ORICHALCUM - THE METAL OF ATLANTIS

By

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The most important skill of a good scientist is the ability to choose the right problem at the right time. It is the scientist who knows where a research idea is ready to bear fruit, ... [1]

SUMMARY

In this article we direct our attention toward orichalcum, Gk. Oper $\chi \alpha \lambda \kappa o \varsigma$ *oreikalkos*, an unknown metal which sparkled like fire, extracted from the mines of Atlantis, used to cover stone walls, sidewalks and columns of Poseidon's temple. Hesiod mentioned it before Plato, and, as in previous work we identified the Atlas Mountain in the Peruvian Andes, we have a good opportunity to test our theory; searching references of this metal in autochthonous Peruvian sources. Fortunately, in the famous 'Chronicle' of Felipe Guaman Poma de Ayala, lost for 300 years, we not only found the possible composition of orichalcum, but also its relation with a catastrophic Andean upheaval, probably simultaneous with the proto-historic eruption of Santorini.

INTRODUCTION

This article was published in 1986, in the preprint collection "Science and Society" N°004/86 of the Brazilian Center for Research in Physics (CBPF), Rio de Janeiro, at the request of its director, the prominent Brazilian Scientist José Leite Lopes, noted for his contributions on the Quantum Field Theory and Particle Physics. That same year I published, in the same collection of preprints, some preliminary results of my physical interpretation of Greek Mythology, which is now available in the book of my authorship, "Journey to the Mythological Inferno" (JMI). This article is the result of a study on the origin of the Attic System of Numerical Notation and Measurements, attributed to Solon, which will be presented in full in a second volume of JMI, in preparation.

THE ISLAND PLATO NAMED ATLANTIS

No other work stimulated so much the imagination, nor gave origin to so many research studies as Plato's unfinished dialogues of Critias on Atlantis [2]. The island Plato named Atlantis, because its first king was called Atlas, has been described as an immense continent located on the west of the Strait of Gibraltar. Searched for in all the latitudes of our planet, it was even identified with America [3] [4].

In this article, we direct our attention towards orichalcum ($opei\chi\alpha\lambda\kappao\zeta$), an unknown metal mentioned in these dialogues together with gold and silver. According to Plato, orichalcum was a precious metal extracted from the mines of Atlantis and used by its craftsman to cover the stone walls, sidewalks and columns of Poseidon's temple [5].

Hesiod also referred to it, describing it as a shiny metal, a gift from Hephaestus [6]. But neither Hesiod who mentioned it in "The Shield of Heracles" nor Aristotle who mentioned it in a passage of the "Second Analytics" and in "*De Mirabilius Auscultationibus*" (Pseudo-Aristotelic), knew either what type of metal it was or its composition [7].

METALURGICAL REVELATIONS BY A XVI CENTURY CHRONICLER FROM PERU

Felipe Guaman Poma de Ayala, a historian and chronicler from Peru who lived during years 1,535 to 1,616, quoting autochthonous sources, narrated that the people who lived in Peru went through five ages or eras, each referred to as a 'Sun', similarly to Hesiod's myth on the five ages necessary for the evolution of mankind. The men of the 3rd, age were called *purun-runas* and the women *purun-warmi* [8] (Fig. 1) At that time, he says, they began weaving cotton clothes and dyeing them in different colors, they built houses with stone walls and straw roofs because constructions done with sun-dried bricks was unknown; they also started clearing up roads which were preserved until the time of the Spanish invasion.



Fig. 1: From the illustrated account of life in Inca times by Felipe Guamán Poma de Ayala, one of 400 drawings shows men and women of Purun age. The 3rd. Sun age

Guaman Poma left some interesting information on the technical knowledge of the *purun-runas*, which can be found in his catalogue of minerals [9]. When he refers to metals known in the 3rd era, he says: They started looking for silver and gold, their *purun-runas* silver was called *purun-collqui*, and gold, *purun-cori*; and copper they named *anta*. Lead they called *yana-tite*; tin was called *yurac-tite*, and orpiment (AS₂S₃) they called *atocpa-corin*. The later, due to its color, they called fox's gold. In Quechua language *atoc* means fox and *pa* is a syllable meaning ownership. We note that, when referring to some of the minerals, the Indian chronicler seems to be expressing himself in archaic Greek!

