Castle Eden Planetarium: *Newsletter 6*

incorporating

Transit

The magazine of the Cleveland and Darlington Astronomical Society

September, 2001

Located on the Nature Walkway near Thorpe Thewles, Stockton-on-Tees, and jointly founded in 2000 by the Cleveland and Darlington Astronomical Society and Stockton Borough Council, to bring the universe to everyone.

Building progress
from the organising committee

The planetarium committee comprises John McCue (chairman), Ray Worthy (secretary), Ian Miles (CaDAS treasurer), Ron Peacock (project supervisor), Martin Jenkins (Stockton Borough Council), Jack Youdale (CaDAS president), Sam Garside (Castle Eden warden), and Ed Restall (technical advisor).

During the summer, admirable efforts from the band of society volunteers have made real progress, perhaps the most vital being the acquisition of seventy-two seats from the premises of the old Odeon cinema in Middlesbrough. We really needed seating plush enough to making a planetarium show noticeably comfortable, thereby encouraging visitors to return again and again. We now have such seats, and at no cost to the project thanks to the generosity of Luminar Leisure. Floorboarding was completed by Stockton Borough's task-force of New Deal apprentices which is now busy landscaping the planetarium environment.

Ed Restall has the tough job of designing and fitting the many and varied cables needed to run the whole planetarium experience, the noteable feature probably being telescopis image-linking between the observatory and the planetarium, something which may well be unique in this country.

The impressive octagon, designed by Ron Peacock to carry the dome, has been put into place. The dome itself has been planned by Ray Worthy who supervised its construction at the Thirsk factory. It is ready and waiting to go into the planetarium.

Meanwhile, the sound system has arrived. John McCue is working on the public show script, which will be recorded, the show running semi-automatically. Educational leaflets are with Martin Jenkins at Stockton Borough Council's offices in Billingham for final checking and reprographics. They will be sent out to schools soon, expecting educational visits to begin in January, 2002.

The observatory is open again for the winter season with the eight-inch refractor in place until the New Deal apprentices are ready to start removing all the water-damaged vertical timbers. When this happens a temporary reflector (with a three-inch refractor mounted alongside) will be used if necessary while the Millennium Telescope is taking shape. This will be a 19-inch, f/4, reflector intended for deep-sky viewing, and particularly for studies of comets and asteroids. The mirror has been coated at David Sinden's Optical Company, and a rolled aluminium tube has been obtained from the local firm Henderson Engineering. The images from this instrument will be transmitted through to the planetarium, hopefully with spectacular results.

The recent "Sky At Night" showed an astonishingly-equipped observatory belonging to Gordon Rogers, complete with CCD imaging and remote-control, an ideal for which we can aim. Details can be found at www.gordonrogers.co.uk.It is the intended, at a later stage, to optically fold the existing 8-inch refractor and mount it piggy-back on the large reflector.

The planetarium will be the venue for Dr. Allan Chapman's Nov 9th. talk to our society. The building will be officially opened by Allan, but its full functionality as a planetarium will not be seen until the new year.

Volunteers are still very welcome. Please contact any member of the organising committee.

How the moon was made
from John McCue on the Internet

The dominant theory of how our moon was formed is that it is a by-product of a large

off-centre collision between the earth and an approximately Mars-sized protoplanet. This theory has become the consensus view as no other theory reconciles so many of the facts about the Earth and the Moon. Until recently it has been impossible to model this theory, but now new mathematical algorithms and the availability of the necessary computing power are allowing scientists to put the theory to the test.

In a recent copy of Nature Robin Canup and Erik Asphaug of the University of California present the most sophisticated model yet of the formation of the Moon. They use an approach called smooth-particle hydrodynamics which not only models the shock physics, melting and vaporization of the collision but crucially adds self gravity to all the model components, thus creating a more realistic simulation. Increased computing power also allows the researchers to add increased granularity to their model - their simulation is made up of 20,000 individual particles while earlier models relied on only a few thousand.

Their results reveal a class of impacts that yield an iron-poor Moon, as well as the current masses and angular momentum of the Earth-Moon system. This class of impacts involves a smaller - and thus more likely - object than previously considered viable, and suggests that the Moon formed near the very end of Earth's accumulation.

