Pretoria Branch S_2A_3 News
May 2006

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our May talk:

Date: **Wednesday, 3rd May 2006**

Time: **17h15** (to 18h15)

Venue: **Sci-Enza (Discovery Centre), University of Pretoria Main Campus** (Use the Prospect Street Entrance to the campus. The Sci-Enza is in the large white building on the right of the road approx 100 m from the Prospect Street Entrance.)

Speaker: **Prof. Frans Waanders** Director, School of Chemical and Minerals Engineering, NWU (the old Potchefstroom University).

Topic: **Vredefort Dome World Heritage Site**

Refreshments will be served after the talk.

Talk summary

An estimated 2023 million years ago a gigantic meteorite measuring about 10 km in diameter hit the earth 100km south west of the current city of Johannesburg. This area near Vredefort in the Free State is now known as the Vredefort Dome or Vredefort Impact Structure and has been declared a World Heritage Site in July 2005 during the UNESCO meeting held in Durban, South Africa.

Some 130 crater structures of possible impact origin have been identified worldwide. Vredefort Dome is among the top large three and is considered to be the oldest and largest meteorite impact site found so far in the world. The original impact scar, now eroded away, measured about 380km across. It therefore beats the Sudbury impact structure in Canada which is some 200 km in diameter and is estimated to be 1850 million years old. The Chixculub structure in Mexico, (buried under the sea and not visible), with an age of 65 million years is considered to have been the catastrophe which led to the mass extinction of the dinosaurs when an asteroid struck the earth at that time in the earth's history.

When the meteor (with a diameter of about 10 km) hit the earth at a speed of more than 20km per second (or about 76 000 km per hour) it created a crater about 20km in depth. It is estimated that the inner part of the crater measured 90 km in diameter. The impact caused a ripple effect in the earth's crust resulting in three distinctive concentric circles of uplifted rock to be formed. The ring of hills around Vredefort and Parys are the eroded remains of the inner rim of the crater or dome, created by the rebound of the underlying rock and crater modification just after the meteorite struck. Besides the fact that this is the oldest and biggest meteorite impact site in the world, the impact site is unique in the world as the basement of the crater is still intact allowing scientists to obtain important information on how the meteorite impact site evolved, following impact.

Hall and Moolengraaff, two SA geologists have already mentioned in 1925 that the structure looked very similar to the ringed structures on the moon and in 1937 Boon and Albritton proposed that the Vredefort Structure was the scar of an ancient meteorite impact. Since then it has been studied extensively by earth scientists from around the world and has been the subject of many scientific papers.

The Vredefort World Heritage Site is not just of scientific value but is also a place of scenic beauty and an ideal tourist destination. It contains a finely balanced ecosystem consisting of open plains, bushveld, mountains and ravines with abundant flora and fauna. At least 99 plant species have already been identified, of which the world's largest Olive Wood Tree forest is probably the best known. The area is considered an important birding area with over 450 species already identified. The area contains as many identified butterflies as are found in the whole of Great Britain, and is also home to relatively uncommon animal species, such as the rooikat, aardwolf, leopard, several small buck.

A Nobel Prize and two historical scientific advances with SA connections

Cornelis Plug, plugc@mweb.co.za

Even before the current brain drain some persons born or educated in South Africa became famous scientists overseas. Others who made historically significant contributions to science overseas had strong South African connections. Three such persons are introduced below.

Nobel Prize winner Max Theiler and the battle against yellow fever

Max Theiler was born in Pretoria on 30 January 1899, a son of the famous veterinary researcher Arnold Theiler and his wife Emma Jegge. After completing the premedical course at the South African College, Cape Town, he proceeded to London in 1918 and qualified as a medical practitioner at St Thomas's Hospital. Subsequently, during a course in tropical medicine and hygiene at the London School of Tropical Medicine, he was offered a research appointment at Harvard Medical School in Boston, USA.

Proceeding to Boston in 1922 he started research on yellow fever in association with the bacteriologist Dr Andrew Sellards. During an expedition to tropical Africa in 1926-1927 he studied protozoal parasites. He returned to the United States via South Africa, finding no prospects for a suitable appointment here. Continuing his research on yellow fever, he found that injecting the virus into the brain of a mouse enabled him to re-isolate the virus later from the brain tissue. This work led to the development of the mouse-protection test for the identification of yellow fever antibodies in humans. In 1929 he suffered a mild attack of the disease, which rendered him immune.

From 1930 Theiler continued his work on yellow fever and other viruses in the Research Department of the Rockefeller Foundation in New York. By 1937 he had produced an attenuated strain of the virus, called 17D, which could be used as an immunising agent. The vaccine was tested under field conditions in Brazil during 1937-1940, with great success.

In recognition of his discoveries concerning yellow fever and how to combat it, Max Theiler was awarded the Nobel Prize for Physiology and Medicine in 1951. A quiet and unassuming man, he was the first South African to receive this honour. He subsequently directed a world-wide research programme on the arthropod-born viruses of humans and domestic animals, the results of which were published in 1971. He died in New Haven, Connecticut, on 11 August 1972.

C.H. Persoon and the origin of modern mycology
Christiaan Hendrik Persoon was born in Cape Town on 31 December 1762, the son of Christiaan Daniel Persoon and his wife Elisabeth W. Groenewald. In 1775 he was sent to Europe for his education. After completing his schooling he entered the University of Halle in 1783 to study theology. However, a year later he changed to the study of medicine. In 1786 he went to Leiden, the Netherlands, and the next year to the University of Göttingen, where he remained enrolled until 1799.

