STONEZINE 18

THE DIGITAL COUNTERPART TO STONEXUS MAGAZINE,
A TRIBUTE TO STONE, STONEWORK AND STONE ART

STONEZINE 18

EDITOR: TOMAS LIPPS

In this issue:

• Cover photo:
Entryway, fortified settlement at Mons Porphyrites,
Roman quarry site in Egypt's Eastern Desert
photo courtesy of Egypt Travel Link Tours:
www.etltravel.com

The photo in the background here:
Mons Claudianus by Per Storemyr

Notice: This issue has been altered from the usual horizontally oriented format to one resembling the print magazine STONEXUS. This is an experiment. We would like to know what your preference is. Please register your opinion in an email sent to stonexus@earthlink.net. Thank you.

Editorial. . .

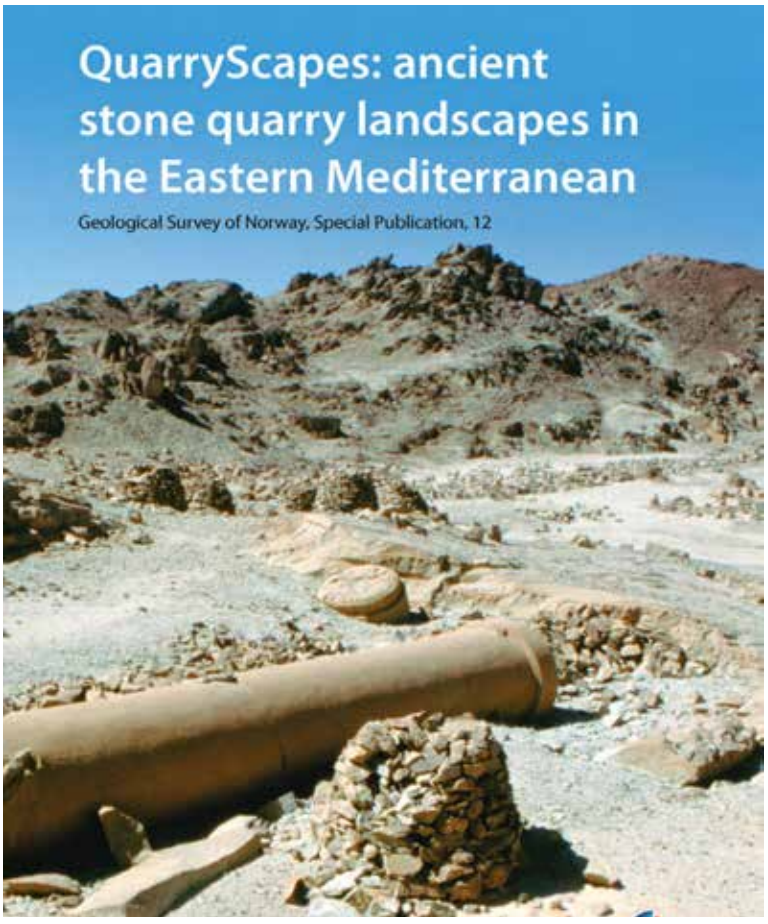
I have been infected, not by the coronavirus, but with a fascination for a particular historical phenomenon—the Imperial Roman quarries in the Eastern Desert of Egypt. These remote industrial colonies established in inhospitable environs on the farthest fringe of the vast Roman Empire were dedicated to extracting and shaping the prestigious native stone and transporting it to the capital.

It was a massive, challenging, costly, and successful enterprise conducted in the service of the Imperial Roman taste for art and architecture. It required, and received, the full measure of Roman organizational skill and technical ingenuity.

Equally amazing, though, was the logistical efficiency of the supply line to the quarry settlements, the volume and variety of the inflow of provisions and materiel necessary to maintain the operations of these remote quarries and sustain the lives of those who lived and worked there.

Researching this subject turned out to be a time-consuming obsession and there has been endless editing which has somewhat delayed publication of this the 18th issue of the STONEZINE and for that I apologize. I hope that you enjoy it.

Tomas Lipps, editor, etc.



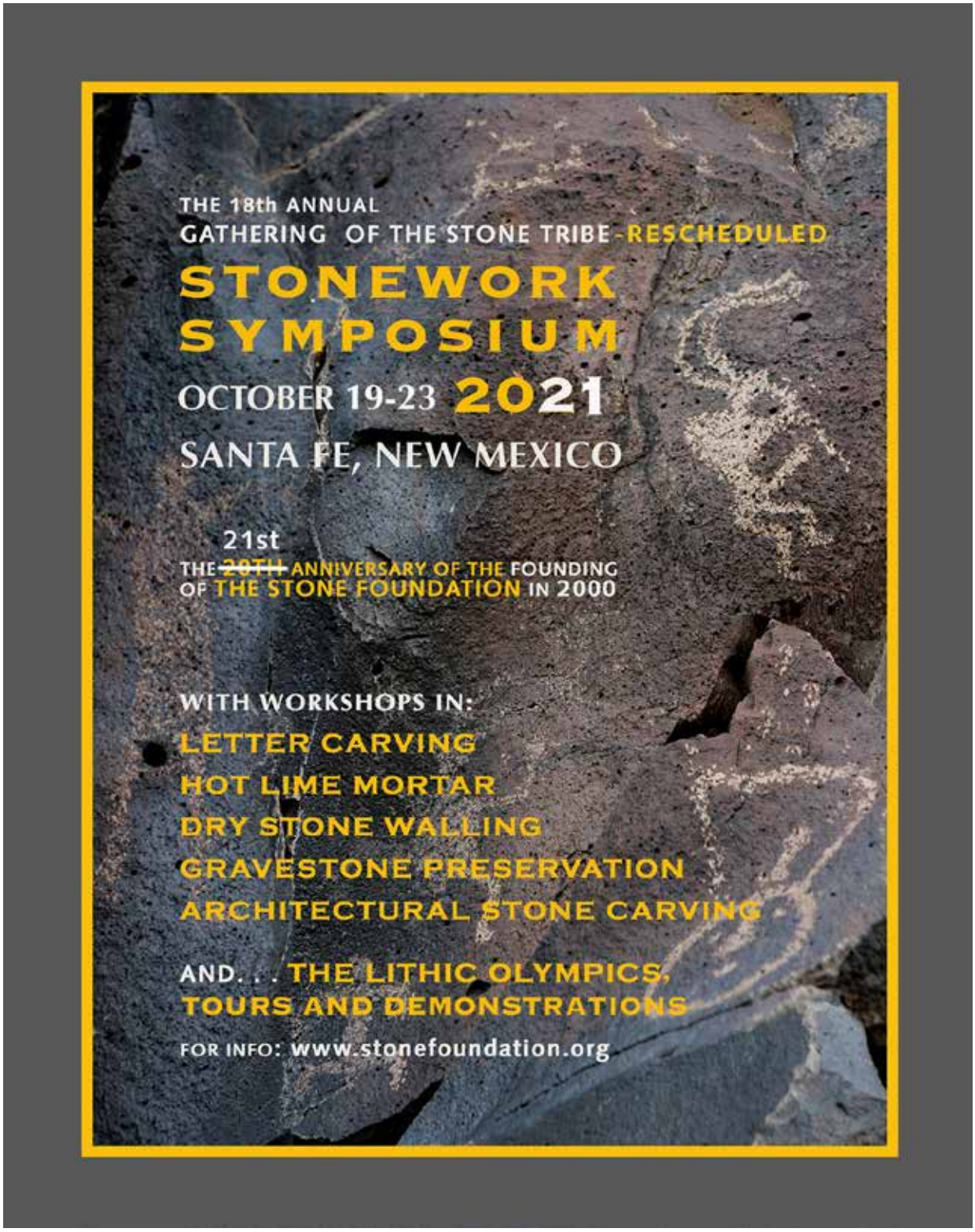
P. S.

If the subject of Egyptian and Roman quarries, the stone taken from them and the way that was done fascinates you half as much as it does me, then open this interesting and informative scholarly paper, if only for the many excellent photographs.

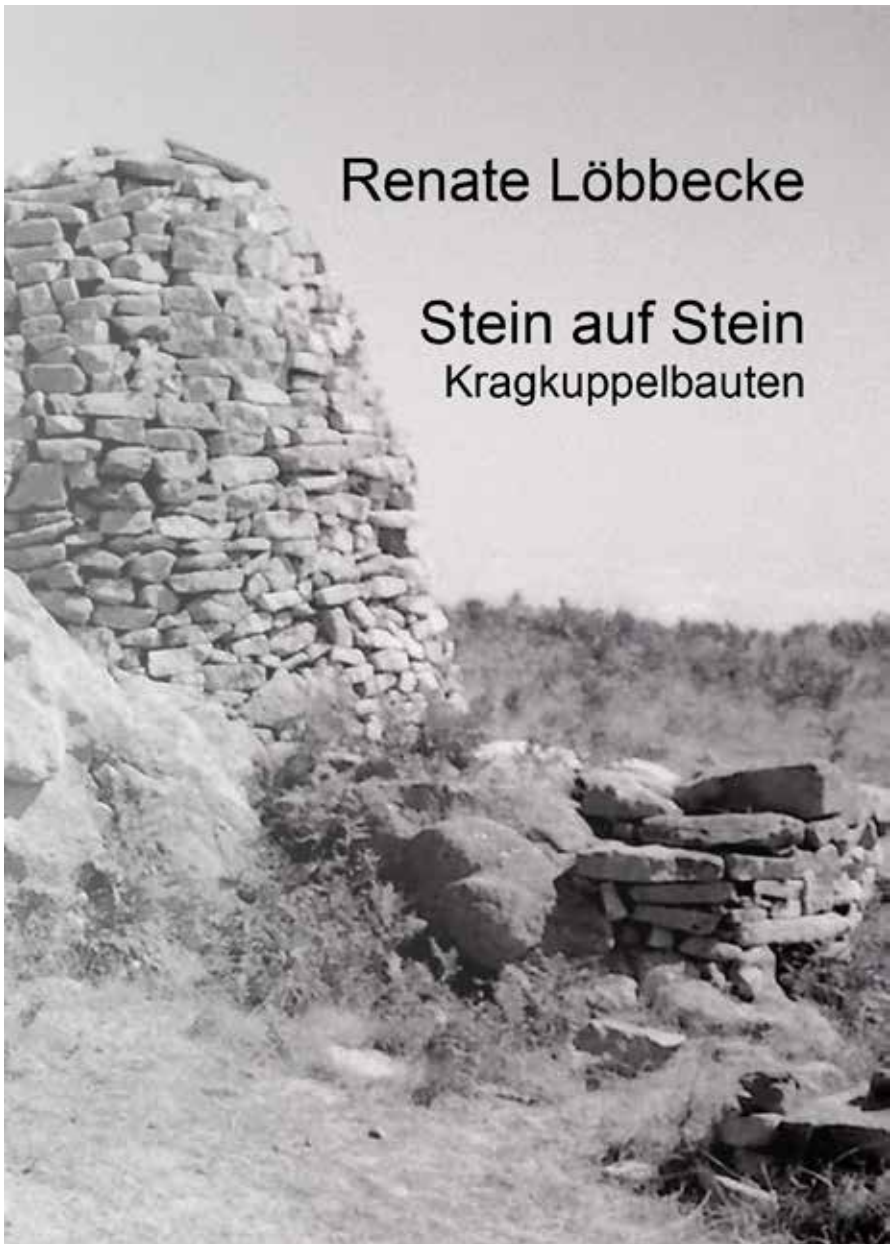
Thanks to geologist/archaeologist/authors James A. Harrell and Per Storemyr for their permission to share this.

Click on this link.

https://www.ngu.no/upload/Publikasjoner/Special%20publication/SP12_s7-50.pdf



STONEWORK SYMPOSIUM 2020, scheduled to occur in October of this year, has been postponed until next year. This is disappointing, but hopefully a vaccine will be discovered by then and STONEWORK SYMPOSIUM 2021 will take place as planned. Meanwhile, keep well and keep up the good work. Let's hope to meet in Santa Fe next year.



Stone on Stone
Corbelled Dome Structures

Renate Löbbecke

Explication by the Author

translation by the editor

Afterword. . .
Even though I had already published the author's words about her own book, Renate Löbbecke sent me a review copy of the English edition—and it is marvelous. There has been sporatic 'scholarly' interest in this wirespread and multifarious phenomenon, but it was Renate and her husband traveling extensively, visiting, photographing, documenting, and correlating corbel dome structures from the Outer Hebrides to the Sinai peninsula who came up with this comprehensive survey. Really good photos, great book.

T L

Stein auf Stein Kragkuppelbauten

STONE ON STONE, Corbelled Dome Buildings

by Renate Löbbecke

I have been traveling the world for more than 30 years in search of corbelled dome constructions. Corbelling is an elementary technique of building that makes it possible to enclose a space using only stones found on-site—and without auxiliary materials such as mortar or wood.

This type of domed construction is ancient. It is known to have been used for burial chambers as early as the 5th millennium BC. Largely ignored, however, is a phenomenon that occurred about 200 years ago, what might be called a 'construction boom' during which many new corbelled dome structures were built—mostly for agricultural shelters. In distant regions completely independent from each other, regions like Ireland, Spain, France, Italy, Greece and Morocco, domed stone structures with comparable yet distinctly different designs emerged.

