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History of the Earth, Laboratory of Revolutions

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History of the Earth, Laboratory of Revolutions

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With the exception of the astronomical and cosmological debates of the 16th and 17th centuries, Geology is the scientific discipline that, in early modern and modern European history, seems to be most entangled with politics and authority—possibly the one in which some of the most anti-authoritarian stances of the 18th century were held. It is also the field in which (in an anticipated homage to Reinhard Koselleck's famous remarks) for the first time the meaning of 'revolution' seemingly changed from circularity to linearity.

1. The True Philosophy of Nature

je veux que désormais,
La Physique en fouillant la profondeur des mines,
Ne découvre par-tout qu'un amas de ruines,
Et lise avec effroi dans les bancs souterrains,
L'histoire de la terre et celle des humains.[1]

* University of Turin (*enrico.pasini @ unito.it*). This note is an extensive revision of two papers I first gave during a panel on "Anti-Authoritarianism in Natural Philosophy: Radicalism and Folk Intuitions" that Charles Wolfe and I organized at the 7th ESHS conference in 2016, and then as a talk at the "Metamorfosi dei Lumi" seminar in Turin. I am grateful to all who participated in the discussions on both occasions, but they might be too many to list here.

[1] Claude-Adrien Helvétius, *Le Bonheur, poéme, en six chants. Avec des Fragments de quelques Epitres* (Londres [Lyon?]: s.n., 1772), 90. "Maintenant, (…) c'est par la connoissance de l'histoire présente de la terre, [que l'imagination] s'éleve à la connoissance de sa formation. Instruite par une infinité d'erreurs, elle ne marche plus, dans l'explication des phénomenes de la nature, qu'à la suite de l'expérience"; Claude-Adrien Helvétius, *De l'esprit* (Paris: Durand, 1758), 489.

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'History of the earth', or 'Earth history', is the original appellation of what we now call 'geology'.[1] A charged science, heavily symbolic, it developed contemporaneously with the birth of the philosophy of history and of 18th-century materialist theories of the origin of life. It inaugurated the vision of an abysmally long past in the natural sciences. Historiography has mainly—and separately—considered either the clash between 'scientific' and 'biblical' accounts of the origins of the world,[2] or the early 19th-century phase of this process and especially its connection with theories of the origin and development of life,[3] although it is also clear that there are multiple threads connecting both phases and attitudes, and even much overlap.

With the exception of the astronomical and cosmological debates of the 16th and 17th centuries, geology is the scientific discipline that, in early modern and modern European history, seems to be most entangled with politics and authority. But geology—differently from astronomy or mechanics—is born as a science of the past (in principle 'post-dictive'[4] rather than predicitive). The present state

[1] A reference is here de rigueur to Rhoda Rappaport, *When Geologists Were Historians, 1665-1750* (Ithaca, NY: Cornell University Press, 1997). But it must be noted that the expression 'theory of the Earth' is perfectly contemporary and is used in the titles of works by, among others, Burnet, Whiston, Hutton, Cuvier.

[2] See e.g., among the most classic studies: Charles C. Gillispie, *Genesis and Geology: A Study in the Relations of Scientific Thought, Natural Theology, and Social Opinion in Great Britain 1790–1850* (Cambridge, MA: Harvard University Press, 1951, 1996[2]); Martin J. S. Rudwick, *Bursting the Limits of Time: the Shaping of Scientific Geohistory in the Age of Revolution* (Chicago: University of Chicago Press, 2005); Martin J. S. Rudwick, *Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago: University of Chicago Press, 2008); Paolo Rossi, *The Dark Abyss of Time: The History of the Earth and the History of Nations* (Chicago: University of Chicago Press 1984).

[3] See, e.g., Alan Desmond's noted *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (Chicago: University of Chicago Press, 1989).

[4] A notion famously championed by George Gaylord Simpson, "Historical Science", in Claude C. Albritton (ed.), *The Fabric of Geology* (Reading, MA: Addison-Wesley, 1963), 24-48, applied to geology as a science concerned with the configurational properties of physical objects in the past. The concepts of postdictability and postdiction had already been used by Hans Reichenbach and Carl Gustav Hempel, apropos of determining past data in relation to probabilistic knowledge; postdictive inference in geology has a classic description in David B. Kitts, *The Structure of Geology* (Dallas: Southern Methodist UP, 1977), 8, 14-16. This view can be contrasted with the statement attributed to Roderick I. Murchison: "Being a geologist, I am an ancient geographer"; quoted by Matthew Duncan, "On the Formation of the Main Land-Masses", *Proceedings of the Royal Geographical Society* 22 (1878): 68.

is, at the same time, sign and result of a history—initially of a *sacred* kind, but such that in a pinch it mutates into a desacralizing item.

When looking at the present state of things, its initial concern was with events that might serve as indications of divine presence. The first appearance of the modern sense of 'geology' is believed to be found in Escholt's *Geologia Norvegica*, a work in Danish that appeared in 1657 and was translated into English in 1663.[1] It dealt mainly with earthquakes, seen as present-time disorders in an originally perfect nature, as well as prodromical signs.[2] Such interweaving of disasters and sacred history would be a hallmark of the discipline for a considerable period.

In a discourse "On the Present State of Geology" delivered at the Parisian Muséum d'histoire naturelle, for the opening of the Geology course, on May 1, 1802—that is, in the same year in which Lamarck published his *Hydrogéologie*—Barthélemy Faujas-de-St.-Fond, who was at the time the only geology professor in France, timidly declared:

> Geology, that science whose aim is the theory of the earth, is beginning to attract the serious attention of learned men and scientists of all nations; its progress is taking a more methodical form; the French are eagerly showing their taste for this beautiful study (…) the ardour with which it is pursued proves better than anything else that it is of interest to scholars, men of letters, and in general to all enlightened people, whose upright minds and high genius like to contemplate the operations of nature in great detail.[3]

[1] Mickel Pedersøn Escholt, *Geologia Norvegica: Det er en kort Undervisning, om det viitbegrebne Jordskelff, som her udi Norge skeede mesten ofuer alt, Syndenfields, den 24. Aprilis udi nærværende Aar 1657. Sampt Physiske, Historiske oc Theologiske fundament, oc grundelige Beretning, om Jordskelffs Aarsager oc Betydninger* (Christiania: Mickel Thomesøn, 1657); *Geologia Norvegica, Or, A Brief Instructive Remembrancer, Concerning that Very Great and Spacious Earthquake, which Hapned Almost quite through the South Parts of Norway upon the 24th Day of April, in the Year 1657, also Physical, Historical, and Theological Grounds and Reasons Concerning the Causes and Significations of Earthquakes*, transl. by Daniel Collins (London: S. Thomson, 1663).

[2] According to *Geologia Norvegica*, minerals are produced in the Earth by fire, or by occult causes (e.g. influence of celestial bodies) and other secret and incomprehensibles manners, that remind us of the divine omnipotence; mines are inhabited by spirits, who sometimes are very dangerous as they can even destroy the mines and kill the miners. Although theologians differ on the causes of earthquakes (whether their only cause is God's power, or there are natural causes by which the Almighty occasions their production), they are forerunners of some forthcoming unusual event, and in general of the Last Day.

