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canopus

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PO Box 412 323, Craighall, 2024

SALT Inauguration – 10 November 2005. Picture by Dr. Stephen Potter

contents

year-end star party – Henley on Klip

The year-end star party will be held at Brian Fraser's dark sky viewing site at Henley on Kilp on Saturday, 10 December 2005. Time: 5pm onwards. What to bring: Food, drinks, chairs, umbrellas (to ward off the rain) and of-course, telescopes if you have!

Directions to Brian's house for the star party: Take the R59 highway to Vereeniging. You get onto it from the N12 near Alberton. Go south for about 25kms and you come across the Blockhouse Engen OneStop garage. It is the only garage on the road so there is no way to get it confused with any other. The first off-ramp after the garage is Randvaal…(ignore it). The second off-ramp is Henley Drive. Take this exit. (Exit number "27" on the exit board.) Turn LEFT off the highway into Henley Drive. At the second stop street turn RIGHT into Ewelme Rd. At the first stop street (just past some shops) turn LEFT into Iffley Rd. Cross the river and at the first stop street turn right into Hearn Rd. About 500m along turn left into Goring Rd. My house is 1772 Goring Rd. Cell no. is 082 568 1391 in case you get lost.

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ATM: Amateur Telescope Making classes held on the premises of Parktown Boys High School on most Saturday afternoons.

ASSA Johannesburg Centre's mailing-list subscriptions:
Announcements and discussion, send a *blank* email to: **assajhb-subscribe@yahoogroups.com**
ATM class' mailing list, send a *blank* email to: **assaatm-subscribe@yahoogroups.com**
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3 cheers for pluto

edited article from a NASA Press Release, 1 November 2005

Using the Hubble Space Telescope to probe the ninth planet in our solar system, astronomers have discovered that Pluto may have not one, but three moons.

"If, as our new Hubble images indicate, Pluto has not one, but two or three moons, it will become the first body in the Kuiper Belt known to have more than one satellite," said Hal Weaver of the Johns Hopkins Applied Physics Laboratory. He is co-leader of the team that made the discovery. The candidate moons, provisionally designated S/2005 P1 and S/2005 P2, are approximately 27,000 miles (44,000 kilometres) away from Pluto – two to three times as far from Pluto as Charon.

These are tiny moons. Their estimated diameters lie between 40 and 125 miles (64 and 200 kilometres). Charon, for comparison, is about 730 miles (1170 km) wide, while Pluto itself has a diameter of about 1410 miles (2270 km). The Earth's Moon by comparison is a whopping 2180 miles (3480 km) in diameter.

The team plans to make follow-up Hubble observations in February to confirm that the newly discovered objects are truly Pluto's moons. Only after confirmation will the International Astronomical Union consider permanent (and catchier) names for S/2005 P1 and S/2005 P2.

The Hubble telescope's Advanced Camera for Surveys observed the two new candidate moons on May 15, 2005. "The new satellite candidates are roughly 5,000 times fainter than Pluto, but they really stood out in these Hubble images," said Max Mutchler of the Space Telescope Science Institute and the first team member to identify the satellites. Three days later, Hubble looked at Pluto again. The two objects were still there and appeared to be moving in orbit around Pluto.

"A re-examination of older Hubble images taken on June 14, 2002 has essentially confirmed the presence of both P1 and P2 near the predicted locations based on the 2005 Hubble observations," said Marc Buie of the Lowell Observatory. The team looked long and hard for other potential moons around Pluto, but they didn't find any.

These Hubble images represent the most sensitive search yet for objects around Pluto and it is unlikely that there are any other moons larger than about 10 miles across in the Pluto system.

editorial

Robert Groess

The universe is truly amazing. At the beginning of each publication cycle, I scratch my head and bite my nails (figuratively, of-course) wondering where the next set of articles will come from. And over the course of the month, my fears are slowly abated as the Universe unfolds its awesome script. Indeed, it has been my great fortune, time and again, to end off the Canopus month with having too much at hand – a lot of this being in no small part thanks to all of the dedicated team of detectives, spies and informants that bring you the articles that you read today. As always, a hearty mention of gratitude to all of you who have submitted – columnists included!

This month's Canopus kicks off with its sibling, Canopus Digital. Those of you who have signed up for this electronic format will enjoy the benefits of reading, sorting, storing and searching through PDF files. Above and beyond those technical features, Canopus Digital will feature something that Canopus "classic" will not – and that is a section dubbed "Breaking News" (in the next edition). In order to keep the editor (yours truly) sane and not too over-worked, the two Canopii are synchronized with each other. In effect this means the printed edition is the prototype – the printed copies get mailed off – and then Canopus Digital is upgraded and fitted with the latest news, to be sent off around the 27th of each month, for the following month. (Yes – these are incentives to promote Canopus Digital.) Our international readers will no-doubt benefit tremendously by receiving the electronic copy within a few seconds of everyone else – not like the traditional mail service which can be delayed by up to 3 – 4 weeks!!

