



# South Downs Mercury



The monthly newsletter of South Downs Astronomical Society  
Issue: 428 - April 2010 Editor: John Simper

**Next Meeting - Friday 26<sup>th</sup> March** Main Hall of Lower School, Chichester High School, Kingsham Rd., at 7.30pm.

☉ "What's Up!" - Guide to the month ahead, by SDAS member John Whittington.

☉ "Imaging Weather Systems" - by SDAS member Dick Barton.

☉ Main Speaker Storm Dunlop: "Atmospheric Optics (3)." Fellow of the RAS and past President of the BAA.

\*\*\*\*\*

## In the News:

☉ This image of the huge Andromeda galaxy (courtesy NASA/JPL-Caltech/UCLA) is among the first to be released from the Wide-field Infrared Survey Explorer (WISE) space telescope mission to map the entire sky at infrared wavelengths. Launched last December, WISE will have a lifetime of only 10



months before its hydrogen coolant is exhausted. This image shows Andromeda and two of its satellite galaxies, M32 and M110, just above and below the main spiral, respectively. Andromeda, or M31, is the closest galaxy to our own, some 2.5 million light-years away, and the only galaxy visible to the naked eye from Earth. More images from WISE can be found at [http://www.nasa.gov/mission\\_pages/WISE/main/index.html](http://www.nasa.gov/mission_pages/WISE/main/index.html)

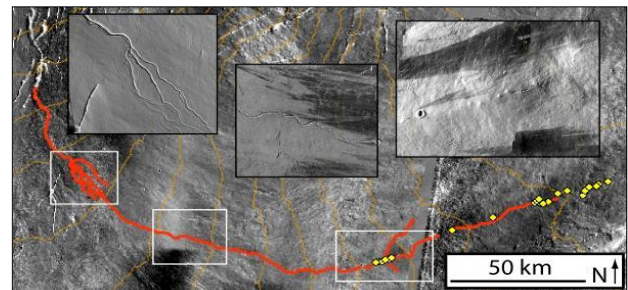
☉ Scientists have long debated the cause of the mass extinction 65 million years ago, one of the biggest in Earth's history. Now, a panel of international experts says it's official: an asteroid around 15 kilometers wide hitting the Earth at Chicxulub, Mexico was the culprit. After surveying evidence for and against competing theories, the panel conclude that the most telling evidence lay in the structures preserved in the interior of the crater and computer predictions of how much rock was vapourised or ejected by the impact.



The massive volcanism that produced the Deccan traps of India around this time has also been proposed as the main cause of the extinction. But in the panel's view, the computer models strongly support the impact hypothesis, predicting that a crater 30 km deep and 100 km across, with sides as high as the Himalayas was created, which then collapsed inwards as the deepest parts of the crater rebounded upwards, creating a wide, shallow hollow.

The panel's paper is published in the March issue of *Science* journal, at <http://www.science.org/cgi/content/abstract/327/5970/1214>

☉ Also long debated is whether channels on Mars were formed by water or by lava. Flowing lava can carve or build paths very much like riverbeds and canyons etched by water, and this probably explains the Ascræus channel (marked in red in the image below), meandering across the surface of Mars. In a paper presented by Jacob Bleacher to the Lunar and Planetary Science Conference at NASA's Goddard Space Flight Center, particular features in the black boxes show close-ups of some of the structures that lava can form, such as branched channels (left), a snaking channel (middle) and rootless vents (right), also marked by yellow spots on the



main image. More comprehensive details can be found at <http://www.sciencedaily.com/releases/2010/03/100304165916.htm>

☉ A reader of the newsletter directs our attention to the <http://astronomy.fm/> website, which carries many varied and interesting videos, blogs, articles and radio broadcasts on matters astronomical.

## SPAGHETTI ASTRONOMY: REVEALING THE UNIVERSE WITH FIBRE OPTICS

Author, broadcaster and expert astronomer, Professor Fred Watson, Astronomer in Charge of the Anglo-Australian Observatory at Siding Spring, will be presenting an illustrated talk at the South Downs Planetarium at 7:30 p.m. on Saturday 17<sup>th</sup> April. Tickets price £5.00 (Adult) and £3.50 (Children) can be bought on the evening, but best to ring ahead (01243 774400) to make a reservation.

