

# HOW MODERN WAS LEIBNIZ'S BIOLOGY?<sup>1</sup>

## I. Introduction

Among historians of philosophy and science there is something of a fashion for attributing modern ideas to thinkers of an earlier age. The reason for this is not hard to fathom – one's favourite thinker from the past gets kudos for supposedly being ahead of his or her time, and some of that kudos no doubt rubs off on the historian or commentator who first spotted it. But such an approach rarely does justice to past thinkers, as quite often it makes them out to be what we want them to be rather than what they were. This is so because attributing modern ideas to a past thinker is often achieved by an inadequate consideration of what that thinker actually said, and sometimes even achieved simply by not considering enough of that thinker's work. In this paper I will consider several cases where certain modern ideas have been attributed to Leibniz because the commentators who have attributed those ideas simply did not consider enough of his work. The area of Leibniz's work I want to consider is his biology. More specifically, I want to consider three issues within Leibniz's biology, namely the origin of fossils, the extinction of species, and evolution, and ascertain whether Leibniz really held the very modern-sounding views on these issues that some commentators have attributed to him.

Before we begin in earnest, it is worth noting that scholars have claimed that Leibniz accepted the following theses:

(1) that fossils have an organic origin

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<sup>1</sup> I would like to thank Peter Clarke and Vernon Pratt for their helpful comments on an earlier draft of this paper.

(2) that some species have become extinct

(3) that some species have evolved over time

If it is true that Leibniz accepted all three theses, then it would be hard to escape the conclusion that Leibniz was very forward-thinking in his biology; indeed, aside from Robert Hooke, it is hard to think of any philosopher or naturalist from Leibniz's time who would have accepted all three of the above theses. But given that Hooke was a dedicated naturalist, whereas Leibniz never rose beyond the rank of "attentive spectator" in matters of biology, as one scholar aptly puts it,<sup>2</sup> it would be even more surprising to find Leibniz espousing the above three theses. As it happens, though, he did not. As I will show, Leibniz did not accept (1) in its unqualified form (he believed that some though not all fossils have an organic origin), and he rejected (2) outright (though he did believe that sub-species may become extinct). As for (3), I have already argued elsewhere that while Leibniz entertained the idea of evolution occurring *within* the confines of rigidly determined species' boundaries, he did not accept the more modern idea of one species evolving into another.<sup>3</sup> In what follows I shall have occasion to consider Leibniz's thoughts on evolution, but my principal focus in this paper is with claims (1) and (2). I shall begin my discussion with (1), the claim that fossils have an organic origin.

## II. The origin of fossils

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<sup>2</sup> Jacques Roger: "Leibniz et les Sciences de la Vie", *Studia Leibnitiana* supplementa II (1969), p. 209.

Unless otherwise noted, all translations in this paper are my own. I would like to thank John Thorley, Geert de Wilde, Michael Pickles and Dan Cook for very helpful comments and suggestions on some of my translations.

<sup>3</sup> Lloyd Strickland: *Leibniz Reinterpreted*, London 2006, pp125ff.

During Leibniz's time, various explanations for the existence of fossils were defended. For instance, one theory claimed that the Earth contained within it the 'plastic power' that caused rocks to grow in shapes that mimicked the form of a plant or animal. On this hypothesis, fossils were dismissed as mere 'tricks of nature'. Another hypothesis held that sometimes the seeds of plants and animals got trapped in stones or material that later hardened into stones, so that when these seeds tried to grow inside the stone they ended up giving the stone the form that the creature would have had. On this hypothesis too, fossils were considered to be merely 'tricks of nature'. Another hypothesis in play during Leibniz's time was the modern idea that fossils were formed from the bodies of dead plants and animals which after a great period of time had become petrified. I shall call these, respectively, the 'plastic power' hypothesis, the 'seeds' hypothesis, and the 'organic origin' hypothesis. For much of the late 17<sup>th</sup> century the majority sided with either the plastic power or seeds hypotheses, i.e. those that dismissed fossils as merely tricks of nature. However the organic origin explanation grew steadily in popularity until eventually, around the early 1720s or thereabouts, it won almost universal acceptance among scientists and other thinking persons. But which of the three hypotheses got Leibniz's support? Two answers to this question can be found in the literature. The most common view of those who have dipped into this aspect of Leibniz's biology is that, of the various explanations for the origin of fossils, Leibniz endorsed only the organic origin hypothesis.<sup>4</sup> Another view is that Leibniz initially endorsed the plastic power

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<sup>4</sup> For example, Catherine Pécaut: "L'oeuvre géologique de Leibniz", *Revue générale des Sciences pures et appliquées* 58 (1951), p. 292; Paolo Rossi: *The Dark Abyss of Time*, Chicago 1984, pp. 59-60; Martin J. S. Rudwick: *The Meaning of Fossils*, Chicago 1985 (revised edition), p. 91; Roger Ariew: "G. W. Leibniz, life and works" in: Nicholas Jolley (ed): *The Cambridge Companion to Leibniz*, Cambridge 1995, pp. 32-33; David R. Oldroyd: *Thinking About the Earth*, London 1996, p. 87; E. P.

hypothesis before abandoning it in favour of the organic origin hypothesis.<sup>5</sup> I shall contend that both interpretations are in fact mistaken, and that Leibniz's view throughout his career was that some fossils should be accounted for by the plastic power hypothesis (albeit understood in a peculiarly Leibnizian way), and others by the organic origin hypothesis. I shall argue that the texts allow for no other interpretation.

The first text we need to consider is one that has emerged only recently, and was published for the first time by Claudine Cohen in 1998.<sup>6</sup> An English translation, made from scans of the original manuscript, has since appeared in my *Shorter Leibniz Texts* (2006). Leibniz left the paper in question without a title so I have called it "On the origin of fossils", which sums up the contents of the paper. I have tentatively dated it to the late 1670s.<sup>7</sup>

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Hamm: "Knowledge from underground: Leibniz mines the enlightenment", *Earth Sciences History* 16 (1997), pp. 81-82; Alan Cutler: *The Seashell on the Mountaintop: A Story of Science, Sainthood, and the Humble Genius Who Discovered a New History of the Earth*, New York 2003, p. 162.

<sup>5</sup> Claudine Cohen: "Leibniz's *Protogaea*: patronage, mining, and the evidence for a history of the Earth", in Suzanne Marchand and Elizabeth Lunbeck (eds.), *Proof and Persuasion: Essays on Authority, Objectivity, and Evidence*, Brepolis 1996, p. 133; Claudine Cohen: *The Fate of the Mammoth*, London 2002, p. 57; Roger Ariew: "Leibniz on the unicorn and various other curiosities", *Earth Science and Medicine* 3 (1998), p. 283.

<sup>6</sup> Claudine Cohen: "An unpublished manuscript by Leibniz (1646-1716) on the nature of 'fossil objects'", *Bulletin de la Société Géologique de France* 169 (1998), pp. 137-142.