I have documented around 60 different regions in 20 countries that I visited. In 2012 my observations were published by the Walther König company in the book *Kragkuppelbauten* (now available in English as *Corbelled Domes*), but the topic did not let go of me and I kept exploring, visiting new areas such as the Outer Hebrides in Scotland, the Wachau in Austria and the Alto Alentejo in Portugal.

I have great respect for the physical performance and complex creative powers of anonymous farm workers that has resulted in these structures. In many regions where they transformed the landscape but are no longer being built or used, nature has started to reclaim them though you can still clearly see where people have designed and built and where they have not. The working symbiosis of Man and Nature that converted stone material into useful structures was based upon a relationship determined by ambivalence, by initial creativity and then, subsequent neglect.

When I'm in one of these typical stone-designed landscapes I am aware of the hardships the builders experienced but what I see pleases me. I find it beautiful. The tension between rough labor and the resultant aesthetic appearance affects me and I am always in a condition of highest sensual and spiritual attention for everything I see. These unique man-made forms composed of raw rocks may have been abandoned but the objects they contain—old tools, broken chairs, dusty bottles, etcetera—are testimonials to the pleasure they must have given to their builders.

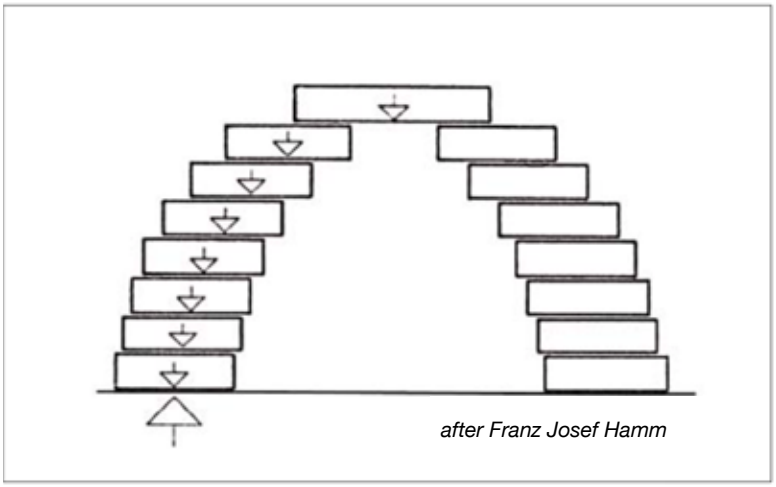
The designs of these structures depend on the physical properties of the stones used and the skills of the builders. Horizontal rings of stone are layered one above another, each layer projecting slightly beyond the one below it. In this way the interior space is incrementally narrowed until the rings meet at the apex of the vault and can be covered by a single capstone which *(unlike the keystone of a 'true arch')* has no static function and might be missing.

The dry stone construction technique used in such buildings does not require a binder such as mortar, nor is any timber formwork needed.

A corbelled dome over a round floor plan is the easiest and most stable form to be made. Corbelling the dome creates an ogival shape, an elipical hemisphere in cross section, a roughly equilateral triangle with curving sides.

Viewed from the outside, the stacked stone forms of these (mostly) round, domed buildings fit harmoniously into the surrounding nature. When inside I am surrounded by the enclosing walls and roof. Their curvature, the cavity they create and the sparse light within it embrace me protectively and I experience the essence of a dwelling as what the writer Heinrich Klotz described as a "third skin."

Translator's note: The term, 'cantilever,' used by the author to describe the construction technique used in the buildings she studied has been changed in the text to the term familiar to English speaking builders—corbel.



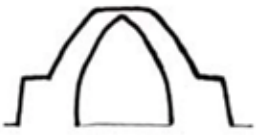
BASIC TYPES:

Type 1
The outer shape corresponds to the inner dome layer.

Type 2
The casing is pulled up vertically on the outside; only inside can the dome-like vault be seen.

Type 3
The outside of the dome disappears completely in the tower-like casing.

Type 4
A clearly offset roof rises above a vertical base.



Type 5
The building is surrounded by a base.

Type 6
The outer layer is divided by steps

Spain, Extemadura, 2009

Egypt, Sinai, 1993

France, Vaucluse, 1996

Spain, Lanzarote, 2010

Oman, 1996

France, Dordogne, 2009

Italy, Apulien, 1995

Spain, Valencia, 2008

Italy, Apulia, 1995

Italy, Apulia, 2008

Spain, Menorca, 2006

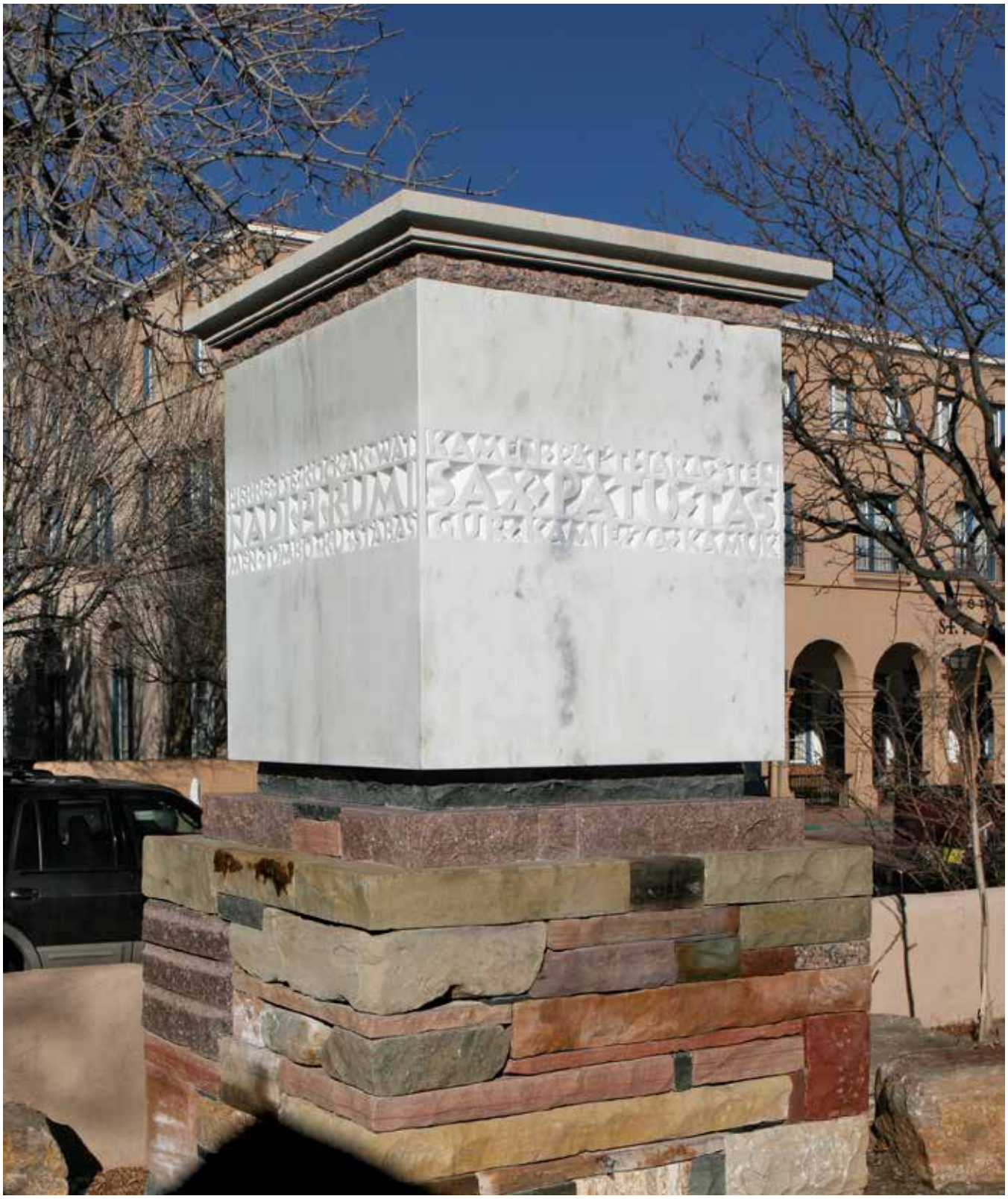
Oman, 1996

LITHIKOS GALLERY

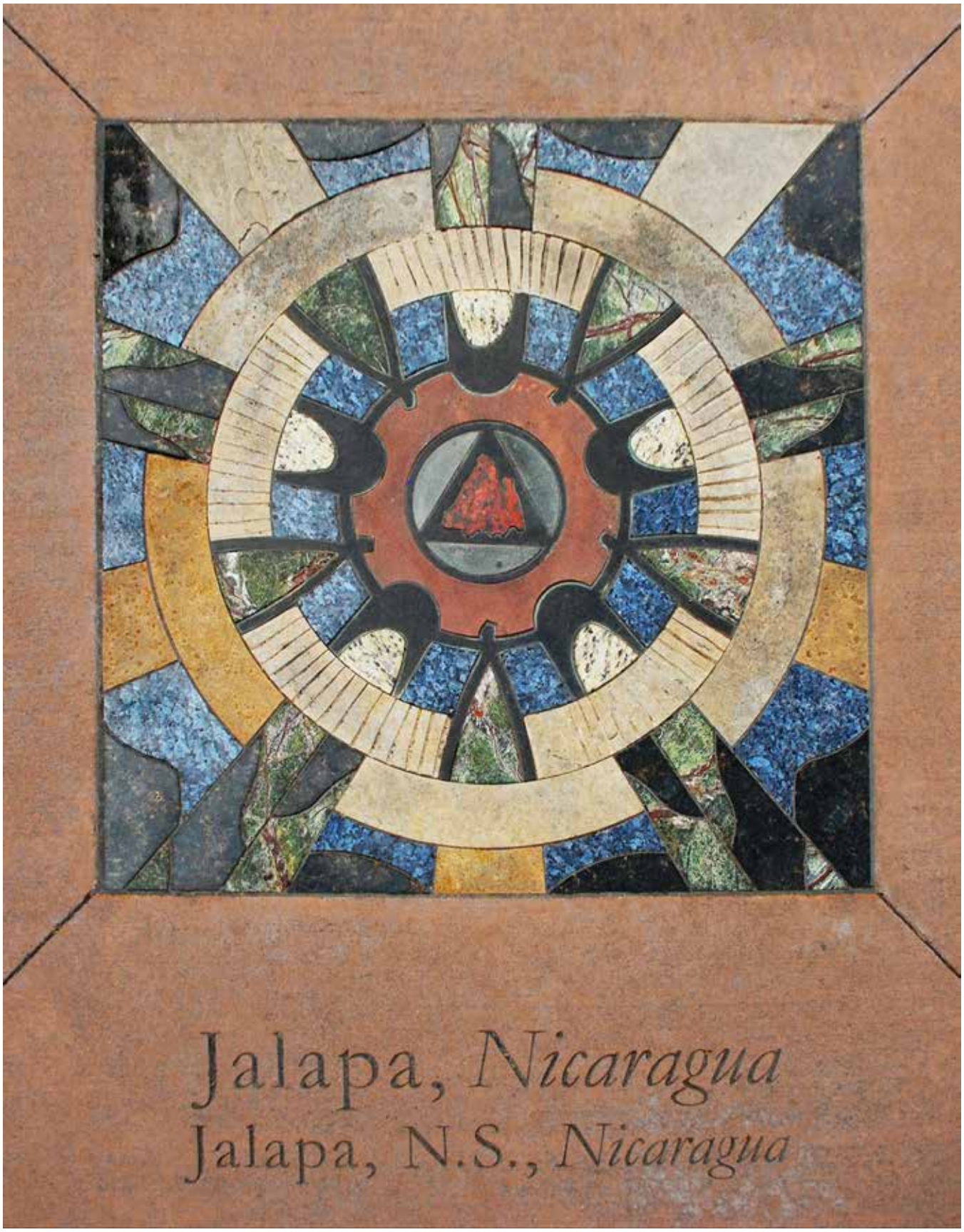
Photos by David F Wilson that were not used in his article *CREATIVE SPACE* in stonexus XVIII

Dry stone garden walls by John Scott in Ontario

Japonesque stone ramparts, Rolex Building, Dallas, TX, detail. By Suminori Awata, Kyle Schlagenhauf and others