## How to Contact us:

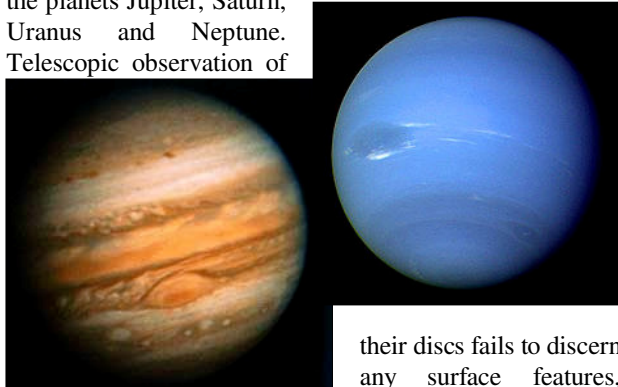
Editor - by email at: [sueandjohn88@btinternet.com](mailto:sueandjohn88@btinternet.com)

Or by telephone: 01483 200286

Society - by email via: [www.southdownsas.org.uk](http://www.southdownsas.org.uk)

## PLANETARY ATMOSPHERES (2)

Last month we examined the chemical make-up and evolution of the atmospheres of the terrestrial planets after they formed from the solar nebula. This month, moving to the colder outer reaches of our Solar System, we examine the four Gas Giants, the planets Jupiter, Saturn, Uranus and Neptune. Telescopic observation of



their discs fails to discern any surface features, showing only a distinctive colour (such as Neptune) or markings (Jupiter) indicative of a thick opaque atmosphere.

Remote sensing of the atmospheres of these giants indicate their atmospheres to be remarkably similar to each other, mainly hydrogen and helium with trace amounts of various other elements and compounds, but unlike anything seen in the inner Solar System (see table below.)

	Temp (K)*	Principal gases
Jupiter	165	86% (H <sub>2</sub> ), 14% (He)
Saturn	135	80-85% (H <sub>2</sub> ), 15-20% (He)
Uranus	75	80-85% (H <sub>2</sub> ), 12-17% (He), 1-3% (CH <sub>4</sub> )
Neptune	70	77-83% (H <sub>2</sub> ), 15-20% (He)

(\*Temperatures at point where pressure = 1 bar)

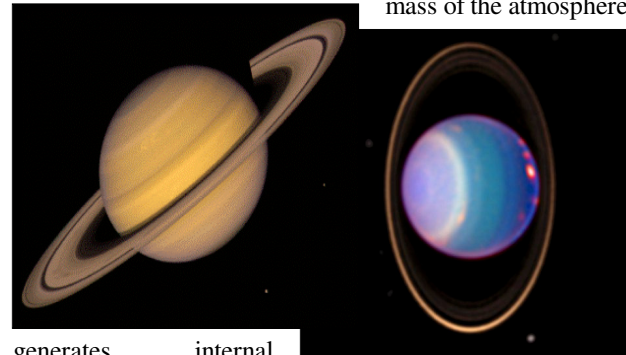
The physical processes that led to the formation of the inner planets worked equally well in the outer regions of the solar nebula. Aggregation of condensed dust grains in the nebula formed progressively larger bodies and, as each proto-gas giant grew in size, they increasingly absorbed the many small bodies in and close to their orbits. The larger swept areas of the orbit of these outer planets, compared to the terrestrial planets, enabled them to eventually grow to rocky bodies with similar (Uranus and Neptune) or much larger masses (Jupiter and Saturn) than their inner solar system counterparts. Their large mass (and high gravity) and lower temperatures of gases in the nebula (with relatively lower thermal velocities), enabled the proto-giants to capture and retain gases from the nebula.

The relative proportion of gas to dust incorporated into these planets was enhanced over the proportions in the local nebula because the solar wind from the newly formed Sun had driven gas out of the inner regions, also to be captured by the gas giants. And, the location and relatively large size of the innermost giant, Jupiter, resulted in it being the prime beneficiary of this out-flowing gas. At the same time as nebula material was aggregating there was also a gravitational segregation of rocky minerals into a core region, and lighter gases into the planetary atmosphere.

Precise details of the composition and structure of the atmospheres of the gas giants are hindered by the lack of close-up data from passing or orbiting space probes. But where information is available, some reasonably firm conclusions can be drawn. For example, estimates of the structure of each of the giants indicate that the relative proportions of gas (atmosphere) and rocky material (core) varies considerably between the giants (see table below).

	Core Mass (Earth Masses)	Atmosphere Mass (Earth Masses)
Jupiter	5	313
Saturn	12	83
Uranus	1	9
Neptune	1	16

It is debatable whether the cores of all of the giants are fully compacted or exist as loose aggregations of rock and ice. But, it seems reasonable to suggest that the large mass of the Jupiter atmosphere overlying its core, and Saturn's large core mass, both produce greater degrees of core compaction than Uranus and Neptune. On Jupiter and Saturn, the enormous mass of the atmosphere



generates internal pressures sufficiently high for helium in the lower layers of the atmosphere to be liquid, and the hydrogen to be present in its metallic form. Overlying these lower levels, pressure steadily reduces and the uppermost 15-20% of the hydrogen/helium atmosphere exists mainly as a cold mixture of these gases.

