(Front Cover)

ASSA Symposium

Durban

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Durban Country Club

7 – 9 August 2008

Durban is just about the worst city in Southern Africa for observational astronomy, being in the sub-tropical zone and subject not only to erratic weather but also to serious air and light pollution.

But we boast a Beautiful Coastline, Great Attractions and Terrific People, and it is in that context that we, the Combined Durban and Midlands centres of the Astronomical Society of Southern Africa – ASSA, welcome you to the Biennial ASSA Symposium, and we trust that you will find the Symposium, the City of Durban and its Terrific People, entirely to your liking.

The Theme for the Symposium is:
"The interaction between Astronomy and Cosmology"
which is intended to embrace a wide range of interests for both professional and amateur astronomers. Your committee has gratefully received abstracts of 25 papers covering this wide range of interest, which are printed for your convenience in this brochure.

We invite you to relax, to enjoy the papers, to enjoy the Durban Country Club, to catch on old and new acquaintances, make new friends and to create an Astronomical Memory of this occasion.

Mike Reid
Chairman Organising Committee

SYMPOSIUM ORGANISING COMMITTEE

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Delegates Programme

Abstracts ASSA 8th Biennial Symposium

Title: SALT: Since the inauguration

Prof. Phil Charles
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SALT was inaugurated by President Thabo Mbeki in November 2005 and many assumed this meant it was fully complete and in normal operations. That was not the case. SALT was constructed, but not tested and commissioned. That is what has been happening since, and we have learnt a great deal about the HET concept for large telescope design and how to make it work to its full potential. I will describe our current status and how we have (almost) solved the difficulties that arose from the South African improvements and changes that were implemented.

Title: Galileo Galilei

Dr. I.S. Glass
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Galileo Galilei (1564-1642) is regarded as the founder of modern science. In particular, next year will see the 400th anniversary of his discoveries with the telescope, which brought him to fame and delivered a fatal blow to the Aristotelian viewpoint of medieval times.

In this talk I will describe Galileo's character, his life and his work. He was a prickly individualist who did not suffer fools and had no time at all for the conventional scientific wisdom of his day. In a lifetime spent in the conservative Duchy of Florence and the liberal

Republic of Venice, with short visits to Rome, he championed the Copernican model of the heavens and demolished the Ptolemaic cosmos. His book, the *Starry Messenger*, established his reputation. His outspoken support of Copernicus led to attacks in 1614 by conservative clerics. These he successfully shook off, but his publication of the *Ptolemaic-Copernican Dialogue* in 1632 led to his conviction by the Inquisition on the charge of a "vehement suspicion of heresy" and sentencing him to lifetime house arrest.

Nevertheless he continued his scientific activities from home and in 1637, aged 73, discovered the libration on the Moon. He wrote up his early unpublished discoveries in the *Discourses on Two New Sciences* of 1638, surreptitiously published in Leiden. Though blind thereafter, he continued to receive pupils and visitors until his death.

Title: Recent and Ongoing Projects of the Deep Sky Observing Section

Mr. Auke Slotegraaf
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An overview of recently completed and currently active projects of the Section will be given. Amongst others, the basic Discover! Setoff star charts, the Top 100 deep sky objects list, the impact of Merit Awards, and the web-based DOCdb deep sky data base, will be discussed. Observing projects by the Section's major contributor, Magda Streicher, will also be reviewed.

Title: A dedicated Amateur, a Study, and Report on Elusive Faint Deep Sky Objects done through my 16’ S/C Telescope

Mrs. Magda Streicher
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1. NGC 3372 – The bright orange Eta Carinae is surrounded by an orange-red nebula about 15 inch wide, called the Homunculus nebula. Detailed observations and sketches over the years.
2. Study of unexpected found objects, like UGC 2838 in the star cluster Pleiades, Galaxy in Helix Nebula NGC 7293, LHA 120-N59c reflecting nebula discovered by Karl Henze, IC 1296 a faint galaxy close to the Ring Nebula M57.
3. ESO: 172.7 – Bipolar Nebula discovered in infrared by Glass and Wegner. Observation and study through the 16 inch on amateur level.
4. 4. Possible third companion in the known double star WDS02474+1713, discovered in combined effort by Tim Cooper and I.
5. Supernova 1987A-Sanduleak-69º202 – Search and observation with valuable feedback.

