

In addition to his physics Bohm was also exploring other avenues such as language. Bohm felt that our subject-verb-object languages acted as a barrier in thought to a deeper understanding of the quantum world and so developed a verb-rich language he called the Rheomode. He also became concerned with what he saw as the fragmentation within knowledge and society and called for an approach of wholeness. He became interested in the connections, or rather the wholeness, of mind and matter. He also wondered that just as we have proprioception of our body (the ability to know where one's arm is in space without looking at it) would it be possible to develop a proprioception for thought.

Bohm had also developed an interest in a form of dialogue. In this around forty people meet in a leaderless group to discuss whatever comes up. After many such meetings a deep level of trust develops and the dialogue moves to a new level. Bohm believed that within such a dialogue people would come to experience how their ideas and beliefs are structured not only in the mind but as symptoms and sensations in the body. He also felt that dialogue could clear up what he felt was the "pollution" in our language. During this same period Bohm was working actively with his colleague, Basil Hiley using non-commuting algebras to investigate such notions as pre-space.

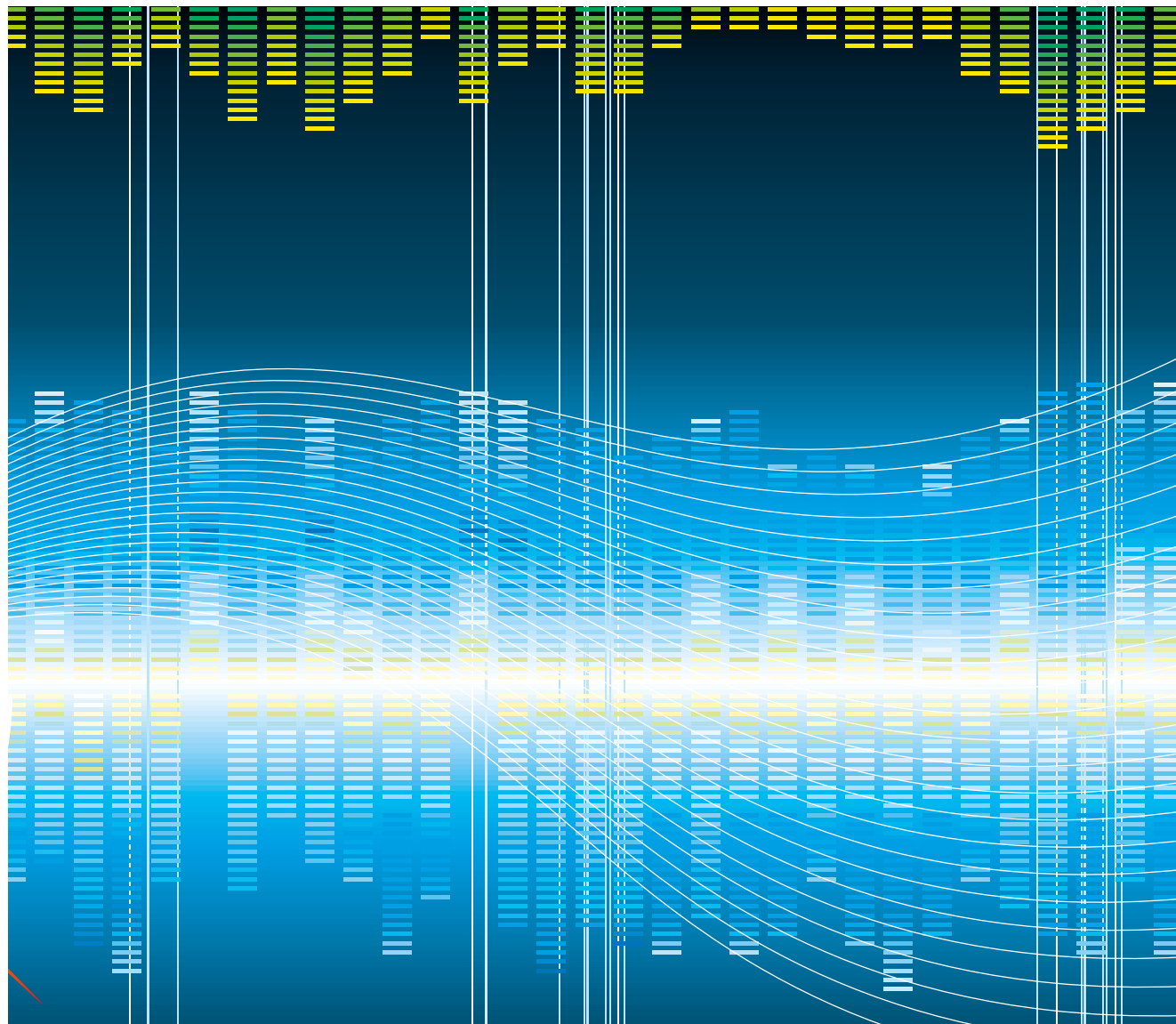
The documentary will also deal with the depression that dogged Bohm in the last years of his life and the ill health caused by his heart problems.