The year was 2001. The month, July. I was on my way to the Silvermine Nature Reserve in the Cape Peninsula, with two ladies in the car with me – both avid rock climbers – both exceptionally talented. One of them had recently endured a serious fall from a rock-face, though she looked none-the-worse for wear. In fact, she demonstrated supreme confidence in tackling the climb she was about to attempt (and master with ease) – a testament to the philosophy of life that drives her. I had never been to Silvermine before, and colleague of mine was going to show "Lisa" and I the place (while they would tacitly scale a rock-face or two). Indeed, these two women lived the metaphor of climbing to new heights amid the stark contrasts of surrounding, harsh, terrain. Chris Stewart has kindly forwarded an article by Dennis Overbye about "Lisa", and highlights of her illustrious career of scaling the stark and demanding rock-face which is the edifice of modern physics. I trust you will enjoy the article, to which I can attest, is an accurate description of *The* Dr. Lisa Randall.

That leaves me to wish all of you and your respective families a festive holiday season and all the best for 2006.

The Editor.

chairman's chat

Brian Fraser

A couple of weeks ago I was asked to give a talk on astronomy at a team-building conference in Phalaborwa. It was at a seminar for the local municipal managers and the talk actually took place at a bush braai in the Kruger National Park after a night game drive.

Sounds like fun, and it was, except that I came away stunned at the ignorance of rural people as far as astronomy is concerned.

In preparing the talk I had realized that I would have to stick to some real basics and be prepared for some simple questions, but I never dreamed that I would come across people who had absolutely no concept of our universe.

Which brings me to my point. Those of us who have been privileged to have access to astronomy books, magazines and can surf the internet for fantastic astronomy pictures and news have a duty to pass on this knowledge to those in this world who are less fortunate than us.

There is a Neil Armstrong or a rocket scientist out there who has just never been given the opportunity to learn anything about our incredible universe. Obviously there are many people who just couldn't be bothered, like many of your neighbours in the city, but there are also those few who would dearly love to look through a telescope or hear a talk on some basic astronomy.

So next time you take your telescope out into the country, include some of the locals in a short observing session and show them one or two of the splendours that keep you interested in astronomy.

This is the last Canopus for the year and I have to report that we are no closer now to having any clarity from SAASTA on the future of the observatory. We all know the wheels of government turn slowly but the lack of progress has a direct impact on our ability to make full use of the facilities at the observatory. We now have some concerns about the working of the 26-inch dome and this may pack up at anytime and deny us the use of a useful observing tool.

Would somebody please try to persuade SAASTA to put this on their New Year Resolutions list.

I hope you find that 20-inch under the Xmas tree this year, but whether you do or not I hope you have a peaceful time.
And some clear skies…

encarni's reflections

Encarni Romero Colmenero – erc@saao.ac.za

Dear all,

I'm dedicating my column this month to the biggest event at SALT/SAAO this year: the inauguration of SALT! You have probably already seen the news items etc., about the event, which took place on the 10th of November, but they were all so short compared to the real thing!

The day turned out sunny and beautiful, despite my having to close SALT early the night before due to high winds. The buses with the guests started arriving at about 9:45 am, just as I was on my way to grabbing some cereal for breakfast - luckily one of the guests gave me a cereal bar so I got to mingle and eat at the same time! Most of the buses had arrived by about 10am, and everybody went straight for a marquee which was set outside the hostel (where we astronomers sleep) with drinks. While we were all mingling and greeting each other etc., president Thabo Mbeki had a private tour of SALT and of the 1.9m telescope. We were all already seated in the main marquee by 10:45am, and perfectly on queue, president Mbeki arrived at 11am and the inauguration started.

MC Dr. Rob Adams chaired the event. We first heard the singing of the South African National Anthem by a children's choir, followed by a traditional Ghorro player (which was fantastic!) and a welcoming address by the premier of the Northern Cape, Premier Peters. Prof. John Wiley, Chancellor of Wisconsin University in the USA, also addressed the audience in the name of all the SALT partners, followed by the president of the NRF, Dr. Khotso Mokhele, who had a good reason to be proud that day, since he had been instrumental in getting funding for SALT from the South African government. The minister of Science and Technology, Dr. Mangena, was next, and he introduced the president himself.

All the speeches were brilliant, but President Mbeki's was, in my opinion, the best - you should be able to find a transcript of the whole speech on our website if you are interested. Meanwhile, I'll tell you that my favourite part was when he talked about ridding ourselves of astrology (yes, you read right!) and ignorance and replacing it with science and fact. He said that it is about time that we take responsibility for our own actions rather than blaming the stars or the Moon or the planets. Hurrah! He also talked at some length about South Africa being the cradle of humanity, and how fitting it was that it is here, in South Africa, that man has built SALT to investigate our past, and our future. Please don't quote me - I am telling you what I remember - it was a big day for me and my memory has never been good! Check out our website for the full transcript, I guarantee you will enjoy it. (**http://www.salt.ac.za**)

After president Mbeki's wonderful speech, he unveiled a plaque commemorating the event, and he received some gifts (I don't know what they were - I couldn't see from my seat because everybody stood up at that time and I am rather small... sniff). SALT was then declared inaugurated and the president left first, while we listened entranced to the afro-poetess Chigo. We then left the marquee for the drinks tents again while the marquee got ready for lunch. Three red and white small airplanes flew by doing acrobatics, the middle one leaving a trail of smoke. Lunch, which was served at about 1pm, was also exceedingly nice, served in the form of a buffet with many tables from which we could serve ourselves without the usual annoying queues. The food was lovely and fresh, but to my dismay, there were no sweeties for dessert!! :o

After lunch all the guests had an opportunity to have a guided tour of SALT. There were many tour guides, and all the tours proceeded surprisingly efficiently. After each tour, the corresponding bus departed for Cape Town, so before we knew it, we were back to normal in Sutherland. Well, not quite… Herman, our system's engineer, decided to have a little celebration of our own at SALT, to which he invited everybody on site! :)

All in all, despite all the last minute panics and usual minor hiccups, we had a fantastic day, all the effort so many people put in paid off and the inauguration was a resounding success. I am so proud to be a 'local'!