During these years he changed subjects once again, this time to botany. He started publishing in 1794 and acquired a reputation through his detailed studies of the classification of the fungi. A doctoral degree was conferred upon him by the *Kaiserliche Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher* in 1799. Continuing as a private researcher he published his most important work, *Synopsis methodica fungorum*, in 1801. It laid the groundwork for the current systematics and nomenclature of fungi. As a result he is still recognised today as the father of systematic mycology.

Persoon settled in Paris in 1802 and remained there for the rest of his life. He wrote another important botanical work, *Synopsis plantarum...*, which dealt with flowering plants and was published in two volumes in 1805-1807, and in six volumes in 1817-1822. During all his years in Europe he kept in touch with his sisters at the Cape through letters. The money which his father had left him in 1776 and on which he had been living ever since eventually ran out, leaving him destitute. In return for a small annuity from the Dutch government he made over his botanical collections to the Rijksherbarium at Leiden. Two contemporaries who visited him in 1823 described him as ugly in appearance, unsociable, uncommunicative, and living in poverty. He died on 16 November 1836.

The American mycologist C.G. Lloyd, who studied all Persoon's collections, wrote of him: *Thus lived and died perhaps the greatest genius mycology has ever known, for Persoon was a builder. He began the work with practically nothing and left a system of which others have availed themselves with much too little acknowledgment.*

Francis Guthrie and the four colour conjecture
What is the least number of colours needed to fill in any map, real or invented, so that neighbouring countries are always coloured differently? This deceptively simple question taxed the ingenuity of both professional mathematicians and amateur problem solvers for more than a century.

Francis Guthrie, born in London in 1831, first learned of the map colouring problem in 1852. He was a student at University College, London, where he obtained the degrees BA (1850) and LLB (1852) with first class honours. He surmised that four colours would suffice to colour any map, and thus became the originator of the so-called four colour conjecture. Next he tried to formally prove the conjecture, but was not satisfied that his proof was valid. His younger brother Frederick brought the conjecture, together with Francis's unsatisfactory proof, to the attention of their professor of mathematics at University College, Augustus de Morgan. The latter put what came to be known as "Guthrie's problem" to other mathematicians. The resulting frenzy of attempts to solve it (in which Guthrie played no part) produced a number of proofs of the four colour conjecture that were all later shown to be invalid, but in the process many preliminary steps towards a valid proof were achieved. The problem was finally solved only in 1976. Its history is described in a recent book by R. Wilson, *Four colours suffice: How the map problem was solved* (Princeton University Press, 2002).

Meanwhile Guthrie came to the Cape in 1861 to teach mathematics at the newly established Graaff Reinet College. In 1878, after a lengthy visit to England, he became professor of mathematics at the South African College, Cape Town. His contributions to pure and applied mathematics included a textbook, *The laws of magnitude, or, the elementary rules of arithmetic and algebra demonstrated* (London, 1870), as well as papers on topics such as "On the square root of minus one" (1870), "On the free rotation of a rigid body" (1880), and "Continuous girders, arched ribs and tension circles" (1878). The latter formed the basis for later developments in aeronautical engineering.

He had a life long interest also in meteorology. From 1862 he supplied regular observations to the Cape of Good Hope Meteorological Commission, and later served on the Commission for 17 years. His papers in this field included "The heat of the sun in South Africa", "Sea levels in South Africa from barometric observations", and "On rain making".

Another of his interests was botany. During the early 1860's he persuaded Harry Bolus to take up botany as a hobby and the two became life long friends. One of Guthrie's particular interests was heaths and he collaborated with Bolus in a revision of the family Ericaceae for the *Flora Capensis*. Bolus completed the work after Guthrie's death in 1899 and named the genus *Guthriea* and the species *Erica guthriei* after his friend.

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Contributions to this newsletter
will be greatly appreciated. Please forward any news (in electronic format please – and less than 200 words) which might be of interest to members, whether scientific, professional or personal, to Walter Meyer ***wmeyer@up.ac.za***.

Members are also strongly encouraged to make suggestions for potentially interesting speakers for our monthly talks.

Pretoria Branch S_2A_3 News
June 2006

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our June talk:

Date: **Wednesday, 7th June 2006**

Time: **17h15** (to 18h15)

Venue: **Sci-Enza (Discovery Centre), University of Pretoria Main Campus** (Use the Prospect Street Entrance to the campus. The Sci-Enza is in the large white building on the right of the road approx 100 m from the Prospect Street Entrance.)

Speaker: **Dr Geoff Grantham** Council for Geoscience

Topic: **Antarctic–Aouthern African Geological Relationships**

Refreshments will be served after the talk.

Talk summary

The talk will briefly look at working methods and conditions and will then focus on similarities between the geological evolution of western Dronning Maud Land, Antarctica and southern Africa with emphasis on the Pan African (450-650Ma) and Grenvillian (~1000-1200Ma) periods.

S2A3 Membership fees

Please encourage potential members to join the S2A3. The current membership fee is R70 – forms will be available after talk at the podium.

The sun shining on an icy Antarctic landscape. In our June talk, Dr Grantham will discuss the Geological similarities between southern Africa and Antarctica.

England goes to pot: Cannabis as medicine in 1689

Cornelis Plug, plugc@mweb.co.za

The reputed effects of dagga on human behaviour and psychological processes, as described by observers at various times and in different cultures, provides some fascinating reading. Years ago, while studying some of the works of the seventeenth century English scientist Robert Hooke (1635-1703), I came upon a brief article entitled “An account of the plant call'd Bangue, before the Royal Society, December 18, 1689". This plant is none other than the one we now call dagga in South Africa. It was practically unknown in England at the time, and Hooke's paper may well represent the first attempt (in English) to give a scientific account of its effects. Before considering his description, however, it may be useful to briefly mention some earlier references to the plant.