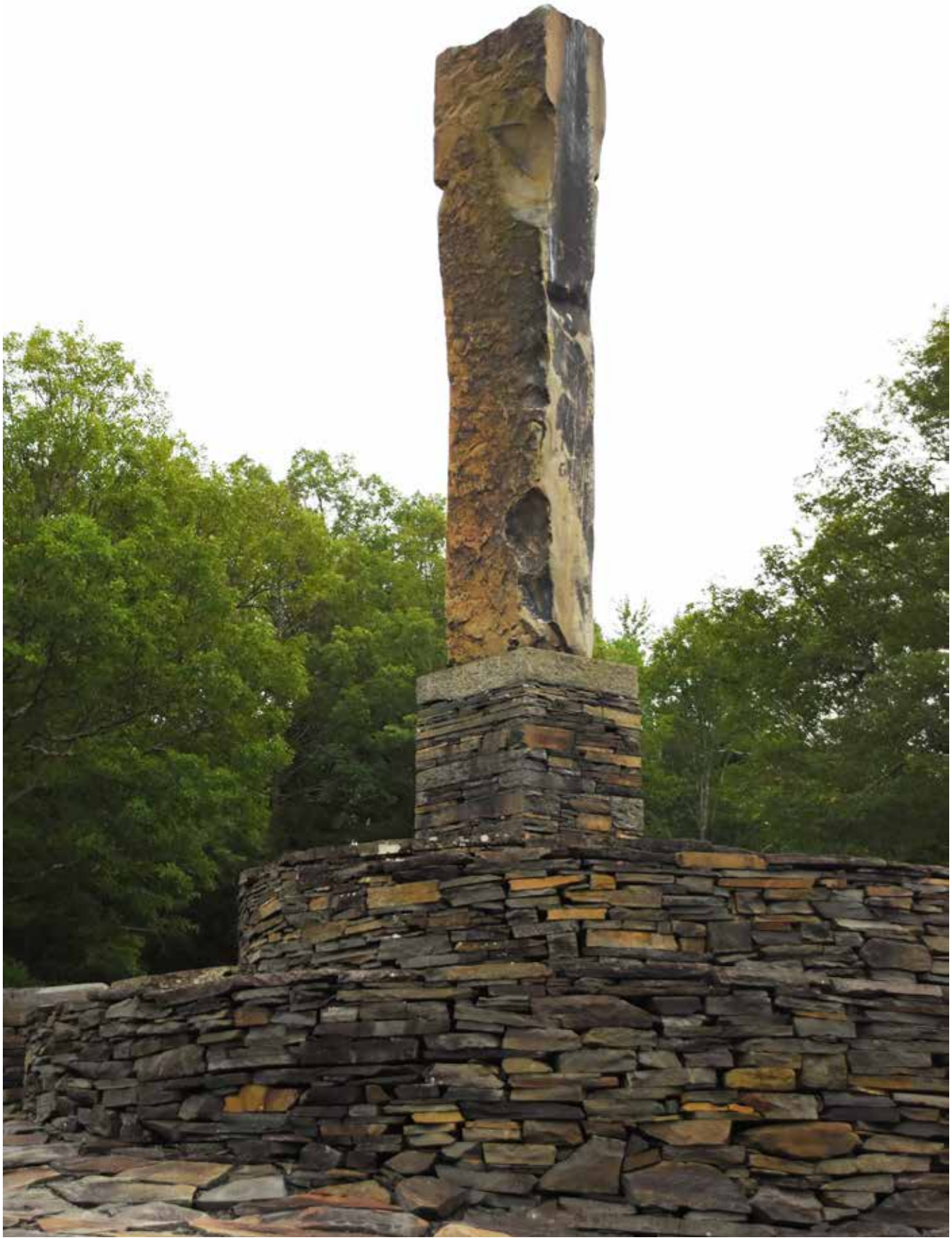
The Multi-Lingual Cornerstone of the Lithosphere, *erected in 2010 to commemorate the 10th anniversary of the founding of the Stone Foundation in Santa Fe, New Mexico. Stone Foundation members donated the 3' x 3' x 3' block of Yule marble and the stone for the plinth which was built by member volunteers. The lettering, which features the words for STONE in many languages of the world, was designed by Karin Sprague and carved by her and several other Stone Foundation members during Stonework Symposium 2013 in Santa Fe.*



One of several square stone mosaic tiles at the Sister City Plaza *in Boulder, CO.*
Designed by and built with Christian Muller & Leap Year, inc.

Blue whale, sculpture by Kevin Carman, Gualala Arts Center, *Gualala, CA.*

Backyard stonescaping, detail. Dan Snow, Vermont



Opus 40, *the Monolith, early Land Art by Harvey Fite, Sauguerties, NY*
(The monolith is 14 feet long and weighs 9 tons. It is not pinned; it stands balanced on a thick plate of lead.)

The Sculpture Project, *Rapid City, South Dakota. Sculptor Masayuki Nagase's workshop in the Main Street Square.*

The Sculpture Project, *Rapid City, South Dakota. sculptor, Masayuki Nagase*

The Sculpture Project, *Rapid City, South Dakota. sculptor, Masayuki Nagase*

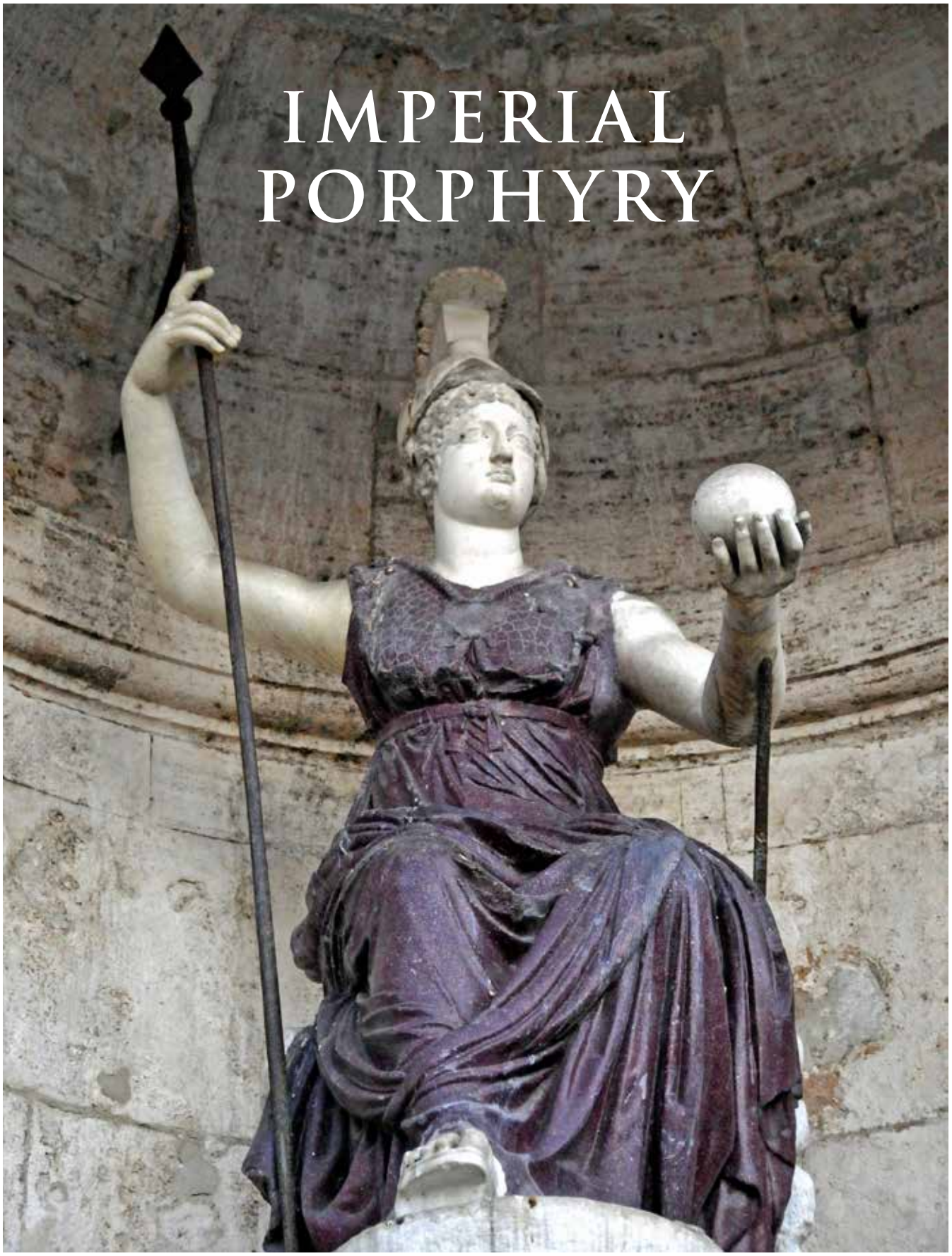
Moon window in perimeter wall by Jared Flynn, the Stone Trust campus, Vermont.

Mohonk Mountain House Resort Hotel, *New Paltz, New York.*

Mohonk Mountain House Resort Hotel, *New Paltz, New York.*

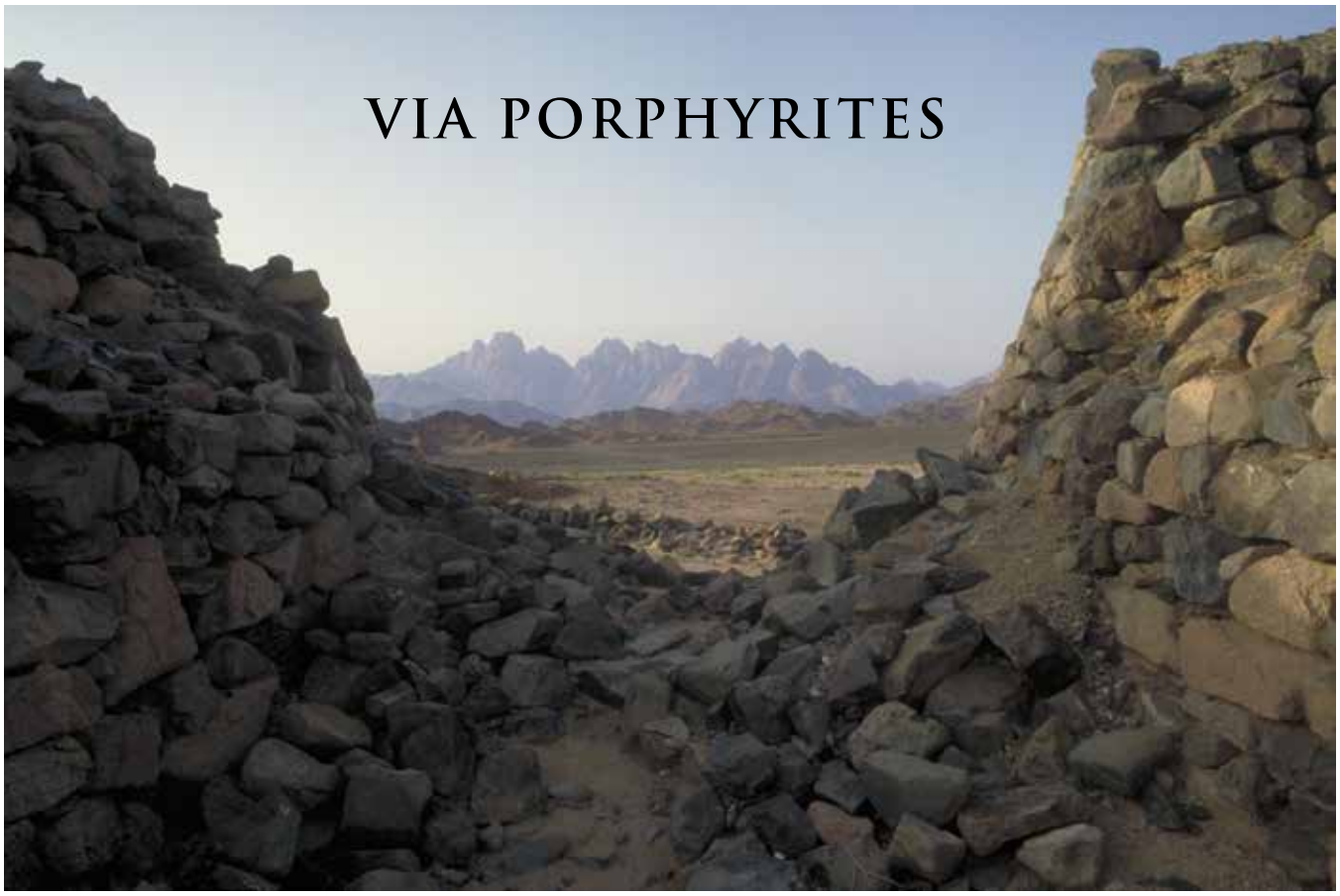
Sculpture by Edwin Hamilton, Petaluma CA.

IMPERIAL PORPHYRY



Statue of the goddess Minerva clad in Imperial Porphyry, Rome. photo: Dennis G Jarvis via Wikimedia Commons.

VIA PORPHYRITES



The fortress at Badi'a, one of seven hydreumata, or Roman watering stations, along the nearly 100-mile trek from the quarries to the river Nile.

Imperial porphyry—glowing purple flecked with white— is found in only one place: atop a few barren peaks in Egypt's Eastern Desert. At the apogee of Roman power, this beautiful stone became a jealously guarded symbol of rulership itself.

It was quarried in Egypt under appallingly difficult conditions and carted to the Nile along the Via Porphyrites, the Porphyry Road. Today, the area is a fascinating—and still very harsh—early industrial landscape.

Written by Louis Werner
Photographed by Lorraine Chittock

In the year 18, in Egypt, a Roman legionnaire named Caius Cominius Leugas found a type of stone he had never seen before. It was purple, flecked with white crystals and very fine-grained. The latter characteristic made it excellent for carving, and it became an imperial prerogative to quarry it, to build or sculpt with it, or even to possess it. This stone soon came to symbolize the nature of rulership itself. We call it *Imperial Porphyry*.

