“*Fertilissimi sunt auri Dardae, setae vero et argenti*”.
**Notes on some ancient open-air gold mining sites
in Ladakh**

« *Fertilissimi sunt auri Dardae, setae vero et argenti* ». *Note sur quelques
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Electronic version

URL: <https://journals.openedition.org/emscat/4647>

DOI: 10.4000/emscat.4647

ISSN: 2101-0013

Publisher

Centre d'Etudes Mongoles & Sibériennes / École Pratique des Hautes Études

Electronic reference

Martin Vernier, “*Fertilissimi sunt auri Dardae, setae vero et argenti*”. Notes on some ancient open-air gold mining sites in Ladakh”, *Études mongoles et sibériennes, centrasiatiques et tibétaines* [Online], 51 | 2020, Online since 09 December 2020, connection on 13 July 2021. URL: <http://journals.openedition.org/emscat/4647> ; DOI: <https://doi.org/10.4000/emscat.4647>

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"Fertilissimi sunt auri Dardae, setae vero et argenti". Notes on some ancient open-air gold mining sites in Ladakh

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Martin Vernier

Introduction

- 1 Gold-digging ants are part of the antique bestiary. About the size of a dog, they are reported to dig up gold from sandy areas. Herodotus (c. 484-c. 425 B.C.E.) located them in northern India¹. The Greek historian didn't claim first-hand information and was only quoting other travellers' sayings of the time. Nevertheless, as happens most of the time when the precious yellow metal is involved, the fact captured attention. Word-of-mouth turns into tale and becomes legendary, or was it the other way round? Some two thousand five hundred years have elapsed yet the attraction of the myth remains strong, and numerous people have contributed to keeping it alive until now.
- 2 In his detailed study of the Dardic population of Ladakhi Baltistan, The French Himalayan explorer Michel Peissel attempts to give a precise location to Herodotus's "land of the gold digging ants"; he might be one of the last, to date, to have focused on this issue². Today, anecdotes about these gold-digging ants have indeed become an unavoidable element of the common ancient history of Ladakh. This puts into perspective the de facto lack of precise historical facts at our disposal for this period of time in this area. In spite of a limited lack of chronological elements that might aid in better understanding the history of the country, these legends have incited most historical studies about Ladakh to begin with reference to classical authors of the

Mediterranean world. I am no exception, and for good reason as I am intending to give a descriptive account of four sites from Central Ladakh that nearby inhabitants consider to be ancient open-air gold mines and, in so doing, following Peissel's attempt, try to link some physical remains with what the legend of the ants may be interpreted as meaning³. The point here is not to add another page to the tale, but rather to point to some possible archaeological evidence in support of the fact that Ladakh might well be considered as a possible location for the origin for these gold-related tales (while not excluding the bordering regions of Pakistan).

Textual sources

- 3 Despite the loss of the original account on Mauryan India by Megasthenes (c. 350-c. 290 B.C.E.), thus a contemporary of the Mauryan emperor Chandragupta (322-298 B.C.E.), later classical authors such as Diodorus of Sicily, Strabo, Pliny and Arrian reported several fragments of it⁴. In his book *Ladakh, Physical, Statistical & Historical*, Cunningham quotes the latter, himself referring directly to Megasthenes, who had supposedly stated that "Indian ants dug gold out of the earth, not for the sake of metal, but in making burrows for themselves"⁵. He then quotes what became a famous saying, as far as Ladakh is concerned, by Pliny the Elder⁶ in his *Natural History*: "Fertilissimi sunt auri Dardae"⁷. Actually, the full quote is "*fertilissimi sunt auri Dardae, setae vero et argenti*", thus adding silk and silver to the gold⁸. Factually, this quotation is extracted from a paragraph of chapter 22 that mixes elephants, tall towers and thick walls and mostly refers to armed forces available in the various mentioned areas, roughly located between the Ganges and the Indus. Nevertheless, five paragraphs later, in chapter 23, dedicated to the Indus area itself, Pliny mentions "Capitalia; the highest of the Indian mounts; the inhabitants of which, who on the other hillside exploit considerable mines of gold"⁹. This rather vague "other side of high mountain range" matches the Indus area in general well as seen from the Indian Gangetic Plains. Actually, the Pakistani archaeologist Dani, while referring to Herodotus' proposal, wrote: "The geographic region is certainly Northern Areas of Pakistan, where even today gold-washing is done in the rivers by a tribe, called Soniwals (literally meaning gold people)"¹⁰. I will come back to this on-going activity for the search for gold by some Gilgit-Baltistan communities and its methods, but let us first turn our attention to the area concerned here. The designation of northern areas of Pakistan refers to where the Indian Plate, the Kohistan-Ladakh Island arc and the Eurasian Plate meet¹¹. This rather large geological region made the area most favourable for economic mineral deposits such as gold and copper, and, geographically speaking, it includes at least the western part of Ladakh as well¹². Not much is found in historical sources that favour the hypothesis of north Pakistan over that of Ladakh. The few sites locally held to be former gold mines and described below tend to indicate similar traditions to those related in connection with gold-digging ants along the Upper Indus.
- 4 The fact that history retains ants, rather than marmots, as responsible for the extraction of gold-bearing sands of the Indus is, although secondary to our main concern, equally an enigma of the tale as well as an identification feature. The enigmatic aspect comes from the uncertainty of the animal species concerned. As proposed by Cunningham, this confusion might originate from a misunderstanding of the local and the Sanskrit names for the species concerned by the soldiers of Alexander

the Great¹³. This remains hypothetical. In his book, Peissel credits Ritter with being the first "recent scholar" to suggest that the gold digging ants would actually have been marmots (Peissel 1984, p. 147). After him, Cunningham (1970), Lassen (1861), Rawlinson (1858-1860) and Schrader (see Sprockhoff 1963) present the same argument. On the other hand, Francke, in his "Contribution to the question of the gold-digging ants" reports two local tales from Khalatse (Tib. Kha la tse) that, despite not directly referring to gold-mining ants however refers to ants diving for gold (Francke 1924). This encourages Francke to believe that "Herodotus was right when he called the gold-digging creatures of his tale 'ants' and not 'marmots' or otherwise"¹⁴. Whether ants or marmots, this points to something happening on dry land and this, in my view, constitutes an element of better comprehension for distinguishing the Ladakhi remains discussed below with the living traditions of gold panning and washing still attested nowadays in the neighbouring area of Gilgit-Baltistan and which, consequently, take place on the immediate banks of the river, a location not used neither by ants nor by marmots to establish their habitat. Actually, the reference to ants and marmots, which establish their colonies or dig their burrows only on firm and dry ground, seems to exclude waterside remains that would have resulted from technical bonds to continuous-flow gold washing on closely situated river-banks.

