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Encore des Buffonades, mon cher comte?

Response to "Towards a Theory of Big History"

Conference Registration

Georges - Louis Leclerc, Comte de Buffon

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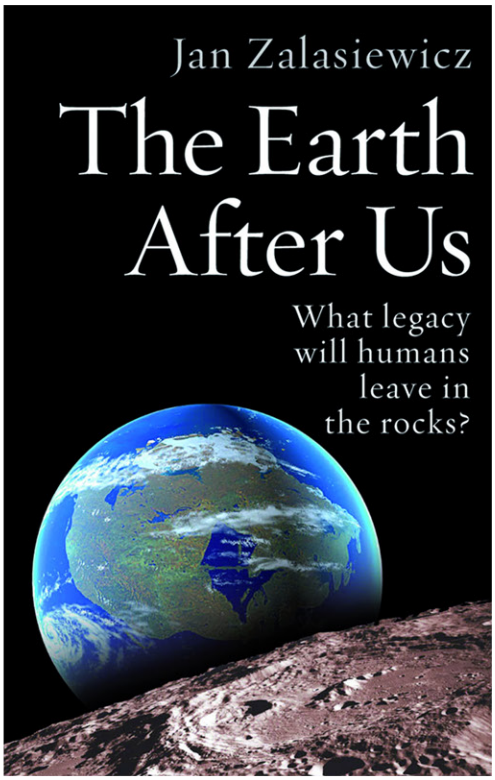
Essay on Comte de Buffon begins *Origins* series on Universal Scholars

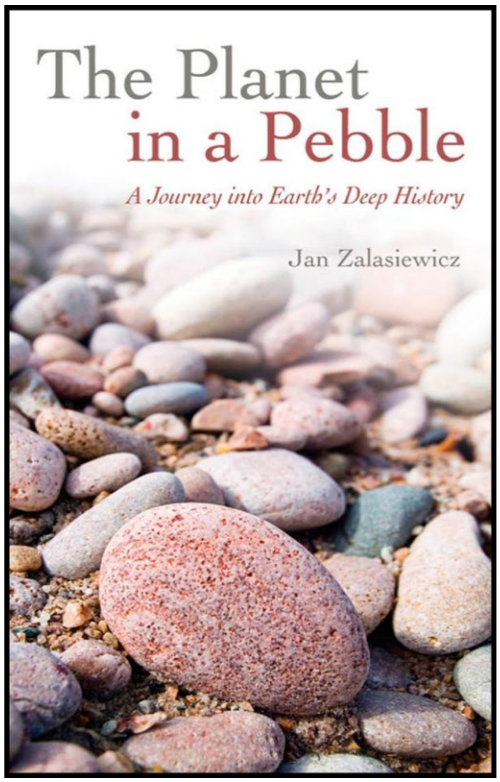
Fred Spier



The essay below by British geologist Jan Zalasiewicz looks at the work of Comte de Buffon from a modern geological point of view. It is planned to be the first of a series of essays in *Origins* about works of earlier universal scholars seen from the standpoint of science, and big history, today. Centuries ago, some of these scholars had very similar aims as modern big historians. But their contributions have largely been forgotten or are considered outdated, because their universal insights were often lost amid the process of academic specialization that gathered speed in the nineteenth century.

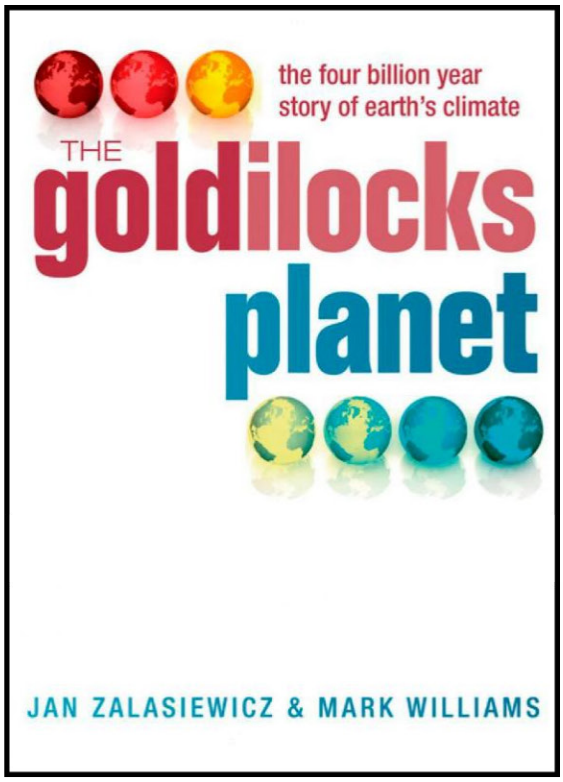
To be sure, many of those earlier ideas are indeed outdated, not least because science had not yet provided all the data and insights available today. Yet even with their far more limited empirical knowledge some of these scholars were very perceptive, while they sought to interpret everything from a universal point of view. They may therefore be considered forerunners of big history and, in consequence, deserve our attention today as early pioneers. Bringing these universal thinkers back to life and tracing their influence on, and importance for, big history are major aims of this planned series of essays.