The Romans used this porphyry for the Pantheon's inlaid panels, for the togas in the sculpted portraiture of their emperors, and for the monolithic pillars of Baalbek's Temple of Heliopolis in Lebanon. Today there are at least 134 porphyry columns in buildings around Rome, all reused from imperial times, and countless altars, basins and other objects.

Byzantium, too, was enamored of porphyry. Constantine the Great celebrated the founding of his new capital, Constantinople (later Istanbul), in the year 330 of our era by erecting there a 30-meter (100 feet) tall pillar, built of seven porphyry drums, or cylinders, that still stands. Eight monolithic columns of porphyry support Hagia Sophia's exedrae, or semicircular niches. Justinian's chronicler, Procopius, called the columns *"a meadow with its flowers in full bloom, surely to make a man marvel at the purple of some and at those on which the crimson glows."*

Anna Comnena, daughter of the 11th-century emperor Alexius I, described the *porphyra*, a porphyry-veneered room in the palace where women of the ruling family were taken to give birth. The choice of porphyry for this room in particular was no accident: It ensured that members of the imperial family were literally porphyrogenitos, or "*born to the purple.*"The room is in the form of a perfect square from floor to ceiling, with the latter ending in a pyramid. The stone used was of a purple color with white spots throughout like sand sprinkled over it.

Porphyry served the imperium in death as well as birth. Nero was the first emperor to be entombed in a porphyry sarcophagus, according to Suetonius. Constantine's porphyry sarcophagus has been lost, but that of his wife Constantia, decorated with peacocks, lambs, and grapes and thought to be a copy of his, is now in the collection of the Vatican Library. Those of the Holy Roman Emperors Frederick II, Henry IV and William I, and that of the Empress Constance, all porphyry, are in Sicily's Palermo and Monreale cathedrals.

In later centuries, porphyry columns and other pieces were widely reused in new constructions, often reappearing far from their original Roman context. In 786, Charlemagne received permission from Pope Hadrian to remove classical columns of porphyry from Rome to build his cathedral at Aachen. The renaissance Medici family commissioned portrait busts carved from porphyry blocks that had been warehoused in Rome since imperial times. Other sources are unknown and unguessable: The Victoria and Albert Museum in London contains a pair of fine porphyry earrings. A church in Kiev is decorated with porphyry wall and floor revetments; how the stone made its way there is probably an interesting story, but unrecorded.

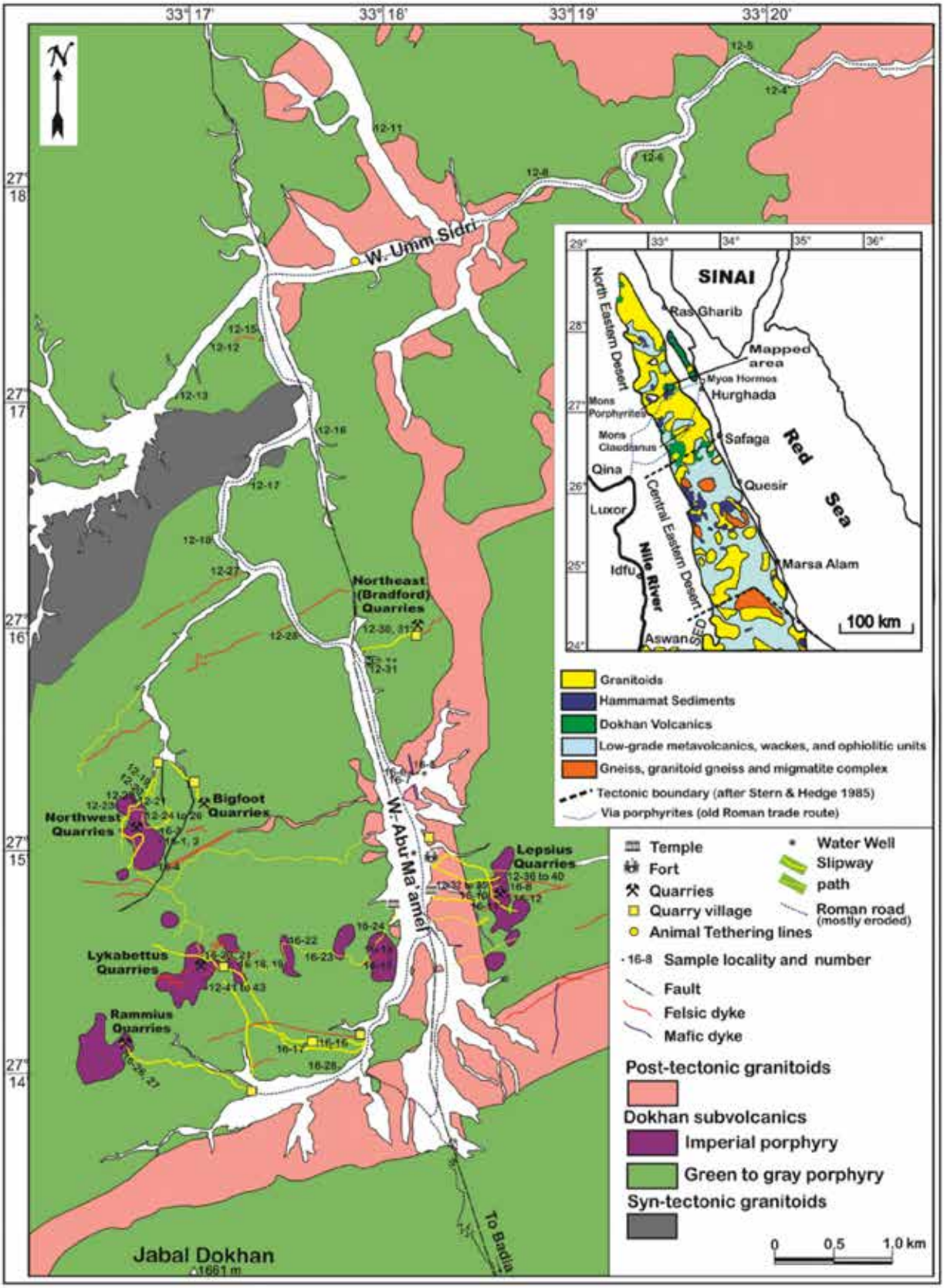
What makes imperial porphyry so precious and rare is that it is found at only one place on earth, atop a 1600-meter (mile-high) mountain in the eastern province of Egypt. The Romans named the site Mons Porphyrites, or Porphyry Mountain, and the Arabs today call it Jabal Abu Dukhan, or Smoky Mountain.

Thrust to the earth's surface in the same volcanic action that once formed the Red Sea, the porphyry found at Mons Porphyrites is, as far as specialists know, geologically unique. But the site is so barren and so remote that only slave labor* could ever have extracted the stone, and even then only for the relatively brief historical moment when Roman power was at its zenith.

photos:
above: Inscribed lintels lie amid the ruins of the second-century Temple of Serapis in west central Egypt, where the Via Porphyrites, the seven-day road to the Nile, began.

right: A doorway remains of the second-century Temple of Serapis in Wadi Abu Mu'amal.

**It is now known that these quarryworkers free men who were paid for their skilled and un-skilled labor, and that they were paid more than their counterparts working elsewhere in less harsh circumstances.*



Detailed geological map of the Wadi Um sidri-Wadi Abu Ma'amel based on field work and Landsat image processing.
Inset map: geological map of the Eastern Desert of Egypt (modified after Eliwa et al. 2010;Ali etal. 2012
from A new look on Imperial Porphyry: a famous ancient dimension stone from the Eastern Desert of Egypt,
International Journal of Earth Sciences, March 2018, Authors: Mahrous M. Abu El-Enen, Joachim Lorenz, Kamal A. Ali, Volker von Seckendorff

When George Murray, chief of the Egyptian Geographical Survey in the 1930s, visited the quarry, he found a place so barren that it made him shudder.
A ruined fortress, three lifeless villages, abandoned temples and shrines, dry wells, broken pillars, cracked stone baths—*"the fossil whims of three centuries of Emperors,"* he called it. The local Ma'aza Bedouin have a similar saying about the place: *"The Romans left; only the ibex remained."*

But geographers and the Bedouin see things differently from archeologists. David Peacock of the University of Southampton in England is co-director of the Egypt Exploration Society's Mons Porphyrites Project, and he finds it "the most remarkable Roman industrial landscape in the world." Some of his recent finds, including the stele inscribed by the Roman discoverer of the quarry, help to explain how the work was carried out under conditions that would be daunting even today.

Among the more startling finds are a hair-pin, cosmetic brush, and toy comb made from oyster shell—evidence that women and children may have lived here alongside the men. Also surprising is written evidence, on inscribed pottery shards, or *ostraca*, that work proceeded here even during the sun-scorched summer.

top of page: Abandoned for reasons we do not know, this quarried monolith has lain blocking its slipway for more than 1500 years.

above: Looking some 1600 feet uphill, at the end of the myriad slipways running up the mountain's two facing flanks, are the porphyry quarries, which appear to have plenty of the stone left for the taking. The 6 foot long, 20-ton blocks and drums were lowered down these steep, smoothed and banked slipways, restrained only by the blocks and tackle attached to paired stone butts set at close intervals on either side of each slipway, all along their length.

right: Ruins of the village at Mons Porphyrites with a broken water basin.

Labor involved more than mere quarrying. After cutting and rough-dressing the blocks and column drums—and apparently also such larger pieces as the monolithic pillars eventually used in Hagia Sophia—the pieces were loaded onto oxcarts, which were driven 150 kilometers (about 100 miles) to the Nile at Qena (Kainopolis of the Ptolemaic era), where they were shipped downstream by barge and then by sea to their final destinations. Byzantine poet Paul Silentarius refers to this in his ode to Constantinople's porphyry, *"powdered with bright stars, that has laden the river-boat on the broad Nile."*

The road from the quarry westward to Qena, which Ptolemy the Geographer put on his second-century map, was a route described first by Strabo, and it is to this day known as the Via Porphyrites, the Porphyry Road. Along the way are seven *hydreumata*, or fortified wells, each one a day's march from the next. Outside the fortifications are lines of large stones to which oxen were tethered at night.

above: Plastered stone pillars surround the well near the Temple of Serapis. As porphyry was borne down the mountains, the several thousand workers, mostly slaves and prisoners *damnati ad metalla*, "condemned to the mines," also had to carry water up to the sun-scorched heights where they labored.

Archaeologist Steven Sidebotham of the University of Delaware, an authority on the Roman roads of the Red Sea mountains, surveyed the Via Porphyrites in 1989. He concluded that from the first to the third centuries of our era, the hydreumata were used as watering stations for the porphyry carts, and that in the following three centuries, when quarrying had ceased and tribal raiding from the south had commenced, they became Roman border posts along the line of communication between the Nile and the fort at Abu Sha'ar on the Red Sea coast.

Today the area is uninhabited except for the occasional Ma'aza Bedouin grazing his camels. Ibex, hyrax, and rabbit live here now. Around water holes, trumpeter bullfinches, desert larks, and mourning chats flock in *sayaal* trees (*Acacia raddiana*) and the wispy-needled yasar trees (*Moringa peregrina)*. In the fall, thousands of white storks cross overhead, riding thermal currents on their way from the Sinai to central Africa.

The Via Porphyrites follows three major systems of *wadis*, or streambeds: Wadi Belih, Wadi al-Attrash and Wadi Qena. Between the first two it crosses the divide between the Red Sea watershed and that of the Nile. From Wadi Belih, there are two approaches to the quarry. One is a winding route up Wadi Umm Sidri and into Wadi Abu Mu'amal ("Workplace Wadi"), and it is this route that the oxcarts followed. The other is a steep but more direct footpath over a 950-meter (3000') pass.

A late-winter trek along the route in the company of two Ma'aza Bedouin, 72-year-old Salaama Mir'i and his 18-year-old son Suleiman, provides ample opportunity to reflect on the hardships faced nearly 2000 years ago by Rome's mostly Christian slaves, the thousands *damnati ad metalla*, or "condemned to the mines" in Egypt.

In walking to Mons Porphyrites, I follow in the footsteps of two British explorers, Sir John Wilkinson, a former president of the Royal Geographical Society, who rediscovered the quarry in 1823, and Leo Tregenza, a Qena-based schoolteacher who, in the 1940's, spent his summers in these parts and wrote of them in his classic account *The Red Sea Mountains of Egypt* (Oxford University Press, 1955). When I tell Salaama of my intended route, he startles me by saying, "Yes, I know it, I came this way years ago with an ingilizi named Genza." "Leo Tregenza?" I ask. "Yes," he says, "A man always writing in a book, with many tins of bully beef and cocoa." When I later telephone Tregenza, now well into his 90's and living in Wales, he says, "There is not a day that goes by that I don't think of those men. Tell them that when you see them next."

Salaama dispatches his son to guide me up the quarry footpath north from our first camp in Wadi Mu'allaq, the Hanging Wadi, which cuts into the mountain on the other side of the summit from the old quarry. From the pass into Wadi Abu Mu'amal the view sweeps from the present to the ancient past: to the southeast, the white hotels of the booming resort town of Hurghada rise off the coastal plain. To the southwest floats Jabal Qattar, a massif of precambrian red granite, and just beyond is Jabal Shayyib, at 2242 meters (7175') Egypt's highest point outside the Sinai Peninsula.

