International Big History Association

Origins

Volume IV Number 6

Birth of the Biosphere

Cosmosis 1: A New Kind of Big History

A Little Big History of a Big Historian

An abandoned quarry in the Scaglia rossa limestone of the Late Cretaceous and Early Cenozoic, above the village of Furlo in the Umbria-Marche Apennines of Italy. The Scaglia rossa is a wonderful recorder of Earth history for a hundred million years.

Table of Contents

Birth of the Biosphere

Jan Zalasiewicz
Department of Geology
University of Leicester

Did the great man have a sense of humour – in his ambitious youth, that is? That has always been at the back of my mind since my very first encounter with his name, in parentheses following the name of one of those graptolite species that – among the dwindling number of palaeontologists whose lot it is to study these problematic Palaeozoic palaeoplankton – tends to make the heart sink and provoke a tired smile simultaneously, as at a joke too oft-repeated.

Pristiograptus dubius (E. Suess, 1851), it reads. And, alas, *dubius* by name and dubious by nature, for sure, with this particular beast[1]. Numerous, unassuming in appearance, not liking to change its form very much for mind-numbing lengths of time (was it the equivalent of a career civil servant, in those Palaeozoic seas?) – it is not the favourite species of a harassed biostratigrapher (of this one at any rate). It has spawned a whole shoal of subspecific variants based upon minute variations in shape that often seem to be of – yes, I'm afraid so – of dubious palaeontological reality. Maybe Eduard Suess, in 1851 and 20 years old, could see into the future, to wryly predict the taxonomic despair that his newly-named baby would cause.

Suess grew to become one of the grand men of European geology. The paper in which he launched *Pristiograptus dubius* and a few kindred graptolite species into the world was Suess's first in a long and extraordinarily productive career.

It was also his last on graptolites. It left, indeed, scars[2]. Suess had the misfortune to let his teenage enthusiasm run away from him within the jealously guarded terrain (both geographic and taxonomic) of the mighty Joachim Barrande – a man who was on the way to reaching grand old man status himself. It was a delicate situation. Suess wished to publish jointly with Barrande, who had worked on these fossils for years. But it was not so common, then, for a young tyro to link up with an established savant. It didn't take much, also, to arouse Barrande's territorial instincts[3]. He declined the offer, and hurried to publish his own Graptolites de Bôheme in 1850 – a work that soon became – and remained – a classic of the literature. This was hardly an encouraging omen. Suess nevertheless wrote his own work on these fossils – in which he cited the elder man's new publication, and even dedicated a species ('Graptolithus barrandei') to him.

Barrande was not mollified, not one bit. He fired off a riposte of 'observations' that, at 48 pages, was close to the length of Suess's offending article. He poured scorn on the young interloper's new species – not even sparing the one dedicated to himself – in what was later described as a kind of taxonomic execution. The novice palaeontologist was understandably dismayed: "Such was my entry into the scientific literature – in the worst possible manner!" he later wrote. Luckily for Suess, the post he had acquired, in the museum of Vienna, had by then been secured[4]. Suess, despite his dismay, proved resilient. In the following years he transferred his attentions to brachiopods, then to Cenozoic mammals, with occasional forays into ammonite palaeontology. Then, the stream of palaeontological papers slowed[5]. Suess had wider ambitions. He wanted to take over the world.

In the terms that he set himself, he pretty well succeeded. Das Antlitz der Erde, the end result was called, loosely translated into The Face of the Earth[6]. Our library has a copy, and the other day I staggered back with it for a swift perusal. The staggering was unavoidable, as the four component tomes are each of imposing solidity. The perusal, therefore, became something of a more daunting prospect[7]. Successively published in German in 1883–1909, in French in 1897–1918, in English in 1904–24 and in Spanish in 1923–28, it is a synthesis of world geology as then known, laying out the structures of mountains and plains around the world. Amid the

detailed descriptions, there are some of the Suess ideas: of his inference that slabs of crust rose and subsided through time to create the changing pattern of continents and oceans, and of his more durable concepts of Gondwanaland and the ancient oceans of Tethys and Panthalassa.

The final chapter though, ventures into another realm. It is simply titled 'Life'. After musing on the significance of the many human cadavers examined by an eminent pathologist colleague, he notes that above the earthly lithospheric structure that he had described so minutely, there was a living envelope, that he called the biosphere.

It was not quite the first coinage of the term, for he had introduced it in the slim book that he had written on the origin of the Alps in 1875. In the last and most general chapter on the outer structure of the Earth, he used the metabolic metaphor of a plant living in interference with the three "geological envelopes", namely the lithosphere, the hydrosphere – also both Suessian neologisms – and the atmosphere, but otherwise virtually without comment[8]. Historians of the biosphere concept usually take it as the throwaway comment of a dedicated hard rock man, struck by a passing idea and just noting it down before moving back quickly to more seriously tectonic matters. Well, reading that valedictory chapter of Das Antlitz – and knowing the solid palaeontological credentials of his youth – suggest that it was a little more than that (thus it may be no mere accident that the first and the last books of Vienna's famous Academician ended with the biosphere). Nevertheless, it seems clear that Suess regarded Earthly life in fairly straightforward terms as a living envelope, a complex organic outgrowth on a planetary surface of rock, air and water.

The idea of the biosphere, hence, was born in Vienna[9]. But, it was quickly taken to far-off Russia, where it was raised in obscurity, and remained largely hidden from mainstream, western scientific thought for decades, hidden behind the linked barriers of language and politics.

It's something of a wonder, indeed, that the guiding muse behind the concept, Vladimir I. Vernadsky, lived to develop the idea, as he managed to offend both the Tsarist Court and the Soviet Establishment that followed it. Survive through it all he did, though, to die of entirely natural causes in 1945, at the grand age of 82. It took another 53 years for Vernadsky's crowning achievement, *The Biosphere*, originally published in Russia in 1926, to be published in full in English in 1998[10].

In this case, the ideas were worth waiting for. It's still a thought-provoking read, by turns illuminating, surprising and at times perplexing. Mercifully, unlike Suess's magnum opus, one does not need a fork-lift truck to help carry it home for study. It is essentially a transcript of a couple of essays written in Paris in 1925 ("The Biosphere in the Cosmos" and "The Domain of Life"), published in Russian in Leningrad in 1926, then in French in Paris in 1929, after which the ideas largely dropped out of sight in the West (and in the Soviet Union, too).

Vernadsky's concept of the biosphere went much deeper than Suess's. He perceived that life was intricately interlinked biogeochemically with the rock, water and air at the planet's surface, and powered by solar energy. To him, it was this, *le tout ensemble*, the whole system of life and non-life together that was the planetary phenomenon of the biosphere. This was no passive occupation of a rocky substrate by a film of life (as conceived by another of Suess's admirers, the French geologist and paleontologist Pierre Teilhard de Chardin), but an evolving and interacting whole-Earth system. Not only did the Earth support life, but life as "living matter" shaped the cosmic character of the Earth as a planet in the Solar System. This was the logic that the maverick British scientist James Lovelock, working in the 1960s with NASA's space programme, used to deduce the non-existence of life on Mars (because that planet's atmospheric chemistry is simply in equilibrium with its solid rock surface). He used the self-same logic to develop, in close collaboration with the late microbiologist Lynn Margulis, the still-controversial Gaia hypothesis – that is, of the long-term regulation of the Earth by the totality of that life to maintain the conditions that then allow that life to exist. Lovelock, as he developed his ideas, was unaware (until the mid-

1980s) that the Russian biogeochemist Vernadsky had already taken a long walk through this kind of territory.