Crowdsourcing

Crowdsourcing is an approach to funding that does not rely on one or two people giving large sums of money but rather upon a large number of people giving small sums, some as low as £10 or £20. It depends upon getting a message out using various social media and our website www.thebohmdocumentary.org. We will commence our funding program early in the New Year. For those of you who read this article please pass on the message and the web address. We are depending on your interest and generosity to complete this film.



David Bohm,
F. David Pleat
and his wife Saral



Recent Developments in Science and Medicine

Marilyn Monk

Bacterial infection of mosquitoes blocks transmission of dengue and malaria parasites

The dengue and malaria parasites are transmitted among humans by mosquitoes. Recently, it has been shown that if the mosquitoes are themselves infected with a parasite - in this case a bacterium, *Wolbachia* - then transmission of dengue and malarial parasites to humans is blocked. Infection with the *Wolbachia* bacterium is maternally transmitted in the mosquito population. The question is whether the bacterial infection is maintained in the mosquito population so that the control of dengue fever and malaria continues. The challenge is to find the right strain of bacteria to block transmission by the mosquito, and the right mosquito that will pass the bacterial infection to her daughters.

Hoffmann, O'Neil and colleagues (Department of Genetics, University of Melbourne) introduced *Wolbachia* into the dengue mosquito vector, *Aedes aegypti*, in Australia. The infected mosquitoes survived and transmitted the infection in the wild, thus demonstrating that *Wolbachia* infection could be a practical approach to dengue suppression over extensive areas.

Similarly, *Wolbachia* infection of the anopheline mosquito, *Anopheles stephensi*, blocks transmission of the malarial parasite, *Plasmodium falciparum*. Bian, Xi and colleagues (Michigan State University, USA) show that female mosquitoes infected with *Wolbachia* bacteria and bred with uninfected mates pass the infection on to their offspring, swiftly spreading the malaria-blocking bacterium to entire insect populations in the laboratory within eight generations.

The strategy of *Wolbachia* infection of the transmitting mosquito could thus eventually control dengue and malaria. Field trials will be the next step.

Reference

Hoffmann AA, Montgomery BL, Popovici J, Iturbe-Ormaetxe I, Johnson PH, Muzzi F, Greenfield M, Durkan M, Leong YS, Dong Y, Cook H, Axford J, Callahan AG, Kenny N, Omodei C, McGraw EA, Ryan PA, Ritchie SA, Turelli M and O'Neill SL.

Successful establishment of *Wolbachia* in *Aedes* populations to suppress dengue transmission.

Nature 476: 454-457 (2013)

Bian G, Joshi D, Dong Y, Lu P, Zhou G, Pan X, Xu Y, Dimopoulos G and Xi Z.

Wolbachia invades *Anopheles stephensi* populations and induces refractoriness to *Plasmodium* infection.