Looking north along the wadi floor, the remains of the stone fort and the Temple of Serapis are visible. Five white-plastered stone pillars surround the well. The temple has largely fallen, but the dedicatory inscriptions are still legible on the lintels that lie scattered on the ground. *"Built when Rammius Martialis was governor of Egypt,"* Tregenza translated from one, which dates the temple to between the years 117 and 119.

Nearby are four symmetrical crown-of-thorn trees (*Zizyphus spina-christi*) which Tregenza regarded as old enough to have been planted by the Romans for their shade. Further down the wadi is the great stone ramp where the porphyry blocks were loaded off quarry skids and onto long-distance carts.

One wonders how such heavy loads were managed. At the nearby white-granite quarry of Mons Claudianus lies a 22-meter (70'), 240-ton column, abandoned presumably when it cracked while being rough-dressed into an approximation of its final shape. Smaller columns there—so many that the Ababda Bedouin call the place *"Mother of Pillars"*—are in the same condition, which makes one think that for the Romans, shipping large monoliths out of these mountains was a relatively routine task.

Here, too, are the lodging huts, watchmen's posts, blacksmiths' benches and dipping baths, the rock-hewn cisterns, the rubbish dumps and even the rough gravesites that all testify to everyday life against all odds. Tregenza recorded his find of a tombstone, made of porphyry, that belonged to "John of Hermopolis," presumably a Christian slave.

Earlier British visitors found improbable inspiration in this desolation. Poet and amateur archaeologist Christopher Scaife, when not documenting Roman epigraphy in the area, was known to prance about the Temple of Serapis dressed in a blue toga. Tregenza himself found poetry in the color of the porphyry scree, seeing in it *"a lurking bloom linked to the softness of the sky and the fine blue mist that descends from it."*

But for me, there are only heat, dust and sharp stones that cut my boots. I am glad when I arrive back in camp after a six-hour return trip from the quarry. As twilight falls around our campfire, Suleiman makes unleavened bread under the coals, cleaning it with a whisk of ripped shirting before we dip our pieces into a bowl of melted *samna* (ghee, or clarified butter). Beyond, on the Red Sea coast, the lights of Hurghada blink and the pack camels nose closer for the night.

The next morning we begin our trek toward the Nile. Badi'a is the first hydreuma along the route. Like the others, it measures roughly 14 square meters (150 sq ft) with interior rooms, in ruins but still unexcavated. The well itself has long ago drifted full of sand. The corner towers have fallen into cones of stone linked by the graceful undulations of the more intact walls. Recent surface finds by Peacock include coins from the reigns of Hadrian, Trajan, Constantine and Theodosius, as well as pot and glass shards.

The westward march from Badi'a moves between Jabal Qattar's red granite massif on the left and Abu Dukhan's black basalt on the right, the two hills placed like navigational buoys on a river. This stretch is still in the Red Sea watershed, so the gentle slope is against us until we top a pass some 250 meters higher than the point where the oxcarts would have begun their journey, just before the next hydreuma at the mouth of Wadi Qattar.

The well at this station was renovated by Egypt's Prince Farouk in the 1930's, and the Roman walls are now destroyed. Farouk quarried porphyry briefly, and used it to provide Cairo's modern building entries with their distinctive purple lintels. But his efforts lasted only long enough to relearn how hard the work was. Since then, the only modern quarrier was one Lady Cowdray, wife of a Scottish oil magnate, who had promised her husband he would be buried in a porphyry sarcophagus—and so he was.

A twisting, refreshingly shady side route winds through the ever-narrowing Wadi Qattar, past prehistoric drawings of ibex, giraffe, and sickle-boats, into the heart of the massif and up to a place known as Wadi Naqaat, or the Dripping Wadi. The sand here is pink, eroded from the quartz and felsites that make up the summits.

Sir John Wilkinson's description of the wadi, published in the 1832 Journal of the Royal Geographical Society, remains accurate. *"A mountain torrent's bed,"* he called it, *"filled with large stones until it terminates at a precipitous rock overgrown with hanging water weeds, down which the water drops into a basin of plentiful supply."*

Naqaat was home to a Christian anchorite community—founded perhaps by runaway slaves from Mons Porphyrites—and the hermits' fourth-century rock church remains in perfect condition, though roof-less. An inscription, now removed to Cairo, shows that it was built by Flavius Julius when Hatres was Bishop of Maximianopolis—the Roman name for modern Qena—a statement that dates it to the year 339 of our era.

In a fifth-century history of Christian hermits written by Palladius, one can read the first-person account of a man named Posidonius: *"Living in the porphyry district for a year I met no man nor heard a voice nor tasted bread, keeping myself alive on dates and wild honey. Once these things failed me and I decided to go back to the world of man, but walking out I spied a Roman and in fright returned to my cave. On my way I came upon a basket of fresh figs, which overjoyed me and lasted for two months.*

Four fig trees still grow next to Wadi Naqaat's pool. Ibex prints cross the mud bank, and moss and maidenhair ferns hang from the dripping wall. The water level, raised by the torrential rains three months before my passing, has receded slightly, but Salaama assures me that this is indeed a perennial source.

The entire wadi has apparently been well-watered by the rain. Slightly lower, a yasar tree is covered with tiny white blossoms, and mountain mallow plants *(Malva parviflora)* and *humaad*, with its edible red flowers, grow everywhere. We gather some mallow; it will add texture and freshness, if not much flavor, to the mostly tinned meals that will sustain us on our trip.

The way from Qattar to Deir al-Attrash, the next station, often follows in the old automobile tracks left from the 1930's, before the building of the asphalted Qena-Safaga road, when this was the principal crossing from the Nile to the sea. The tall Roman cairns placed in the middle of the wadi floor seem unnecessary as route markers, a fact that led archaeologist Sidebotham to suggest that they were signal towers for flags or mirrors, for there is an unimpeded line of sight from one to the next.

Outside Deir al-Attrash's mud-brick walls lie several broken porphyry drums and blocks that apparently fell off their wagons. Out here, far from their loading ramps, the Roman carters had no way of putting them back onto a cart again, and thus had no option but to leave them behind, where they are slowly eroding to nothing, their purple chips and sands becoming lost among the dull schists and diorites that dominate these low foothills.

The tributary wadis entering from Jabal Qattar's western flanks are broader than those that slice into the higher peaks.

As we approach the mouth of Wadi al-Attrash, a herd of 13 loose camels wanders up to us. *"Many different brands,"* notes Salaama from a distance, *"but all Khushmaani,"* referring to a Ma'aza clan that rivals his own Masaari lineage.

We pass the turnoff to Mons Claudianus and, high on an outcrop, see another ruined hydreuma with walled guard posts. The route soon squeezes through the landmark Bab al-Mukheniq, the Gate of Suffocation, formed by two high granite ridges, before entering the gravel plain known as Naq' al-Tayr, or Bird Swamp. Just as the march begins in earnest, across to the long bluff that drops off into Wadi Qena, I ask myself, *"Where is the swamp—and where are the birds?"*

The watery mirage shimmering across the plain answers the first question, and Tregenza takes care of the second. As he witnessed in the fall of 1949, this is where migrating storks by the thousands land to rest, fooled perhaps by the same false promise of a drink that I too had momentarily believed.

The flat limestone plateau that separates the Nile Valley from the wadi system we are in provides a straight-edged horizon, in contrast to the craggy, igneous teeth of the mountains now at our backs. The Wadi Qena is broad and hot, crisscrossed with the ruts of joyriding jeeps, but the soft rays of the setting sun illuminate a fainter trace in the firm sand: Roman cart tracks.

The three-meter-wide (10') tracks spread out all across the plain, running in sets of two parallel lines, as if this had been a proving ground for racing chariots. The tracks are almost imperceptible when we look directly down; they can best be seen by standing in the middle of a set and gazing along them toward the horizon. In some low spots where rainfall has collected they are easier to see, because grass grows in their double wheel-tracks and nowhere else.

Many of the tracks lead to the hydreuma of Saqqia, built on a low hill beside the plain. At the center of its earthen berm perimeter are two wide wells which once fed the upper-level animal troughs and cisterns with water lifted by shadouf the ancient Egyptian counterbalanced water-lifting device. Seashells dot the ground; they were used to make the lime plaster that still coats the troughs. The odd porphyry chip or blue faience shard turns up with a kick at the dirt.

Al-Heita, the penultimate hydreuma, has a double fort, one in the wadi bed next to a rare stretch of paved Roman road, and the other high on a shoulder of Jabal Abu Had, which is a limestone shelf at Wadi Qena's eastern limit.

The yellow brick of the fort's upper walls, showing the remains of finely executed barrel vaults, are a beautiful and conspicuous ruin against the sky.

It was here that Tregenza found a Roman love letter written on an ostracon. "*From Isadora to her lord and master, greetings. As I begged you before, please do not forget me. I want you to send the bottle and ink so I may write to you again.*" Here was additional evidence that Roman women, too, once traversed these desiccated parts.

It was here I had to leave Salaama and Suleiman. I would have to miss the last water station—which is said to be completely ruined—and take a truck down to Qena, where Rome's presence still resonates in the magnificent Temple of Denderah, a temple ironically, lacking any sign of porphyry decoration.

The two Ma'aza will return with the camels past Mons Porphyrites to their home range in the Wadi Umm Duheis above Hurghada. I wonder if they, like Isadora, might also leave a record somewhere of this journey. If so, I hope it will not resemble the message on papyrus recently found in the Fayoum, west of the Nile between Qena and Cairo. That was written in the year 163, 18 centuries ago, by Satabous of Dimai, and in it he complained bitterly that his camels had been unfairly requisitioned by the authorities—for "*draft service on the porphyry road.*"

Written by Louis Werner.
Photographed by Lorraine Chittock.
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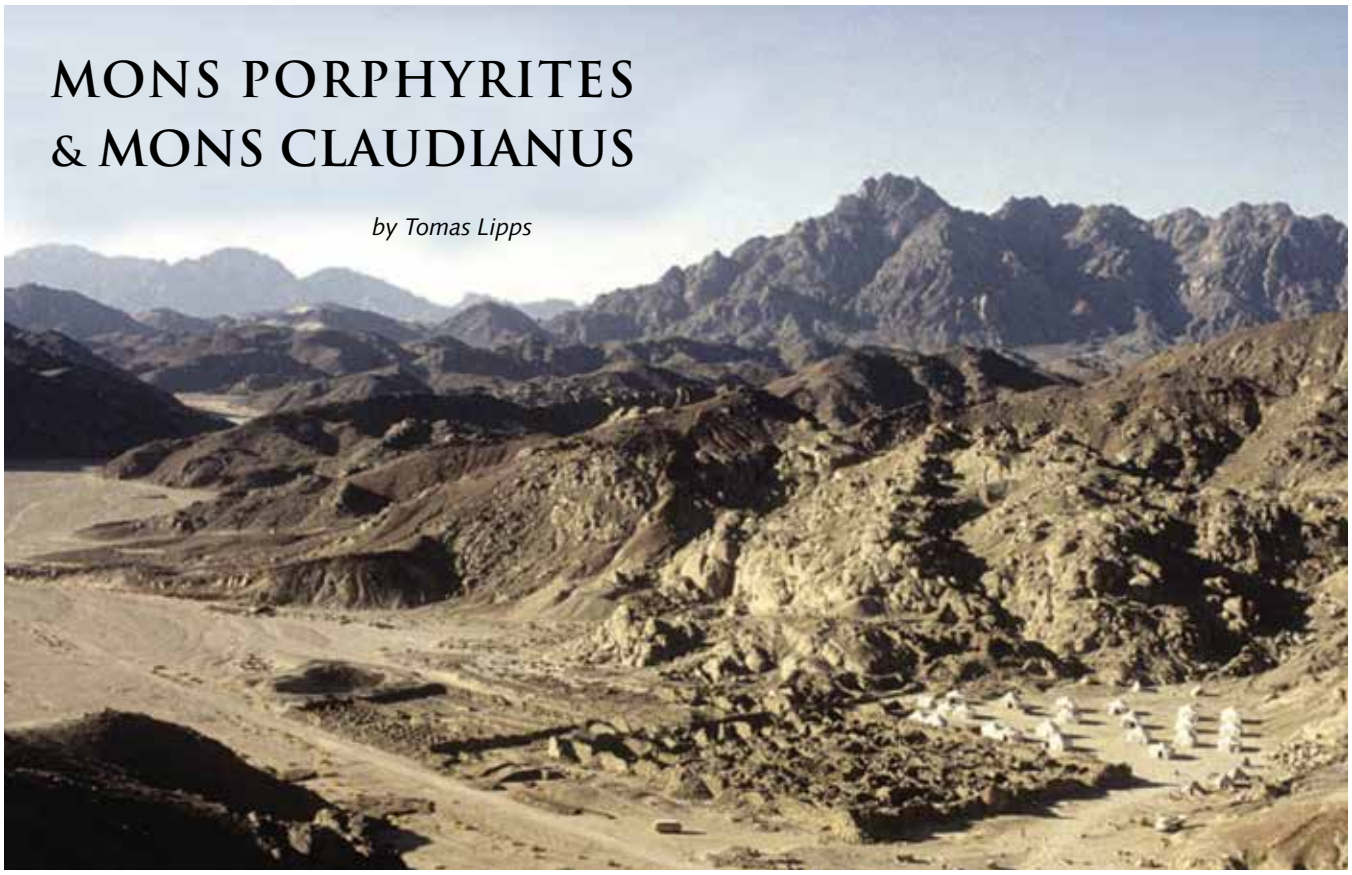
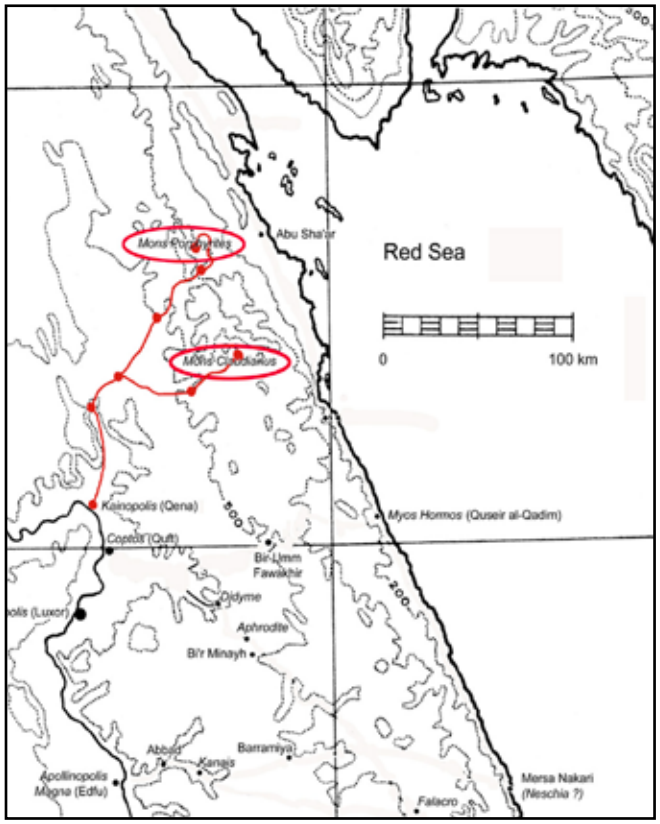
Rough-dressed blocks of imperial porphyry lie near Deir al-Attrash, where they fell from their carts -- perhaps the result of a broken wheel, a collision, or an ox maddened by a snake. Far from the quarryside loading equipment, the Roman carters had no choice but to abandon the hard-won stone to the desert.

