

## Natural Resources in Roman Egypt: some aspects of extraction, transport and administration<sup>1</sup>

***Abstract:** The administration of natural resources in Roman Egypt deserves more scholarly attention. Focusing on a number of case studies of natural resources in Roman Egypt, this paper seeks to collect relevant information, considers a range of aspects in their extraction, transport, and administration, and hopefully will pose questions for further study. The Roman state carefully regulated the supply and sale of these resources, and their administration was carried out using contractors and liturgists who were also regulated. While the state was able to profit directly from the exploitation of resources, they were also able to devolve their administration onto the local population. The paper seeks to understand some ways in which an imperial power made demands on its provincial territory.*

The Roman state's control over and administration of natural resources in the province of Egypt has not received sufficient scholarly attention. Egypt's wealth in a wide range of resources, agricultural produce, stones and minerals, papyrus, among many other products is well known. Recent research has focused largely on agriculture and the economy of Egypt and the wider Roman world, or on detailed analyses of estate management or tenancy within the land economy.<sup>2</sup> There has also

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<sup>1</sup> My thanks to Matt Gibbs, and to the anonymous referees, for comments on an earlier draft.

<sup>2</sup> D. Rathbone. *Economic Rationalism in Third Century AD Egypt: The Heroninus Archive and the Appianus Estate* (Cambridge 1991), D. Kehoe, *Management and Investment on Estates in Roman Egypt during the Early Empire* (Bonn 1992), and J. Rowlandson, *Landowners and Tenants in Roman Egypt, the Social Relations of Agriculture in the Oxyrhynchite Nome* (Oxford 1996), with the discussion of A.K. Bowman, 'Quantifying Egyptian Agriculture', in A.K. Bowman and A. Wilson

been much work on the extractive industries, principally the quarries of the Eastern Desert.<sup>3</sup> Otherwise, little has been done since the monumental work of Alan Chester Johnson, published as part of Tenney Frank's Economic Survey of Ancient Rome.<sup>4</sup> This gathers evidence for a wide range of economic issues in Roman Egypt, setting out a huge array of evidence from both literary sources and the papyrological record published before 1936. Thus it serves as a starting point but it is out of date, and a modern synthesis of evidence published since would be a valuable addition to the literature.

The purpose of this paper is to study the most interesting evidence for a range of natural resources, using them as case studies, in order to explore some themes arising from the particularly interesting evidence. Several problems and approaches present themselves. First the evidence is diverse, spread over a wide chronological period (making a picture of development over time extremely difficult to achieve), and is widely spread geographically (raising a number of questions of typicality). The second issue is the desirability of putting together a huge range of archaeological evidence, and even more importantly placing this alongside the documentary evidence: what we need is a comprehensive study of the production and consumption or use of resources, which would then offer some picture of the relationship between point of production and point of use (where this was

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(eds.), *Quantifying the Roman Economy: Methods and Problems* (Oxford 2009) 177-204.

<sup>3</sup> See A. Hirt, *Imperial Mines and Quarries in the Roman World* (Oxford 2010) for the most recent discussion of quarries, taking account of recent archaeological work at Mons Claudianus and Mons Porphyrites, and superceding K. Fitzler, *Steinbrüche und Bergwerke im ptolemäischen und römischen Ägypten* (Leipzig 1910).

<sup>4</sup> A.C. Johnson, *Roman Egypt to the Reign of Diocletian* (Baltimore 1936).

different).<sup>5</sup> But, quarries aside, the archaeological evidence for Roman Egypt is poor, and there is virtually nothing preserved to give us a clear picture of the processing of resources; in short there is little sign of industry. This is because little archaeological evidence remains of the cities of Roman Egypt and especially of Alexandria, the main focus, for example, of the glass industry. This problem is exacerbated for Alexandria because few documents are preserved which come from the city, and as a consequence we have to rely on literary sources, which only occasionally offer an account of such activities: ‘the city is rich, wealthy and prosperous. Some are glass blowers, some are making paper, and others are engaged in weaving linen; everybody at least seems to be engaged in some occupation’.<sup>6</sup>

Papyrological evidence, although promising in what it can reveal about resources and industries in the *chora* of Egypt, still presents problems, and it can hardly be said that we have a complete picture. Again the problem lies in the fact that we have comparatively little evidence from the cities of Egypt – the *metropoleis*. What we do have a better picture of is the different economies based on agricultural estates. In such settings, a whole range of secondary economic activities took place, ranging from the brewing of beer, to weaving, oil and wine production, dying and fulling, among others.

