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Feature Article

2001: The Crystal Monolith

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Abstract. In the famous movie "2001: A Space Odyssey", Stanley Kubrick and Arthur Clarke claim that an extraterrestrial civilization catalyzed the evolution of hominids on our planet. To represent such a powerful civilization, they use a crystal. To date, it seems that we have not been contacted by advanced civilizations and that we are alone to manage our own future. Yet Kubrick and Clarke perhaps intuitively touched a truth about the power of crystals. An argument is developed here that genuine crystals, mainly quartz single crystals, were the earliest catalysts of the abstract thinking, symbolism, and consciousness.

Keywords. Crystals, crystallography, abstract thinking, paleoneurobiology, Kubrick, "2001: A Space Odissey".

THE MONOLITH OF "2001: A SPACE ODYSSEY"

Art, in its very different forms, has contributed and contributes almost as much as science and philosophy to create our conception of the outside world. For instance, most citizens believe nowadays that we are not alone in the universe, in spite of the fact that we have no evidence of the existence of extraterrestrial life even in the closest planets and their moons. The science-fiction movie "2001: A Space Odyssey"[1] and the novel based on its script is one of the masterpieces of film that has contributed in large measure to our vision about the great question of the habitability of the universe. The movie, released in 1968, was directed by Stanley Kubrick based on the script he wrote with the science-fiction writer Arthur Clarke. The screenplay was based, in turn, on Clarke's 1951 story, "Sentinel of Eternity".[2] The plot in both cases tells of the tangible existence of alien civilizations much more advanced than our own. How, in a novel or a film, could such a mighty civilization, capable of modifying humankind's evolution, be visually represented? What would an alien Big Brother look like? It had to be something that would evoke ultrahuman power, something enigmatic, disturbing and even fearsome, a secular image of God. Clarke and Kubrick described their vision of the star character of the movie, the monolith, with the following words:

> *It was a rectangular slab, three times his height but narrow enough to span with his arms, and it was made of some completely transparent material; indeed, it*

was not easy to see except when the rising sun glinted on its edges. As Moon-Watcher had never encountered ice, or even crystal clear water, there were no natural objects to which he could compare this apparition. It was certainly rather attractive, … (Figure 1).[3]

They chose a parallelepiped, a transparent slab, perfectly smooth with sharp edges and dihedral ninety-degree angles. In a word, they chose a crystal. As a completely transparent monolith was ill-suited to the art of film, Kubrick was compelled to darken the transparent slab, but both authors agreed that the icon had to be a crystal. In fact, in the early versions of the *2001* screenplay,[4] the monolith was specified as "a cube about fifteen feet on a side, and it is made of some completely transparent material".[5] They wrote: "the hominids watch, wide-eyed, mesmerized captives of the Crystal Cube.[6] Moreover, the sequence entitled "Killing the lion" ended with the following phrase: "And then one night the crystal cube was gone, and not even Moonwatcher ever thought of it again. He was still wholly unaware of all that it had done". The final version of the screenplay also explicitly talks of a "crystalline monolith";[7] and the hypnotizing sound that attracts Moon-Watcher "pulsed out from the crystal".[8] Clarke also had chosen a crystal for "Sentinel of the Eternity": the machine left purposefully on our moon by the alien civilization was a crystal pyramid. He wrote: "Perhaps you understand now why that crystal pyramid was set upon the Moon instead of on the Earth".[9] The sentinel that will alert that humans have the technology to cross the space was a "crystal pyramid" with hard, scratch-proof "crystal walls", most probably a diamond.

The choice of a crystal to represent a supernatural intelligence, or of any machine built by it, was inevitable. In everyday language, the word crystal evokes concepts such as order, purity, transparency, harmony, perfection, reason, intelligence… and power. These are all justified because they allude to the physical and chemical properties that have characterized crystals throughout history, and to how these properties have been transmuted to our cultural heritage through the arts and philosophy. Humans have held a fascination for crystals since primitive times, and even today it is thought that crystals hold some enigmatic power. Since the very formation of our consciousness, but mainly since the discovery of their three-dimensional order in the nineteenth century, crystals have represented the exact opposite of the atavistic, the biological, and the human. Thus, the image of a device placed on purpose by an advanced alien civilization or from that civilization had to be a crystal. The selected shape, a pyramid, or cube or slab, was changing through the different stages of the script – but it was always thought to be a crystalline polyhedron.

Figure 1. A frame of the movie "2001: A Space Odyssey" directed by Stanley Kubrick. The black monolith was a crystal clear cube in the original script but after considering the technical problems Kubrick decided to use a black cube and then a black slab.