MONS PORPHYRITES & MONS CLAUDIANUS

by Tomas Lipps



above: The fortified settlement at Mons Claudianus and the tents of the international archaeological team during their excavation campaign in 1987. photo: Adam Bülow-Jacobsen.
below: Map (detail) of the Eastern Desert during Roman occupation.



The igneous mountain range

dominating Egypt's Eastern Desert between the Nile River and the Red Sea is the sole source on the planet of a rock known as Imperial Porphyry.

Vessels and animal figurines carved from this porphyry have been dated to the Old Kingdom (2613-2181 BC) and the ruins of an early dynastic building were discovered near its singular source. The ancient Egyptians evidently sought and removed pieces of this porphyry but they did not exploit it to any great extent.

The Romans, however, did exploit it, and on an industrial scale. In the summer of AD18 a Roman 'prospector' named Caius Cominius Leugas came upon this marvelous rock and recorded his discovery and the date thereof on a stele of black porphyry. Before long quarried blocks were on the move overland, south and west to the Nile, then downriver to Alexandria and finally Rome—from the empire's farthest outpost, *Mons (Mount) Porphyrites*, to its very heart.

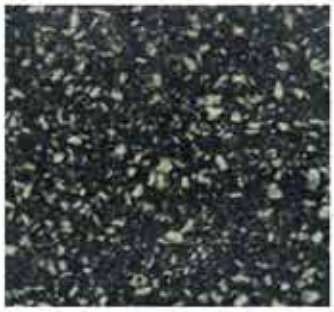
Later, 50 kilometers to the south, a source of tonalite gneiss rock was discovered—the ideal material for the tall columns needed in the monumental architectural structures that were about to be built in Rome—and a quarry was established there, *Mons Claudianus*.

This is the story of those quarries. . .

H10-Gebel Manzal el-Seyl
HCalcareous tuff

H-10 - GebeManzal el-Seyl
Tuffaceous limestone

H12a - Mons Porphyrites
Andesite-dacite porphyry

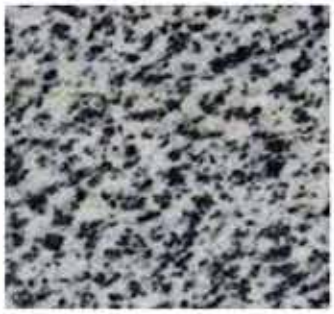


H12a - Mons Porphyry
Andesite-dacite porphyry

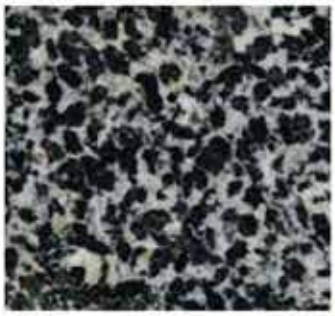
H14 - Wadi Umm Towat
Trachyandesite porphyry

H15 - Wadi Umm Balad
Quartz diorite

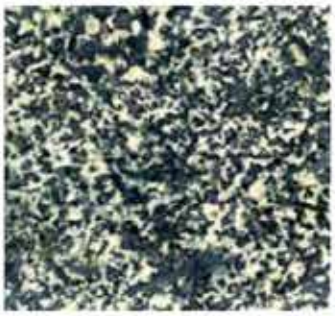
H17 - Wadi Umm Shegilat
Pegmatic diorite



H18 _ Mons Claudianus
Tonalite gneiss



H19 - Wadi Burud
Quartz diorite



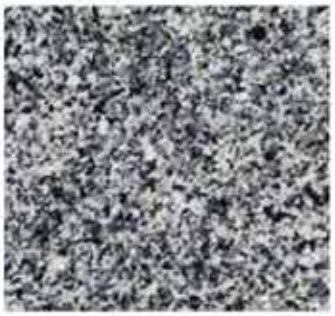
H22 - Wadi Umm Wikala
Metagabbro

H26 - Wadi Umm Esh
Serpentinite

H28a - Wadi Hammamat
Metagraywacke

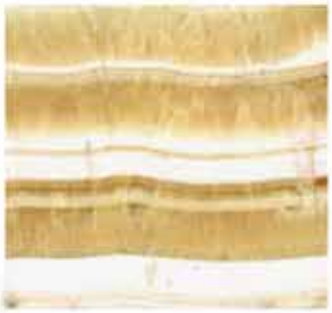
H28a - Wadi Hammamat
Metaconglomerate

H29 - Gebel Umm Naqqat
Pegmatic diorite

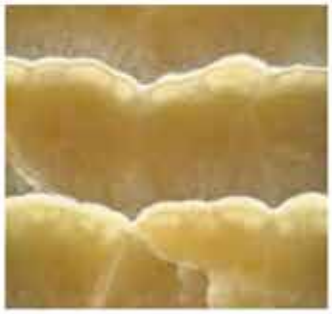


H30 - Wadi Abu Bokari
Granodiorite

H31 - Rod el-Gamra
Dolerite porphyry

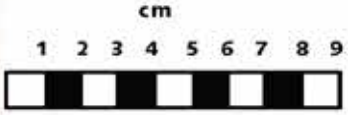


T 2 - Wadi Araba
Travertine



T3 - Wadi Umm Argub
Travertine

08 - gebel Rod el-Baram
Soapstone/steatite



Selected stones from ancient quarries in the Eastern Desert photos by James Harrell, *Ancient Eyptian Quarries*, page 21

The Romans established other quarries for architectural and sculptural stone, and numerous mines for gemstones throughout the region, but the quarries at Mons Porphyrites and Mons Claudianus were the major stars of this constellation of extraction sites.

The two quarry sites were similar; each consisted of a fortified settlement, barracks and residences, stables, storage structures, temples, bath houses, wells, cisterns, cemeteries and, of course quarry workings, slipways, workshops and loading ramps.

They differed in two ways, though—the types of stone extracted and the layout of the quarries. At Mons Claudianus the principal rock was the tonalite gneiss known as *granito del foro* which was found in a number of sites in relatively close proximity.

The several individual sources of the porphyry at Mons Porphyrites, however, were scattered and the quarry sites were distant from the main settlement. The shortest routes to the more distant sites took as many as two and a half hours to traverse. Therefore the pattern of settlement was dispersed. In addition to the base encampment there were separate villages at each of four satellite quarries.

The history of these quarries has attracted numerous archaeologists and scholars of many nationalities and much of what they have learned has come from interpreting the thousands of *ostraca*—pottery shards with text written in ink that were used for all manner of communications and notations including records of quarry activities as well as personal communiqués. These were found in the middens or garbage dumps and they have provided information about the quarry settlements that could not otherwise be known.

For instance there is one *ostracon* in particular that contains a record of the distribution of water rations at Mons Claudianus for a single day in the first decade of the second century. It gives significant information about the character of the work force and the number of inhabitants in the settlement.

above: photo, Adam Bülow-Jacobsen.

"This is a list for one day of the distribution of water and it gives us the exact numbers within each category of workers that were employed in the quarries. . .a staggering 917 people of whom 60 only were military.

The other 857 were civilians, ranging from the architect to the lowliest water-carrier. We learn that there were also doctors, veterinarians, barbers, and cobblers. We also learn that there were two kinds of workers in almost equal numbers, the pagani*, i.e. the native, paid, skilled workers, mainly employed as stone-masons and smiths.*

Another group, almost as big, are those of the familia *who mostly did unskilled labor, carrying water, and so forth.*

The interest of this text is, of course, that it tells us how much water people got—between 6.5 litres (1.7 gallons) for the highest ranks down to 3.25 litres (6.87 pints) for stonemasons and 2.16 litres (4.5 pints) for the unskilled, which is surprisingly little seen from our point of view, but corresponds rather well with what we know about the British forces in North Africa during the Second World War: 2 pints = 1,136 litres per man per day in the fighting units and, for those behind the front-line, between 4,5 and 6,8 litres per day for everything except the radiators of the vehicles, a problem the ancients did not have."[1]

It is interesting to note that there are no slaves or convicts listed among the work force. This dispels the long-held belief that convicts, Christians, Jewish and other captives were sent to the quarries as slave labor; the workers were in large part free, trained and well-paid craftsmen.

"(Another) thing that we learn from the ostraca *and nowhere else is the importance of steel. Ordinary iron is too soft to make much of an impression on granite, so quarry-tools were fitted with a steel-tip or edge which was welded on. Forge-welding demands higher temperatures than were obtained in the forges next to the quarries where the tools were regularly sharpened by re-forging.*

When a point has been used and re-sharpened a certain number of times, the steel-tip is worn away and has to be replaced, which was done in the quarry.

Not a single tool has been found at Mons Claudianus, and even if we had some, they would be corroded and the hardness measuring would be unreliable. But now that we know that this method was used we have the explanation on why the slag in Quarry 92 shows that temperatures obtained there, contrary to the small forges in the quarries, would have permitted welding." [2]

[1, 2] *Adam. Bülow-Jacobsen. QUARRY MARKS.*

WATER. . .

This vital substance was the life blood of *Mons Porphyrites* and *Mons Claudianus* and the many other Roman quarries and mines in the Eastern Desert.

Water was not completely absent in this desert terrain. It existed underground—in certain places. Rainfall was rare, but when it occurred it was captured and stored.

The original 1st century site of the *praesidium*, or fortified quarry settlement at Mons Claudianus was selected for its proximity to several prospective quarry sites.

The nearest water that could be found, though, was a kilometer away. A well was dug there and water carried to the *praesidium* and stored in several mortared cisterns lined with waterproof plaster. Later a new *praesidium* was built near the well and the original one continued to function to exploit the nearby quarries.

The entire Mons Claudianus complex relied on water from four wells: the one next to the newer *praesidium*, two other wells a kilometer away to the north and south and a major well three kilometers away. The wide-spread locations of the wells indicates the scarcity of sources and the difficulty in finding them.

Water in movement, water in reserve. . .

Pack-animals carried water in amphorae and waterskins from where it was found to where it was stored and from there to where it was used—from the wells to the cisterns—from the cisterns along zigzag paths to the dozens of quarry sites and the hundreds of thirsty humans and animals working there—to the tubs used by the blacksmiths to quench the tools they were constantly forging and tempering—to the *praesidium* for domestic use and the vegetable gardens—to the animal lines—to the bath-house of the Roman administrators.

Like blood, water flowed through the body of the quarry complex, sustaining it—but unlike blood, the water did not recirculate, it evaporated.

The numerous way-stations along the roads were built around wells or near wells and held water in reserve for the men and animals in passage and the Roman soldiers that provided security against indigenous marauders.

TRANSPORT AND SUPPLY. . .

Two simple words that, when applied to the quarrying enterprises in these distant desert mountains, involve challenges that can be likened to hypothetical human colonies on the moon or other planets.

The massive rock blocks, once separated from their lithic matrix (an act that was often unsuccessful, as evidence of many failed attempts at wedging shows) had to be manoeuvred from their elevated beds down sometimes precipitous slopes along narrow slipways—an arduous and dangerous feat during which lives were doubtlessly lost.