This paper, rather than considering the production and working of the products, seeks to understand the administration of the resources by the Roman state, the ways in which an imperial power tapped provincial resources and imposed itself on a population. It will focus on a range of important products, alum, natron, timber, salt, and on fish and fishing rights, which had a range of different uses. What

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<sup>5</sup> Some material in this direction can be found in P. Van Dommelen and A. Bernard Knapp (eds.) *Material Connections in the Ancient Mediterranean: Mobility, Materiality and Identity* (Oxford 2010).

<sup>6</sup> SHA, *Saturninus* 8.

follows is a description of what evidence we have with some general observations. The production and sale of these resources were carefully controlled by the Roman government; a fuller understanding of how these ‘monopolies’ worked would be highly desirable.<sup>7</sup>

Under the Ptolemies, monopolies existed for a wide range of different commodities. The system of monopolies was much less apparent in the Roman period, although it is interesting that government control over natural resources and the most commonly used commodities continued, even if in slightly different form, that is more properly seen as state regulation than as monopolies. The production and sale of these commodities was carefully regulated, but also the transport of them was controlled to a similar level, through state contracts with private transporters. In addition. There is also a curious link to taxation, which further allowed the state to control and profit from natural resources. So these, then, are our main themes: state control of production, the transport of commodities by contractors, and finally, further ways in which commodities could be exploited. The stories that are told in our evidence are local in character, concerning the Oxyrhynchite and Arsinoite nomes, but they have a more general relevance, and the patterns that can be seen, even if specific details, institutions and procedures may have no parallel, have a wider resonance.

*Alum* (στυπτηρία)

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<sup>7</sup> Discussion in S.L. Wallace, *Taxation in Egypt from Augustus to Diocletian* (Princeton 1938) 181-90; some issues are glossed in R. Taubenschlag, *The Law or Graeco-Roman Egypt in the Light of the Papyri (332 BC – 640 AD)*, 2<sup>nd</sup> ed. (Warsaw 1955). Still useful is F. Heichelheim, “Monopol,” *RE* 16.1.147-99. There are some useful comments in J. Bingen, ‘Le papyrus Revenue Laws: tradition grecque et adaptation hellénistique’, *Rheinische-Westfälische Akademie der Wissenschaften, Vorträge G 231* (Opladen 1978) (repr. in *Hellenistic Egypt: Monarchy, Society, Economy, Culture* [Berkeley 2007] 157-188).

Alum is a chemical compound of potassium and aluminium sulphate. We know it was mined from the pharaonic period onwards, and was used for a variety of purposes: tawing leather, dyeing, and treating fabrics,<sup>8</sup> glass production,<sup>9</sup> and for medicinal and cosmetic purposes.<sup>10</sup> It is found in the Western Desert oases of Dakhla and Kharga, where it was mined until comparatively recently in some quantity.<sup>11</sup> In the early Arab period, some 44 tons were mined and taken to Cairo annually.<sup>12</sup> Alum was well known to Pliny the Elder, who considered the Egyptian variety to be the finest.<sup>13</sup>

The production, transport, and sale of alum were carefully regulated by the state at a high level. A small number of texts give us some idea of its

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<sup>8</sup> P. Nicholson and I. Shaw (eds.), *Ancient Egyptian Materials and Technology* (Cambridge 2000) *SV. alum*. For a comprehensive discussion of alum and its trade through the ages, see C. Singer, *The Earliest Chemical Industry: An Essay in the Historical Relations of Economics and Technology illustrated from the Alum Trade* (London 1948), now outdated.

<sup>9</sup> B. Gratuze and M. Picon, “Utilisation par l’industrie verrière des sels d’alun des oasis égyptiennes au début du premier millénaire avant notre ère,” in P. Borgard, J-P. Brun and M. Picon (eds.), *L’alun de Méditerranée* (Naples and Aix-en-Provence 2005) 269-76.

<sup>10</sup> See in general R.S. Bagnall, *Egypt in Late Antiquity* (Princeton 1993) 146, for uses.

<sup>11</sup> See M. Picon, M. Vichy and P. Ballet, “L’alun des oasis occidentales d’Égypte Recherches sur le terrain et recherches en laboratoire,” in Borgard, Brun and Picon (n. 9), 43-58.