The Greeks name hematite ($\alpha\mu\alpha.\tau\tau\eta$ blood stone) and magnetite ($\mu\alpha\gamma\eta\varsigma.\lambda\iota\theta\sigma\varsigma$, also called H $\rho\alpha\kappa\epsilon\iota\alpha.\lambda\iota\theta\sigma\varsigma$, Heracles' stone), iron minerals Fe₂O₃ and Fe₃O₄ respectively [10], both mentioned by Theophrastus (c. 371 to 287 B.C.) which, together with many other minerals kept the same suffix *tite*, which is equivalent to *litos* and means stone or mineral. Guaman Poma de Ayala also calls lead *yana-tite* which means black mineral in Quechua; and tin, which is a white metal; he calls *yurac-tite*, which means white mineral in Quechua [11a]. According to Alonso Ramos Gavilán (1621), the commonly accepted meaning for the Aymara voice *titi* is tin, lead or copper, therefore, we can say that in the region of Collao *titi* usually specified metals or minerals. Lake Titikaka, also called Chucuito, located in this area, preserves the name of the Andean region rich in minerals, for *titi-káka* means mountain of tin or lead [11b].

The most important information contained in the Ayala's catalogue is the mention of names given to the most coveted metals [12]. If we eliminate the prefix *purun* which only indicated the era, the combined names for gold and silver form the world *cori-collque* which would be very appropriate to denominate in Quechua a precious alloy formed by those elements, inasmuch as a copper and gold alloy is called *anta-cori* in Quechua [13]. Is it really possible to obtain this alloy in practice? Modern metallurgy proves that gold and silver are mutually soluble in all proportions, thus resulting in a more fusible and malleable alloy than pure gold.

COMPOSITION OF CORICOLLQUE

According to Plato, orichalcum had fire like reflections [14]. Assyrian knew red and yellow gold, from Sargon's time onwards. The red gold (*Sariru russû*) is described as a product from *Aralu* (the Assyrian Underworld, the Greeks called it Hades) "the dust of its mountains" [15a]. Limet belives that the Sumerian GUSKIN.SÁR.DA is a gold-alloy halfway between the gold-copper alloy, called "red gold" (GUSKIN.HUS.A) and the pure gold (GUSKIN.Sİ.SÁ) [15b]. The reddish combination of gold and silver appears when one incorporates a small percentage of copper (See Table I). It is sufficient to add 5% of copper into 75 parts of gold and 20 parts of silver alloy to obtain a splendid pinkish color [16]. Gold alloys with less than 12% copper are very malleable and easy to work with. Did the ancient Peruvians know a precious alloy of this type? A metallic alloy of this type was discovered in a set of jaguars of Chavin style, amazingly shaped in thin sheets of precious metal and soldered with exquisite craftsmanship [17].

The jaguars were found in 1925 by a peasant in Chongoyape and classified as "Chavinoids" due to the artistic style. It is too risky to venture a date of manufacture. Lechtman et al. believe they were made between the years 400 and 100 B.C. but they could be older. Nevertheless, authors quoted have accepted this possibility, by admitting that Peruvian metallurgic traditions have been kept from very early eras.

We have no precise way to establish an exact date for the beginning of metallurgy in Peru, but Lothrop assures us that, in the region of Chavín de Huántar, metallurgy was developed very early in magnificent style and with extraordinary manufacturing techniques [18].

Various analyses were carried out of the metal used in manufacture of the jaguars to ascertain their average value. These analyses showed they had the following composition: 9% copper, 76% gold and 15% silver. If we take into account the fact that, through heating in the air the surface can loose copper by oxidation, with the concomitant increase of precious metals, we must admit that the Peruvian goldsmiths from the Chavin's era knew how to work efficiently an alloy of precious metals "with fire like reflections" which they probably called *coricollque*.