<sup>7</sup> Cohen has suggested that this paper was written between 1665, a date which marked the publication of a book mentioned by Leibniz in the paper, namely Kircher's *Subterreanean World*, and 1678, when Leibniz met Steno. See Cohen: "An unpublished manuscript", p. 139, and *The Fate of the Mammoth*, p. 53. Cohen's reasoning is that Steno, who favoured the organic origin explanation for fossils, would have converted Leibniz to that view when they met. A potential weakness with this reasoning is that in 'On the origin of fossils' Leibniz does endorse the organic origin explanation for fossils (as well as the plastic power hypothesis). My own dating is based on internal evidence. On page 3 of the manuscript

Now as Cohen has observed, in “On the origin of fossils” Leibniz makes a number of remarks in favour of the plastic power hypothesis. For instance:

it is well known that stones grow and assume a thousand strange forms.<sup>8</sup>

such a great quantity of shells and so-called fish bones are found piled up on top of one another that there is...reason to believe that the Earth, in those places, had in it some particular force to produce them in such great quantity.<sup>9</sup>

I nevertheless maintain that most of the so-called bones of terrestrial animals or fish, which are believed to have been petrified some thousands of years ago, are only true rocks perhaps formed not long ago by the plastic power of the Earth.<sup>10</sup>

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(15r), Leibniz uses the word ‘des-unir’ in the sense of ‘uncoordinated’ (i.e. uncoordinated movement of limbs). Now according to the *Trésor de la langue Française*, the first recorded instance of ‘des-unir’ (désunir) being used in this sense was 1678 (see vol. VII p. 41) which, if right, would make “On the origin of fossils” later than that. However I agree with Cohen that it must be earlier than the *Protogaea*, because some of the opinions aired in “On the origin of fossils” are rejected or revised in the *Protogaea* (e.g. that of the seas being at one time much higher than they are now). As the ideas for some of these opinions no doubt took form during Leibniz’s stint as a mining engineer between 1679 and 1684, I suspect that “On the origin of fossils” was written either shortly before or near the beginning of that stint, i.e. the late 1670s.

<sup>8</sup> LH 37, 4 Ff 14r. English translation in: Lloyd Strickland: *Shorter Leibniz Texts*, London 2006, p. 138. Hereafter: *Shorter Leibniz Texts*.

<sup>9</sup> LH 37, 4 Ff 14r-14v / *Shorter Leibniz Texts* p.139.

<sup>10</sup> LH 37, 4 Ff 15r-15v / *Shorter Leibniz Texts* p. 140.

So in this paper Leibniz is clearly endorsing the plastic power hypothesis, and holding that stones are naturally produced by the earth, and sometimes in the form of a plant or animal. But interestingly, this is not the only explanation for fossils that Leibniz gives in that paper, as the following passage makes clear:

Nevertheless, to show that I am fair-minded, I admit that we should say that these rocks were at some point parts of animals in cases where a too perfect resemblance is found, which could not be the effect of chance.<sup>11</sup>

Unfortunately Leibniz says no more than this (the passage just quoted is in fact the very last sentence of “On the origin of fossils”), but from it we can surmise the following: fossils that bear a great resemblance to a living thing, or a part of a living thing, were, according to Leibniz, formed from that thing, and so accounted for by the organic origin hypothesis, while any fossil that does not have a striking resemblance to a living thing or its parts is accounted for by the plastic power hypothesis. Of course what this means is that at the time “On the origin of fossils” was written, Leibniz would most likely have used the plastic power hypothesis to explain away as tricks of nature a great number of fossils which do in fact have an organic origin, but which do not meet his criterion of “a too perfect resemblance” (and it should not be overlooked that many fossils do not have “a too perfect resemblance” to animals and plants, extinct or otherwise, because of variations in the means of preservation).<sup>12</sup>

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<sup>11</sup> LH 37, 4 Ff 15v / *Shorter Leibniz Texts* p. 140.

<sup>12</sup> I myself have a trilobite fossil which looks somewhat like an organized animal form, but it is sufficiently lacking in detail for it to be easily mistaken for a strangely shaped rock. A few minutes spent in any shop selling fossils will soon reveal that while some fossils can boast of intricate detail and an uncanny resemblance to once-living things, others cannot.

Indeed, Leibniz says as much in that text: “I...believe that the forms of these animal bones and shells are *often* merely tricks of nature” [emphasis mine].<sup>13</sup>

As “On the origin of fossils” has become available only quite recently, many commentators have attempted to discern Leibniz’s thoughts on fossil origins from what he says on the subject in the *Protogaea*, which was written between 1690 and 1693 (the dates vary depending on which secondary source is consulted). In the *Protogaea* Leibniz says at various points that fossils are formed from once living animals. His main argument for this view is the astonishingly close similarity between the forms of living animals and those found in rocks. Here are two passages from the *Protogaea* in which Leibniz uses this argument to defend the view that fossils have an organic origin:

I have held in my hands fragments in which a mullet, a perch, and a bleak, were engraved into the rock. A little earlier, an enormous pike had been dug up, its body bent and its mouth open, as if, surprised while alive, it had stiffened that way by the petrifying force. I have also seen fish of marine origin, like ray, herring, and lamprey, and the latter are sometimes criss-crossed with herrings. In these circumstances, most people have recourse to the idea that these are tricks of nature (an empty expression); [But] There is such a great agreement between these representations of fish and true fish, with the fins and the scales always expressed in the minutest detail; and the number of these images seen in the same place is so great that we should suspect a clearer and more constant cause than either a game of chance or I know not what seminal ideas, empty

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<sup>13</sup> LH 37, 4 Ff 14r / *Shorter Leibniz Texts* p. 138.

words of philosophers which conceal the great arrogance of the proud intellect of men.<sup>14</sup>

A more careful analysis will show that the shellfish of the shore, no less than those found in rock, have the same kind of texture consisting of hard parts and fibres, and what appears to be seams, and are divided into cells.<sup>15</sup>

In these passages Leibniz highlights the extraordinary similarity between the fossil form and the form of an animal, likewise when he says, during a discussion of the fossil fish found in Osterode and Eisleban, that “one must immediately acknowledge not only the fish but also the genus of the fish and the true magnitude and symmetry of its parts, and the scales, and everything else.”<sup>16</sup> It is interesting that in the *Protogaea* Leibniz’s discussion focuses *only* on those fossils that have a very clear and very distinct resemblance to living things. He all but ignores those whose resemblance to living things is not so immediately obvious, despite the fact that these are just as common. In any case, in the *Protogaea* there is no hint of support for the plastic power hypothesis – in fact Leibniz ridicules those who invoke it, as well as those who invoke rival ‘tricks of nature’ explanations.

On the basis of what we have seen so far, it seems as though Leibniz started out by endorsing both the plastic power and organic origin explanations for fossils (in the late 1670s), before abandoning the former view in favour of the latter, which then became the only explanation for fossils that Leibniz accepted. This is certainly

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<sup>14</sup> G. W. Leibniz: *Protogaea* §18, in Dutens II, p. 215.

