaded and not scorched by the Sun.

VENUS

Venus is known as Earth's twin, but when comparing the two planets, other than their size they are completely different. The second planet from the Sun has a rotation period longer than its orbit about the Sun. It also rotates clockwise (all the other planets rotate anti-clockwise).

Venus has a day of 243 Earth days and orbits the Sun every 224 Earth days. Its diameter is 12,104 km, slightly smaller than Earth.

Living on Venus would be hellish, with an average temperature of +480C, a crushing gravity and sulphuric acid rain coming down from a very thick carbon dioxide atmosphere. Not very hospitable, to say the least.

Venus does have some fascinating features, the most prominent being the Maxwell Mountains. These mountains rise up 7 km from the surface.

Venus has been explored by the Russian Venera spacecraft, and more recently by the US's Magellan. These space probes unveiled Venus as a planet mankind is not likely to colonise for centuries, if ever.

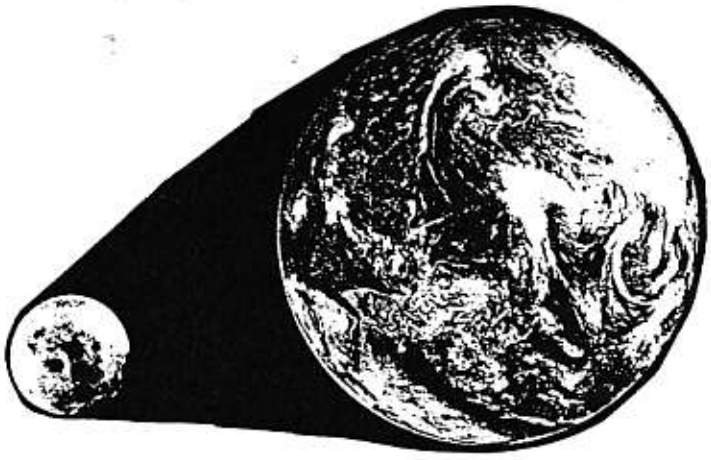
Venus equals Jupiter in brightness and is well worth getting out of bed early, even on these cold winter mornings. It is currently at about -4, -5 magnitude. i.e. extremely bright.

EARTH

Our cradle, and clearly the most beautiful planet in the Solar System. I envy the first astronauts returning from Mars and slowly seeing this bright blue object start to grow through the windows of their space ship. From Mars, they would see two morning/evening stars.

The Earth is 12,700 km in diameter and has a rotation period just under 24 hors. Its year comprises 365 days. Its axial tilt of 23.4 degrees gives us or seasons. Various temperatures range all over the Earth. The mean temperature is 15C. Parts of the planet, such as Antarctica can drop below -50C, and the equatorial regions can rise to +55C.

Earth is the only known body in the solar system to have liquid water on its surface. Many astronauts and probes detect life signs emanating from the planet, especially at night with cities and towns bright with lighting.



MARS

My favourite! Mars is a small reddish world with many similarities to Earth. Revolving in orbit are its two tiny moons, Deimos and Phobos. These are captured asteroids.

The Red Planet has a 24 hour 37 minute day, seasons due to a 25.2 degree tilt, a mean temperature of -23C. However, many areas on the equator can reach +15C to +30C during the day. Its sidereal orbit around the Sun takes 686 Earth days or 667 Martian days.

The thin Martian atmosphere contains 95% carbon dioxide with slight traces of oxygen and other gases.

With Mars being just over half the Earth's diameter (6,700 m), it has only one-eighth of its gravity. So a person weighing 100 kg on Earth would only weigh 37.7 kg on Mars. (A great weight reduction program. I might add your mass remains the same.)

Lots of other dangers confront colonists. Massive dust storms with winds of 200 km/hr, but with the atmospheric pressure only being 3-7 millibars, it is equivalent to 10-20 knots.

The planet has many wonderful and various landscapes of unique beauty. Mars has the largest known volcano, Olympus Mons. It is very old and believed to be extinct, as are its other three Tharsis companions. Anther huge and spectacular site is the Valley Marinas (named after the Mariner spacecraft which photographed it for the first time, back in the 60's). This enormous canyon stretches across one third of the planet. If on Earth, it would reach from Sydney to Earth and a bit more. It is also 7 miles (11 km) deep in places. Every morning, mists and clouds rise from the valley and evaporate into the thin Martian atmosphere by mid-morning.

