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Original article

ARCHAEOBOTANY IN THE MINES AND QUARRIES IN THE GRECO-ROMAN PERIOD IN THE EASTERN DESERT OF EGYPT

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Abstract:
This research deals with the study of the plant remains that were found in mines and quarries in the eastern desert of Egypt during the Greco-Roman Period*, recognizing potential areas of cultivation in the Eastern Desert, considering the potential crops cultivated there and their scale, and how these relate to the physical archaeobotanical remains recovered from the sites, pinpointing the processes and the agents of cultivation, production, and circulation of foodstuffs, as revealed through Greek texts.*

1. Introduction

During the Greco-Roman Period (date range ca. 332 BC – AD 364), the Eastern Desert witnessed prolonged phases of vigorous economic activity. Not only was is it an area rich in natural precious metal and stone resources, but it was also a gateway to the markets of the East, connecting them to the Mediterranean world, fig. (1) This led to various "settlers" to establish themselves in this area, whether for the short or long terms, besides the permanent inhabitants of the area, nomadic people of various origins. These settlers include soldiers, workers in the mines and quarries, merchants and travelers, many of whom came from the Nile Valley, the Mediterranean world and the regions of the Red Sea and beyond. Providing sustenance to these individuals was crucial, and required an intricate network of sourcing and supplying foodstuffs [1]. Thus, the logistics of bringing huge amounts of food and fodder to all these sites required very considerable effort and organization. The rich archives of ostraca recovered from the rubbish heaps at these desert sites, including accounts, private letters and instructions, offer a detailed picture of these logistics. We learn that regular food caravans travelled the roads and delivered supplies, while private letters highlight that many further foods were requested from and sent by family and friends, either via the caravan or via people travelling to and between the various stations. Meat and vegetables are frequently mentioned, [2]. The search hinges on two primary source materials: textual evidence and archaeobotanical finds. So, what was life like for the people working at the ports and quarries, mines, and at the service stations?

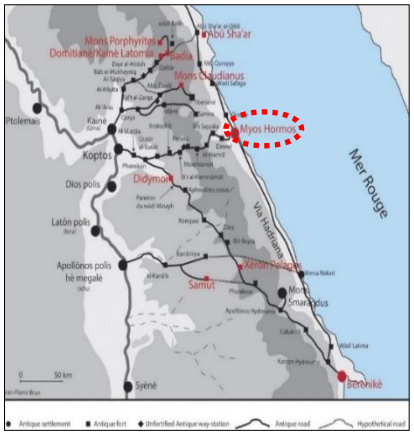


Figure (1) map of the Eastern desert shows **a**. *port Berenike* **b.** port Myos Hormos (*After: Bouchaud, 2018*)

2. Archaeobotany in the mines and quarries.

2.1. *Archaeobotany (Food plants).*

Thanks to the arid conditions in the Eastern Desert organic remains are generally well preserved at these quarry and mines

sites, and plant food remains such as grains, seeds, fruit stones, vegetative plant tissues including chaff, as well as animal bones, textiles, leather and some papyri, have been recovered during the archaeological excavations, Thus we find the seeds and stones of fruits such as olives, grapes, dates, citron and sebesten, the shells of nuts such as walnut, hazelnut and pine nut, as well as the chaff and straw of the cereals [3].

2.2. *Archaeobotanical finds in mines and quarries.*

2.2.1. Mine Bir Samut

Archaeobotanical finds in mine Bir Samut like Hulled barley [4], free-threshing wheat grain [5], Lentil [6,7], Oil plants [8], Olive has adapted to grow in diverse climatic conditions it can tolerate drought stress and different temperature, fig. (2) [9,10].

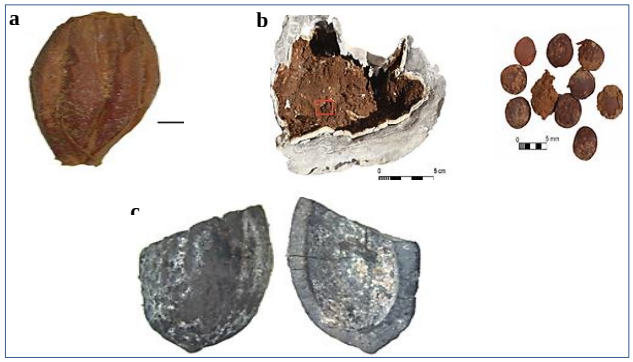


Figure (2) **a.** Hulled barley, **b**. lentils (Lens culinaris) contained on a lead plate, inside the red square and details Only one lentil (top left) does not have testa (*After: Bouchaud, 2021*), **c.** olea stone fragments from Bir Samut (*After: project, https://desertnetworks.hypotheses.org/1146, 21/8/2023*)

2.2.2. Quarries Mons Claudianus and Mons Porphyrites

Archaeobotanical finds in Quarry Mons Claudianus and Mons Porphyrites like Cereals (grains of barley, rachis segments of hard, hulled grain of rice Oryza sativa) and Vegetables (Leaf beet, cabbage, lettuce, cress and endive), fig. (3) [8].