Until next time,

Encarni

does asteroid 2004MN4 have our name on it?

edited article by Rusty Schweickart – the Planetary Report Vol. XXV, No.4, July/Aug 2005

The year 2004 ended in an awful week. Most folks were involved in and looking forward to the holiday season, when suddenly it seemed that the world went out of kilter. The main event occurred about 8 a.m. PST (6 p.m. SAST) on December 26 (Boxing Day), as the India tectonic plate lurched farther under the Burma plate and Earth's crust off the northwest coast of Sumatra broke along a northwest-southeast line. The Burma plate jumped upward by about 10 meters. The resulting magnitude 9.0 earthquake created a massive tsunami that ultimately killed more than 250,000 people.

For the next 2 months, this huge human tragedy dominated the news. But the coincidence of the holiday season and the Indian Ocean tsunami allowed another rare and potentially devastating event, developing at the same time, to go virtually unnoticed. This is the still-unfolding saga of near-Earth asteroid (NEA) 2004MN4. In June 2004, using the Bok telescope at Kitt Peak, Arizona, Roy Tucker, David Tholen, and Fabrizio Bernardi discovered the asteroid, but weather and other circumstances made it impossible for others to confirm its existence. On December 19, Gordon Garradd of the Siding Spring Survey in Australia rediscovered the asteroid, which was designated 2004MN4. MN4, as it came to be called, made a particular splash within the scientific community even upon its initial acknowledgment as a potential Earth impactor, entering the list of potentially risky asteroids at a Torino level of 2, the highest risk rating ever assigned to an asteroid. (See JPL's Sentry impact risk table at **neo.jpl.nasa.gov/risks** and Torino scale explanation at **neo.jpl.nasa.gov/torino_scale.html**.)

The asteroid, initially thought to be about 500 meters in diameter (subsequently downsized to 400 and then 320 meters), was headed for the vicinity of Earth with an ominous encounter date of Friday, April 13, 2029. Based on observations up through December 23, 2004, it appeared that MN4 would most likely pass outside the orbit of the Moon, but the uncertainty about its orbit also included about a 1 in 300 possibility of an Earth impact.

By December 24, the entire NEO (near-Earth object) community was watching intently as additional tracking information narrowed the uncertainty further. MN4 was determined to be coming even closer to Earth than previously thought. Indeed, the error ellipse (a range of predictions for the asteroid's orbit) had shrunk, and the probability of impact with the Earth had risen to 1 chance in 60, warranting a Torino scale rating of 4. Although the probability of MN4's missing Earth was more than 98 percent, this was nevertheless the most threatening potential impact situation that the NEO astronomers had ever seen – by far!

Those involved in the tracking and calculations were amazed that almost nothing about MN4 appeared in the press. This lack of publicity had its good side: in many prior cases, actual situations had been mischaracterized by much of the press, usually in the alarmist direction.

With excitement substituting for sleep, most of us NEO watchers attended closely to new calculations, watching on Christmas Day as the probability of Earth impact rose again, to 1 in 47. On the morning of Boxing Day, it rose yet again, to 1 in 37 - about the same probability as rolling snake-eyes or boxcars (double 1s or double 6s) in dice. Still, very few in the general public were aware of this unusual risk, and the certain disaster of the Indian Ocean earthquake/tsunami drew attention even further from the possible disaster of an asteroid impact. The probability of MN4 impacting Earth had risen to unprecedented levels, levels that most of us in the NEO community believed we would never see in our lifetimes. The combination of events that day gave a surreal sense that Mother Nature was bent on reminding us of just who is boss.

With a great sense of relief, tempered by a touch of disbelief, we NEO observers finally relaxed when JPL announced that Jeff Larsen and Anne Descour of the Spacewatch Observatory near Tucson, Arizona had discovered faint traces of MN4 on photographic plates taken in March 2004. Integrating these data with the more recent observations yielded a still smaller error ellipse, but in this case one that excluded Earth. Although it would come close to Earth, MN4 definitely would not hit us - at least not on April 13, 2029. We already know that it will miss us in 2029, so do we really care about its orbit? As a matter of fact, yes, we do!

Our best information indicates that in the fading twilight on April 13, 2029, Londoners will be able to see MN4 with their naked eyes. They will have to look just to the west of due south, about 45 degrees above the horizon, to catch this magnitude 3 object as it passes behind Earth, headed toward the just-set Sun. It will dim slightly over 40 minutes as it moves almost horizontally to the west, passing closest to Earth in the west-southwest at 21:40 local time. The asteroid will pass over London at less than one tenth the distance to the Moon and 4,000 miles *inside* the geostationary Clarke orbit. There will doubtless be evening parties all across northern Europe celebrating this unique cosmic event.