The thin Martian atmosphere is only 1/100th as thick as the Earth's but can still protect humans from cosmic rays. However, solar flares still remain a constant danger and any habitats would need to be built beneath the Martian regolith.

Mars has other similarities to Earth as it has the same land mass (there being no oceans) and contains water stored up in the polar caps and frozen as permafrost under its surface.

A number of spacecraft have visited Mars since the early 60's and discovered many diverse landforms and rocks. However, the main issue yet to be solved is

whether Mars has now or had life in the past. Life such as early forms of bacteria or lichen as found deep down in Antarctica which don't rely on oxygen, may still exist. These small microbes would be protected from Mars' near vacuum and sterile surface. During the next ten years, with rovers and balloons scanning the surface, this age old question may soon be solved.

In November this year, the Russians will launch Mars 96 which will contain a rover. It will reach the Red Planet by September 97. Mars Pathfinder, which will also have a rover, is being sent in December and it is hoped will reach its destination by 4th July, 1997. Finally, the U.S.A. have the Mars Global Surveyor which will conduct some of the tests meant to be performed by the lst Mars Observer.

For all the UFO and mystery lovers, these craft are going to take high resolution pictures of the entire surface and also around the high interest area of Cydonia and The Face.

Let's pray the Galactic Ghoul doesn't cause these spacecraft to be lost or destroyed.

Mars is presently about Mag. 1.7 and can be seen in the morning sky with the naked eye. In a telescope, it appears as a small fuzzy ball with little or no surface features visible.

JUPITER

The largest planet and first gas planet (it is known as a gas giant) in the solar system. It is a whopping 143,000 km in diameter and its major storm front, the Great Red Spot, can fit up to 12 Earths squashed together.

Jupiter, despite its size, rotates the fastest of all the planets, having only a 9 hour day. However, it takes 4,332 Earth days to orbit the Sun.

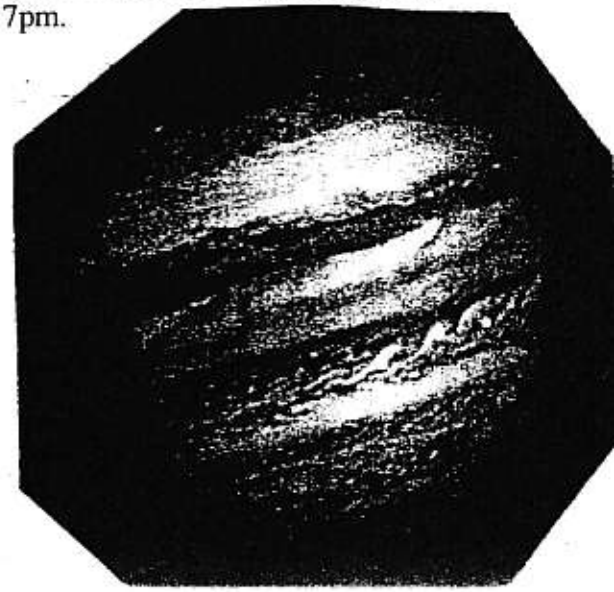
As recently as 27th June, information is coming to us via the Galileo probe. It is currently taking pictures of Ganymede, the largest moon in the solar system. Information from the probe has already exceeded all expectations and changed many theories about the internal heating structure and working of the planet. Winds blow at a ferocious rate of 500 km/hour.

Lightning storms and water are less prevalent than first thought or observed when comet Shoemaker-Levy crashed into the planet. However, the storms are far more savage than on Earth. Temperatures have been recorded at a mean of -180C at the cloud tops.

Jupiter has some 16 moons, four of the most interesting being Ganymede, Europa (water ice surface), Io (very volcanic, with Pele the active volcano most observed by Voyager during its encounter) and Callisto.

Clearly, I cannot wait for the information to start filtering back and appearing on the news (we hope) on a nightly basis.

Jupiter is currently the highlight of the night sky, blazing at -2.7 magnitude, from around 7pm.



SATURN

From Earth, it is the most fantastic sight seen by even an average sized telescope. The multi-ringed planet is blessed with 21 moons, with 3 or 4 of the larger ones being of most interest. Saturn is also very big but surprisingly could float on water if a large enough ocean could be found.

It is 120,539 km in diameter, takes 10,759 Earth days (29.5 years) to orbit the Sun but has a relatively short day of only 10 hours 13 minutes.

Its moon Titan, with its thick nitrogen atmosphere and possible methane lakes, could sustain life. The temperatures are a chilly -180C, The atmosphere keeps some warmth.