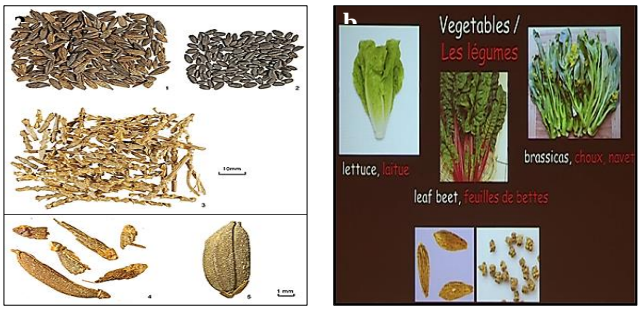


Figure (3) **a.** Cereals **1** desiccated grains of barley (Hordeum vulgare) **2** charred grains of hard/durum wheat **3** desiccated rachis segments of hard/durum wheat (Triticum durum) **4** desiccated husk fragments of rice **5** hulled grain of rice (Oryza sativa) (*After: Van der Veen and Tabinor, 2007*), **b.** Seeds of certain vegetables, such as leaf beet, cabbage, (Brassica), lettuce, cress and endive (*After: Marijke, 2007*).

2.2.3. Fruits

Found in Quarry Mons Claudianus and Mons Porphyrites some fruits like sebesten or Egyptian plum, The fruit stones of Zizyphus spina-christi (This fruit tree is cultivated in Egypt, and occurs, albeit rarely, in the Eastern Desert [10]. Four trees of this species can be found planted in a square formation at the Roman station at Umm Sidri, at the junction of the Wadi Abu Ma'amal and Wadi Umm Sidri, fig. (4) [11].

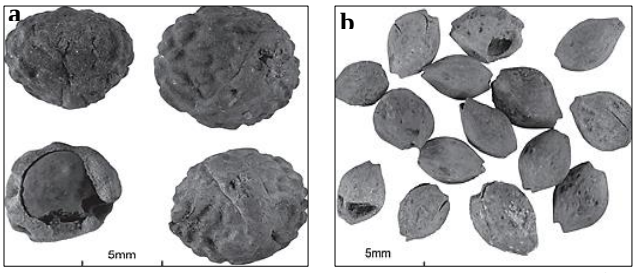


Figure (4) **a.** Sebesten or Egyptian plum, **b.** Zizyphus spina-christi (*After: Van der Veen and Tabinor, 2007*)

2.3. *Collecting and analysing of plant remains?*

For material (screening and manual flotation), time and logistical (limited export volume) reasons, it was decided to process small volumes of sediment – between 0.15 liters and 3 liters. A total of 21 samples, representing 16 stratigraphic units and 33.15 liters of sediment, were treated by dry sieving using calibrated mesh sieves of 2 mm (heavy fraction) and 400 µm (fine fraction). The fine fraction was sometimes subjected to flotation: the sediment was deposited in a bucket of water and the lightest particles, floating on the surface, were collected in 300 µm calibrated flexible sieves. This simple process presents a risk of fracturing and loss of plant matter but allows the plant elements to be separated quickly from the sediment and considerably reduces the volume of sorting. Very small volume samples were directly observed without prior sieving, fig. (5) [12].

Figure (5) **a.** select the sediment most likely to contain this type of plant remains, **b.** sieve its sediment **c.** separates it in water **d.** dry sieving of a sediment sample using a 2 mm and 400 µm mesh sieve (left); Manual flotation of a fine fraction (400 µm) **e.** the sorting with the naked eye **f.** microscopic observation. (*After, Bouchaud, 2020*)

2.4. *Textual evidence*

➢ "Garden" O. Claud. 2 370, Lettre de Fabricius, curator de Raima, à Iulius Aquila, fig. (6).

Figure (6) O. Claud. 2 370 (*After: https://papyri.info/ddbdp/o. claud;2;370)* (29/8/2023)

- **Metadata**
  - **Date: AD 98 - 117**
  - **Provenance:** Raima - Egypt (Eastern desert - Aegyptus) [written] Claudianus Mons - Egypt (Eastern desert - Aegyptus) [found]
  - **Language/script:** Greek
  - **Material:** Pottery – ostracon
  - **Storage location:** Egypt, Mons Claudianus, international excavations 1987-1990, now in Qift, storeroom EAS Claudianus no. 599 [13].

Ἰουλίῳ Ἀκύλ[α (κεντυρίωνι) Φαβρίκις κουρα-] τορ Ῥαειμα
χα[ίρειν. πολλάκις (?)]ἔγραψες περὶ λα[χάνων εἰ γέγονεν]
ἐν τῷ κήπῳ [μου ὧδε. ἔπεμ-] 5ψά σοι καυλίω[ν δέσμας . . ,
ἀσ-] πάραγον α, θρ[ιδάκων] δέσμας β. ς. [-ca.?-] κύριε,
πέμψο[ν -ca.?-] χάριν σου . [-ca.?-], tab. (1) [14].

- **Translation:**

Phabricis the curator of Raeima greets Iulius Akyla (the centurion). You have written many times (asking me) about the vegetables whether it could be in my garden here. I have sent to you bundles of cabbages..., asparagus, and two bundles of lettuces, our sir, send … your greeting [15].