- 5 Let us take leave of the ants for a while and turn our attention to locally written sources on gold mines in Ladakh. These appear in what remains to date the most comprehensive and authoritative reference text on Ladakh history, and the only local one as regards its earlier period: the *Chronicles of Ladakh (La dwags rgyal rabs)*¹⁵. References to gold mine sites indeed come at the very beginning of the Chronicles, as one such site is mentioned as a geographical marker to fix the limits of a part of the kingdom at the time of its partition to his three male heirs by Nyima-Gon (Tib. sKyid lde nyi ma mgon), a representative of the Central Tibetan royal house and founder of the first Ladakh dynasty in the 9th century CE¹⁶. To his son Palgyi-Gon (Tib. dPal gyi mgon) he gave "*Mar-yul*, the inhabitants using black bows, in the east, *Ru-t'og* and the gold mine of *Gog*¹⁷ [...] to the north, to the gold mine of *Gog*". Gold mines were thus obviously known during those early days, so that referring to their location makes sense for the largest number of them¹⁸. Subsequent to this early quotation, which directly refers to the foundations of what would further develop in Ladakh as a social and political entity, gold mines are strangely enough not mentioned again in the Chronicles. One might have expected mention of these, either as suppliers of income for the ruling power or, as such, as positions to be held in times of trouble.
- 6 However, gold in itself remains present throughout the text of the chronicles. Indeed, "gold" (Tib. *gser*), "gold dust" (Tib. *gser phye*) and "gold water" (Tib. *gser chu*) appear repeatedly throughout the text, without the origin of the yellow metal, local or not, being mentioned¹⁹. For instance, a gift of more than 100 zho (about 2,8 kg) of gold (amongst other things) is said to have been sent by the king Sengge Namgyal (Seng ge rnam rgyal) to Tagtsang Rachen (Tib. sTag tshang ras chen)²⁰. Such noticeable quantities of the precious metal sent as presents during the height of the Namgyal (Tib. rNam rgyal) dynasty (16-17th centuries) could suggest a local production, but in the absence of any evidence supporting this possibility it remains speculative.
- 7 "Gold and gold thread, called *Zirri*, both genuine and false" appear without much more detail regarding their quantity, in Cunningham's list of Chinese articles brought by caravans to India via Ladakh, but they are not further reported in his tables of import

and export duties thus indicating their rather negligible character²¹. Silver ingots or bars, called "kuru" by Yarkandi and "yambu" (Tib. *yam 'bu*) by Ladakhi²², were used as business benchmarks all along the caravan trade routes and are reported as being imported to Ladakh from Yarkand in "considerable quantities". Despite repeated mention of gold coins from neighbouring countries, locally named in Ladakh "ser jao" (Tib. *gser ja 'bu*) or just "serki dong" (Tib. *gser gyi dong*), the country seems never to have produced its own equivalent. The only native coin reported being the silver "jao" (Tib. *ja 'bu*)²³. Regardless of this relatively late introduction of local coinage, goldsmiths and blacksmiths have played an important role in the social and economic life of the area, and obviously for a very long time. The place of the latter category of people in the traditional Ladakh system of social strata points in itself to the impact and the depth of this aspect of the traditional economy as well as reasserting the various beliefs previously mentioned regarding mining activities.

- 8 Art historians and especially anthropologists have studied the various aspects of metal craft in Ladakh to some extent²⁴.
- 9 Not much more detail is reported by the western explorers of the 19th century, despite the very fashionable scientific and empirical motivations, not to mention the venal ones, of those colonial times. In the narrative of his pioneering travels in the "Himalayan provinces of Hindustan and the Punjab in Ladakh and Kashmir [...] from 1819-1825", Moorcroft gives little information about mineral production, while regretting the scarcity of factual content in this information. He thus cites the widely attested presence of near-surface deposits of sulphur and soda, and reports lead and iron as being found in pits. Surprisingly enough, copper is mentioned only rather evasively while he states that gold "is frequently found in the rivers of *Chan-than*, and it was also discovered in the sands of the *Shayuk*"²⁵. Regarding the search for gold, he reports the government call for an end to it following clerical advice and threatens that its collection might "be followed by a bad grain harvest"²⁶. Similar superstitious beliefs from Chang-thang were reported to him as well, for instance that "lumps of native gold, occasionally found in the mountain, belong to the Genii of the spot, who would severely punish the human appropriation of their treasures"²⁷.
- 10 Cunningham's comments on the presence of gold in Ladakh also confirm a prohibition on its extraction. He relates: "the washing (of Indus' sands to extract the gold dust within) is entirely carried on by Musulmans from Balti, as the Buddhists of Ladakh have long been prohibited from the search"²⁸. But he explains the prohibition as originating from a king's apprehension that his subjects might neglect their fields to search for gold (thus implying rather significant gold sources). Despite this more pragmatic approach credited to the ruling class, Cunningham again quotes Moorcroft and the superstitious beliefs he first reported. Peissel, for his part, quotes Herrmann who, despite the fact that he had never been to Ladakh, explains the extraction of Gold in the Suru (Tib. *Su ru*) valley until recent times in terms of its inhabitants being of the Islamic faith and thereby free from similar superstitions related to earth-spirits²⁹. This assertion should, however, be put in perspective as Chaudhary also reports the consideration of unholiness pertaining to the gold-washing activity in Pakistan's Upper Indus by the Soniwal Muslim community and explains how members of this group are consequently placed at the bottom of the local social hierarchy by other members of the same faith³⁰.