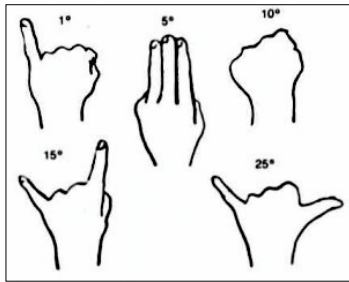
Clouds of condensed methane observed high in the otherwise featureless atmospheres of Neptune and Uranus are not seen on Saturn and Jupiter. In contrast, these two giants exhibit belts of atmospheric activity with large eddies at their edges, indicative of strong winds at the equator and falling away at the pole. Wind speeds on Saturn at the equator reach nearly 500 m/s, more than twice those measured on Jupiter. A particularly distinctive eddy feature is the long-lived Great Red Spot on Jupiter, measuring approximately 26,000km east to west and 14,000km north to south. A similar, but smaller and relatively recent Great white Spot can be seen on Saturn, but a dark spot observed in 1989 by Voyager 2 as it passed Neptune is no longer visible.

Next month we will stretch the title of this short series of articles and look at the composition and causes of atmospheres of some of the minor bodies in the solar System as well as some of the 166 (and counting) moons and satellites of the planets.

## PRACTICAL ASTRONOMY

This month we'll look at a simple way of navigating our way around the heavens without using a telescope. Separation between stars and other astronomical bodies are measured in degrees - 360 of them in a circle, and 90 between the horizon and the zenith point, directly overhead. To estimate smaller angles, perhaps between the major stars in the Orion constellation, or the overall angular size of Ursa Major, the Plough, we can use that most versatile of human limbs - the hand! So how does it work?

Unless you have exceptionally large/small hands and arms,



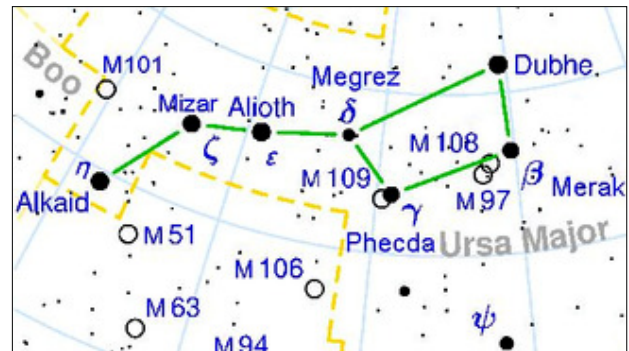
hands and fingers on your outstretched arm are remarkably good measuring sticks. Holding your hand at full stretch, and sighting with one eye closed, the width of your little finger will be about  $1^\circ$ . Three fingers will be  $3^\circ$

and a clenched fist will be  $10^\circ$ . Larger angles can be estimated using 1<sup>st</sup> and 4<sup>th</sup> fingers (about  $15^\circ$ ) and a span (about  $25^\circ$ ).

A useful constellation on which to check your particular "measuring stick" is Ursa Major. The width of the constellation, measured from Alkaid to Megrez, is about

$10^\circ$  (a clenched fist) and between Dubhe and Alkaid is about 1 span ( $25^\circ$ ). This constellation also provides a good pointer to finding the North direction - project a line upward from Merak through Dubhe (the pair of stars forming the outer edge of the constellation), and Polaris (the North star) sits by itself, at due north. For an observer in the Northern Hemisphere, its elevation will correspond with the observer's latitude - for Chichester, that will be  $50.8^\circ$ , i.e. almost exactly two spans above the horizon.

Of course, as with all such approximate estimating methods, there are limits as to how far it can be used - our hands and fingers are too large to estimate angles smaller than about  $1^\circ$ , such as the apparent diameter of the Moon (half a small finger width). But, as a quick and easy way to find angular

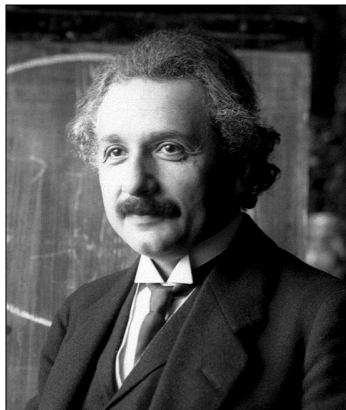


positions around the sky, the method has much to commend it.