Table (1) correcting some words in the text

The word in the text	Emendation
κουράτορ	κουράτωρ
ἔγραψες	αψἔγρας
χάριν	νειχαίρ

➢ "Seeds" O. Claud. 2 232, fig. (7)

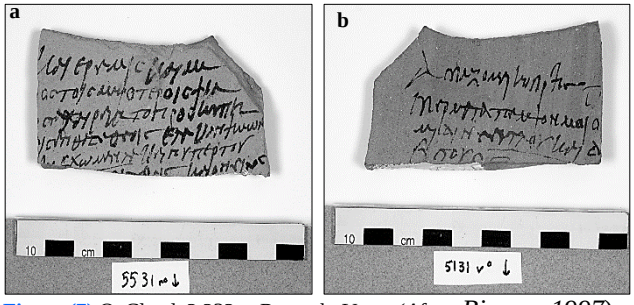


Figure (7) O. Claud. 2 232 a. Recto, b. Verso (*After: Bingen, 1997*)

- **Metadata**
  - **Date:** Mid-2nd century AD: AD 125-175
  - **Provenance:** Claudianus Mons - Egypt (Eastern desert - Aegyptus)
  - **Language/script:** Greek
  - **Material:** Pottery – ostracon
  - **Storage location:** Egypt, Mons Claudianus, international excavations 1987-1990, now in Qift, storeroom EAS Claudianus no. 5531[16].

[Διόσκορος] [Δρακων] Ερεμ<ησ>ις καὶ Ἀμ-
[μωνιανος] [κουρατο]ροςτοῖς ἀμφοτέροις φιλ-
[τάτοις] [---] [πλε?]ῖστα
χαίρειν. τὸ προσκύνη-
[μα] [ὑμῶν]
[ποιῶ]
[παρὰ]
[τ]οῖς
ἐνθάδε θεοῖς. ἐλαβαν ημῶν
[τὴν]
[φάσιν]
[ὅτι]
' [---]ιν
ἔχωμεν λαβεῖν ' ὑπὲρ τοῦ
[---][.....]ις καὶ ὁ Νεῖλος [----------]
ἀσπάζομαι Κωπρῆς [.....]
σπέρματα. πέμψον μοι ὀ[ψάρια] [κομίσασθε]
[δεσ?]-
μίδιν σεύτλου καὶ δ[ιαμερίσατε]
[αὐτὸ]
10 εἰς
τοὺς
γ [---][14], tab. (2)

- **Translation**

Dioscorus to Dracon and Eremesis and Ammonianus, the curator, all his best friends, many greetings.I pray for you to gods here. I have received your answer: "We have the … to take". Over the … and Neilus. I greet Kopres … seeds. Send me sauces. Carry a bundle of beets and divide it between three (of you) [17].

Table (2) correcting some words in the text

The word in the text	Emendation
Δράκων	Δράκωνι
Ἀμμωνιανὸς	Ἀμμωνιανῷ
οκουράτορς	κουράτορι
ανβαἐλ	ονβαἐλ
ἡμῶν	ὑμῶν
ἔχωμεν	ἔχομεν
δεσμίδιν	δεσμίδα
σεύτλου	σεύτλων

➢ "Receive 3 bunches of beets and also a bunch of chicory" O. Claud. 2 228, fig. (8)

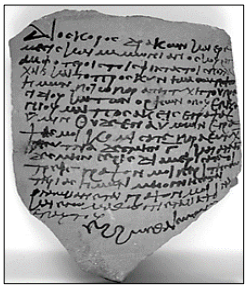


Figure (8) O. Claud. 2 228 (*After: Bingen, 1997*)

- **Metadata**
  - **Date:** Mid-2nd century AD: AD 125-175
  - **Provenance:** Claudianus Mons - Egypt (Eastern desert-Aegyptus)
  - **Language/script:** Greek
  - **Material:** Pottery- ostracon
  - **Storage location:** Egypt, Mons Claudianus, international excavations 1987-1990, now in Qift, storeroom EAS Claudianus no. 5528 [18].

Διόσκορος Δράκων καὶ Ερε-
μεσις καὶ Ἀμμωνιανὸς κουρά̣τ(ορι)
ἀμφοτέροις τοῖς φιλτάτοις πολλὰ
χαίρ(ειν). καὶ τὸ προσκύνημα ⟦σου ποιῶ⟧
5ἡμῶν ποιῶ παρὰ τῇ Τύχῃ τοῦ πρε-

σιδίου καὶ τῶν ὀρήων ὅπου ἐπιξε-
ν{ι}οῦμαι. ποσάκεις ἔγραψα
ὑμῖν οὐδὲ ἕνα ὑμῶν {ε}γρά-
ψας μοι; κομίσατε παρὰ Εὐτυχ( )
10σεύτλια δέσμην γ καὶ ἄλλη(ν)
δέσμην σεριϲ. διαμερίσατε οἱ
τρεῖϲ. γράψον μοι περὶ τῆϲ σω-
τηρίας ἡμῶν. μὴ ὀγνήσεται
ὃ λαμβάνεται γράψον μοι ἵνα
15καὶ ἐγὼ μάθω ὅτι 'ἐλαβα τὸ
ἐπ᾽ αὐτοῦ.'
ἐρρῶσθαί σε εὔχομαι [14], tab. (3).

- **Translation**

Dioscorus to Dracon and Eremesis and Ammonianus, the curator, all his best friends, many greetings. I pray for you to Tyche the garrison and the mountains where I dwell. How often have I written for you while no one of you have written to me? Carry from Eutyches three bundles of beets and another bundle of chicory. Divide it between three of you. Write to me about your safety. Don't hesitate to write to me what you receive there, so I may know what you have received from him. I pray to be in good health. [19]

Table (3) correcting some words in the text.