These essays may also teach us a lesson of modesty, namely that everything we do in big history today is also based on contemporary scientific knowledge, which keeps changing, as I have witnessed myself teaching big history over the past twenty years. As a result, our story keeps changing, too, while over time some of our insights may become just as outdated as those of earlier universal scholars.



Jan Zalasiewicz is an outstanding British geologist, who has combined studying the minutest detail with the grandest possible overviews. He is part of a team of geologists that, in 2008 CE, proposed formal consideration of the *Anthropocene* as a geological epoch. His books, all highly recommended, include:

2008 *The Earth After Us: What Legacy Will Humans Leave in the Rocks?*
2010 *The Planet in a Pebble: A Journey into Earth's Deep History*
2012 (together with Mark Williams) *The Goldilocks Planet: the four billion year story of Earth's climate*



Encore des Buffonades, mon cher comte?

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The cat returns – naturally. Not to be loved or hated this time, but simply – anatomized. Peer into the feline soul, and what do we find? Our cat sits and listens. To hear, now, that it has 'an innate malice, a false character, a perverse nature'… (a paw is licked, thoughtfully) … which age increases even more and education only masks'. The green eyes open a little wider. The analysis continues. The words are of 'determined thieves … flexible and flattering like rogues … they have the same deftness, the same taste for wrongdoing, the same bent for plunder … the appearance of attachment is seen by … their ambiguous looks'. The cat looks up, ambiguously, and yawns. One aristocrat can always recognise another.

The aristocrat here – the clumsy two-legged one, that is – is George-Louis Leclerc, the Comte de Buffon. He is giving a taxonomic description of a creature that had not long ago been called Felis catus – though he had no truck with this classification. The binomial epithet, Linnaeus's new invention, was to him quite simply inadequate and – worse – a guess at inferred biological relationship. Buffon gave much thought to this kind of problem, and to many others. He was a scientist by choice even before the profession properly came into being. He lived long – but, luckily for him, not too long. He died in 1788, just a year before the French Revolution. Had he lived longer, Madame Guillotine would likely have claimed him (she took, instead, his son[1]).

Political fashion aside, Buffon was influential – Ernst Mayr called him the most important naturalist between Aristotle and Darwin. He was quite literally epoch-making. To be precise, he made seven of them (the cat, in its domestic variety, appeared in the seventh). The epochs will detain us later. As far as stratigraphy goes, it wasn't a bad start. But first things first.

George-Louis Leclerc was born into the kind of family that might figure in the slow, patient novels of a century ago. They lived at Montbard, in the Bourgogne region of France. Generation by generation, by judicious choice of employment and spouse, they climbed gradually higher.
Labourers first, most likely; then a barber-surgeon's apprentice, who earned enough to send his son to train as a doctor – and his son, in turn, became a local judge. This was Buffon's grandfather. Buffon's father became a lawyer – and bought the rights to collect the unpopular (but lucrative) salt tax locally. Marriage improved the family prospects yet further – his wife's uncle was wealthy (from tax collection, also), and he was childless, too, so when the young George-Louis arrived into the world, it was a good move to ask him to be godfather. He died soon after, leaving his fortune to the infant: with it, the father bought for him the rights to the holding of Buffon, a small village a few miles away, and the lord's rights to the castle there.

The young Buffon, therefore, grew up into a tradition of careful and solid security: a lesson that he wasn't to forget. He could – he should – have grown up to become a person of some standing in local government. But, somehow, he became France's greatest naturalist. That's the assessment of Jacques Roger, his biographer, made in the full knowledge of that redoubtable trio who followed him – Geoffrey St. Hilaire, Lamarck and Baron Cuvier. (The shade of the Baron, at least, may well be taking offence at this point.)

He trained in law – but during his studies developed a taste for the scientific ideas then being discussed, avidly, among small groups of like-minded people. He declared that he would be a scientist. His father was not amused, not least because that profession barely existed – and even if he secured any kind of position, it would mean stepping down (or falling off) the social ladder. The young George-Louis was to prove him wrong, on both counts. Relations with his father seem never to have been good. They took

a turn for the worse when the father, a widower, married a young woman, threatening George-Louis's inheritance from the rich uncle. George-Louis threatened a lawsuit, and won. He kept the Montbard estate, and its castle, and that provided him with a base – and a workplace – for the rest of his life.

His career, too, progressed – because he carefully cultivated his contacts and, mainly, because he developed a tradition of work (12 to 14 hours a day) that he sustained, day in, day out, for the rest of his life. He made his reputation first with mathematics, obtained a junior position at the Academy of Sciences, researched (at Montbard, largely) the properties of timber, then became head of the Royal Botanic Gardens. He had arrived.

Mathematics had been abandoned: at the highest levels, it wasn't his calling. He was an effective administrator, both at the Gardens and at Montbard. His own studies turned to natural history, and over a lifetime he systematically described everything, from minerals to animals and plants – to humans, even, in his Histoire Naturelle, amounting to 36 volumes. Voluminous in every sense, but brilliantly written, it put him on the same kind of level as Voltaire and Rousseau in public philosophical debate.