<sup>15</sup> *Protogaea* §25, in Dutens II, p. 220 / *Shorter Leibniz Texts*, p. 140.

<sup>16</sup> *Protogaea* §20, in Dutens II p. 217.

Claudine Cohen's assessment: "As the seventeenth century ended, the organic origins of fossil remains became widely accepted by the scientific community. Leibniz himself took the lead, moving from a belief in "figured stones" to recognizing animal remains as proof of the earth's history."<sup>17</sup> By the time of the *Protogaea*, according to Cohen, "Leibniz no longer believed in fossils existing *sui generis* in the earth."<sup>18</sup> But Cohen's assessment is undermined by at least two texts which she does not consider. The first is a letter Leibniz wrote to Wilhelm Tentzel in June 1696 following the discovery of an elephant skeleton in Tonna, Germany. Tentzel had concluded that the remains were of organic origin, a view with which Leibniz agreed:

like you I certainly conclude, and this is what I have always thought, that such things are from the animal kingdom and are not formed by some plastic power of the earth, as are those things which are called tricks of nature, which are in any case much less developed, and less similar in details.<sup>19</sup>

There are two things we should note about this passage. First, in it Leibniz seems to sanction the organic origin hypothesis *and* the plastic power hypothesis. Second, Leibniz clearly lays down the criteria by which the plastic power and organic origin hypotheses are to be applied. If a fossil (or other kind of remains) has a very great similarity to a living thing or its parts, as does the elephant skeleton under discussion, then it is to be explained via the organic origin hypothesis. If the resemblance is not so great, then the fossil (or other kind of remains) is to be explained via the 'plastic

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<sup>17</sup> Cohen: *The Fate of the Mammoth*, p. 57.

<sup>18</sup> Cohen: *The Fate of the Mammoth*, p. 60.

<sup>19</sup> A I 12, p. 639.

power' hypothesis. This suggests that even during his maturity Leibniz found a place for both the organic origin and plastic power hypotheses, and used the latter when the criteria for the former was not met.

Further support for this interpretation comes from a short article Leibniz placed in a journal called *Miscellanea Berolinensia* of 1710. The article in question is an open letter addressed to Christian Maximilian Spener, who had discovered a crocodile fossil and then written a dissertation about it at Leibniz's urging. This dissertation was published in the first volume of the *Miscellanea Berolinensia* along with Leibniz's congratulatory letter. It is interesting to note that this letter has often been ignored by Leibniz scholars, even those interested in his biology. In his letter, Leibniz used Spener's discovery of the crocodile fossil as a springboard to talk about his geological views in general. When he turns to the matter of fossils, Leibniz repeats the point made in "On the origin of fossils", the *Protogaea*, and the Tentzel correspondence, that when there is a great similarity between the form of a fossil and the form of a living thing, "it can hardly be doubted that it [the fossil] is an impression of one [a once-living thing]."<sup>20</sup> But when he comes to consider whether or not fossils "may be accounted for by what the vulgar call 'tricks of nature'," as he puts it, he says, revealingly, "I would not deny this in some cases."<sup>21</sup> He then rounds off the

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<sup>20</sup> G. W. Leibniz: "Letter from G. W. Leibniz", *Berlin Miscellanea* 1 (1710), p. 119 / Dutens II p. 177 / *Shorter Leibniz Texts* p. 143.

<sup>21</sup> "Letter from G. W. Leibniz": *Berlin Miscellanea* 1, p. 120 / Dutens II p. 177 / *Shorter Leibniz Texts* p. 143. Leibniz seemingly makes the very same points in a text sent to the Paris Academy of Sciences in 1706. Although the text itself is now lost, we do have Fontenelle's report of it (recently published by Rhoda Rappaport), which gives us a good idea of what Leibniz wrote in the text. In it, Leibniz rehearses his familiar argument that fossils with a great similarity to living creatures have an organic origin, but also says "When this exactitude is not found [in fossils], I more easily grant that they are

discussion by saying: “nevertheless in many cases the sheer accuracy of these forms proves that a different judgement should be made.”<sup>22</sup>

What are we to make of this? First of all, it should be clear enough that in the 1710 letter to Spener, Leibniz does not want to explain all fossils by the organic origin hypothesis. As in earlier years, he is reserving the organic origin explanation of fossils only for those fossils which have a very clear resemblance to living things and their parts. Second, and again as in earlier years, Leibniz is prepared to dub some fossils (namely those insufficiently similar to living things) ‘tricks of nature’. In the Spener letter, however, Leibniz does not equate tricks of nature with those things brought about by a plastic power; in fact he does not mention plastic powers at all. However, given his previous track record of identifying tricks of nature with those things brought about by a plastic power, it is reasonable to assume that he would have made the same identification at the time of the Spener letter, and that thus in this letter, as in earlier texts, Leibniz held that some fossils could be explained by the operation of a plastic power.

Now if this is right, and Leibniz did explain some fossils via the organic origin hypothesis and some via the plastic power hypothesis in the late 1670s, in 1696, and in 1710, what are we to make of the fact that he is hostile towards the plastic power hypothesis in the *Protogaea*, which dates from the early 1690s? Did Leibniz accept the idea of some fossils being formed by a plastic power in the late 1670s, then reject it in the early 1690s, then accept it again after 1696? It would be odd indeed if Leibniz

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tricks.” See Rhoda Rappaport: “Leibniz on geology: a newly discovered text”, *Studia Leibnitiana* 29 (1997), p. 11.

<sup>22</sup> “Letter from G. W. Leibniz”: *Berlin Miscellanea* 1, p. 120 / Dutens II p. 177 / *Shorter Leibniz Texts* p. 143.

had done that. But I don't think that he did; in fact I believe he had the same use for the plastic power hypothesis at the time of the *Protogaea* as he did in the late 1670s, 1696 and 1710. The best way to explain this is to consider the further mystery of how Leibniz could have accepted the plastic power hypothesis at *any* of those times. For the idea of a plastic power, understood as some mysterious formative force or principle, seems entirely at odds with Leibniz's oft-stated view that nature should be explained mechanistically. So how could Leibniz have accepted the idea of a plastic power at all? The solution to this mystery is simple: Leibniz understood the term 'plastic power' in two entirely different senses, one of which he consistently accepted, the other he consistently rejected. This is what Leibniz says in "On the origin of fossils":

I therefore believe that the forms of these animal bones and shells are often merely tricks of nature, which have been formed separately, without coming from animals. For it is well known that stones grow and assume a thousand strange forms: witness the stone figures collected by the Reverend Father Kircher in his *Subterranean World*. It is likewise known that plants very often take the form of animals or their parts: witness the mandrake and several others which could be collected. Indeed, it should not be imagined that in animals themselves the parts form by means of a soul or some mysterious principle; on the contrary, I believe that this happens by purely mechanical reasons, and if they are known in detail as good a reason would be given for these figures as for that of a sugarloaf or a hat. That is why these same mechanical reasons, being able to be found outside of an animal, will give the same shape to a sap which

has solidified. This is so obvious that I would be surprised if it did not occur on occasion.<sup>23</sup>