According to Plato, sheets of orichalcum were used to coat the temple of Poseidon. In Peru, religious monuments were coated with sheets of *coricollque*, called tumbaga by the Spanish invaders. Is it pure coincidence that laminating was the most important and traditional Peruvian metallurgy?

THE END OF PURUN-RUNAS AGE. CONCLUSIONS

According to Plato, in the short but fatal lapse of one day and one night, dreadful earthquakes and floods submerged Atlantis into the depths of the Ocean. "This is the reason why, even nowadays, that ocean is inaccessible and difficult to navigate due the slime the submerged island left in its stead". With this explanation Plato [19] tried to conceal the ignorance that existed regarding the history and geography of one of the most civilized nations of the 5th century before our era. Only legends remained from the most distinguished achievements of men of the first three ages, and those of the 4th - Linage of Heroes– quoted by Hesiod.

America is the only "island larger than Libya and Asia put together", located in front of the Strait of Gibraltar. The information available to Plato, and which he transmitted with the best of intentions, was distorted. America did not sink, but a disaster of enormous proportions must have befallen the men of the third age. In Peru, the echo of this catastrophe was preserved through different traditions. According to Guamán Poma de Ayala [20], the *purun-runas* were annihilated by a (sic) pestilence – many people died – "they say that during six months the condors and vultures ate without being able to eat it all".

The myth of the island of Atlantis, qualified by Aristotle as pure fantasy, again acquires importance. What to believe? "Aurea mediocritas", advise us to follow the horatian thought. That is to say; we must not consider ourselves too wise to the point of judging it pure fantasy nor so naïve as to go searching for it in the bottom of the Atlantic. A good hypothesis states that the myth of Atlantis is based on genuine traditions, but that did not occur 9,000 years before, as stated by this author in the dialogues of Critias, but 900 years before Solon's time.

It is possible to justify this as an error of transcription? The Greeks of Athens and the rest of Attica followed a decimal system usually known as Attic or acrophonic [21]. Acrophonic means that it was based (apart from the symbol I for 1) on the first sound of the numeral. This system used capital letters, I, representing the unit, which may be repeated up to four times. \Box , the first letter of $\pi\epsilon\nu\tau\epsilon$, stands for 5 (\Box was the symbol for II from the sixth to third century B.C.). Δ , the first letter of $\delta\epsilon\kappa\alpha$, stands for 10; the number 50 was expressed \Box (or 5 times 10); 100 was represented by H (the first letter of $\epsilon\kappa\alpha\tau\sigma\nu$, the world *hekaton*); the number 500 was expressed \Box (or 5 times 100); X (*Xt\lot khilioi*) for 1000; in the same way they wrote \Box (or 5 times 1000) for 5000. To write down the numbers 9; 90; 900 and 9000, in a similar way to the one used by the Romans, they used the following notations: $\Box I I I I I = 9$; $\Box \Delta\Delta\Delta\Delta = 90$; $\Box HHHH = 900$; XXXX= 9000. My suggestion is that Solon really did hear the Atlantis tale in Saïs, and was correctly informed that the catastrophe occurred $900 = \Box HHHHH$ years before. The increased time by a factor of 10, $9000 = \Box XXXX$ years, could be an error of transcription.

Decreasing time by a factor of 10, the 'disappearance of Atlantis' is contemporary to a violent volcanic eruption in the island of Thera, in the Aegean Sea. Through discoveries made during modern archaeological excavations of a late Minoan settlement near the village of Akrotiri, begun by Marinatos in 1967, it was proven that the cataclysmic eruption of Santorini (Thera) did occur in the seventeenth century B.C. The large amounts of fine silicate ash and sulphur aerosols injected into the stratosphere and upper troposphere may have produced serious effects on weather and climate that persisted for several years. A specially notable and severe frost-ring damage record from bristlecone pines at seven localities in the western USA in the B.C-early A.D. time period was correlated with the proto-historic eruption of Santorini, indicates that the event occurred 1,626 years B.C. [22].

Summarizing, a cataclysmic phenomenon detected on a world scale, involving a volcanic activity of extremely high intensity did occur in the seventeenth century B.C. But, should we really only blame the volcano Santorini for this cataclysm?