Early references to Bangue

The word *bhang* (also *bang, bangue, beng, bhung*, etc) is widespread in Eastern languages such as Urdu and Persian. All its variants derive from the Sanskrit work for hemp. Its first European form was the Portuguese *bangue*, which was also the earliest form in English. It is the native name of the Indian variety of the common hemp, *Cannabis sativa*, which in warm countries develops narcotic and intoxicating properties. The plant is an annual herb that is native to central Asia, though it has become a cosmopolitan weed and is cultivated in many countries. It is grown for three products: the fibre of the stem, long used in rope and sail-making (the English word canvas was originally derived from the Latin word *cannabis*, or hemp); the oily seeds, which have been used as food for birds and to yield a vegetable oil; and the resin that the plant develops in warm climates, which is used as a drug. The leaves and seed-capsules that secrete the resin may be chewed, smoked, or eaten, or an infusion of them drunk.

The plant has been employed for its fibre from ancient times. For example, the Greek historian Herodotus (c.484-c.425 BC) mentions the wild and cultivated hemp of Scythia (the region immediately north of the Black Sea) and describes hempen garments made in Thracia (in modern Turkey). Hempen cloth became common in central and southern Europe in the 13th century.

The intoxicating properties of the plant have also been known since ancient times and its medicinal use seems to have spread through India and the Middle East in the early Middle Ages. Knowledge of its possible value as a medicine was slow to reach western Europe, but in 1563 the use of *bangue* as a drug in India was mentioned in a Portuguese work by Garcia de Orta. Some decades later, in the English translation of J.H. van Linschoten's *Discours of voyages to ye East and West Indies* (1598), *bhang* is mentioned as a drug, with opium and others. Robert Burton in his *The anatomy of melancholy* (1651) likened its effects to that of opium, while John Fryer described it as “a pleasant intoxicating seed mixed with milk” in *A new account* *of East India and Persia* (1673). In 1690 Berlu in his *Treasury of drugs* described it as having "an infatuating quality and pernicious use". However, the plant received relatively little medical attention in England until the early 19th century. Hooke's report of 1689 is therefore of some interest.

Hooke on bangue

Hooke received a quantity of the dried plant and seeds, as well as a detailed description of its effects, from a person whom he does not identify. His paper was published posthumously in Hooke, R. *Philosophical experiments and observations* (London, 1726; reprinted by Frank Cass & Co.,1967). The author's use of language invites some direct quotations.

The plant "grows very common in India, and the Vertues, or Quality thereof, are there very well known; and the use thereof (tho the Effects are very strange, and, at first hearing, frightful enough) is very general and frequent". With regard to its name, "Tis call'd by the Moors *Gange*; by the Chingalese, *Comsa*, and by the Portugals, *Bangue*". Hooke describes the plant as "so like to Hemp, in all its Parts, both Seed, Leaves, Stalk, and Flower, that it may be said to be only Indian Hemp".

Intoxicating and medicinal effects

"The Dose of it is about as much as may fill a common Tobacco-pipe." This is rather a heavy dose, as may be seen from its effects: "This powder ... doth, in a short Time, quite take away the Memory and Understanding; so that the Patient understands not, nor remembereth any Thing that he sees, heareth, or doth, in that Extasie, but becomes, as it were, a mere Natural, being unable to speak a Word of sense; yet is he very merry, and laughs, and sings, and speaks Words without any coherence, not knowing what he says or doth; yet is he not giddy, or drunk, but walks and dances, and sheweth many odd Tricks; after a little time he falls asleep, and sleepeth very soundly and quietly; and when he wakes, he finds himself mightily refresh'd, and exceeding hungry. And that which troubled his Stomach, or Head, before he took it, is perfectly carried off without leaving any ill symptom".

Hooke's informant claims to have taken the drug often to cure an upset stomach. He also relates that it is used by "Heathen Priests, or rambling Mendicant Heathen Friars, who will many of them meet together, and every [one] of them dose themselves with this Medicine, and then ramble several Ways, talking they know not what, pretending after that they were inspired".

Hooke had earlier described the accidental poisoning of some children by the roots of hemlock (which can lead to paralysis and death), and compared the effects of cannabis, as described by his informant, to the early symptoms of hemlock poisoning. However, the cannabis plant appeared to him to have medicinal value and to have no long-lasting ill effects. He therefore proposed to grow it in England to investigate whether it would have the same medicinal properties as the imported plant. If successful, he thought, it "may possibly be of considerable Use for Lunaticks, or for other Distempers of the Head and Stomach".

A brief follow-up

Interest in the medicinal properties of cannabis increased during the early part of the 19th century, following the publication of reports of Napoleon's expedition to Egypt, where it was encountered. Systematic investigation of its possible uses in British medicine began with a number of trials with the drug carried out in Calcutta by Dr O'Shaughnessy during 1838-1842. Its intoxicating effects were found to vary greatly, depending on the nature of the plant, the method of preparation, individual differences, and cultural norms and expectations. The first effects of a small dose are usually cheerfulness and an increase in appetite. Larger doses produce hallucinations, delirium, and sleep. Disturbed perception of time and place, and rapidly shifting ideas, are common symptoms. Its medical effects have proved inconsistent and not very satisfactory. Its antispasmodic and pain-relieving properties led to attempts to use it in the treatment of various conditions, including tetanus, rabies, and some psychiatric disorders, particularly as it appeared to have fewer unpleasant side-effects than opium - another 19th century favourite. Its use as a recreational drug, and occasional use as medicine, continues today.