His most widely read work, though, was shorter in content – a single slim volume – but the one that ranged most widely over time and space. It was Les Époques de la Nature – the story of the Earth, written late in his life. Vividly imagined, evocatively written, popular with the public, controversial among his peers and more than a touch heretical, it was also the first science-based narrative of the Earth: its first stratigraphy. It was the crowning achievement of a remarkable life.

It is curious that there seems to be no English translation of Les Époques. Not just in modern times – there seems to be no translation, even, that can be tracked down in the contemporary electronic jungle (a jungle that otherwise seems to have developed quite respectably deep roots, temporally speaking). Is that because Buffon became so quickly passé, a figure of the ancien régime, that he dropped out of sight with uncommon speed? Or is it, as Jacques Roger notes, because he wrote too much: all those weighty volumes of the Histoire Naturelle, mostly published in his lifetime. Now, the Origin of Species isn't a slim paperback – but it's just a single doorstop of a book at least. Or is it because he was too popular? He wrote French beautifully, evocatively, excitingly – and he wasn't shy of big ideas. So, with more than a hint of sour grapes, some of his fellow savants spoke of him as a 'phrasemonger', the inference being that that excluded him from the highest levels of the scientific elite.

Perhaps. For whatever reason, he's not terribly well served in the English-speaking world. For a quick introduction, there's a fine essay by Stephen Jay Gould (with whom, by the way, there is a more than a hint of resemblance as regards character, scientific and literary), in The Lying Stones of Marrakech. There is also an English-language version of Roger's biography of him. That's rather larger, and dauntingly comprehensive, but it's a gem. Very considerable scholarship is worn lightly and with elegance – and, as a bonus, is quite beautifully translated by Sarah Lucille Bonnefoi. There's John Lyon's and Phillip Sloan's varied compendium. And there's also honourable mention of Buffon in Martin Rudwick's magisterial (no, there really is no other word for it) accounts of the origins of geology in The Meaning of Fossils and Bursting the Limits of Time.

Nevertheless, Buffon remains somewhat in the shade of his illustrious successors as regards the big ideas of the day. Take the question of extinction, for instance – the idea that, long ago, strange and unfamiliar plants and animals walked the Earth, then died out. In my mental landscape, taken largely from Rudwick[2], it is Cuvier who 'invented' extinction, by showing that the mammoth is both different from the elephant and is nowhere present today. It's a lovely, persuasive account. But Buffon, I am now persuaded, got there first.

It's all there in Les Époques. The structure of the book is a little unusual to modern eyes, mind. There is a 'First Discourse', a kind of introduction, then the main text – the seven epochs given a chapter each – followed by a considerable amount of 'Justifying

Notes' – in which detailed evidence to support the narrative is provided, chapter by chapter (there's a useful glossary, too).

Part of the reason to have the 'First Discourse' was to get the apologies in first. Buffon was writing, of course, when the religious orthodoxy held considerable sway, and when it was dangerous to one's career – even when one was as well-connected and politically astute as Buffon was – to disseminate ideas that ran counter to prevailing biblical interpretation. It is sometimes said that Buffon scorned the religious hierarchy, and wrote his apologias in carefree irony. But to me he seemed to be taking care to cover his back, and was genuinely concerned to placate the Sorbonne (which was then the main theological college in France). Thus, after working hard to argue that the Biblical timescale – that he was about to shatter – was written metaphorically rather than literally, he wrote that his 'purely hypothetical' ideas concerning the Earth could in no way harm the 'unchanging axioms' of religious faith, that were 'independent of all hypothesis'. The stratagem worked, on the whole – though he did have some anxious moments on the way.

In that 'First Discourse', he noted that in rock strata there were the remains of animals and plants that could not be found in nearby land or in adjoining seas. Therefore, these had either died out, or moved elsewhere on Earth. So there, at the beginning of the main text, there is a modest suggestion, hedged about with some caution.
Go to the 'Notes Justificatives', though, and the equivocation disappears. He quotes the 'large petrified volutes' (i.e. ammonites, that were 'up to several feet across'),'bélemnites', 'numismales' (nummulites) and other such that were common in the limestones around Paris. The significance of these, he noted, for sure depended on 'long study and reflective comparison of all of the species of petrifactions found in the heart of the Earth': that is, he was looking forward to the start of a science, not yet born, that came to be palaeontology. Nevertheless, 'these examples, and others I can cite, are sufficient to prove that species of shells and crustaceans used to be present in the sea that do not exist any longer'. You can't have a clearer – and more reasonably founded – statement than that.