In the 1920s, Vernadsky did not entertain the notion of an abiotic Earth, or of an origin of life[11]. He knew that some of the oldest rocks then recognized on Earth show signs of life – the characteristic layered structures of stromatolites, for instance – and regarded any attempt to look more deeply into the past as an attempt beyond what science could then do, and therefore not worthy of speculation. The vision is eerily like that of James Hutton's inability to see on Earth the vestige of a beginning, or prospect of an end. Life, to Vernadsky, was always a powerful geological factor, not least because of its ability to take over any piece of land or sea, given even half a toehold.

It's an idea that he developed so vividly that it can seem to veer into the absurd. He noted the way that living organisms may multiply exponentially, if there is space to go into and resources to sustain them. There was, he said, a "pressure of life". He gave the example of microbes, that can divide to produce new microbes every half an hour or so. Allow these to multiply at that rate for a little while and they can create a front that can advance, he calculated, at 331 metres per second (while the more reproductively relaxed Indian elephant could only manage 0.9 mm a second). A caricature, for sure, but it demonstrated Vernadsky's view of the impossibility of holding back life from anywhere that it can get into.

What, then, was life? Vernadsky was not concerned with describing it in terms of any conventional (by then) biological classification or distribution of the animal and plant species on Earth. Rather he saw it in total (coining the specific concept of 'living matter') as a mechanism by which a planet may collect, convert and store the energy it receives from its sun. How big is this mechanism? He realized the difficulty of making measurements, but suggested that living organisms formed only a small (but powerful) part of the entire biosphere. How variable is it? Here, Vernadsky stuck his neck out further than seemed geologically sensible, even then. As it had always been an integral part of the Earth system, he stated, the biosphere must have been constant in size and essentially unchanging. Not unchanging as regards its component species, of course – he well knew these had been different in the successive geological periods. But that to him was mere detail: their combined scale and function, he said, were a planetary constant[12].

Vernadsky's 'empirical generalizations', as he called them, give pause for thought, even today. They build to a striking vision that tried to get to the heart of a planetary mechanism, building on – or perhaps cutting clean through – the plethora of data being assembled by the biologists and palaeontologists of the day. True, some of his colleagues considered that he was going too far. He was, one of them said, forgoing his solid and useful studies of rocks and minerals to analyse the 'geochemistry of the soul of the mosquito'. That kind of criticism has, indeed, been leveled at subsequent versions of the concept – witness the decidedly mixed reception to the Gaia hypothesis. But there's no doubting their power in generating ideas regarding the most fundamental aspects of our peculiar planet in the cosmos.

Who was Vernadsky, and how did he arrive at his ideas? There's a fine account of this by the American environmental historian, Kendall Bailes, and in addition to the description of Vernadsky himself, it's illuminating about science in Russia before and after the Revolution. Bailes was terminally ill with AIDS in California as he was finishing it, but there's no hint of his own personal tragedy in the elegant – riveting, indeed – account.

Vernadsky grew up in Tsarist Russia, where his father was a professor of political economy who was also a prominent liberal activist and manager of a printing house. Vernadsky absorbed the academic (and independent) spirit – and also became involved in overt political activity. He became a member of Kadets (the Constitutional Democratic Party). This kind of activity could become all too often fatally conspicuous, before and – especially – after the Bolshevik Revolution. However, as the foreword to his biography points out, while a liberal historian could not survive in Stalin's Russia (Vernadsky's son, who was exactly that, had wisely emigrated

to the US in the 1920s, like his younger sister), a liberal geochemist (one, moreover, expert in mineral resources and radioactivity) might. And so it was to prove – although there were some close calls along the way.

Vernadsky's academic background is a little counter-intuitive for someone who was (eventually) to have such an influence on the Earth's biological history. His early studies were firmly within mineralogy and crystallography. He was, for instance the first person to synthesize the metamorphic mineral silliminite, and he went on to work on 'gliding planes' in crystals – planes of deformation determined by particular patterns of molecular structure. It was detailed and specialist work, and the road from there to the biosphere might seem a long one, but Vernadsky had unusual attributes.

He kept his interests very broad, not simply as an intellectual magpie, but as someone who always wanted to see the relation between phenomena, to see things in context and understand their history – and their use to humankind in general and Russia in particular. For instance, he developed his work on minerals not towards more specialist data-gathering and analyses, but towards trying to map out and catalogue the mineral resources of Russia and the USSR. This was in part because he knew they were useful to the material development of human society, and partly because he wanted to see how the various mineral assemblages had evolved. Considering their evolution, indeed, went as far as thinking to what extent Darwin's ideas on biological evolution might be applied to them. Being first a student and collaborator of V. V. Dokuchaev, the father of Russian soil science, he took a serious interest in soils, a stuff in which life, death and non-life are inextricably mixed, and recognized them as a fundamental part of the life cycle of the whole biosphere.

This breadth of interest was stimulated in his youth by intense discussions with fellow students, the influence of the more charismatic of his teachers (who included Dmitri Mendeleev), and by a strongly international outlook. While still a schoolboy, he had determined to learn science by reading the great works of eminent foreign scientists in the original language. He perfected his German by reading Humboldt's *Cosmos* and *Aspects of Nature*, and his English by reading Darwin's *The Origin of Species* and *The Descent of Man*. He had a struggle over the latter, for his father did not want him to read such a dangerous and controversial book at such tender age. Vernadsky was insistent, though, and got his way. This self-taught polyglot could therefore later travel easily through Europe (he visited Canada and USA in 1913) – and did so through most of his life, with the exception of the worst Stalinist years, meeting or working with the likes of Marie and Pierre Curie, Alfred Lacroix, Henry Le Chatelier, Lord Rutherford, Otto Hahn and other giants of European science – including Eduard Suess, too (in 1911), whom he took care to acknowledge in his writings.

Maintaining breadth as a scientist is not generally a sensible career strategy. Vernadsky knew that, periodically berating himself as an encyclopedic dilettante who was all too often distracted by things that stopped him from keeping focus on whatever should have been the task in hand.

Perhaps more than most scientists, he left a trail of half-finished research projects, dropped as he followed some other line of inquiry. The tactic was to pay off in the end, but he often doubted that he would ever manage to crystallize the vision that was, slowly and fitfully, incubating within him.

Another quality that helped him greatly to become a professional scientist – but was definitely a mixed blessing as far as actually doing scientific research – was a talent for both teaching and organization. Even as a young professional scientist, he was busy creating research teams that developed into a research school that he led for most of his long career. The trouble was, this kind of activity often put him in the position of being caught between the Tsarist government, which was generally trying to exercise direct control over the universities – not least to have a free hand to suppress revolutionary elements, and the student body itself – which did include revolutionary elements (the number of which increased, with depressing predictability, as the government's repression intensified).

Vernadsky did not have much sympathy with either side. His readings of Humboldt and Darwin had strengthened his belief (that he maintained throughout his life) that society should be run on rational, secular lines, and not through the divine right and inherited power claimed by the tsars and the nobility. He was an idealist, too. He did not believe that even a brutal and often plain stupid power system in society should be overthrown by violence, but that it should be transformed by evolutionary means, working within the system to improve it by reasoned persuasion. More close to home, he thought the university system should be independent and free to run itself, not least to preserve the spirit of free and open inquiry; he profoundly disagreed with any dogma, whether of the aristocracy, the revolutionaries or anyone else. When forced to choose, though, he tried to protect the students – even when they were revolutionaries.