Society member Down Under

from David Weldrake, Mt. Stromlo, Aus.

Our society member David Weldrake, you will recall, graduated with first-class honours in astrophysics last year and is now Down Under pursuing research at Mt. Stromlo observatory. He sends us regular reports of his adventures, and here is his latest batch. -Ed. "Well, last night I was working late in here, till about midnight. It was a great clear sky, total full moon when I walked here. When I left I noticed it looked quite a bit darker, but still clear, so I looked skyward, and the Moon had turned into a first Quarter! I couldnt believe it, there was a lunar eclipse, and I didnt know anything about it! Apparently It was only a partial, hence no news about it, but it sure did give me a shock!!!!!

This is to keep you updated on what's happening here. Last weekend, I had the key to the Oddey Dome again (9" refractor), and I had a good look around the Southern Skies with it. Some of the objects here, they're so bright and detailed. Eta Carinae is incredible, 2 degrees of dustlanes and bright nebulosity, so much detail. Omega Centauri was breathtaking. Filled the field of view, totally resolved, made M13 look like a misty smudge. Jewel Box was OK, just a smattering of coloured stars, but there are better clusters about.

We saw Uranus at 600X. Quite a nice disc, seeing was apparently 0.7" that night, and it had a very green colour, of course from here its at altitude 80 degrees. Mars was good, a very white patch over the NP, not the NPC, it was much bigger than that. The planet was distictly yellow, compared to last time, and there was 2 fingers of yellow encroaching on the bright white at the pole. No doubt the dust storm weve all been hearing about. Its very impressinve at 600X at the zenith. There were some vague dark markings, specially at the southern regions, just south of the equator. Dont know what they were, the dust storm was making them very hard to see.

We saw Comet Linear 2001/A2, that bright mag+5 one in Pegasus. Saw it easily in the binocs, and was great through the scope. It looked like a big bright unresolved globular, and we suspected a tail going off to the NW. See it if you can, it wont be back for 40 odd thousand years. The Lagoon was easy with the naked eye, the Milky Way incredible. The dustlanes in Sag and Sco have so much fine detail to them. The Lagoon was fantastic, there was an embedded star near the centre, and we could see it lighting up the nebula, and there was a bowshock in the gas near it, very bright, and a larger curve of nebulosity centred on it further away. Great. The Triffid was also good, the dustlanes were easy, and we could see well that reflection part too.

We looked at an object called NGC6164/5 in Norma, a post AGB star thats just forming a PNebula. We could see the star, with 2 blobs of nebulosity at either side of it, 1/2 a degree away! It was amazing, the first time Ive seen anything like this, it actually one of my objects I'm working on here, and it was great to actu-

ally see it! We looked at the planetary in the middle of Corvus, found it very easily. It had a faint central star and fuzzy edges, and was very large, about 5 arcmins.

We also looked for Barnards Galaxy NGC6822, and suspected a very vague localised brightening, but I can't say if we really did see it. We shifted to that nearby planetary NGC6818 instead, and it was amazing, very bright and very blue. Nice vague central hole in it too.

On to Ara, where we saw NGC6397, a very big and bright globular cluster, much bigger and brighter than M13, with 5 chains of stars coming from it, totally resolved, looked like a starfish. Theres also a big open cluster near there called NGC6193 that was great in the binocs.

There's a very bright globular in Pavo called NGC6752 that was another better than M13, and a SB galaxy NGC6744 that was nice, had a very elongated central bar, and we saw the arms vaguely too.

Well, we also saw many other objects that I cant remember off the top of my head, but we saw about 60 odd in total, 90 per cent of them first time objects for me. You guys have got to come here sometime and see these skies for yourselves.

Talking about good skies, I'm going observing at Siding Spring next Wednesday, using the 2.3M. Never been there before. Should be fun. I'm taking NIR spectra of post AGB stars with an instrument called CASPIR. I'll be there from wednesday until sunday, so I'm keeping my fingers crossed for good seeing. (0.5" is the norm). Apparently at new moon you can read a newspaper by the light of the Milky Way!!!!! Unbelievable for me from smoggy Teesside.