What will be invisible to all of us on that evening is the 28-degree turn that MN4 will take as it whizzes past us. MN4 will end up in quite a different orbit on April 14 from what it had on April 12, shifting from an orbit 323 days long to one of about 428 days. Exactly what its new orbital period will be depends on precisely how far behind Earth it passes on April 13, and the result could, although it is highly unlikely, make all of the 2029 parties in Europe seem highly inappropriate.

The big "if" in all this is the very low probability that the orbit of MN4 will end up not at 426.1250 days but, in fact, about 30 seconds shorter than that, or 426.1246 days. In that very specific and improbable instance, Earth and MN4 will come together on April 13, 2036 in a cosmic collision the likes of which happen here on Earth about once every 50,000 years. This narrow "window" through which MN4 could pass to bring about such a collision is called a keyhole. The likelihood that MN4 will pass through this keyhole is extremely low (about 1 chance in 12,000 at this writing).

So will MN4 pass through the keyhole, or won't it? The answer is that we don't know yet. Although we have been tracking this asteroid since early 2004 and we have more data on it than on most NEAs we've discovered, the data are not accurate enough yet to answer this question. Normally, with the optical tracking that we have on this asteroid, we could predict what will happen to it about 31 years in advance. But in this particular case, the very close pass by Earth in 2029 will dramatically amplify the small unknowns that currently exist in its orbit.

If we assume that MN4 has our address and, without intervention, will deliver in 2036, will we be able to make this the first successful exercise in impact prevention? There's no question that very shortly after the 2029 parties are over, we'll know how close our return visitor will come in 2036, but unfortunately, we'll have much too little time left to do anything about it. Furthermore, the amount of energy that it would take to successfully deflect MN4 between 2029 and 2036 would exceed our capability by quite a large margin.

The good news, however, is that if we were to deflect MN4 prior to 2029, it would require very little energy to get the job done. In fact, deflecting MN4 (from a 2036 impact) prior to 2029 would require less than 0.01 percent (1 ten-thousandth) of the energy that it would take after 2029. This should (if we do our homework) be well within not only our capability but within the reach of some alternative deflection techniques as well.

Where does this leave us? Will we know by 2014 whether or not MN4 will collide with Earth in 2036? At the moment, our best guess is that unless we do something special in terms of gathering and refining data, the answer to that is probably "no." It looks as though we'll have to determine the specific distance that MN4 will pass behind Earth in 2029 within an accuracy of about 600 meters to know for certain what our situation will be in 2036.

The unfortunate reality is that there is no-one designated within [any] government to analyze this, or any similar situation. There are critical decisions to be made, options to be evaluated, and actions to be taken. One of those choices is to gather much better information about where the asteroid is going soon enough to do something about it, if necessary. By launching a scientific mission to 2004MN4, we can do excellent and valuable science, and in addition, we can know whether or not MN4 has our name on it.

Embarrassing moments in asteroid tracking.

the apollo moon landings hoax – hoax

compiled by Chris Stewart

Every now and then (all too frequently, in fact) we are confronted with items supposedly debunking the awesome accomplishments of an era that we slightly older types lived through. Things like this…

> Did the Apollo moon landing really occur???
>
> "In 1969 computer chips had not been invented. The maximum computer memory was 256k, and this was housed in a large air conditioned building. In 2002 a top of the range computer requires at least 64 Mb of memory to run a simulated Moon landing, and that does not include the memory required to take off again once landed. The alleged computer on board Apollo 11 had 32k of memory. That's the equivalent of a simple calculator…"
>
> Read more and decide for yourself…
>
> **http://www.ufos-aliens.co.uk/cosmicapollo.html**

The people who wrote that evidently know nothing, and certainly do not do their homework. That they persist in propagating disinformation is an insult to the many thousand dedicated engineers, scientists, technicians, managers, administrators, pilots, trainers, etc. who devoted a good portion of their careers (and even put their lives on the line) to succeed in what is probably the most difficult human endeavour ever tackled. In my opinion the killjoys are too lazy to educate themselves, and are really stupid if they can truly believe that an unprecedentedly expensive programme - in which literally millions of people participated one way or another - was simply a hoax that could be covered up.

In rebuttal to this specific attack from the ignorant nay-sayers, let me explain. The on-board guidance system computers of the Apollo Command- and Lunar Excursion Modules were - for their time - absolute marvels of microminiaturisation. In fact, it was developments like that which spurred on the growth of electronics, thereby enabling the computing power of today's machines to come into being, and which we can now take for granted.

The guidance computers were about the size of an attaché case. They had many functions to perform, on admittedly limited capability by today's standards. But the people who brought them into being were extremely inventive and ingenious. Their programs were beautifully crafted to be exceedingly efficient and effective, whereas modern programming practice allows gross inefficiencies because the cost of manpower is much more than that of computing power - the exact inverse of the situation pertaining during the Apollo era. Plus, the programs were purpose-built to do specific tasks, and there was hardware to do the rest.

