Introduction

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Cancún is located in what is known as the Mayan Riviera. In the popular imagination of our contemporary world, the Maya are best known as a lost civilization whose ruins are scattered throughout the tropical jungles of Mexico and Central America. Yet, as Coe [3] (p. 11) reminds us, the Maya are hardly a vanished people: their population numbers over 7 million people, which makes them the largest single block of indigenous people north of Peru. Already at the time of the Spanish conquest, the Maya were found in an area that included all of the Yucatan Peninsula (including, of course, the area of Cancún) and parts of the states of Tabasco and Chiapas in Mexico, as well as Guatemala, Belize, and the western portion of Honduras and El Salvador.

Ideas related to the creation of life have a long history in the Old World, reaching back to the times of classical antiquity, and are expressed in a diverse range of intersecting fields jointly known as artificial life today [1]. It has been argued that the modern sciences of the artificial could learn something from these classical myths [6]. What is less well known is that ancient Mesoamerican cultures also possessed a rich corpus of myths related to what we would now refer to as artificial life. In other words, although this is the first time that an *ALife* conference takes place in Mesoamerica, in a sense the central concept of the field, i.e. the creation of life via artificial means, has already been around the region for centuries if not for over a millennium. In the following we will focus on the specific case of the Maya, from whom several myths related to this concept have survived.

According the Mayan creation account, as recorded by the Quiché Maya during colonial times in the 16th century book Popul Vuh [10] [1], all was empty in the beginning, only murmurs and ripples in an endless sea under a dark night sky. The creator gods convened to bring about the dawn of the world with all of its geological and biological features. But this world was unable to appreciate the grandeur of their efforts and the animals lacked language to express themselves properly. So the gods decided to create humans. A first human design made from mud failed mainly because of its unreliable material composition. The mud man was dissolving and only talked senselessly [2]. So the gods dismantled it.

The gods therefore tried another human design, this time based on wood. They created "manikins, woodcarvings, human in looks and human in speech. [$\cdots$]. They

[1] Page numbers of all the quotations of the Mayan myths refer to this book.

[2] As noted by Tedlock (1996), this reference to a single man made from mud might be an allusion to the Biblical myth of Gods creation of Adam from the dust of the ground, turning this part of the story into an indirect resistance to the colonial doctrine. For the writers of the Popol Vuh, "a singular creature of mud could neither have made sense, nor walked nor multiplied" (p. 231).

came into being, they multiplied, they had daughters, they had sons, these manikins, woodcarvings" (p. 70). Nevertheless, although this design was already better, these replicating manikins had another unexpected defect, because "there was nothing in their hearts and nothing in their minds, no memory of their mason and builder" (p. 70). Although these wooden people could multiply, talk, and move around, their bodies were still too dry and deformed and they lacked an appreciation of their own existence, and "and so they fell, just an experiment and just a cutout for humankind" (ibid.).

In revenge the animal species they had been eating and the tools they had been using began to speak themselves and turned against their former masters: "Their faces were crushed by things of wood and stone. Everything spoke: their water jars, their tortilla griddles, their plates, their cooking pots, their dogs, their grinding stones, each and every thing crushed their faces" (p. 72). What is most interesting from the perspective of artificial life is that their household utensils, and even the houses, became enlivened and took issue with the people's fall from grace. Here, for example, is the lament of their grinding stones:

> "We were undone because of you. Every day, every day, in the dark, in the dawn, forever, r-r-rip, r-r-rip, r-r-rub, r-r-rub, right in our faces, because of you. This is the service we gave you at first, when you were still people, but today you will learn of our power. We shall pound and we shall grind your flesh," their grinding stones told them. (p. 72)

As their utensils rose up against them and their houses collapsed, these wooden humans with their crushed faces scattered in all directions and took refuge in the forests. Today we can still see this previous version of the human form: they are what we call monkeys. Interestingly, this shows that the Maya had no problem conceiving of non-human primates as precursors to humans, an idea which only took hold in the Western imagination following the development of evolutionary theory, in particular after the publication of Darwin's controversial book *The Descent of Man* in 1871.