Science 340: 748-751 (2013)

Gut microbes and obesity

The importance of the billions of microbes in our gut, and the balance of the different microbial populations, is becoming increasingly evident for many of our bodily functions. In a recent paper, Everard, Cani and colleagues (Metabolism and Nutrition Research Group, Université Catholique de Louvain, Brussels, Belgium) have reported that the presence of one bacterial population - a mucin-degrading bacterium, *Akkermansia muciniphila*, residing in the mucus layer of the intestine - is inversely correlated with body weight both in rodents and humans. The intestines of obese humans

and mice, and those with type 2 diabetes, have much lower levels of this bacterium. In addition, mice that were fed a high-fat diet, had 100 times less *A. muciniphila* in their guts than mice fed normal diets. Conversely, feeding obese or diabetic mice with the *Akkermansia* bacteria resulted in an improved metabolic profile associated with the increased abundance of the bacterium in the gut. High-fat diet-induced metabolic disorders were reversed and the intestinal level of endocannabinoids increased (thus providing greater control of blood-glucose levels and inflammation, and defence against harmful microbes in the gut). As a control, the researchers showed that treatment with heat-killed *A. muciniphila* cells did not improve the metabolic profile or mucus layer thickness, so live bacteria were required. These studies may open the way towards the development of a treatment that uses this human mucus bacterium for the prevention or treatment of obesity and its associated metabolic disorders such as diabetes and colitis.

Reference

Everard A, Belzer C, Geurts L, Ouwerkerk JP, Druart C, Bindels LB, Guot Y, Derrien M, Muccioli GG, Delzenne NM, de Vos WM and Cani PD.

Cross-talk between *Akkermansia muciniphila* and intestinal epithelium controls diet-induced obesity.

Proc. Natl. Acad. Sci. USA 110: 9066-9071 (2013)

Foreign ladybird invades armed with biological weapon

The Asian harlequin ladybird, *Harmonia axyridis*, is threatening the life of indigenous ladybirds in many countries. Originally this foreign ladybird was brought to Europe and North America to control aphids. Now it is a serious pest outcompeting native ladybird species and even eating them! One reason foreign species represent a threat to local species is that they carry new diseases. Vilcinskis, Vogel and colleagues (Institute of Phytopathology and Applied Zoology, Justus-Liebig-University of Giessen, Germany) have shown that the foreign ladybird, *Harmonia*, carries a single-cell parasite, microsporidia, that causes it no harm but is deadly to the indigenous native seven-spot ladybird, *Coccinella septempunctata*. The microsporidian parasite, easily observed under the microscope, is present in the eggs and larvae of harlequin ladybirds in a dormant and apparently harmless state. But when injected into seven-spot beetles in the lab they die within two weeks. Parasites brought in by foreign species may also be involved in the disturbing decline of our bees. The dangers of foreign invaders bringing new diseases to indigenous populations have long been known. It brings to mind the introduction of new diseases, such as small pox, causing devastation to local populations following the European invasion of the New World.

Reference

Vilcinskis A, Stoecker K, Schmidtberg H, Röhrich, CR and Vogel, H.

Invasive harlequin ladybird carries biological weapons against native competitors.

Science 340: 862-863 (2013)

Special nerves for itchiness identified

It has previously been thought that itch is a lesser stimulation of the same nerves which register pain. However, Mjshra and Hoon (Laboratory of Sensory Biology, National Institute of Dental and Craniofacial Research, NIH, Bethesda, USA) have recently found that a subset of special neurons expressing a specific protein are responsible for the transmission of the itch sensation from extremities to the brain. They screened for genes in sensory neurons that are activated by touch, heat, pain and itch. They found that one particular protein, called natriuretic polypeptide b, or Nppb, was expressed in only a subset of sensory neurons. Mutant mice lacking Nppb expression do not respond to itch-inducing agents but still respond to heat and pain. In addition, injection of the protein Nppb into either normal or the mutant mouse triggered frantic scratching. Neurons in the spinal cord bear receptors for the Nppb protein and blocking these receptors blocked the itch sensation but not heat and pain. Thus information about the itch sensation is transmitted along a distinct pathway. Hoon and Mishra, and others, also showed that another molecule previously implicated in the itch response, gastrin-releasing peptide, or GRP, could not be found outside the spinal cord. However, GRP is still involved in the itch response as it produces strong scratching responses when injected into mice lacking Nppb or its receptor. These results place GRP-releasing neurons downstream of Nppb in the transmission of the itch sensation. The neural pathways for itch in humans are similar, though not identical, to those in mice. The identification of a distinct neural circuit distinguishing itch from pain may lead to solutions to the common problem of itch associated with many conditions, including eczema and psoriasis.