This, predictably, led to a hard life. To try to protect the academic system, he became not only a senior university administrator, but also a member of parliament, and devoted much of his energies to try to hold the line of university independence, occasionally – though strictly temporarily – with some success. At the same time, he tried to do his best by his students and his researchers. Fitting in any research around all of that was all too often a distant dream.

The ideas of *The Biosphere* crystallized amid a succession of events that others would find catastrophic in personal terms. Vernadsky became unpopular enough with the tsarist government to lose his university position, as they tried unsuccessfully to clamp down on the rising tide of revolution in the country. When the Revolution came, he lost the small family estate that had maintained him and his family after his dismissal, and moved to the Ukraine, in part to recuperate after a bout of TB. There, in 1917, while turmoil was being experienced by most of the country, he was taking an enforced break from his many administrative duties. His ideas finally came together. Those few weeks, he later said, were among the most creative of his life. He filled forty pages of graph paper with the ideas that brought biology into geochemistry, to create the discipline of biogeochemistry (a field developed since the 1940s in the United States by the English-born ecologist George Evelyn Hutchinson[13], thanks to Vernadsky's works translated by his Yale friend and colleague, the son George Vernadsky). That, in effect, turned the biosphere from Suess's descriptive green blanket into the dynamic agent that shapes our habitable planet.

His individual peace was not to last. He was later caught between the fighting Red and White armies (the violence of both of which he deplored), and went into hiding from the Bolsheviks after one of his research assistants was killed in the times of the Red Terror. It did not help that he had been mistaken for another former professor who had a similar-sounding name (Bernatsky), a minister in the former government. The research student who ran errands for him at that time, incidentally, was a young man called Theodosius Dobzhansky, later to become one of the great developers of Darwin's ideas in the form of evolutionary genetics.

Once things had settled down, and the Bolshevik government took a grip, Vernadsky went back to being a prominent academic. Lenin, at that time, showed an ability to deal with the universities more competently than the clumsy Tsarist powers, instinctively suspicious of an independent science establishment, had done. He wanted the academics on his side, to show a civilized face to an outside world that had looked upon the Revolution with alarm, and also to gain the scientists' active help in finding and using the resources to build his new society. He encouraged, for instance, Vernadsky's idea of mapping the mineral deposits of Russia (though, then as ever, securing some funding for this was not so easy). He allowed the university system to keep significant autonomy and freedom of thought and writing, and, for a while at least, reined in his government ministers who wanted more direct control of the academics. Vernadsky was sufficiently impressed to stay within the new Soviet system.

He could also keep travelling, and he once again spent time in Europe, particularly in Paris, where his most well-known (if ill-documented) contacts were with Pierre Teilhard de Chardin and the philosopher Edouard Le Roy. It was the combination of these

that led to a further development of the idea of biosphere, to have yet another 'sphere' (Teilhard and Le Roy) or 'biospheral period' (Vernadsky). This was termed the noosphere, in which the emergence of human thought and action are conceived as another accelerating force that emerged from the biosphere to shape the Earth's geology and evolution. He wished to develop these ideas further. In 1923, he published in the Transactions of the Liverpool Biological Society a "plea for the estabishment of a bio-geochemical laboratory". It was a proposal ahead of its time[14].

After this prolonged stay in France (from July 1922 to December 1925), Vernadsky returned to the new Soviet Union. It was not an easy decision. Revolutionary Russia was not clearly evolving into a benign and tolerant democracy. His son emigrated to the USA. Vernadsky himself tried to find a position where he could develop but, despite his talents and reputation, did not succeed in this. He returned to a Russia that was to evolve into the nightmare that Stalin presided over, and somehow lived through it all.

Remarkably, even in those times, he even kept arguing for the right of academics to develop their ideas and thoughts freely, without the straitjacket – dialectical materialism – which was supposed to be the guiding principle of their lives. That did not make him popular with the ruling powers, but somehow he did not perish in Stalin's purges as millions of others – including some of his own colleagues – did. Characteristically, Vernadsky tried as best he could to help or find shelter for the families of the victims whenever he could. Why was he allowed to live? His renown in Russia and Ukraine, and to some extent outside it, certainly helped. The practical side of his work (those mineral resources and with the Radium Institute) was also a factor. And, he was not overtly political in this, or any kind of threat in the various struggles for power and position. His criticisms were those of an academic, and they were expressed internally, and not broadcast to the outside world. He did what he could, but probably knew, or guessed, how far he could go.

Through all of this he developed his ideas of the interconnections between the living and non-living world. In that first statement on the biosphere, he had omitted something that he might have been in a position to be aware of, even then. This was the transformation of the Earth that we know now as the 'Great Oxidation Event' some two and a half billion years ago, when the appearance on Earth of the first photosynthetic organisms changed the composition and chemical activity of the atmosphere. The enormous Banded Iron Formations of those early Precambrian times, which outcrop extensively across Russia, might have alerted him to the fact that the Earth might have existed in very different biogeochemical states in the past.

His ideas in this respect did evolve, though, as one of his last essays (one of the few items of his Soviet-era work to be published in the West) shows. He admitted (after Oparin's work) the possibility of an origin for life, and hence of an abiological early Earth. He recognized successive phases of the biosphere, quoting some proper stratigraphy – the appearance of calcified plant material (the stromatolites, one presumes) in the Precambrian and skeletonized animals at the beginning of the Cambrian, for instance. There is a little improper stratigraphy, too – he quotes 'our green forests' appearing for the first time in the Cretaceous, when something quite satisfactorily forest-like had appeared by a couple of hundred million years previously, in the Carboniferous. A detail, that, and it doesn't affect the material quality of his argument. Suess wouldn't have got that wrong – but then, he wouldn't have thought through the Earth's functioning in the way that Vernadsky did. Stratigraphy's a fine thing, but it's not everything, after all.

From those unfortunate misunderstandings over fossil graptolites, to debates over the utility of analyzing a mosquito's soul, the biosphere has come a long way – in people's minds, not least. How this might translate into the continued function of the biosphere itself is another story, of course – but one can be quite sure that Vernadsky pondered that question, too.

Acknowledgements: My thanks to Jacques Grinevald – a key figure in reviving Vernadsky's reputation in western science – for pointing me in this direction, and for scrupulously correcting the draft manuscript. If this essay has any scholarly merit, it is largely due to him. The small oasis of peace chez Ryszard and Grażyna Kryza in Wroclaw, Poland, allowed the words to emerge.

Endnotes

1. Not to mention the synonyms provided by your friendly household thesaurus – dodgy, shady, fishy and so on.

2. As reported in Siedl et al. 2009.

3. For more on this singular palaeontologist, see 'Of Barrie and Barrande' (Newsletter 73).

4. The story has a happy ending of sorts – indeed two happy endings. Firstly, Barrande's wrath had cooled some years later. Suess was surprised, one day, to find the older man at his door. He had, it seems, reflected upon events and come to inter a hatchet. Subsequent visits established, finally, an amicable relationship. And, of Suess's much-maligned species, most still survive to this day – including (alas) *dubius*.