What is the S_2A_3?

The *S_2A_3* aims to stimulate a broad public interest in science and its applications, research, discoveries, history, ethics and philosophy. To do so, the ***S_2A_3*** arranges regular meetings, with speakers who are both entertaining and knowledgeable, as well as field trips, excursions and other interesting events.

Being added to our **e-mail address list** is *free.* Anyone wishing to receive ***S_2A_3*** announcements via e-mail but who has difficulty using the listserver service, is welcome to send their address to: **owner-s2a3_announce@kendy.up.ac.za**

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By subscribing to the S_2A_3 List server you will be notified via e-mail of forthcoming popular scientific lectures and other events of interest presented by the S_2A_3. See http://s2a3.up.ac.za/ for more details.

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The list server will respond with a message checking the validity of your e-mail address. Please follow the instructions in that message to complete your subscription. If you have difficulty in subscribing or unsubscribing from this list, or you have questions about the list itself, you may contact the list owner at: owner-s2a3_announce@kendy.up.ac.za.

Contributions to this newsletter

will be greatly appreciated. Please forward any news (in electronic format please – and less than 200 words) which might be of interest to members, whether scientific, professional or personal, to Walter Meyer ***wmeyer@up.ac.za***.

Members are also strongly encouraged to make suggestions for potentially interesting speakers for our monthly talks.

Pretoria Branch S_2A_3 News
August 2006

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our August talk:

Date: **Wednesday, 2nd August 2006**

Time: **17h15** (to 18h15)
(AGM at 17:00)

Venue: **Sci-Enza (Discovery Centre), University of Pretoria Main Campus**
(Use the Prospect Street Entrance to the campus. The Sci-Enza is in the large white building on the right of the road approx 100 m from the Prospect Street Entrance.)

Speaker: **Prof Rudi J van Aarde**
Conservation Ecology Research Unit, University of Pretoria

Topic: **Conservation of southern Africa's elephants: Dealing with causes rather than symptoms**

Refreshments will be served after the talk.

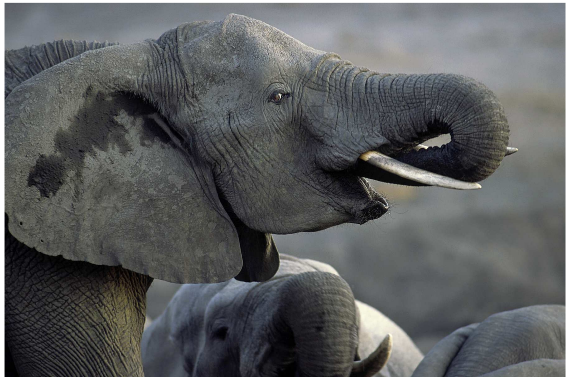
Talk summary

Some 350 000 savannah elephants live in Africa - nearly 220 000 of these occur in seven clusters of conservation areas that have been established across eight neighbouring southern African countries. These countries stretch over an area of about 6 million km². Elephants are increasing across most of these countries and often come into conflict with people. Elephants also destroy native vegetation and affect habitats for other species in some of the conservation areas in the region. Local conservationists therefore have to managed elephant numbers. Their management options include contraception, culling and translocation. More recently, the restoration of metapopulation dynamics also became an option. This illustrated talk reviews the applicability of these management alternatives.

Contraception as a method of population control has unwanted outcomes for individual elephants. It also does not prevent the destruction of vegetation. Most southern African conservation managers do not have the logistical support to apply contraceptives to large populations of free-ranging elephants. Culling can reduce populations but also stimulates population growth and movements within populations and annul the objective of the exercise. Culling is relatively expensive and unpleasant. For elephants translocation to confined areas adds little to reducing population growth rates. Newly established confined populations also destroy the vegetation of their new ranges and worsened the problem. All these methods focus on the symptoms of the so-called "elephant problem" and ignores the man-induced causes thereof.

Metapopulation dynamics may be restored by enabling elephants to disperse. This will involves the development of linkages between existing populations. Our findings suggest that metapopulation dynamics can reduce local population growth by providing opportunity for source and sink interactions across southern Africa. Metapopulation dynamics therefore may improve the regional stability in elephant numbers and reduce their impact on vegetation and on people.

Metapopulations may be restored through the development of a network of megaparks across southern Africa. This is now addressed by initiatives of Peace Parks Foundation and the University of Pretoria to ecologically delineate transboundary and transfrontier conservation areas. These areas will extend across the southern African distributional range of elephants. This approach calls for the replacement of local conservation management policies by a regional conservation plan that will benefit conservation across the region.



For elephant conservation, it is all about water. The artificial distribtuion of water interferes with the natural limitiation of their numbers and is giving rise to the destruction of vegetation. Photo: R van Aarde.

S_2A_3 2006 AGM

The 2006 AGM will be held on 2 August in the Sci-Enza at 17:00 (Before the talk). We need more committee members and specifically a new secretary. Please contact Elise Venter at elise.venter@up.ac.za if you can help.

Of science and its attributes

Cornelis Plug, plugc@mweb.co.za

The word "science", derived from the Latin *scientia*, meaning "knowledge", has been part of the English language since medieval times. Over the centuries it has taken on several meanings, not all of which survive to the present. Dictionaries tell part of the story, but a sense of what science is about can also be gained by the manner in which its practitioners have characterised it. A few opinions about the nature of science are quoted below, followed by some thoughts on the meaning that S_2A_3 attaches to the term "science".