\*\*\*\*\*

## AN APRIL ANNIVERSARY

This month we celebrate the life of Albert Einstein, who died on April 18, 1955 at Princeton, New Jersey. Arguably the greatest theoretical mathematician in history, he was born at Ulm, in Württemberg, Germany, on March 14, 1879, moving six weeks later to Munich, where he later on began his schooling at the Luitpold Gymnasium. Later, the family moved to Italy and Albert continued his education at Aarau, Switzerland and in 1896 he entered the Swiss Federal Polytechnic School in Zurich to be trained as a teacher in physics and mathematics. In 1901, the year he gained his diploma, he acquired Swiss citizenship and, unable to find a teaching post, he accepted a position as technical assistant in the Swiss Patent Office. In 1905 he obtained his doctor's degree.



During his stay at the Patent Office, and in his spare time, he produced much of his remarkable work and in 1908 he

was appointed Privatdozent in Berne. In 1909 he became Professor Extraordinary at Zurich, in 1911 Professor of Theoretical Physics at Prague, returning to Zurich in the following year to fill a similar post. In 1914 he was appointed

Director of the Kaiser Wilhelm Institute

and Professor in the University of Berlin. He remained in Berlin until 1933 when he renounced his citizenship for political reasons and emigrated to America to take the position of Professor of Theoretical Physics at Princeton.

At the start of his scientific work, Einstein realized the inadequacies of Newtonian mechanics and his special theory of relativity stemmed from an attempt to reconcile the laws of mechanics with the laws of the electromagnetic field. He dealt with classical problems of statistical mechanics and problems in which they were merged with quantum theory: this led to an explanation of the Brownian movement of molecules. He investigated the thermal properties of light with a low radiation density and his observations laid the foundation of the photon theory of light. In his early days in Berlin, Einstein postulated that the correct interpretation of the special theory of relativity must also furnish a theory of gravitation and in 1916 he published his paper on the general theory of relativity.

In astronomy, Einstein's work laid the foundations for the study of the Universe and the development of a new science, Cosmology. Much as Newton had done some 300 years earlier, he set out and established a new framework within which physical observations of the Universe could be explained. His many contributions to astronomy include the special and general theories of relativity, the founding of relativistic cosmology and explaining the perihelion advance of Mercury, the prediction of the deflection of light by gravity and gravitational lensing.

## April 2010 Sky Diary:

### Chart for Chichester, mid-month, 9.00 p.m.

(Compiled by Peter Littlejohns)

**Mercury:** very well placed up to middle of the month. At its greatest elongation on the 8<sup>th</sup>, fading from mag. -0.8 to mag. 2.0. On the 15<sup>th</sup>, in a direction just north of west, Venus and the crescent Moon will join it.

**Venus:** shining at mag. -3.9 in the evening twilight, passing the Pleiades on the 24<sup>th</sup>.

**Mars:** fading to mag. 0.8 as apparent diameter shrinks to 8". Only 5<sup>0</sup> from the Moon at 06:00 on the 22<sup>nd</sup>.

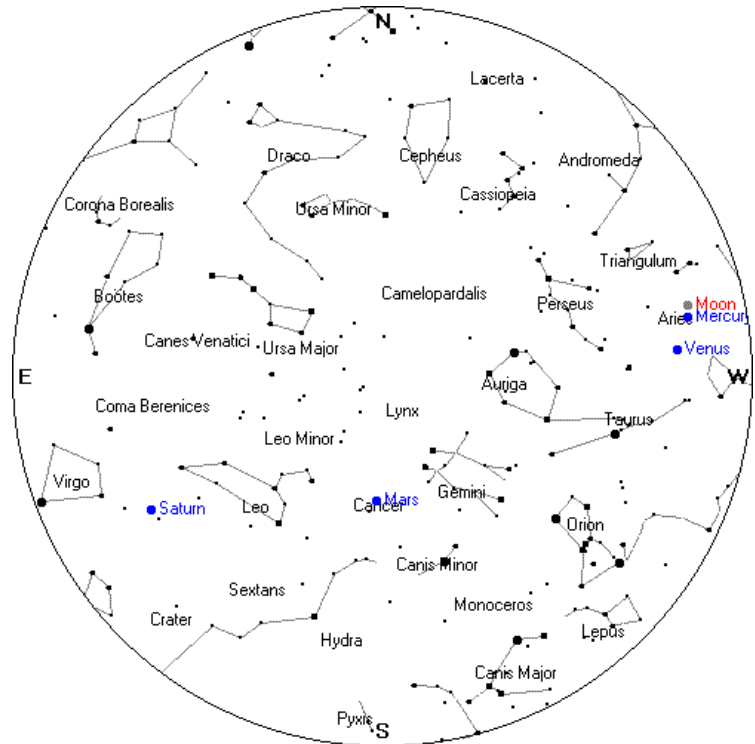
**Jupiter:** rising about 45 minutes before sunrise, becoming much more observable next month.