5. There are sixty-one palaeontological publications in total listed by Zapfe (1981).

6. It should really be a touch more poetic than that, for in German the usual word for face is the common or garden 'Gesicht', while 'Antlitz' is closer to 'visage' or 'countenance'. In standard barbarian English, though, the translation chosen probably hit the right spot.

7. Indeed, with the volume now creating a small gravitational anomaly in my room, no one had succeeded in this, in over a century. A number of pages were still joined at the top, having never been cut through.

8. Suess wrote "eine selbständige Biosphäre", in *Die Entstehung der Alpen*, Wien, W. Braunmüller, 1875, p. 159.

9. Perhaps no very large concept about Earth and life can ever be said to be truly new, though, given the human impulse to make sense of our surroundings. Reaching farther back, the biosphere in embryonic form is often said to be found in Jean-Baptiste Lamarck's *Hydrogéologie*, published in 1802 (see Ghilarov 1998).

10. *La Biosphère*, Paris, Librairie Félix alcan, 1929, was presented as the follow-up of La Géochimie (Librairie Félix Alcan, 1924), after Vernadsky's lectures at the Sorbonne in 1922-23. To much of the English-speaking world that is still a large barrier to understanding.

11. Vernadsky's biogeochemical approach was not ignored, nevertheless, by his fellow Russian Alexander Oparin in his own pioneering work on the origin of life from non-living matter.

12. In his last, unfinished book, *The Chemical Structure of the Biosphere as a Planet and its Surroundings* published twenty years after his death, Vernadsky did go on to modify his ideas about the origin and evolution of the Earth.

13. Hutchinson's 1970 article on the biosphere in Scientific American is justly celebrated.

14. Ignored in the west, this was set up within the Academy of Sciences of the USSR in 1928, following Vernadsky's Department of Living Matter

Dr. Jan Zalasiewicz
Senior Lecturer in Palaeobiology
University of Leicester
Department of Geology
University Road
Leicester
LE1 7RH, UK

within the KEPS (Commission for the Study of Natural Productive Forces), formed during the First World War.

REFERENCES

BAILES, K. E. 1990. *Science and Russian Culture in an Age of Revolutions*: V.I. Vernadsky and his scientific school. Indiana University Press, Bloomington and Indianapolis, 238 pp.

GHILAROV, A. 1998. *Lamarck and the prehistory of ecology*. International Microbiology 1, 161–164.

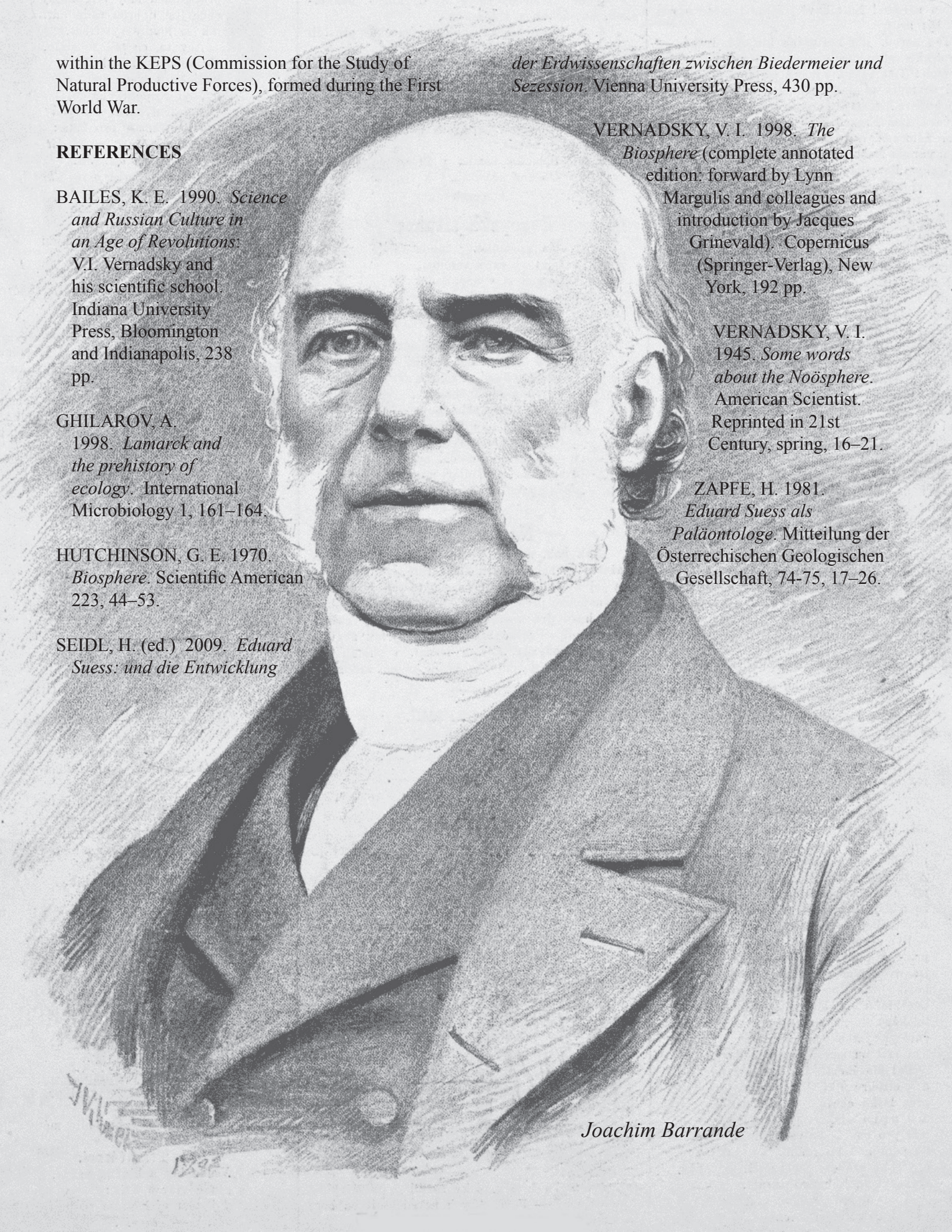
HUTCHINSON, G. E. 1970. *Biosphere*. Scientific American 223, 44–53.

SEIDL, H. (ed.) 2009. *Eduard Suess: und die Entwicklung der Erdwissenschaften zwischen Biedermeier und Sezession*. Vienna University Press, 430 pp.

VERNADSKY, V. I. 1998. *The Biosphere* (complete annotated edition: forward by Lynn Margulis and colleagues and introduction by Jacques Grinevald). Copernicus (Springer-Verlag), New York, 192 pp.

VERNADSKY, V. I. 1945. *Some words about the Noösphere*. American Scientist. Reprinted in 21st Century, spring, 16–21.

ZAPFE, H. 1981. *Eduard Suess als Paläontologe*. Mitteilung der Österrechischen Geologischen Gesellschaft, 74-75, 17–26.