What dictionaries say about science

One of the early meanings of the term, based on the Latin, was: *the state or fact of knowing*. Another was: *a craft, trade, or occupation requiring trained skill (e.g., shoemaking)*. Both these meanings are now obsolete. A third meaning, still sometimes encountered today, is *a trained skill, (e.g., sailing, or boxing)*. However, the most common meaning from late medieval times to the 18th century seems to have been *a particular branch of knowledge or study*, which would have included subjects such as reading, elocution, theology, arithmetic, rhetoric, and ethics.

Two further meanings are more relevant to current usage:

1. During the 18th century "science" began to

acquire a more restricted meaning: *A branch of study which is concerned either with a connected body of demonstrated truths (e.g., mathematics), or with observed facts systematically classified and more or less connected by general laws*. Furthermore, a science *includes trustworthy methods for the discovery of new knowledge within its own domain*. This meaning of the term includes the various categories of sciences identified by defining adjectives such as biological, cultural, descriptive, exact, experimental, historical, natural, pure, or social. It also includes the application of scientific methods to fields of study formerly considered to represent subjective or indemonstrable knowledge, such as political science, or science of religion.

2. From about the middle of the 19th century "science" began to be treated as synonymous with *natural science*, thus restricting it to the study of the material universe. This meaning is currently dominant.

Natural science as seen by some of its early practitioners

Some characteristics of natural science have been repeatedly confirmed by scientists and philosophers, often over a period of centuries. The following are some examples.

The scientific study of nature constitutes the most effective way of acquiring knowledge about the material universe; hence scientific knowledge is superior to the dogma laid down by religious authorities, in so far as the latter pertain to the material world. During the middle ages, when Europe was dominated by Christian orthodoxy much as the Middle East is dominated by Islam today, this was a fairly radical view. None the less at least two prominent scholars supported it during the 13th century, the German Albertus Magnus: *For natural science is not simply receiving what one is told, but the investigation of causes in natural phenomena*; and the Englishman Roger Bacon: *Authority has no value unless its reasons be shown; it does not teach, it only calls for assent*. Six centuries later the British biologist Thomas H. Huxley (1860), champion of Darwinism, was more outspoken: *Extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules*. (The mythical Greek hero Hercules was reputed to have strangled two serpents while still in his cradle).

The defining characteristics of science relate to its methods, and the assumptions and attitudes of its practitioners, rather than to its factual content. Huxley (1870) was less belligerent on this point: *The scientific spirit is of more value than its products, and irrationally held truths may be more harmful than reasoned errors*. The mathematician Karl Pearson (1892) wrote: *It is not facts themselves which make science, but the method by which they are dealt with.* Furthermore, similar methodological assumptions and principles underlie all the sciences. According to Pearson (1892): *The unity of all science consists alone in its method, not in its material*.

Scientific knowledge takes the form of general principles, rather than isolated observations. As early as the 4th century BC the Greek philosopher Aristotle made this clear: *In the study of nature we must strive to discover and establish principles which all things obey*.

In searching for such general principles one must of course assume that natural phenomena display regularities that are amenable to study. One of the few scholars who stated this explicitly was the 12th century astronomer Adelard of Bath: *We must assume that all nature is based on a sure and logical foundation*.

Scientific knowledge includes the products of insight and reasoning, in the form of hypotheses and theories. Roger Bacon (13th cent) said: *For there are two methods of acquiring knowledge, namely by reasoning and experience*. However, scientific theories and hypotheses should relate to the available observations, as was made clear as early as the 5th century BC by an unidentified Greek physician: *Now I approve of theorising if it lays its foundation in incident, and deduces its conclusions in accordance with phenomena*. Charles Darwin added a personal touch when he wrote: *I have steadily endeavoured to keep my mind free so as to give up any hypothesis, however much beloved (and I cannot resist forming one on every subject), as soon as the facts are shown to be opposed to it*. The interdependence of theory and experiment was succinctly expressed by the philosopher Immanuel Kant (18th century): *Experiment without theory is blind; theory without experiment is lame*.

Excessive theorising may be ridiculed, for example, according to the 19th century author Samuel L. Clemens (better known as Mark Twain): *There is something fascinating about science; one gets such wholesale returns of conjecture out of such a trifling investment of fact*.

The object of science is not merely to systematically describe natural phenomena, but to predict and even to control them. The physicist W. Whewell (1858) wrote: *It is a test of true theories not only to account for, but to predict phenomena*. The political economist Karl Marx was more concerned with controlling events: *Hitherto philosophers have interpreted the world in various ways; the point, however, is to change it*.

Scientists, like everyone else, sometimes resist change. The German physicist Max Planck (1905) cynically concluded that: *A new scientific truth does not triumph by convincing its opponents, but rather because its opponents die, and a new generation grows up that is familiar with it*.

The SA Association for the Advancement of What?

S_2A_3 does not have a formal definition of the "science" that it strives to advance. However, the subjects listed under the various sections of the association during its first decade provide an indication of the branches of knowledge considered at that time to fall within the ambit of science. In addition to mathematics and the natural sciences we find:

Applied sciences: engineering, architecture, surveying, irrigation, mining, agriculture, forestry, and sanitary science/hygiene (i.e., public health).

Social and cultural sciences: anthropology, ethnology, archaeology, economics, sociology, education, philology, political economy, history, and mental science (i.e., psychology).