Reference

Mishra SK and Hoon MA.

The cells and circuitry for itch responses in mice.

Science 340: 968-971 (2013)

After 36 years the Voyager 1 spacecraft has reached interstellar space

To read about the travels of Voyager 1 and 2 is truly inspiring. These great spacecraft explorers were launched in 1977 - their mission to go beyond our solar system into interstellar space with pioneering explorations of Jupiter, Saturn, Uranus and Neptune *en route*. These extraordinary space probes are under the management of Ed Stone who, for 36 years now, has led the team of scientists guiding the spacecraft through the solar system and deciphering the information they return to earth. The story is covered in detail by Alexandra White in *Nature* in May 2013 and there is also a lot of information accessible on the internet.

The two rockets were launched a few weeks apart – Voyager 2 on 20th August 1977 and Voyager 1 on 5th September 1977. They had different routes to follow and different tasks to perform. They both passed Jupiter in 1979, not the first spacecraft to do so but these spacecraft carried more sophisticated equipment. Thus they discovered plasma surrounding Jupiter's magnetosphere at hundreds of millions of degrees Celsius, sulphur volcanoes belching



from Jupiter's moon Io, and fractures in the icy surface of Jupiter's moon Europa (a possible clue to a subsurface ocean that could harbour extra-terrestrial life?). After Jupiter, Voyager 2 passed within 34 million miles of Saturn in 1981 photographing its moons, Rhea and Dione, discovering new 'shepherd' moons that herd the ice and dust in Saturn's outermost ring, and gigantic auroras around the planet's northern and southern poles.

After Saturn, Voyager 1 and Voyager 2 diverged. Voyager 1 headed towards the edge of the universe, the boundary with interstellar space, while Voyager 2 was directed past the other planets, Uranus and Neptune. In 1986, Voyager 2 discovered ten new moons for Uranus (photographing the innermost major moon, Miranda), and an odd magnetic field oriented far away from the planet's rotation axis. Continuing on to Neptune, Voyager 2 provided a composite image in 1989 showing the Great Dark Spot and other giant features in Neptune's atmosphere including violent atmospheric activity with winds of 2,100 kilometres per hour and huge storms.

Recently, Voyager 1 passed beyond the edge of our solar system. It is now generally agreed that it is in the space between the stars. Galactic cosmic rays, normally too weak to penetrate the heliosphere and enter the Solar System, have now been detected by Voyager 1. At the same time scientists have detected a change in orientation of the magnetic field under the influence of nearby stars. Interpretation of new data is complicated as the spacecraft enters a realm completely unknown to science.

Eventually, time will run out for these extraordinary spacecrafts. Both are powered by radioactive decay and on-board generators and their power is becoming depleted. By 2020, mission managers will start switching off scientific instruments, one by one. And by 2025, all the plutonium power will be gone, and the Voyagers' mission will be over.

In the meantime more surprises are expected.

Reference

Witze A.

Voyager: Outward bound.

Nature 497: 424-427 (2013)

Designing leaves and flowers

Have you ever wondered how leaves and flowers know when and how to depart from the main stem as a plant grows and develops, and how they receive instructions to develop leaves and blossoms in their different and beautiful designs? It is thought that an underlying programme determines the different functions and shapes of all the plant organs but it is not known how the programme is modulated to create these differences. In order to shed light on this question, Sauret-Gueto, Coen and colleagues (Department of Cell and Developmental Biology, Norwich Research Park, Norwich, UK) have investigated petal growth and shape in *Arabidopsis thaliana* (a small flowering plant native to Europe and Asia and a popular model organism in plant biology and genetics). They label some of the cells in the growing petals, at various stages of development, with a dye called GFP (green fluorescent protein) and then follow the distribution of the label in the petal cells arising from these original labeled cells (clones) as the plant grows and the flower takes on its shape. The patterns they observe show that petals elongate in a polarity field and increasingly spread outward towards the distal end of the petal. They identify a role for a gene, called JAGGED, which promotes growth rate to spread the distal end of the petal by an interaction with auxin function. Previous studies of leaf development have shown a similar 'polarity field' along the leaf providing directionality in leaf development with specific growth rates parallel and perpendicular to this field giving rise to the leaf shape. By comparing their results with petals to those on leaf development, the authors show that plant organs share an underlying developmental framework

that has evolved under different selective pressures to form unique structures. Simple modifications of this underlying developmental system thus generate distinct forms in leaves and petals.