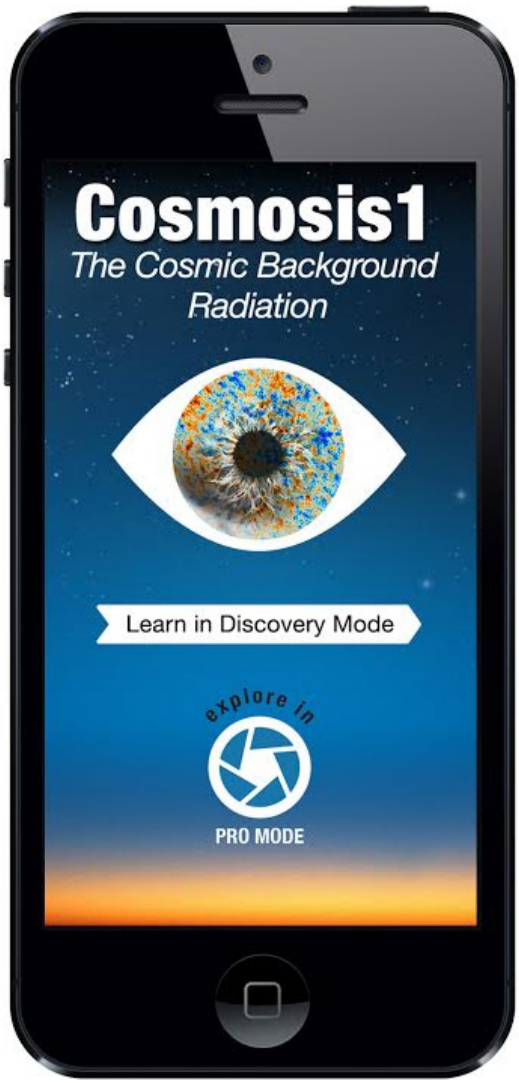


Joachim Barrande

Cosmosis1: A New Kind of Big History App

Rich Blundell
Macquarie University

In May of last year I was awarded an Innovation and Scholarship grant to produce the first in a series of Big History-themed smartphone apps. I wanted to try something different and perhaps invent a whole new kind of app; one that would provide accurate educational content, and also tap into the truly transformative ideas embedded within the cosmic narrative. Instead of another app that lets you know when the next bus will arrive, or puzzle over virtual candy combos, I wanted to design an app experience that tells the stories of cosmic evolution in provocative new ways. I also wanted it to deliver something you couldn't get from a textbook, so it had to be both intellectually disruptive, *and* experiential. Thus, a new app concept was born. An "Epiphany App" is an educational app that delivers at least one paradigm-shifting realization as part of the experience.

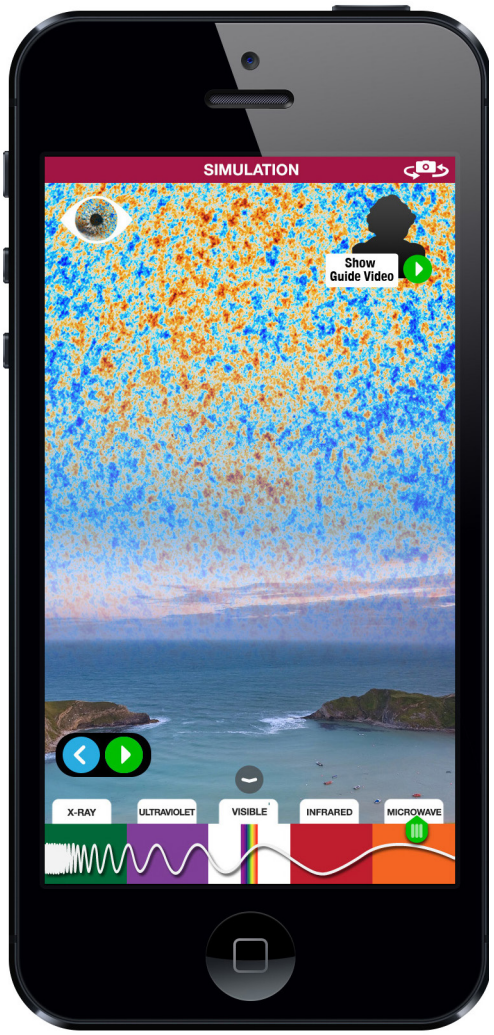


The concept of a disruptive epiphany dovetails nicely with the subject of my ongoing PhD research on transformative learning in Big History. I assembled some of the most compelling ideas to emerge from the Big History narrative and thought about how I could turn them into rich experiences. As far as making them transformative, I drew on preliminary research results with my own students. And for more personal inspiration, all I had to do was recall the many moments of awe and connection that I have felt in my own engagement with the story of the universe.

In order for this app to deliver the goods, it has to provide a profound and personally meaningful experience. The good news is Big History is full of genuinely mind-shifting moments. Starting at the beginning, I decided this first app should deal with an early threshold of cosmic evolution. I chose the Cosmic Microwave Background Radiation (CBR) as the subject of the first app. The challenge was how to make the CBR both a lived-experience, and a personally meaningful one.

Cosmosis1 takes users on a journey to visualize the world as revealed through five different wavelengths of light. Using embedded guidance videos and interactive visualizations, I show learners real-time simulations of the world through X-ray, ultraviolet, visible, infrared, and finally, microwave light. The experience culminates when a powerful piece of evidence in cosmic evolution, the Cosmic Background Radiation, is revealed where it actually is; NOT just on a flat computer screen, but in the sky as would be seen from anywhere on earth. The app places the CBR image into the background of the phone's camera viewer, as if the viewer were at the center of a sphere of cosmic background microwave radiation (in other words, as it really is!). But more than just making it real, the experience then makes the CBR personally meaningful. The idea of *Cosmosis1* is to bring an abstract scientific concept into the phenomenological realm - in other words,

to provide a lived-experience upon which users can build more sophisticated conceptual knowledge. This is accomplished using science, imagination, and Deweyan constructivist learning theory. I apply a synthesis of concepts and techniques, developed through my research, that I call *radical hermeneutics*. I published the educational theory behind the app in the *International Journal of Immersive Education* in June 2013. But to get the full-experience, you'll just have to try the app for yourself.



The complete *Cosmosis Epiphany App Series* is designed to enhance high school and college-level courses. In the future there will be one app for each week of a Big History course, following the chronology of cosmic evolution. Each threshold of cosmic evolution provides a basis for a different educational epiphany. Alternatively, each individual app can also supplement existing courses in physics, astronomy, biology, etc. The apps should also appeal in informal formal educational contexts. In any case, all *Cosmosis Epiphany Apps* will encourage users to get outside to experience nature and culture in new ways.

The *Cosmosis1* App will be free for educational use and available to the public through iTunes for a small fee. The first release is for iPhones only, but will be available for Android and tablets as soon funding becomes available. Rich will be releasing a limited number of prototype versions the first week in June and is now recruiting beta testers. If you wish to be a beta tester please use the contact form on the website provided.

The Competitive Grants Scheme at Macquarie University where I am enrolled has funded the Cosmosis1 CBR app. Funding for future thresholds is currently being sought. I have been working with Fred Adam from Ubik2.com as the Artistic Director and a team of programmers in Spain. More information can be found at http://cosmosis.omniscopic.com/

Rich Blundell *has a long and storied background across the sciences and humanities. Perhaps one of the "last children in the woods" he started his academic career in the "outside" sciences: first geology, then biology, and ecology, and then through astronomy, chemistry, and physics. These passions brought him on several adventures and documentary expeditions around the world exploring the sciences of cosmic evolution. Rich came in from the field in 2009 to complete a Masters Degree in education on communicating science to the public. In 2011 he launched an interdisciplinary PhD exploring the transformative potential of Big History from personal to cultural levels. His dissertation (currently in-progress) spans the science-humanities divide by integrating technology and the arts into culminating creative-practice projects. In addition to a poster on Cosmosis1, Rich will be also presenting an excerpt from his traveling public lecture series titled: "Shakespeare in the Cave: A Big History of Art" at the IBHA conference in August at Dominican University.*

The Cosmosis1 App provides a new lived-experience of science... an epiphany, really. By making abstract science real, it suggests the hidden world that's just behind the scenes. This app shows you what your eyes keep you from seeing.