Title: W Ursae Majoris Stars

Mr. Christopher Middleton
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W Ursae Majoris stars are members of a class of elipsing variable stars in which the components are of a spectral type A to mid K. They are named after the prototype W Uma. W Uma stars are similar in brightness and are almost in contact. Primary and

secondary minima of light curves are nearly equal. Contact binaries, W Uma stars or EW stars display continuous changing brightness because of tidal distortion of the components. An energy transfer from the larger more massive of the two to the smaller less massive one results in an almost equal surface temperature over the entire system. The two components are surrounded by a common envelope.

Personal 12 inch telescopes were used in the observation of some previously un-researched southern W Uma Eclipsing Binaries. Report on the Instrumentation, some observations, Data reduction and analysis of some filtered light curves is made. Periods and Epoch's on a few candidates are presented along with detailed modelling of the contact systems using a software package Binary Maker 3.

Title: Modelling of W Uma Type Variable Stars

Ms Patricia Skelton
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W Uma type variable stars are overcontact eclipsing binary star systems. Their classification in terms of their observed properties will be described, and a model to explain their characteristics will be discussed. The All Sky Automated Survey (ASAS) has discovered hundreds of stars that they classify as eclipsing binaries with continuously varying light curves. The data, together with an ephemeris determined for each star, are publicly available. Using the ASAS data, the phase-magnitude plots are being produced and used as input in a modelling programme to determine physical parameters of the stars, such as their temperatures, mass ratios and inclination. The Wide Angle Search for Planets (SuperWASP) has extensive data of many variable stars and this will be used to refine the ASAS models of the stars. Systems which display either a linear increase/decrease or a periodic variation in flux over time are systems which will be monitored as possible candidates of the Applegate mechanism.

Follow-up observations will be done on some systems, such as those displaying total eclipses and/or period changes.

Title: Semi-regular Variables

Dr. I.S. Glass
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The Semiregular Variables (SRVs) are cool giant variables, related to the Miras. Because they are red and normally have small amplitudes of variation, they were not easily picked up by the early photographic variable star searches.

The position changed in the last decade with surveys like MAHO and OGLE, which surveyed many millions of stars in the Magellanic Clouds and near the Galactic Centre on a nightly basis for several years. There are now vast numbers of SRVs known, but only in these special fields. Infrared surveys have produced magnitudes for all these stars and they can be shown to obey period-luminosity relations as the Cepheids and Miras do. They have potential as distance indicators and tracers of galactic structure.

The Hipparcos parallax satellite found distances for many nearby stars that are, or are suspected to be, SRVs. This should have offered the possibility of calibrating their period-luminosity relation using stars directly found by trigonometry. Unfortunately, very few of them have been observed well enough to get their periods and the many automatic sky surveys now running are not able to cope with such bright stars.

The current position will be summarized and the opportunity will be explained for a dedicated amateur effort to remedy the situation.

Title: Astronomy in Cartoons

Mr. Michael Poll
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Astronomical events and phenomena are frequently depicted in cartoons and cartoon strips in newspapers and magazines. The moon, stars and comets are often seen, as are illustrations of space travel, and cartoons also reflect public perceptions of the sky. The depictions and descriptions are sometimes accurate and sometimes not. This paper shows a number of examples of these cartoons and analyses the astronomy in them.

Title: The South African Observations of comet C/2006 P1 McNaught – An Analysis

Mr. Tim Cooper
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Comet C/2006 P1 McNaught was the brightest comet since C/1965 S1 Ikeya-Seki, and was well placed in the evening sky immediately after sunset. It provided the ideal opportunity for South African observers to hone their observing skills. Despite this, only a handful of observers contributed visual observations and useful images. This paper analyses the global observations, including those of ASSA observers, and shows how visual and photographic observations can be used to derive parameters which define the behaviour of the comet.