From this it is clear that during the time when Leibniz is most outspokenly in favour of the idea of a (plastic) power or force capable of producing stones which have some similarity to living things, he conceives it in an entirely mechanical way, i.e. as the simple functioning of the laws of nature. In a passage from the same text that we have already seen, Leibniz argues that “we should say that these rocks were at some point parts of animals in cases where a too perfect resemblance is found, which could not be the effect of chance.”<sup>24</sup> This suggests that those rocks not featuring “a too perfect resemblance” to animals *are* the effects of chance. Drawing these points together, it seems that Leibniz’s thinking is that the same laws of nature operate on organic and inorganic things alike, and from time to time their operation on some inorganic materials just happens to give rise to objects that have some similarity to the parts of plants and animals. But when this does happen, Leibniz puts it down to mere coincidence, and does not consider it the result of some mysterious formative principle. The same mechanistic understanding of plastic power is to be found in a text written for Tentzel in 1697: “For anything that appears in salts and crystals by a plastic power...can be explained by a simple mechanism.”<sup>25</sup> Thus when Leibniz endorses the idea of a plastic power, as he does in “On the origin of fossils” and the Tentzel correspondence, he conceives it in an entirely mechanical way. However when Leibniz ridicules the idea of a plastic power in the *Protogaea*, he does not

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<sup>23</sup> LH 37, 4 Ff 14r-14v / *Shorter Leibniz Texts* pp. 138-9.

<sup>24</sup> LH 37, 4 Ff 15v / *Shorter Leibniz Texts* p. 140.

<sup>25</sup> A I 14, p. 426.

conceive it in a mechanical way at all, but rather as something “beyond the custom of nature”, i.e. as something *beyond* the mechanical laws of nature.<sup>26</sup> It is certainly unhelpful that Leibniz chose to use the term ‘plastic power’ in two entirely different senses, one of which – the one he endorsed – was clearly at odds with its common meaning of ‘a mysterious force or principle’. Yet once we realize that Leibniz did use the term ‘plastic power’ in two different ways, we are able to explain, first, why he seems to accept the idea of it in the late 1670s, then reject it in the early 1690s, then endorse it again in 1696 and 1710, and secondly, how he felt able to accept it at all. The picture that emerges from this thus seems to be as follows: throughout his writings, Leibniz wanted to explain astonishingly detailed fossils as products of organic origin, and less detailed fossils as products of a plastic power, understood in rigidly mechanistic terms (i.e. that such fossils were merely chance formations of rock shaped by the laws of nature).<sup>27</sup> At no point, it seems, did Leibniz believe that fossils were formed by a plastic power in the sense of ‘a mysterious formative principle’, which is how his contemporaries would have understood the term. If this is right, then we find that his position on the origin of fossils in fact remained remarkably consistent. If there is any change in Leibniz’s view on fossil origins, it lies in the fact that in an early writing on the subject (“On the origin of fossils”) he claims that “most” fossils are tricks of nature, i.e. chance formations of rock, while in a much

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<sup>26</sup> Leibniz, *Protogaea* §28, in Dutens II p. 221.

<sup>27</sup> It is worth noting that in one of the passages from the Tentzel correspondence quoted earlier, Leibniz says that “this is what I have always thought” when invoking the organic origin explanation for fossils that bear a striking resemblance to living things. Given that he did indeed invoke such an explanation in “On the origin of fossils”, as we have seen, I see no reason not to take this claim at face value, which entails that Leibniz was thoroughly consistent in the way that he explained the origin of those fossils that bear a striking resemblance to living things.

later writing (the open letter to Spener) he claims that only “some” fossils can be accounted for this way.<sup>28</sup> Yet this does not alter the fact that Leibniz consistently drew a distinction between those fossils that he believed had an organic origin, and those he believed did not.

So late on in his life, at a time when the ‘organic origin’ explanation of fossils had become very fashionable, Leibniz felt unable to endorse it unequivocally. This is not to say, of course, that Leibniz’s attitude towards fossils is not modern at least to some degree, because he did accept that some, perhaps even most fossils had an organic origin. But Leibniz’s unwillingness to jettison the plastic power/tricks of nature explanation entirely (albeit conceived mechanistically), means that, on the matter on the origin of fossils anyway, Leibniz was not as modern in his thinking as many commentators have made out.

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<sup>28</sup> The shift in opinion noted here almost certainly came about partly as a result of another shift in opinion, on the issue of whether the seas were once much higher than they are now. In “On the origin of fossils” Leibniz appears to find such an idea problematic because it is not clear what would have happened to the excess water. By denying that the sea had ever been so high as to cover mountains, he had a great difficulty in explaining the fossilised shells and fish found in the mountains via the organic origin hypothesis, though presumably he would have used that hypothesis to explain some types of fossils dug out of the ground. Yet by the time of the *Protogaea* Leibniz was arguing that the sea had once been so high as to cover much of the planet, mountains included, and had developed what he took to be a plausible explanation for what happened to the excess water. This made it easier for him to account for the fossilised shells and fish found in the mountains via the organic origin hypothesis, which in turn would have led to a more restricted use of the plastic power/tricks of nature explanation of fossil origins. Hence Leibniz’s change of mind on the issue of ancient sea levels may well explain, at least in part, the apparent disparity between his early view that most fossils were accounted for by the plastic power/tricks of nature hypothesis, and his later view that only some fossils were best explained by it.

### III. Species extinction

Of course acknowledging the organic origin of fossils, or at least some fossils, gives rise to a thorny problem, which is this: some of the forms delineated in fossils are of animals and plants that can no longer be found. How is this to be explained? To the modern mind the obvious explanation is that the creatures in question have become extinct. But in Leibniz's day this was not a widely held view, not least because the idea of extinctions did not sit easily alongside the idea of the completeness of the great chain of being, which was still a widely accepted hypothesis in the 17<sup>th</sup> century (and to a lesser extent in the 18<sup>th</sup>). Even those not wedded to the idea of the *scala naturae* shrunk back from admitting the extinction of species, usually on theological grounds (scripture says nothing about lost species, after all). But of course the fact that the prevailing view in Leibniz's time was decidedly against species extinction does not necessarily mean that Leibniz fell in with it. So did Leibniz accept species extinction? Roger Ariew has argued that he did, claiming that Leibniz "is committed to there having been animals which no longer exist."<sup>29</sup> Ariew makes it clear that by this he means Leibniz is committed to the view that there were once living species which are now extinct. But why should he think this? Unfortunately Ariew's reason for thinking that Leibniz is committed to the idea of species extinction is not made

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<sup>29</sup> Ariew: "Leibniz on the unicorn and various other curiosities", p. 285.

clear, but given the proximity of that claim to a comment about unicorns,<sup>30</sup> we might perhaps suppose that Ariew's reasoning is something like this:

Premise: Leibniz believed that unicorns no longer exist

Conclusion: Therefore Leibniz is committed to the idea that at least one species, namely the unicorn, has become extinct.