The word in the text	Emendation
Δράκων	Δράκωνι
Ἀμμωνιανὸϲ	Ἀμμωνιανῷ
ἡμῶν	ὑμῶν
πρεϲιδίου	πραιϲίδιων
ὀρήων	ὀρέων
ποϲάκειϲ	ποϲάκιϲ
οὐδὲ	οὐδείϲ
κομίϲατε	κομίϲαϲθε
Εὐτυχ(--)	Εὐτυχῃ
ϲευτλία	ϲευτλίων
δέϲμην	δέμαϲ
ϲέριϲ	ϲερίδων
ὀγνήϲεται	ὀκνήϲητε
λαμβάνεται	λαμβάνετε
μάθω	μανθάνω
αβαὲλ	εβαὲλϲ

- "Receive 3 bunches of Lettuce 3 bunches of Cabbage" O. Claud. 2 226, fig. (9).

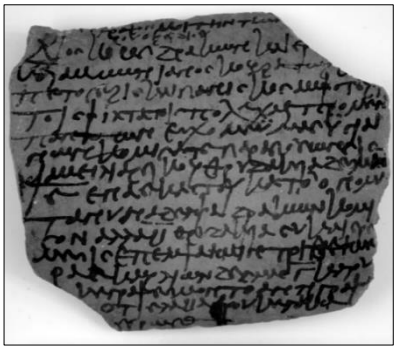


Figure (9) O. Claud. 2 226 (*After: Bingen, 1997*)

- **Metadata**
  - **Date:** Mid-2nd century AD: AD 125-175
  - **Provenance:** Claudianus Mons - Egypt (Eastern desert - Aegyptus)
  - **Language/script:** Greek
  - **Material: pottery , ostracon**
  - **Storage location:** Egypt, Mons Claudianus, international excavations 1987-1990, now in Qift, storeroom EAS Claudianus no. 5410 [20].

Διόϲκορος Δράκων καὶ Ερ[εμησις]
καὶ Ἀμμωνιανὸς κουράτωρ ϰ[αὶ]
5Πετοϲερις καὶ Πανίϲκος ἀμφοτέροι[ϛ]
τοῖς φιλτάτοις πολλ(ὰ) χαί(ρειν). πρὸ μὲν
πάντων εὔχομε ὑμᾶς ὑγιαί-
νων. κομίϲατε παρὰ Πουῶνϲις τ[οῦ]
φαμειλιαρειϰοῦ θρυδάϰεια δέϲμας
10ε ἕνα ἕϰαϲτοι ϰατ᾽ {ο} ὄνομα.
τὰ νῦν, ἄδελφα Δράϰων, ϰόμι-
ϲον ἄλλα β θρυδάϰεια ϲυ καὶ Ερε-
μεϲις. ἔπεμψα ἡμιν τριθ ε ημε-
ρας ϰαυλίων δέϲμας γ καὶ οὐ-
ϰ ἔγραψες μον τὸ ἀντίγραφ̣ον
ὅτι 'ἔλαβα' ἢ 'οὐϰ ἔλαβα'.
ἔρρωσθ(ε) [14], tab. (4)

- **Translation**

Dioscorus to Dracon and Eremesis and Ammonianus, the curator and Petoseris and Paniscus, all his best friends, many greetings. First of all, I pray for you to be in good health. Carry from Pounsis five bundles of lettuces of the same family, one (bundle) for each one by name. Now, my brother Dracon, carry another two (bundles of) lettuces for you and Eremesis. I have sent for you three bundles of cabbages three days ago and you did not write to me your reply that "I have received or I have not received." Farewell. (P.S) Write to me the price of your vinegar [21].

Table (4) correcting some words in the text

The word in the text	Emendation
Δράϰων	Δράϰωνι
Ἀμμωνιανὸϲ	Ἀμμωνιανῷ
κουράτωρ	κουράτορι
Πετοϲέριϲ	ετοΠϲίρει
Πανίϲϰοϲ	Πανίϲϰῳ
εμοχὺε	εὔχομαι
ὑγιαίνων	ὑγιαίνειν
κομίϲατε	κομίϲαϲθε
Πουῶνϲιϲ	Πουώνϲεωϲ
αμειλιαρειϰοῦφ	αμιλιαρικοῦφ
θρυδάϰεια	θριδακίου
ἓνα	μίαν
ἑϰαϲτοι	ἑϰαϲτοϲ
ϰατο	ϰατ᾽
ἀδελφα	ἀδελφε
κόμιϲον	κόμιϲαι
θρυδάϰεια	θριδάϰια
ϲύ	ϲοὶ
ἡμῖν	ὑμῖν
τριθεήμερας	τριθημέρῃ
ἔγραψες	ἔγραψας
μον	μοι
τὸ ἀντίγραφον	τὴν ἀντιγραφὴν
ἔλαβα (bis)	ἔλαβον
ἔρρωϲθε	ἔρρωϲο