According to Tedlock, the moral of this story is that we disenchant nature and overrely on technology at our peril. This ethical concern becomes even more pressing when we consider the contemporary push toward using the tools and insights of artificial life for the creation of so-called living technology [2]. For if we were indeed able to create the conditions for genuinely autonomous, automatically self-reproducing, and open-endedly evolving examples of technology, then how could we guarantee that this living technology will remain favorably inclined towards humans rather than turn out to be just self-interested or even confrontational [4] (pp. 549-551). After all, autonomy is the logical opposite of controllability. Such a vision is still far from being realized in practice. Nevertheless, this failed creation story is a timely reminder that we must balance our efforts to improve technology with a healthy dose of humility and caution. We do not want to end up creating tools akin to the Mayan's disgruntled grinding stones that resent their users.

At this point the narrators of the *Popul Vuh* temporally leave the problem of the origins of modern humans aside in order to relate some myths about the origins of

various personified celestial movements and constellations. One of the myths is of special interest for us because it involves the construction of an artificial life form, which is explicitly conceptualized as being an artificial replica of organic life. In this myth the Four Hundred Boys, patron deities of alcoholic intoxication, scheme to kill a self-aggrandizing crocodilian earth monster, Zipacna, but end up being killed by him instead (and thus serving as a representation of the setting of the Pleiades). The Hero Twins, Hunahpu and Xbalanque, want to revenge their death and so they set a trap for Zipacna:

> It's mere fish and crabs that Zipacna looks for in the waters, but he's eating every day, going around looking for his food by day and lifting up mountains by night. Next comes the counterfeiting of a great crab by Hunahpu and Xbalanque. And they used bromeliad flowers, picked from the bromeliads of the forest. These became the forearms of the crab, and where they opened were the claws. They used a flagstone for the back of the crab, which clattered. After that they put the shell beneath an overhang, at the foot of a great mountain. (p. 84)

Then the Hero Twins talk with the hungry Zipacna and let him know that they have seen a crab that he could eat. They guide him to the bottom of the canyon:

> The crab is on her side, her shell is gleaming red there. In under the canyon wall is their contrivance. "Very good!" Zipacna is happy now. He wishes she were already in his mouth, so she could really cure his hunger. He wanted to eat her, he just wanted it face down, he wanted to enter, but since the crab got on top of him with her back down, he came back out. "You didn't reach her?" he was asked. "No indeed she was just getting on top with her back down. I just barely missed her on the first try, so perhaps I'd better enter on my back," he replied. After that he entered again, on his back. He entered all the way only his kneecaps were showing now! He gave a last sigh and was calm. The great mountain rested on his chest. He couldn't turn over now, and so Zipacna turned to stone. (p. 85) [3]

In this way Zipacna was "defeated by genius alone" (p. 85), that is, by an artificial crab that could make sounds and move around. In other words, although the imagined technology, consisting of flowers and stones, is clearly unrealistic, here we find the very idea of artificial life as such (see illustration in Figure 1). This myth is special because, in contrast, the rebelling utensils were animated by a divine wrath rather than by artifice, and the mud man and the wooden manikin were supposed to be actual living beings instead of imitations of living beings. However, the idea of the counterfeit crab, in an abstract sense, is no different to how we understand the concept of artificial life from a modern perspective: it was an artificial imitation of life rather than natural life itself.

[3] According to Tedlock (1996), Zipacna's struggle to wrestle his body into the right position to consummate his hunger becomes a symbolic parody of sexual intercourse (p. 35). This is confirmed by one of his Maya informants, who notes with amusement the gender reversed roles in that finally the man ends up on his back. This interpretation is also supported by the fact that in Mópan Maya the term for crab, yux, is used as a metaphor for vulva.