Title: Optical coatings for the Amateur Astronomer

Mr. Andrie van der Linde
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In keeping with the motto 'aperture is everything', amateur astronomers are prepared to pay a premium for telescope aperture. However, they give little attention to the eyepieces and accessories they use in the remainder of the optical path. The optical coatings of these accessories can make or break a telescope and can mean the difference between seeing a faint object or detail or not seeing it at all. The following aspects are discussed in the paper:

- Accessories without coatings or with limited coatings can reduce the amount of light at the end of the light path by a significant amount (e.g. by 20% - that is loosing 1 inch of aperture on a ten inch telescope and 1½ inch on a 14 inch telescope!)
- Optics without coatings or with limited coatings reduces the image contrast because the reflected light is scattered inside the eyepiece that contributes to the background light.
- Manufacturers can use coatings to hide defects in the design and manufacturing of optics. An example will be available o demonstrate this.
- Should filters be coated? How to determine the quality of optical coatings – an easy test.
- A selection of uncoated, partially coated and fully-coated optics will be available to demonstrate the test.

Title: Delta Scorpio: Eight Years of Erratic Behaviour

Mr. Brian Fraser
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This talk looks at the erratic variability of Be stars in general and delta Sco in particular. After 8 years of photometry the cause of the variability is still open for discussion and various explanations are presented.

Title: Sketching

Mrs. Magda Streicher
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The correct way of sketching deep sky objects will be illustrated.

Title: Lasers and Laser Safety for Amateur Astronomers

Mr. Andrie van der Linde
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It is now almost 50 years since the first Laser was successfully demonstrated in May 1960. Initially Laser technology was the exclusive domain of scientists and the military. Technological advancement now places the Laser into the hands of young children who can buy a red laser pointer at flee markets for less than R10.00. The Laser became a useful tool in the Amateur Astronomer's accessory box with Laser Collimators and Green Laser Pointers the most notable. The unsafe use of Lasers by Amateur Astronomers was placed in the spotlight in the January 4

2005 incident where a New Jersey stargazer pointed his green Laser Pointer at a passenger jet. This is but one example of an unsafe laser practice. The power density of a 5mW laser pointer on a person's retina can easily be more than 250 times higher than when the person looks directly at the Sun. The paper will deal with the following:

* A brief history of lasers and some examples of its application by professional astronomers.
- A simplified explanation of how green laser light is created.
- The classification of lasers.
- Some issues on regulation locally and abroad.
- Risks of exposure to laser radiation.
- Results from more than 100 green laser pointers tested for safety, showing remarkable deviations from their actual classification and the existence of unacceptable limits of infrared radiation in some cases.
- Safe practices when using lasers in the industry and recommendation for amateur astronomers.

Title: A Possible Explanation of Cirrus Clouds

Dr. Anthony de Wet
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The nuclear wave function of N-15 may be derived from an irreducible presentation of the Lorentz group without any attempt to describe the dynamics of the individual nucleons although the space in which they move may be determined by geometry. This wave function has a giant resonance that may be quenched by cosmic ray frequency 90 degrees out of phase and hence cause the nucleus and adjacent supercooled water droplets in the stratosphere to freeze and be observed as cirrus ice clouds in an environment rich in Nitrogen. Freezing of supercooled water droplets by cosmic rays has actually been observed in the laboratory.

Title: Composite Supernova Remnants: Observations, magneto-hydrodynamical and radiation modelling

Prof. Okkie de Jager
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The evolutionary endpoint of a massive star is a Type II supernova explosion leaving an expanding supernova shell, a rapidly rotating neutron star and its associated pulsar wind nebula, which also expands with time. Several such components remnants have been observed up to date. A review of their observed properties will be given. We also present results of magneto-hydrodynamical fluid simulations of such composite remnants which were performed as part of one of the three flagship projects of South Africa's largest computer cluster (the CHPC in Cape Town). These simulations predict the time evolution of the supernova shell radius, the pulsar wind nebula radius, the magnetic field strength, the particle density, and the important time history of the reverse shock which usually result in an offset pulsar wind nebula. Movies constructed from these simulations will also be shown. From these simulation parameters, we show how we develop a particle spectrum consisting of ultra-relativistic electrons and positrons which predict the time evolution of the multi-wave spectra (radio, infrared,

X-ray and gamma-ray) of such pulsar wind nebulae The results are compared against actual observations, which also allow us to measure the creation rate of these electron positron (matter/antimatter) pairs in the super-strong magnetic fields above the pulsar polar caps.