2.5. *Archaeobotany (Fodder crops).*

The samples contain a number of plant species that are likely to have been used for animal feed rather than for human consumption. The most important of these are barley grain, and cereal chaff and straw (especially wheat chaff). Virtually

all the samples are dominated by large quantities of chaff and straw (those from Badia especially so). Chaff and straw were an important animal fodder in Roman Egypt and there is ample evidence that this by-product of the cereal harvest was traded and transported over considerable distances [22, 23]. Analysis of animal droppings of both camels and donkeys from Mons Claudianus provided direct evidence that barley grain, as well as chaff and straw, were fed to the working animals, and the quantities recovered at the various sites of the Mons Porphyrites complex indicate that the same was true here. In fact, several camel droppings contained complete barley grains and wheat rachis, fig. **(**10-a**)** [24]. potential source of animal feed. They were and are commonly eaten by animals, like barley, it is clear that the amount of fodder required must have been very considerable, and this is illustrated by the text of papyrus P Giss 69 (Pefta, 1989), fig. **(**10-b & c**)**. This papyrus concerns a letter addressed to Apollonios, strategos of the Heptakomia Apollo-nipolites nome, dated to AD 118/ 119. He is asked to send all the barley in his nome to Qena (the Nile valley town nearest to Mons Claudianus), as a great number of animals has been assembled for bringing down a 50-foot column. The local vegetation around the quarry sites would not have been sufficient to support large numbers of animals, and, moreover, both camels and donkeys need concentrates, body-building foods such as barley grain, if being used for energy-intensive tasks, as well as roughage and bulk (such as chaff and straw or desert shrubs) [25].

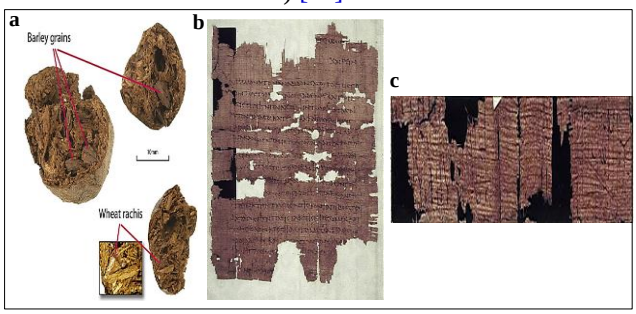


Figure (10) complete barley grains and wheat rachis (*After: Peacock, 2007*), papyrus P Giss 69 shows **b.** recto**, c.** verso (*After: https://papyri.uni-leipzig.de/receive/Gie Papyri_schrift_00003730*) (9/9/2023).

2.5.1. Recto

[. . . . .] Ἀ[πολλωνίωι τῶι] τειμιωτάτωι χαίρειν.
Χαιρήμονα τὸν ἀναδιδόντα σοι τὸ ἐπιστό-
[λι]ον τοῦτο οὐκ ἀγνοεῖς, ἄδελφε· καὶ γὰρ πέ-
5ρυσι ἐπὶ τὴν παράλημψιν τῶν ἱματίων
αὐτὸν παρὰ σοὶ κατέλειψα καὶ νῦν δὲ πρὸς
παράλημψιν κρειθῆςἔπεμψα αὐτὸν, ᾧ
παρακαλῶ ἐν πᾶσι σπουδάσαι καὶ πᾶσαν τὴν
οὖσαν ἐν τῷ ὑπὸ σοὶ ν[ομῷ κ]ρειθὴνέν
10τάχει αὐτῷ ἐπιστεῖλαι καὶ βωήθειαν δῶναι,
ἵν[α δι]ὰ σπ[ο]υδῆς ἐμβαλόμενος πᾶσαν τὴν
[κριθὴν τα]χέως εἰς Καινὴν παρακομίσῃ,
ἐπεὶ διὰ τὴν τοῦ πεντηκοντάποδος στύλου
καταγωγὴν πλεῖστα κτήνη ἔχομεν καὶ
15ἤδη σχεδὸν κρειθῆ λειπόμεθα· πλεῖστον
μοί, ἄδελφε, καὶ ἐν τούτῳ παρέξῃ, ἐὰ[ν ἡ]
κρειθὴταχέως . [. . . .]. ἰσγένηται.
(hand 2) (ἔτους) γ Ἀδριανοῦ Καίσαρ[ος τοῦ κυρίου [LRI] -
ca.?- [PDI] γ.

2.5.2. Verso

[Ἀπ]ολλωνίωι στρατηγῶι Ἑπτακωμίας**.** [26]

- **Translation**
  - **Recto**

… to Apollonios, the most honored. Greetings. Chaeremon, the man presenting this letter to you, is not unknown to you, brother, for last year I left him with you for the consignment of cloaks. Now I have sent him for the consignment of barley. I enjoin you to aid him in all things and to hand over to him all of the barley currently in your name, and to render assistance, so that once he has quickly Loaded all of the barley he can afifty – foot column, and already we are nearly out of barley … were to arrive swiftly. In the third year of the reign of Hadrian Caesar, the third day of the month of …

  - **Verso**

To Apollonios, Strategos of Heptakomia [26]. Moreover, the texts indicate) that some barley was intended for the pigs and piglets that were kept at Quarries, mines [27], Like (Private letter (O. Krok. II 153 © A. Bülow-Jacobsen), fig. (11), and Reviewed by Dr/ Radwa Rafik.

Figure (11) O. Krok. II 153 (*AfterL Jacobsen, 2019*)

- **Side convex**

Φιλοκλῆς Καππαρίῳ τῷ ἀδε-
λφῷ καὶ Διδύμῃ ἀνφοτέ-
ρυς πλῖ<σ>τα χαίρινκαὶ διὲ πα-
ντὸς ὑγιεν. δώσις Ἄμμ-
ωνι τῷ συ φέροντι τὴν
ἐπιστολὴν βύνι ⟦αρτ⟧ ἀρ-
τάρας δύω. μὴ ὦν
ἄλλως ποήσῃς. ἔπεχ-
ε τὰ χοιρίδια καὶ πά-
ντα τὰ ἐς ὗγον. ἀσ-
πάζετε ὑμᾶς Ἡγ-
εμονὶς καὶ Σ̣κίψ.
ἀσπάζου Ἀντων-
ᾶν τὸν γουράτορ-
αν καὶ Κλαύδιον
καὶ Θερμουθ-
ᾶν. ἔρρωσο.