[3] "La Géologie, cette science qui a pour but la théorie de la terre, commence à fixer sérieusement

This "beautiful" theory must be considered as "the true philosophy of nature" (*la véritable philosophie de la nature*), since it is "constantly supported", he writes with a possible jibe at some German circles, "by facts".[1] Facts of this sort: "So many irrefragable witnesses attest to events of the greatest order, terrible upheavals, periods of calm and reproduction, often interrupted by new disasters"; "these great upheavals, of which our globe has been the victim on several occasions".[2] In this work 'upheavals', 'revolutions' (violent or calm, shorter or longer), 'catastrophes' (the most recents of which produced the animal fossils that have occupied natural philosophers since the 16th century), are the basic concepts, the combination of which outlines the history of the earth.[3]

In sum, it would seem, it presented itself as a 'true' philosophy of disruptions; yet this can also be seen as a particular moment in the development of geological vocabulary: "The technical vocabulary of early geology included at least three terms—monuments, revolutions, and accidents—so commonplace in eighteenth-century writing that only one of the three, monuments, has been in part recognized as fulfilling a peculiar function at that time".[4]

'Monuments' was borrowed from the language of historiographers and meant essentially 'sources', 'documents', remains of the past that inform on it. Jussieu, for instance, wrote that:

In the necessity of explaining the manner in which figures of plants or shells found in various parts of France imprinted on several types of stone, could be made, without there

l'attention des hommes instruits, et des savants de toutes les nations; sa marche prend une forme plus méthodique; les Français manifestent avec empressement leur goût pour cette belle étude; (…) l'ardeur avec quelle on s'y livre prouve mieux que tout ce qu'on pourrait dire, combien elle intéresse les savants, les hommes de lettres, et en général toutes les personnes éclairées, dont l'esprit droit et le génie élevé aiment à contempler en grand les opérations de la nature", Barthélemy Faujas-de-St.-Fond, "De l'état actuel de la géologie. Introduction", in *Essai de géologie, ou mémoires pour servir à l'histoire naturelle* (Paris: Patris, 1803), 1-2.

[1] Faujas, "De l'état actuel", 2-3.

[2] "Tant de témoins irréfragables attestent donc des événements du plus grand ordre, des bouleversements terribles, des périodes de calmes et de reproductions, interrompues souvent par de nouveaux désastres" (Faujas, 3); "ces grand bouleversements, dont notre globe a été plus d'une fois victime" (Faujas, "De l'état actuel", 220)

[3] See e.g. Faujas, "De l'état actuel", 311.

[4] Rhoda Rappaport, "Borrowed Words: Problems of Vocabulary in Eighteenth-Century Geology", *The British Journal for the History of Science* 15, no. 1 (1982): 27.

being in the region or in the vicinity bodies that could have served as types for these impressions, I have assumed some extraordinary revolution which preceded us by a long time, such as that of some flood.[1]

Here the discoveries of fossils are precisely called *monumens*, 'monuments', i.e., documents testifying to these revolutions. Rappaport suggests a distinction (which is indeed attested in the sources) between universal and local revolutions, with the latter being the main case. As she remarks, this use of 'revolution' is not inceptive: Steno had no special word for such cataclysms; Hooke spoke unconvincingly of 'earthquakes', but had he "developed this theory twenty years later, he might well have said 'revolutions' instead of 'earthquakes', and with different results". Revolutions were historical changes to the earth's crust, "occurring in series", just like astronomic or political revolutions. "Like 'monument', 'revolution' possessed some novelty in the early decades of the century, and it became a conventional, normal, unexamined part of the vocabulary of Georges Cuvier and his older contemporaries".[2]

This novel character is confirmed, inter alia, by the case of the main classical source for such material. In his *Geography*, Strabo had already discussed the findings of shells in the mountains and inner lands thousands of miles from the sea. He criticized Strato's and Eratosthenes' theories concerning extraordinary events that would change sea levels (like the crumbling of a rocky wall in the place were the Street of Gibraltar would open, and Hercules would subsequently build two columns, allowing the beforehand higher Mediterranean waters to flow into the ocean). Instead, he pointed to more common events, not necessarily slow or imperceptible, but which one would abstain from wondering at: the rising and subsiding of the terrain, volcanic eruptions, earthquakes. But he fully accepted the idea of geographical variability induced by these causes. The word used for these geographical (not yet geological) metamorphoses was

[1] "Dans l'obligation d'expliquer la maniere dont s'est pû faire l'impression des figures ou de plantes, ou de coquillages qui se trouvent en divers endroits de la France sur plusieurs sortes de pierres, sans que l'on puisse rencontrer dans le pays ni dans le voisinage des corps qui ayent pû servir de types à ces impressions, j'ai supposé quelques révolutions extraordinaires qui nous ont précedés de longtems, telle que seroit celle de quelque inondation", Bernard De Jussieu, "De l'origine des pierres appellees yeux de serpents et crapaudines", in *Histoire de l'Académie Royale des Sciences: Année 1723* (Paris: Durand, 1753), 205.

[2] Rappaport, "Borrowed Words", 37.

metaschematismoi,[1] transformations, rendered in the Latin and Italian versions that were available before the 19th century,[2] with *singulares mutationes*[3] and *particolari trasfigurationi*;[4] other instances of change large and small, natural and political, were simply *metabolai*, changes, translated as *mutationes* and *mutamenti*. This, as we shall see, was going to change.

2. Revelation and Revolutions

Steno, the pious founder of stratigraphy, writes in his *Prodromus* (1669) that "In regard to the first aspect of the earth Scripture and Nature agree in this, that all things were covered with water; how and when this aspect began, and how long it lasted, Nature says not, Scripture relates". *Scriptura loquitur*: the Scripture is, at least in this case, more loquacious than geological remains.[5] The same happens as for the second aspect, *secunda terrae facie*, whereas the subsequent phases (for a total of six) are more clearly exhibited by Nature (*Natura demonstrat*)—yet again without any opposition to Scripture.[6]

[1] Strabo, *Geogr.* I, iii, 4.

[2] I have no knowledge of a French translation in the 16th-18th centuries, which of course does not mean that there was none.

[3] Strabo, *Rerum geographicarum libri XVII*, ed. by Isaac Casaubon, Lat. transl. by Wilhelm Xylander (Paris: Typis Regiis, 1620), 49 (the same expressions are found in the 1571 edition).

[4] Strabo, *La prima parte della Geografia di Strabone*, transl. by Alfonso Buonacciuoli (Venezia: Francesco Senese, 1562), 22v.

[5] Nicolaus Steno, *The Prodromus of Nicolaus Steno's Dissertation Concerning a Solid Body Enclosed by Process of Nature Within a Solid*, transl. by John Garrett Winter·(New York: Macmillan, 1916), 263. "De prima terrae facie in eo Scriptura, et Natura, consentiunt, quod aquis omnia tecta fuerint; quomodo sero, et quando coeperit, et quanto tempore talis extiterit, Natura silet, Scriptura loquitur", Nicolaus Steno, *De Solido intra solidum naturaliter contento Dissertationis Prodromus* (Florentiae: sub signo Stellae, 1669), 69.

[6] Steno, *Prodromus*, 69-70.

Concordism and biblical geology will outlast the developments of Earth science, although this specific kind of earth history begins to evanesce, for the purpose of scientific development, in the 1780s with James Hutton's geological theory, in which there are neither beginning nor end to be observed or inferred, and everything on the terrestrial globe has been produced, in interminable times, by the slow operation of ordinary natural causes.[1] But still in 1809 the Swiss meteorologue, fossil collector and geologist Jean-André Deluc was desperately promoting the battle in favor of orthodoxy and the authority of Scripture: "The weapons of those who attack [the Revealed Religion] have changed, and the defence must conform to them: it is attacked by Geology, and this is necessarily a science to be acquired by theologians, as essential as that of ancient languages".[2]

[1] "But if the succession of worlds is established in the system of nature, it is in vain to look for any thing higher in the origin of the earth. The result, therefore, of our present enquiry is, that we find no vestige of a beginning, — no prospect of an end"; James Hutton, "Theory of the Earth; or an Investigation of the Laws Observable in the Composition, Dissolution, and Restoration of Land upon the Globe", *Transactions of the Royal Society of Edinburgh* 1, no. 2 (1788): 304 (when printed separately, p. 96). No catastrophes, no Floods, nor the eventual retreat of the sea: the continents undergo erosion, depositing sediments at the bottom of the ocean, which are compressed by water into rock formations, subsequently uplifted by volcanic activity to form new continents, as well as penetrated by volcanic rocks. Lyell recalls the "imputations" of "infidelity and atheism" against 'volcanists' (Charles Lyell, *Principles of Geology, Being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes now in Operation* [London: J. Murray, 1830], vol. 1, p. 67-68). "Above all, the aqueous doctrine [of the German geologist Abraham Gottlob Werner] was orthodox while the igneous doctrine was heterodox" (Edward W. Claypole, "Darwin and Geology", *The American Geologist*, 1 [1888]: 154). See also ch. 1 of Jan M.I. Klaver, *Geology and Religious Sentiment: the Effect of Geological Discoveries on English Society and Literature between 1829 and 1959* (Leiden: Brill, 1997).