<sup>12</sup> See G. Wagner, *Les Oasis d’Égypte à l’époque grecque, romaine et byzantine d’après les documents grecs* (Cairo 1987) 306-9.

<sup>13</sup> *NH* 35.52, also *Hdt.* 2.180; A. Lucas, J.R. Harris, *Ancient Egyptian Materials and Industries*, 4<sup>th</sup> ed. (London 1962) 257-9.

administration.<sup>14</sup> The mining of alum was leased by the state to *μισθωταί* (contractors),<sup>15</sup> who usually acted collectively, but could act individually.<sup>16</sup> They seem to be involved not only in the production of alum itself, but also with its transport by third parties and eventual sale.<sup>17</sup> A notable pattern in Roman Egypt is that contracts for tax collection and other essential tasks were farmed out to *μισθωταί*, when none could be found, they came to be overseen by liturgical supervisors (*ἐπιτηρηταί*).<sup>18</sup> These *ἐπιτηρηταὶ στυπηρίας* were drawn from the bouletic class and were appointed as a board of three, at least in the evidence we have.<sup>19</sup> Their primary responsibility was to draw up accounts of alum every five

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<sup>14</sup> T. Kruse, “P. Heid. Inv. G 5166 und die Organisation des Alaunmonopols im kaiserzeitlichen Ägypten,” in B. Palme (ed.), *Proceedings of the 24<sup>th</sup> International Congress of Papyrology* (Helsinki 2007) 523-48, publishes a new text relating to the alum administration, and offers the most recent and detailed treatment.

<sup>15</sup> We know little of the process of allocating monopolies.

<sup>16</sup> *P. Oxy.* 12.1429 (AD 300), acting individually; *P. Oxy.* 31.2567 (AD 253), for acting collectively. On collective action, see most recently M. Gibbs, “Trade Associations in Roman Egypt: Their Raison d’être,” *Ancient Society* 41 (2011) 291-315, who is right to distinguish between collective action and the operation of a ‘college’.

<sup>17</sup> *P. Oxy.* 12.1429 (AD 300): the lessee of the contract describes himself as *μισθωτ(ης) ἀρχολ(ήματος) στυπηρίας*. The use of *ἀρχόλ(ημα)* suggests production and sale cf. n. ll. 1-2. The word is also used in *P. Oxy.* 31.2567 (AD 253), suggesting onward sale to retailers.

<sup>18</sup> *BGU* 3.697 = *W. Chr.* 321 = *Sel. Pap.* 2.370 (AD 145); *P. Col.* 8.228 (AD 205/6); *P. Oxy.* 17.2116 (AD 229); *P. Oxy.* 31.2567 (AD 253), on which, see A. Jördens, *Statthalterliche Verwaltung in der römischen Kaiserzeit: Studien zum praefectus Aegypti* (Stuttgart 2009) 302.

<sup>19</sup> N. Lewis, *The Compulsory Public Services of Roman Egypt* 2<sup>nd</sup> ed. (Florence 1997) 28-30.

days.<sup>20</sup> These accounts were produced in sextuplicate, copies being sent to the office of the *dioiketes*, *oikonomos*, and the archives of the *procurator ad Mercurium* in Alexandria, and presumably the lessees of the monopoly.<sup>21</sup> In one of the most intriguing documents, the report is addressed, if the reading is correct, to the overseer of the prefect's correspondence.<sup>22</sup> This arrangement probably reflects a whole series of earlier changes to the administration of such contracts, which had come into force by the third-century.

Other documents mentioning alum concern its transport, and a small range of taxes paid on this. One second-century text from the Arsinoite nome, is a receipt for payment to a transporter, through the bank of Sabinus, for the transport of thirty light talents of alum (12 metal talents) from the Small Oasis to the Arsinoite.<sup>23</sup> The transporter, Panouphis from the village of Soknopaiou Nesos, had paid a customs toll of 1 drachmas 3 obols, in total 45 drachmas, and a fee of 7 drachmas 3 obols per talent, a total of 90 drachmas, so in all 145 drachmas. The transaction is ordered by

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<sup>20</sup> On penthemeral accounts, see A. Abd-el-Ghany, 'Notes on the Penthemeral Reports of Revenues Accounts in Roman Egypt', *ZPE* 82 (190) 107-13 and *P. Pintaudi* pp. 124-128. Most likely the tightening up in the supervision of these matters was an innovation of Trajan, as the earliest *penthemeros* report dates to AD 119, but subsequent changes must have taken place after the introduction of town councils into the cities of the *chora* after AD 200.

