Revealing the big picture

When I was little, I discovered that I was good at jigsaw puzzles. I recall the satisfaction of seeing the image gradually emerge as the pieces were assembled. It's not a talent I mention on my CV. But it has turned out to be very helpful in my career

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A problem with science today is that its domain is so vast that no-one can be expert in all fields. A common quip is that the career path of a researcher is "to learn more and more about less and less until they know everything about nothing." Joking aside, the silo-ing of knowledge and expertise, and the tendency not to link the parts, is a widespread problem in the modern world, and not just in science.

The US space agency NASA addressed the matter many years ago by introducing the concept of the T-shaped professional – someone with deep expertise in a particular field, but with the breadth to engage across disciplines. Their 'Helicopter View' allows them to apply their talents to greatest effect, and to create meaningful knowledge rather than isolated facts. This broad perspective is critical for understanding complex systems, such as the Earth's climate system, which operate as an interconnected whole, and in which individual components interact in ways that produce emergent behaviours not evident when examined in isolation.

I first encountered the power of interdisciplinary thinking in the 1970s as a PhD student at UCL's Mullard Space Science Laboratory. My task was to determine the origin of the celestial soft X-ray glow that had been discovered using sounding rockets to loft instruments above the atmosphere. Familiarity with features of the optical sky learned at the Oxford University Observatory during my undergraduate physics studies, and of the radio sky acquired from an MSc course at Jodrell Bank, allowed me to devise a novel sounding rocket experiment. Following a successful flight (British National Skylark SL1203 launched from Woomera, Australia, in 1974, see Figure 1), the combination of the X-ray, radio, and optical data revealed the emissions to be Galactic in origin[1].

Some years later, as Executive Director of the International Geosphere-Biosphere Programme (IGBP), I led an initiative uniting thousands of scientists from 75 nations to study Earth's bio-geochemical cycles. To make progress, we had to overcome academic disciplinary boundaries as well as language, institutional, national and cultural barriers. The objective was to establish a framework guiding the investigation of multiple individual research 'jigsaw pieces', and then to assemble the fragments so that the 'big picture' of climate system behaviour emerged.

The IGBP was itself nested within a high-level arrangement of the World Climate Research Programme (focusing on the physical climate system) and International Human Dimensions Programme (examining societal roles and responses). See Figure 2.

The success of the programme generated new and important knowledge about the workings of the planet[2]. By integrating

Figure 1: The Skylark SL1203

(a) X-ray astronomy payload ready for launch

(b) The launch in February 1974

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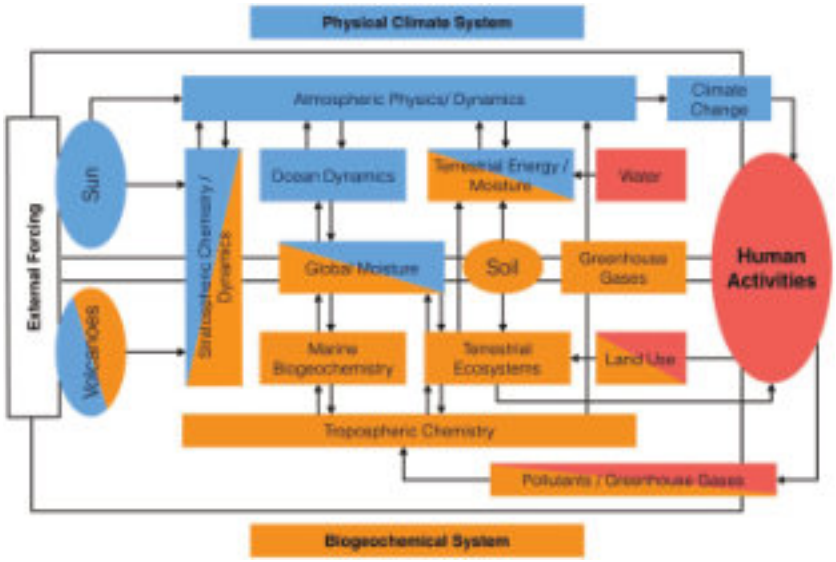
these efforts – now combined as the programme Future Earth (https://futureearth.org) – we generated new insights about how the Earth's systems function – insights that would have been impossible by means of independent research projects.

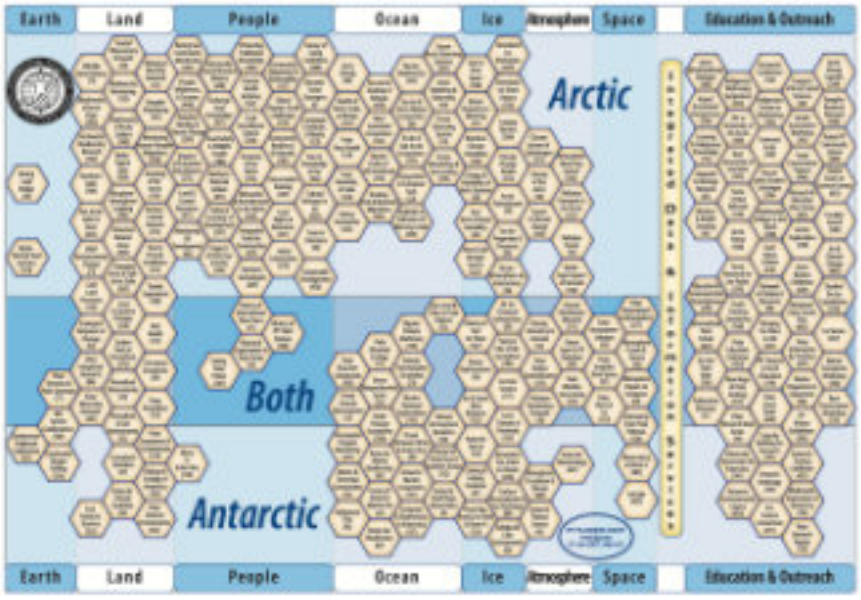
A similar approach proved successful when I chaired the Planning Committee for the International Polar Year 2007–2008. This ambitious campaign, sponsored by the International Council for Science and the World Meteorological Organisation, built on the heritage of the International Geophysical year 1957–1958 to bring together 50,000 researchers from over 60 nations in an integrated research effort to explore and characterise the Polar Regions[3].