These fields imply a wide interpretation of "science", even though medicine and veterinary science were omitted. S_2A_3's current interpretation, judging by the fields of expertise of persons recently honoured by its awards, or invited to deliver lectures, seems to give less recognition to the social and cultural sciences - in terms of the dictionary definitions above there appears to have been a shift from meaning 1 to meaning 2. However, in other respects the scope has widened somewhat. For example, in addition to newly developed sciences (e.g., computer science, ecology) S_2A_3 now also supports attempts to preserve the natural environment.

Pretoria Branch S_2A_3 News

September 2006

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our September talk:

Important: Please note the change from the usual time and date!

Date: **Thursday, 14th September 2006**

Time: **18h30** (to 19h30)

Venue: **Sci-Enza (Discovery Centre), University of Pretoria Main Campus** (Use the Prospect Street Entrance to the campus. The Sci-Enza is in the large white building on the right of the road approx 100 m from the Prospect Street Entrance.)

Speaker: **Prof Anusuya Chinsamy-Turan** Zoology Department, University of Cape Town

Topic: **Dinosaurs: How we know what we know.**

Refreshments will be served after the talk.

Talk summary

Most of what is known about dinosaurs has been reconstructed from clues left in the fossil record. The preserved hard parts of their skeletons, i.e bones and teeth, yield especially valuable clues for today's detectives working the dinosaur case, as they allow scientists insight into the biology of these animals. Prof Chinsamy-Turan's work focusses specifically on the microstructure of dinosaur bone, which provides a unique record of the growth processes dinosaurs experienced and clues to the factors that could have influenced these. During the talk she will share some of the insights gained through her work and explain how they are helping to complete the puzzle of dinosaur biology.

About the speaker

Prof Anusuya Chinsamy-Turan is a palaeobiologist in the Zoology Department of the University of Cape Town. She is a National Research Foundation (NRF) B1-rated scientist and a global expert on the microscopic structure of the bones of dinosaurs and other extinct animals. She has published extensively in international scientific journals such as Nature and in the popular press. She is the author of The Microstructure of Dinosaur Bone: Deciphering Biology through Fine Scale Techniques, the first book entirely devoted to fossil bone microstructure.

Prof Chinsamy-Turan is Vice President of the Academy of Science of South Africa, President of the Association of South African Women in Science and Engineering (SA WISE), and a member of the Sasol SciFest National Advisory Committee. Her work has been recognised through several highly-acclaimed awards, more recently the title of 2005 Distinguished Women Scientist from the Department of Science and Technology. She was the overall winner of the 2005 Shoprite Checkers / SABC2 Woman of the Year Award, as well as winner in the Science and Technology Category. In 2003 she won the National Science and Technology Forum Award for outstanding contribution to Science Engineering and Technology; in 1997/1998 she was awarded the Royal Society of South Africa Gold Medal for Research excellence; and in 1995 she was awarded the NRF President's Award for research excellence

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The golden ratio: Science or mysticism?

Cornelis Plug, plugc@mweb.co.za

According to a widespread belief people find rectangles with a particular length to breadth ratio more pleasing than others. Given a choice between a series of rectangles ranging from square to long and thin, it is claimed, the ratio between the length and breadth of the preferred figure will always be close to 1,61803.... Known as the golden ratio, the divine proportion, or phi, this number has some intriguing mathematical properties. It appears also to play a role in many natural phenomena, and is seen by many as a fundamental ratio in art and architecture.

Origin of the golden ratio

The Greek mathematician Euclid (born c. 365 BC) was the first to explicitly define the golden ratio (though not by that name). He did so in Book 6 of *The elements*, the most successful textbook of all time. A line is divided in this ratio if the shorter part is to the longer part as the longer part is to the whole line. Euclid applied this ratio in the geometrical construction of a regular pentagon (five-sided figure) and other geometrical figures. As his book was mainly a compilation of existing knowledge, the ratio may well have been used earlier, particularly by the philosopher Plato or the followers of Pythagoras.

Though originally regarded only as a geometrical property, a numerical value began to be attached to the golden ratio in medieval times. Starting with the definition, some algebra and arithmetic show that its value is 1.61803... and that it is a non-recurring decimal number.

Phi in mathematics

The Greek letter "phi" for the golden ratio appears to have been introduced by the American mathematician Mark Barr at the beginning of the 20th century, to commemorate the Greek sculptor Phidias (5th century BC) who may have used the ratio in his work. Mathematicians have pointed out that phi has some surprising properties. For example, its reciprocal (1/phi) can be obtained by simply subtracting one from the ratio, that is 0.61803... And adding one to the ratio gives its square: 2.61803... These properties underlie an interesting geometrical phenomenon. If one draws a golden rectangle (with sides in the ratio phi:1) and removes from it a square based on the shorter side, then the remainder is again a golden rectangle.

Many other esoteric properties of phi have been found and one of these is important for understanding the role of phi in nature. Consider a series of numbers (beginning with 1, 1) constructed so that each subsequent number is equal to the sum of the previous two: 1, 1, 2, 3, 5, 8, 13, 21, 34 etc. This is called a Fibonacci series, after the Italian mathematician Leonardo Fibonacci (c. 1175-1230). Phi and the Fibonacci numbers are related in the following way: The ratio of any Fibonacci number to the number preceding it in the series is approximately equal to phi, and the further along these numbers are in the series, the closer the approximation becomes. Thus the ratio of the 6th to the 5th number (8/5) is 1.60, while the ratio of the 9th to the 8th number (34/21) is already much closer to phi at 1.619.