In 1997, the spacecraft known as Cassini will lift off and reach its destination by 2003. Its small probe, called Hugyes, is going to infiltrate Titan and hopefully land on its surface.

Saturn can currently be seen from about 1 am in the early morning sky.

URANUS

The third largest gas planet, with its smaller but also majestic ring system, Uranus is otherwise quite bland. Voyager took many photos of the planet and discovered it has 15 moons, with the most interesting being Miranda. The other major moons are Umbrial, Oberon and Titania.

Uranus's diameter is 51,118 km, its temperature is a very cold -220C. It has a sidereal orbit of 30,685 Earth days (84 years) and a 17 hour day. Uranus is tilted at a remarkable 115 degrees.

NEPTUNE

Almost the same size as Uranus, is slightly smaller with a diameter of 50,538 km. Currently it is the outermost planet as Pluto intersects it until 1999.

Neptune's mean temperature is -220C, with Triton, the largest of its 8 moons, being the coldest body in the solar system at -240C.

Recently, Triton was found to have a slight and clear nitrogen atmosphere.

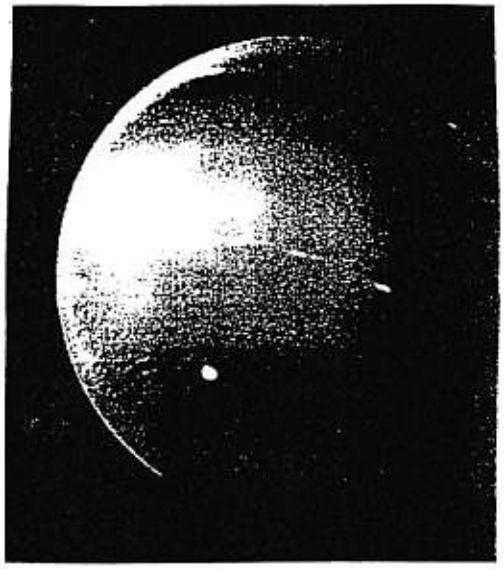
The other major moon of Neptune is Nereid.

Neptune has a 16.7 hour day and takes 60,190 days (248 years) to orbit the Sun. (Not many birthday parties).

The blue gas giant is also known for its large storm front known as the Great White Spot. Unlike its distant cousin on Jupiter, this one has moved or dissolved and another smaller storm has been seen by the Hubble Space Telescope.

Neptune also has a ring system although it is not complete in some parts.

Neptune, and more often Uranus, can be seen with small telescopes in the night sky. Uranus appears as a small greenish disc at 5.5 magnitude. Neptune is slightly more bluish and at magnitude 9.0



PLUTO

Pluto is the smallest planet at only 2,342 km diameter. Our moon is larger. Pluto has only one moon, Charon, which is roughly half its size.

Pluto is the only true double planetary system. This cold remote world is currently enjoying slightly warmer conditions due to it being inside Neptune's orbit and holding a very tenuous atmosphere. At -220C this small icy body is thought by some to be an escaped moon of Neptune (and it very well could be).

The thin atmosphere will be sustained by the planet until 2012, well after it became the outermost planet again in 1999.

NASA, in conjunction with Russia, is planning a fast fly-by of Pluto in 2003, to reach it in 8 years and capture and view some photographs before atmosphere freezes over.

Hubble Space Telescope took some stunning but not so clear shots of Pluto showing some albedo and a polar cap. Let's hope when the space craft reaches this distant body we can see some unusual surface features.

A LITTLE LIGHT HISTORY

(Part 1)

Written and Compiled by Peter Druery

What is light? As amateur astronomers we are so often concerned about the ability of our telescopes to 'grasp' light, or for that matter, whether our own eyes will be able to see a particular object, that we sometimes forget that it is the light itself which we are actually observing.

Regardless of whether our personal interests lie in trying to capture faint objects on a photographic emulsion or whether we are interested in why a star is a particular colour, it still boils down to the fundamental commodity that we are detecting, light!

So let's consider the fundamental nature of light by taking a short tour through the development of mankind's understanding of this amazing and yet so important phenomenon of the universe.

THE PARTICLE THEORY

The first scientists to suggest that light consisted of a stream of particles were the ancient Greeks. Pythagorus (about 500 BC) and Democritus (about 450 BC). These guys had the idea that vision was caused by particles being projected from the object into the pupils of the eye.