Title: Applying Visual Basic and possibly AutoCAD to programming Planetary Orbits as a Test of a Gravitational Hypothesis

Mr. Ed Reid
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It is necessary to apply a number of tests to any hypothesis before making it known to an audience wider than one's colleagues, who are themselves often prematurely sceptical The essential test of a gravitational hypothesis is that which will compare it to, at least, the Newtonian Planetary Orbit Model and desirably the Einsteinian. Anyone who attempts or contemplates attempting rigorous comparisons to even the Newtonian Model, knows the formidable amount of computational effort required if computerisation is not possible. This is especially true in the case of a radical hypothesis for which "of the shelf software" is not available. Though it takes some time and effort, for non programmers, to master Visual Basic, the rewards for learning to use this tool are truly worthwhile – especially as the resulting output is indeed visual. "A picture is worth a thousand words – or numbers" is not just a proverb. AutoCAD is not, perhaps, a commonly available vehicle for application by some amateurs but its use happily avoids a great deal more programming effort than that which would be required by using Visual Basic alone.

The objective, therefore, of this paper is to illustrate just such a case. This will be achieved by first outlining the gravitational hypothesis to be tested then describing the basic algorithm of the planetary orbits test. A brief discussion of the algorithm will then follow and some descriptions of translations to code will be made to illustrate the ease with which self programmed solutions can be made by amateurs.

Algorithms used were originally formulated by (a) Meus to generate seed data in place of actual observations at the same

Julian date for nine plants and (b) Thomas and Gauss to calculate orbits according to the radical physics. Spline curves are employed.

The Hypothesis: Bizarre as it may sound the hypothesis is this: *All* matter in the universe, including that of the observer and any available instruments, undergoes a perpetual decrease in absolute mass density. The major consequence of this decrease is the phenomenon of gravity. One philosophical stumbling block of even the Einsteinian model is the idea of action at a distance. If all matter is, in fact, losing density at a constant rate, then gravitational or macro-phenomena, as opposed to quantum mechanical level behaviour, is a natural and direct result which requires no action at a distance or, indeed, the necessity of gravitons.

Title: Cracking the Surface of Europa

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Europa is the second Galilean moon of Jupiter, the largest planet in the solar system. Jupiter is such a large planet that the gravity given off by the planet affects the moon which revolves around the planet. Europa is the smallest of the Galilean satellites with a diameter of ~1500 km. The significance of this moon, compared to others, is that Europa has a subsurface ocean beneath its ice shell. The presence of this ocean allows the ice shell to flex, this occurs as the ocean inside is pulled towards Jupiter. The pull causes a tidal bulge on the moon resulting in deformation and therefore creation of the cracks and various features seen on the surface.

There are three processes which characterise plate tectonics on Earth: extension, contraction and lateral shearing. However plate tectonics are not the driving force for the deformation of Europa, plate tectonic processes need not be crucial for deformation of a lithosphere but some features characteristic of these processes

have formed on Europa. The features on the surface include ridges, bands, plains, chaos and crater materials, folds and strike-slip faulting.

Ridges, bands, troughs and cycloids are all related to extensional processes which occur all over the surface of the moon. Ridges are the most prevalent feature on the surface with the most common type being a double ridge; this is a central trough flanked on either side by raised parallel ridges. These features are found in terrains of all ages on Europa, appearing in some of the oldest and newest terrains. Troughs are ridgeless tension fractures and might also show normal faulting across the depression. Bands, also termed smooth bands, are features which have a component of extension and dilation and infilling of new lithospheric material from below. Matching features on either side of the band gives evidence that the smooth band material is new material forming along progressively dilating walls of tension fractures. The formation of bands could be because of complete lithospheric separation in a low but uninterrupted event of tectonic extension.

Cycloids are similar to ridges but have a curved shape and link up to form chains through the linking of cusps and cycloids. The cycloids may have a central trough but generally have single ridge topography. The formation process of cycloids is different to the other features found on the surface and appears to be unique in the solar system. Minor compressive features have been recorded on the surface but none to balance the domination of extensional features found in the ice shell. Folding, convergence bands and contraction along ridges all accommodate small amounts of contraction.