The golden ratio in nature

The golden ratio can be found in many natural phenomena. These include growth patterns in plants, for example, the spacing of leaves around a stem, or of seeds around a seed head. Optimum growth patterns (e.g., to ensure even spacing of seeds in a sunflower head, or maximum exposure to sunlight of leaves on a vertical plant stem) can often be described in terms of the Fibonacci series and phi. Furthermore, the Fibonacci series and phi underlie the construction of so-called logarithmic spirals and the fact that many natural structures, (e.g., spiral galaxies and spiral sea shells) have this shape partly explains why phi appears to be present everywhere. However, the reasons for finding phi in other phenomena (e.g., the crystal structure of some alloys, or the properties of black holes) are less clear, though it may be just coincidence.

The golden ratio in art and architecture

Many authors have claimed that the golden ratio underlies the dimensions of the pyramids of Egypt, the Greek Parthenon, and other ancient buildings and monuments. Such claims are based on the interpretation of recent measurements, rather than on documentary evidence. The ratio was first brought to the attention of artists in Europe by Luca Pacioli in his three volume treatise *De divina proportione* (1509). Many artists, including Leonardo da Vinci, are said to have used Pacioli's "divine proportion" to achieve the most pleasing forms in their paintings and sculptures. In most cases this is difficult to prove and the importance of the golden ratio in art appears to be highly overestimated. Nonetheless some architects and artists did include the ratio in some of their designs or art, including the architect Le Corbusier and the surrealist painter Salvador Dali.

Finding the most pleasing form

The first experiment to determine the shape of the most pleasing rectangle was performed by the German physicist-psychologist Gustav T. Fechner in the 1860's. His findings provided some support for the golden ratio hypothesis, but were subject to methodological problems. Many later psychologists made similar determinations and most found a weak preference for length to breadth ratios in the vicinity of the golden ratio. My own contribution to the controversy formed part of a series of experiments on scaling the perceived shape of plane figures, and was published in the *South African Journal of Psychology* in 1976. The results can be summarised as follows:

- The subjects of the investigation (nearly 1000 University of Pretoria students) were able to consistently express the perceived oblongness of rectangles, diamond figures and pear-shapes, presented either horizontally or vertically, in numerical form. Furthermore, an analysis of the errors in immediately and delayed reproductions of such figures showed that oblongness is remembered as a single impression, and is not reconstituted by calculating a ratio of remembered lengths and breadths. Oblongness is therefore a measurable psychological attribute.
- When the students rated their preferences for similar figures (with length to breadth ratios varying from 1.0 to 8.5) on a five-point scale, maximum preference was found for a ratio of about 1.9 – 2.0. Drawings of the same shapes with "most pleasing" dimensions showed maximum preference in the region 1.4 – 1.8 for the three shapes. However, maximum preference was not clearly defined, as all ratios between 1.0 and 2.5 were well represented. The specific value of the golden ratio is therefore of little psychological significance.
- An hypothesis proposed by Stone and Collins in 1965, that the most pleasing figure is determined by how well it fits into the combined visual field of the two eyes, was not supported, as the preferred oblongness of pear shapes (which do not match the shape of the visual field nearly as well as rectangles or diamond shapes) was much the same as for the other figures. The weak preference for certain shapes therefore seems to result from our frequent contact with objects such as books, paintings, windows, etc.

The golden ratio as a modern fad

The amount of attention being given to the golden ratio seems out of all proportion to its significance in science and art. For example, a Google-assisted search of the internet using the term "golden ratio' resulted in a staggering "approximately 661 000 results found." Some of the sites deal with the work of mathematicians or natural scientists. Many others advertise "golden ratio" products such as books, T-shirts, or massage chairs. Others apply the ratio in predicting price movements on the stock market. For a summary of the mathematical properties of phi, see Eric E. Weisstein. "Golden ratio" at http://mathworld.wolfram.com/GoldenRatio.html. A good recent book on the whole topic, written by an astrophysicist, is Livio, M. *The golden ratio and aesthetics* (2002).

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Pretoria Branch S_2A_3 News
October 2006

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our October talk:

Important: Please note the change from the usual time, date and venue!

Date:	**Tuesday, 10th October 2006**
Time:	**18h00** (to 19h00)
Venue:	**Senate Hall, Main Campus, University of Pretoria** (Use the main entrance to the Universtiy, turn left and follow the road. The Senate Hall is in the Administration building in the southwestern corner of the campus. (Use the entrance at the southwestern corner of the building). The map at http://saip2005.up.ac.za/ maps/UPMainCampus05.pdf shows the Admin building as building no. 12.
Speaker:	**Prof Peter Richerson** Department of Environmental Science and Policy University of California Davis
Topic:	**Evolution on a Restless Planet: Did Climate Change and Climate Variation Drive Human Evolution?**

Refreshments will be served after the talk.

South Africa's first scientific journal

Cornelis Plug, plugc@mweb.co.za

The first quarter of the nineteenth century was a period of modest scientific activity at the Cape of Good Hope. A Society for the Encouragement of Agriculture, Arts and Sciences (1800-1802), the first scientific society in southern Africa, flourished briefly in Cape Town, but despite its comprehensive name it was devoted entirely to agricultural innovation. However, from about 1825 public interest in science and education flourished for about a decade. Most scientific activities during this period were carried out by amateur scientists, either at their own expense or funded by public subscription.

Local agricultural societies started to make their appearance in Graaff Reinet (1824, 1829), Cape Town (1831) and elsewhere. The Cape of Good Hope Horticultural Society was founded in Cape Town in 1826. Soon afterwards the first local professional organisation, the South African Medical Society (1827-1847) was established. In 1828 the South African College was founded – the first institution in southern Africa to provide high school education. From November 1828 the South African Mechanics' Institution, an organisation for the advancement of adult education among the working classes, organised public lectures. There were no local scientific journals at this time, but newspapers published articles of scientific interest. For example, during May and June 1829 descriptions of some local bird species, mainly falcons, appeared in the *South African Commercial Advertiser*. These were written by the British zoologist Dr Andrew Smith (1797-1872), who resided in Cape Town for some years.