The universe is an incredible13.8 billion-year evolutionary story leading up to the very moment you read these lines. I think the world needs an app that can begin to convey this reality. Welcome to Cosmosis1, the world's first cosmic "Epiphany App."

This is not your typical kind of app. Cosmosis1 will change the way you see the world by revealing a cosmos that your eyes keep you from seeing. So instead of letting you know when the next bus will arrive, or puzzle over virtual candy combos, Cosmosis1 will show you a cosmic story that is actually your story.

The cosmic story is also scientific reality. How do we know this? Where did it all come from? Where did YOU come from? Where is the evidence for this claim? Well, it's all around you. Look into the sky, or at a blade of grass, or even your own hand. If your eyes could be fine-tuned to see in a slightly different wavelength of light, you would suddenly be able to see an otherwise hidden world of evidence. That's precisely what this app allows you to do.

If science is not your thing, don't worry. You won't even know you are learning. I'll will be your onboard video guide so you'll be able to watch (or just listen) as I explain things. You are free to explore with me or on your own. If you are already into science, this app will still blow your mind because you'll finally be able to actually experience the science that you already know. Plus, the app provides links to more information and experiences about the phenomena explored through the app. Either way, with the right guidance, science, and a little imagination, you'll be able to see the world a lot differently.

http://cosmosis.omniscopic.com/

A Little Big History of a Big Historian

Esther Quaedackers
University of Amsterdam

For this issue of *Origins*, I was asked to write something about myself and my experiences in studying, researching and teaching Big History over the past decade. At first, I was slightly hesitant to do so, because I was not sure if my story would be interesting for you, *Origins* reader. Yet I eventually decided to tell you about my trajectory anyway, because it may provide some insights into the specific challenges and opportunities younger academics who want to pursue Big History are presented with today.

My Big History story starts in 2003, when I took Fred Spier's Big History course at the Eindhoven University of Technology in the Netherlands. At that time, I was studying for my Master's degree in architecture, which I loved but also felt slightly uneasy about. I very much enjoyed designing buildings, but on the other hand, I had the nagging feeling that I did not really know what I was doing. I had no clear idea of how what I was designing fit into the big picture. That bothered me, because I felt that what architects designed did affect the big picture. Admittedly, that view was partly grounded in a delusion of grandeur that stems from being in your early 20s and perhaps also from professional tunnel vision, but is was also based on numbers. For instance, in the US buildings account for 41% of primary energy consumption: this means that US buildings alone are responsible for 7% of global primary energy consumption.[1] And large amounts of important resources, such as 51% of the world's steel production, are used for construction.[2] Such amounts of energy and resource consumption affect the intricate webs of relationships between geological, biological, cultural and geo-political factors that shape our world. Yet I did not know how exactly, and this, coupled with unanswered questions about how buildings influenced social structures and people's mental images of the world, led me to believe I was unable to make informed decisions while designing buildings.

I tried to remedy the problem by taking various extracurricular courses on subject ranging from philosophy to environmental science and astrophysics. Doing so almost prevented me from taking Big History when I saw a flyer for the course: I thought that I had already learned about most of the things that would be covered in Big History. I quickly found out I was very wrong about that. As it turned out, the course offered something I had not even realized I was missing. It offered a framework that could be used to connect all the bits and pieces of knowledge that I had been trying to gather. This framework allowed me to tie my thoughts together into a rudimentary big picture that explained why the world around me was the way it was. It made me want to explore Big History further. So I was thrilled when I was offered a position as a teaching assistant in Fred Spier's other Big History course at the University of Amsterdam.

Even though Big History had provided me with a big picture of the world around me, I still had not found a satisfactory answer to the question how buildings fit into that picture by the time I obtained my Master's degree. I therefore decided I wanted to try to explore that question further in a Ph.D. thesis. Doing so proved to be a major challenge, however. First of all, there was a practical problem that needed to be solved. No formal Big History Ph.D. program existed when I wanted to start to work on my question. That problem was not insurmountable in the Netherlands, where anybody with a Master's degree is allowed to pursue a Ph.D., as long as they can find a suitable professor willing to supervise their work. But finding a supervisor turned out to be hard. Fred Spier was not allowed to supervise Ph.D. theses, because, according to university rules, only full professors who are heading a research group are allowed to do so. And a Big History research group, of course, did not exist because Fred was not allowed to take on Ph.D. students. Other professors were very reluctant to get involved in a Big History research project. A few seemed interested at first, but after a while they started to try to bend my research question into a more conventional, safer direction. I don't blame them. At

that time, my research question more or less came down to the question: how Big History can help us gain a better understanding of building. Of course that question was irresponsibly vague and broad. Consequently, my research ideas went everywhere, and after a little while, I felt like I was drowning in them. Yet I did not know how to focus without loosing my Big History perspective. This proved to be a second, more fundamental problem I came across when trying to pursue a Big History Ph.D.

During that time, while sitting in a Parisian café, my husband Marcel asked me how I thought Big History could help him explain his surroundings, including the Parisian street plan we had been struggling to make sense of. I could not answer him directly and started to brainstorm, connecting that street plan to a variety of phases in Big History. Doing so turned out to be a lot of fun and also resulted in some interesting novel ideas about why the streets had developed the way they had. Back at home in the Netherlands I kept thinking about the approach and eventually turned it into an assignment for a Big History student who needed to complete an additional task to receive a certain number of credits. I asked the student to link a specific subject that fascinated her to an aspect of all the 12 Big History lectures she had attended. As a result, she produced an interesting story about milk that, like the story on the Parisian streets, contained some interesting original ideas. The approach seemed to work, partly because it turned out to be easy to discover surprising new questions in the academic no man's land that lies between the usual disciplines that study for instance milk, and the planets of our Solar System. Thinking I had stumbled upon something promising, I decided to develop the approach further.

I started to use the perspective, that was later called the little Big History approach by Fred, in my plans for my Ph.D. thesis. I eventually decided I would write about the little Big History of a single building. I chose Tiananmen, also known as the Gate of Heavenly Peace, in Beijing, because I was curious about its history, and started to connect the gate to the history of the Cosmos, Earth, life and human societies. This allowed me to solve the two problems I had faced when trying to set up my Ph.D. project. It allowed me to focus while still using a Big History perspective. The focus on a single building, combined with some preliminary results the approach had already yielded, also raised interest among potential supervisors, two of which finally agreed to take me on as a Ph.D. student. My Ph.D. position was not funded, mainly because it turned out to be impossible to find a funding program in the Netherlands that Big History fit into. But I did not care. I was getting paid for teaching Big History at the University of Amsterdam, where I had progressed from being a teaching assistant to being a lecturer. I would work on my Ph.D. research in my free time.

I also started to work on little Big Histories with my students. In the beginning, I simply asked them to write a little Big History by connecting a specific subject of their own choice to aspects from all classes, like I had asked the student who wrote about milk. When time progressed, I began to regard this assignment as a exercise in wild and divergent thinking, and I started to encourage students to treat it as such. To counterbalance the somewhat quirky exercise, I also started to ask students to elaborate seriously their favorite connections, and support them with the best evidence they could find. In the end, students were asked to weave together the best elaborated links between the students' subjects and the history of the inanimate world, life and humanity into coherent stories.