<sup>21</sup> The archive of the procurator seems a more plausible interpretation of *P. Oxy.* 17.2116, where we might read [Ἐρ]μιαικὸν instead of [Ῥω]μιαικὸν, as suggested by G. Rickman, *Roman Granaries and Storebuildings* (Oxford 1971) 305. On the *Procurator ad Mercurium*, see F. Beutler-Kränzel, "Procurator ad Mercurium," in *Palme* (n. 14) 53-6, and Jördens (n. 18) 200-1.

<sup>22</sup> *P. Oxy.* 17.2116: ἐπιτηρητῆς ἡγεμονικῶν ἐπιτολῶν καὶ ἄλλων, see *P. Oxy.* 51.3615 intro.

<sup>23</sup> *BGU* 3.697 = *W. Chr.* 321 = *Sel. Pap.* 2.370 (AD 145).

the ἐπιτηρηταί of alum in the Arsinoite nome (which may show that each nome had a separate administration, and that there were regional variations in practice).

There are interesting aspects to this text. First, Panouphis is a professional transporter: he is mentioned in quite a few customs house receipts from the Fayum, and his coming from the village of Soknopaiou Nesos is also an indication, for inhabitants of this village seem to have specialized in transport.<sup>24</sup> Second, he is paid for transport, and costs for customs duties are covered. The bank of Sabinus is also well known to us, as it is through it that a number of payments for state transport are paid, and therefore the administration of the transport of alum bears comparison with transport of grain and other tax commodities.<sup>25</sup>

In another document concerning the transport of alum, this time probably from the Oxyrhynchite nome, one Heliammon pays 38 drachmas 4 obols to the ἐπιτηρηταί of alum, but also ἐπιτηρηταί of the ὑποκειμένα, for transport on three camels and three donkeys.<sup>26</sup> We have no record of how much alum was transported, and the talent weights mentioned in the previous document are obscure to us. It is notable that the ἐπιτηρηταί were also responsible for the collection of ὑποκειμένα. Just what this tax was in this case is unclear, but it is accepted that generally ὑποκειμένα were taxes most usually paid in money to various officials and that it was a Roman innovation.<sup>27</sup> The fact that no details of the amount of alum

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<sup>24</sup> C.E.P. Adams, *Land Transport in Roman Egypt: A Study of Economics and Administration in a Roman Province* (Oxford 2007) 240.

<sup>25</sup> On the bank of Sabinus, see C. Geens, ‘Financial Archives of Graeco-Roman Egypt’, in K. Verboven, K. Vandorpe, and V. Chankowski (ed.), *Pistoi dia tèn technèn: Bankers, Loans, and Archives in the Ancient World: Studies in Honour of Raymond Bogaert* (Leuven 2007) 133-152, esp. 147-9.

<sup>26</sup> *P. Col.* 8.228 (AD 205/206).

<sup>27</sup> See J.D. Thomas, *The Epistrategos in Ptolemaic and Roman Egypt. Part II: The Roman Epistrategos* (Opladen 1982) 219-221.

transported are adduced in the text suggests that it is not a receipt for customs dues, but rather that, along with *P. Heid. Inv. G. 5166*, published by Kruse, this payment was made for the use of transport animals, perhaps according to a set rate.<sup>28</sup> It may then be the case that transporting alum was also regulated by the state and concessions were under contract.<sup>29</sup> How such contracts may have operated is unclear. It is possible that they were attractive to professional transporters. It is clear that these existed and were specialists plying desert routes, which were both arduous and potentially dangerous.<sup>30</sup> The payment of 90 drachmas for the transport of 12 talents of alum recorded in *BGU 3. 697*, as we have seen, is also a payment to such a transporter.<sup>31</sup> A possible parallel to this may be the case of the transport ‘company’ owned by Nikanor, which operated in the Eastern Desert in the first century AD. Nikanor and his sons transported a wide range of commodities between Koptos, the main Nile emporium, and Myos Hormos and Berenike, the ports on the Red Sea coast. Much of that transported was destined to supply individuals living and working there, but importantly, one ostrakon records the delivery of wheat to soldiers based at Apollonos Hydreuma, a station on the route to Berenike. It is likely, as the delivery was part of a larger consignment intended as military supplies, that it was transported under government contract or license.<sup>32</sup>

A small number of other documents concern taxes on alum. An Oxyrhynchos papyrus, probably of the late fourth century, preserves a fragmentary list of taxes on land, where land with alum (presumably) is taxed at a rate of 40,000 drachmas per aroura.<sup>33</sup> An ostrakon from Kellis preserves a receipt for the tax on

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<sup>28</sup> Kruse (n. 14).

