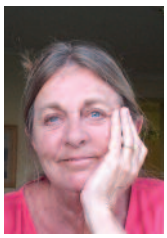

Recent Developments in Science and Medicine

Marilyn Monk

Environmental disorder promotes racial disharmony

It has been known for some time that shabby neglected environments encourage more crime and antisocial behaviour. The 'broken windows' hypothesis (sociologists James Wilson and George Kelling) proposes that people are most likely to commit criminal and antisocial acts when they see evidence that others have already done so. A cleaner environment promotes better behaviour. For example, zero tolerance against graffiti in the New Yotk subway in the 1980s improved safety. In a recent study, Stapel and Lindenberg (Tilburg University, Netherlands) have extended these findings to show that a disordered environment (e.g., litter, broken pavement, a broken bicycle) is correlated with increased stereotyping and racial discrimination.

The researchers observed the behaviour of people in ordinary situations (for example, in a railway station or a street) to score the effects of a shabby/neglected environment versus a clean/tidy environment. They observed, for example, that study subjects sit further away from someone of another race if a railway station is a mess. The findings have important implications with respect to an environmental cause of some forms of prejudice and have obvious policy implications. Discrimination can affect quality-of-life and cause serious health issues. As the authors say 'Diagnose environmental disorder early and intervene immediately.' Local authorities take note.

Reference

Stapel DA, Lindenberg S. (2011). Coping with chaos: how disordered contexts promote stereotyping and discrimination. *Science 332: 251-3.*

Natural selection in moths - peppered or black?

The appearance of the black variant form (known as carbonaria) of the light coloured spotted (peppered) moth, *Biston betulatira*, coincided with the industrial revolution in the nineteenth century. The natural habitat of the peppered moth - the light coloured bark of the birch trees - had become covered with soot. Consequently, the black variant form survived and multiplied because of its selective advantage – it could not be seen by predators on the sooty surfaces where it lived. After new laws in the 70s ensured the 'clean up' of industrial pollution, the light coloured peppered moth re-appeared. This is one of the best known examples of natural selection although the mechanism has not been understood so far. It was not linked to known genetic pathways of melanism, and it was not known whether the black form emerged from one ancestral event or several times.

Ilik Saccheri and colleagues (Institute of Integrative Biology, University of Liverpool, UK) have used molecular genetics to show that one mutation from a single ancestor causes the increased dark pigment (called melanism) in the typically light-coloured moth. They used a technique called linkage mapping, following groups of genes inherited together and comparing black moth specimens over time (1925 to 2009). They also compared linkage groups between the peppered/black moth and other moth species. In this way, the carbonaria phenotype was mapped as only one core sequence variant in a 200-kilobase region (orthologous to a segment of silkworm chromosome 17 where DNA sequence is known). They showed also that the carbonaria region coincides with major wing-patterning loci in other lepidopteran systems, suggesting the existence of basal color-patterning regulators in this region. Now this region regulating colour is known, further research will identify new pigment-controlling pathways common to moths and butterflies.

Reference

van't Hof AE, Edmonds N, Dalíková M, Marec F, Saccheri IJ (2011). Industrial melanism in British peppered moths has a singular and recent mutational origin. *Science 332: 958-60.*

Monitoring junk in space

Gwyneth Dickey Zakaib reports in Nature in April 2011 on a new 110 million dollar telescope (the Space Surveillance Telescope, SST) developed by US military (US Defense Advanced Research Projects Agency, DARPA) which will scan the sky several times per night to protect satellites from collisions with debris and with each other. Collisions are dangerous. Even a centimetre-sized piece of debris can cause considerable damage to crucial weather, communication or missile warning systems. Currently, an estimated 22,000 artificial objects are orbiting Earth, from small bits of debris to large satellites, and that number of orbiting objects is expected to triple in the next 20 years. The US air force currently keeps a record of all known orbiting objects with ground- and space-based telescopes and radar but the increasing number of objects requires more advanced surveillance. The SST started its work this year in February and the results are still being assessed. If successful, the US intends to build more of these wide-field, ultra-sensitive telescopes and locate them at strategic places around the planet for 360-degree surveillance.

Cooperative behaviour - elephants lend a helping trunk.

A study of how animals work together leads to a deeper understanding of the evolution of co-operative behaviour. Plotnik et al (Yerkes National Primate Research Center and Department of Psychology, Emory University, Atlanta, USA) extended tests applied earlier to primates – chimpanzees and bonobos - to elephants. Elephants are only distantly related to humans but are considered to be among the most cognitively advanced animals. However, there was little evidence of this until now due to the danger and difficulty in conducting behavioural experiments on such a large animal. In these tests, two animals are required to co-operate in a

shared goal and to understand the partner's role in the co-operation. The task requires the two individuals to simultaneously pull the two ends of the same rope to release food from a platform. Pulling one end alone will not work.