The "simulations" referred to no doubt devote a lot of their processing to handle graphical user interfaces, and the typical PC has huge overheads that have nothing to do with the specific task. Significantly, the guidance computers received regular updates and corrections from mainframe computers on Earth. So, they only had to handle portions of the mission at any one time. Nevertheless, during the Apollo 11 Lunar descent, the LEM guidance computer became overloaded. This required certain functions to be terminated so that the computer could be freed to concentrate on the critical issues. The functions that were offloaded had to be performed manually by the astronauts, and it was largely through their skill (honed by many hours of intense training) that they landed safely. It is a tribute to the people involved at all stages of the mission, that they succeeded.

The colleague who set me up for this particular rebuttal, is intelligent and educated, and at least took the trouble to ask my opinion as being the closest person to an expert that he could find. So I thought he deserved a reasoned response.

He considered my response "bitter and dismissive". I replied that had I been one of the Apollo team he could be sure I would be bitter when confronted with what is ultimately a malicious - even slanderous - attack, irrespective of the motivations for the originator's actions. However, since I was not directly involved, and only suffer a sort of reflected dishonour as also being a technical type, I consider my answer to be merely "scathing". The work of the hoaxters on the other hand really is "dismissive" of a truly great achievement.

After a discussion over a cup of tea, he was convinced that what I was saying must be true. He came to this conclusion not because of logic, but because he perceived me to be "passionate" about the subject. The popularity of the tabloid press, and the way people typically argue about anything, indicate that a large proportion of the population is far more readily swayed by emotion than rational evidence. Why is this?

It appears that most people simply don't have the mental tools (understanding of the scientific process, knowledge of the technical domains involved, training in logic, …) to comprehend or make a reasoned judgement for themselves. In the absence of comprehension, they typically don't make much effort to seek the facts from reputable sources, or work through the argument, because that is too much like hard work. This is exacerbated by the fact that the sensationalists have planted a big seed of doubt in their minds, regarding the veracity of the "establishment's" utterances. There generally is good reason to distrust the government – and everybody likes a good conspiracy theory.

So, I suppose I can understand it. But I don't have to like it. People are of course entitled to their opinions. But to propagate disinformation on this subject simply amounts to defamation on a grand scale. It is not a positive human trait, and those who participate wilfully are in my estimation not even worthy of contempt.

reckless party in 26" dome

edited email from Lerika Cross to ASSA Jhb.'s landlords, SAASTA

Herewith a report of the findings by ASSA JHB's curator of instruments, (Dave Hughes) when asked to come and close the telescope dome on Saturday, 5 November 2005. We understand that the party that was held in the dome on 4 Nov. caused damage to the extent that the dome could not be closed:

– the rope was pulled off the dome pulley. The dome was thus left open and it rained onto the telescope. Dave managed to restore the rope to the pulley and close the dome at considerable personal risk;
– the pulley guard on the dome wheel was broken;
– the platform appears to be bent and some wooden boards are broken;
– the fuse box was tampered with and all fuse holders broken;
– the isolator box was broken into;
– there was an attempt to bridge the fuses and thus switches were burnt out;
– extensive damage was done to switching gear and the motor was overheated;
– the telescope cannot be examined because the platform is out of commission until fixed and made safe. Dave disabled and secured the platform to the ground for safety reasons;
– the projection screen was forcefully detached.
– the floor was very sticky with spilled liquid.

The recommendations from ASSA JHB are:
– a more thorough technical evaluation is needed by a professional entity to assess the extent of the damage. In this regard we suggest that Plant Technology (of Racklift International) who are agents for the racklift be asked to provide this assessment.
– the company/party that caused the damaged must be made to pay for costs in restoring the equipment - to lay a charge of reckless behaviour would not be out of place as people's lives were at risk if the platform fell or someone electrocuted themselves. If this happened, SAASTA could have been sued. Presumable no indemnity forms were signed by each and every member of the public that attended the party;
– that no more functions are held in the dome until the situation has been made safe. ASSA JHB will make a plea in due course when meeting with [SAASTA] to not allow the dome to be open to parties, not allow smoking and to treat the building as a precious national asset that needs to be carefully preserved.

Dave Hughes kindly offered not to submit a call-out bill for his help on Saturday.

unravelling gravity, space & time: lisa randall

edited article by Dennis Overbye

The portal to the fifth dimension, sadly, is closed. There used to be an ice cream parlor in the student center at the Massachusetts Institute of Technology. And it was there, in the summer of 1998, that Lisa Randall, now a professor of physics at Harvard and a bit of a chocoholic, and Raman Sundrum, a professor at Johns Hopkins, took an imaginary trip right out of this earthly plane into a science fiction realm of parallel universes, warped space and otherworldly laws of physics.

They came back with a possible answer to a question that has tormented scientists for decades, namely why gravity is so weak compared with the other forces of nature: in effect, we are borrowing it from another [dimension]. In so doing, Dr. Randall and Dr. Sundrum helped foment a revolution in the way scientists think about string theory - the vaunted "theory of everything" - raising a glimmer of hope that coming experiments may actually test some of its ineffable sounding concepts.