He also detailed at length reports of enormous fossil skeletons pulled from the swamps adjoining the Ohio River, in North America. These had bones and tusks (of 'very good ivory') resembling those of an elephant – but the teeth were quite different, without complex grinding surfaces, but terminating in five or six blunt points, thus being more like those of a hippopotamus. After considering, then rejecting, the notion that these might represent a mixture of elephant bones and hippopotamus teeth (among many bones, none other like the hippopotamus were found) Buffon concluded that this was an animal that had not survived to the present. For 'an animal that is larger than an elephant cannot hide anywhere on Earth and still remain unknown'. This was pretty much the argument that Cuvier later, and influentially, applied to the mammoth. Here was Buffon using this logic two decades (and one political revolution) earlier, on what we now know as the mastodon.

There's more to Les Époques, though, than one flash of palaeontological insight (a lucky hit, some might say). In this first attempted history of the Earth (and of the planets, indeed), from beginning to end, time's arrow flew inexorably from the white heat of (non-divine) creation to envisage a future Earth, frozen and biologically dead. It is a history derived from the evidence of the ground, some seen by him personally, and the rest taken from his prodigious reading and correspondence. A good deal of the history is not original to him, but was a weaving together of ideas that were then beginning to circulate, by word of mouth or in print. But le tout ensemble is his alone. And the evidence told him, quite clearly, that Bishop Ussher's few thousand years did not come close to being sufficient. The Earth had to be older. How much older?
His measuring stick was essentially the same as that later used by Lord Kelvin – the cooling of the Earth. In an early trial run at Les Époques, the 'Theory of the Earth', one of the first volumes of his Natural History, he had, in effect, an Earth without a history, without a beginning or end. (It was somewhat akin, indeed, to that of James Hutton's vision). Within a

rather vague timescale, land and sea, now and then, changed places. Later, though, he was persuaded (through Leibnitz's work) of an originally molten state of the Earth. That fitted in with the evidence he knew of (such as that temperature increased upon descending into mines underground), and with the overall vision that he was developing. Moreover, it gave him a measuring stick for Earth time.

How to calibrate that measuring stick, though? He heated up variously-sized balls of iron and measured how long they took to cool. Measuring the temperature of such objects was not so simple, then. Buffon did not trust the crude thermometers of the day (this was when ideas of phlogiston were still current, remember) and measured instead the time it took for the ball to cool sufficiently to be held by hand for a minute without injury[3].

Projecting his data gave him a figure of 75,000 years since the Earth had formed as a molten globe. He was aware that the error bars were very large, and he was very deliberately conservative. But, even so, that gave a starting point for the whole narrative. He, and the Earth itself, could begin.

How to construct an Earth? In Buffon's chosen process, the first epoch begins with a comet striking a glancing blow against the sun, the material flung out then condensing as the planets, that therefore start their existence as molten masses surrounded by vapour. They subsequently cooled – but how did the Sun stay white-hot? Buffon did not (deign to?) consider it as, for instance, a stupendously large burning coal-ball. For him, it was the effect of all the bodies of the Solar System, seen and unseen, orbiting around it. He thus seems to be invoking gravitational stretching and squashing – which is what we now know provides the heat energy to keep, for example, the volcanoes of Io erupting. Buffon was wrong, of course (the effect on the Sun is trivial) – but he was thoughtfully and interestingly wrong.

In the second epoch, the Earth cools, and begins to solidify. A crust develops on the surface, and this develops wrinkles and ridges – these are the present mountain chains – and, beneath those, bubbles that become underground caverns and cavities (he was to need those, later). To us now, it may seem that he had actually gone backwards from a steady-state Huttonian Earth where mountain ranges rose and fell, to a single-cycle Earth that has retained its primordial contours to the present day.

That would be a little unfair. In creating the first science-based whole-Earth narrative, he was positing a logically consistent succession of different states, through his empirically determined time scale. This fixed time scale could only allow a single basic geography, so this is far from Hutton's 'deep time'. Nevertheless, to a child beginning to swim, the shallow end of a pool may seem scarily deep. Even with his 75,000 years, Buffon went out of his way to reassure his readers (who measured time in hours, years and, perhaps, human lifetimes), suggesting ways to them of mentally coping with the unimaginable temporal abyss of those seventy-five millenia (think in terms of money, he said, and not years[4]).

It took, he said – extrapolating from his iron-ball experiments – two thousand, nine hundred and thirty-six years for the Earth to solidify. Even as he wrote, he knew these figures were likely out by orders of magnitude[5]; but he maintained this precise conservatism partly, perhaps, to avoid his readers contemplating yet more outlandish time-spans, partly not to deepen his sinfulness vis-à-vis the watchful Sorbonne, and partly to keep the story rattling along. Because, goodness me, the story does move on. In its original version, shorn of the notes, glossary – and without Roger's illuminating but lengthy commentary in the widely-recommended 1962 edition – it's just a shade over two hundred pages long – and that's with large print and small pages. It's a slim paperback ideal for a short railway journey – had railways been invented then, of course.

So, on with the story. Buffon word-paints a picture of a solid, but still hot, Earth wreathed in water vapour, a jagged barren landscape formed of igneous ('vitrescible') rocks. Below, precious metal ores form within rock fractures – and there's a lot on the details of this: metals were big business, of course, then as now, and a good early school for practical geology.

