

Taxonomy in the Solar System

s ananthanarayan explain why some lesser members are difficult to tell apart

LIKE the planets, comets and asteroids are in orbit around the sun. Generally small in size, they are visible to the naked eye for a short time, but they are important components of the Solar System and tell us much about how the planets developed and fell into regular orbits.

There is a celebrated object in the sky called *3200 Phaethon*, which visits every December and causes spectacular *meteor showers*. It is thought to be an extinct comet but it also shows features of an asteroid and there is a case for it to be considered an asteroid. The real nature of *32 Phaethon* has thus been something of a question and Humberto Campins of the University of Central Florida and colleagues appear to have worked it out by going back to its parentage!

Their paper was presented last week at the 42nd annual Division of Planetary Sciences Conference at Pasadena, California, in the course of the world's largest conference for scientists who study the origin of the Solar System.

Comets

A comet is a small, icy Solar System object that, typically, follows an acutely elliptical orbit and gets close to the sun. During its pass near the sun, solar radiation generates an atmosphere of dust and frozen gases that evaporate. The solar wind, or the force of radiation, pushes this dust and gas plume outward and it becomes visible as the *coma*, or tail. The word "comet", in fact, is Greek for "long haired". The core of the comet is itself a loose collection of ice, dust and

small rocky particles, from a few hundred metres to tens of kilometres across.

Comets arise either from the Kuiper Belt — objects in orbit just beyond Neptune — or they arise from the Oort Cloud, which is a collection of distant icy objects in the outer Solar System, beyond the orbit of Pluto.

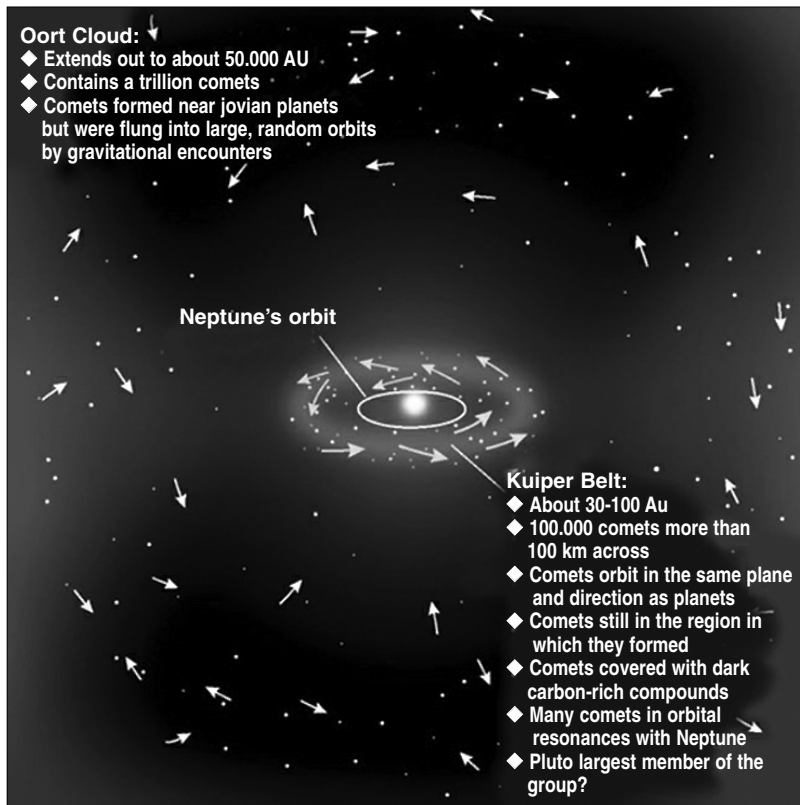
The nearer comets have orbit periods of a few years, while the more distant ones have periods of hundreds or thousands of years. These long period comets arise from the Oort Cloud, being drawn out of their regular orbit by the effect of the outer planets or by the effect of stars.

These objects, once set plunging towards the sun, withdraw to large distances that extend well beyond the limits of the Solar System.