Archaeological studies carried out in the Peruvian Andes show this to be a rather simplistic claim. Stratigraphic excavations carried out in the cave of Huargo by the archaeologist Augusto Cardich, located at 4,000 m.a.s.l, in the state of Huanuco (Peru), indicate that during the last 25,000 years a cataclysmic eruption occurred in the Andes [23] (Fig. 2).

Fig. 2: Ground plan of Huargo cave, showing the rectangle Exc. N° I, Grid I, AB=2.00m X CD=1.50m excavated by Augusto Cardich, at 4,000m a.s.l. of Huámuco state (Peru). The only two layers with volcanic ashes found in this period were dated by radiocarbon as belonging to the second millennium B.C. (Fig. 3). The oldest of them, and the one with the highest concentration of volcanic ash (about 13 %, see Fig. 4), was dated by radiocarbon as belonging to 1,620±230 years B.C. At the back of this Cave Cardich found prehistoric paints, oldest than the layers with volcanic ashes (Fig. 5).



Fig. 3: Cross section view of the profile excavated along the edge AC of grid I, showing 10 natural layers of sediments (see Table II)



Fig. 4: Sedimentology of the deposits in the Huargo cave, Apendix 3, by Renato R. Andreis and Jorge Casajus: Revista del Museo nacional, Tomo XXXIX, p. 42 Lima (1973).

Fig. 5: Prehistoric paints in the Huargo cave. Paints. a and b represent two animals (probably cervids) painted in black color, and partially overlaid with red hematite. c represent a human figure with a kind of skirt. The bar represents a 10cm length.

Andean volcanoes within a radius of 800 km from the Huargo cave are not known. The closest to the South are in the state of Arequipa. At the North, the volcanic region is below two degrees of latitude, in Ecuador, to an even greater distance. Therefore, if the volcanic ash deposit within the cave open to the North, did not come from a nearest unknown volcano, we should infer that the Andean upheaval was truly catastrophic.

ADDENDUM

In "Journey to the Mythological Inferno" Hesiod's mountain of Atlas was identified with the highest peaks of the Peruvian Andes, where a resounding palace was erected to the apocalyptic gods. One of the Titans, or Hecatoncheires, was identified with Typhon, on the Raimondi Stele, and related with the Mexican-Central American god called *Ehcatonitiuh*, meaning the "Sun's Wind"; who, according to the Nahoas, who lived in Mexico prior the Spanish conquest, caused great destruction to mankind. There are many variants concerning that legend, about the name and duration of each 'Sun', and as the order in which they occurred. Boturini text, quoted by J. Imbeloni [24] (p. 300), relates that the third 'Sun' ends with a great hurricane called *Ecatonatiuh*, that roll-over all the trees, houses and strong buildings.

According to some Peruvian traditions, Viracocha, as creator, civilizer, and legislator, appear during a period of obscurity and darkness. His presence is linked to a phenomenon that seems to describe a volcanic eruption near the ruins of the principal temple of Viracocha, in the present day village of San Pedro de Cacha, about 120 km south of Cusco. The narrations, which establish the volcanic eruption with the presence of Viracocha; explain that, to punish the Canas Indian who worshipped a goddess situated on the highest points of the mountains, he sent down a terrifying fire from the sky, which melted like wax the peak of a hill near Cacha. In February 1985, with the advise of the archaeologist Manuel Chávez Ballón (Photo 1.), Prof. of the National University of San Antonio Abad of Cusco, the author visited the remains of the temple of Viracocha (Photos 3 and 4) and, after an hours climb, reached the crater of extinct volcano Quinsach'ata (Photo 5). The volcanic rocks show slight erosion and, despite being highly porous and the climate quite severe, seem to indicate a geologically recent volcanic eruption, confirming mythological traditions. The archaeologist Chavez Ballón informed the author that he encountered very old ceramic fragments inside the crater, classified as type A Marcavalle from Early Horizon [25] (Photo 2.), dated around 1,400 to 1,200 B.C., indicating that the volcanic eruption occurred some hundred years before the ceramic offering was deposited inside the crater. Thus the Ouimsach'ata eruption could be another evidence of the catastrophic Andean upheaval, probably simultaneous with the volcanic ash deposited in the Huargo cave.