Of course, because I'm working in the NIR, our time on the scope is during gibbous moon, so maybe it won't be so good this time. Never mind, next time maybe, apparently my supervisor goes once a month, might tag along. Best wishes for now"

Dialling

from John Crowther, Redcar (CaDAS)

We still speak of dialling a phone number, although nowadays we usually push buttons. An older meaning of the word relates to the construction and use of sundials. One of the more unusual objects to be vandalised nowadays are sundials, since the 'gnomon' (the important bit which casts the shadow) is rather easy to break off. There are broken sundials in Stewart's Park, Marton, in Pannett Park, Whitby and even the sundial at Wydale is without its gnomon. Guisborough Market Cross is a four-face sundial and sadly in need of repair.

We also find sundials not lined up north and south. There is even one in River Gardens, Sleights with the 'gnomon' pointing south instead of north. So we should look in private gardens to find sundials which work. Recently I found a fine example, made in 1872, in a garden at Guisborough. It had been moved from Durham many years ago and engraved on it was its longitude west of Greenwich. In those days even our small country observed local time, for there was no radio or television to tell us GMT. This meant that the west of England was a few minutes behind the east. Sundials sometimes had a magnifying glass above them, which focussed the suns rays and fired off a midday gun, so that churches and public buildings were able to check their own clocks.

Sundials often have mottoes engraved on them. The most popular one is "Tempus Fugit" - "Time Flies". My favourite one is "Sun look on me, so that I may be looked upon". If we change the Sun into "Son of God" then we have a challenging Christian Statement, which we pray may influence our lives.

Making a Sundial.

This may be made easily from card. However, in order to be more permanent, make it from wood and a surplus 33 rpm record, 45rpm record or CD, which will be the dial. Strong scissors or a fine saw, such as a fretsaw, can be used to cut out the material. You will also need a protractor to draw the angles - a large circular one is the most suitable.

The base may be fixed to a post or set up on a wall or step. The size of the dial and the thinness of the centre rod or dowel, which casts the shadow, determine the accuracy of your sundial and a 33 record, being bigger, is even better than a 45 or a CD. Built to withstand wind, this sundial works from March 22nd until September 22nd.

The base is square with sides equal to the diameter of the disc. (a 33 is approximately one foot, a CD approximately five inches). Triangular parts support the disc, although they need to be large as the longest side supports the disc. If you are making a wooden one, 1/4 inch is the minimum thickness needed. Cut two right-angled triangles, with one angle 36 degrees. The triangular parts are fixed to a square base with the 36 degree angle against the base. The triangles are parallel to the sides of the base and set in from the edge. Use thin nails or screws or small blocks on each side firmly glued to the base. The size of the base and the triangles needs to be suitable for the diameter of circle you are going to fix to the triangles.

The sun moves across the sky 15 degrees each hour and so we divide 180 degrees into twelve equal segments. If your garden catches early and late sunshine two extra segments may be added, one on each side and then the time will be measurable from 4am until 8pm. David included a compass rose last month and this is useful, especially if your dial is of card and perhaps clear varnished. If you use an old record first paint one side matt white: you may need two coats.

Then use a card template in the form of a 15 degree segment, using masking tape and a tinlet of black paint with a fine brush, both obtainable from a model shop. Then the lines are painted on the white disc, just two at a time so as to guard against smudging. Roman numerals are the easiest as they are straight lines: eg I II III IV V Vl VlI VllI IX X XI XII Hence we have on the disc, starting at southwest, III IV V VI VII VIII IX X XI XII (pointing north) I II III IV V VI VII VIII IX (pointing southeast), each at 15 degree intervals.

The disc is glued to the hypoteneuse of the triangles, with the XII at the lowest point. A needle or pin is fixed to the centre of the disc to cast the shadow. The completed base is set up horizontally on a post. The disc has the XII to the North, sloping at 36 degrees the horizontal.

Eclipsing binary project from Alex Menarry, Darlington (CaDAS)

The course I am doing with the University of Central Lancashire requires me to submit a "mini-project" this year. Foolishly, I have opted for an observational subject, hoping that the weather this autumn and winter will be kind. Eclipsing Binary Stars is the basic subject, which involves drawing up a list of stars to watch, estimate the magnitudes and note the times of maxima and minima. My inadequate knowledge of the sky is groaning under the strain of even finding some of these eclipsing binaries. Add the problems of learning the techniques of visually estimating magnitudes and I am struggling.