This would be a good argument if the premise is true, but it is doubtful that it is. I think that there are grounds for supposing that the premise is false. Obviously, to say that Leibniz believed that unicorns no longer exist implies that Leibniz believed that unicorns did exist at one time. Is this the case? Ariew thinks it is, and reaches this conclusion after an examination of Leibniz's discussion of the unicorn in the *Protogaea*. But in the *Protogaea* Leibniz does not obviously accept that unicorns ever existed. He certainly doesn't say that; in fact his discussion on the unicorn is somewhat non-committal. He starts off by noting that what people usually take to be the remains of a unicorn horn is in fact the remains of a narwhal. After that, Leibniz goes on to note that there are alleged eyewitness accounts of the unicorn, though he does not say if he believes them. And lastly, Leibniz considers the case of a so-called unicorn skeleton that had been dug up in the 1660s. Leibniz describes it in some detail but fails to venture any opinion as to whether the skeleton is really that of a unicorn or not. So it's not clear at all that Leibniz did believe that there were once unicorns.<sup>31</sup>

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<sup>30</sup> "His unicorn is, after all, no different than any other animal whose remains can be examined; he realizes that he is committed to there having been animals which no longer exist." Ariew: "Leibniz on the unicorn and various other curiosities", p. 285.

<sup>31</sup> However, given that the Old Testament contains no less than seven references to unicorns, it is possible that Leibniz may have leaned towards belief in their existence out of deference to Scripture if

But let's suppose that he did. And let's suppose, as Ariew does, that Leibniz believed that unicorns have existed partly on the grounds of the eyewitness accounts that he mentions. I believe that these eyewitness accounts will throw light on Ariew's argument, so we need to look into them further. In the *Protogaea* Leibniz mentions that "a quadruped unicorn with the size of a horse is to be found in Abyssinia [Ethiopia], if we believe Jerome Lobo and Balthasar Tellez."<sup>32</sup> Leibniz says no more about Lobo's and Tellez's accounts than that, and his rather neutral language ("if we believe...") is hardly suggestive of a wholehearted acceptance of these accounts. But leaving that aside, what else can we glean from Leibniz's sources? Of the two people mentioned, neither claimed to have seen a unicorn, though the former evidently knew people who had. Lobo (1593-1678) was a Portuguese Jesuit who spent almost ten years in Ethiopia, from 1624 to 1634. During his time there, he appears to have been given sufficient information on unicorns for him to state with some confidence their shape (horselike), colour (bay, with a black tail) and behaviour (timid).<sup>33</sup> Although Lobo does not say when the sightings occurred that gave rise to these morsels of information, it is not unreasonable to assume that they were supposedly made during

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nothing else. The references are at: Numbers 23:22; Deuteronomy 33:17; Psalms 22:21; Psalms 29:6; Psalms 92:10; Isaiah 34:7; Job 39:9-12.

<sup>32</sup> *Protogaea* §35, in: Dutens II p. 230.

<sup>33</sup> Jerome Lobo: *Relation historique d'Abissinie*, trans. Joachim Le Grand, Paris 1728, p. 70. Written originally in Portuguese, this book was first published in a French translation in 1728, though the original manuscript was known to a number of people in the 17<sup>th</sup> century, including Balthasar Tellez, who made use of it (and another of Lobo's unpublished manuscripts – see note 34) in his own volume on Ethiopia. Samuel Johnson's English translation of Lobo's book in 1735, made from the French, leaves the reader with the impression that Lobo had in fact claimed to have seen a unicorn, due to Johnson's unfortunate policy of translating the impersonal French pronoun "on" as "I". See Samuel Johnson: *A Voyage to Abyssinia*, New Haven 1985, p. 46.

his time in Ethiopia, i.e. between 1624 and 1634. As for Tellez (1595-1675), he too was a Portuguese Jesuit, and apparently no more fortunate than Lobo in that in his book *Historia general de Ethiopia Alta* (1660) he too had no first-hand accounts of unicorn sightings to offer. In fact, he could only scrape up third-hand accounts, since his primary source on unicorn matters was Lobo! Availing himself of Lobo's unpublished manuscript material, Tellez thus mentioned a unicorn sighting by a man who was Lobo's missionary companion, another by a Portuguese Captain of good reputation, and some sightings by native Ethiopians.<sup>34</sup> None of these sightings are dated, but given that they are drawn from Lobo we can say that these too are likely to have occurred between 1624 and 1634. This means that these sightings occurred no earlier than 60 or 70 years before Leibniz discussed them in the *Protogaea*. Now as I've already mentioned, Leibniz doesn't say whether he accepts these eyewitness accounts, but if we suppose, as Ariew does, that he *did* accept them, then Leibniz would be committed to believing that unicorns existed at least as late as the 1620s or 1630s. This means that if he *also* believed that unicorns had died out, which is what Ariew seems to claim, then he must have believed that they had died out at some point between the 1620s/1630s, when people of Lobo's acquaintance saw one, and the early 1690s, when Leibniz wrote about them in the *Protogaea*. But Leibniz says absolutely nothing that would make us suppose that he did believe this, which is hardly surprising because he had absolutely no evidence to believe that unicorns had died out in the six or seven decades prior to him writing about them (certainly neither Lobo nor Tellez suggested that unicorns had died out, and the so-called unicorn skeleton

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<sup>34</sup> These accounts are to be found in: Peter Wyche: *A Short Relation of the River Nile*, London 1669, pp. 32ff. In writing this book, Wyche used the same unpublished manuscript of Lobo's as Tellez did when writing his. Note that this is not the same manuscript that became *Relation historique d'Abissinie*.

excavated in the 1660s was hardly evidence that the species as a whole had become extinct). So it is highly probable that if Leibniz did believe that unicorns existed in the past, then he also believed that unicorns existed during his time as well, in which case he could not have believed that they had become extinct.

Looking back at Ariew's argument, we now have two reasons for thinking the premise is false: first of all, there is no clear evidence, at least in the *Protogaea*, that Leibniz did believe in unicorns, and second, if he did believe that they existed in the past, then in all likelihood he believed that they still existed. And this puts Ariew's assertion that Leibniz believed in species extinction on very thin ground. And what I want to do now is show that it gets even thinner, because there are very good reasons for supposing that Leibniz did not accept species extinction.

Leibniz certainly rejected the idea of lost species early on in his career. In "On the origin of fossils", Leibniz briefly considers the idea but dismisses it out of hand:

I add that rock shells of several unknown species are found that one will seek in vain in the sea, a sign that these are tricks of nature, unless it is maintained that these species have been lost, which is not likely.<sup>35</sup>

So early on, in the late 1670s or thereabouts, Leibniz is certainly *against* the idea of species becoming extinct. Ariew is aware of this, but claims that it is not important because Leibniz changed his mind about "every other aspect of the matter" so that "There is no reason to believe that Leibniz would continue to hold it is not likely that the[re] are lost species."<sup>36</sup> By "every other aspect of the matter" Ariew means two

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<sup>35</sup> LH 37, 4 Ff 14v / *Shorter Leibniz Texts* p. 139.