The characteristic feature of comets is that they contain frozen gases that form the *coma* when then come near the sun and this cloud of gas and dust becomes visible in sunlight. After many passages near the sun, comets may lose their supply of gas and become "extinct" when they resemble *asteroids*, the other category of *near earth objects*.

Asteroids

The term *asteroid*, which means "star-like", was first used to describe any object orbiting the sun that was not a *planet* and also did not qualify as a *comet*. But now the word is generally used to describe rocky and metallic objects of the *inner Solar System* going as far out as the orbit of *Jupiter*. This helps distinguish this class of objects from outer Solar System



objects, with a more volatile composition, more like comets that are being discovered.

Asteroids are thought to be remnants of material in the early history of the Solar System that did not grow large enough to become planets. The main asteroid belt is between the orbits of Mars and Jupiter, although there are many families with different orbit characteristics. It is considered that it was the mass of Jupiter that put an end to planet formation and pushed most of the lesser object into the asteroid belt.

Asteroids are for the most part rocky, nickel-iron or

basaltic, some with an icy covering, and some with traces of amino acids and organic substances that are considered to be source of the raw material of life on earth.

3200 Phaethon

The great characteristic of this object is that it comes closer to the sun than any other asteroid — its closest approach is nearer than that of Mercury, the innermost planet. And the orbit crosses that of Venus, earth and Mars. Its surface could get as hot as 1,400° F and for this reason it was named after Phaëton, the son of Helios, the sun God.

Phaethon is also now known to be the cause of the *Geminids meteor showers* that light the mid-December night sky. Given its close approach to the sun and its apparent activity, Phaethon seems like a good comet candidate. But given its structure and its composition of dark material, it appears to be, as it did to its discoverer in 1983, clearly an asteroid. Phaethon thus shows both comet and asteroid features, like

many other objects, but the origin of Phaethon has been a question.

New findings

Humberto Campins and colleagues analysed the spectral, or chemical characteristics, and used mathematical modelling of the way the orbit came about to find a close link between Phaethon and *Pallas*, one of the largest members of the main asteroid belt. *Pallas* is surrounded by Phaethon-sized objects and itself has a highly inclined orbit. Its surface composition matches Phaethon and it appears that the *Pallas* family may have been the source of Phaethon and several *near earth asteroids*, pushed into its deep orbit by a collision or other perturbation. It seems clear, then, that Phaethon is not comet; it is pedigree asteroid!

Humberto Campins had won international acclaim earlier this year with his paper in *Nature*, where he reported evidence of water and organic chemicals on the surface of the asteroid *24 Themis*. This was first evidence of a way water may have been restored to the earth after the collision that created the moon, which would have vapourised any of the existing water.

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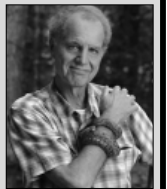
Gaspra, an "inner asteroid belt" object, the first to be closely approached by the Galileo spacecraft in 1991.



Comet Hale-Bopp as seen in Pazin, Croatia, on 29 March 1997.



A meteor shower.



Hal Herzog

Why some animals are more equal than others...

Dogs are pets, snakes are scary and chickens are dinner. But why do we see animals in such different ways? The field of 'anthrozoology' has the answers, says rob sharp

ON a car journey several years ago at two in the morning, author and psychologist Hal Herzog turned to his fellow passenger, Amnesty International campaigner Tony Dunbar, to discuss the cockfight the pair had just witnessed in a small North Carolina township. Herzog was surprised by Dunbar's response to the carnage. "There are bigger moral problems," the charity worker said.

You might expect a representative of Amnesty International to have expressed concern. After all, cockfighting is illegal across most of the USA. However, this cruel pursuit, in which gamecocks tear each other limb from limb, is, Herzog argues, a small problem compared to other types of animal cruelty. One of America's foremost psychologists specialising in human-animal relationships, he is dedicated to understanding our often contradictory behaviour towards different species. In his new book, *Some We Love, Some We Hate, Some We Eat*, he tackles the history of our keeping animals and attempts to explain why we like and loathe certain creatures.