Such stories slightly resemble this short piece, which I gave a little Big History spin just for fun. It has already touched briefly on the connection between my personal history and the history of our planet, explaining what role planetary resource considerations have played in my search for a framework like Big History. It will touch more extensively on the links between my explorations of Big History and the history of life and humanity.

The invention and development of the little Big History approach is not unlike the biological mechanism of adaptive radiation, after all. In an adaptive radiation, a random variation that happens to work can rapidly spread and adapt to open niches. The little Big History approach that was invented 'by accident' in a Parisian café, happened to work and has spread, not only to my own research and teaching

practices, but also to other courses and projects, where it has been adapted to new environments. For example, various Big History courses around the world have adopted the approach and a little Big History assignment has even become part of the Big History project curriculum. The recent History Channel series on Big History was partly inspired by little Big Histories. A number of researchers from different universities have been experimenting with the approach, and we are currently in the process of composing a book filled with such little Big History research projects. Apparently, there were a lot of open niches in the Big History world that little Big Histories could spread and adapt to.

Such open niches can provide tremendous opportunities for younger academics. It is definitely true that getting your foot in the door can be difficult and sometimes requires taking somewhat unconventional paths, but the door opens into a huge, but nevertheless still rather empty, space where all kinds of novel educational and research approaches can flourish. The little Big History approach is just one of them. Therefore, venturing into the field of Big History can be an exhilarating adventure that allows you to explore uncharted academic territories and perhaps find great (although probably no great monetary) rewards.

Niches for Big Historians may have opened up due to two rather fundamental processes in human history: increasing specialization and the increasing speed of collective learning. Specialization in the professional and academic world have encouraged people to learn a lot about very specific things. The Master's programs that are currently offered by my own university are a case in point: there are now 222 of them, ranging from 'Gravitational Astroparticle Physics' and 'Atomic Scale Modeling of Chemical, Physical and Biological Systems' to 'Sport Psychology' and 'Human Centered Multimedia'.[3] The more advanced the level of education becomes, the more specific the subject the educational program revolves around often becomes. It seems to be the case that in the course of their education, many people are stimulated less and less to think broadly and come up with connections between different fields of knowledge. It could even be the case that people are actually unlearning to do so, as it has been boldly claimed that schools are responsible for the decline in divergent thinking capacities that can be observed in children when they are growing up.[4]

But even though many people are not trained to think broadly, the capacity to do so has become vital. The increasing speed of collective learning and the corresponding rise of the internet have created situations in which information about almost everything is more easily available than ever before. In such situations, it is easy to succumb to information overload. Overarching ideas, that can act as frameworks that tie different bits of information together, can help prevent that. Looking back, the ability to serve as such a framework has been on of the characteristics of Big History that attracted me to the field in the first place. It may also be a reason why so many others have flocked to Big History over the past decade or so. In the Netherlands alone, we are currently teaching 7 different academic Big History courses at several universities and have even evoked interest from the business world.

All of this makes me believe there will be an increasing demand for people trained in Big History in general, and for people who have taken advantage of open niches and have developed their own personal take on Big History in particular. I think this demand will come from the academic world, but also from the broader world of education and perhaps even from the field of consultancy. So trying to get your foot in the door, even if it means having to overcome institutional or other problems, might be a worthwhile investment.

Endnotes

1. http://buildingsdatabook.eren.doe.gov/ChapterIntro1.aspx
2. http://www.worldsteel.org/steel-by-topic/construction.html
3. http://www.uva.nl/en/education/master-s/master-s-programmes/masters-programmes.html
4. http://www.youtube.com/watch?v=zDZFcDGpL4U&feature=player_embedded

INTERNATIONAL BIG HISTORY ASSOCIATION CONFERENCE

AUGUST 6 - 10, 2014

DOMINICAN UNIVERSITY OF CALIFORNIA
SAN RAFAEL (SAN FRANCISCO BAY AREA), CALIFORNIA

TEACHING AND RESEARCHING BIG HISTORY: BIG PICTURE, BIG QUESTIONS

The theme for the 2014 conference is "Teaching and Researching Big History: Big Picture, Big Questions." The conference seeks to continue the dialog begun at the first IBHA conference in 2012. In addition IBHA seeks to create a forum for the articulation, discussion, and distillation of questions central to Big History. Among the topics that are to be addressed at the conference through a series of panels, roundtables, and discussions are:

- *Big History and energy*
- *Big History in education*
- *Big History pedagogy*
- *Big History scholarship*
- *Big History research agenda*
- *Evolution of complexity*
- *Identification and analysis of thresholds*
- *Continuity and Contingency in our Universe*
- *Big History: interdisciplinary, multidisciplinary, or trans-disciplinary?*
- *Big History and the future*
- *Big History and meaning*
- *Big History outcomes and assessment*
- *Politics and Big History*
- *Little Big Histories*

International Big History Association

The IBHA Conference will convene on the campus of Dominican University of California in San Rafael, which is located twelve miles north of the Golden Gate Bridge. Attendees will have the option of selecting from one of several hotels in San Rafael and the surrounding area or staying in on-campus accommodation.
San Rafael is a wonderful destination in Marin County surround by woods and beaches. For all things San Rafael go to http://www.sanrafael.com. For a complete guide to San Francisco and its many attractions, visit http://www.sanfrancisco.com/. And if you have more time to explore the larger Bay Area, see http://www.visitcalifornia.com/Explore/Bay-Area/.

Please find more details on the conference at www.ibhanet.org. We hope you can join us for this fantastic second IBHA conference!

Program Committee: Cynthia Brown, Lowell Gustafson, Fred Spier, Harlan Stelmach, Joseph Voros

Transportation to/from San Rafael
Flying into SFO
We suggest taking the Marin Airporter from SFO to Marin and disembarking at the Central San Rafael Transit Center. Approximate travel time is 1.5 hours. Buses pick up passengers at SFO every 30 minutes, on the hour and half-hour, beginning at 5:00 AM. The last bus of the night departs from SFO at midnight. Fare is currently $20. http://www.marinairporter.com/schedules_sfo_to_marin.html
From the Transit Center in San Rafael, there are taxis available to take you to your hotel. If you are staying at the Four Points by Sheraton in San Rafael, it is approximately 3.3 miles from the Transit Center to the hotel.
Flying into OAK
We suggest taking the Sonoma County Airport Express to Marin and disembarking at the Central San Rafael Transit Center. Fare is currently $26. Please refer to the Airport Express website for travel times and pick-up times. http://airportexpressinc.com/schedules.php
From the Transit Center in San Rafael, there are taxis available to take you to your hotel. If you are staying at the Four Points by Sheraton in San Rafael, it is approximately 3.3 miles from the Transit Center to the hotel.

Hotel
Four Points by Sheraton
1010 Northgate Drive
San Rafael, CA 94903

Central Reservations 1-800-325-3535
Hotel Reservations 1-415-479-8800
Callers reserving a room at the Sheraton should identify themselves members of "DU-IBHA" arriving on Wednesday, August 6th and departing Sunday, August 10th, 2014 to secure the special rate and receive their confirmation number. Callers should have a credit card ready to guarantee reservation.
~~Discounted Rate: $114 (by 5pm local time, June 13th, 2014)~~ All discounted rooms are reserved.
Group Rate: $139 (by 5pm local time, July 11th, 2014) A limited numbner are still available.
Reservations may be cancelled without penalty up to 24 hours prior to arrival.