[2] "Les armes de ceux qui l'attaquent ont changé, et il faut y conformer sa défense: on l'attaque par la *Géologie*, et c'est nécessairement une science à acquerir par les théologiens, aussi essentielle que celle des anciennes langues", Jean-André Deluc, *Traité élémentaire de géologie* (Paris: Courcier, 1809), 3-4. One can also mention the rather serious efforts of Andrew Ure, *A New System of Geology, in which the Great Revolutions of the Earth and Animated Nature, Are Reconciled at once to Modern Science and Sacred History* (London: Logman, 1829). It is a minor staple of provincial anti-Illuminism: "de Luc a fait voir que Moïse a été un fidèle historien de la terre, et que ces soi-disant observateurs qui affectent de le mépriser, malgré toutes leurs prétentions ne font en géologie que balbutier auprès de lui. On n'a pas essayé de lui répondre", wrote Pierre Gourju, *La Philosophie du dix-huitième siècle dévoilée par elle-même, ouvrage adressée aux pères de familles et aux instituteurs chrétiens* (Lyon, Perisse Frères, 1816), vol. 1, p. 237.

The season of true concordism begins with Burnet's *Telluris theoria sacra*, in which an imaginative use of Cartesian science is used to show that earth history, when properly interpreted, not only does not contradict Scripture, but rather confirms it. "Supported by the sole words of Scripture, I could never convince myself that the rainbow could have existed before the Flood. I became more and more convinced of this view as I tested it against natural reasons".[1] And when history is silent (for instance, regarding antediluvian longevity), now theory can supply,[2] "so that even when history is silent, the consent of the recalcitrant may be elicited by the evidence of that very thing".[3]

Burnet speaks at first like the Latinized Strabo: in the title of this work, he mentions as his subject the *mutationes generales* of the Earth, and remarks that his subject matter, of which "there is nothing else, it seems to me, in which the mind can be more honestly occupied", will encompass "the greatest vicissitudes and changes of things, and as it were the natural history of the world when is born and when it perishes".[4] These 'changes', mutationes, are all brought back

[1] "Quare nunquam a me impetrare potui, solis verbis Sacrae historiae nixus, ut crederem, Iridem fuisse in coelo seculis ante-diluvianis. In qua sententia magis magisque confirmabar, cum ad rationes naturales eam exegissem", Thomas Burnet, *Telluris theoria sacra orbis nostri originem et mutationes generales, quas aut jam subiit, aut olim subiturus est, complectens. Libri duo priores de diluvio et paradiso* (London: R. Norton for W. Kettilby, 1681), 206. On the one hand, "ea quae possumus attingere lumine Naturae, non sint proprie objecta aut materia revelationis" ("Things we can get by natural light are not properly objects or matter of revelation", 115); on the other hand, with an argument that is also reminiscent of Galileo, if not of Campanella, "non minus repugnare veracitati divinae, facultates animae, quas ipse Deus condidit, esse falsas; quam Scripturam Sacram, quam ipse dictavit, esse falsam: Cumque utriusque sit author Deus (…) et admissa utriusque divina origine, id maxime cavendum, ne Deum Deo opponamus" ("It is no less repugnant to divine truthfulness that the faculties of the soul, which God himself created, are false; than that the Holy Scripture, which he himself dictated, is false: since God is the author of both (…) once we admit the divine origin of both, we must be very careful not to set God against God", 7).

[2] "Et cum Cœlum ante-diluvianum juxta Hypothesin nostram, plane aliud fuerit ab hodierno, illius constantia et benignitas tantum profuere vivacitati, quantum hodierni asperitas et inconstantia eidem adversantur. Et quidem licet omnis historia hac in re siluisset, ex sola theoria et rei ipsius intuitu facile pronunciassem, Res omnes animatas, et viventium formas, in mundo primaevo, quam hodierno, multo fuisse permanentiores" (Burnet, *Telluris theoria sacra*, 176).

[3] "ut tacente Historia, rei ipsius evidentia vel reluctantibus assensum extorqueret" (Burnet, *Telluris theoria sacra*, 283).

[4] "non aliud occurrit, ut mihi videtur, in quo magis honeste occupari possit ingenium, quam haec ipsa, in qua versamur, materia; quae majores rerum vicissitudines et mutationes, et quasi historiam

to a universal one, after which only ruins remain: "Good God, if I feel anything to be true, or if it is given to a mortal to judge and discern rightly, a broken world has collapsed, and we inhabit its ruins" (*fractus orbis collapsus est, et nos habitamus ipsius ruinas*).[1]

Burnet mentions indeed 'revolutions' without waiting for the 18th century, but not in the *Telluris theoria sacra*. In the *Archaeologiae philosophicae* of 1692 he already uses 'revolution' in an extended sense, where both planetary revolutions, sweeping cataclysms, and universal restitutions (palingeneses, *revolutiones mundanas*) are intended: "a necessary change of the created and uncreated world; together with the order of all things in the created world, both intellectual and corporeal: throughout all ages, all revolutions, forms, and faces, until there is a return to the state of the Uncreated World".[2] He calls them precisely 'revolutions' and 'catastrophes',[3] and purports to find them not only in the Scripture, but in pagan writers as well:

> although Plato mentions neither the Flood nor the Conflagration in these revolutions and catastrophes of the world, he nevertheless mentions a great concussion of Heaven and Earth, under this transformation of things; and from that concussion everything are disturbed, and every kind of animal became extinct. Which (…) corresponds not obscurely, according to our opinion, (…) to the events of the Flood.[4]

naturalem nascentis et denascentis mundi complebitur" (Burnet, *Telluris theoria sacra*, 4).

[1] Burnet, *Telluris theoria sacra*, 104.

[2] "Vel, ut idem pluribus enunciemus, est vicissitudo necessaria mundi creati et increati; una cum ordine rerum omnium in mundo creato, tam Intellectualium quam Corporalium: per omnia saecula, omnes revolutiones, formas, et facies, donec regressus fiat ad statum Mundi Increati"; Thomas Burnet, *Archaeologiae philosophicae, sive Doctrina antiqua de rerum originibus* (London: R. Norton for W. Kettilby, 1692), 437.

[3] Edmund Halley, unconvinced by the solutions proposed by Burnet, although he recognized that "the Earth seems as if it were new made out of the Ruins of an old World", such as fossil remains ("Some Considerations about the Cause of the Universal Deluge, Laid before the Royal Society, on the 12th of December 1694", *Philosophical Transactions* 33 [1724-1725]: 122), proposed the shock of a comet, as a natural means possibly used by God to start the universal Flood, to account for "the strange Catastrophe we may be sure has at least once happened to the Earth" (123).

[4] "Denique, licet in his mundi revolutionibus et catastrophis, nec Diluvii, nec Conflagrationis, meminerit Plato: Ingentem tamen concussionem Coeli et Terrae, sub hac rerum conversione, memorat; atque ex illa concussione perturbata omnia, et extincta omne genus animalia. Quod (…) in Diluvio factis, (…) secundum sententiam nostram, non obscure respondet" (Burnet, *Archaeologiae philosophicae,* 484-85).