Reference

Sauret-Güeto S, Schiessl K, Bangham A, Sablowski R and Coen E.

JAGGED controls *Arabidopsis* petal growth and shape by interacting with a divergent polarity field.

PLoS Biol 11: e1001550 Apr 30 (2013)

Pesticides threaten biodiversity

It is vitally important to know more about the effects on biodiversity of different agricultural pesticides and the range of concentrations which cause harm to different species of plants and animals. Beketov, Liess and colleagues (Department of System Ecotoxicology, Helmholtz Centre for Environmental Research-UFZ, Leipzig, Germany) analysed the effects of pesticides on stream invertebrates in Germany and France and in Victoria, Australia. The range of research areas was wide - 23 streams in the central plains of Germany, 16 in the western plains of France and 24 in southern Victoria, Australia. Streams were divided into three different levels of pesticide contamination - uncontaminated, slightly contaminated and highly contaminated. The research shows severe losses (up to 42 per cent) of species in highly contaminated streams, for example mayflies and dragonflies, at pesticide concentrations considered to protect the environment. It is not clear, however, whether the results represent loss of diversity on a global scale as the streams reported might be the most highly contaminated.

Another recent report concerns the effect of pesticides on our bees. Dave Goulson (University of Sussex, UK) is concerned with the environmental risk of accumulation in the soil of neonicotinoid insecticides killing soil invertebrates such as *Eisenia foetida*, a type of earthworm. Recently the European Commission has imposed a two-year ban on three commonly used neonicotinoids over concerns that they are killing bees. The chemical remains in the soil for several years and accumulates with repeated yearly use on crops such as maize and soya beans. Earlier studies also suggest that grain-eating birds such as partridges may die after eating seeds treated with neonicotinoids so there is more at risk here than our honey bees.

Reference

Beketov MA, Kefford BJ, Schäfer RB and Liess M.

Pesticides reduce regional biodiversity of stream invertebrates.

Proc Natl Acad Sci USA 110: 11039-11043 (2013)

Goulson DJ.

An overview of the environmental risks posed by neonicotinoid insecticides

J Appl. Ecol. doi: 10.1111/1365-2664.12111 (2013)

Predicting best treatment for depression - CBT or SSRI

Treatment of depression is a disheartening process. Less than 40 per cent of patients respond to treatment without recurrence. McGrath, Mayberg and co-workers (Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, USA) use neuroimaging (positive emission tomography, PET) to investigate metabolism in different regions of patients' brains in search of a biomarker that might predict which treatment for depression would have the better outcome, cognitive behavioural therapy (CBT) or drug treatment with escitalopram oxalate (a serotonin uptake inhibitor, SSRI).

Brain glucose metabolism was measured prior to CBT or SSRI treatment randomisation. Of 38 patients (men and women 18 to 60 years). 12 responded well to cognitive

behavior therapy and 11 to escitalopram. There were 9 non-responders to cognitive behavior therapy and 6 non-responders to escitalopram. The neuroimaging identified involvement of the right anterior insula in discriminating the different responses to mode of treatment. Insula hypometabolism (relative to whole-brain mean) was associated with a good response to cognitive behavior therapy and poor response to escitalopram, while insula hypermetabolism was associated with a good response to escitalopram and poor response to cognitive behavior therapy. This study provides the first objective marker to guide initial treatment selection for depression – a positron emission tomography scan could predict whether a patient with depression will be more likely to respond to drugs or to cognitive behavioural therapy.

Reference

McGrath CL, Kelley ME, Holtzheimer PE, Dunlop BW, Craighead WE, Franco AR, Craddock RC and Mayberg HS.

Toward a neuroimaging treatment selection biomarker for major depressive disorder.