- 11 In his *Geology of Kashmir and Chamba*, Lydekker qualifies these as speculations, speaking clearly about what he reports as a negligible amount of gold³¹ while, however, acknowledging the difficulties he faced in finding out "to what extent the operation of washing the river sands for gold is still carried out"³². Despite this statement he clearly mentions "very numerous" gold-searchers' pits to be seen along the Suru³³ and the Indus. As such, he mentions Achinathang (Tib. A ci na thang) village³⁴, in today's Lower Ladakh, and at Skyiu (Tib. sKyu) in Markha (Tib. Mar kha) valley³⁵.
- 12 Peissel is the only scholar, as far as we are aware, to have experimented with gold panning in the area. He did so in Zanskar, in 1978, near the village of Pidmo (Tib. Phig mo), along the Zanskar river with two local assistants and confesses his disappointment of having found "but few grains of gold" for a full day's work spent by the water's edge. However, he qualifies his statement, adding that "more professional gold-seekers could have found larger quantities"³⁶. As previously mentioned, prospecting for gold by means of panning and washing is still done as a part-time occupation along the Indus banks by the Soniwal community (Pakistan Karakorum Upper Indus)³⁷.
- 13 In Ladakh, textual and oral tradition attest to a rather widespread activity relating to metal work, whether it is gold or other less precious metal found locally. The most obvious implementation being perhaps foreign crafts communities that have settled in some areas especially because of their rich ore content. The village of Chiling (Tib. Phyi gling), along the Zanskar river, is emblematic of such a scheme. Its inhabitants, among whom numerous "goldsmith" (Tib. gser mgar) and "blacksmith" (Tib. mgar ba) families are still to be found, are asserted to be Nepali Newari craftsmen who came to settle here at the end of the 16th century³⁸ following a king's proposal meant as a gesture of gratitude for fulfilling a royal command having to do with metal craft³⁹. It is said that they chose the place especially for its high quality native copper found in large quantities in the nearby Zanskar river⁴⁰.
- 14 It might be relevant to briefly mention here a site located in the Hundar Brog gorges, in Nubra valley, which presents clear evidence of metallurgic industry. The site consists of a fortified village located on a terrace that is difficult to get to and demarcated by vertical rock faces. It was briefly documented during the 2013 and 2014 MAFIL (Franco Indian Archaeological Mission in Ladakh) campaigns. Abram Pointet, who noticed it on satellite images in the spring of 2013, first revealed the site's existence.
- 15 In 2015, the MAFIL team carefully examined the cone of waste from the metallurgy industry. The area covered by the mixture of ash, charcoal, slag and red ferrous soil is spread across the slope in a cone shape that is 10,2 m long and a maximum of 3 m wide. An examination of the surface layers at the top of the cone revealed a layer of ashes mixed with stone of a thickness of 7 cm, followed by a layer of a centimeter consisting of partially charred twigs, beneath which the soil was compacted with a high content of slag and charcoal⁴¹.

Potential sources for gold in Ladakh

- 16 The geology of the country has been, and still is, the object of numerous studies and the ore component within the geological diversity of these mountains has been repeatedly commented on⁴². Gold occurrence in the area can result from two types of deposits. The Ladakh Batholith, which is also one of the largest types of geological components of the

country North of the Indus, is the most probable primary source for gold in Ladakh. This batholith is made up of several types of magmatic rocks, mainly granitoids, coeval to the subduction of the ancient ocean during the Cretaceous and the Cenozoic (100-45 Ma). This type of geodynamic environment is favourable to fluid circulation and concentration of gold associated with quartz veins⁴³. The Ladakh batholith (or its lateral equivalents) is a 30-50 km wide zone outcropping North of Leh and extending laterally all along the Himalayan chain for about 2 500 km (Trans-Himalayan batholith). In Northern Pakistan, in the Gilgit-Balistan area, Ahmad *et al.* conclude a possible economic interest of some gold occurrences found in the extension of the Ladakh Batholith⁴⁴. In any case, published reports of modern gold prospection in Ladakh are rather rare and succinct⁴⁵.

- 17 The second type of primary deposit should probably be investigated in connection with the Indus suture zone. In Ladakh, it is not yet clear if these deposits are connected to an accreted old oceanic arc formed during the subduction or if they are related to strongly deformed zones (shear zones) created after the closure of the ocean and the collision of India and Asia to form the Himalayas. They are made up of an "ophiolitic blend" which is a mixture of rocks from the old oceanic crust and mantle and from sedimentary rocks. Indian geologists have prospected in two areas related to this type of pattern. One is located in the upper Indus area, near Hanle (Tib. Ouam le/An le) and the second lies north of the Tso Khar (Tib. mTsho dkar)⁴⁶. More relevant to our concern, secondary ore deposits are present in the form of placers that can be found in big rivers such as the Indus, Shyok and Zaskar rivers. The catchment area of the Indus river in Ladakh is made up of the Ladakh Batholith (mainly on the north bank) and the Indus suture zone. The erosion of the two types of primary deposits described above is the obvious potential source of gold. In this regard, it is interesting to note that the gold indices location described by Singh in the Bazgo Tokpo (Tib. Ba mgo tog po) area is located just upstream of the old mining sites of Alchi-Lardo (Tib. A lci la mdo) described below⁴⁷. In contrast, the Ladakh Batholith is not present in the catchment area of the Zaskar river, along which the Choksti (Tib. lCog ti) mining site is located, and therefore cannot be held as the primary source of gold in this latter case. However, the lateral equivalent of the tectonic units studied by Wangdus and Uppal are outcropping just downstream of Chilling village⁴⁸. This "ophiolitic blend" could in that case well be the source of gold. Other possibilities include the erosion of former placer deposits in the Tertiary Molasses Basin or granitic magmatic intrusions such as the Nyimaling (Tib. Nyi ma gling) granite outcropping in the upstream part of the Markha catchment area, a location which, despite a lesser index of probability, should be considered as well.

Archaeological survey

- 18 To my knowledge, there has been no survey of the historic mining sites of the country, or at least not from an archaeological perspective. During the course of the "Ladakh rock art survey project" I conducted in 2003 and 2004, I took the opportunity to document the few open-air mining sites I came across, or was informed about, during this survey work. This documentation was further regularly augmented and updated over the course of time. Unfortunately, the last decade has witnessed the destruction of two of these major mining sites, among the four initially documented. Facing the fast

disappearance of this as yet very little studied aspect of the patrimony of Ladakh, I decided to share the documentation realized on these sites over the last fifteen years.

- 19 The four open-air gold mining sites presented below are all located in the area of lower Ladakh, in a radius of less than 20 km between Choksti, along the Zaskar river, a few bends before it joins the Indus at Nimo (Tib. sNye mu?), and downstream the Indus somewhere between Gadpa sngonpo (Tib. Gad pa sngon po, blue cliff/location unknown) and Ulle Tokpo (Tib. 'u le/'u lag grog po).
- 20 Choksti site is located on the left bank of the Zaskar river. Bazgo (Tib. Bab sgo/Ba mgo) site on the right bank of the Indus. Alchi-Lardo site is located between Alchi (Tib. A lci) bridge and Lardo (Tib. La rdo) village; it stands on the left bank of the Indus river⁴⁹. The site mentioned by Francke, which he rather vaguely located downstream from Ulle Tokpo, is the fourth site we consider here, and the only one published that is clearly identified by the author as an open air gold mining site⁵⁰. It was unfortunately already too damaged the first time I visited it (2003) to be documented in a convincing manner⁵¹. As previously mentioned, out of the four sites mentioned here, two have been partly or completely destroyed. "Francke's" site, downstream Ulle, was located next to the road (NH1) and it has irrevocably suffered the successive stages of road widening and retracing. It is today totally erased by fillings and terracing work. The only element at our disposal that indirectly testifies of the once existing nearby site is a little cave Francke held as a shelter occasionally inhabited by gold-diggers⁵². Bazgo site is located downstream from the eponymous village on a flat terrace within a curve of the Indus and was flooded by Alchi dam project in 2014; as such, and not taking into account Francke's, its documentation is the least extensive presented here.
- 21 Accordingly, I will focus on just three sites, of which only two are still accessible.