Empedocles (490 BC) and Euclid (300 BC) felt that the eye sends out ocular beams that cause sight as soon as they meet something else that is emanated by an object.

Aristotle (350 BC) rejected both these theories of light, and proposed that vision was the result of some kind of action occurring in a transparent medium between the eye and the object.

It is difficult to illustrate that light actually takes time to travel from one point to another because whenever a light is turned on, it seems to appear from everywhere at once. It wasn't until Olaus Roemer observed the moons of Jupiter late in the 17th century that it was observed that light took about 16 minutes to travel, across Earth's orbit.

Isaac Newton is identified as one of the main proponents of the early particle theory. Newton, it appears, fist became interested in light when he set out to construct an astronomical telescope. One of the problems he ran onto was a coloured border that surrounded the image.

This problem led to Newton's extensive study of light and colour. The results were published in 1672, in his first scientific paper, *Philosophical Transactions*. Criticism from some of his contempories led to more careful research on the nature of behaviour of light.

In 1704, Newton finally published his celebrated treatise, *Opticks*, in which he compiled nearly all his work on light. A study of this work reveals Newton's gradual tendency to view light as consisting of particles, or 'corpuscles'. It is interesting to note that Newton also contributed a great deal to the theory of sound and water waves.

Newton developed two basic assumptions with his theory:

1. *The intersection of two streams of particles will result in collisions between particles that will cause them to deviate from their original path.* Two intersecting beams do not show this behaviour, however. This variance can be explained in terms of particles, only if the particles are assumed to be incredibly small.

2. *Particles of light should be attracted by the Earth's gravitational filed and should therefore move in a curved path.* The faster a particle moves, the less curvature there is in its trajectory. If light is assumed to be moving very fast, the fact that its path is straight can be accounted for.

His main objection to the theory that light may be a wave was that a wave theory could not explain why light travels in a straight line in *any* medium. Newton felt that if light were a wave it should show considerable bending.

EXPLAINING LIGHT BEHAVIOUR IN TERMS OF PARTICLES.

* When a particle (like a bullet) strikes a reflecting surface, the angle of incidence is equal to the angle of reflection. Light can be shown to behave in a similar manner.

* When an object is immersed in water, its position appears to be shifted. We can consider the behaviour of an individual particle of light going from air to water. The uneven pull on the particle when it is at the air-water interface can account for the abrupt bending as it enters the water.

* Dispersion by a triangular prism can be explained by the assumption that particles of light causing the different colours are different sizes.

THE WAVE THEORY

The *diffraction* of light was discovered by Francesco Grimaldi, a professor of mathematics at the University of Bologna. His description of this phenomenon and a number of other experiments was published in 1665 shortly after his death. Newton was aware of Grimaldi's work but felt that what was occurring was some kind of refraction effect.

In 1678 Huygens developed a theory suggesting light was a wave that moved through the 'ether' that pervaded everything. Huygens pictured light as consisting of longitudinal (compression) waves. Using this theory he could account for diffraction, reflection, refraction, and partial reflection and transmission, as well as explain why light rays could pass through each other.

Christian Huygens proposed his wave model at about the same time that Newton proposed his particle model. For about a century, however, most scientists favoured Newton's particle model. The reasons for this appear to be:

1. Huygens did not try to account for the colour of light in terms of waves.

2. Most scientists felt that if light really is a wave, it should refract more. What appeared to be a slight amount of diffraction when light passed through a small opening was, they felt, probably just a refraction effect.

3. Waves interfere when they pass through each other. When light rays intersect, no interference is possible.

4. Newton has made an outstanding contribution to science in the field of mechanics, and weak spots in his theory were overlooked.

Thomas Young's work in 1802 illustrating interference of light did a lot to enhance the credibility of the wave model. Young was an expert in many fields of science and, among other experiments, he repeated all of Newton's work with light. In spite of his impressive work, his ideas were received with hostility by many British scientists who were extremely reluctant to abandon Newton's theory.

In 1818 Augustin Fresnel, a French engineer, correctly pointed out that diffraction becomes more apparent as the ratio of the wavelength to slit width increases. Independently he also discovered

the optical phenomena that Young had been discovering. Fresnel was able to coordinate all of this in a mathematical theory of wave motion.

Both Young and Fresnel discovered that light can be polarised. They realised that this indicated that light was not a longitudinal wave, as Huygens had suggested, but a transverse wave. This generated a new problem: liquids and gases will transmit only longitudinal waves. (Waves on the surface of water are approximately transverse, while waves propagated through water are longitudinal).