<sup>29</sup> Kruse (n. 14) 531.

<sup>30</sup> Adams (n. 24) 239-248.

<sup>31</sup> Suggested by Kruse (n. 14) 532.

<sup>32</sup> C.E.P. Adams, “Supplying the Roman Army: O. Petr. 245,” *ZPE* 109 (1995) 119-24.

<sup>33</sup> *P. Oxy.* 16.1905 (late fourth century). On the date, see *BL* 8.251.

alum, with a payment of either 60 or 600 silver drachmas.<sup>34</sup> We would like to know more about how these taxes were levied, and also about how customs tolls were levied or waived. Only one document, from Bahariya Oasis, hints at the kind of information set out in official reports of alum, where specified amounts of alum presumably collected on days of a particular month are set out, but it is so fragmentary that little can be made of it.<sup>35</sup>

All of this, of course, raises more questions than it provides answers. But before turning to these questions, it would be helpful to discuss other natural resources: salt, natron, fish (closely associated with salt), and finally timber. There is less evidence for these commodities, even though they were in common use, but such as does exist hints at similar administrative details and patterns in transport as seen with alum.

### *Salt and Natron*

In the Ptolemaic period, the production of and trade in salt was carefully regulated. In the second-century BC, the right to sell salt was auctioned by the state to individuals,<sup>36</sup> and there may have been some form of tax on its consumption. But the main salt tax was a capitation tax known as the ἀλική.<sup>37</sup> It was profitable and

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<sup>34</sup> *O. Kellis* 24 (AD 314/315 or 328/329).

<sup>35</sup> *O. Bahria* 14 = *SB* 20.14,936 (third century).

<sup>36</sup> *P. Tebt.* 3.732 (C. 142 BC), a report to a *dioiketes* that the right to sell salt had been put up for auction by an ἐπιμελητής. The ἐπιμελητής seems to have had a general competence for financial matters within the nome, and was thus different in character from ἐπιμελητοί in the Roman period.

<sup>37</sup> W. Clarysse and D. Thompson, *Counting the People in Hellenistic Egypt*, 2 vols. (Cambridge 2006) 38-39, who provide a full bibliography, to which should be added B. Muhs, *Tax Receipts, Taxpayers, and Taxes in Early Ptolemaic Thebes* (Chicago 2005) 41-51, S. von Reden, *Money in Ptolemaic Egypt: From the Macedonian Conquest to the end of the Third Century BC* (Cambridge 2007) 65-67 and J.

easy to levy a tax on such an important and central resource, and despite the tax being a capitation tax, it seems that some link with the actual product remained. In terms of production, this can easily be controlled by a state, for, as with the other resources discussed here, deposits of salt lay largely in marginal areas that could be easily monitored. However, the salt tax apart, despite the obvious importance of salt, this product is rarely mentioned in Ptolemaic papyri.<sup>38</sup> A papyrus dating to the mid-second century BC, in which an individual is brought to justice for the illegal processing of rock-salt on his property, suggests some degree of control and some (though unclear) link between the distribution of salt and the salt tax.<sup>39</sup> However, the present state of our evidence suggests less control in the Ptolemaic period than in the early Roman.<sup>40</sup>

In the Roman period, it seems that the production and sale of salt was carefully regulated by the state. Surprisingly, however, our information is thin, limited to evidence of concessions (granted by auction) and license fees paid to the state. We know little about its production. A third-century text from Hermopolis preserves a list of individuals allocated to various task, presumably by the state,

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Manning, "Hellenistic Egypt," in W. Scheidel, I. Morris, and R. Saller (eds.), *The Cambridge Economic History of the Greco-Roman World* (Cambridge 2007) 434-459, esp. 458.

<sup>38</sup> H. Cadell, "Problèmes relatifs au sel dans la documentation papyrologique," *Atti dell' XI congresso internazionale di papirologia* (Milan 1966) 272-85 collects the evidence, to which add B. McGing, "Illegal Salt in the Lycopolite Nome," *APF* 48 (2002) 42-66 and texts published by Clarysse and Thompson (n. 35).