<sup>36</sup> Ariew: "Leibniz on the unicorn and various other curiosities", p. 285n53.

things: (1) that Leibniz had changed his mind about the aquatic origin of fossilised shells, and (2) that Leibniz had changed his mind about such fossils being tricks of nature. In other words, on the basis of these two shifts in thinking, Ariew thinks it likely that Leibniz changed his attitude towards species extinction too. Now this in itself is a rather flimsy argument, not least because Leibniz did *not* obviously change his attitude towards (2), as I have shown; in fact he consistently maintained that while some fossils came from living creatures, others were merely tricks of nature (i.e. chance formations of rock). But leaving that aside, there is another very good reason why we should not accept Ariew's reasoning and the attendant claim that Leibniz believed in species extinction, which is that he explicitly denied it.

Let us first of all see what Leibniz has to say about extinctions in the *Protogaea*. At one point in the *Protogaea* Leibniz tackles head on the question, Why is it that there seem to be so many fossils of animals that cannot now be found anywhere? Leibniz's answer to that is *not* to say that those animals have become extinct; instead he insinuates that these animals probably *are* still around. And to illustrate, he considers the example of a kind of large ammonite that had been found in fossils, yet apparently was no longer present in the sea. He then asked what was obviously intended to be a rhetorical question: "But who has fully explored its hidden recesses, or the subterranean abysses?"<sup>37</sup> After writing that, Leibniz then went on to explain that fossils are swept up by floods from distant places, which accounts for why they are found in places where there are no living animals of the same species. This means

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<sup>37</sup> Leibniz: *Protogaea* §26, in: Dutens II p. 220 / *Shorter Leibniz Texts* p. 141. Interestingly, John Ray, writing at about the same time, raised the question of how it was that the very same large ammonite could no longer be found in the sea. His answer was that it probably could still be found in parts of the sea that humans had not yet explored. Ray thus stated outright what Leibniz only insinuated. See John Ray: *Three Physico-Theological Discourses*, London 1693 (2<sup>nd</sup> edition), p. 149.

that we find fossils of a species in an area where there are no living members of that species, which makes us think – wrongly, according to Leibniz – that the species has died out. So Leibniz gives us a reason that explains why one can look in vain for living members of a species that have been found in fossils. In doing this, Leibniz is clearly implying that, in his view, these species have not died out at all, but are still to be found in some places on the Earth. So in the *Protogaea* Leibniz seems not to be in favour of the idea of species extinction.

But my claim that Leibniz did not accept species extinction need not be rested on what is said in the *Protogaea*. For Leibniz explicitly *denies* species extinction in a text written later than the *Protogaea*; in a letter to Wilhelm Tentzel written during August 1696, Leibniz says this: “I do not assert that any *species have died out*.”<sup>38</sup> This remark surely closes the book on the issue of species extinction for Leibniz, for in addition to there being no positive evidence that he ever accepted the idea, we have unambiguous textual evidence that tells us he rejected it. We are thus forced to dismiss Ariew’s claim that Leibniz accepted the modern idea that some species have become extinct.

Interestingly, however, although Leibniz rejected the idea that species became extinct, he did seem to allow that *sub*-species might become extinct. This idea emerges most clearly in letters written for Wilhelm Tentzel in the mid-1690s, which to a large extent were concerned with the recent discovery of a partial elephant skeleton in Tonna. Leibniz was made aware of this discovery by Tentzel (who in fact published a tract on it), and it became a key topic of their correspondence for more

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<sup>38</sup> A I 13, p. 204. It is worth noting that Leibniz goes on to say “although I am not prepared to say that it [the idea of species extinction] is absurd”, which undermines Claudine Cohen’s claim that “It was impossible for Leibniz to conceive of extinct species” (Cohen: *The Fate of the Mammoth*, p. 57).

Clearly he could conceive of species becoming extinct; he just denied that it happened.

than a year afterwards. Leibniz wrote a fair summary of some of the themes of this correspondence in a letter to Thomas Burnett from June 1696:

In Tonna, near Gotha in Thüringen, some parts of a skeleton were found, which is of an elephant according to all appearances. Some doctors from there claimed that it is a production of the Earth, a trick of nature. I was consulted, and I said that I had no doubt at all that it is from the animal kingdom, and if it is not from an elephant it is still from an analogous animal, either from elephants or similar animals that have formerly lived in these countries, or that there were amphibious sea animals of the nature of the elephant when a large part of the globe of the Earth was still submerged: for species can be greatly changed by length of time, just as by the interval of places, witness the differences between American animals and ours.<sup>39</sup>

While this nicely summarizes Leibniz's thoughts on the matter, it needs fleshing out with detail, for which we need to look at the Leibniz-Tentzel correspondence. These are Leibniz's first remarks to Tentzel on the elephant skeleton:

I agree with you that it is the remains of an animal. But I would not likewise confirm that it comes from an elephant. For I have for a long time now suspected, seeing how often these remains are discovered everywhere, and how unsuited these animals are to these regions, unless they were brought there by human agency, that some remains customarily attributed to elephants are from

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<sup>39</sup> A I 12, p. 735.

marine animals; for not only other, great arguments but also glossopetrae convince us that a part of these regions was once immersed by the sea.<sup>40</sup>

Here, Leibniz gives two reasons for thinking that the Tonna skeleton is from a marine animal rather than an elephant, despite appearances: (1) elephant-like remains are found in various places, including Germany, despite elephants not being suited to the environment there, and (2) at least part of Germany was at some point in the past under water.<sup>41</sup> Tenzel was unimpressed with Leibniz's reasoning, and in his reply he stressed the great similarity between the unearthed skeleton and that of a terrestrial elephant, and the great dissimilarity between the unearthed skeleton and that of a walrus, which is the marine animal that Tenzel believed Leibniz had in mind. In the next exchange, Leibniz conceded the strength of Tenzel's reasoning ("I acknowledge what you say") but continued to wonder whether the Tonna skeleton might be from a marine animal anyway.<sup>42</sup> This time, Tenzel decided that Leibniz must be thinking of a hippopotamus, which prompted him to note the very great dissimilarities between the Tonna skeleton and a hippopotamus skeleton. He also wrote this:

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<sup>40</sup> A I 12, p. 602.

<sup>41</sup> Similar reasoning is to be found in a letter to Duchess Sophie written in July 1692, prompted by the discovery of an elephant's tooth in Brunswick: "Nevertheless as people did not start finding such bones in these countries and elsewhere today, and as elephants hardly live in cold countries, one could doubt if this tooth would not be from relics of some large sea monsters, since seashells and other remains of sea animals are often found in the middle of the land that the ocean perhaps once covered. For walruses or sea oxen are found in the North Sea that have some relation with the elephant, and there are even some of them that have tusks, which are valued as much as and more than ivory." A I 8, p. 30.