If any kind person out there can spare me some of their time looking at the sky together and confirming the position of the stars on my list, I should be most grateful. In fact any help with the problems of which stars to attempt, drawing finder charts, where to get information and that sort of thing would be a great help.

Sir Fred Hoyle
from John McCue on the Internet

The world lost an original thinker recently with the passing of Sir Fred Hoyle. Here is the BBC's Online report of his controversial but highly productive scientific life.

"The English astronomer who coined the term "Big Bang" to describe an academic theory on the creation of the cosmos, has died at the age of 86. Despite popularising the theory by mockingly giving it its name, Professor Sir Fred Hoyle challenged the belief that the cosmos was caused by a huge explosion 12,000 million years ago.

He advocated instead the "steady state" theory - that the cosmos had no beginning but new galaxies were formed as others moved apart.

Until the end of his life, Hoyle championed the "steady state" theory of the universe which maintained that the cosmos had no beginning. This was despite increasing evidence, amounting in the view of many to proof, that the cosmos began in a Big Bang some 12,000 million years ago. In 1992, when the American George Smoot found tell-tale ripples in the fabric of the cosmos, Hoyle refused to accept it. "I have an aesthetic bias against the Big Bang," he admitted.

Sir Fred also put forward the so-called Panspermia Theory, which suggests that life, or the building blocks of life, could be carried to planets by comets or drifting interstellar

dust particles.

Hoyle received numerous scientific prizes, honorary degrees and professorships. His many other books included Frontiers of Astronomy (1955), Man and Materialism (1956), Star Formation (1963), Galaxies, Nuclei and Quasars (1965), The Relation of Physics and Cosmology (1973), Ten Faces of the Universe (1977), On Stonehenge (1977) and The Cosmogony of the Solar System (1978).

Published in 1957 his science-fiction book The Black cloud described an intelligent cloud of cosmic dust sapping the Sun of solar energy to create a second Ice Age on Earth.

In 1962, Sir Fred wrote A For Andromeda, which became a BBC-TV series, and his play for children, Rockets In Ursa Major, opened in the West End.

Born at Bingley in the West Riding of Yorkshire to wool merchant parents, he could navigate by the stars at the age of 10 and often stayed up all night gazing through his telescope. Sir Fred was educated at Bingley grammar school and Emmanuel College, Cambridge, where he studied mathematics.

In 1939, he was elected a fellow of St John's College, Cambridge, and married Barbara Clark. They had a son and a daughter.

During World War II, Sir Fred conducted research for the Admiralty. He was elected a Fellow of the Royal Society in 1957 and knighted in 1972.

Sir Fred founded the Institute of Astronomy at Cambridge, where he was Plumian Professor of Astronomy from 1958 until 1972.

His most important discovery, made in 1958, was with the American physicist William Fowler, of the way the heavy chemical elements that fill our bodies, such as oxygen, carbon and iron, were forged in the nuclear furnaces of giant stars which later exploded and from whose relics the solar system was born. In short, we are literally made of stardust. But this epochal discovery was strangely rewarded. Fowler won a Nobel prize for it, but Hoyle, to his justifiable annoyance, did not.

Fred's quintessentially British eccentricity and his courageous opposition to a number of mainstream paradigms will always remain an inspiration for people interested in science in general and researchers in particular.

Is Ceres the biggest asteroid? from John McCue on the Internet

Astronomers announced Monday that they have discovered an object in the distant Kuiper Belt that could rival Pluto's moon in size.

A team of astronomers from Lowell Observatory, MIT, and the Large Binocular Telescope Observatory said that the new object, 2001 KX76, is the brightest Kuiper Belt object (KBO) yet discovered and thus likely the largest. The object was discovered in images taken in late May using a 4-meter telescope in Cerro Tololo, Chile.

"This object is intrinsically the brightest Kuiper Belt object found so far," said Robert Millis, director of Lowell Observatory and head of the survey team. "The exact diameter of 2001 KX76 depends on assumptions that astronomers make about how its brightness relates to its size."