Figure 1. Location of the mining sites

© map background by A. Pointet (<http://www.abram.ch/lzmmaps.php>), M. Vernier, 2018

Bazgo

- 22 This mining site is located downstream from the village of Bazgo some 400 m beyond its last irrigated fields. It stretches along the Indus river 250 m on a north-southern axis some 100 m wide. I first documented the area as part of the "Ladakh Rock Art Project"⁵³ in May 2003, focusing on its rock art content while noticing the strange features of the terrain. A second visit to the site took place in 2004. In August 2007, I again visited the site along with two colleagues and spent time to further explore the details of the terrain⁵⁴. Following this visit, while questioning the villagers on our way back, we were told that the site was considered to be a former gold mine. In 2014, the "Nimoo Bazgo Power Project" i.e. "Alchi dam" was completed⁵⁵ and the site flooded.
- 23 Before the site was flooded, several atypical and obviously man-made configurations on the ground were visible on this flat bank. Among these, could be distinguished, on the eastern side of the site, some raw stone piled walls of sinuous shape. These form small mounds of piled up stones and pebbles stretching along similarly sinuous shallow trenches. This pattern is repeated on the whole eastern area in a manner apparently disorganized but for the fact that it follows the general direction of the riverbank. The whole presents a muddled topography in which hollows and bumps are mixed without obvious sequential organisation. The western part of the site is delimited by a large crumbling dry-stone wall dividing it diagonally and fading away on its south-eastern part. On both western sides of this ruined wall, at the foot of the large rocky slope, other pits are visible. They are more or less organized in a line on the down slope. These look to have been deeper dug but to have been refilled over time by rocks falling from the nearby slope. Heaps of unearthed soil, held by rough piled stones, are clearly visible. Some 22 engraved pebbles were dotted across the site. Among these are several images of ibexes (depicted in various ways, such as linear drawing, bi-triangular or outline rendering), yaks and dogs, and anthropomorphic figures such as hunters and riders. The most astounding figures are those of two warriors, wearing helmets, swords and weaponry maces and represented in association with an ibex and a dog (fig. 3)⁵⁶. On the site, several animal figures, mainly ibex, have the inside of their bodies decorated by hook and scroll-like motives, thus potentially linking these particular decorative elements with those present on the animal style figures from Central Asian steppes that, as well, contribute to characterizing them⁵⁷. A few engraved capital Tibetan letters (dBu chen) are also to be noticed.

Figure 2. a) The crumbled wall that divides the site, as seen from its northernmost side. b) Pits and heaps of soil at the bottom of the slope

© Bruneau, 2007

Figure 3. Engraving of two warrior figures with sword, helmet and arm mace juxtaposed with a dog and an ibex figure; Himalayan Rock Art Database (HiRADa) code: L-BZZ-Ro-Zo00-Bo0020-Lo01

Digitalized report on transparent plastic sheet

© Vernier, 2003

Alchi-Lardo

- 24 Alchi-Lardo site is located only a few hundred metres downstream from the ancient fort overlooking the historical location of a bridge over the Indus. It is located down the road, 1,4 km as the crow flies, downstream from the modern Alchi-Bazbo Bridge, on the

left bank of the Indus, before Lardo village and, measuring roughly 100 by 40 m, is the smallest among those considered here. I first documented the few boulders having rock art located on the site in May 2004 and noted at the same time the strange cavities that dot the area⁵⁸. In 2015, as part of the Alchi hydropower distribution scheme, a large metallic pillar has been implanted next to the site. Bulldozers engaged in that work, criss-crossing the terrain and digging for the fixing base of the pylon, have largely damaged the eastern part of the site⁵⁹. On two locations, next to each other, series of adjacent underground holes are still clearly visible despite their advanced refilled state. The cavities, up to four grouped together, have been dug out in a radiating pattern from a central pit. They are dug horizontally under the ground up to more than 2 m deep. In some places, at the mouth of the cavities, coarsely piled stones strengthen the corners and help support the dome-like ceiling. The earth that has been dug out seems to have been banked around the pit and roughly maintained, in some places by lines of arranged stones, mostly on the downwards slope. Rock art figures are engraved on dark reddish boulders protruding from the ground on the riverbank. Around 50 figures have been recorded, among those bi-triangular anthropomorphic figures, one with an undetermined object in one hand. Several ibex, wild sheep and other unidentified mammals as well as a large triangle, circles and a sun design are distributed over the rock surface. A large geometrical compartmented figure composed of four elements, roughly square, piled on one another and topped by a sort of dome and three lines issuing from the latter perpendicularly. The whole figure might well represent an archaic type of stupa.

Figure 4. Picture and theoretical section view of one of the gallery groups at Alchi Lardo site