Their work undermined well-worn concepts like the idea that we can even know how many dimensions of space we live in, or the reality of gravity, space and time. The work has also made a star and an icon of Dr. Randall. The attention has been increased by the recent publication to laudatory reviews of her new book, "Warped Passages, Unraveling the Mysteries of the Universe's Hidden Dimensions"

"How do we know we live in a four-dimensional universe?", Dr Randall asked a crowd who filled the Hayden Planetarium on a stormy night last week. "You think gravity is what you see. We're always just looking at the tail of things." Although it is the unanswerable questions that most appeal to her now, it was the answerable ones that drew her to science, especially math. "I really liked the fact that it had definite answers," Dr. Randall said. At Stuyvesant High School, where she was in the same class as Brian Greene, the future Columbia string theorist and best-selling author.

Fired by the dream of a unified theory of everything, theorists flocked to string theory, which envisioned the fundamental elements of nature as tiny wriggling strings. Dr. Randall, however, resisted this siren call, at least for a while. For one thing, physicists thought it would take a particle accelerator 10 million billion times as powerful as anything on earth to produce an actual string and test the theory. String theory also stubbornly requires space-time to have 10 dimensions, not the 4 (3 of space and 1 of time) that we experience. Preferring to stay closer to testable reality, Dr. Randall was drawn to a bottom-up approach to theoretical physics, trying to build models that explain observed phenomena and hoping to discover principles with wider application. But Dr. Randall and string theory had their own kismet.

In the mid-90's, theorists discovered that the theory was even richer than its founders had thought, describing not just strings but so-called branes, as in membranes, of all dimensions. Our own universe could be such a 3-brane, an island of three dimensions floating in a sea of higher dimension, like a bubble in the sea. But there could be membranes with five, six, seven or more dimensions coexisting and mingling like weird cosmic soap bubbles in what theorists sometimes call the multiverse.

"The stuff we're really famous for was really lucky in a way," Dr. Randall said. Naïve calculations from first principles suggest, Dr. Randall said, that gravity should be 10 million billion times as strong as it is. You might find it hard to imagine gravity as a weak force, but consider that a small magnet can hold up a paper clip, even though the entire earth is pulling down on it. But there was a hitch with the way the theory worked out in our universe. It predicted reactions that are not observed. Dr. Randall wondered if the missing reactions could be explained by positing that some aspects of the theory were quarantined in a separate universe [or dimension]. She called up Dr. Sundrum, who was then a fellow at Boston University and happy to collaborate, having worked with her before. A lot of physics is taste, he explained, discerning, for example, what is an important and a potentially soluble problem. Dr. Randall's biggest strength, he said, is a kind of "unworldly" instinct. "She has a great nose," Dr. Sundrum said.

"It's a mystery to those of us - hard to understand, almost to the point of amusement - how she does it without any clear sign of what led her to that path," he continued. "She gives no sign of why she thinks what she thinks." Dr. Randall and Dr. Sundrum's model consisted of a pair of universes, four-dimensional branes, thinly separated by a five-dimensional space poetically called “the bulk”.

When they solved the equations for this setup, they discovered that the space between the branes would be warped. Objects, for example, would appear to grow larger or smaller and get less massive or more massive as they moved back and forth between the branes. Such a situation, they realized to their surprise, could provide a natural explanation for the hierarchy problem without invoking supersymmetry. Suppose, they said, that gravity is actually inherently as strong as the other forces, but because of the warping gravity is much much stronger on one of the branes than on the other one, where we happen to live. So we experience gravity as extremely weak.

"You can be only a modest distance away from the gravity brane," Dr. Randall said, "and gravity will be incredibly weak." A result was a natural explanation for why atomic forces outgun gravity by 10 million billion to 1. Could this miracle be true? Crazy as it sounded, they soon discovered an even more bizarre possibility. The fifth dimension could actually be infinite and we would not have noticed it. In this case, there would be only one brane, ours, containing both gravity as we know it and the rest of nature. But it would warp space in the same way as in the first model, trapping gravity nearby so that we would experience space-time as four-dimensional. This new single brane model did not solve the weak

gravity problem, Dr. Randall admitted, but it was a revelation, that an infinite ocean of space could be sitting next to us undetected.

"So when we wrote this paper, what we were concentrating on was this amazing fact that really had been overlooked for 100 years - well, years, whatever - that you can have this infinite extra dimension," she said. "I mean it was quite wild." When Dr. Randall and Dr. Sundrum published their first paper, describing the two-brane scheme, in 1999, she said that many physicists did not recognize it as a new idea. In fact, she said, the extra dimensions don't have to be very large in the two-brane theory, less than a millionth of a trillionth of a trillionth of an inch.