Clarke and Kubrick belong to a group of intellectuals who believed in the existence of advanced alien civilizations capable of traveling across the universe that could have purposefully altered the evolution of life on our planet,[10] a theory that can be seen as a secular version of Christian visitation. More than fifty years after the film's premiere, we are yet to have any contact with an extra-terrestrial civilization. We have already visited Saturn and Jupiter, we have found in their moons jets of water[11] and clouds of organic compounds[12], but no sign of life yet. Our rockets and probes have traveled beyond our solar system. It is worth remembering that we have been emitting radio waves into outer space for some 130 years. At the speed they travel, we have already reached celestial bodies that are 130 light-years away, a distance far enough to reach other solar systems such as alpha-centauri,[13] or the Trappist-1 and its seven planets where NASA optimistically pushes astrobiological groups to search for life.[14] This means that within a distance of 65 light years from Earth either there is no life, or the life that there is either has not noticed (it is not capable of hearing us) or does not know how to respond. Or they are a bunch of intelligent but rude aliens that do not want to know anything about us (which, given the state of the management of our planet, would be a sign of intelligence). All in all, we need to sort out our intraplanetary disputes and environmental challenges, because it does not seem that anybody out there is going to come and lend us a hand

CRYSTALS

Having taken the position that the vision of Kubrick and Clarke may remain science fiction for the foresee-

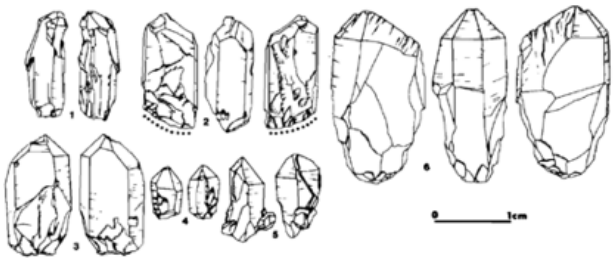

Figure 2. Collection of quartz crystals from the Acheulian site of Singi Talav. From reference 18. (D'Errico).

able future, I do not dispute the possibility that the two geniuses responsible for the masterpiece *2001* were not so misguided on the role that crystals have played in evolution. We now know that the first objects that hominids collected without any applied purpose were quartz crystals. A set of varied, irrefutable proofs have been gathered and in part contributed by paleoart experts such as Robert Bednarik[15] and James Harrod.[16] For example, Pei Wenzhong, who discovered Peking Man, published in 1931 the discovery of twenty quartz crystals in the famous Zhoukoudian cave along with the remains of *Homo erectus* that date from 700,000 years ago.[17] One of them was a perfectly faceted, smoky quartz crystal, a hexagonal prism, biterminated in pyramids of some six centimeters in length. In 1989, at the famous archaeological site of Singi Talav in India, six practically complete quartz prisms from the Lower Acheulean strata (300,000 – 150,000) were found (Figure 2). These prisms are natural, have not been modified and measure between 7 and 25 mm in length.[18] Smaller quartz crystals were excavated at the Acheulean site of Gesher Benot Ya'aqov, in Israel (240-750 years ago).[19] Bednarik discovered a fragment from a sizeable transparent rock crystal also in the Acheulean, this time at Gudenushöhle, in Austria,[20] and quartz crystals at various levels ca. 276-500 kiloyears ago in Wonderwerk Cave (South Africa).[21]

In summary, almost a million years ago (perhaps even earlier if other discoveries are confirmed), the *Homo erectus* brain was so drawn to the shapes of quartz crystals that they decided to collect and travel with them.[22] Crystals collected by hominids have been found alongside hominid fossils far from their place of origin. In several cases, the crystals found in these sites (for instance in Singi Talav) came from different outcrops. Despite being collected in different sites, they were identified as objects of the same type, a formidable exercise of pattern recognition. These crystals were not tools since they are too small to be used for any practical purpose. They have not been worked on or modified,

Figure 3. A recreation of the collection of crystals by Homo erectus. ©Javier Trueba/Juan Manuel García-Ruiz. With permission.

nor do they have perforations or signs of use as trinkets or jewels. No, they were objects considered valuable in of themselves. They were esteemed in the Acheulean, they continued to be so in the pre-historical and historical eras. And there is no evidence that the human fascination for crystals is waning even today. The question is unavoidable: why were those hominids, still without a developed consciousness, drawn to those quartz crystals? Why did they value them and carry them as precious treasures? (Figure 3).