**Saturn:** due south at midnight in mid-month, shining at mag.0.7. A small telescope will pick out its still narrow rings and its largest moon, Titan, at mag.8.3.

**Uranus:** unfavourably placed this month.

**Neptune:** unfavourably placed this month.

**Meteors:** The Virginid and Alpha Virginid showers peak on the 12<sup>th</sup> at about 5/hour. The Lyrids reach their maximum rate of about 15/hour on the 22<sup>nd</sup>/23<sup>rd</sup>. These sporadic meteors are debris from Comet Thatcher and best viewed after 02:00.



\*\*\*\*\*

### Last Month's (March) Meeting:

🔭 At our March meeting we were treated to two first-class presentations. Lucy Rogers, **"Its ONLY Rocket Science"**, talked about the use of rockets to launch satellites for space exploration and Earth communications. Lucy explained that whilst space has no boundary, the atmosphere gently tailing off with distance from Earth, by convention it is defined as "beginning" at a height of 100 km. With some audience participation, Lucy then explained that, at sea level, the curvature of the Earth is about 5 m over a distance of about 8km. So, a rocket travelling at 8000km / second would also fall about 5m towards the centre of the Earth. Travelling at this speed at sea level, a satellite would also remain in orbit, circling the Earth, whereas at the height of the ISS, about 400km, the necessary orbital speed drops to about 7.7km/sec.

Geo-stationary satellites, at a height of 35,800km, take one day to circle the Earth, thus appearing to remain at a fixed point above the Earth's surface.

Getting into orbit requires multi-stage rockets, usually with the first stage boosting the payload high into the atmosphere and, after separation, the second stage delivering the payload into a parking orbit. A third stage delivers the payload satellite into final orbit and thereafter only minor rocket burns are required to compensate for the

slight orbital degradation due to atmospheric friction and orbital perturbations due to the Moon and Sun.

By their very nature, most rocket launchers are one-shot devices, each stage either burning-up as it re-enters Earth's atmosphere or, with the payload, remaining in orbit. Costs of a launch of something like Ariane 5, that can lift payloads of nearly 10,000kg, are about £85 million, up to about £250 million per launch of the space shuttle.

In addition to all the critical engineering and electronic involved in a rocket launcher and its payload(s), there is the small question of launch window, the time when the rocket and payload can be most energy-efficiently launched. According to the complexity of the mission and the final, perhaps inter-planetary, target of the launch, this can vary between about 40 minutes in successive days over a period of several weeks down to the ultra-critical 1-second window for some missions.

Thank you Lucy for such an interesting presentation.

We were treated also to a talk by Dr Andrew Coates of the Mullard Space Sciences Laboratory on **"Saturn, Titan & Enceladus: recent results from Cassini"**. I'm afraid we have no space to report on Andrew's presentation, but Andrew, please accept our thanks for a most interesting talk and for standing-in at short notice for Chris Lintott

\*\*\*\*\*

### Planetarium Shows in April:

Fri. 2<sup>nd</sup> 7:30 p.m. The Easter Full Moon  
Mon 5<sup>th</sup> 3:30 p.m. The Night Sky This Easter  
Wed. 7<sup>th</sup> 3:30 p.m. Saturn: Lord of the Rings  
Fri. 9<sup>th</sup> 7:30 p.m. Hubble's Glorious Universe  
Sun. 11<sup>th</sup> 3:30 p.m. All Aboard - A Tour of the Planets  
Mon. 12<sup>th</sup> 3:30 p.m. The Northern Lights

Wed. 14<sup>th</sup> 3:30 p.m. Prepare for Blast-Off!

Fri. 16<sup>th</sup> 7:30 p.m. The Stars This Month

Sun. 18<sup>th</sup> 3:30 p.m. The Northern Lights

Fri. 30<sup>th</sup> 7:30 p.m. Eclipses of the Sun and Moon

**Do remember! SDAS Members can watch planetarium shows at the special, discounted, ticket price of only £5.**

Booking by Telephone: 01243 774 400 or 07818 297 292