Those assumptions center on the reflectivity, or albedo, of KBOs: the brightness of an object is a function of both its size and albedo. One object could be brighter than another because it is larger, more reflective, or some combination of both. To determine the size of a KBO requires astronomers to determine, or at least estimate, its albedo.

In the past, astronomers have used an albedo estimate of 4 percent to estimate the size of KBOs, based on their compositions and the effect radiation exposure would have to darken their surfaces. That value gives 2001 KX76 a diameter of 1,270 kilometers, larger than both the largest asteroid, Ceres (diameter: 932 km) and Pluto's moon Charon, 1,200 km across.

Earlier this year another team of astronomers was able to directly measure the albedo of another large KBO, Varuna. Using that larger albedo value – 7 percent – gives 2001 KX76 a diameter of 960 km, still larger than both Ceres and Varuna, which is 900 km across.

The discovery of 2001 KX76 is more ammunition in the debate regarding the classification of Pluto, the smallest and most distant planet. As new discoveries close the gap in size between the largest KBOs and Pluto, 2,275 km across, some planetary scientists have argued that Pluto should either be jointly classified

as a planet and KBO or be stripped of planet status altogether.

Pluto appears to share a number of characteristics with objects in the Kuiper Belt, a disk of icy bodies beyond the orbit of Neptune. Of the more than 400 KBOs discovered since the first, 1992 QB1, was found nine years ago, a sizeable fraction have similar orbits to Pluto, locked in an orbital resonance with Neptune such that they complete two orbits of the Sun in the time it takes Neptune to make three. Pluto also appears to have a similar composition to many KBOs based on spectroscopic studies of the belt.

Millis believes that the gap between Pluto and the largest KBOs will continue to shrink, if not disappear outright, as studies of the belt using larger ground- and space-based telescopes continue. "We have every reason to believe that objects ranging up to planets as large or larger than Pluto are out there waiting to be found," he said. "Until the Kuiper Belt has been thoroughly explored, we cannot pretend to know the extent or the content of the solar system."

Deep Thought Computer in the North-East

from Spaceflight Now

(*Catch up the latest news on Spaceflight Now's home page, www.spaceflightnow.com)*

The past, present and future of the universe is about to be revealed in unprecedented detail by Britain's biggest academic supercomputer called the Cosmology Machine, based at the University of Durham. Trade and Industry Secretary Patricia Hewitt launched the "time machine" on its first simulation programme this week when she switched on the 1.4 million state-of-the-art installation at the University's Physics Department.

The Cosmology Machine takes data from billions of observations about the behaviour of stars, gases and the mysterious dark matter throughout the universe and then calculates, at ultra high speeds, how galaxies and solar systems evolved. By testing different theories of cosmic evolution it can simulate virtual universes to test which ideas come closest to explaining the real universe.

The gigantic new facility - manufactured by Sun Microsystems and supplied by Esteem Systems plc - has been installed at Durham with the help of 652,00 from the Joint Research Equipment Initiative (JREI). The JREI was set up by the DTI's Office of Science and Technology, the Higher Education Funding Council for England (Hefce) and the research councils - in this case, the Particle Physics and Astronomy Research Council (PPARC) - to provide strategic investment in key scientific infrastructure for research of international quality.

The funding forms part of 18 million worth of special strategic investment in Durham science by DTI and the research and funding councils over the past two years.

The supercomputer is operated by the Institute for Computational Cosmology (ICC), part of the Ogden Centre for Fundamental Physics now being developed at Durham. Its breathtaking capacity for calculations will set new standards in science that could also help other areas of research.

The supercomputer is called the Cosmology Machine. Its engine room is an integrated cluster of 128 Ultra-SparcIII processors and a 24-processor SunFire. It is the largest computer in academic research in the UK and one of the 10 largest in the UK as a whole. can perform 10 billion arithmetic operations per second. This number of operations would take a numerate individual about a million years of continuous calculation to complete.

Alternatively, if all of the Earth's six billion inhabitants were proficient at arithmetic, it would take them about two hours to carry out the same number of operations that the supercomputer can carry out in a single second. It has a total of 112 Gbytes of RAM and 7 Terabytes of data storage. (A terabyte is more than a million million bytes).