<sup>42</sup> A I 12, p. 639.

I shall not believe that the remains are those of a marine animal until something among marine animals is shown to me which is similar, and to which the description of the remains of our skeleton exactly corresponds as well as it does to an elephant.<sup>43</sup>

It subsequently emerges, however, that Tentzel and Leibniz were talking at cross purposes because Leibniz, it seems, did not think that the Tonna skeleton came from an extant marine animal, but rather from one that is no longer around. He argued that the early Earth may have afforded the opportunity for enormous marine animals to thrive:

in a larger or more fertile arena as it were, there may once have been some larger aquatic or amphibious beasts, and they may have carried larger or otherwise more conspicuous armour of the mouth than those which we see today in the hippopotamus or in the rosmarum [walrus].<sup>44</sup>

Leibniz's language here strongly suggests his belief that whatever these enormous aquatic/amphibious animals were, they are no longer around. This might further suggest that Leibniz endorsed the idea of species extinction after all, though this is not in fact the case, as the following passage (from another letter to Tentzel) makes clear:

I do not assert that any *species have died out*, although I am not prepared to say that it is absurd. But I think we must distinguish between extinct species and

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<sup>43</sup> A I 12, p. 653.

<sup>44</sup> A I 14, p. 429.

those that have greatly changed. Thus the dog and wolf, cat and tiger can be seen as being of the same species. The same can be said about the amphibious animals or marine oxen once analogous to the elephant.<sup>45</sup>

Aside from the denial of species extinction, which we have already seen, there are two interesting points made here. The first is scarcely more than an allusion to some kind of evolutionary-type changes within the elephant (and perhaps the dog and cat) species. I shall treat this in a separate section. The second point of note is Leibniz's claim that the large elephant-like marine animal whose existence he has postulated, was a member of the elephant species rather than a separate species in its own right. Consequently, if there was such a marine animal, and it has now died out, then there has been no extinction of the whole species group, just of that particular variant. What we can also glean from this is that Leibniz considers a species group to be rather broad in extent. He takes the elephant species, for instance, to include not just modern terrestrial elephants, but also marine variants. Likewise, he takes dogs and wolves to belong to the same species, and also cats and tigers. In the *New Essays* (1703-04), Leibniz makes a very similar claim, namely that the various types of cat may belong to one and the same species:

Various cat-like animals, such as the lion, the tiger and the lynx, may once have been of the same race and may now amount to new subdivisions of the ancient cat species.<sup>46</sup>

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<sup>45</sup> A I 13, p. 204.

And in the same work, he says precisely the same thing about dogs:

There are such great differences amongst dogs that mastiffs and lap-dogs can very well be said to be of different species. Yet it is not impossible that they are the remote descendants of the same or similar breeds, which we would find if we could go back a long way, and that their ancestors were similar or the same, but that after much change some of their descendants became very large and others very small.<sup>47</sup>

He goes on to suggest there what all of these different breeds, hybrids, and sub-varieties have in common is “an unchanging specific inner nature which is not further subdivided in our world” and “which is further varied only by the addition of accidents.”<sup>48</sup> For Leibniz, this “unchanging inner nature” is what defines membership of a species group, so that even if two animals look and behave in a different way, they will nevertheless belong to the same species if they both have the same “inner nature”. Although we do not find the claim that each species is marked out by its own “inner nature” in the Tenzel correspondence, we do find Leibniz making use of the underlying idea; in one letter to Tenzel, Leibniz claims that the remains found in Tonna

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<sup>46</sup> A VI 6, p. 317. English translation on p. 317 of G. W. Leibniz: *New Essays On Human*

*Understanding*, trans. and ed. Peter Remnant and Jonathan Bennett, Cambridge 1996. Hereafter: *New Essays*.

<sup>47</sup> A VI 6, p. 325/ *New Essays* p. 325.

<sup>48</sup> A VI 6, p. 325 / *New Essays* p. 325.

are either from an elephant or at least from an elephant-like animal, just as there are animals of the feline and canine species which are called neither cats nor dogs. In general, therefore, the first thing to be asked at this point is whether it was an elephant, or another creature of the elephant species which may once have lived in these regions or seas, but was destroyed by very great changes in circumstances.<sup>49</sup>

From this passage alone it is clear that Leibniz is placing his postulated marine animal squarely within the elephant species. So even though Leibniz allows that the elephant-like marine animal may have died out, in his view this represents only the extinction of a sub-species of elephant, as the species itself continues to survive through terrestrial elephants. We can say, then, that while Leibniz denied the occurrence of lost species, he did accept the idea that sub-species may become extinct.

#### IV. Evolution

Aside from the matter of extinctions, Leibniz's notions of species and sub-species figure prominently in the last area of his biological thought that we shall address, which is that of evolution. While some scholars have attributed to Leibniz something not far removed from the Darwinian version of evolution,<sup>50</sup> whereby one species is held to evolve into another, others have made the vaguer claim that Leibniz believed

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<sup>49</sup> A I 13, pp. 346-347.

<sup>50</sup> For example, Arthur O. Lovejoy: *The Great Chain of Being*, Cambridge, Massachusetts 1936, pp. 256ff. See also Hamm, p. 81.

in “the transformation of animal species”,<sup>51</sup> which is not obviously the same thing. I have argued elsewhere that Leibniz was only sympathetic to the idea of evolution occurring within a species group.<sup>52</sup> My reasons for this will become clear in what follows.

In a passage quoted a little earlier, we found Leibniz saying this:

we must distinguish between extinct species and those that have greatly changed. Thus the dog and wolf, cat and tiger can be seen as being of the same species. The same can be said about the amphibious animals or marine oxen once analogous to the elephant.<sup>53</sup>

As I have already noted, Leibniz here appears to hint at the idea of evolutionary change. Specifically, we might read this passage as suggesting that there has been change within the elephant species, a reading made all the more plausible by a remark Leibniz makes in another letter to Tentzel, namely that there is some credibility to the idea that “change has happened in elephants themselves.”<sup>54</sup> On the basis of these scraps, we might suppose that Leibniz considered his hypothetical elephant-like marine animal to be the ancestor of terrestrial elephants. Unfortunately in the Tentzel correspondence Leibniz does not say such a thing outright, though he gives another tantalizing glimpse as to his understanding of evolutionary change when he explains that whether and in which way a species changes depends on certain prevailing living

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<sup>51</sup> Jacques Roger: “Leibniz et la théorie de la terre”, in: *Leibniz 1646-1716. Aspects de l’Homme et de l’Oeuvre*, Paris 1968, p. 143.

<sup>52</sup> Strickland, pp. 128f.

<sup>53</sup> A I 13, p. 204.