JAMA Psychiatry 70: 821-829 (2013)

Alcoholic relapse prevented by blocking memories of drinking

Relapse to alcoholic drinking is often stimulated by pleasant memories associated with drinking in the past. These learned associations can be very difficult to overcome. If these associated memories could be blocked at the time of their inception, relapse might be prevented. It is known that memories can be erased soon after they are recalled by a process dependent on protein synthesis, specifically, in the case of post-traumatic stress and drug addiction, the mTORC1 (mammalian target of rapamycin complex 1) protein pathway. Barak, Ron and colleagues (Department of Neurology, University of California San Francisco, USA) used a rat model to demonstrate the involvement of mTORC1 in alcoholic relapse and moreover prevented relapse by blocking this protein pathway. Rats offered the choice of 20 per cent alcohol or water chose to drink alcoholically. After seven weeks, alcohol was removed, and after another 10 days the rats were given a small alcohol taster as a reminder. The memories triggered by the smell and taste of alcohol involved activation of mTORC1 in amygdalar and cortical regions of the rat brain. If at the same time the reminder was given, the rats were treated with rapamycin (the inhibitor of mTORC1) they did not resume alcoholic drinking and sustained a long-lasting suppression of relapse. This work raises the possibility that rapamycin or a related compound may be developed into an effective treatment for alcohol abuse.

Reference

Barak S, Liu F, Ben Hamida S, Yowell QV, Neasta J, Kharazia V, Janak PH and Ron D.

Disruption of alcohol-related memories by mTORC1 inhibition prevents relapse.

Nat Neurosci 16:1111-1117 (2013)

Modelling the coastline to resist climate change

Various aspects of the natural coast line protect people and property from the hazards of climate change such as extreme weather (storms and hurricanes), sea level rise and flooding, and damaged ecosystems. Coastal forests, intact coral reefs, sand dunes, wetlands and marshes are all natural protective barriers. Arkema, Silver and colleagues (The Natural Capital Project, Stanford University, California, USA) used five sea-level-rise scenarios to calculate a hazard index for every km of the United States coastline. They identify the most vulnerable regions where conservation

and restoration of reefs, wetlands and vegetation, and building of sand dunes, have the greatest potential to protect coastal communities against climate change damage. Coastal defense planning is already underway in several areas such as New York and Louisiana, recently hit by hurricanes. Conservation-based protection strategies may be added where practical to engineered barriers in the future. Nature Conservancy scientists are already using the models underlying this study to rebuild oyster reefs off the coast of Alabama - a project that has trapped sediment and dissipated wave energy that normally would have eroded the shore.

Reference

Arkema KK, Guannel G, Verutes G, Wood SA, Guerry A, Ruckelshaus M, Kareiva P, Lacayo M and Silver JM.

Coastal habitats shield people and property from sea-level rise and stormJournal name:.

Nature Climate Change 3: 913–918Year published: (2013)

Blood markers predict suicide risk

Suicide claims the lives of over a million people per year and is a leading cause of death amongst psychiatric patients. However, suicide may be preventable if risk could be determined and acted upon. Le-Niculescu and colleagues (Department of Psychiatry, Indiana University School of Medicine and Indianapolis Medical Center, USA) have identified differential gene expression in blood samples from patients with bipolar disorder and compared samples of those with thoughts of suicide with those who had exhibited no such thoughts. In this way, they were able to identify a number of markers that potentially predict whether suicide is a risk in individual patients. (Note that the psychological assessment did not directly ask about suicidal thoughts which some individuals may deny or choose not to share.) The molecular approach used to identify differentially expressed genes, Convergent Functional Genomics (CFG), integrates multiple independent lines of evidence to reduce false-positive and false-negative results. Specific gene expression levels of candidate blood biomarkers identified in bipolar patients were examined in the bloods of actual suicide victims available from coroner investigations. In this way, the researchers found that 6 out of the 41 most correlated expressed genes associated with suicide ideation showed a significant difference. The most significant biomarker, identified as spermidine/spermine N1-acetyltransferase 1 (SAT1), also correlated with the number of hospitalisations of bipolar subjects. A similar, though weaker, pattern was observed in psychosis (schizophrenia/schizoaffective disorder) patients. In addition to SAT1, three other biomarkers (PTEN, MARCKS and MAP3K3) were identified that showed similar but weaker correlations with suicide risk. This approach, using two simple measures for anxiety and mood, and SAT1 blood expression levels, will help to predict future hospitalisations and suicide risk.