© picture: Zerega, 2019; drawing: Vernier, 2003-2018

Choksti

- 25 This site is the largest one and measures roughly 330 by 60 m. It also slopes the most, although its lower part is rather flat. It is located down the road, on an east-west axis on the left bank of the Zanskar river, roughly 8 km upstream from its confluence with the Indus and some 15 km downstream from Chilling, the best known village of Ladakh as far as silversmithery is concerned. A built structure (*mane*, Tib. *ma ne/ni*), eponymous of the mantras engraved on stones as a meritorious act and layed on it, stands by the road on the easternmost side of the site attesting the use of this itinerary in historical times, a fact that also stands for the other sites. A small long-lasting source springs from the rocks at the westernmost end of the site. I first documented the site during the early 2003 rock art survey tour and even camped there twice. Several successive visits over the years make it the best-surveyed site among those presented here. The remains are located on a gentle slope, between the overlooking rocky wall of the mountain and the Zanskar river. The terrain has been extensively excavated all along the bottom of the slope, on a line, following the change in the gradient of over 300 m. Secondary excavations are located on a similar parallel line at the widest point of the site and in few locations on the down slope. The mining excavations, in the form of tunnel-like cavities, are horizontally dug up to 5 m deep on the slope. Some of these cavities are subdivided underground into two or three small-diverted galleries. The openings of many galleries are very much obstructed by fallen rocks and sand from the cliff above⁶⁰. The soil extracted from the galleries has been piled below and held by retaining dry stonewalls. In some cases these holding structures have been built one on top of the other (fig. 6). The whole results in a sinuous open-air corridor-like pathway, bordered by the successive galleries on the mountainside and by the piled material on the other side (fig. 7). Several galleries have their entrance supported by stony piles. In some cases similar supporting structures of piled pebbles are clearly visible inside the galleries as well. Below this first zone, on flatter ground, on an area measuring roughly 100 by 20 m, the ground bears traces of multiple alignments: areas cleared of their surface stones and piled pebbles. The whole strongly recalls the previously described remains of Bazgo site (fig. 8). Some 50 m further down the gallery line, on almost flat ground and closer to the river, several structures are scattered amongst large rock bars. Those, forming natural rock shelters have indeed been turned into structures, sometimes multiple-room ones, by means of dry stonewalls. They contain fireplaces, niches in the wall, doorsteps and storage areas for fuel. Shepherds and travellers obviously used these structures as halting and camping spots until recently⁶¹. Other rough stone enclosures are located closer to the even larger rock bars vertically protruding from the ground that forms the bank of the river in this location. On those latter large water-polished dark rock formations and on other similar boulders around are engraved figures. Rock art motifs amount to only two dozens but these include figures of interest such as a representation of a bird comparable to a mythical bird-like creature (Tib. *khyung*)⁶² (fig. 9). Snow leopard, ibex and anthropomorphic figures as well as a few Tibetan letters (upright style of the Tibetan alphabet, Tib. *dbu can*) are also present. The patina of these carvings stretches from very dark (ibex, undefined animal figures) to medium (mythical bird-like creature or *khyung*, hunting scene, leopard, letters) and light coloured (ibex and other animal figures).

Figure 5. Site of Choksti, aerial view with various remains highlighted

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Figure 6. On-site explanatory sketches of the galleries

© Vernier, 2015

Figure 7. a) View of the footpath inside the trenches, between the galleries and the piles of soil; b) View of the entrance to a gallery

© a) Vernier, 2003; b) Vernier, 2015

Figure 8. View of the lower zone at Choksti (facing south) with its group of piled stones and largely cluttered up terrain in the forefront

© Bruneau, 2007

Figure 9. The *khyung*-like bird representation at Choksti site; HiRADa code: L-SRB-Ro-Zo01-Bo0006-Lo01-Pe001

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Analysis

- 26 Locally all named Serkha (Tib. *gser kha*), meaning “gold mouth”, “opening”, those three sites share some common features. The most noteworthy of these is definitely their location close to the riverbeds of Indus or Zaskar and their overall appearance. In fact, these sites appear on the terrain like sinuous trenches, following the contour lines of the terrain. Piles of unearthed materials more or less maintained in clusters by arranged and piled stones surround them downwards. The size of these excavation fields varies from some 40 m wide at Alchi-Lardo site to stretch over 330 m long by 60 wide at Choksti. The latter being the largest, spread over a length of more than 330 m. The importance of the material evacuated from the trenches and piled next to those varies equally from one site to another and is tributary to their topographical environment as well as, in some instances, subsequent human interventions. At Bazgo and Choksti sites, basic remains of walls are still visible on the site. There are more than simple wall remains at Choksti where rudimentary terracing work and proper structures in the form of chambers are still visible on the site⁶³.

Figure 10. Theoretical comparative cross sections of sites

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- 27 Numerous such open-air mining sites must have once dotted the landscape and many of these may still be visible through the area, as mentioned in the literature and reported in the introduction. The sites approached here are all located in the historical core of the country and, despite this preliminary brief presentation, reveal similarities. They indeed have in common:
- A. topographical location features,
 - B. physical aspects of their remains,
 - C. rock art components.
- 28 A: as clearly explained by Moesta who deserves to be quoted here “gold, being proportionately heavier (specific gravity 19), sinks faster than sand and other minerals into the beds of rivers and streams and tends to settle more easily at certain places. Depending on the size of the nuggets and the velocity of the river, the sand and other minerals continue with the flow while the gold particles sink. The concentration of gold at such places increases in proportion to the other weather-beaten particles [...]. These sediments are found in the sharp bends, after constrictions, directly preceding the waterfall of a stream or an island” (Moesta 1983, p. 101). Chaudhary (2009, p. 137), referring to where the Marut people (Gilgit-Baltistan) chose to work on gold extraction further adds “at the curves, or at places preceding small islands [...], and, more especially, they prefer to work in the vicinity of the rocks on these islands, which protrude when the tide is low”. Broadly speaking this corresponds to places where the water current slows down and finds places for its heaviest sediments to be deposited, such as a large underwater terrace or a rock formation protruding into the waterway.
- 29 The sites of Bazgo and Alchi-Lardo, to a lesser extent, correspond to a once “underwater terrace” pattern. The Alchi-Lardo site is an especially convincing example of a “sharp bend, after constrictions” (in this case the constriction being the place where the Alchi-bazgo historical bridge used to stand, a few hundred metres

upstream). Choksti, the largest site, is also located on a curve of that type but adds to its configuration the "rock formation protruding on the way" scheme.