Shearing is a large process on Europa with many of the bands and ridges showing lateral offset due to shearing. Shearing has been recorded on band-like faults, ridge-like faults, with band-like faults showing the largest lateral offset on any other body in the solar system, apart from the Earth.

One significant factor of the presence of a subsurface ocean is that Europa could possibly possess life in the waters. One of the key factors needed for life to be sustainable on a planet, or moon, is a source of nutrients, energy (on earth mostly from the sun) and liquid water. Earth is lucky to have the perfect climate and a sustainable source of nutrient as well as free water on the surface. However not all life on earth is dependant on energy from the sun. Strange creatures have been discovered deep in the ocean where life was thought never to exist. Therefore it is possible that life could exist in the surface ocean of Europa provided an energy source is available. This is why the cracks on Europa are so important to study. The dilation which occurs in Europa's bands is assumed to be infilled with new lithospheric material from below. It is thought that living organisms could use these opening features to get near enough to the surface of the moon and "feed" from the energy from the sun and the frictional energy caused by the upwelling of the water.

The study of the cracking of Jupiter's moon is not only intriguing to a geologist but to a layman as it may be the source of extraterrestrial life, which is the most burning question to the public: is there life somewhere else out there?

Title: Cosmology today: achievements and questions

Prof. George Ellis
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Theory and observations have led to a concordance standard model of cosmology, invoking a hot big bang early era during which nucleosynthesis took place, with subsequent structure formation by gravitational attraction, during the expansion of the universe, leading to the large scale structures we see today. This

model is supported by numerous observations of galaxies and other sources, and of the cosmic microwave background radiation. However puzzling features of the late universe are the

predominance of dark matter on smaller scales and of dark energy on larger scales. Prior to the hot big bang era there was probably an inflationary era, but we do not know what mechanism underlies this; we do not have a good account of what came even earlier – the origin of the universe itself. Some very speculative possibilities have been put forward, including the possible existence of a multiverse; however none of this is well established science, despite some strong claims by supporters of these theories.

Title: Astronomy-Cosmology Interaction: A Review of Anomalous Redshift Data

Mr. Hilton Ratcliff
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In line with the theme of the symposium – *The Interaction between Astronomy and Cosmology* – it seems appropriate to confine my paper to things seen on the sky. One of the greatest challenges facing astrophysics is derivation of remoteness in cosmological objects. At large scales, it is almost entirely dependent upon the well-established Hubble relationship in spectral redshift. The comparison of galactic redshifts with distances arrived at by other means within the local group has yielded a useable curve to an acceptable level, and the assumption of scale invariance allows the adoption of redshift as a standard calibration of cosmological distance. However, there have been several fields of study in observational astronomy that consistently give apparently anomalous results from ever-larger statistical samples, and would thus seem to require further careful investigation. This paper presents a review summary of recent independent work, primarily by teams led by D.G. Russell[1], M. Lopez-Corredoira[2] , and H.C. Arp[3], but including also several other important contributions that will be fully cited in the text. The observational evidence is represented *per se* without making theoretical conclusions or extrapolating the data to cosmology.

[1] Professor of physics: Owega Free Academy, New York, USA.
[2] Professional astronomer: Instituto de Astrofisica de Canarias, Spain.
[3] Professional astronomer: Max Planck Institut fur Astrophysik, Garching, Germany.

Title: The First Stars

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Star formation is an on-going process that can be observed in many galaxies, including our own Milky Way. Deep inside giant molecular clouds (GMCs), gravitational perturbations lead to the formation of prestellar cores that slowly accrete material, eventually gain enough mass to become stars. Cold dust in GMCs blocks optical radiation but is transparent to long wave-length radiation which can be observed with telescopes operating in the far infrared to radio regime of the electromagnetic spectrum. Together with various species of molecules, the dust and molecules assist the star formation process by radiating some of the heat produced by the in-fall and accretion.