Evidently much of the stone shaping was done at the quarry face—even entire columns—and finished below, at *wadi* level, near the loading ramps. This, particularly in the case of the columns, makes sense as it would reduce the weight and make them less difficult to move.

The first stage of transport was difficult, especially at Mons Porphyrites where the porphyry was often quarried from very summits of mountains.

In both quarries the descent was managed in the same way—a system that involved closely spaced pairs of dry stone cairns standing opposite each other on either side of the slipways. The purpose of the cairns is a matter of conjecture, so allow me to speculate:

They were not substantial enough to anchor posts or ropes, chains, pulleys or winches, but they must have been used in some way to facilitate and control the downhill progress of large blocks or columns.

Presumably, sledges were used to transport stone from quarry face to *wadi* level (the columns might have required two sledges, one in front, one behind).

A likely scenario is that a large log was laid across the slipway, against the uphill sides of a pair of cairns, behind the descending sledge.

This log could act as a *cleat*. Multiple lines, from the sledge *belayed* around the log (secured by turns around the cleat) could control the rate of descent. Simply wrapping the rope(s) several times around the log and gradually releasing it—as the sledge was pulled from below—would, I think, work.

This way, only one large log would be required—repositioned in stages as the sledge descended (a companion log might be repositioned in advance of the sledge for security, a barrier, if needed, to arrest the momentum of an out-of-control sledge).

The sledge could slide over a succession of smaller logs. As it advanced these would be taken from behind and placed in front of it. These smaller logs, and the larger one, and the ropes belayed around it would have to be constantly lubricated, probably with palm oil (the palm tree was also a source of fibre for rope).

The process I've described is similar to that used at Carrara until modern mechanized equipment altered it—the ropes were belayed around groups of wooden posts, compound 'plugs' driven into stone crevices. This evidently wasn't feasible in the Eastern Desert.

At the quarry face, on the slipways, in the workyards and at the loading ramp, stone pieces were moved using spars or levers and log rollers. Were cranes in operation, gin poles? There is no historical record of them but Bülow-Jacobsen reports seeing large square holes that might have been made for the beams of a crane. Also holes in stones for lewis pins have been recorded.

Pack animals were the preferred means of transport but for moving stone from the quarries to the Nile, wagons were indispensable—and useful for hauling provisions and materiel on the return trips to the quarries.

Three views of the slipway at the Lykabettus quarry at Mons Porphyrites. . .above, left: the quarry and workers' village. above right: the full extent of the slipway from quarry face to wadi level. photos Valerie Maxfield.
below: slipway with stone cairns. photo: J P Brun

above: Mons Claudianus. Two unsuccessful attempts at wedging.
below: Mons Claudianus. A whole wall has been squared off with a series of wedgings. photos: Adam Bülow-Jacobsen.

These wagons, singly or in convoys, were drawn by donkeys and/or camels (though camels were used mainly as pack-animals, they are known to have been harnessed to pull loads).

Commonly the wagons were four-wheeled and carried stone blocks and sculpture blanks, 'plates' (veneer slabs), millstones, basins, bathtubs, sarcophagi—and columns. Two-wheeled wagons are also mentioned in the records; they must have been used to rapidly transport one or two people and small loads.

Most of the stone blocks, basins, plates and other objects could be loaded on wagons and pulled by donkeys and or camels, but exactly how the tonalite gneiss columns from Mons Claudianus then in demand for the many monumental building projects in Rome were transported is not known.

Some of these columns were as much as 50 feet long, or longer, and weighed more that 200 tons!

There is a (single) reference to a twelve-wheeled wagon at Mons Claudianus (with a crew numbering 39). This twelve-wheeled wagon must have been built to transport columns but how such a wagon with such a load functioned and how it was pulled and steered is also a matter of conjecture. It has been estimated that it would take the combined force of 300 donkeys and/or camels to move one 30 ton column and the wagon it rested on—but it is hard to imagine that many animals harnessed and pulling in unison.

Fortunately, the road from Mons Claudianus to the river was relatively straight because a wagon so long with (presumably) fixed axles would be stiff and, heavily laden, nearly impossible to steer. (I wonder if the forward axle, or axles, were able to swivel.)

Adam Bülow-Jacobsen, a leading researcher of Roman presence in the Eastern Desert who spent many years excavating Mons Claudianus and interpreting its records, postulates that the 12-wheeled wagon (or wagons) were presumably used for the 30 ton columns which have been found near the loading ramp that fits the height and length of this wheeled monster.

Moving the 50 foot columns that weighed 200+ tons was a task of a much higher order. I am in accord with Bülow-Jacobsen's belief that log rollers and rails (with the column mounted on a sledge) would have been the most effective means of transporting such a load.

The logs and the rails they rolled on would be removed from the rear of the sledge after it passed and taken ahead and placed in advance. A tedious way to accomplish a journey of 120 kilometers, but effective.

Initiating movement and steering the sledge would have been easier and momentum, once achieved, would facilitate progress. Some way of slowing or stopping the sledge would be necessary (the road to the river was consistently slightly downhill) so it wouldn't overrun the animals and men pulling it but removing the rails might accomplish that.

In whatever way the columns were transported—via the twelve-wheeled wagon, or sledge, rollers and rails—when they arrived at the Nile they were transferred to boats or barges. No easy task, one assumes.

Then, when the water level was high during the summer floods, they were floated down the Nile River to Alexandria where they were transferred to vessels to take them across the Mediterranean Sea to the Roman port of Ostia. There, they were transferred back onto barges and pulled up the Tiber River to Rome, unloaded and hauled to the building site.

Stone out, provisions in. . .

Food, wine and materiel were supplied from the valley and conveyed to the quarries by caravans of pack animals but also they would undoubtedly travel on the wagons that had delivered the stone as they travelled back to the quarries.

There was a constant flow of produce from the valley: wine, vinegar and oil, pigs and goats, chickens and geese, barley and wheat, onions and lentils.

Fish and other foodstuff were brought from the not so distant Red Sea coast. The bones found in middens (rubbish dumps) of both quarry settlements reveal dozens of types of fish including some freshwater varieties.

Investigation of the contents of various middens indicates that the inhabitants and workers at these quarries, some of them anyway, lived quite well:

"*The analyses of the faunal and botanical remains have demonstrated that the inhabitants of these sites had access to a balanced diet of carbohydrates (wheat, barley, pulses), protein (meat, fish, pulses, nuts), sugars (dates, figs, grapes), fats (meat, olive oil, and oil-containing seeds), and minerals and vitamins (fruits and vegetables)* (Hamilton-Dyer 1994; Van der Veen 1996, 1998,). *They also obtained a wide range of flavourings (condiments); they made beer and the ceramic evidence attests the import of wine, olive oil and fish sauce* (Tomber 1996). *The foods contain both staples, such as wheat, barley, pulses, dates, grapes, olives, onions, and fish, and luxury foods (that is, foods not essential for human nutrition), such as game, oysters, snails, artichoke, pomegranate, herbs, nuts and pepper. Four different sources of food supply could be identified (Van der Veen 1998), with the Nile Valley the prime provider, although fish came mostly from the Red Sea coast, and some desert species (plants and animals) were used; finally, there is evidence for the local cultivation of vegetables."*[3]

Essential materiel travelled too: lime and charcoal, rope and chain, levers, timber, logs, tools and iron to make tools and the invaluable steel pick and chisel tips.

Post-riders on horseback travelled back and forth along the chain of waystations carrying communications. Such as the message from the quarry to a prefect that more steel and charcoal were needed to fulfill a certain order.

[3] *Van der Veen, A life of luxury in the desert*?

Watch-tower at Wadi Umm Diqal, three kilometers from Mons Claudianus at the site of the largest of the wells supplying it, one still used today.

The first four meters are solid.masonry so it was not a water tower. It is thought to have been built there after quarrying operations had ceased. The well and tower are part of an enclosure that may have been the center of of a monastic community established in the 5th century (there are ruins of hundreds of stone huts in the vicinity.
photo: Egypt Travel Link Tours.

INFRASTRUCTURE

Each fortified *praesidium* had a substantial perimeter wall with watchtowers situated at intervals. These walls, and the towns within them—living quarters and administrative spaces, cisterns, storehouses, shops and workshops, as well as the structures outside the wall but in close proximity, bath-houses, granaries and temples—were all built of stone and some of those structures were plastered. Piles of burnt and unburnt seashells indicate that the lime for plaster and mortar was made there although some must have been imported.

The plan view of the *praesidium* of Mons Claudianus, shown above, is remarkable in that the perimeter wall, similar to the perimeter walls of many of the fortified way-stations is not actually a rectangle, but a parallelogram. The rule of 3-4-5, used by the Egyptians since 3000 BC to establish right angles and well known to Roman carpenters and stonemasons, was, for some reason, not applied here.

Oddly too, the towers that are known to have been at the corners of the perimeter wall as well as flanking the main gate are not shown. See photo on following page.

The many cisterns, sunken and above ground, were built of mortared rubble masonry and were plastered or faced with fired brick.

Adjacent to the walled *praesidium*, and occupying a nearly equal amount of space, were the stables, constructed of stone and mudbrick.

The quarry workings also required stonework, the smithies, the slipways, the numerous cairns along them and the loading ramps were all built with stone.

Other stone-built structures included watch-posts, and towers. "*The whole Claudianus complex is overseen from a series of watch-posts,* skopoloi*, positioned so as to be inter-visible, and functioning as a sort of internal telephone system. In addition there are two larger towers, placed for long-distance communication and early warning of approaching visitors (above).*" [4]

A very large crew, or crews, of stonemasons and smiths must have been kept busy at all times building and rebuilding this extensive hardscape.

The infrastructure included the roads from the quarries to the river and the fortified waystations established at intervals along those roads with their wells and/or cisterns supplied from nearby wells. As each had a garrison of soldiers they functioned as *praesidia* or military bases. The stables and watering troughs often occupied more space than the forts themselves did.

Cairns were built along the roads and, occasionally, signal towers.

The *praesidium* Abu Zawal on the Mons Claudianus road to the river was typical of such waystations; it was rectangular in layout with towers at the corners and on either side of the entrance, nearby stables, a well and/or cistern in the center of the courtyard and small rooms arrayed around it.

It was unusual, though, as it was built on the site of an Old Kingdom gold mine where quartz rocks were broken and crushed for the gold they contained. The quartz tailings served as a foundation for the Roman fort and hundreds of ancient stone hand-mills were built into its walls.

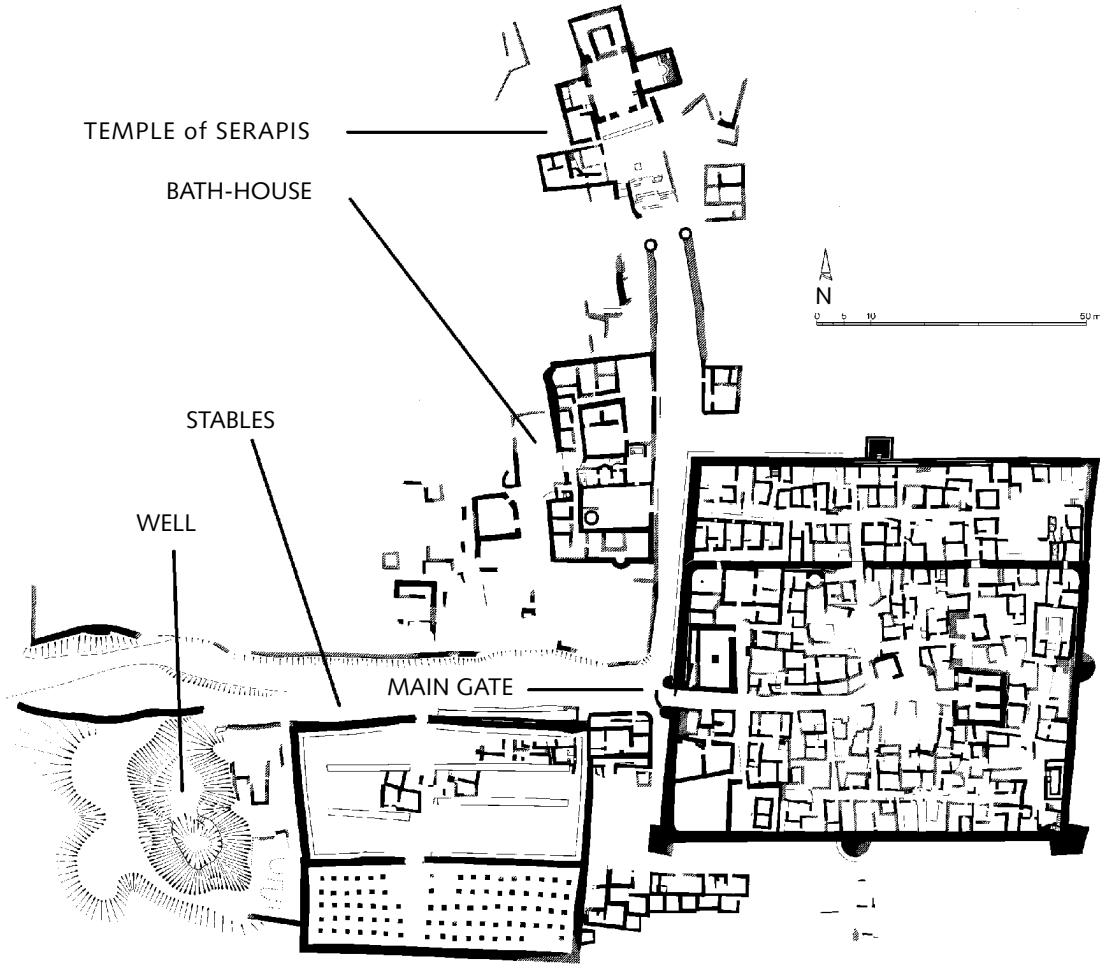
Mud bricks were also used in the construction of some *praesidia*, often above a stone-built lower wall. There are remnants of mud-brick barrel-vaulted roofs at the El Heita waystation, the penultimate one before the end of the road at Qena on the Nile, though these might have been a post-Roman addition.