Some thirty to thirty-five thousand years after the Earth formed, he reckoned, it was cool enough for the gathering rainfall to begin to settle on the surface, without instantly being vaporised, as thick mists swirled, and tempests raged. It's evocative stuff, reminiscent of Conan Doyle (or Jules Verne); one can see how the lay reader could be entranced – and the scientific establishment could look on, a little sniffily. And what an ocean formed! Buffon took the information he had – that strata with fossils could be found on mountains up to 4,000 metres high – and that's where he placed the primordial sea level.

It was a Waterworld – but one where the broad-brush geology is perfectly sensible. There's no debate here between Plutonism and Neptunism. Buffon simply states, matter-of-factly, that the primary rocks are broken down, decomposed by the water to produce the salts in the world ocean and the sands and muds that accumulate in layers on the sea floor. What's more, he sees the link between muds and shales and slates, attributing the various states of these strata to different degrees of drying and compaction (his one-way history doesn't allow for much in the way of metamorphism).

There was lithostratigraphy, though, based on that of the hills and valleys around his beloved Montbard. He is clear that, in that region, there are layers of shale, overlain and succeeded by limestone. He describes, for instance, the three-dimensional connection between a well sunk in a valley (through fifty feet of shale) and the layers of limestone in the valley sides above. The limestone is full of shells, so the stuff of the rock, therefore, is made of the remains of countless generations of ancient animals; they extracted their shell-material out of the waters in which they lived (into which it had previously been put, of course, by the action of the waters upon the primordial fire-rock). Ancien régime, perhaps, but there's some very modern-seeming sedimentary geochemistry here.

Now, he sees that the shales contain many fossils, too – those ammonites and belemnites. Life, therefore, appeared in his history pretty much together with the formation of sedimentary strata. The organic particles of which life is made, he thought, more or less automatically formed themselves into complex organisms, as soon as conditions became tolerable for life. There is no long gestation period for organic molecules here, still less any notion that it is the smallest, simplest kind of life that comes first. Life is thus an inevitable, and immediate, outcome of chemistry – on the Earth and, he said, on other planets too.

Buffon was not an evolutionist in anything like the modern sense or, indeed, really at all. But in a sense he was a biostratigrapher, for he could see that, in any one place, there was a succession of strata and fossils (the 'elephant bones' from the surface sediments he knew came later than the ammonites). Perhaps more exactly, he was a biogeographer charting the course of life, as it followed the conditions of a changing Earth.

The pattern in such a model was – must be – clear and logical. The first regions to cool are the polar regions, and this is where rain first falls, and the oceans first gather. The cooling proceeded equator-wards, and the watery and habitable zone followed. Indeed in one of Buffon's more Hollywood-esque flights of fancy, he saw the southern tips of South America and southern Africa as having been carved by the ocean waters, as they rushed northwards from the southern ocean (he had no idea, then, that those waters might conceal an Antarctica).
The polar regions, therefore, saw complex and abundant life while the low latitudes remain fiercely hot and inhospitable. As the Earth cooled, the polar regions gradually congealed, and the baton of life was passed on towards the equator. Species of animals and planets migrated, became extinct, or came into existence – assembled ready-formed from organic particles – as the Earth's climate belts migrated. It's phantasmagoric stuff, but somewhere in there lie the beginnings of palaeoclimatology.

That might be stretching it a touch. But there is, for sure, in Buffon's account of his third epoch, some astonishing palaeoenvironmental reconstruction. For as well as the ammonite-bearing shales, he was aware that, elsewhere, there were strata containing coal seams. He knew that the coal strata and the marine shales tended to be tilted[6] and near-

horizontal, respectively, and he guessed correctly that the marine shales lay on top. He could see, too, that the coal-bearing strata contained many impressions of plants that looked 'tropical' in nature, hence fitting in nicely with his cooling trend.

The coals, he went on, were the remains of the Earth's first vegetation, swept from the mountaintops that poked above the water, and into the sediment layers that surrounded them. Successive layers of plant debris and mineral sediment accumulated, to form the many layers of coal in these beds. He wondered at the immense amount of plant material that grew and was buried, and mused on the immensity of past time that they must represent. More: he expressly compared these ancient coal-accumulating environments with the mouths of the Mississippi and the Amazon – and then (in some detail) with the coastal swamps of Guyana, where trees live and die and fall into the morass, there to decay[7].

As an identification of a modern analogue, it's a bulls-eye. Not that he saw any of these places, but he travelled in his mind through his extensive correspondence and his voluminous reading. The mind, he said once, is the best crucible.

In his fourth epoch, the waters receded, and the land masses (draped with fossil-bearing strata) were exposed. The water went, he thought, underground, as the roofs of caves and caverns (those bubbles in the cooling crust, you might recall) cracked and foundered (accompanied by earthquakes), allowing the waters to drain downwards.