"My passion for the subject comes from all sorts of places," he explains. "I once found myself living in a place where my neighbours were cockfighters. The thing was, they seemed like nice people; they just happened to bet on roosters on a Saturday night. I realised my justification for eating meat wasn't any different. It got me thinking."

Herzog is an anthrozoologist. It's nowadays a burgeoning field of science, what he calls "the study of human-animal interactions". The answer might just be that some of them look like us. Late Harvard biologist Stephen Jay Gould thought Walt Disney drew Mickey Mouse with big eyes to make him resemble a human child. "We are, in short, fooled by an evolved response to our own babies and we transfer our reaction to the same set of features in other animals," he said. You could say it's a form of Freudian "projection". We are subconsciously imposing a set of rules of behaviour on our pets, because of their resemblance to our human family. The closer the match, the more familiar the animals seem.

This also explains why we loathe certain animals. In a 2001 Gallup poll, Americans were asked about the things that "made them sweat". Four of their top 10 fears were animals, with snakes topping the list (the other common fears were of spiders, mice and dogs).

According to Herzog, both sexes' behaviour towards animals is more or less the same, except when people's behaviour becomes especially loving or particularly violent. Since Victorian times, 85 per cent of animal rights activists have been women. And if you look at those who are intentionally cruel to animals, nine times out of 10 they are male. "There's a mixture of nature and nurture," explains Herzog. "Women are more empathetic, because of biology. Oxytocin, a hormone involved in female reproduction, is thought to be involved with attachment to animals. Testosterone is thought to send men in the other direction."

"I think there is some evidence to suggest that pets help with our lives, but it is not as profound as the pet industry wants you to believe," he comments. "There is some literature showing that (pet ownership) is good for people. There is a body of work, not quite as large but which gets a lot less attention, which dictates that there is no difference between pet owners and non-owners on health."

The Independent, London

Will marijuana use become legal?

If Proposition 19 is passed in less than a month in the USA, the consequences cannot be underestimated, writes rhishav n choudhury

The war on drugs has been an utter failure, we need to rethink and decriminalise our marijuana laws.
Barack Obama, US President.

THE USA is rethinking and decriminalising its laws. In less than a month, views on the most commonly used illicit drug in the world may be transformed. On 2 November the fate of Proposition 19, more commonly known as the "The Regulate, Control and Tax Cannabis Act of 2010", a California ballot proposition, will be decided. If passed, it will legalise various marijuana-related activities, allow local governments to regulate those activities, permit local governments to impose and collect marijuana-related fees and taxes. California is the home of Hollywood and, thus, has a major socio-cultural influence on media and society, not just in the USA but throughout the world. If this law is passed, the consequences cannot be underestimated. Within the next decade, if similar legislation is passed elsewhere, packs of marijuana cigarettes, cannabis coffee houses and marijuana-based drinks may become common. Since the properties and effects of cannabis are still not fully understood, is it premature to legalise its use?

The cannabis plant, also known as marijuana, is indigenous to Central and South Asia and evidence of its consumption can be found as far back as the third millennium BC. In fact, marijuana is known to have been used by the ancient Hindus and Nihang Sikhs in India, a practice that continues among many followers. According to a 2004 UN estimate, marijuana is used by at least four per cent or 160 million of the world's adult population on a yearly basis and at least 0.6 per cent or 22 million on a daily basis for recreational, religious and medicinal purposes.

Although having ancient roots and significant usage in modern times, marijuana was criminalised in many countries by the early 20th century for its intoxicating effects, among other reasons. Apart from its effects on the mind and body, the "gateway-drug" theory may have played a part in inducing the contemporary negative views on this drug. This theory suggests that an individual trying cannabis increases the probability of using harder and more dangerous drugs, such as cocaine and heroin. Although the theory is widely disputed, it does

suggest a step-by-step process into the world of illicit, intoxicating drugs, which seems convincing.