When *Homo erectus* raised his head and looked at the African savannah or the Asian forests, everything he saw was curved or branched. The trees, the bushes, the furrows carved by water, the streams, the clouds, the mountains, the animals, and their fellows: there was not one straight line,[23] no object formed by flat surfaces, no polyhedral shapes. Today, thanks to the pioneering and quixotic Lewis Fry Richardson[24] and the sagacious Benoit Mandelbrot,[25] we know that the geometry of nature is fractal geometry. Everything that nature has created on the face of the earth is the product of continuous branching and curvature. Everything except crystals. When *Homo erectus* tried to understand the world with their preconscious brains, the first thing they had to do was to find visual patterns, to separate what is the same from what is different. When they found quartz or pyrite crystals, they would have understood that these shiny, polyhedral objects formed by straight lines, flat faces and deterministic angles, free of curves, were utterly unique. We must remember that, with the exception of crystals, the straight line, the grid, polyhedra and, of course, Euclidean geometry, were all invented by humans. This exceptional Euclidean nature is the reason

Figure 4. The dolmen of Alberite. A) The red star shows the location of Alberite in South Spain. The red circles show the possible provenance of the crystal. B) The quartz crystal found in the dolmen. Photograph courtesy of Salvador Dominguez-Bella. C) Picture of the dolmen by Pedro Cantalejo; d) Scheme of the dolmen, from the Gabinete de Bellas Artes of the Museo of Cádiz, Junta de Andalucía.

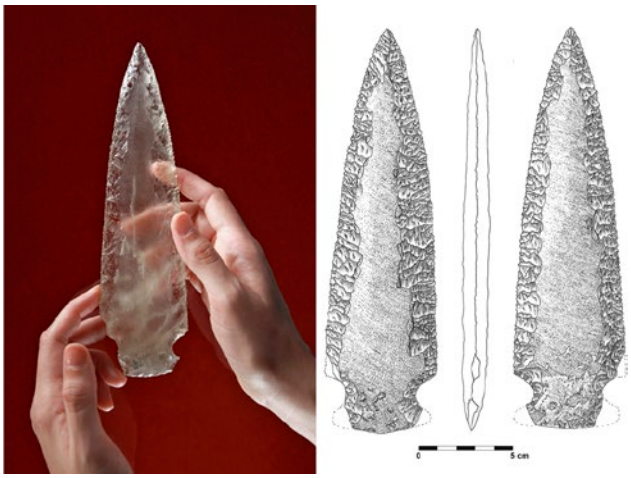

Figure 5. A 25 cm long dagger blade of rock crystal from the Copper Age found in tomb 10.042-10.049 of the Archaeological Zone of Valencina de la Concepción-Castilleja de Guzmán (Seville). Photography: Miguel Ángel Blanco de la Rubia. Courtesy of the ATLAS Research Group (University of Seville).

why rock (quartz) crystals were among the first objects collected by hominids, before the creation of our consciousness.

However, there was something even more enigmatic about these objects. Everything that *Homo erectus* saw around them had an origin, a history, a beginning and an end. Plants sprouted and grew, streams rose up from the rains, as did the forms etched by erosion; animals were born, and they themselves saw their children born: all things, even the rudimentary tools that they had managed to produce, had an origin, had a beginning and an end. However, those mysterious crystals did not. Who was the creator of something so singular? That question had to have an answer sooner or later. Inevitably, the crystals were seen as "machines", devices that for the first time "communicated" with the beyond, whatever or whoever the beyond was – any of the versions of the great beyond that the monolith from *2001* encompasses.[26]

The role of crystals as icons of power grew during human evolution and prehistory. A dramatic example is the case of the Dolmen of Alberite (Cádiz, Spain), a funerary installation ca. 6000 years old (Figure 4).[27]

A smoky crystal of quartz of about 45 cm in length was found within a well preserved dolmen. The crystal has a blocky habit, and consists of a well developed {100} hexagonal prism terminated with {101} pyramids faces. Its origin is undoubtedly pegmatitic. The crystal is well faceted but it is not transparent, and it has some deformations. This suggests a sophisticated ability to identify single crystals from other rocks and mineral aggregates. The collection and location of this crystal was purposeful because it is the only singular object found in the dolmen. The use and meaning of this object are unknown but indeed was not a tool because there is no sign of hitting or percussion, no pieces have been removed from it, and it is too large to be used as a utensil. Most probably the crystal was considered an icon, a means of enormous value, of power. The reason is that this type of pegmatitic quartz crystal does not exist near the area of the location of the Dolmen. The closest areas from which this type of crystals are known are the Gredos Range near Madrid, or the Galicia massif northwest of Spain.[28,29] Therefore, these early mineral collectors had to transport that crystal from at least 500 kilometers or perhaps 900 kilometers to place it in the dolmen of Alberite. Only an icon of great relevance would have been the subject of that effort. Almost coetaneous with Alberite, quartz crystals were labored in many other sites in Europe and elsewhere. They worked the crystals of quartz with admirable skill and expertise, capable of converting, for example, a dagger into a work of art rather than a weapon (See Figure 5).[30]