Photo 1: The author with the archaeologist Manuel Chavez Ballón, in his archaeology workshop, Cuzco 25/02/1985.

Photo 2: Ceramic fragment Type A Marcavalle (1,400 to 1,200 B.C.) collected by archaeologist Chavez Ballon in the crater of Quimsach'ata volcano.



Photo 3: Remains of the great temple of Viracocha (Con Tici Viracocha Pachayachachic- The Creator of the world). The hill at right is the Quimsach'ata volcano. Photo 4: Central wall, North-South, of the great temple of Viracocha, with remains of stone bases of eleven cylindrical columns, at each side of the wall.



Photo 5: Inside the crater of Quimsach'ata volcano

TABLE I

According to L. Knab «Traté des alliages et de dèpóts metáliques», Edition G. Steinheil, Paris (1892), the following interrelations exist between color and composition of different gold alloys:

Metallic color	Gold	Silver	Copper	Iron	
Yellow gold	1000				
Red gold	750		250	and part and the	
Pale red gold	750	200	50	dat tat her ne	
Green gold	750	250			
Blue gold	750			250	
White (English) gold	750	150 - 190	100 - 60		

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Layer	thickness (m)	Relevant descriptions
1	0.05	
2	0.05	
3	0.05 to 0.08	
4	0.03 to 0.05	Volcanic glass appears in small quantity
5	0.12 to 0.15	In this layer, dated by C 14 at 1,610±230 years B.C., there is a greater quantity of volcanic glass here than in the preceding layer. There were also 53 ceramic fragments found in this layer, of five different types
6	0.06	There is clear evidence of human occupancy in this layer, there was also red pigment of hematite found, it's possible that it was used for the red color in the cave paintings.
7	0.30	
8	0.30	In this layer, dated by C 14 at 11,500±700 years B.C., with evidences of human presence, indicated by man made artifacts, man coexisted with extinct animals, as the horse <i>Equus Amerhippus</i> and the <i>Scelidotherium</i> , as well as with the current fauna of the gender <i>Lama</i> .
9	0.30	Without evidences of human presence.
10	0.30	At 1.60m from the cave surface, it is the deepest layer without consolidation. As the precedent layer, there is no evidence of human presence.

The two Radiocarbon dates: on the 5th layer, situated between 0.20m and 0.35m in depth, and on the 8th layer, situated between 0.70m and 1.00m in depth, were carried out on the 4th of April 1973, at the Laboratory BVA, Arsenal of Vienna, Austria, by Dr. Lucio Adolfo Cardich. Appendix 1, Augusto Cardich "Excavaciones en la Caverna de Huargo, Peru, p. 30, Revista del Museo Nacional, T. XXXIX, Lima (1973).

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- 9. Idem. Folio 60, p.49.
- 10. Dana Mineralogy VII Ed., Vol. I, p.527 and p. 698, John Wiley & Sons, London (1944).
- 11a. Titi means heavy, with a lot of weight, metallic lead, according: Jorge A. Lira "Diccionario Kkechuwa-Español", 2nd. Ed. P. 339 and p. 344, Editora Guadalupe Ltda., Bogotá – Colombia (1982).
- Alonso Ramos Gavilán, "Historia del Santuario de Nuestra Señora de Copacabana" p. 90, Ed. Ignacio Prado Pastor, Lima (1998).
 - 12. The name *collqui* is preserved in the Collquipocro toponymics; a mineral site located in the district of Pampas, Department of Ancash (Peru). *Collquipocro* means silver pit in Quechua. Different types of sulfurous silver minerals have been extracted from the mines located in Collquipocro, including native silver. A. Raimondi, "Ancash", p. 112, Lima (1873).
 - 13. The ancient inhabitants of Peru knew a copper and gold alloy, called *antacori* by the joint-world *anta* = copper and *cori* = gold.
 - 14. Plato, Critias, 116c.
 - 15a.R. Campbell Thompson "A Dictionary of Assyrian Chemistry and Geology", p.59, Oxford, At the Clarendon Press (1936).
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