Reference

Le-Niculescu H, Levey DF, Ayalew M, Palmer L, Gavrín LM, Jain N, Winiger E, Bhosrekar S, Shankar G, Radel M, Bellanger E, Duckworth H, Olesek K, Vergo J, Schweitzer R, Yard M, Ballew A, Shekhar A, Sandusky GE, Schork NJ, Kurian SM, Salomon DR and Niculescu AB.

Discovery and validation of blood biomarkers for suicidality.

Mol Psychiatry Aug 20. doi: 10.1038/mp.2013.95. [Epub ahead of print] (2013)

Sinking land due to fish farming causes rising sea levels

We are used to being concerned about the effect of rising ocean level, as well as warming and increasing acidification, on fish populations. Now we are being alerted to the need to be

concerned about the effects of fish farming on ocean levels. Higgins, Syvitski and colleagues (Department of Geological Sciences, University of Colorado, Boulder, Colorado, USA) have used satellite-radar surveillance of the Yellow River delta in China to chart the land subsidence caused by extensive aquaculture over a period from 2007 to 2011. The data show subsidence rates in the area of the fish farms as high as 25 cm per year, probably due to ground water pumping. This sinking of the land mass is equivalent to 100 times the rate of global average sea level rise (around 3 millimetres a year) caused by warming water and melting ice. Similar sinking of land mass due to groundwater pumping has been seen in Bangkok. Deltas can also sink when new sedimentation is prevented by dams or diversion of water for irrigation. The Yellow River shoreline has receded by 7 kilometres over the last two decades. Sea walls have been built to stop this erosion but until now little attention has been paid to the vertical subsidence occurring due to aquaculture. Asia produces 89 per cent of the world's farmed fish and shrimp. It is vitally important to be aware of the impact that this kind of aquaculture can have on local sea-level rise.

Reference

Higgins S, Overeem I, Tanaka A and Syvitski JPM.

Land subsidence at aquaculture facilities in the Yellow River delta, China.

Geophys Res Lett 40: 3898–3902 (2013)

The earth's habitable lifetime

For a planet to support life, it is generally agreed that we need water and a temperature not too hot nor too cold. These conditions are not static in a solar system. The luminosity of a typical star increases as its composition and chemical reactions evolve over billions of years, pushing the habitable zone (HZ) for a particular planet outward. The habitable zone lifetime, defined by boundaries encompassing conditions that will support life, may include or exclude planets during the lifetime of the star. The other important consideration is the length of time required for the evolution of complex life within the habitable zone time period. Rushby, Watson and colleagues (School of Environmental Sciences, University of East Anglia, Norwich, UK) estimate the evolution of the habitable zone lifetime of our earth to be between 6.3 and 7.8 billion years and our earth is now about 70 per cent through this time period and will continue to be habitable for about another 2 billion years. The authors used their approach to also determine the habitable zone lifetimes of 7 confirmed HZ exoplanets (extrasolar planet, or a planet outside the Solar System) and 27 unconfirmed Kepler candidates (Kepler is a space observatory launched by NASA to discover Earth-like planets orbiting other stars). This work identifies planets outside our Solar System with long 'habitable periods' – i.e., the best places to look for life. Climate dynamics such as atmospheric composition and volume will also be important. Interestingly, just as our sun brightens and the Earth becomes too hot for life, Mars will be entering the habitable zone in our solar system.

Reference

Rushby AJ, Claire MW, Osborn H and Watson AJ.

Habitable Zone Lifetimes of Exoplanets around Main Sequence Stars.

Astrobiology 13: 833-849 (2013)

Marilyn Monk is UCL Emeritus Professor of Molecular Embryology at the Institute of Child Health, University College London, and Honorary Professor at Melbourne and Monash Universities, researching gene expression and its regulation in development and cancer. She is also an Alexander Technique Teacher and Psychosynthesis Counsellor.