- 30 B: Common basic physical aspects. These aspects show the remains of a similar way of attempting to extract ore by mining between two layers of alluvial deposits located on curves of large riverbanks of the type previously presented. In some instances the number of small galleries and the amount of soil involved in the digging process show that this activity was anything but inconsequential. The relative distance between those mining sites and permanent human settlements indicates that the mining activity probably extended over an important time period rather than being an intensive and punctual exploitation. This possible operating mode matches the seasonal reality of the country better as well as the evidence on sites. Indeed, temporary stays on sites leaving little evidence can well be imagined, while no evidence of more elaborate lodging infrastructures, corollary to a larger number of people staying on site, are to be found. This fact holds true regarding the mining activity remains themselves. There is no evidence of important engineering work such as water channelling, basins, bank arrangement or remains of piles of sieved material that would have been involved in large-scale exploitation. In my opinion, a work on a larger scale and under a governing power's supervision would most probably have left more evidence of its logistics, if not references in the local literature too. Strangely enough, surveys of the sites did not reveal ceramic shards, at least not in sufficient amounts so that they could not be missed. Thus I would lean in favour of a scenario involving local actors, in small numbers at any time but nevertheless specialised in some way for the task, working on the sites seasonally, but long term. Such a type of semi-nomadic scheme, or at least relocated secondary activity pattern, is still attested for the Marut people of the Chilas area. Chaudhary (2009, pp. 136-137) reports that they migrate twice a year, from March to May, and September to November, to pitch their tents in rock shelters along the Indus for gold-panning activities, taking along with them a few working tools and only basic equipment.
- 31 C: The presence of rock art of diverse types and mixed periods present on all four sites, as is the case on almost all historical bridge locations in the country, encourages us to consider mining sites as similarly part of Ladakh's past anthropic landscape⁶⁴. Indeed, figures, generally considered as representative of the earliest types of rock art are presents on mine sites. They consist in basic linear zoomorphic and anthropomorphic representations (Choksti, Bazgo, Alchi-Lardo), typical Bronze Age related elements, such as weaponry maces and mushroom-shaped helmets are present as well (Bazgo). As previously mentioned, more precisely culturally-contextualised figures are also represented, such as mythical bird-like creature (Tib. *khyung*) designs, anthropomorphic figures with marked physiological details, dressed and holding attribute of several combined elements and basics of architecture (Alchi-Lardo, Choksti). Historical engravings in the form of Tibetan letters are present on sites as well not to speak of even more recent engravings of the graffiti type. With a view to our main concern, Rock Art content is especially interesting at Bazgo site (see above) as there it includes several motifs clearly related to the Bronze, if not the Iron Age⁶⁵. This diversity of types and periods shows that, perhaps independently of their function, the gold-mining sites presented here are located at one of the crossroads of the various influences of Rock Art present in Ladakh⁶⁶.

Concluding remarks

- 32 The activities of ants and marmots recounted in tales that are all that is known of them must, as previously pointed out, have taken place exclusively on dry land. Therefore, any evidence from the immediate vicinity of a riverbed can hardly be envisaged as resulting from animals' activities. In any case, remains pointing to the use of water for panning and washing sediment have not been identified, perhaps because traces resulting from this surface work, which does not involve deep soil digging, have, long since, been erased from the surface of the shore by natural phenomena such as high waters and repeated floods. Thus, nothing remains from water-related activities, assuming these existed in the past. If gold-washing activities, as still asserted today in Gilgit-Baltistan and as reported in the literature regarding Ladakh, can indeed be considered, I did not find in the literature any Baltistan equivalent to the evidence of Ladakh sites presented here.
- 33 Indeed, on the sites previously described we are left with a different type of ground evidence such as "tunnel-like cavities", "piles of dug earth" and "sinuous open-air corridor-like trenches". Of course, this type of remains can't be credited to ants or marmots. The sites described here certainly display the man-made remains of a laborious and organised activity but, unfortunately, lack of proper archaeological investigation on site prevents us from better defining the amplitude and exact nature of this activity.
- 34 It is clear, as shown above through an overview of the relevant literature, that the presence in the streams of Ladakh of ore of various types has been known about for a long time. Regrettably, the gold-digging ants tale casts little light on, and brings no determining elements to the possible link between the presence of gold ore in the area and the sites on the riverbanks, thus leaving us with fast disappearing evidence and long lasting legends. We have to admit that from the very approximate geographical descriptions contained in the literature of antiquity it cannot be ruled out that it directly refers to the area known today as Ladakh. At best the Upper course of the Indus can be envisaged with a high degree of certainty. That still leaves us with a very large area of possibilities.
- 35 The human geography dimension, implied by the mention of Dardic people in connection with gold-digging ants, unfortunately sheds no additional light on the riddle⁶⁷. In fact, a Dardic population, or at least a Dardic-speaking enclave, is still found in lower Ladakh. But in this regard Francke holds the Dards to be successors of the Mons in Lower Ladakh and proposes for the former a period of occupation in the area stretching from "after the Kushana period (c. A.D. 200-400)" to "[...] before the Tibetan conquest c. A.D. 1000"⁶⁸. This takes us well beyond the writing period of the authors of antiquity. In fact, as soon as we turn our attention towards the Dardes, and even more towards the case of the Mons, we come to an aspect of the human history of Ladakh of which very little is now known and about which not all researchers agree. Reconstructing the chronology of the different peoples who occupied the territory would lead us far beyond the scope of this paper. Furthermore, it cannot be guaranteed that the term "Dardic" has not been an evolving term rather than the designation of the same human group over time (i.e. from Herodotus' to Francke's).
- 36 In any case, the remains observed and described above, would *a priori*, according to their state of conservation, fit better into a "pre-tibetanisation" period of Ladakh, i.e. in

a Dardic context as envisaged by Francke, rather than into a 5th century B.C.E. context as implied by the ancient literature. This timeframe, prior to the Tibetan conquest and the more or less contemporaneous introduction of Buddhism in the area, may fit better into the pattern in the perspective of the subsequent taboos regarding soil extraction, as mentioned in detail above.

- 37 It is unfortunate that through time the legend has been transmitted almost unchanged without anyone, until very recently, thinking to better define the region whose riches it evoked. Indeed, the time that has elapsed since the first mentions in the literature and the failure to reconsider and better define its components leaves us with little chance of ever knowing more about the precise area to which the authors of antiquity were referring.
- 38 We can only hope that archaeological investigations will be conducted on the most significant historical open-air mining sites before the rapid and on-going development of the country erases what they could help contribute to our knowledge of its past. Indeed, such investigations could provide us with information about material, technical and economic inputs directly related to gold mining activities that would prove very valuable in interconnecting our still disjointed perception of the local history, especially in its endemic social and economic aspects.

Acknowledgements

- 39 I would like to offer my warmest thanks to all friends and colleagues without whom none of this work would have been possible. First, to Jean-Luc Epard (PhD, associate professor, Structural and Alpine Geology, University of Lausanne) and Nicolas Buchs (PhD student, University of Lausanne) whose various contributions on specific geological aspects have been of great help. Many thanks are due to my colleague, to whom I am so much indebted, Laurianne Bruneau (associate professor EPHE and permanent researcher CRCAO, Paris, Co-director of MAFIL (Mission Archéologique Franco-Indienne au Ladakh) for her valuable insights, her extraordinary sense of bibliographical archives and her availability in supporting my work. Without her, I would probably still be scrabbling around in Zaskar without worrying about sharing my work. My gratitude also goes to Abram Pointet for his help and suggestions on the site's mapping and the geographical issues, to Pascale Dollfus and Rebecca Nordman for their help in sorting out the toponyms and Ladakhi dialect issues. To Mary Premila for her kind and very professional help as she provided me with a much needed proofreading of my English. Of course, in this regard, all errors that may still remain are mine alone. In Ladakh and Zaskar I would like to thank those who have made my various studies possible over the past decades and who accompanied me on sometimes very demanding tours in the field. Among them I am especially indebted to Ven Tsering Tundup, Tonyot Dorje, Tsetan Spalzing, Tsewang Gombo and Lobsang Eshey. I would also like to express my deepest gratitude to Pierre Moor for his repeated support and the Italo-Swiss foundation Carlo Leone et Mariena Montandon for their initial support during the "Ladakh Rock Art Survey Project 2003-2004".
- 40 My most sincere thanks go to my wife and my daughters for their love, their patience and their understanding of my consuming passion which takes me away from home so often and for so long.