As the sea-level dropped, another phenomenon began: volcanism. This is not just Buffon trying to please the book-buying public, to pack as much of the Earth's genuine melodrama as possible into his narrative. It was his deduction of cause-and-effect in Earth processes, based upon imperfect information, mostly drawn from secondary sources. He knew that many active volcanoes were at or near sea level – Stromboli, Etna and so on. He also knew that there were extinct volcanoes in France, inland on high ground in the Auvergne. This was before, too, scientist-explorers such as Alexander von Humboldt explored the high Andes, to bring back reports of Chimborazo and Cotopaxi.

Therefore, he reasoned, the mechanism that produces volcanic eruptions is something to do with the proximity of rock, air and water – and he surmised the spontaneous, catastrophic combustion of minerals such as pyrite. It was wrong, of course, but for the day not unreasonable[8]. And, it gave his pen free rein to indulge in colourful descriptions of a ravaged Earth with emerging (and foundering) landscapes, vanishing seas and volcanoes. Once the general mayhem died down, though, the world, now just 15,000 years ago, emerged into the fifth epoch, with new lands: the northern kingdom of the giant elephants.

Buffon knew of the many finds of bones that resembled elephants, rhinoceri, hippopotami and such in Europe – and the stories of similar bones, extracted in large numbers from the frozen lands of Siberia. He more or less ignored the common assumption that their remains had been swept into those regions by Noah's Flood. He knew there were simply too many of these skeletons for such an explanation to be true. And – other than his carefully crafted assertions, aimed at the Sorbonne, of the absolute primacy of divine scripture – he did not try to look for evidence of Biblical events in the strata (and criticized those who did). He simply interpreted the evidence in terms of natural – i.e. physical, chemical and biological – processes[9].

For him, this was evidence of a warmer Earth – still unbearably hot in the tropics, he thought, but with a tropical-style fauna inhabiting northern lands that are now mostly frozen wastes. And those lands might have been yet hotter, because some of the Siberian bones were larger than those of modern elephants. Thus, although he did not distinguish elephant from mammoth (as Cuvier was to do later), he did note differences. He ascribed these to what we might today call ecophenotypic variation, with morphology controlled by environment (in this case, temperature). This fitted, quite reasonably, within his over-arching narrative of a cooling Earth.

With the sixth epoch there came the separation of the continents. For the bones of the 'elephants' were scattered across Europe, Asia and North America. Thus, he deduced there must have been free movement, then, between these continents. It's not quite continental drift that Buffon is invoking here. It is ocean formation, though – that of the Atlantic, in particular – with Buffon invoking former connections between North America, Greenland, Scotland, Scandinavia. It is another episode of crustal foundering that he saw as the cause. Islands such as the Azores and Newfoundland are seen as remnants of a former landmass, the great 1755 Lisbon earthquake is mentioned as, in effect, an after-shock of these larger crustal displacements and (of course) the legend of Atlantis is brought in, too.

The Earth's new geography though, remained old in human terms. For he could see the new, later stratigraphy was building: the Nile and Mississippi deltas, the coastal plain of Guyana, built of Amazon muds. These new (and enormous) masses of sediment must, he saw, have post-dated the birth of the Atlantic. As we get nearer to the present, Buffon's timescale, amazingly, is not so far off our modern late Pleistocene-Holocene chronology. And, of course, these new landscapes were the foundation of the seventh epoch: the epoch of mankind.

It has a curious title: Lorsque la Puissance de L'homme a secondé celle de la Nature . That doesn't mean that the power of human actions on the Earth were secondary to natural forces – but rather that they assisted them. Here, humans arise (as an animal species set apart from all others) and begin to transform the world. It is the first real expression of the Anthropocene concept[10], and it is mixed in with history that is both real (Egyptian, Chinese) and very speculative (a much earlier, peaceful and enlightened civilization). Generally Buffon saw this as a good thing – not only in itself, but because humans could, for a while, warm the world and stave off the final, terminal freeze. He finishes as an optimist, looking forward to humanity seeking glory not through war but through science – and finding true happiness in peace[11].

Well, it was quite an epic, in scope if not in length. There was something to please – and annoy – everybody. The reception it received was mixed – and, among Buffon's fellow savants, generally critical. The atmosphere is nicely given by a letter written (and perhaps sent) by Jean Etienne Guettard[12], which can only be referring to Les Époques. 'Yet more Buffonades, my dear Count…' it begins, going on (in rather rambling fashion, to be honest) to first faintly praise the 'delicate and elegant phrases' with which Buffon 'with brilliant spirit, like Syrano (sic) de Bergerac', traced his 'hypothetical ideas'. Guettard then made clear that he thought this brilliance was put to ends that were not worthy of 'the great Buffon' who was now 'incorrigible, and that is not good, my dear Count, that is not good'. The fine adventure story, he went on, warming to his theme, 'would be devoured by the maidservant and then amuse the lackey' – but it was unworthy of one who could shine a light for the most sublime Spirits…

In truth, Buffon's optimistic cosmology of his first epoch offered an easy target. Even as he was writing, realisation was dawning that comets were not objects that were sufficiently large and dense to tear planet-sized masses of material from the Sun. And, there were complaints, as predicted, from among the theologians, who realised the significance of Buffon's timescale for the literal interpretation of the Scriptures. But, these were an annoyance rather than a danger for Buffon – who, in any event, was hard at work on continuing the Histoire Naturelle, with the world of minerals his latest enthusiasm.