Expansive Nature Experiences and the Mystical: A Personal View

Matthew Colborn

The author describes his own personal experiences with nature, dubbed Expansive Nature Experiences (ENE) and discusses their affinities with Extrovertive Mystical Experiences. It is suggested that ENEs are a more common, dilute version of a full-blown mystical experience. Explanations are surveyed, from the transpersonal to the neurobiological. Then the health and ecological benefits of inducing ENEs are examined, and related to recent findings concerning Attention Restoration Theory and exposure to the natural world. The author concludes by suggesting that these experiences suggest an animistic reading of nature, and remains agnostic about whether they point to a transcendental reality.

It's early August, and I'm standing on the sea shore, looking over the North Sea. A cormorant glides parallel to the deep, blue water, the sun shines overhead and the sky is blue. I've taken off my shoes and socks, and am wading in the cool water. At my feet, in the shallows, little fragments of red and green seaweed float, hugging the tide-line. The water's pretty clear and between waves, I can see the sandy bottom. A flock of sanderling follows the surf, scurrying away whenever there's a wave, and at one point, a small flatfish, probably a dab, zooms away, heading for deeper water. I turn and stare far out to sea, and that's when it happens.

Something deep within relaxes, and my consciousness seems to expand towards the horizon. Everything holds fascination, from the gulls bobbing over the sea to the sand clouding underwater at my feet. Worries recede, and I feel a deep and increasing sense of unity with the seascape before me. My surroundings feel alive, and shot through with mood and purpose, but it's the sea that dominates. Its might is palpable, even though it's wearing a benevolent face. And at the periphery of consciousness, still held at bay by errant thoughts, hovers a greater feeling of sheer awe.

The Expansive Nature Experience

I've experienced this state of consciousness repeatedly within a natural setting, or even when contemplating living things in captivity. It's happened in the woods near my home, amongst deserts and mountains, at an aquarium, or when contemplating the sky at night. Over the years, I've found that these very personal experiences have a range of features, which include;

- A sense of expansiveness.
- A slackening of the barrier between self and the world.
- Deep relaxation.
- Deep absorption or interest or even a sense of intoxication with the natural world.
- A strong sense of mood within the landscape.
- A sense of purposiveness within nature.
- A sense of the truth of a strongly animistic as opposed to a mechanistic interpretation of the Cosmos.

Related experiences have long been reported by many different people from very different cultures and in widely separated times and places, and labelled in various ways. My own personal label is Expansive Nature Experience (ENE), which captures a sense of the main features. ENEs overlap with a family of Exceptional Human Experiences that have been noted by various researchers, including Maslow's Peak Experiences, meditative and other absorptive states and even Edward O. Wilson's 'biophilia.' In this article, I'd like to focus on their relation to what have been dubbed *Extrovertive Mystical Experiences*.

ENEs can be seen as a dilute version of full-blown mystical experiences, which Paul Marshall acknowledges share much with everyday experience. He characterizes Extrovertive Mystical Experiences as combining 'a sense of unity, deepened knowledge, sense of reality, altered time-experience, light, bliss and love.'¹ Shared features include an elevated consciousness of the cosmos, indescribable feelings of joyousness, a unifying vision or sense of the unity of the universe and, especially important for me, a strong sense of beauty.² So if Extrovertive Mystical Experiences differ in degree and not in kind from the ENE, it seems appropriate, in my view, to consider whether they share a common source.

Explanations

There have been a range of explanations offered for Extrovertive Mystical Experiences, some of which are naturalistic, and tend to look at brain-processes, others of which have emphasised their transpersonal nature. Bucke, for example, posited a cosmic consciousness, Inge and Underhill spoke of the presence of God in creation, whereas Otto posited an innate knowledge of a spiritual reality in the world.³ More recently, Stephan Harding has interpreted mystical feelings in nature in terms of 'encounters with Gaia.'⁴ Sir Alister Hardy suggested that the 'transcendental element...is fundamental: the feeling that there is a spiritual reality that appears to be beyond the conscious self with which the individual can have communion in one way or another....'⁵

More recent explanations have tended to focus on the brain. Researchers like Michael Persinger have attempted to explain these sorts of feelings as directly related to Temporal Lobe Epilepsy, and have even claimed to generate them in the lab.⁶ D'Aquili and Newberg, meanwhile, carried out SPECT/