The South African Institution and its successor

The first local society established to promote all branches of science was founded in Cape Town in 1829 and named the South African Institution. In 1832 it amalgamated with the South African Literary Society to form the South African Literary and Scientific Institution. Despite this change, it remained primarily a scientific society and played an active role in the advancement of science for a few years. For example, its members were instrumental in founding the Cape of Good Hope Association for the Exploration of Central Africa (1833-1850). The main purpose of this association was to organise and finance a scientific expedition, led by Dr Andrew Smith, to explore the interior of southern Africa. The expedition penetrated to the central Transvaal in 1834 and brought back large collections of natural history specimens.

After 1836 interest in science began to decline. The South African Literary and Scientific Institution survived for another 20 years, but there are few records of its activities.

The South African Quarterly Journal

One of the most important endeavours of the members of the South African Institution and its successor was to publish the first local scientific journal, the *South African Quarterly Journal*, as an independent venture financed by public subscription. The aims of the journal were to publish the papers read before the Institution, disseminate scientific knowledge in general, and encourage scientific investigation. The first four issues appeared between October 1829 and September 1830, while the fifth was dated October 1831. Four more issues were published during 1833-1834, and a final issue in December 1836. The first four issues included, among others, the following contributions, most of them the first locally published scientific papers in their respective fields:

– "A description of the birds inhabiting the south of Africa", by Dr Andrew Smith. In a series of four articles under this title Smith provided technical descriptions of many species of vultures, falcons, eagles and hawks, based mainly on his own observations. He also contributed "Observations relative to the origin and history of the Bushmen", a detailed description of San culture, based largely on his own encounters with them.

– "An account of the earthquakes which occurred at the Cape of Good Hope during the month of December 1809", by Wilhelm L. von Buchenroder (1782-1846), soldier and merchant. He gave a full account of the effects of the various shocks, particularly at Cape Town, Jan Beesjie's Kraal (now Milnerton) and Blaauwberg Valley. Some damage was done to buildings, while cracks and holes opened in the ground near Blaauwberg, from which muddy water was ejected. This paper was later also published in the *Philosophical Magazine*.

– "Sketches of the botany of South Africa", by James Bowie (1789-1869), a British gardener and plant collector who resided at the Cape for most of his professional life. This paper was mainly a list of flowering plants, but was soon followed by his "Remarks on the culture of exotic vegetables, adapted for the soil and climate of South Africa", a series of three papers on the cultivation of exotic plants, shrubs and trees at the Cape. These papers earned him the Institution's gold medal for contributions to botany in 1830.

– "An historical account of the formation, progress, and present state of the European colony at the Cape of Good Hope", by Reverend M. Borcherds, minister of the Dutch Reformed Church at Stellenbosch. In two papers with this title Borcherds gave a detailed account of the founding of the colony, covering the period from April 1652 to December 1653, based on documentary sources.

– "Remarks on the geology of South Africa", by Reverend Dr George Thom (1789-1842), minister of the Dutch Reformed Church at Tulbagh. Thom had collected fossils, mainly molluscs, since 1814. He recognized that those found near Uitenhage were formed at a later period than those found in the Bokkeveld.

- "Notes on South African geology", by Charles H. Grisbrook (1799-1867), who later practised as an apothecary in Graaff Reinet. Following Thom's paper, Grisbrook reported that he and W.L. von Buchenroder had collected fine fossil specimens on the banks of the Swartkops River, near Uitenhage, in 1828. He also mentioned locations where various interesting minerals and rock types could be found.

- "Observations on the seal fishery of the Colony, and some of the physiological peculiarities of seals, with remarks on Dyer's Islands, etc.", by A. Johnstone Jardine. This paper was based on Jardine's observations at Cape Agulhas during a sealing expedition. Dyer Island is just south of Kleinbaai.

- "A list of plants found in the district of Uitenhage, between the months of July 1829 and February 1830, together with a description of some new species", by Christian F. Ecklon (1795-1868), botanist and collector of natural history specimens at the Cape for most of his life. His list included 1640 species, with indications of the localities where each was found, and descriptions of presumed new species in footnotes.

– "Substance of the journal of two trading travellers, and of the communications of a missionary, regarding their recent visits to the countries in the rear of the Portuguese settlement at De la Goa Bay", by John Centlivres Chase (1795-1877), civil servant and writer on southern African geography. His paper summarised the journal of two traders, Robert Scoon and William McLuckie, who were the first colonists to visit the Matabele Chief Mzilikazi, during their journey from Griqualand West to Mozambique in the winter of 1829. Chase made important contributions to the cartography and geographical knowledge of the subcontinent in later years.

– "On the horse sickness", by Thomas Perry (1769-1836), district surgeon (apparently without formal medical qualifications) of Graaff Reinet. Perry had studied horse sickness, to which he referred as "this deadly lung inflammation", for some years. In 1830 he wrote to the Governor describing the symptoms and post-mortem effects of the disease and discussing its possible cure. The Governor referred the report to the Colonial Medical Committee for publication, resulting in the above paper.

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Contributions to this newsletter

will be greatly appreciated. Please forward any news (in electronic format please – and less than 200 words) which might be of interest to members, whether scientific, professional or personal, to Walter Meyer ***wmeyer@up.ac.za***.

Members are also strongly encouraged to make suggestions for potentially interesting speakers for our monthly talks.