In the development of concordist geology, when new theories will extend this framework from the Flood to the very phases of creation, such great upheavals are precious. Its main intellectual resource is summarized a century later by Deluc:

It seems, then, that the days of Creation signify only periods. Time is nothing to the Divinity, and centuries are but instants in the duration of the Universe. We believe, therefore, that we may extend these periods as necessary, without departing from Moses' account; provided, that in the various stages of the formation of the universe, we do not invert the order of the days, as recorded by this Sacred Historian.[1]

Catastrophes mark the various passages from one stage to the next, while in the time that follows, the previous states remain only as remnants and ruins.[2] This is a durable, as said, but also a mutable framework. At the beginning of the 19th century, James Parkinson still evokes these "remains of a former world" which surround us, changed "in their appearance, during the revolution of innumerable ages".[3] On the one hand, we have one "vast revolution, which this planet has experienced"; there is also a particular event, i.e., the universal flood that can be described as an "astonishing revolution of the earth", a "grand

[1] "Il semble donc que les jours de la Création, ne signifient que des périodes. Le tems n'est rien pour la Divinité; et les siècles ne sont que des instans dans la durée de l'Univers. On croit donc pouvoir allonger ces périodes au besoin, sans s'écarter du récit de Moyse; pourvû que dans les différens progrès de la formation de l'Univers, on n'intervertisse pas l'ordre de ces jours, tels que cet Historien Sacré les rapporte", Jean-André Deluc, *Lettres physiques et morales sur l'Histoire de la Terre et de l'homme* (Paris: Veuve Duchesne, 1779), vol. 1, p. 357.

[2] Hutton himself cannot avoid the mention of ruins, but they are not the result of extraordinary commotions: we see "rivers undermining the sides of mountains, and causing scenes of ruin and destruction", James Hutton, *Theory of the Earth: with Proofs and Illustrations* (Edinburgh: Creech, 1795), vol. 2, p. 102; "the mountains are degraded, the ruins of those mountains are amassed at their feet, and the sea is making constant encroachments on the coast, while those travelled materials are gradually protruded into the sea" (in the posthumous *Theory of the Earth: with Proofs and Illustrations. Vol. III*, ed. by Archibald Geikie [London: Geological Society, 1899], 183).

[3] James Parkinson, *Organic Remains of a Former World: An Examination of the Mineralized Remains of the Vegetables and Animals of the Antediluvian World*, vol. 1, *The Vegetable Kingdom* (London: C. Whittingham, 1804), 8. Practical matters are at the center of his work: "laying thus crushed together, in a rude and confused mass, they are suffering those changes, by which they become the chief constituent parts of the limestone, which forms the humble cottage of the peasant; or the marble, which adorns the splendid palace of the prince" (8).

revolution" beyond the powers of the human mind[1]. On the other hand, many more special revolutions must have taken place, that we are similarly unknowledgeable of. When charcoal is found inside compact ironstone, as reported by a fiable source,

> By what natural, or artificial fire, this charcoal was burnt, or by what singular revolution it was carried into the depth of from three to four fathoms, and there so intimately combined with the iron-stone that it seems to form one body with it, he observes, no mineralogist can with certainty explain.[2]

Who is 'he'? Parkinson is quoting from Cramer, *Bergrath* at the mining authority of Altenkirchen, who actually says first that no mineralogist can explain these inclusions, and then suggests as a hypothesis of his own, "daß nämlich Holzkohlen in der Gegend auf eine gewöhnliche Art oder durch natürliches Feuer gebrannt, und einige oder mehrere Stücke davon durch eine gewaltsame Revolution der Natur verschüttert und in die Teufe gebracht worden"—that the charcoal was burnt in the region in some usual way or by natural fire, and some pieces of it, or more, have been shed "by a violent revolution of nature" and brought down into the depths.[3]

Note that by the end of the 18th century the language of geological revolutions has reached the normal and practical prose of German engineers. This must have been an acquired habit, most likely due to the influence of the French, where, as we shall see, this terminology had become common more than half a century earlier. Consider the mid-century example of Johann Gottlob Krüger, a German physician who had studied philosophy, then medicine, and had a rapid scientific career, writing books on various natural arguments, and in 1746 published a *History of the Earth*. The core of his theory were three main 'undocumented transformations' of the Earth, namely two earthquakes and a flood. This concept, in German *Hauptveränderungen der Erde*,[4] is translated into French in

[1] Parkinson, *Organic Remains*, 13, 255, 272.

[2] Parkinson, *Organic Remains*, 288.

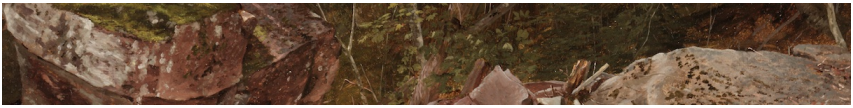
[3] Ludwig Wilhelm Cramer, "Über Merkwürdigkeiten in Eisensteinen", *Der Gesellschaft Naturforschender Freunde zu Berlin Neue Schriften* 2 (1799): 301.

[4] See § 91: "so erhellet daraus so viel, daß drey Hauptveränderungen mit der Erde vorgegangen seyn müssen, davon keine Nachrichten vorhanden sind, nemlich zwey Erdbeben und eine Ueberschwemmung", Johann Gottlob Krüger, *Geschichte der Erde in den allerältesten Zeiten* (Halle: Lüder-

1752 as such: it is clear that the terrestrial globe has undergone 'three major revolutions', *Révolutions capitales*.[1] Such a liberal use of 'revolution' in a natural acceptation even predates, as for French, the 18th century: in Marsilly's 1665 translation of Chrysostom's *Homily 76*, in a section which comments on "And the stars shall fall from heaven, and the powers of the heavens shall be shaken" (Matthew 24, 29), Chrysostom's expression 'this mutation', *tosauten metabolen*, is surprisingly rendered by the translator with 'this great revolution of all nature', *cette revolution generale de toute la nature* .[2]

Also the geological revolutions, quite expectably, will be not only 'capital', but 'general' revolutions as well. In volume 9 of the *Encyclopédie* (1765), in the article "Ivoire fossile", d'Holbach writes:

> We must conclude that in times not rembered in history, Siberia enjoyed milder skies, and was inhabited by animals that some general revolution of our globe has buried in the bosom of the earth, and that this same revolution has entirely changed the temperature of this region.[3]



wald, 1746), 165.

[1] "il paroit évident, que le Globe terrestre a subi trois Révolutions capitales, dont nous ne trouvons aucune mention dans les annales. Ce sont deux Tremblemens de Terre, et une inondation", Johann Gottlob Krüger, *Histoire des anciennes revolutions du globe terrestre, avec une relation chronologique et historique des tremblemens de terre, arrivés sur notre globe depuis le commencement de l'ère chretienne jusqu'à present* (Paris: Damonneville, 1752), 230. Oddly enough, the French title is much longer than the German one, and looks much more like the typical German titles of the time.

[2] Jean Chrysostome, *Homélies ou sermons*, transl. by Paul-Antoine de Marsilly (Paris: P. Petit, 1665), vol. 3, p. 418.

[3] *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers*, ed. by Denis Diderot and Jean le Rond d'Alembert (Paris: Briasson et al., 1751-1772), vol. 9, p. 63. I quote from the ARTFL Encyclopédie Project, edited by Robert Morrissey and Glenn Roe (`https://encyclopedie.uchicago.edu/`https://encyclopedie.uchicago.edu, accessed Dec. 30 2024).

