

W(h)ither science?

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One letter can make one hell of a difference: Substitute A for T or C for G, and you change the coding of DNA, the structure of the resulting protein, and a person's life: GAG to GTG is all it takes to transform a healthy individual into a sufferer of sickle cell disease.

Add an h to a word in a punning title and we question whether science can save us or if it will simply shrivel as global environmental change diverts its funding into shoring up Western civilisation against the onslaught of a rapidly transforming world.

As a child of the sixties, and as a professional scientist, I have been brought up to believe that Science Will Save Us, will provide solutions to the problems created by technological leaps and human avarice. Science gave us the green revolution in agriculture, genetically modified organisms, solar power generation. It will give us carbon neutral technology, 'sustainable' urban environments, an internet with a direct mind interface:

*Perhaps it will.
Perhaps it won't.
I don't know;
You don't know;*

*She, he and it does not know.
Scientific knowledge is not predictable.
But the scientific process may help us to recognise and comprehend
What and where we are.*

This is the best of times and the worst of times to be a scientist. Unprecedented levels of funding are being pumped into the global science budget, allowing us to see further and deeper and closer, bringing a level of respect that elevates scientists to a quasi-priesthood. This has spawned a public interest in science that regularly finds scientific news stories at the top of the BBC News website's list of 'most popular stories now.'

But in a strange, twisted paradox, science and scientists are also among the least trusted individuals in society, whilst science itself (the process by which we obtain 'factual' knowledge about the universe and our place in it) is hopelessly misunderstood by the media and politicians. It only takes a raft of hacked and de-contextualised emails to float the reputations of scientists, and science itself, down shit creek with no method of propulsion:

Boredom is a big part of what drives human creativity, by which I mean the full spread of creativity, from the fine arts, through written forms and music, to the sciences:— it's all part of the same drive to prevent our brains from becoming mired in that choking ennui that tastes like stale tea and soggy biscuits.

Boredom is the neuronal curse of a cognitive, self-aware consciousness. It is the reason we invent our stories of gods and heroes.

*Boredom is a tax we pay for being human.
Boredom has driven understanding.*

Science cannot save us. But it can allow us to understand where we are in relation to the rest of the universe and to appreciate that we are part of the natural world, not separate from nature. And perhaps that will save us, perhaps that is science's lasting contribution to the future of our species. My personal science studies interacting assemblages of co-dependent species, trying to comprehend the processes that maintain these interactions, how they have evolved and what the implications are if they disappear, for both the ecosystems they are part of and for *Homo sapiens*.

We are only just beginning to understand how we are wholly dependent upon the 'ecosystem services' provided by pollinators, decomposing fungi, plants that protect against floods and tsunamis, pest-eating animals, and more, and more. An overriding message from this body of knowledge is

that ecosystems are more stable, resilient, and function better if they contain a diverse, richly connected, highly interacting set of animals, plants, fungi, bacteria and other organisms. That includes, I believe, the human ecosystem that forms a nexus within the set of ecosystems that make up the biosphere:

We are part, not separate.

We are linked, we require

All the rest of the links

To survive.

Science has traditionally been seen as responding in a linear fashion to economics: throw enough money at a problem and the problem will be solved. But we are reaching the limit of that linear response when we consider ecosystem services: a scientific asymptote beyond which we cannot purchase what we need to live. Collaborations of ecologists and economists have sought to assign a dollar value to the environmental capital upon which we depend, though these are things that cannot be bought and their value is greater than the GDP of several planets, even if we had the technology to make, or replace, all that the planet provides.

In one of my first year undergraduate lectures on biodiversity, I ask the students to imagine that they are stranded in a remote forest in Britain, lost with no map, no water and no food. It doesn't matter how they got there; could be a plane crash, or the end of civilisation. They may even have been abandoned by their evil step-parent. Doesn't matter: the point is survival. The weather has been cool and wet and there are mushrooms and toadstools in abundance, various species sprouting from every fallen log, pile of dung and grassy ride. It's a long way to anywhere and the stranded students are hungry; very hungry. Would they risk eating these fungi? What are the chances of them being poisoned and dying? My purpose is to get them to think about our engagement with the natural world, our ability to understand how dependent we are upon the environment around us and what it provides for us.

Our ancestors would have known the answer. They would have known that very few (about 1%) of fungi in the British Isles are deadly poisonous. A larger number (some 6%) will make you sick, but it's still a small proportion

compared to the number that are edible and good, which is about one fifth. The remaining 70% or so are inedible: they are slimy, woody, bitter or otherwise unpleasant; they might make you gag as you try to swallow their vile caps and stems, but they won't kill you.

This is not an exhortation to go and randomly try eating every toadstool and bracket that you see. But my students, almost without fail, tell me that they would not risk eating any of those wild fungi because they have been told that they are 'bad for us' repeatedly by parents and as part of the collective mass of stories that we tell each other about nature: that it is dangerous, poisonous, destructive. So it is, but rarely, not all of the time. So are we, also not constantly, but infrequently. Because we are a component of the natural world, and we reflect our origins, but most people do not know it. The question I ask my students is thus not just about human understanding of biodiversity, it is about the natural world and our place as part of it:

To be a part, and not apart, we need to understand.

Understanding may come from a life of trial and error, as it did for our ancestors,

Or the observational and experimental trial and error of the scientific method.

One of the myths that we tell ourselves is that we are the Earth's stewards,

Looking after a fragile and delicate planet.

This is the reverse of the fact: the Earth is OUR steward,

And it is our species that will fall if our ecosystems fail.

Science does not have all of the answers, but it does have a lot of the questions.