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NOTES

1. Herodotus (1645, French edition), pp. 225-227. Also reported in Cunningham 1970, p. 233.
2. Peissel 1984, pp. 73-75, 169-170.
3. In Ladakh, the lack of excavation, to date, does not enable us to propose any absolute or relative dating for the remains discussed in this paper.
4. As rightly mentioned by Petech, among others, Herodotus is the first to mention the gold-digging ant tale in connection with Dardic people (i.e. Ladakh and Baltistan populations living along the Indus). Petech 1977, pp. 5-6.

5. Cunningham 1970, p. 23
6. Pliny the Elder, 23-79 A.D.
7. Pliny the Elder 1848-1850, p. 718.
8. Pliny the Elder 1848-1850, chap. 22, p. 67.
9. Pliny the Elder 1848-1850, chap. 23, p. 5. My translation from a French version.
10. Dani 1989, p. 114.
11. Khan *et al.* 2018, p. 1.
12. Generally speaking, gold ore deposits can be found in mountain belts such as the Himalayas or the Alps. The key condition is that some geological processes had to be invoked to increase the concentration of this rare element. Such processes imply the circulation of hot water at depth (several kilometres below the earth's surface). These hydrothermal fluids can be related to magmatic events such as the emplacement of a granitic intrusion, or metamorphism. The latter is inherent to mountain building and encompasses the mineralogical transformation of a rock due to the elevation of pressure and temperature during the stacking of rocks in a mountain range.
Sedimentary processes to form secondary ore deposits can, in a second step, enhance this primary gold concentration. The native gold particles can be eroded and transported by streams and rivers where they can be slowly welded to form bigger nuggets. The nuggets transported by the rivers can be sorted somehow, thanks to their specific hydrodynamic behaviour, concentrated and deposited in specific locations in the riverbed (this phenomenon is, on a different scale, similar to what is produced by a miner when using a pan). Secondary deposits of this sort are known as “placers” (this technical information peculiar to geology, and other information below as well, are included here thanks largely to Jean-Luc Epard's generosity. Epard, email dated January 1st 2019).
13. Cunningham 1970, p. 233.
14. Francke 1924, p. 68.
15. Regarding the *Chronicles of Ladakh* (compiled in the 17th century CE but narrating events as early as the 10th century), several versions of which exist, I am using the transcribed Tibetan text and its English translation as published by Marx (1891), with additional crosschecks from Petech (1977).
16. Marx 1891, p. 103 (Tibetan text), p. 117 (English translation).
17. Marx clearly says he does not know to what location “Gog” refers and states that “Here, Gog may be east or north” (1891, p. 117). In Ladakhi language *gog* or *gog po*, “ruined”, “crumbled”, “collapsed”, is widely used as a cognomen for a place dotted with ruins or vague remains, whether these latter were built by man or not. Vitali's attempt to define more precisely the limits of the lands inherited by Nyima-gon's successor by crosschecking other literary sources (the *mNga' ris rgyal rabs* and the *gDung rabs zam 'phreng* in particular) remained vague and contains no mentions of any gold mine site (Vitali 1996, p. 157-158).
18. The various golden funerary masks found on the western Tibetan Plateau and its neighbouring areas, such as in Mustang and Spiti, attest to the use of gold at an earlier stage. Golden masks found in a Mustang grave site by Mark Aldenderfer belong to an archaeological context whose pertaining human remains have been dated by means of radiocarbon analysis. Nine dates have been obtained that range from 400 cal. CE to c. 850 CE (Aldenderfer & Eng 2016, p. 376). About golden masks in general see: Aldenderfer & Eng 2016; Bellezza 2014, 2014, 2013, 2011; Tong & Li 2015.
19. For instance, the donation of gold by Ladakhi kings to monasteries or high-ranking religious authorities is regularly asserted, as is the command of copies that religious books be written in gold letters (as well as in silver and copper letters).
20. Marx 1891, p. 113-114 (Tibetan), p. 134 (English translation).
21. Cunningham 1970, p. 242.

22. Most probably so named due to its Nepali origin as perceived by Ladakhis.
23. Native coinage seems to be a rather late production in Ladakh. Rhodes report that in 1781 "a Muslim goldsmith from Leh was hired to strike Ladakhi coins called *ja'u*" (Rhodes 1981, p. 122). Cuhaj and Michael's catalogue reports at least 15 of such coins, dating from 1815-1816 to 1928 (Cuhaj & Michael 2012).
24. Clarke 1995; Rigal 1976.
25. Moorcroft *et al.* 2004, p. 314.
26. Moorcroft *et al.* 2004, p. 314.
27. Moorcroft *et al.* 2004, p. 314.
28. Cunningham 1970, p. 232.
29. Peissel 1984, p. 73.
30. Chaudhary 2009, pp. 129, 140. See also Chaudhary 1997.
31. "In general, the product of these alluvial gold washings, many of which are now totally abandoned, is believed to be very small, and is said only just to repay the labour expended on it even in the winter season when agricultural work is slack, or nil" (Lydekker 1883, p. 334).
I am very grateful to Nicolas Buchs and Jean-Luc Epard for finding and forwarding me this reference.
32. Lydekker 1883, p. 333.
33. In lower Suru valley, several places along the eponymous river are called "serthang" (Tib. *gser thang*) or "golden-plateau", "flat area".
34. Lydekker reports gold searchers' pits "sunk in a pebble alluvial terrace some 120 feet above the level of the river" (Lydekker 1883, p. 267).
35. Lydekker 1883, p. 333.
36. Peissel 1984, p. 73.
37. Regarding the economy and society of the Soniwal people, the tools and method they use in gold extracting, see Chaudhary 1997, 2009.
38. Amongst others, see Ahmed & Harris 2005, p. 17.
39. The village, Chiling (Tib. *Phyi gling*, *phyi* meaning "outsiders"), owes its name to its inhabitants being of foreign origin.
40. Zanskar actually means "white copper" (Tib. *bzangs dkar*).
Lydekker wrote that he himself saw, in 1879, as part of the Governor of Ladakh's own collection, specimens of pure native copper "in the form of water-worn nodules reaching to 22lbs. in weight", and found in the lowest part of Zanskar river (Lydekker 1883, p. 334). Clarke asserts the same and adds gold (Clarke 1995). Similarly, investigations and petrochemical analyses conducted in Baltistan region reveal the same favourable environment there for mineral deposits such as gold and copper (see Khan *et al.* 2018.)
41. Radiocarbon analysis obtained for a charcoal sample taken on that site at 17 cm soil depth gave a calibrated date stretching from 1429 to 1619 CE (see Bruneau 2016, p. 5 et 2017, p. 12). About the site in general see Vernier & Bruneau 2015, p. 13; and Devers *et al.* 2015, pp. 39-40 (sampling collected in collaboration with Samara Broglia de Moura).
42. For reports of investigations on gold mineralisation in various areas of Ladakh, see Baldev 1995; Absar *et al.* 2001; Wangdus & Uppal 2002, 2004. Similar information on nearby Pakistani Gilgit-Baltistan area can be found in Moesta 1983 and Searle & Khan 1996.
43. Searle *et al.* 2016.
44. Ahmad *et al.* 2018, p. 11.
45. For an example of a report dealing with gold concentration in the Ladakh Batholith in the Basgo area, see Singh 1995, pp. 291-292.
46. See Wangdus & Uppal 2002, 2004.
47. See Singh 1995, p. 291.
48. See Wangdus & Uppal 2002, 2004.