3. Revolutions and Ruins

In the *Encyclopédie*, the first meaning of 'revolution' is the political one: "in political terms, a considerable change in the government of a state. […] There are no states that have not been subject to more or fewer revolutions".[1] There is also a very short article on the revolutions of the Earth ("Révolutions de la terre"), that is, "the name given by naturalists to the natural events by which the face of our globe has been and still is continually altered in its various parts by fire, air and water".[2] Apart from the fact that political revolutions can be many or few, while geological are 'continuous', readers do not get much information. There will be an afterthought concerning the relevance of this topic, aided by a reversed headword and a clever use of the alphabetical order: "Terre, révolutions de la", again written by d'Holbach. Here the distinctions between general and particular (or local) revolutions, as well as between continuous and momentary, are formalized.[3] A beautiful passage describes this universal condition of perpetual revolution, which has post-Butlerian (the ruins) and pre-Huttonian (destroy and produce) features, from a geological point of view, and effectively embodies, from a more general standpoint, a partly Heraclitean, partly Lucretian vision of the natural world:

We see all these causes, often combined, acting perpetually on our globe; it is therefore not surprising that the earth offers us almost at every step a vast heap of debris and ruins. Nature is busy destroying on one side to produce new bodies on the other. The waters are continually working to lower the heights and raise the depths. The waters enclosed within the earth's bosom gradually mine it, making excavations that gradually

[1] "… en terme de politique, un changement considérable arricé dans le gouvernement d'un état. (…) Il n'y a point d'états qui n'aient été sujets à plus ou moins de révolutions", *Encyclopédie*, vol. 14, p. 237.

[2] "… c'est ainsi que les naturalistes nomment les événemens naturels, par lesquelles la face de notre globe a été et est encore continuellement altérée dans ses différentes parties par le feu, l'air et l'eau", *Encyclopédie*, vol. 14, p- 237-38.

[3] "Ces *révolutions de la terre* sont de deux especes, il y en a qui se sont fait sentir à la masse totale de notre globe, & l'on peut les appeller *générales;* d'autres n'operent des changemens que dans de certains lieux, nous les appellerons *locales ;* quelques-uns de ces changemens sont opérés par des causes qui agissent sans cesse ; d'autres sont opérés par des causes momentanées", *Encyclopédie*, vol. 16, p. 171.

destroy its foundations. Subterranean fires break and destroy other places; let us therefore conclude that the earth has been & still is exposed to continuous revolutions, which contribute unceasingly, either rapidly, or little by little, to changing its face.[1]

The following year a devotee of d'Holbach, Nicolas Boulanger, in his *Antiquité dévoilée* (1766), underlines geological evidence for the Flood, the "famous physical revolution" ("cette fameuse révolution physique qui a, dit-on, changé autrefois la face de notre globe"[2]), that he sees as a well-attested natural event which wiped out a refined antedeluvian civilization, whose survivors, shocked by the 'total revolution' of the Earth, imagined that it was due to the wrath of a dispotic god: "the revolution that submerged one part of our globe to expose another, or what has been called the universal deluge, is a fact that we cannot deny, and that we would be forced to believe even if traditions had not told us about it".[3]

Eventually, however, the association of revolutions and ruins will be especially exploited and even exported into human history by another of d'Holbach's followers, Constantin-François Volney, in his famous *Ruins, or Meditations on the Revolutions of Empires*: "The temples are fallen, the palaces overthrown, the

[1] "Nous voyons toutes ces causes, souvent réunies, agir perpétuellement sur notre globe; il n'est donc point surprenant que la terre ne nous offre presque à chaque pas qu'un vaste amas de débris et de ruines. La nature est occupée à détruire d'un côté pour aller produire de nouveaux corps d'un autre. Les eaux travaillent continuellement à abaisser les hauteurs et à hausser les profondeurs. Celles qui sont renfermées dans le sein de la terre la minent peu-à-peu, et y font des excavations qui détruisent peu-à-peu ses fondemens. Les feux souterreins brisent et détruisent d'autres endroits; concluons donc que la terre a été et est encore exposée à des révolutions continuelles, qui contribuent sans cesse, soit promptement, soit peu-à-peu, à lui faire changer de face", *Encyclopédie*, vol. 16, p. 171.

[2] Nicolas Antoine Boulanger, *L'antiquité dévoilée par ses usages, ou examen critique des principales opinions, cérémonies et institutions religieuses et politiques des différens peuples de la terre* (Amsterdam: Marc-Michel Rey, 1766), vol. 1, p. 8. From this we must conclude, that at the time of the Flood, the course of the seasons, the order of nature, and even the march of the universe were suspended for a time, if not completely changed by this revolution ("Que conclure delà, sinon qu'au temps du déluge le cours des saisons, l'ordre de la nature, et même la marche de l'univers a cessé pour un temps, si même elle n'a été totalement changée par cette révolution?", 267).

[3] "… la révolution qui a submergé une portion de notre globe pour en mettre une autre à découvert, ou ce que l'on a nommé le déluge universel, est un fait que l'on ne peut récuser, et que l'on seroit forcé de croire quand même les traditions ne nous en auroient point parlé", Boulanger, *L'antiquité dévoilée,* 10.

ports filled up, the cilies destroyed; and the earth, stripped of inhabitants, is become a place of sepulchres. … Great God! whence proceed these fatal revolutions?"[1] The surface of the Earth, in this case, preserves the remnants of the revolutions of perished countries: "what profound truths are written on the surface of your soil! remembrances of times past, return into my mind! places, witnesses of the life of man in so many different ages, retrace for me the revolutions of his fortune!"[2] On the one hand, we have perpetual vicissitudes, "successive revolutions and returning agitations"[3] that sound sort-of cyclic (although concepts of cyclicity are nearly absent from the text of the *Ruins*). On the other hand, only ignorance engenders such revolvings:

since the errors of progenitors have not instructed their descendants, the ancient examples are about to re-appear; the earth will see renewed the tremendous scenes it has forgotten; new will agitate nations and empires; powerful thrones will be again overturned, and terrible catastrophes will teach mankind that the laws of nature and the precepts of wisdom and truth are not to be infringed with impunity.[4]

It is noteworthy that a footnote, which in its original formulation seems to have an immediate political import, after the window of opportunity has closed, is reformulated in this perspective. This is the first version:

[1] Constantin-François Volney, *A New Translation of Volney's Ruins; Or Meditations on the Revolutions of Empires. Made under the Inspection of the Author*, vol. 1, p. 10 (Paris: Levrault, 1802; repr. New York: Garland, 1979). It is the second English translation, to which Jefferson surely contributed these first chapters; see Thomas Jefferson, *The Papers*, vol. 33, ed. by Barbara B. Oberg (Princeton: Princeton University Press, 2006), 341–342. Cf. "les temples se sont écroulés, les palais sont renversés, les ports sont comblés, les villes sont détruites, et la terre, nue d'habitants, n'est plus qu'un lieu désolé de sépulcres… Grand Dieu! D'où viennent ces funestes révolutions?", Constantin-François Volney, *Les ruines, ou méditation sur les révolutions des empires*, bk. 1, ch. 2 (Paris: Desenne, Volland et Plassan, 1791), 9.

[2] Volney, *Ruins*, 40.

[3] Volney, *Ruins*, 73; "des révolutions successives, et une agitation renaissante", Volney, *Les ruines*, 47.

[4] Volney, *Ruins*, 58; "puisque les fautes des aïeux n'ont pas encore instruit leurs descendans, les exemples anciens vont reparoître la terre va voir fe renouveler les scènes imposantes des temps oubliés. De nouvelles révolutions vont agiter les peuples et les empires. Des trônes puissans vont être de nouveau renversés, et des catastrophes terribles rappelleront aux hommes que ce n'est point en vain qu'ils enfreignent les lois de la Nature, et les préceptes de la sagesse et de la vérité", Volney, *Les ruines*, 47.

It is remarkable that this has in all instances been the constant progress of societies: beginning with a state of anarchy or democracy, that is, with a great division of power, they have passed to aristocracy, and from aristocracy to monarchy. Does it not hence follow that those who constitute states! under the form, destine them to undergo all the intervening troubles between that and monarchy: and that the supreme administration by a single chief is the most natural government, as well as that best calculated for peace?[1]

This token of supporting constitutional monarchy still appears in the 1792 edition. In the 1798 third edition, corrected and augmented of Volney's *Catechism of the Citizen*, the last period is replaced by this much more ambitious formulation: "But at the same time, it would be necessary to prove that social experiments have already been exhausted for the human species, and that this spontaneous movement is not the very effect of its ignorance".[2] Not only has the role of the critique of ignorance and willful error been restored, but the space has been cleared for an open future of new revolutions.