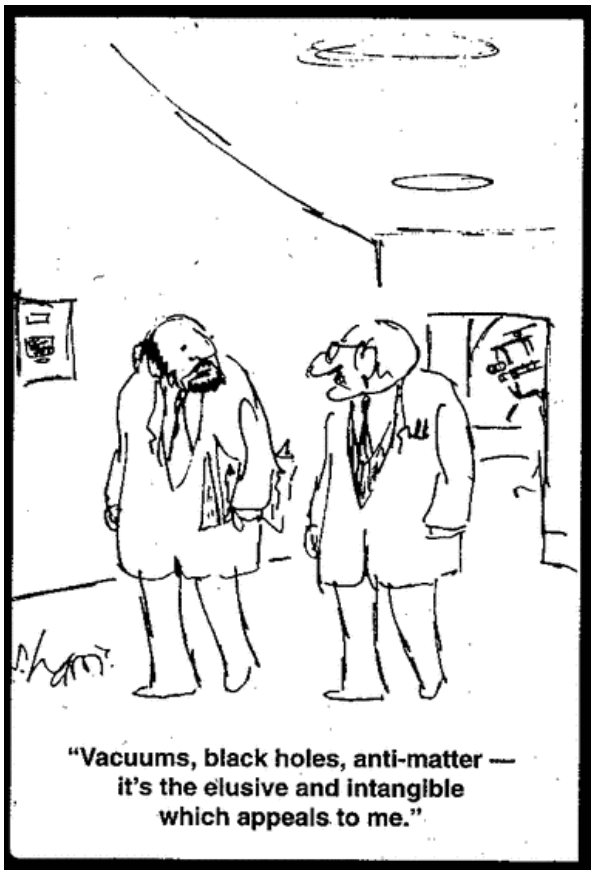
When they published their second paper, about the infinite dimension, she said, even some of their best friends, reserved judgment. But by the time a long-planned workshop on strings and particle physics at the Kavli Institute for Theoretical Physics in Santa Barbara rolled around that fall, string theorists were excited about the Randall-Sundrum work and an earlier proposal.

It was shortly before a conference that Dr. Randall had organized during the Kavli workshop that she had her own experience with gravity: she fell while rock climbing in Yosemite, breaking several bones. Only a day before, she said, she had completed a climb of Half Dome and was feeling cocky. Since she was the conference organizer, her ordeal was more public than she would have liked. "In some ways you sort of want to do this in private," Dr. Randall said. "On the other hand people were really nice."

"It's not completely obvious what gravity is, fundamentally, or what dimensions are, fundamentally," she said over lunch. "One of these days we'll understand better what we mean, what is the fundamental thing that's given us space in the first place and dimensions of space in particular." She held out less hope for time, saying, "I just don't understand it. "Space we can make progress with."

Is time an illusion?

"I wish time were an illusion," she said as she carved up the last of her chocolate bread pudding, "but unfortunately it seems all too real."



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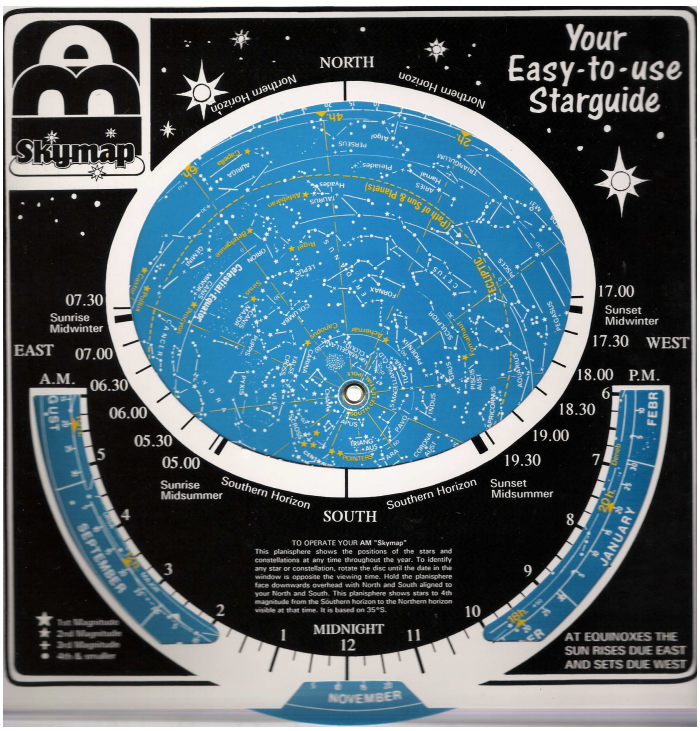

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through my looking glass

Ed Finlay

The constellation of Pegasus, the flying horse, is a northern constellation and was included by Ptolemy in his 48 constellations. The most obvious feature of this constellation is the so called 'great square' which makes up the body of the horse. This large asterism is made up of 4 stars; Alpha Peg (Markab), Beta Peg, and Gamma Peg together with Alpha Andromedae (Alpheratz). This star was once called Delta Pegasi but was later made the first star of Andromeda. Look due north about 40 degrees above the horizon for this constellation.

There are two deep sky objects of interest in Pegasus, M15, a globular cluster close to the head of the horse and NGC7742, a type 2 Seyfert galaxy.

M15 is one of the brightest globular clusters in the northern sky and is easily visible in small telescopes but you will need at least 6 inches of aperture to begin resolving the stars at its outer edges. Magnitude is about 6.5, distance is around 40,000 light years. You can find it about 4 degrees north of Pegasus' nose.

The other object is a lot more difficult to see. NGC7742 is a small spiral galaxy about 8 degrees southwest of Gamma Peg. At mag.12.5 you will need a dark sky and at least a 10inch aperture scope to see this one. You can distinguish it from the stars in the field of view by its fuzzy outline. It looks to me like a planetary nebula. Its spiral structure is only apparent in photographs.