- **Side concave**

εηνπ̣εκ
ν̣.. νονονοτεω
ονεεπυμμ
οοεωοηνις, tab. (5) [28].

▪**Translation**

Philokles to Kapparius his brother and Didyme, both of them, many greetings and all good health. Give to Ammonus, the bearer of this letter, two artabs of malt. So don't do otherwise. Look after the little pigs and everything in the house. Hegemonis and Skips greet (both of) you. Greet Antonas, the curator, and Claudius and Thermouthas. Farewell [29].

Table (5) correcting some words in the text.

The word in the text	Emendation
ἀνφοτέρυc	ἀμφοτέροιc
cταπλῖ	cταπλεῖ
χαίριν	χαίρειν
διὲ	διὰ
ὑγειν	ὑγιαίνειν
cιcδώ	cειcδώ
cυ	coι
βύνι	cβύνα
cρτάραὰ	cρτάβαὰ
δύω	δύο
ὦν	οὖν
cῃcποή	cῃcποιή
cὲ	cἰε
ὗγον	οἶκον
cπάζετεὰ	cπάζονταιὰ
γουράτοραν	κουράτοραν

2.6. *Archaeobotany (charcoal).*

Wood charcoal fragments constituted the majority of plant remains found at Samut North and Mons Claudianus, Mons Porphyrites, and some taxa were recognized to charcoal, Acacia nilotica, Acacia raddiana, Leptadenia pyrotechnica, and Moringa sp. Tamarix sp, fabaceae, Brassicaceae, Aerva sp, prosopis sp., fig. (12) [8].

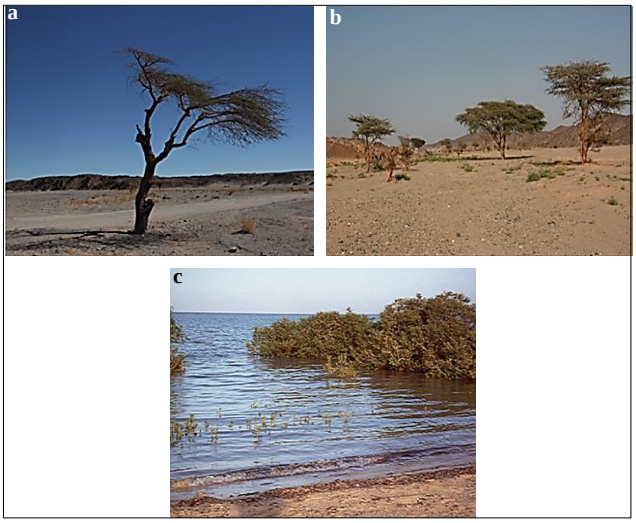


Figure (12) **a.** isolated recently cut acacia (Acacia tortilis subsp. raddiana), **b.** Gallery forest of acacia trees (Acacia tortilis subsp. raddiana/ tortilis, ehrenbergiana), **c.** mangrove (Avicennia marina) on the Red Sea coast, south of Qusayr al-Qadim. (*After: Bouchaud, 2021; Van der Veen, 2011*).

2.6.1. The charcoal stock in mine samut

The presence of a forge, used to produce and repair iron tools, requires a controlled heating processes to reach and maintain temperatures above 1000 ◦C. The charcoal stock from storeroom 137 in Samut North, fig. (13-a & b) confirms the local use of charcoal fuel. In parallel, the use of green and seasoned wood must be considered, notably for domestic activities (i.e. cooking, heating, lighting), although we do not have any robust argument to confirm or discard this hypothesis Charcoal study did not allow the differentiating of charcoal fuel from burnt wood. Moreover, the charcoal dataset might result from a mix of heating activities [30], With the exception of specific contexts (i.e. charcoal stock 137.02 and Forge 403.06) the functional understanding of other charcoal assemblages is tricky [12]. Correspondence analysis (CA) was carried out in order to hierarchize relations between archaeological contexts (individuals) containing charcoal, seeds and fruit remains, and archaeobotanical/coprolites components (variables), fig. (13-c). Contextual structuring defines the two axes. On the one hand are clear artisanal contexts, (i.e. charcoal storage room 137 and Forge 403), characterized by the absence of seeds, coprolites and similar dendro-anthropological criteria (hyphae and vitrification), On the other hand, utility rooms, such as kitchen 116, storeroom 125 and guard room 130 are associated with the presence of seeds, coprolites, charred twigs and branches. In between, there are a bulk of contexts which cannot be assigned but tend to be related to the first group. The analysis shows how fuel resources strongly structure the archaeobotanical assemblages, by splitting contexts where charcoal fuel has been exclusively stored or used and contexts with more variable fuel resources [12].