The Romans were well acquainted with stone arches, vaults and domes. Corbelled domes were widely used throughout the Bronze Age Mediterranean world and the true arch was common knowledge.

[4] *Maxfield, p 166*

above:: Mons Claudianus, ruins of main gate into the settlement. photo Valerie Maxfield.

below: Plan view of the fortified settlement.
at Mons Claudianus by Valerie Maxfield.



above: Mons Claudianus, aerial view. photo: Chriusha via Wikimedia Commons.

below: Typical dry stone construction in the village.

below:
Bathtub, plastered with opus signinum*— lime mixed with brick dust which acts as a pozzolan and makes the plaster harder and less absorbant.*
photos: Egypt Travel Link Tours.

There are many excellent photos of the Roman quarry sites at Mons Porphyrites and Mons Claudianus on view at the Alamy stock photo website. At $70 US per image we cannot afford to purchase an album to publish here but If you wish to see them I suggest you use the links below and ignore, if you can, the watermarks.
(There is no charge to you for this advertisment, Alamy.com.)

Temple of Serapis, Mons Porphyrites *https://www.alamy.com/search.html?qt=mons%20**porphyrites**&imgt=0*

*https://www.alamy.com/search.html?qt=mons%20**claudianus**&imgt=0*

Given the scarcity of wood and the plenitude of stone, corbelled domes would be a suitable technique for covering space in that environment, but only a single example has been reported.The absence of arches is also remarkable. Doorways and window openings were always surmounted by lintels.

Though wood was a precious commodity, it was evidently used as a framework for woven matting, bundled reed, palm fronds or animal skin roofing material. No traces of wood (or metal) have survived centuries of weathering and the adept scavenging skill of the native bedouin tribes.

Stone roofs, where they existed, generally consisted of long stone slabs although I found one reference[5] to a vaulted roof—in the bath-house at Mons Claudianus.

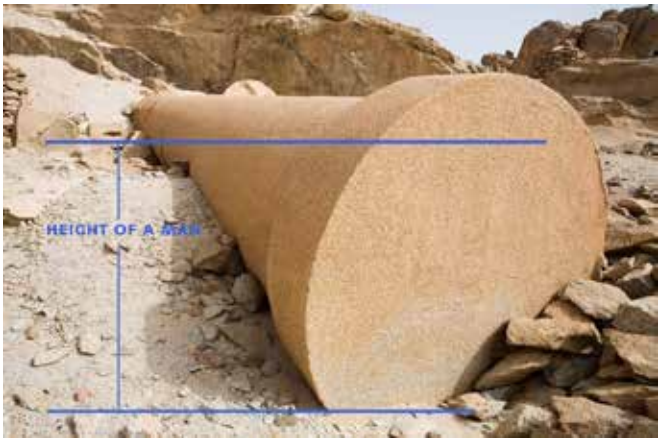
PRODUCTION

There are said to have been 130 different quarry sites at Mons Claudianus and at least 40 at Mons Porphyrites, though they were not all active at any one time. The ancient quarrymen never went very deep. They took the most easily accessible stone then moved on to another site. Stone quality in quarries is not homogenous and sometimes the good stone gave out.

The physical business of the quarry sites extracting, shaping and transporting massive blocks of stone was a daunting undertaking.

"The process by which the workers extracted these massive blocks of granite at Mons Claudianus was similar to that used in Mons Porphyrites. After a particular granite bed was identified, the quarrymen used chisels, picks and hammers to cut a trench along the intended line of separation perhaps 30 centimeters wide and 30 centimeters deep. Next they cut wedge holes at intervals in the bottom of the trench. An average wedge hole, 13 centimeter, at Mons Claudianus required about two and a half hours and as many as six thousand hammer blows to create. But the depth of the wedge holes depended on the size of the piece to be separated. A series of 13 centimeter wedge holes, for example, can split a block of granite 2 meters thick, while shallower wedge holes suffice for thinner blocks. The original trench, which was easier to cut than the wedge holes, effectively placed the holes deeper into the stone, thus enabling the quarrymen at Mons Claudianus to split blocks of granite up to 6 meters thick."[6]*

Mons Claudianus is most known for producing the tall columns of tonalite gneiss that were highly valued for the imperial building projects going on in Rome. Many of these columns were immense. The one still in place at the quarry (pictured above) was abandoned (like the famous unfinished obelisk at Aswan) because of a crack that iron staples could not arrest. It is 65 feet long, 8.5 feet in diameter and weighs more than 200 tons. Imagine the work involved in hewing this perfectly round, impeccably straight, tapering column from an even more immense monolithic rock.



As the water-ration *ostraca* indicated, workers at the Eastern Desert quarries, skilled and unskilled, were not slaves but free Egyptians who were paid for their work—and better paid than their counterparts working in less harsh environments. The quarriers, stonemasons and blacksmiths were the highest paid artisans.

A smithy was comprised of a smith, a bellows operator and a steel temperer, a forge, an anvil, a quenching bath, iron and steel stock and, of course, charcoal. It is estimated that one smith served 12 quarrier/masons.

The Mons Porphyrites quarries were established in the early first century AD and the Mons Claudianus quarries slightly later. Activity fluctuated in both quarries depending on the demand for their products.

The Mons Claudianus quarries ceased operation in the early to mid 3rd century, but the rulers of Byzantium had inherited the Roman esteem for purple porphyry so Mons Porphyrites was kept in operation quarrying, shaping and transporting it through the 4th and into the 5th centuries.

above: The columns of the portico of the Pantheon in Rome were quarried at Mons Claudianus. Each was 39 feet (12 m) tall, five feet (1.5 m) in diameter, and weighed 60 tons.

[5] Jackson, At Empire's Edge, p38 [6] Jackson, ibid, p42

**The rock he refers to as 'granite' is actually tonalite gneiss.*

ADDENDUM
to the article Mons Porphyrites and Mons Claudianus

There are two important aspects of this enormous industrial enterprise that can be classified as mysteries:

1) How were huge stones, quarried and hewn high in the mountains, brought down to the valley floor and. . .

2) How were the most massive of them (200 tons) then transported overland 120-130 kilometers to the river Nile *(and 3) how they were transferred to water craft, but that is beyond our purview here).*

There is no certainty among the archaeologists and scholars who have investigated these sites about how either of these feats was accomplished.

Regarding the first mystery:

The pairs of dry stone cairns flanking the slipways in both quarries were obviously integral to the process but how they were used is not known.

I theorize that a logs placed against the uphill sides of the pairs of cairns flanking the slipway acted as a horizontal stanchions.

If two or more ropes from a loaded sledge below the stanchion were belayed around it, the friction between the rope and the wood would hold the sledge and its load in stasis and—pulled from below as tension is released from above—its descent could be controlled.

A series of wooden slabs laid across the surface of the slipway and lubricated with oil would allow the runners of the sledge to slide easily over them. The ropes and the stanchion would also need to be lubricated.

To question this theory about cairns I ask: why are there so many cairns and so close together? And why do they occur also on relatively level ground? *(See Ancient QuarryScapes cover photo on page 2.)*

Good question(s). Perhaps the ropes/hawsers made in Egypt of palm fiber were not as good as those in Carrara and stages of descent had to be kept short?

Perhaps the cairns, which could be readily constructed anywhere, were used as counterweights to stabilize stanchions to which pulleys were attached?

Quarries in Carrara on the Italian mainland date back to at least 155 BC so quarrying was going on there and in Egypt's Eastern Desert (and elsewhere) simultaneously.

The Mons Porphyrites quarries ceased production and were abandoned in the 5th century, but in Carrara quarrying continued as it had been done for ages until the advent of modern equipment in the mid-20th century.

A significant difference: in Carrara the stanchions are short, vertical and compound, a grouping of logs or beams wedged tightly together in a socket carved into the rock. In Porphyrites and Claudianus pairs of dry stone cairns were used—why? Perhaps because the distance to be travelled from the quarry face to the loading ramps was considerably longer in the Eastern Desert than at Carrara—also, wood was scarce, and stone was plentiful.

above: At Carrara, a loaded sledge (lizzatura) *being lowered down a steep slope. The men are taking small wooden beams from behind the sledge and placing them in front of it. The beams were smeared with soap to facilitate the passage of the sledge runners.*

below: Men handling the hawsers, wrapping them around the stanchion posts (piri) *and gradually releasing the tension.*

below: A 'socket' carved in a rock outcropping into which the posts, are placed. From this photo it seems that taller posts were placed in the deeper center hole and shorter posts were hammered into place around those to tighten the 'bundle.' Obviously steel cables were employed here.

Regarding the second mystery, transporting the huge weighty columns:

Early tools, the lever and wheel, were employed extensively at these quarries. Levers raised and moved rocks and hewn stones. Wheeled wagons carried all but the heaviest loads from quarry to river.

The roller can be considered to be a wheel, but its ability to turn is affected by the amount of weight it bears and character of the surface beneath it.

If log rollers are placed between the runners of a sledge loaded with one of the immense columns and the track formed by parallel split log rails, it is ready to move.

Once the use of levers and the pulling power of men and animals overcomes the inertia of the sledge and momentum is achieved, it can be maintained by constantly pulling forward (and, as necessary, backwards).

Controlling the rate of movement is critical and by expeditiously removing rollers and rails from behind and carrying them to the front to extend the track forward, the sledge could be moved steadily along the straight, flattened roads that sloped slightly downhill to the river 120 kilometers away.This seems a more feasible mode of transport for the 200 ton columns than the 12-wheeled wagon mentioned on page 39 (which, Bülow-Jacobsen believes, were used for the30 foot long columns).

These are as stated, matters of conjecture and after months of research and speculation this is how I imagine they happened.

What are your thoughts?

ADDENDUM to the ADDENDUM:

I sent drafts of the article to several of my sources for review and comment and have been incorporating their responses.

Then, just yesterday, I heard from archaeological geologist James Harrell. He informed me about something that I had not read elsewhere: that the runners of some sledges at Mons Porphyrites were iron clad. This means they might have been pulled over the stone surfaces of the slipways.

This was a single reference though, a request for more iron as the supply was evidently erratic. Also, there must have been many sledges in operation at the numerous quarry sites at any one time so it seems that sledges with wooden runners sliding over relatively small (lubricated) pieces of wood as was done in Carrara would have been feasible and not dependent on a supply of iron.

Furthermore, he theorized that the cairns acted as bollards and that ropes from the sledges around their bases could have functioned to retard the sledges' descent as needed. No logs required. This would explain why the cairns were more closely spaced where the slipway slopes were steepest.

But most interesting were his thoughts about how the 50-foot columns might have been transported. What if the columns were *not* mounted on sledges pulled over rollers rolling on rails? What if the columns themselves were the rollers!

Oriented perpendicular to the track created by the parallel rails, they could be pulled, broadside, forward. Levers could help initiate movement but ropes wrapped around the ends of the columns would be used to pull, steer and halt the columns' forward progress.

Unlike other columns, those very long ones had wider rims or collars at the ends which Harrell speculates were to keep the ropes in place.

Fortunately the floors of the wadis were quite wide and flat so this could work. And there would be no need to return sledges and rollers to the quarry.

A brilliant theory, however. . .taking rails from behind the column after it passed and bringing them forward to extend the track would be problematic, given that 1) the space between the bottom of the column and the road surface would only be the height of the rails—and 2) that ropes around the ends of the very long columns would stretch fore and aft.

The rails would have to be carried or dragged in a wide path around the ends of the column which would take time and slow the rate of progress.

I've been puzzling over how this might have been done while wondering about the ropes and how they would have been 'attached' to the column.

Simple loops around the ends would involve friction and impede the rotation of the column. I imagine that if the rope from the front went over the top of the column and was belayed once or twice around it, then men and/or animals pulling forward would cause the column to roll ahead.

As the column advanced, however, the rope being pulled forward would lengthen and the end being held behind would shorten. At some point progress would have to be halted (ropes pulled backward and the column blocked with chocks) and the ropes adjusted.

This would be an opportunity to extend the track.

So the column would advance in stages (and the men and/or animals pulling it would have an opportunity to rest).

While I think that James Harrell's broadside rolling column theory and Adam Bülow-Jacobsen's belief that the columns were transported lengthwise on a sledge are equally credible, I am inclined to favor the former.

How about you?

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FINIS.
WILLIAM M. TIMLIN. 1893-1943