On the one hand, after the French Revolution, one would say, it would be common to speak of geological revolutions, even by non-revolutionary authors: this could even be a way of covertly speaking of the Revolution itself as a kind of catastrophe. On the other hand, natural revolutions, if they are the effect of a divine plan immune from human evil, must not be confused with those brought about by humans. In Cuvier's words, which express at the same time a strong anti-actualism (the position opposite to that of Hutton we mentioned above) and an equally strong desire to separate these two kinds of revolutions:

It has long been thought that we could explain anterior revolutions by existing causes; as in political history we easily unfold past events, when we are well acquainted with the systems and intrigues of our own times. But unfortunately we shall find that this is

[1] Volney, *Ruins*, 81-82; "… ne résulte-t-il pas de ce fait que ceux qui constituent des états sous la forme démocratique, les destinent à subir tous les troubles qui doivent amener la Monarchie, et que l'administration suprême par un seul chef soumis à des règles est le gouvernement le plus naturel, comme il est le plus propre à la paix?", Volney, *Les ruines*, 342-43.

[2] "… subir tous les troubles qui doivent amener la monarchie; mais il faudrait en même tems prouver que les expériences sociales sont déjà épuisées pour l'espèce humaine, et que ce mouvement spontané n'est pas l'effet même de son ignorance", Constantin-François Volney, *Les ruines, ou méditation sur les révolutions des empires. Troisième édition corrigée, et augmentée du Catéchisme du Citoyen Français* (Paris: A.J. Dugour et Durand, An VII [1798-1799]³), 69.

not the case with physical history; the thread of the operations is broken; the march of nature is changed; and not one of her agents now at work would have sufficed to have affected her ancient works.[1]

The same separation, however, had already been possible from the antipodal political standpoint, and on the basis of opposite geological conceptions. Human revolutions had become the backbone of history in Condorcet's *Outline*:

Every thing tells us that we are approaching the era of one of the grand revolutions of the human race. What can better enlighten us as to what we may expect, what can be a surer guide to us, amidst its commotions, than the picture of the revolutions that have preceded and prepared the way for it?[2]

The models of these 'grand revolutions' were not cyclic, nor astronomical, but, if any, geological. For Condorcet, again, rocks and fossils are "authentic monuments of the ancient revolutions of the globe".[3] He is not speaking of exceptional catastrophes, but, on the one hand, of the interminable action of erosions and eruptions, and on the other hand, of even older revolutions carried out by agents still unknown:[4]

[1] "… l'on a cru long-temps pouvoir expliquer, par ces causes actuelles, les révolutions antérieures, comme on explique aisément dans l'histoire politique les événemens passés, quand on connaît bien les passions et les intrigues de nos jours. Mais nous allons voir que malheureusement il n'en est pas ainsi dans l'histoire physique: le fil des opérations est rompu; la marche de la nature est changée; et aucun des agens qu'elle emploie aujourd'hui ne lui aurait suffi pour produire ses anciens ouvrages", Georges Cuvier, "Discours sur les révolutions de la surface du globe", in *Recherches sur les ossemens fossiles de Quadrupèdes: où l'on rétablit les caractères de plusieurs espèces d'animaux que les révolutions du globe paroissent avoir détruites* (Paris: Déterville, 1812), vol. 1, p. 117. Translation from Georges Cuvier, *A Discourse on the Revolutions of the Surface of the Globe, and the Changes Thereby Produced in the Animal Kingdom* (Philadelphia: Carey and Lea, 1831), 17.

[2] Nicolas de Condorcet, *Outline of an Historical View of the Progress of the Human Mind* (Philadelphia and New York: M. Carey et al., 1796), 22. "Tout nous dit que nous touchons à l'époque d'une des grandes révolutions de l'espèce humaine. Qui peut mieux nous éclairer sur ce que nous devons en attendre; qui peut nous offrir un guide plus sûr pour nous conduire au milieu de ses mouvemens, que le tableau des révolutions qui l'ont précédée et préparée?", Nicolas de Condorcet, *Esquisse d'un Tableau historique des progrès de l'esprit humain. Ouvrage posthume de Condorcet* (Paris: Agasse, an III [1794]), 19.

[3] Condorcet, *Outline*, 170; " monumens authentiques des anciennes révolutions du globe", Condorcet, *Esquisse*, 219.

[4] The Gesellschaft der Wissenschaften in Göttingen (Blumenbach against Cuvier, so to say) awarded

Men who have long possessed no other knowledge than that of explaining by superstitious or philosophical reveries the formation of the earth (…) have learned to ascertain the effects of the slow and long continued action of the waters of the sea, of rivers, and the effect of volcanic fires; to distinguish those parts of the surface and exterior crust of the globe, of which the inequalities, disposition, and frequently the materials themselves, are the work of these agents; from the other portion of the surface, formed for the most part of heterogeneous substances, bearing the marks of more ancient revolutions by agents with which we are yet unacquainted.[1]

Ruins and revolutions, at least in the revolutionary field itself, were swiftly moving from geology to history. As Shelley wrote on July 23, 1816, in his *Mont Blanc, Lines Written in the Vale of Chamouni*:

> the rocks (…) have overthrown
> The limits of the dead and living world,
> Never to be reclaimed.

in 1818 a prize for a work which would offer "the most thorough and comprehensive study of the changes in the earth's surface that can be traced in history, and the application that can be made of such knowledge in the study of earth revolutions that lie outside the realm of history" (quoted in Johannes Walther, *Einleitung in die Geologie als historische Wissenschaft* [Jena: Fischer, 1894], XV). This distinction between historical *Veränderungen der Erdoberfläche* and extra-historical *Erdrevolutionen* mirrors this page of Condorcet's, be it intentional or not.

[1] Condorcet, *Outline*, 223-224. "Les hommes qui n'avoient su longtemps qu'expliquer par des rêves superstitieux ou philosophiques, la formation du globe, (…) ont appris à y reconnoître les traces de l'action lente et long-temps prolongée de l'eau de la mer, des eaux terrestres et du feu; à distinguer la partie de la surface et de la croûte extérieure du globe, où les inégalités, la disposition des substances qu'on y trouve, et souvent ces substances mêmes, sont l'ouvrage de ces agens; d'avec cette autre portion, formée en grande partie de substances hétérogènes et portant des marques de révolutions plus anciennes, dont les agents nous sont encore inconnus", Condorcet, *Esquisse*, 271-72.

4. Down from the merry-go-round

Political revolutions have long been considered as recurrent phenomena similar to astronomical revolutions,[1] a view that is famously represented in the so-called Polybian circle of constitutional 'change',[2] which, after a natural establishment of power, proceeds according to natural laws through six forms of polity, each of which undergoing genesis and decadence, in a sequence from monarchy to tyranny, aristocracy, oligarchy, democracy, ochlocracy, and finally monarchy again, repeatable in principle ad infinitum. "Voila la revolution des Estats et des Republiques, voila l'ordre de la Nature, suivant lequel la forme des Republiques se change, et retourne en son premier estre".[3]

Such "is the circle", according to Machiavelli, "in which all States turning about have been and are governed"; but not only is he unconvinced that it's possible to repeat it, even its completion seems unlikely to him: "seldom do they return into the self same Governments: for hardly any Common-Wealth can be of so long durance as to undergo so many changes, and yet stand afoot".[4] What usually happens, is that a nation is conquered by a neighbor; "but were

[1] It seems true that the concept was always political when it was not naturalistic: even Antoine Varillas's *Histoire des révolutions arrivées dans l'Europe en matière de religion* (1688) was devoted to political revolutions fueled by religious conflicts, which the author considered to be an explicit goal of the Protestant field; just as those of Rousseau's *siècle des révolutions*, they consisted in the toppling of monarchs.

[2] The usual *metabole*.