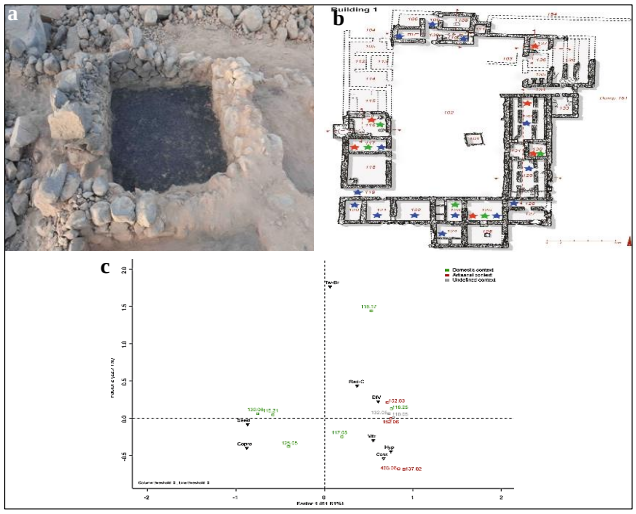


Figure (13) **a.** charcoal fragments from room 137, **b.** plan of building 1 room 137, **c.** correspondence analysis on archaeological contexts with charcoal, seed and fruit remains. Cons = consistence, Copro = coprolite, DIV = charcoal taxonomical diversity, Rad-C = radial cracks, Hyp = fungi hyphae, Tw-Br = twigs, branches, Vitr = vitrification (*After: Bouchaud, 2021*).

2.6.2. A broad definition of taphonomy: from wood gathering to charcoal analysis.

The nature of the processes involved is diverse, fig. (14) human practices with wood collecting and hearth manage-ment, combustion itself and depositional and post-depositional processes. According to some authors, only these last processes should be included in the definition of "taphonomy". Furthermore, we also believe that "archaeologist" and "anthracologist" filters should also be considered as sampling and quantification methods may also distort the final assemblage. All of these filters (or agents) must be taken into account when considering distortional factors between the natural

environment and the charcoal diagram. Conditions are different in natural contexts since the first filter (i.e. human practices) is excluded [30].

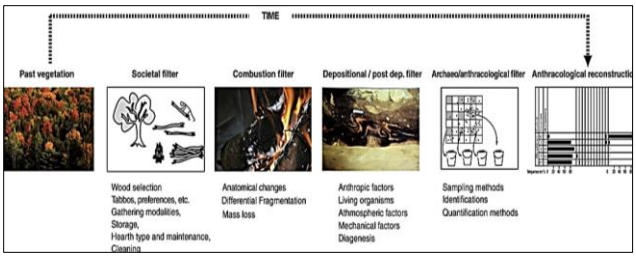


Figure (14) successive filters from the past vegetation to the anthracological reconstruction. (*After: Parisot, 2010*).

3. Results

Based on the previous data some important results were extracted as follow:

1) The most common food plants found at the mines and quarries, tab. (6) & fig. (15).

Table (6) the most common food plants found at the mines and quarries

Site name	Mine Bir Samut	Quarries	
		MC	*MP*
Cereals	√	√	√
Pulses	√	√	√
Vegetables	**?**	√	√
Fruits	**?**	√	√
Oil plants	√	√	√

MC: *Mons Claudianus;* ***MP****: Mons Porphyrites*

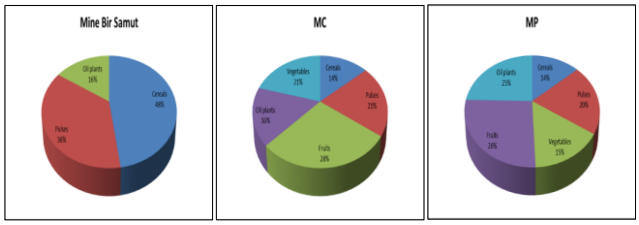


Figure (15) graph showing the most common food plants found at the mines and quarries. Mine Bir Samut, Mons Claudianus, Mons Porphyrites.

2) One of the most numerous categories of plant remains was used in animal fodder found was chaff (rachis nodes) and straw, and especially that of durum or hard wheat, while grains of barley were also numerous, fig. (16).

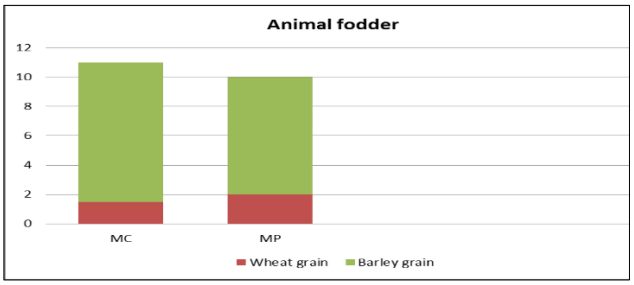


Figure (16) graph showing distribution the barley grain and wheat grain in MC, MP

3) The written sources mentioning the importations of charcoal from the Nile Valley, (O. Claud. I 21), fig. (17) the strongest argument in of this practice is the abundance of Nile acacia charcoal in non-domestic contexts [31]. Its recurring presence in those specific contexts and its absence in the desiccated wood corpus suggests that at least some acacia wood was brought from the Nile Valley as charcoal, reducing the weight and volume for transportation while meeting the important fuel needs at different sites. The convergence of papyrological sources and the charcoal results indicate that these imports were particularly aimed at quarry sites.

Figure (17) O. Claud. I 21, international excavations 1987-1990, now in Qift, storeroom EAS Claudianus no. 3188. (*After: Bingen, 1992*).