Figure 2: A schematic of the Earth system showing the domains of the International Geosphere-Biosphere Programme (orange), the World Climate Research Programme (blue) and the International Human Dimensions Programme (pink) before they merged in to 'Future Earth'



Source: Mauelshagen F (2014) Redefining historical climatology in the Anthropocene. *The Anthropocene Review*, 1. Adapted from the 'Bretherton Diagram' produced for NASA by Francis Bretherton (Earth System Science Committee, NASA Advisory Council (1986) *Earth System Science. Overview. A Program for Global Change*, p. 19).

Figure 3: International Polar Year 2007–2008 projects showing their distribution in terms of topic of study and polar focus



Credit: Dave Carlson

Its objectives were to explore new frontiers, to deepen our understanding of polar processes and their global linkages, to increase our ability to detect changes, to attract and develop the next generation of polar scientists, engineers and leaders, and to capture the interest of the public and decision-makers. It comprised 228 international projects – 171 scientific and the rest focused on education and outreach (Figure 3).

The scale and depth of the initiative yielded a snapshot of the state of the polar regions for future reference, and new understanding of these critical Earth system environments[4].

Following International Polar Year scientific conferences in St Petersburg in 2008 and Oslo in 2010, the final conference "*From Knowledge to Action*" took place in Montreal in 2012. The event attracted participants from academia, industry, non-governmental organisations, education, Arctic communities, and circumpolar indigenous peoples. Together those groups shared and applied the new scientific findings to address policies and decisions in reaction to accelerating polar change. A strong emphasis was placed on the participation of the indigenous peoples, whose welfare and livelihoods are especially at risk.

Since then, interdisciplinary synthesis has been a hallmark of the research programme that I led at British Antarctic Survey, and of the galleries (especially the 'atmosphere' climate science gallery) that were installed when I was Director of the Science Museum.

More recently, I have been collaborating with neuroscientists, psycho-sociologists and communications specialists to investigate why the global response to climate and environmental crises falls short of what the science deems is necessary. As an experimental scientist with a physical sciences background, I was initially taken aback by how little I had previously understood about the limitations of my primary observational instrument – my own brain. I had

Figure 4: The process by which the UCL Climate Action Unit assembles the pieces of knowledge to create the 'Agency to Act' on climate change

Credit: Kris De Meyer and Lucy Hubble-Rose

assumed that presenting overwhelming evidence would lead society to reasoned action. My colleagues in behavioural sciences, however, found this expectation amusingly naive.

At University College London, I Chair the Climate Action Unit (www.ucl.ac.uk/climate-action-unit)[5] which applies key insights from the mind sciences to help organisations, decision makers and the general public who wish to act on climate change but are confronted by psychological or institutional barriers that block or hinder progress. Our mission is to transform how society responds to climate change, intervening at a scale where 'The planet will ultimately notice'. Grounded in a systems-based understanding of why governments, businesses, institutions, civil society, and individuals struggle to act at the necessary scale and pace, we focus on unlocking this inertia. Rather than conducting research, we deliver tangible outcomes and impacts to accelerate progress towards Net Zero and enhanced adaptation.

Our approach is rooted in behavioural science. We design and facilitate targeted interventions that bridge disciplines and expertise, solve communication and collaboration challenges, and remove barriers to action. A key insight is that the conventional 'linear' model of communication – assuming facts alone drive behaviour – is flawed. Instead, recognizing that 'Actions drive Beliefs' enables a virtuous cycle of engagement and commitment. Through carefully structured workshops and events, we empower key actors to discover their 'Agency to Act' (Figure 4).

Daniel Kahneman, the Nobel laureate in economics, describes the human mind as "a machine for jumping to conclusions", noting that "Thinking to humans is as swimming to cats – We can do it, but prefer not to". In practice, people filter information based on preconceptions and often act against their own best interests. Social influence is particularly powerful, meaning that storytelling and demonstrable examples are far more effective than raw data in motivating action. Self-persuasion, generated from experience of action, can lead to a virtuous spiral of strengthening resolve. These insights should be integral to policymaking, just as they are now shaping research communication and the delivery of 'actionable information'.

The climate crisis, like my childhood jigsaw puzzles, requires assembling diverse pieces into a coherent picture. Interdisciplinary collaboration and the co-production of actions – between scientists, economists, behavioural experts, business leaders, and policymakers – are the key to unlocking progress. By breaking down silos and fostering synthesis, we can generate the knowledge and agency necessary to navigate the defining challenges of our time. These are insights and skills not commonly taught to natural scientists, who have much to learn from the world of social and behavioural research. As a parliamentarian, you face the same challenge: making sense of complex, interlinked issues and translating insights into meaningful policy and legislation.

The upshot is that I find myself still discovering and assembling new and unexpected jigsaw pieces – and being astonished and inspired by the pictures that emerge!

References

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