[3] "Here is the revolution of States and Republics, here is the order of Nature, according to which the form of republics changes, and returns to its original state", Polybius, *Les histoires, avec les Fragmens ou extraits du mesme autheur, contenant la pluspart des Ambassades. De la traduction de P. Du Ryer* (Paris, A. Courbé, 1655), 377, translating Polyb., *Hist.* VI, 9, 9-10. The term rendered with 'revolution' is *anakyklosis*, the 'order of nature' corresponds to *physeōs oikonomia*. From the complex of sources we have cited, Early-Modern English and French seem to be more forthcoming in their use of 'revolution' than Italian and German from the same centuries. Yet, 'Totalrevolution' is a word coined in 18th century German: it predates the French Revolution and is used not only in medical, administrative, and political contexts, but also in geological contexts—with both positive and negative intentions (e.g., support or opposition to Cuvier). Many English uses of 'revolution' as political change, both as a cyclic event or as an overturn, are described by Christopher Hill, "The Word 'Revolution' ", in *A Nation of Change and Novelty: Radical Politics, Religion, and Literature in Seventeenth-Century England* (London: Routledge, 1990), 82-101.

[4] Niccolò Machiavelli, *Discorsi*, I, 2; *Machiavel's Discourses Upon the First Decade of T. Livius, translated out of the Italian, by E.[dward] D.[acres]* (London: Ch. Harper and J. Amery, 1674[2]), 13.

it not for this, a State were alwayes capable of revolution into these sorts of Government (*a rigirarsi infinito tempo in questi governi*)".[1] In principle, these revolutions are potentially infinite—It is not that Machiaveli did not appreciate novelty;[2] but he had a naturalist idea of human vicissitudes and a perennialist view of nature. The *Discourses* present us with a world of unlimited duration, and a nature—including human nature—eternal and unchanging in its principles.

In Burnet's *Archaeologia* there was an *Appendix* he described so: "On the Brahmins of the present day among the Indians, and their doctrines, it will not be ungrateful, I think, nor alien to the purpose, to attach here, by way of an Appendix, some of their doctrines concerning the Origins and Revolutions of Things".[3] An Indian philosopher deals with the nature and history of our globe also in the clandestine opus of Benoît de Maillet, a diplomat, historian and amateur scientist who in 1729 wrote a *Nouveau système du monde, ou entretien de Talliamed philosophe indien avec un missionnaire francois divisé en trois conversations*, which would circulate secretly, be repeatedly reworked and be published posthumously twenty years later, having soon an English translation.[4]

The Indian philosopher Telliamed, anagram of the author, presents first of all a remarkable epistemology. We are told that Telliamed, instead of first attempting to investigate the origin of our globe, has begun, one might say more scientifically, with the study of its nature. In this way, indeed,

[1] Machiavelli, *Discorsi*, I, 2; *Machiavel's Discourses*, 14.

[2] For instance, one who becomes prince of a state, "the best expedient he can finde, for the maintenance of that Principality, is, that he (himself being a new Prince) make everything new in the State, as […] in the Cities to make new Governments with new names, with new jurisdictions, with new men, and to enrich the poor". Machiavelli, *Discorsi*, I, 26; *Machiavel's Discourses*, 91. Making the rich poor is neglected, as a new prince's innovations plainly have limits. Rousseau will be more open to it.

[3] 'De Brachmanis hodiernis apud Indos, eorumque dogmatibus' non ingratum erit, opinor, nec a proposito alienum, de eorum dogmatis circa rerum Origines et revolutiones, per modum Appendicis, quaedam hic attexere", Burnet, *Archaeologia*, 471.

[4] Benoît De Maillet, *Telliamed, ou, Entretiens d'un philosophe indien avec un missionnaire françois sur la diminution de la mer, la formation de la terre, l'origine de l'homme, &c.* (Amsterdam: L'Honoré et fils, 1748); *Telliamed, or, The World Explain'd: Containing Discourses between an Indian Philosopher and a Missionary, on the Diminution of the Sea, the Formation of the Earth, the Origin of Men and Animals: and Other Singular Subjects, Relating to Natural History and Philosophy; a Very Curious Work* (London, T. Osborne, 1750).

he has discovered the true Origin of this Globe, how and by whom it was formed. Hence, by natural Consequences, he has fixed in some Measure, not the first Instant of its Existence, which he did not believe possible for human Reason to do, but the Period at which it commenced to be habitable, that in which it began to be peopled, and that in which it may cease to be so.[1]

The culmination of this research is the discovery and delineation of a condition of perpetual and universal revolution: "He has also laid before us all the Revolutions, to which not only this Globe, but all the others in the Universe, may be subject in the Immensity of Ages".[2] Revolutions in the skies are not only astronomical movements but, primarily, cyclical cosmic processes: "the opaque Globes become luminous, while those last become dark, and intirely lose ther Light (…) this continual Circle of Revolutions is formed and renewed perpetually in the vast Immensity of Matter".[3] These 'revolutions' also entail celestial displacements, movements of planets from one system (a Cartesian vortex) to another. They cause great alterations, especially increases or decreases of surface waters such as those that have completely covered our globe in the past:

in these Revolutions, our Planets entering into other Vortices, are, with respect to the principal Star, in Dispositions, different from that in which they are at present, (…) Now in these Differences, the Waters with which they are now covered, will be augmented, or diminished according to their greater or less Proximity to the Star.[4]

[1] De Maillet, *Telliamed, or the World Explain'd*, xviii-xix; "Par la matiere et l'arrangement de ces compositions, il prétend avoir reconnu quelle est la véritable origine de ce Globe que nous habitons, comment et par qui il a été formé. De-là, par des conséquences naturelles, il a crû pouvoir fixer en quelque sorte, non le premier instant de son existence; ce qu'il ne lui a paru possible d'exécuter par le raisonnement humain, mais celui où il a commencé d'être habitable, celui où il a commencé d'être peuplé, et celui où il peut cesser de l'être", De Maillet, *Telliamed, ou Entretiens*, vol. 1, p. xx.

[2] De Maillet, *Telliamed, or the World Explain'd*, xix; "il nous a exposé comme en perspective toutes les révolutions ausquelles, selon lui, non pas cette terre seulement, mais encore cette infinité de Globes que renferme le vaste univers, doivent être sujets dans l'immensité des siecles", De Maillet, *Telliamed, ou Entretiens*, vol. 1, p. xxi-xxiii.

[3] De Maillet, *Telliamed, or the World Explain'd*, xxv; "les globes opaque deviennent lumineux, tandis qu'au contraire ceux-ce s'obscurcissent et perdent entièrement leur lumière (…) ce cercle continuel de révolutions se forme et se renouvelle sans cesse dans la vaste immensité de la matière", De Maillet, *Telliamed, ou Entretiens*, vol. 1, p. xxxiii-xxxiv.

[4] De Maillet, *Telliamed, or the World Explain'd*, xxv; "dans ces révolutions, nos Planètes entrant au hazard dans d'autres tourbillons, (…) se trouvent dans des dispositions différentes par rapport

Thus "we see the Waters of the Globe diminished, which (…) have perhaps been collected there, in a Position with respect to a preceding Sun different from that in which they now are".[1] Mountains have emerged from the waters, organisms born from seeds spread in the sea have eventually left the water and transformed into terrestrial—even into human beings.[2]

De Maillet was not a geologist, nor even a dilettante in the field; his inventions were quite naive, and yet the Telliamed exerted a considerable influence. D'Holbach was instead a cognoscenti, if not a practitioner.[3] Also in his *Système de la nature*, we see that "Suns extinguish and encrust themselves; planets perish and disperse themselves in the vast plains of air; other suns kindle and light themselves; new planets form themselves to make their revolutions or to describe new routes".[4] But the connection with past events of the Earth is scientifically more up-to-date:

> comets shew themselves so unexpectedly to our wondering eyes; their eccentric course disturbs the tranquillity of our planetary system; they excite the terror of the uninformed, to whom all is marvellous; the experimental philosopher himself conjectures that in former ages these comets have overthrown the surface of our globe and caused the greatest revolutions upon the earth.[5]

à l'Astre principal (…). Or dans ces différences, les eaux dont ils sont couvertes aujourd'hui augmenteront ou diminueront, selon leur plus ou leur moins de proximité de l'Astre", De Maillet, *Telliamed, ou Entretiens*, vol. 1, p. xxxiv.