Plotnik and colleagues showed not only could the elephants co-operate in these tasks, but they also inhibited the pulling response on the rope if they were alone. and they waited if the arrival of the second partner elephant was delayed. Indeed, elephants learnt to wait for the partner elephant in a manner comparable to chimpanzees. The results are interpreted as demonstrating that the elephants understand co-operation in a manner similar to chimpanzees, and that the process of co-operation has evolved separately and independently from the co-operative behaviour developed in chimpanzees. The Asian elephants used for these experiments live in a conservation centre and have been trained to perform for visitors, i.e. they are accustomed to being trained. Future tests to determine how readily the elephants can learn to wait for a non-social cue, such as a green light, are needed to distinguish between what the authors refer to as "a well-developed propensity toward partner-oriented, deliberate cooperation" and a more general propensity to learn quickly.

Reference

Plotnik JM, Lair R, Suphachoksahakun W, de Waal FB (2011). Elephants know when they need a helping trunk in a cooperative task. *Proc Natl Acad Sci USA 108:5116-21.*

A happiness gene

The levels of serotonin in the body are correlated with the sense of well being and happiness as measured by life satisfaction. However, a gene concerned with transporting serotonin in the brain (the 5-hydroxytryptamine transporter gene, 5-HTTLPR) has been found to have two different variants amongst humans – the short and long form. Individuals with the longer form have a happier outlook on life. In a study of a representative sample of 2574 Americans in their 20s, behavioural economist Jan-Emmanuel De Neve (London School of Economics) has demonstrated that individuals with the transcriptionally more efficient version of the serotonin transporter gene (the long form) report significantly higher levels of life satisfaction. The volunteers were surveyed for their happiness levels and their DNA tested for which 5-HTT gene they carried. Sixty-nine percent of individuals who had inherited two copies of the long version of the 5-HTT gene stated they were satisfied or very satisfied with their lives, compared to only 38 percent who had instead inherited two copies of the short version of gene. However, it is important to note that many other genes and, indeed, our life experience, account for most of the variation in human happiness.

References

De Neve JE (2011). Functional polymorphism (5-HTTLPR) in the serotonin transporter gene is associated with subjective well-being: evidence from a US nationally representative sample. *J Hum Genet 56: 456-9.*

Lux Fatimatha (2011). Happy disposition? New study claims it could be in your genes. *BioNews 606: 09/05/2011.*

The Anthropocene – the human epoch

Does human impact on the planet deserve to be officially recognized? Are we living in a new geological epoch — the Anthropocene? An epoch typically lasts tens of millions of years and our current epoch, the Holocene, began only 11,700 years ago. Is it too soon for a new epoch? Although the term, Anthropocene, has long been used informally to refer to the current, human-dominated phase of Earth's history, a working group of the International Commission on Stratigraphy, the body that defines the divisions of geological time, is studying the case for making it official. As an addition to the earth's time scale, the Anthropocene would be unusual – there are no planetary upheavals, no major rock changes, no major volcanic impact, nor extraterrestrial bombardment. It is more an era of prediction of changes to come.

There is no doubt that humans and their use of the land have changed the terrestrial biosphere forever. Through food production and urbanization, humans have altered more than half of the planet's ice-free land mass. A paper from E C Ellis (Department of Geography and Environmental Systems, University of Maryland, Baltimore, USA) presents an analysis across our geological epoch, the Holocene, of the extent to which human populations have altered the terrestrial biosphere. Although this has been significant for more than 8000 years, it is only in the past century that the geological record has become irreversibly altered so as to differ substantially from that of the Holocene or any prior epoch. Deforestation, mining, road building, sedimentation in rivers and oceans, fossil-fuel releasing carbon into the atmosphere, acidification of the oceans, and extinctions and dwindling biodiversity. Although geologically unusual, the official recognition for the Anthropocene would focus minds on the challenges to come and would provide a powerful framework for considering global change and possible interventions.

References

Ellis EC. (2011). Anthropogenic transformation of the terrestrial biosphere. *Phil. Trans. R. Soc. 369: 1010-35.*

Nicola Jones (2011) Human influence comes of age. *Nature 473: 133*

Healing holes in ozone layer

22 years after the Montreal Protocol to ban anthropogenic chlorofluorocarbons (CFCs) and related ozone-destroying chemicals, there are promising signs of a decrease in the hole in the ozone layer over the Antarctic. Researchers in Australia, Murray Salby and colleagues (Macquarie University, Sydney, Australia) have shown that average springtime Antarctic ozone levels have recovered by 15 per cent since the late 1990s. Previously it has been difficult to assess the size of the hole due to dramatic natural fluctuations in stratospheric ozone levels from year to year. However, the researchers were able to account for the natural fluctuations and measure an overall trend in recovery. To add to the evidence, the increase in ozone levels revealed by the calculations closely mirror the decrease in the levels of anthropogenic chlorine in the region.

The effect of recovery of the hole in the ozone layer on Antarctic climate is under debate. There may be knock-on effects. Ozone absorbs sunlight so more ozone means that the stratosphere heats more causing a change in circulation patterns around the Antarctic. In the more immediate term, the strong correlation between winter weather patterns and springtime ozone levels means that the ozone hole can now be used to forecast levels of ultraviolet light over major population centres during the summer months.

Reference

Salby, M., Titova, E. & Deschamps, L. (2011). Rebound of Antarctic ozone *Geophys. Res. Lett.38: L09702.*

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