And, Les Époques did bring him a new readership that went far beyond the servant classes that Guettard seemed so disdainful of. Catherine the Great of Russia ordered a copy, was captivated – not least because her Siberia was shown as a cradle of life on land – and corresponded with Buffon over the next two years. Buffon was delighted, and replied in glowing (if not downright flattering) tone to the formidable monarch.

As royalty went into sharp decline just after Buffon's death (he was 81), so did his reputation, at least in

France. Even in natural history, these things matter, and the reputation of the man ennobled by Louis XV suffered with respect to that man of the people, Citizen Linnaeus. And, of course, there came the wave of the new with Cuvier et alii, to eclipse the works of the past.

Buffon might rest, today, in the shade of his illustrious successors. But he's not to be forgotten completely, as the man who tried to put together a truly holistic account of the Earth and its inhabitants. And did it in style. Indeed, the phrase he is probably most associated with now, is 'le style c'est l'homme même' ('the style is the man himself').

At this point, one might detect, somewhere in that comfortable spot in the back of the room, a superior twitch of long whiskers. The paws stretch out, sleepily. There is no need, though, to wake to loudly protest the case. It is naturally self-evident that the monopoly of real style on this planet has been entirely feline – from long, long before the seventh epoch.

Endnotes

1 It's a sad story. The young Buffonet (the nickname says it all, really) could not live up to the almost superhumanly high standards set by the father. His youth was short and somewhat erratic. He came of age, briefly, in the Revolution – joining, indeed, the revolutionaries. This revolution, famously and greedily, ate its own children – even the adopted ones. There came a denunciation – and after that, the scaffold. His last words, facing the tricoteuses, were 'Citizens, my name is Buffon'.
2 'Life's revolutions', Chapter 3 in *The Meaning of Fossils*.
3 One suspects that with trial and error of this sort, occasional injury was part and parcel of the process. Worse, it seems that Buffon regarded women's hands (more sensitive, you see) as the best measuring devices. Scientific, perhaps, but not ideally gallant.
4 Well, that might have worked for the wealthier of his readers.
5 His unpublished manuscripts show that he was stretching his timescale, some forty-fold, to three million years. Out of prudence, he didn't publish this.
6 The tilting he thought was due to the sedimentary layers accumulating on steep slopes.
7 So frequently in those thick forests, he noted, that travellers needed to be careful to sleep next to healthy and not rotting trees, to avoid being crushed in their sleep.
8 The most violent eruptions, we must recall, are typically phreatomagmatic ones, where the flash-heating of water suddenly introduced into a magma chamber can greatly increase the explosivity of an eruption.
9 Jacques Roger discusses at length the evidence of what religious belief Buffon may or may not have had. He didn't give much away in his writings, and attended Mass regularly – because that was the done thing. Roger's view is that privately Buffon was by and large an agnostic.
10 Crutzen, 2002.

Acknowledgements

I am indebted to Jacques Grinevald for prompting me to explore Buffon's life and work (and for his subsequent comments on this essay). The initial motive was utilitarian – his role in the Anthropocene story – but there were many and deeper layers to Buffon's life and work, as I came to realise.

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Response to "Towards a Theory of Big History"

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Oregon State University

In last month's edition of Origins I was struck by the importance of Dr. Blanks' critique in his article, "Towards a Theory of Big History." In considering a response, I found myself concerned with these and other basic problems and thought it helpful to reiterate and expand on them here.

The challenges facing the nascent study of Big History all seem to center around two questions: What are the goals of Big History, and according to these, how should it define its terms? That is to say: When BH describes the patterns and governing principles it promotes (now accepted and included in most if not all books on the subject), is it talking about the universe as an historical account of both the 'natural' and 'human' variety? Is it talking about the universe by proposing a hypothesis based on observation that will be scientifically tested? Or is it simply providing a framework for educational and personal purposes that is fulfilling and enhances one's interaction with science and history writ large, without making any assumptions about the physical validity of its guiding principles?

If BH's main function is to inspire youth to become future generations of scientists then it will have to answer criticisms from those most threatened by its presence in the classroom. A clear explanation of the "how and why we know" behind the BH story will be paramount. But if BH in fact suggests that it has observed something novel about how the universe works, then more is required- a clear agenda for BH as a discipline and a body of research supporting will also be critical to its success.

These do not exist at present. For example, BH discusses all developments across time with regard to 'Goldilocks conditions' under which energy flows lead to the rise of new forms of complexity. We talk about these processes anecdotally. How carefully can measure them? Define the laws by which said phenomenon behave? Make predictions?
To clarify, I do not believe the issue is, "Can I study not only the way in which increased energy flows led to the formation of Sumerian city-states, but also the daily life of a peasant from Ur?", as Blanks mentions. This is an issue, but the greater concern is: Can Big History study how increased energy flows lead to the formation of anything at all? BH has grown quickly to fill many different niches in a select academic and lay community, and before it is even able to crawl we seem to be asking it to run.