[1] De Maillet, *Telliamed, or the World Explain'd*, 192-93; "C'est ainsi que nous voyons diminuer celles de notre globe, qui certainement l'ont totalement couvert, comme je l'ai établi, et qui peut-être y avoient été amassées dans une position à l'égard d'un soleil précedent", De Maillet, *Telliamed, ou Entretiens*, vol. 2, p. 108-109.

[2] A transmutation that can also be reversed, as evidenced by the purported sightings of *hommes marins* which provide some of most weird pages of the work.

[3] Giovanni Cristani, *D'Holbach e le rivoluzioni del globo: Scienze della terra e filosofie della natura nell'età dell'Encyclopédie* (Firenze: Olschki, 2003).

[4] Paul-Henri Thiry d'Holbach, *The System of Nature: or, the Laws of the Moral and Physical world. Translated from the French of M. Mirabaud (…) by William Hodgson*, (London: The Translator, 1795), vol. 1, p. 150. «Des soleils s'éteignent et s'encroûtent, des planètes périssent et se dispersent dans les plaines des airs; d'autres soleils s'allument; de nouvelles planètes se forment pour faire leurs révolutions, ou pour décrire de nouvelles routes; et l'homme, portion infiniment petite du globe, qui n'est lui-même qu'un point imperceptible dans l'immensité, croit que c'est pour lui que l'univers est fait», Paul-Henri Thiry d'Holbach, *Système de la nature, ou Les loix du monde physique, et du monde moral* (Londres: s.n. [Amsterdam: M. Rey], 1770), vol. 1, 82-83.

[5] d'Holbach, *The System of Nature*, vol. 1, p. 106-7; "des cometes s'offrent inopinément à nos yeux

Such ostensible disturbances actually obey the same laws of nature that immutably govern the entire system. But on Earth these catastrophic events—these 'revolutions'—are part of a non-circular history, that, as we shall see, has interwoven itself into human history. Revolutions are no longer the same, as it were.

Natural signs of revolutions speak more than history, and more convincingly: "If history did not inform us of these great revolutions (*ces grandes révolutions*), would not our eyes be sufficient to convince us"? The fossil remains of marine animals are a striking proof that vast continents have been once covered by the sea, which then retired. Subterranean fires opened frightful holes: "the elements unloosed, have at several times disputed among themselves, the empire of our globe; this shews us in every part of it, but a vast heap of wrecks, and of ruins".[1] This certainty is projected onto the less attested parts of human history:

> They will perhaps ask us, if those nations which at the present day we see assembled, have all been dispersed originally? we say that this dispersion may have been produced at several times by those terrible revolutions of which, as we have before seen, our globe was more than once the theatre, in times so remote that history has not been able to transmit us the detail.[2]

The successive approach of multiple comets, as those supposed by Halley and Whiston, may have precipitated on Earth a series of global cataclysms, each of which has led to the annihilation of a substantial proportion of the human species. Overwhelmed by fear, the survivors were unable to safeguard for posterity the knowledge that had been lost to those disasters, and solely an "ob-

surpris; leur course excentrique vient troubler la tranquillité de notre systême planétaire; elles excitent la terreur du vulgaire, pour qui tout est merveille; le physicien lui-même conjecture que jadis les comètes ont renversé la surface de notre globe et causé les plus grandes révolutions sur la terre", d'Holbach, *Système de la nature*, vol. 1, p. 57-58.

[1] d'Holbach, *The System of Nature*, vol. 3, p. 20; "En un mot, les élémens déchaînés se sont, à plusieurs reprises, disputé l'empire de notre globe; celui-ci ne nous montre par-tout qu'un vaste amas de débris et de ruines.", d'Holbach, *Système de la nature*, vol. 2, p. 7.

[2] d'Holbach, *The System of Nature*, vol. 3, p. 54; "L'on demandera peut-être si les nations que nous voyons aujourd'hui rassemblées ont toutes été dispersées dans l'origine? nous dirons que cette dispersion peut avoir été produite à plusieurs reprises par les révolutions terribles dont, comme on a vu ci-devant, notre globe fut plus d'une fois le théatre, dans des tems si reculés que l'histoire n'a pu nous en transmettre les détails.", d'Holbach, *Système de la nature*, vol. 2, p. 27.

scure tradition" would "transmit to us the opinions, the systems, the arts, anterior to the revolutions of the earth".[1] Only through the repetition of progress and destruction, that is, through a cumulative line of new revolutions, has been possible the accumulation and preservation of the primitive inventions.

5. Conclusion

Zu schnelle Revolutionen sind gefährlich,
aber zu langsame gedeihen nicht.[2]

Geological change is thorough. Political
shakedowns are quick.[3]

Reinhart Koselleck, in *Vergangene Zukunft*, has described a transition through which, during the 18th century, 'revolution' was "congealed into a collective singular which appeared to unite within itself the course of all individual revolutions".[4] A "linguistic product of our modernity", it becomes "a flexible 'general

[1] d'Holbach, *The System of Nature*, vol. 3, p. 54-55; "Ceux qui purent échapper à la ruine du monde, plongés dans la consternation et la misère, ne furent guère en état de conserver à leur postérité des connoissances effacées par les malheurs dont ils avoient été les victimes et les témoins: accablés de frayeurs eux-mêmes, ils n'ont pu nous faire passer, qu'à l'aide d'une tradition obscure, leurs affreuses avantures, ni nous transmettre les opinions, les systêmes et les arts antérieurs aux révolutions de la terre", d'Holbach, *Système de la nature*, vol. 2, p. 27-28.

[2] Gabriel Peter von Haselberg, "Bützow, Schwerin und Wismar", *Göttingische Anzeigen von gelehrten Sachen* 186 (20. Nov. 1784): 1864.

[3] Mark Seism, *Earthquakes of History, or: Revolutions Past and Future* (Manchester: Clarion, 1916), 83.

[4] Reinhart Koselleck, *Futures Past: on the Semantics of Historical Time*, transl. by Keith Tribe (New York: Columbia UP, 2004), 50.

concept' ", wich by itself possesses "revolutionary power".[1] A "new horizon of expectation" opens up. "Since then, revolution obviously no longer returned to given conditions or possibilities, but has, since 1789, led forward into an unknown future".[2] This universal revolution thus "became a *metahistorical concept*, completely separated, however, from its naturalistic origin".[3]

Koselleck had at hand two main historical acceptations of 'revolution': this 'naturalistic origin' was, of course, the astronomical concept of planetary or celestial revolutions, on which the idea of *revolutio regni* was originally modeled, perhaps with a contribution from the revolving wheel of Fortune ubiquitous in Medieval representations of human vicissitudes. The new revolution was different in several respects, among which: it shifts the historical dynamic from circularity to linear orientation, to directionality; it expands to the whole attainable space of action; it unifies past, present and future phenomena of a new class, not because it is one and the same, or a unique revolution, but since it becomes a general principle "charged with ordering historically recurrent convulsive experiences"[4] (Koselleck uses even the word 'transcendental'). From now on, everything will be revolution.

As we have seen, most if not all these things—shift, orientation, expansion, generalisation, universalisation of revolutions—had already happened, or were happening at the same time, in what might be called theoretical geology, or even better, the philosophy of the history of the earth, concurrent, as we said, with the emergence of philosophy of history. A different 'naturalistic origin' was available and, rather than shunned, it was culturally absorbed and preserved in its essence, and it might have even provided a significant impetus.

[1] Koselleck, *Futures Past*, 44.
[2] Koselleck, *Futures Past*, 49.
[3] Koselleck, *Futures Past*, 50.
[4] Koselleck, *Futures Past*, 50.

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