The first stars formed in the Universe appeared about 150 − 200 million years after the Big Bang. These stars were made entirely of primordial material, i.e. atomic hydrogen and helium only Dust, which is made of carbon or silicate compounds, was not present, nor were there many molecules of hydrogen (H_2). Therefore, the first stars had to form without the cooling influence of dust or molecules. In this talk I will discuss the basic processes of star formation as we understand them in the present galactic environments, and how this differed from conditions in the early Universe. The properties of the first stars, as determined from detailed modelling of the relevant physics, will be presented.

Title: The Facts of Light under Scrutiny

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A thought experiment is conducted in which the nature of free space is questioned, and the constancy of the speed of light is challenged. By virtue of the fact that space has measurable properties (permeability and permittivity) the hypothesis is made that space may not be "nothing" and that it may indeed be "something". If space were "nothing" it should have no measurable properties, and the speed of light in that medium should therefore be infinite. This means that space may be a very subtle but compressible medium, and hence denser in strong gravitational fields, and less dense in inter-stellar and inter-galactic space. This in turn may affect the speed of light in different regions of space. The mathematical implications of this on Maxwell's equations and the generalized wave equations are explored, and the concept is presented to the scientific community as a hypothesis, to invite further research.

Title: A Comparative Study of Quark-Gluon Plasma in the Cores of Some Neutron Stars and in the Very Early Universe

Mr. Frikkie de Bruyn
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Nuclear physics demonstrated that the contents of the pre-hadronic universe, a mere microseconds after the big bang, consisted of a quark-gluon plasma. Observations y NASA's two satellites, the Rossi X-Ray Timing Explorer and the Chandra X-Ray Observatory, showed that a similar quark-gluon plasma could possibly exist at the cores of a group of radio quiet neutron stars,

also referred to as strange stars. The dense quark-gluon plasma should not be confused with super fluid despite its property of very low viscosity. In both instances a new kind of matter is studied which is of great importance for the understanding of matter in its most elementary form; quarks in asymptotic freedom together with quarks. In line with the theme of the symposium *Interaction between astronomy and cosmology* both studies are briefly outlined to demonstrate interaction between the two disciplines.

Title: Why the Earth is Different

Prof. Michael Watkeys
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The inner rocky planets of our Solar System (Mercury, Venus, Earth and Mars), together with the Earth's Moon, all formed about 4500 million years ago and have similar compositions. The Earth, however, stands out just from the others for two main reasons: having a surface that is largely covered by water and being partnered by a large Moon.

Although all the rocky planets degassed water and an atmosphere early in their history, the Earth's abundant water is due to it being the "Goldilocks" planet. It is just the right distance from the Sun to have water in solid, liquid and gaseous forms, and just the right size to have a gravitational field that retained an atmosphere. This water is responsible for the other obvious differences: the lack of a cratered landscape and the presence of life.

During their early evolution, all the rocky planets underwent an intense pummelling and cratering by meteorites as is evident from the surfaces of Mercury and the Moon. In the case of the Earth, this resulted in water being driven back into the planet's interior

thereby lowering the melting point of the mantle. In turn this allowed thermal convection inside the Earth to drive a process of slow solid state movement called creep. This process eventually evolved into plate tectonics that reworked the initial pockmarked surface and given ride to our contrasting regions of continental and oceanic crust.

The presence of an atmosphere and water allowed the Earth's terrestrial surface to be weathered and eroded, with the resulting material being transported and deposited as sedimentary rocks. Carbonate sedimentary rocks (limestone and dolomite) have $C0_2$ as an essential ingredient have acted as a sink for atmospheric $C0_2$ and prevented a runaway greenhouse effect as has occurred on Venus. As life as primitive life evolved, it used increasing amounts of $C0_2$ and expelled 0_2. This gradually altered the composition of the Earth's atmosphere so that by half way through its history, about 2000 million years ago, it changed from a reducing to an oxidising atmosphere.

Title: A Simple Solar Flare Radio Receiver

Mr. Brian Fraser
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Sudden ionospheric disturbances (SID's) are caused by solar flare activity and can be monitored with a simple radio receiver and a recording device.

This talk will focus on 2 local stations that are continuously monitoring the sun and show how easy it is to set up a receiver in your spare room.