This is the equivalent of nearly 11,000 CD-ROMS. It could hold the contents of the 10 million books that make up the British Library collection and still have plenty of space left over.

Vice-Chancellor of the University of Durham, Sir Kenneth Calman said: "This is a fascinating and important branch of physics. I am delighted that my colleagues in Durham have established the expertise and quality to take a lead in advancing the frontiers of knowledge even further."

Professor Carlos Frenk, Director of the ICC, says: "The new machine will allow us to recreate the entire evolution of the universe, from its hot Big Bang beginning to the present. We are able to instruct the supercomputer on how to make artificial universes which can be compared to astronomical observations. It is truly remarkable that all is required to emulate the Universe are the same laws of Physics, such as gravity, that govern everyday events on Earth."

Chief Executive of PPARC, Professor Ian Halliday says, "This is a stunning resource for astronomical research in Britain. It will enable consortium scientists in UK, Germany, Canada and the USA to perform cosmological calculations of unprecedented size and detail. We are poised to confront one of the grandest challenges of science: the understanding of how our universe was created and how it evolved to its present state."

The Durham Institute is a leading international centre for research into the origin and evolution of the universe and is the UK base of the "Virgo consortium for cosmological simulations", a collaboration of about 30 researchers in the UK, Germany, Canada and the USA.

Research ranges from the formation of the first objects in the universe, to the physics of the great clusters of galaxies. Long-term goals are to understand the formation of structures in the universe, to establish the identity and properties of the dark matter that dominates the dynamics of the universe, to determine the parameters of our world model, and to relate the Big Bang theory to astronomical observations.

Black Hole caught feeding

from Ray Worthy of Hartlepool(CaDAS) and NASA News

For the first time astronomers have detected material being consumed by the supermassive black hole in our own backyard. A violent, rapid X-ray flare, captured by NASA's Chandra X-ray Observatory, has been observed from the direction of the supermassive black hole that resides at the center of our Milky Way Galaxy.

A team of scientists, led by Fredrick K. Baganoff of the Massachusetts Institute of Technology (MIT) in Cambridge, detected a sudden X-ray flare while observing Sagittarius A*, a source of radio emission believed to be associated with the black hole at the center of our Galaxy.

"This is extremely exciting because it's the first time we have seen our own neighborhood supermassive black hole devour a chunk of material," Baganoff said. "It's as if the material there sent us a postcard before it fell in."

In a few minutes, the source brightened dramatically, eventually reaching a level 45 times brighter than before the flare. After about three hours, the X-ray intensity rapidly declined to the pre-flare level. "The rapid rise and fall of the X-rays from this outburst are compelling evidence that the X-ray emission is coming from matter falling into a supermassive black hole, confirming that it is powered by the same accretion process as quasars and other active galactic nuclei," said Baganoff.

Baganoff added that the data also provide the best look yet at the area just outside this event horizon, the surface of "no return" for matter or light falling into a black hole.

Studies of the central region of our Milky Way Galaxy in the infrared and radio wavebands indicate the presence of a large, dark object, presumably a supermassive black hole, having the mass of about 3 million suns. The faintness of Sagittarius A* at all wavelengths, especially in X-rays, has puzzled scientists who expected that the infalling matter should shine more brightly on its way in, and this has left some room for doubt.

The latest precise Chandra observations of the crowded galactic center region have dispelled that doubt. Given the extremely accurate position, it is highly unlikely that the flare is due to an unrelated contaminating source such as an X-ray binary system.

"The rapidity of the variations in X-ray intensity indicate that we are observing material that is as close to the black hole as the Earth is to the Sun," said Gordon Garmire of Pennsylvania State University, University Park, principal investigator of the Advanced CCD Imaging Spectrometer (ACIS), which was used in these observations.

"It's truly remarkable that we could identify and track this flare in such a crowded region of space," said Mark Bautz of MIT. "This dis-

covery would not have been possible without the resolution and sensitivity of Chandra and the ACIS instrument."

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NASA press releases and other information are available automatically by sending an Internet electronic mail message to domo@hq.nasa.gov. In the body of the message (not the subject line) users should type the words "subscribe press-release" (no quotes).

Many thanks to society member Alex Menarry for his help in preparing this magazine.

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