49. Choksti: 34° 7'31.22"N, 77°16'6.79"E; Alchi-Lardo: 34°13'57.99"N, 77° 8'12.95"E; Bazgo: 34°11'49.15"N, 77°16'42.81"E.
50. Francke 1905-1907, p. 416, picture in Francke 1999, p. 17.
51. I must mention that the three sites presented here (Choksti, Bazgo and Alchi-Lardo) have been initially documented as landscape/archaeological curiosities. Further survey work and interviews with nearby inhabitants only subsequently informed me about these sites' original function.
52. Francke 1905-1907, p. 416.
53. A two-year project dedicated to the survey and documentation of Ladakh Rock Art patrimony, financed by the Italo-Swiss FCMM (Fondation Carlo Leone et Mariena Montandon).
54. At that time my two colleagues were Laurianne Bruneau and Quentin Devers.
55. The Prime Minister of India Mr. Narendra Modi inaugurated the project on August 12, 2014.
56. In 2010, a privately sponsored rescue plan was organised by the author, jointly with the late Andre Alexander, cofounder and director of THF (Tibet Heritage Fund), to try to save the very distinctive rock art from the site before its flooding. At the last minute, Bazgo villagers' representatives opposed the removing of the engraved boulders, arguing that a locally managed open-air museum to shelter those was planned. Unfortunately, this plan was never implemented and, as far as I know, the engraved boulders were flooded.
57. About animal style petroglyphs and their related context see Bruneau & Vernier 2010; Bruneau 2015 and Vernier 2016.
58. I wrote in my notebook the following comments on the spot during my first visit: "des abris souterrains semi effondrés, sortes de cavernes aménagées, des restes de murs [...] plusieurs cavités en ligne sur le bord de la route" [half collapsed underground shelters, kind of fitted out caves, rest of walls [...] on the roadside, several cavities are disposed on a line].
59. This electric pillar implementation work along this portion of the Indus river has provided an unintentional but nevertheless sometimes interesting kind of random survey of the soil below the surface by means of the pits dug at regular intervals for the anchoring of the pylons (pylons are distributed on a line, stretching up and downstream from Alchi dam, at a distance varying from 200 to 450 m from each other, depending on the topography). This work of civil engineering has allowed for the fortuitous finding of archaeological remains.
60. The asphalt road passing just above the mining site has undoubtedly accentuated the natural landslide process. However, despite this recent bulldozer work on its heights, the site seems relatively well preserved.
61. This site is located on the frozen river itinerary, the *chadar*, which has since protohistorical times connected Zaskar with Ladakh during the coldest months of the year. The large rock bars that form the banks of the river here trap driftwood in relatively large amounts, an indisputable advantage in such circumstances.
62. The *khyung* is a mythical bird-like creature of pre-Buddhist origin. It is often represented with horns-like attribute and sometimes anthropomorphised. About these *khyung* design and bird representation in Ladakh rock art in general see Vernier & Bruneau 2016.
63. Reuse of these structures, located along a major itinerary to connect Ladakh with Zaskar and Markha valleys and beyond, is obvious (the site is located on the frozen river road, the *chadar*, the only access to Zaskar area during winter). Generations of shepherds, travellers and road workers after them have thus added bits and pieces to these remains.
64. Regarding recurrent presence of Rock Art close to historical bridge locations see Vernier 2007, 2016.
65. In neighbouring Gilgit-Baltistan area, the centre of gold-washing activities where Soniwal communities are still working today correspond too to the work of the area's Rock Art heritage location. It includes major sites such as, Thalpan, Chilas, Dudishal and Gais.

66. For more details about the Rock Art content around the junction of the Indus and the Zaskar rivers and what they refer to, see Vernier & Bruneau 2016.

67. Petech 1977, pp. 5-6.

68. Francke 1905-1907, pp. 418-419.

ABSTRACTS

This paper is intending to give a descriptive account of four sites from Central Ladakh that nearby inhabitants consider to be ancient open-air gold mines and, in so doing, tries to link some physical remains with what the legend of the ants, inherited from Antiquity, may be interpreted as meaning. The point here is not to add another page to the tale, but rather to point to some possible archaeological evidence supporting the fact that Ladakh might well be considered as a possible location of origin for these gold-related tales.

Ces notes proposent un compte rendu descriptif de quatre sites du Ladakh central que les habitants considèrent comme d'anciennes mines d'or et tentent ainsi un rapprochement entre vestiges archéologiques et la légende des fourmis chercheuses d'or héritée de l'Antiquité. Plutôt qu'une nouvelle page de ce mythe persistant de l'ouest himalayen, la démarche tente donc, sur la base d'évidences archéologiques, de démontrer que le Ladakh pourrait bien être considéré comme un possible lieu d'origine de cette légende aux accents d'eldorado.

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Mots-clés: archéologie, prospection, géologie, mines, orpaillage, pétroglyphes, Ladakh, Zangskar, Baltistan

Keywords: archaeology, survey, geology, mines, gold panning, rock art, Ladakh, Zangskar, Baltistan

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