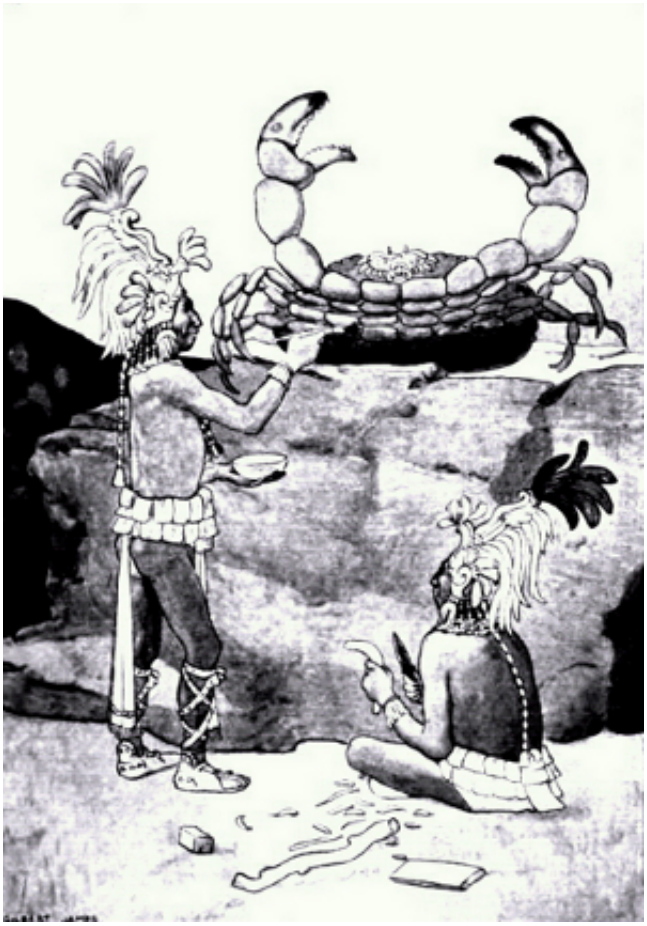

Figure 1: The Hero Twins make an imitation crab. Figure taken from [8] (p. 214); downloaded from the public domain.

Unfortunately, it is difficult to date the origins of this mythical crab to a specific time period of the ancient Maya, but references to the adventures of the Hero Twins are known from Late Formative times (around 300 BC) onwards [7](p. 134). For example, it has been argued that proto-Classic period stele from Izapa, a Mayan site in Chiapas, Mexico, depict early representations of the Hero Twins' defeat of Zipacna's father, the monster bird Vucub Caquix (ibid., p. 182). Future research could try to determine more precisely when the myth of the artificial crab first arose, and how it compares with the more familiar myths from European antiquity, especially from ancient Greece (Mayor, 2016).

After recounting a number of additional myths centered on the exploits of the Hero Twins and other gods, the narrators of the *Popol Vuh* are ready to return to the story of

the origins of human beings. This time the gods are prepared:

> And here is the beginning of the conception of humans, and of the search for the ingredients of the human body. So they spoke, the Bearer, Begetter, the Makers, Modelers named Sovereign Plumed Serpent: "The dawn has approached, preparations have been made, and morning has come for the provider, nurturer, born in the light, begotten in the light. Morning has come for humankind, for the people of the face of the earth," they said. It all came together as they went on thinking in the darkness, in the night, as they searched and they sifted, they thought and they wondered. And here their thoughts came out in clear light. They sought and discovered what was needed for human flesh (p. 145).

This secret ingredient of the living body turns out to be nothing other than drink and food, especially corn. What follows is a Mayan version of the saying that you are what you eat:

> And this was when they found the staple foods. And these were the ingredients for the flesh of the human work, the human design, and the water was for the blood. It became human blood, and corn was also used by the Bearer, Begetter. [· · ·] And then the yellow corn and white corn were ground, and Xmucane did the grinding nine times. Food was used, along with the water she rinsed her hands with, for the creation of grease; it became human fat when it was worked by the Bearer, Begetter, Sovereign Plumed Serpent, as they are called. After that, they put it into words: the making, the modeling of our first mother-father [4], with yellow corn, white corn alone for the flesh, food alone for the human legs and arms, for our first fathers, the four human works. It was staples alone that made up their flesh (p. 146).

Thus, in the end the creator gods had realized that constructing human beings was best done by using existing organic compounds that lend themselves to be formed appropriately and which can at the same time sustain the resulting living beings. Here we have, in a nutshell, a mythological explanation of the fact that as humans we must eat and drink. It is what sustains our existence.