Only solids with the property of elasticity can propagate a transverse wave. In addition, the speed of a transverse wave is determined by the square root of the elasticity divided by the density of the medium. For a wave that travelled as fast as light, the medium would have to be like a solid with a very high elasticity and a very low density. At the same time, bodies (such as planets) would have to be able to travel through the ether unimpeded. A medium with such contradictory properties was hard to visualise.

THE ELECTROMAGNETIC MODEL

James Maxwell was a brilliant theoretical physicist who built on the work of Michael Faraday (1791-1867). Faraday had discovered that an electric charge and a magnetic pole can exert a force on each other if they are in motion relative to each other. He is also credited with introducing the concept of a field and describing the field around electrically charged objects and around a magnet.

Maxwell demonstrated that when an electric charge flows through a wire it produces a magnetic field. He then showed that changing the magnetic field can induce an electric charge to flow through a conductor. He suggested that a single charged particle moving through space would produce a magnetic field that is strongest in the vicinity of the charge and showed the effect of a change in velocity on the strength of the field.

Essentially then, he combined these concepts to correctly make the prediction that a charged particle oscillating back and forth in simple harmonic motion creates a changing electric field, which produces a changing magnetic field, which produces a changing electric field, and so on.

Based on these, and some other relationships, Maxwell was able to predict accurately the speed for these waves and account for the fact that these electromagnetic disturbances do not need a medium in which to travel.

Maxwells theories enabled the following predictions to be made:

1. Accelerated charges produce electromagnetic waves.

2. These waves do not require a medium. (Even Maxwell, like his contempories, still thought in terms of the all-pervading ether).

3. These waves travel at $3x10^8$ m/s (the speed already measured for light).

Maxwell's work also raised the following questions:

a) Do electromagnetic waves really exist?
b) If yes, is light an electromagnetic wave?
c) Do invisible electromagnetic waves exist?

In 1887-88 Heinrich Hertz deliberately set out to determine whether Maxwell's main hypothesis *(that accelerated charges produce EM waves)* was correct. He as not only able to do this but also convinced the scientific community that light itself was an electromagnetic wave.

(TO BE CONTINUED...)

MAS QUIZ NO.2

1. What is the name of our closest neighbouring star?
   a) Alpha Centauri
   b) Mel Gibson
   c) Proxima Centauri
   d) Sirius

2. What Spectral Class is our Sun?
   a) M5
   b) G2
   c) G8
   d) W10

3. Name the spacecraft going to Saturn in 1997.
   a) Cassini
   b) Fettucini
   c) Galileo
   d) Mariner 10

4. What and where is the largest volcano in the Solar System?
   a) Pele ... Io
   b) Olympus Mons ... Mars
   c) Maxwell Mountains ... Venus
   d) Mount Everest ... Earth

5. What is the brightest star in a constellation called?
   a) Alpha (as in Alpha Centauri)
   b) Zed
   c) Gamma
   d) Omega

6. Halley's Comet comes around every...
   a) 26 years
   b) 76 months
   c) 1,000 days
   d) 76 years.

7. What is the largest planet in the Solar system?
   a) Ceres
   b) Jupiter
   c) Saturn
   d) Pluto

8. What are the proper names of our Sun and Moon?
   a) Sol and Luna
   b) Luna and Polaris
   c) Sol and Alpha
   d) Mars and Phobos

9. Name the planets in order from the Sun.
1/ .....; 2/ .....; 3/ .....; 4/ .....
5/ .....; 6/ .....; 7/ .....; 8/ .....
9/ .....

10. The farthest known objects in our universe and seen by the Hubble ST are called:
   a) Phasers
   b) Lasers
   c) Quasars
   d) Quarks

11. The largest moon in our Solar System is:
   a) Titan
   b) Luna
   c) Ganymede
   d) Charon

12. What are two stars in very close proximity to each other called:
   a) Binary's
   b) Digits
   c) Galaxies
   d) Red Giants

13. The closest galaxy to Earth and our Solar System is:
   a) The Andromeda Galaxy
   b) The Large/Small Magellanic Clouds
   c) The Orion Nebula
   d) Galaxy cable TV

(PA)

^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^

ANSWERS TO MAS QUIZ NO.1

1. c), 2 .b), 3. b), 4. d) , 5. d), 6. b),
7. a), 8. c), 9. b), 10. c), 11. b), 12. c).