1 *Ἱερώνυμος ἀρχιτέκ(των) [---]*
2 *Κρονίωνος gen,) τῷ [.....] [πλεῖ]στα*
3 *χαίρειν. [.....] [εἰς] Κλαυ-*
4 *διανὸν ἄνθρακος γόμο\ν/*
5 *α* [32]

- **Translation**

1 *Person's name: reference to Hieronymos engineer*
2*- Person's name: reference to kronion the many*
3 *Rejoice into mons Claudianus eastern desert*
4 *Mons Claudianus charcoal ship's freight "beast's load"*
5 *Numeral a*

4) Wood charcoal fragments constituted the majority of plant remains found at Samut North, Mons Claudianus: Mons Porphyrites, tab. (7) & fig. (18).

Table (7) wood charcoal fragments constituted the majority of plant remains found at Samut North, Mons Claudianus: Mons Porphyrites.

Taxon	Code	Origin	MC	MP	Samut
Acacia tortilis/	ACTO	Local	√	√	√
Acacia sp	ACAC	Local	√	?	?
Acacia nilotica	ACNI	Nil	√	√	?
Cf. Aerva	AERV	Local	√	?	?
Brassicaceae	BRASS	Local	?	√	?
Fabaceae	FABA	Local	√	√	?
Leptadenia pyrotechnica	LEPPYR	Local	√	√	?
Moringa peregrina	MORPER	Local	√	√	?
Prosopis sp.	PROS	Nil	?	√	?

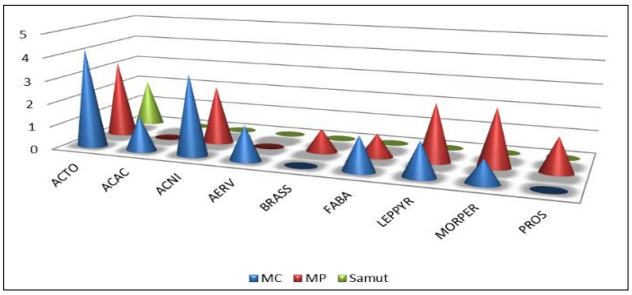


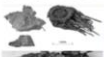
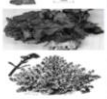
Figure (18) graph showing wood charcoal fragments constituted the majority of plant remains found at Samut North, Mons Claudianus: Mons Porphyrites.

4. Discussion

4.1. *Food plants*

Going back to our original question of what life was like for the Mines and quarry workers working in the Eastern Desert, our evidence indicates that their lives while obviously different from that of those living in the Nile valley and other parts of Egypt were not as dissimilar as one might expect, especially when we focus on food. Plant foods would have been the main source of energy and protein in the diet for most of the inhabitants of Egypt, and the range of plant foods available in the desert during the later 1st to early 3rd centuries AD was very similar to what was available in other parts of Egypt, from where most of the food originated. One unexpected aspect of our results concerns the growing of green vegetables in the desert, something the ostraca have corroborated. It makes us ask what are the sources of water used in growing vegetables? This will be addressed by the researcher in future research. There is an important question here: Are the plant remains that were found the same as the current plants? For example, the cabbage that found the same cabbage as the current cabbage, of course not, tab. (8).

Table (8) the shape of plants, ancient and modern.

Plant type	Old shape	Modern shape	Morphology shape	
			Changed	*No change*
Artichoke bracts			2	√
Garlic			2	√
Onion			2	√
Cabbage			√	×
Grains of barley			2	√
Durum wheat			2	√

4.2. *Charcoal*

Taxonomical identification of acacia species is virtually impossible based on anatomical observations only However, all fragments have axial parenchyma aliform and confluent to a broadly banded transversal section and broad homocellular rays from 1 to 8 (10) cells wide in longitudinal tangential section, fig. (19). We therefore, identified them as one group, ehrenbergiana/etbaica/tortilis, as these are the main acacia tree or shrubs growing locally. Common acacia of the Egyptian Eastern Desert corresponds to trees up to several meters high, namely Acacia tortilis subsp. raddiana (Savi) Brenan and A. tortilis subsp. tortilis (Forssk) Hayne, and shrubby species, including A. ehrenbergiana and A. etbaica Schweinf [33].

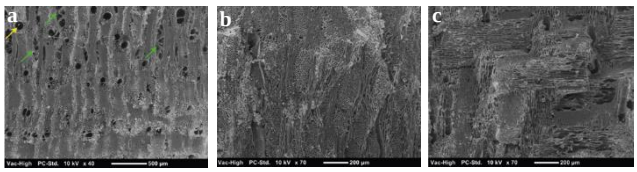


Figure (19) Acacia ehrenbergiana/etbaica/tortilis type; **a.** Transversal, **b.** tangential, **c.** radial sections, green arrows = radial cracks; yellow arrow = fungi hyphae. (*After: Bouchaud, 2021*).

5. Conclusion

The botanical remains, together with the ceramics and textual evidence, recovered at these Roman and Ptolemaic sites highlight that the delivery of food was well organized and consistent, The botanical assemblages at the different sites are very similar to one another, and together with the documentary evidence point to a well-planned supply system, with standard supplies augmented through a variety of private enterprise, such as growing green vegetables in the desert, requesting foods from family and friends back in the Nile Valley, as well as individual purchases from passing caravans, the range of foods available to the workers mines and quarries was impressively wide, including all basic essentials (cereal grain, pulses, fruits, oil-rich seeds, and vegetables).

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