The irresistibly combination of uniqueness, mystery, and harmony is the source of fascination for crystals that has been maintained throughout human history. Those little "monoliths" not only sparked the imagination of our ancestors but have also shaped our culture and our thought. They become idols in which to trust,

the objects that triggered the belief in the existence of extraterrestrial powers, a power able to communicate by sending storms, stones (meteorites) or energy to make stones (lightning stones or fulgurites): the baethylus or sacred stones that were worshipped for millenniums).[31] The use of crystals as objects with magic power was a characteristic shared by many primitive civilizations, including Maoris, Apache, Canadian Indian, Polynesian and the Malagasy of Madagascar.[32] Later on, crystals and minerals were considered arcane curative as described in Babylonian tablets[33] and the *lapidarium* of the Early and Late Middle Ages and the Renaissance;[34] later, the harmony of the universe was explained by Kepler on the basis on the Platonic polyhedra, shapes all of crystalline solids.[35] From the mid-nineteenth century, crystals underlay the teaching that converted order and abstraction into the tools to understand the world, not only for science but also for art and philosophy.[36],[37],[38] They are not extra-terrestrial. No alien civilization put them there. Their origin is as natural as any other object of nature. But their rarity and their allure probably sparked the imagination of a mind already prepared to grasp the meaning of that singularity. Nowadays, our brains are prepared to identify order; in fact, to see order even when order is not there, the origin of some optical illusions. Our brains have evolved to seek geometrical patterns to understand the external world.[39] But are our brains designed to prefer order? In other words, do crystals attract us because the crystals were among the first elements that our ancestors, starting with *Homo erectus*, collected? Or did we gather crystals almost a million years ago because our brain was already designed to prefer order (which benefited the comprehension of nature and therefore could be evolutionarily advantageous)?[40] Did crystals impact our cultural history because they are firmly linked to the birth of art, symbolism, and consciousness?[41]

The hypothesis that I propose in this paper is difficult to prove. Only circumstantial evidence can be offered so far, but the current evidence is strong enough to be worth of more thoroughly investigations. I foresee two main lines of research to explore further the role of crystal geometry in the ability of hominids and humans to develop an abstract vision of the external world.

First, we must increase archeological field studies, particularly in the Paleolithic, to find further material to be studied with modern analytical methods. New discoveries of collected crystals and other manuports will help to reconstruct the story of the use of fluorite, pyrite and especially quartz crystals. This will allow revealing with the highest precision when hominids started to collect crystals and how its significance and "uses" evolve with time. Among the putative evidence for symbolic behavior, it has been proposed that Oldowan hominids were already shaping rocks with geometric shapes, ca. 1.7 Ma.[42] Was the Oldowan (mode I) culture already prepared to collect crystals? Could the "crystal centered" view I propose help to understand the technological jump from the Oldowan to the Acheulean?[43] Oakley were among the first to propose that some of the finer Acheulian handaxes look like masterpieces of artistic craftsmanship rather than tools, i.e., they were made with symmetrical perfection beyond technical necessity.[44] A mind that searched for perfect mirror symmetry is the first step to produce harmony and beauty with patterns. Is this search for symmetry linked to the symmetry of crystals? Is there any correlation between the collection of crystals and the evolution of the mirror symmetry of the handaxes during the Acheulean?

The second line of research must focus on neurological studies. It has been proposed that superior pattern processing is the fundamental basis of most, if not all, unique features of the human brain, and the belief in imaginary entities such as ghosts and gods. The process of pattern recognition involves the electrochemical, neuronal network-based, encoding, integration, and transfer to other individuals of perceived or mentally-fabricated patterns.[41] It will also be very important to understand the current perception of crystal symmetry, and fractal order (either mathematical or random fractals) by humans and closely related primates. This will be precious information for establishing whether *Homo erectus* perceived at the neurological level the finding of the "monoliths" one million years ago, and how they impact cognitive milestones in human evolution. Finally, the investigation opens a great question. Our understanding of the world is based on a limited abstracted vision of a complex physical world. The current level of understanding has been shaped by the Euclidean reduction that we began to use almost one million years ago. What would have happened if there had not been any crystals? Would an understanding of the world that had not drawn on abstraction have been evolutionarily successful? Is there a way to understand the world as it is, and not as we have invented it for ourselves?

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