Limited on-campus housing is available at Dominican for the duration of the conference (check in Aug 5th, check out Aug 10th). A maximum of 20 rooms are available for double or single occupancy (singles booking a room for themselves will have to pay the price of double occupancy). The price is $50 per night per person in a shared suite (double occupancy). Each suite has two separate bedrooms and a shared bathroom. The suites do not include a kitchen, and the price does not include meals other than those already covered by the conference registration fee. Please contact Donna in the IBHA Office if you would like to reserve one of these rooms.

Wine Country Tour
$120 p.p. Limited capacity: 56
Sunday, August 10th
9:30 am pick-up / 3:30 pm dropoff at Four Points Sheraton
* We will need to see if anyone staying on-campus signs up and needs pick-up

This tour includes visits to two distinct attractions in our local wine country. The first site is the beautiful Jacuzzi Family Vineyards where IBHA guests are invited to tour the winery, enjoy a tasting, and partake of a delicious and specially prepared lunch. The second site is Cornerstone Gardens, an ever-changing series of walk-through gardens, where IBHA guests are invited to tour new and innovative garden designs from the world's finest landscape architects and designers. For more information, visit the websites at http://www.jacuzziwines.com/ and http://www.cornerstonesonoma.com/explore/about-cornerstone/

Conference Registration

To register for the 2014 IBHA conference, please click here, or click on "Conferences" at http://www.ibhanet.org/. The first registration window should pop up. Please let us know at ibhanet@gmail.com if this form gives you any trouble. Or print this form and mail your registration fee to:

LOH181
International Big History Association
Grand Valley State University
1 Campus Drive
Allendale MI 49401-9403
USA

Early rates available only through May 31!

Daily bus transportation, meals and evening events are all included with registration. Guest registration includes evening events only.

Name _____

Address _____

City, State _____

Zip _____

Insitutional Affiliation _____

Email _____

Guest Name _____

Total Registration Fee Included _____

Please make your check payable to the International Big History Association

- ☐ Member Early - $295.00 (USD) IBHA Member Early Registration Rate **before May 31**
- ☐ Member Late - $355.00 (USD) IBHA Member Late Registration Rate (after July 19)
- ☐ Member Regular - $325.00 (USD) (June 1 - July 19) IBHA Member Regular Registration Rate.
- ☐ Non-Member Early - $395.00 (USD) **before May 31** IBHA Non-Member Early Registration Rate
- ☐ Non-Member Late - $455.00 (USD) (after July 19) IBHA Non-Member Late Registration Rate
- ☐ Non-Member Regular - $425.00 (USD) (June 1-July 19) IBHA Non-Member Regular Registration Rate
- ☐ Student Member Early - $150.00 (USD) before May 31 IBHA Student Member Early Registration Rate
- ☐ Student Member Late - $210.00 (USD) (after July 19) IBHA Student Member Late Registration
- ☐ Student Member Regular - $180.00 (USD) (June 1 - July 19)
- ☐ Guest Registration - $150.00

Geological Tour of Land's End and Sutro Baths, San Francisco
$50 p.p. Limited capacity: 20
Wednesday, August 6th, 1:00-5:00pm

1 pm pick-up at Four Points Sheraton
5 pm dropoff at Four Points Sheraton
* On-campus pick-up available

Enjoy a beautiful hike at Land's End at the northwestern corner of San Francisco, where stunning views will astonish you at every turn. Hillsides of cypress and wildflowers, views of shipwrecks and the ruins of Sutro Baths provide the setting for a tour with a Big History perspective. Geologist Dr. Christopher Lewis will be your guide through Ocean Beach, the Sutro Baths, and Land's End as you learn how our California coastline came to be. Links to Land's End, Land's End map, Sutro Baths.

Contact Donna Tew in the IBHA office to reserve your place on these tours!

Wine Country Tour

$120 p.p. Limited capacity: 56
Sunday, August 10th
9:30 am pick-up / 3:30 pm dropoff at Four Points Sheraton

This tour includes visits to two distinct attractions in our local wine country. The first site is the beautiful Jacuzzi Family Vineyards where IBHA guests are invited to tour the winery, enjoy a tasting, and partake of a delicious and specially prepared lunch. The second site is Cornerstone Gardens, an ever-changing series of walk-through gardens, where IBHA guests are invited to tour new and innovative garden designs from the world's finest landscape architects and designers. For more information, visit the websites at http://www.jacuzziwines.com/ and http://www.cornerstonesonoma.com/explore/about-cornerstone/

The IBHA is proud to announce that Jennifer Joy, a New York City writer/performer/comedian who draws her themes from Big History, will be performing excerpts from her hit show, ***The Physics of Love***, in a special lunchtime performance at the upcoming IBHA conference.

She has performed to rave reviews in New York City and all over the country. She is currently touring *The Physics of Love*, a romantic comedy based on Big History, to colleges, universities and theatres across the country.

In this multi-character one-woman show, "Lisa" is a science teacher who revels in her nerdiness, seeing everything in her life through the lens of science's Universe Story – from the chaos of her 7th grade class to her bumpy search for love. She is surrounded with quirky characters, including students, many bad dates and finally, The Right One. But will she be able to give love a chance? Filled with humor and intelligence, this show will delight and inspire you!

Critical Raves for "The Physics of Love" *"...(a) powerhouse performer, Jennifer Joy Pawlitschek has written and performs a multimedia piece involving quantum physics... Not only is Ms. Pawlitschek strikingly beautiful in her tall bearing, she's highly articulate and bright, and puts on a captivating show."*
- Mark Mardon, Bay Area Reporter

"Jennifer Joy combines humor, science and humanity in an excellent show about one life in a vast universe."
- Lamont (Monty) Hempel, PhD.,
Hedco Professor and Director,
Center for Environmental Studies, University of Redlands

"There was amazing distinction between each character, with the voices and the body gestures. The science aspect played beautifully into the love story and I loved that it was not boom! Happily ever after. It was, 'let's try this again'. Jennifer is amazing!"
- Jack McKenna, SUNY Potsdam

"The Physics of Love" is a hit! It's magic!

Don't miss this special performance! Thursday, August 7th at 12:15 pm

Letter to the Editor

In her piece in ***Origins*** last month (Vol IV Number 5), "A Movement to Divest Stock in Fossil Fuel Companies," I think Cynthia raises one of the most important questions of our time ─ how we (or IBHA) can reduce our carbon footprint ─ and one of the most difficult to respond to. I would caution that there are other equally important questions, like how to stop the killing fields induced by our 'genetic baggage' (to quote Sagan), and how we might escape our sense of entitlement to basically consume the biosphere. In a limited space I can only suggest that the insight and understanding offered by a 'deep science' view of human existence helps liberate us from the confines and endless demands of a self-centered existence. When we can see the world in a grain of sand our travel time for vacations and conferences is immeasurably diminished.

Dana Visalli

Draft Program for 2014 IBHA Conference.

International Big History Association
Brooks College of Interdisciplinary Studies
Grand Valley State University
1 Campus Drive
Allendale MI 49401-9403

http://ibhanet.org/

Cover Photo Credit: Roland Saekow took this picture of the Italian Apennine Mountains at a Big History seminar offered by Walter Alvarez and Alessandro Montanari in and around Coldigioco, Italy.