Seyfert galaxies were discovered by Carl Seyfert in 1943. These galaxies have active galactic nuclei which are very bright at visible wavelengths; they are suspected of having a massive black hole at their core.

The four main stars of Andromeda, Alpha, Delta, Beta and Gamma Andromedae curve to the north east from the belly of Pegasus. Gamma (Almach) at the tip of the curve is a beautiful double star easily split with a small telescope. Delta, an orange giant of mag. 3.25 is part of a binary system. The companion star is a 12th mag. red dwarf with only $1/40^{th}$ of the Sun's luminosity, too faint for small telescopes.

The most famous deep sky object in Andromeda is M31, the Great Andromeda Galaxy, the most distant object visible to the naked eye. It is an enormous spiral similar to the Milky Way.

You can find it by drawing an imaginary line between Beta and Mu Andromeda, and extend the line approximately the same distance again from Mu.

This object was mentioned by Al-Sufi in his 'Book of Fixed Stars' in 964 AD who named it the 'Little Cloud' and it was first seen through a telescope in 1612 by Simon Marius who described it as resembling 'the diluted light of a candle as seen through horn'.

It was Charles Messier who catalogued the object in 1764 and gave it the number 31.

In 1923 Edwin Hubble found the first Cepheid variable star in the Andromeda galaxy and thus established the intergalactic distance and the true nature of M31 as a galaxy and not a nebula within the Milky Way itself.

This galaxy is the most studied of all deep sky objects. It allows us to study all the features of a galaxy from the outside which we also find in the Milky Way but which we cannot see because the greatest part of our galaxy is obscured by interstellar dust.

There are continuous studies ongoing of the spiral structure, globular and open clusters, starburst activity, interstellar matter, planetary nebula, supernova remnants, the galactic nucleus and companion galaxies such as M32 and M110.

Through my 4inch refractor M31 appeared as a hazy oval of light, brighter towards the centre; the spiral arms were too faint to be seen.

More next month,
Ed.

the sky this month

site location: lat. **26.0 deg S** long. **28.0 deg E** local time – UT = **+2.0 hrs**.

december 2005

dd hh	dd hh
1 16 Antares 0.3S of Moon Occn	18 01 Pollux 1.8N of Moon
1 16 NEW MOON	19 12 Saturn 3.7S of Moon
4 04 Mercury stationary	20 23 Mercury 5.8N of Antares
4 19 Venus 2.3N of Moon	21 03 Regulus 2.8S of Moon
5 05 Moon at perigee	21 04 Moon at apogee
6 06 Neptune 4.1N of Moon	21 19 Solstice
7 18 Uranus 2.1N of Moon	23 05 Venus stationary
8 10 FIRST QUARTER	23 20 LAST QUARTER
11 02 Mars stationary	25 15 Spica 0.8S of Moon Occn
12 05 Mars 1.2S of Moon Occn	27 02 Jupiter 3.9N of Moon
12 17 Mercury greatest elong W(21)	29 02 Antares 0.2S of Moon Occn
15 17 FULL MOON	30 00 Mercury 4.9N of Moon
16 05 Pluto at conjunction	31 04 NEW MOON

january 2006

dd hh	dd hh
2 01 Moon at perigee	21 23 Spica 0.6S of Moon Occn
2 15 Neptune 3.8N of Moon	22 16 LAST QUARTER
3 14 Earth at perihelion	23 18 Jupiter 4.4N of Moon
4 02 Uranus 1.9N of Moon	25 12 Antares 0.0N of Moon Occn
6 20 FIRST QUARTER	26 21 Mercury superior conjunction
8 20 Mars 1.3S of Moon	27 23 Saturn at opposition
14 01 Venus inferior conjunction	29 15 NEW MOON
14 09 Pollux 1.9N of Moon	29 18 Mercury 2.0N of Moon
14 10 FULL MOON	30 03 Neptune 3.7N of Moon
15 16 Saturn 3.6S of Moon	30 09 Moon at perigee
17 10 Regulus 2.6S of Moon	31 14 Uranus 1.6N of Moon
17 20 Moon at apogee	

local times of rise and set for the major planets

Date	Sun		Mercury		Venus		Mars		Jupiter		Saturn	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Dec 7	5.08	18.53	4.03	17.18	8.08	21.53	15.57	3.03	3.02	16.03	22.33	9.27
Dec 17	5.11	19.00	3.55	17.22	7.51	21.26	15.19	2.23	2.28	15.32	21.52	8.45
Dec 27	5.16	19.04	4.05	17.47	7.18	20.43	14.46	1.47	1.55	15.01	21.11	8.03
Jan 1	5.20	19.06	4.16	18.02	6.56	20.16	14.31	1.32	1.38	14.45	20.50	7.43
Jan 11	5.27	19.08	4.41	18.31	5.58	19.11	14.05	1.01	1.04	14.12	20.12	7.04
Jan 21	5.35	19.07	5.15	18.57	4.55	18.04	13.42	0.34	0.29	13.39	19.30	6.21
Jan 31	5.43	19.03	5.56	19.19	4.01	17.11	13.22	0.08	23.53	13.04	18.48	5.37