So what exactly does marijuana do to the human system? Like other psychoactive drugs, it temporarily affects a person's neurochemistry, which in turn changes a person's mood, cognition, perception and behaviour. The most prevalent psychoactive substances in cannabis that induce changes in the brain's neurochemistry are a group of compounds known as *cannabinoids*, most notably tetrahydrocannabinol (THC). This, along with other cannabinoids, acts as an antagonist, which operates by interfering with the synthesis or blocking postsynaptic receptors so that neurotransmitters cannot bind to them. This change in the neurochemistry of the brain can cause changes in the structure and functioning of neurons, as the nervous system tries to re-establish the homeostasis of the body that was disrupted by the presence of the drug.

Exposure to antagonists for a particular neurotransmitter increases the number of receptors for that neurotransmitter, and the receptors themselves become more sensitive, in a process known as *sensitisation*. In other words, these changes lead to the effects marijuana has on humans.

The effects of cannabis may manifest within seconds, depending on the mode of ingestion, and typically lasts for around two to three hours. Some of the short-term physical effects include increased heart rate, reddening of the eyes, a reduction in intra-ocular pressure, muscle relaxation and a sensation of cold or hot hands and feet. On the other hand, psychoactive effects, commonly known as a "high", are less straightforward and are more subjective. Some effects may include an altered state of consciousness, euphoria, feelings of well-being, relaxation or stress reduction, increased appreciation of humour, music or art, joviality, introspection, enhanced recollection, increased sensuality, changes in libido, disruption of linear memory or thought, nostalgia and paranoia or anxiety.

These psychoactive changes are subjective and may or may not take place in the user. One of the peculiar effects of marijuana is the distortion of the perception of space and time, which at higher doses can include altered body image, auditory and/or visual illusions and, in some cases, even depersonalisation and derealisation, or losing clarity of oneself and the world around. Cannabis can affect short-term memory as well, along with motor skills, reflexes and attention, which could pose a problem when driving, although only a few studies reflect impairment in terms of performance effectiveness. The long-term effects of cannabis usage are far from clear and widely disputed. Smoking of cannabis is apparently the most harmful method of consumption, as the inhalation of smoke from organic

materials can cause various health problems, along with the fact that tobacco is regularly mixed with the marijuana when inhaled. Several studies suggest that cannabis has similar health affects as that of tobacco, such as bronchitis, coughing, overproduction of mucus and wheezing. Cannabis smoke also contains numerous carcinogens and thus may increase the possibility of contracting cancers such as lung and testicular cancer, though this is widely disputed as well.

Cannabis use has additionally been associated with stroke and heart disease, although there is as yet no firmly established connection. Apart from physical affects, cannabis use has been assessed by several studies to be correlated with the development of anxiety, psychosis and depression, although here also no definitive causal link has been established. The major debate in the scientific community on the mental aspects of cannabis use involves the direction of causality between marijuana usage and psychotic symptoms. Some studies assert that causality is more likely to involve a path from cannabis use to psychotic rather than from psychotic symptoms to cannabis use. Others hold that cannabis use only forms parts of a causal constellation, implying that it does not trigger mental health problems that would not have occurred in the absence of cannabis use.

There is, however, a school of thought that holds that cannabis used medically has several beneficial effects, including inducement of nausea and vomiting, stimulation of hunger, lowered intraocular pressure, as well as general pain relief. These effects have been shown in studies to be helpful in chemotherapy, treating Aids patients, treating glaucoma, pain, multiple sclerosis and depression. Strangely enough, some studies even indicate moderate cannabis use as beneficial in preventing head and neck cancer, lung cancer and breast cancers due to the well documented anti-tumoral properties of cannabinoids.

There is a growing belief in some US states and certain countries that the medicinal uses of marijuana, especially for the elderly, is beneficial, though it is still illegal and the jury's out on how effective this actually is. According to Dan G Blazer, professor of geriatric psychol-



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