<sup>54</sup> A I 12, p. 662.

conditions, like climate, sea-levels, and the availability of food.<sup>55</sup> As intriguing as this is, however, we have to look outside the Tenzel correspondence – in fact to the summary of it written for Thomas Burnett – in order to get a more definite statement on elephant evolution. As we have already seen, Leibniz informs Burnett that the Tonna skeleton

is from the animal kingdom, and if it is not from an elephant it is still from an analogous animal, either from elephants or similar animals that have formerly lived in these countries, or that there were amphibious sea animals of the nature of the elephant when a large part of the globe of the Earth was still submerged: for species can be greatly changed by length of time, just as by the interval of places, witness the differences between American animals and ours.<sup>56</sup>

Although not as clear cut as one would like, Leibniz certainly seems to be toying with the idea of elephants having sea-dwelling ancestors here. It is worth stressing, however, that he considers these ancestor creatures to belong to the elephant species, for as he says, if the Tonna skeleton is not from a terrestrial elephant then it is from an “amphibious sea mammal of the nature of the elephant.” This leads us to conclude that Leibniz did not endorse a Darwinian form of evolution, whereby one species evolves into another, but rather what would today be termed ‘micro-evolution’, i.e. evolution that occurs within a species. It might seem odd that Leibniz considered that a change from a sea-dwelling elephant-like creature to a terrestrial elephant counted only as evolution within a species group rather than the evolution of an entirely new

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<sup>55</sup> See A I 14, p. 429.

<sup>56</sup> A I 12, p. 735.

species group, but given the concept of ‘species’ with which he was working, it is not odd at all. For as he held that each species is defined by their fixed inner natures, species are therefore made immutable by definition. And Leibniz was not in any way unusual in thinking that a species identified a group of things which all had the same fixed inner nature despite other (obvious but apparently superficial) differences. To have thought of them otherwise during Leibniz’s day would have involved abandoning centuries, even millennia, of tradition, both philosophical and theological. Indeed, the first book of Genesis relates God’s instruction on the fourth and fifth days of creation for living creatures to reproduce “after their kind.”<sup>57</sup> And another source that was for centuries considered scarcely less reputable than the Bible, namely Aristotle, claimed that species always breed true.<sup>58</sup> As both Scripture and Aristotle still had a great deal of authority in Leibniz’s day, it is scarcely surprising that naturalists in the 17<sup>th</sup> and early 18<sup>th</sup> centuries found it difficult even to *think* of the idea of one species evolving into another, let alone endorse such a view.<sup>59</sup>

It is worth noting at this point that Leibniz’s speculations about marine elephants were just that: speculations (Leibniz explained to Tentzel that, in matters to do with antiquity, where certainty is impossible, “the freedom of conjecture must be left to each individual”).<sup>60</sup> Leibniz rested them on no better foundation than his belief that much of the early Earth was at one time covered by the sea, which was itself a conjecture. Consequently his views on sub-species extinctions and micro-evolution were highly speculative, as he well knew. But while these speculations seem to have

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<sup>57</sup> Genesis 1:21, 1:24 and 1:25.

<sup>58</sup> Aristotle: *On the Generation of Animals*, 746a29 and 747b30-33.

<sup>59</sup> A similar point has, of course, been made by Michel Foucault, in: *The Order of Things*, London 2002, p. 164.

<sup>60</sup> A I 12, p. 662.

bemused and irritated Tentzel in equal measure, Leibniz was sufficiently happy with them to repeat and develop them in the open letter to Spener (1710), which we met earlier:

As for the animals unknown in this world, of which we have discovered vestiges, further enquiry must be made as to whether or not the majority were aquatic or amphibious; especially since it can be believed that some terrestrial animals have ultimately descended from marine or amphibious animals which have now been deserted by the sea, and which have changed over a long period of time so that they can no longer bear the water.<sup>61</sup>

Here, Leibniz conjectures that a number of terrestrial animals may have descended from marine ancestors, a clear extension of the earlier conjecture that terrestrial elephants descended from marine ancestors. It is passages like this that have convinced some commentators that Leibniz endorsed a full-blooded form of species evolution,<sup>62</sup> but once again it seems that such an interpretation is misguided. In the above passage, and indeed in other passages such as those from the Tentzel correspondence and the *New Essays* which we considered earlier, Leibniz is clearly engaging in wild speculation, having no solid evidence at his disposal to back up the claims being made. Moreover, in the above passage, and again in other texts that deal with the issue of evolution (e.g. the letters to Tentzel and Burnett, as well as the *New Essays*), Leibniz says nothing at all about species themselves undergoing change. But

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<sup>61</sup> "Letter from G. W. Leibniz": *Berlin Miscellanea* 1, p. 119 / Dutens II p. 177 / *Shorter Leibniz Texts* pp. 142-3.

<sup>62</sup> For example, Lovejoy: *The Great Chain of Being*, p. 256.

then, given his understanding of what a species is, this is hardly surprising – for Leibniz, species are, by definition, fixed and immutable.

## V. Conclusion

My principal aim in this paper has been to show that, despite claims to the contrary, Leibniz was not as modern in his biological thinking as some commentators have made out. On the matter of fossils, Leibniz was consistently unwilling to believe that they all had an organic origin, and claimed time and again that some were merely ‘tricks of nature’, i.e. chance formations of rock. On the matter of extinctions, Leibniz consistently denied that any species had become extinct, though he did conjecture that there might have been extinctions of sub-species. And on the matter of evolution, Leibniz speculated that change may have occurred within species groups, but the more modern idea of one species evolving into another seems not to have even occurred to him.<sup>63</sup>

But even though we cannot justifiably make Leibniz out to be ahead of his time on the matter of fossil origins, species extinctions, or species evolution, we can make him out to be ahead of his time on another, slightly less important matter. In 1999, a group of Australian scientists argued that the very first elephants were most likely amphibious, and used their trunks as snorkels – which of course is what modern

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<sup>63</sup> Pécaut claims that Leibniz had an “intuition” about the modern idea of evolution but did not hold the view himself. She also claims that Leibniz’s remarks on the subject enabled others “to conceive the notion of evolution”, though I suspect that such a claim involves an overestimation of Leibniz’s influence on later naturalists. See Pécaut: p. 295.

elephants still do when crossing deep rivers.<sup>64</sup> Evidence for the idea of an aquatic elephant came from elephant foetuses, which in the early stages of development contain a number of structures that are otherwise only found in fish and frogs. Now although this particular bit of evidence is new, the idea of an aquatic elephant is not, as we now know.<sup>65</sup> Leibniz, then, was not as daring in his thinking as Hooke, and was certainly no anticipator of Darwin, but when it comes to the theory of the aquatic elephant, we can say without fear of contradiction that Leibniz was more than 300 years ahead of his time.

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<sup>64</sup> A. P. Gaeth, R. V. Short, and M. B. Renfree: "The developing renal, reproductive, and respiratory systems of the African elephant suggest an aquatic ancestry", *Proceedings of the National Academy of Sciences* 96 (1999), pp. 5555-5558.

<sup>65</sup> Of course Aristotle believed that elephants were amphibious in their habits, spending much of their time in swamps. But this was quite simply a mistake on Aristotle's part, a mistake which stemmed from his erroneous belief that elephants lived off water plants! See Aristotle: *On the Parts of Animals*, 659a3-9.