Interestingly, although the Maya seem to have distinguished between creating substance (the making) and creating form (the modeling), we can see throughout these repeated trial and errors of creation a concern for their interdependence. The human form cannot be artificially imposed on just any kind of substrate; on the contrary, its embodiment requires very specific material conditions. After having found these conditions the gods celebrated their ultimate success, all the while emphasizing that the origins of the human species are an achievement of divine engineering: the first human beings were not born but made.

[4]The term "mother-father" is not intended to imply androgynous or dual sex. In fact, the first four persons that were created were all male. Mother-father is an expression that is used to refer to their role as lineage heads.

> They were simply made and modeled, it is said; they had no mother and no father. We have named the men by themselves. No woman gave birth to them, nor were they begotten by the builder, sculptor, Bearer, Begetter. By sacrifice alone, by genius alone they were made, they were modeled by the Maker, Modeler, Bearer, Begetter, Sovereign Plumed Serpent. And when they came to fruition, they came out human (p. 146).

The genius of the creator gods, i.e. to sacrifice existing life and to process and refashion its matter and form so as to give rise to new life, is reminiscent of a dominant approach in synthetic biology, which also famously boasted to have created a new form of life, in this case by assembling a new cell by reusing existing cells in combination with synthesized components [5]. The challenge now facing synthetic biology is to go a step further and, like these Mayan gods, create new life without basing it on existing individuals, but only on the processing of more basic organic compounds (i.e. to use nothing but "food alone"). This feat will require genius indeed.

There is a final caveat to this success story: it turns out that this time the creator gods have overshot their target and accidentally created super-humans. These first humans saw and knew all there was to know about the world and did so without any movement or effort. The gods were worried because these flawless individuals looked poised to become godlike themselves, thereby defeating the whole point of their creation. Accordingly, they decided to remove some of their knowledge and to diminish their sight, so that the humans would continue to worship while also being concerned with more practical earthly matters.

> "Aren't they merely 'works' and 'designs' in their very names? Yet they'll become as great as gods, unless they procreate, proliferate at the sowing, the dawning, unless they increase. Let it be this way: now we'll take them apart just a little, that's what we need. [$\cdots$]" And such was the loss of the means of understanding, along with the means of knowing everything, by the four humans. The root was implanted (p. 148).

There are ways to overcome these inbuilt restrictions, as the humans eventually discover. And the Popol Vuh itself, as a sacred book of council, turns out to be one of them. We can make sense of this by considering that the same technology that enables literacy at the same time enables accumulation of knowledge, and it therefore allows humans to progressively better understand and to see more clearly. It is still no different in today's world: now, in addition to all kinds of information technology, we also have at our disposal a range of technologies that enable us to overcome the limitations of our senses. Yet, as Tedlock [10](p. 60) reminds us, we should be careful to leave space for mystery in our lives. The last humans that stopped wondering about the meaning of existence and became overly absorbed in exploiting nature and technology lost the essence of their humanity. They are still with us today: they are swinging through the trees.

On the other hand, the Maya creation myths do not view that which is artificial as necessarily dehumanizing; to the contrary, the creation and use of technology is shown to be part of our essential nature. In agreement with ancient and modern traditions in the philosophy of technology [9], the narrators of the *Popol Vuh* highlight that the

artificial is constitutive of our very being. After all, the first humans were made, not born. What is not clear, and what the narrators leave for their audience to reflect upon, is how we can ensure that people are empowered rather than overpowered by their unavoidable use of knowledge and technology. The difficulty of realizing this ambition is revealed by the end of the Maya civilization, which had largely collapsed even before the arrival of the Spanish conquerors, a catastrophe that is likely to have been precipitated by too much environmental degradation around the major cities. We must do our best to prevent humanity from repeating the same mistakes again, a possibility that looks increasingly likely and which, though now greatly enhanced in scale, would unfortunately be consistent with the Maya's cyclical view of temporality.

With this unresolved challenge in mind, we dedicate this year's installment of the *ALife* conference series to the theme "Artificial life and society".

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