My personal experience with Big History has been overwhelmingly positive! I would love to see it brought to classrooms across the United States and beyond. I would also love to see it become more than an educational tool, and it is for this reason that the rapid spread of BH before its purpose is well defined concerns me, because I fear that acting without proper preparation might undermine both aims.
Big History can be an important step towards the formation of an interdisciplinary research community examining trends across multiple fields to discover patterns of relatedness that specialists might easily overlook. In an age of ever increasing information surfeit this task grows more necessary every day.

Whether in the classroom, the lab, or on paper- I do not believe Big History will succeed as a discipline if it does not make a case for itself as being more than a modern creation narrative. Like the science and the history that have made it possible, the assertions made specifically by and for Big History should be supported by compelling, carefully examined research.

- Matthew McConnell, I would love to hear your comments and criticisms! mccon1mj@gmail.com

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)
Group Rate: $139 (by 5pm local time, July 11th, 2014)

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 6th, 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.

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:

Global Institute of Big History
LOH110
Brooks College of Interdisciplinary Studies
Grand Valley State University
1 Campus Drive
Allendale MI 49401-9403
USA

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 out to the International Big History Association

- ☐ Member Early - $295.00 (USD) IBHA Member Early Registration Rate.
- ☐ Member Late - $355.00 (USD) IBHA Member Late Registration Rate
- ☐ Member Regular - $325.00 (USD) IBHA Member Regular Registration Rate.
- ☐ Non-Member Early - $395.00 (USD) IBHA Non-Member Early Registration Rate
- ☐ Non-Member Late - $455.00 (USD) IBHA Non-Member Late Registration Rate
- ☐ Non-Member Regular - $425.00 (USD) IBHA Non-Member Regular Registration Rate
- ☐ Student Member Early - $150.00 (USD) IBHA Student Member Early Registration Rate
- ☐ Student Member Late - $210.00 (USD) IBHA Student Member Late Registration
- ☐ Student Member Regular - $180.00 (USD) IBHA Student Member Regular Registration Rate
- ☐ Guest Registration - $150.00

A Thank You and a Welcome!

Leslye Allen has served the IBHA as Office Coordinator since the office was first established. She has moved on to a full time position in the Brooks College at Grand Valley State University. We have all been very fortunate to have such a dedicated and capable staff member. Leslye says that, "It has been nothing less than a great experience and not a job for me. I have also just joined as a member! Someday, I'd like to join a committee, but after I get a bit settled." We may not let you wait that long, Leslye!

And now we are delighted to warmly welcome Donna Tew, who started as the IBHA Office Coordinator on April 1st. She will be a wonderful asset for the Association.

Leslye Allen and Donna Tew

Photo: Craig Benjamin

Donna comes with a very strong background in office administration, financial management, special events organization, and travel. She has worked in other offices at GVSU in the past, and has strong references and also considerable experience with the campus culture. Donna is already hard at work on the August IBHA conference, membership, and other tasks. Leslye was able to spend time helping train Donna, for which we are grateful. The other really fortunate part of all this is that the IBHA Office is literally less than one minute's walk away from Leslye's new office, and about three minutes (across the parking lot) from Craig Benjamin, the Treasurer of the IBHA. Our thanks to Craig and Pamela Benjamin for leading two highly successful job searches.

We are happy to welcome Leslye as the IBHA's newst member and Donna as our new Office Coordinator!

A Movement to Divest Stock in Fossil Fuel Companies

By Cynthia Stokes Brown

For the last eighteen months Bill McKibben and his campaign to return carbon dioxide levels to 350 ppm (see www.350.org) have been urging churches, universities, foundations, and cities to divest their investments in fossil fuel companies. On April 5, 2014, the trustees of Pitzer College, one of The Claremont Colleges in Los Angeles, voted unanimously to sell its shares in fossil fuel companies by Dec. 31, 2014, along with other plans to reduce the carbon footprint of the college. The trustees hope that Pitzer can be a model for other colleges and universities. (See http://www.fortmilltimes.com/2014/04/12/3413083/pitzer-college-and-robert-redford.html). At Harvard University, President Drew Faust has made statements against divestment, prompting the faculty to craft in April 2014 an open letter of protest. (See http://www.harvardfacultydivest.com/) Since IBHA is an academic organization, some of its members may be facing this issue on their campuses or may wish to raise it.

Of course, it is too easy just to blame the fossil fuel companies. We, the consumers, are creating the demand. Most of us are using fossil fuel to heat our homes, cook our food, and drive around town and on long trips. We know this is damaging our environment, yet we cannot figure out how to stop. IBHA, as an international organization, is also dependent on fossil fuels. As the costs of fuel and air travel increase, holding our conferences will become more difficult. Can we start discussing this dilemma? Please send any ideas you may have for how IBHA can reduce its carbon footprint for inclusion in Origins.

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http://ibhanet.org/