<sup>39</sup> McGing (n. 38).

<sup>40</sup> Clarysse and Thompson (n. 35) 38.

including a number assigned to the salt works.<sup>41</sup> However, one of the Oxyrhynchite texts concerning alum shows that the *μισθωταί* of alum production also supplied ochre and salt. It is likely that salt was produced in the Western oases, as was the case with alum. It is also found at Lake Mareotis near Alexandria, and at Siwa.<sup>42</sup> It was an important commodity for everyday use, and was commonly imported into the Fayum, for example, for salting fish; its use must have been widespread in Egypt and elsewhere.<sup>43</sup> Customs house receipts from the Fayum provide important evidence for the transport and consumption patterns of a range of commodities, and it is no coincidence that all but one of the receipts mentioning the import of salt come from Soknopaiou Nesos, the main customs station for routes to and from the Western Oases. It may also have been an important point of consumption, for it lay on the shores of Lake Moeris, which had a rich supply of fish.<sup>44</sup> It is noteworthy also that these receipts record the 2.5% tax on much larger than normal consignments, where small caravans of up to eight camels are recorded, and the fact that the harbour of Memphis tax is not paid suggests consumption in the Fayum, probably Soknopaiou Nesos itself.

Although there is no evidence, the balance of probability suggests that the arrangements for transport would be the same; that the individuals in the customs receipts were paid for transport and reimbursed for their tax payments. As far as supervisors go, there is only marginal evidence from an Arsinoite papyrus from

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<sup>41</sup> *P. Ryl.* 2.92 (third century): εἰς ἄλας. At l. ii 27 ἀπαχθῆις suggests that these were prisoners. See Gibbs (n. 16) 296, who further points out that the presence of a *beneficarius* denotes state involvement (cf. l. 15).

<sup>42</sup> See Lucas (n. 13) 268-269 and Nicholson and Shaw (n. 8) *SV.* salt.

<sup>43</sup> J.K. Davies, "Setting the Scene," in Z. H. Archibald, J. K. Davies, and G. J. Oliver (eds.), *Hellenistic Economies* (London and New York 2001) 24-26 for salt as an important commodity, and more recently Clarysse and Thompson (n. 35) 2.36-38.

<sup>44</sup> P.J. Sijpesteijn, *Customs Duties in Graeco-Roman Egypt* (Zutphen 1987) 58.

Theadelphia, which mentions an ἐπιτηρητῆς ἐρμηνίας ἄλοπωλ(ίων), who may have overseen the importation of salt and perhaps its storage and sale to merchants.<sup>45</sup>

What is tantalizing here is the use of the word ἐρμηνίας, for it suggests a connection with the office of the *procurator ad Mercurium*, and if this is correct, his further close involvement with another natural resource.<sup>46</sup> In the city of Arsinoe, similar salt stores (ἄλοπώλια) existed, indeed a city quarter takes its name from them.<sup>47</sup>

As far as sale is concerned, this seems to have been carefully controlled. Indeed the Roman state, if we are to believe Livy, controlled the price of salt from an early date.<sup>48</sup> The best evidence for this from Egypt comes from the Arsinoite village of Tebtunis, where an ordinance relating to what appears to be an association of salt merchants fixes price levels for salt in the village market.<sup>49</sup> It is clear that the association enjoyed exclusivity, for the clauses in the ordinance stop members from selling to traders and merchants outside the association. Another text shows that the salt-merchants were responsible for paying a tax to the state, the details of which payment were lodged in the village registry office.<sup>50</sup> The same document suggests

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<sup>45</sup> *P. Fay.* 23 (second century AD), with *BL* 1.129; 2.55 (it is unclear if salt merchant(s) [ἄλοπώλης] in this text is singular or plural – both appear in the *BL*; if the latter, it may point to an association); see also *Stud. Pal.* 10.125 (fifth or sixth century).

<sup>46</sup> See *P. Oxy.* 31.2567 (n. 1. 9). On ἐρμηνεῖς, see W. Peremans, ‘Les ἐρμηνεῖς dans l’Égypte gréco-romaine’, in *Das römische-byzantinische Ägypten. Akten des internationalen Symposions 26.-30. September 1978 in Trier* (Mainz 1983) 11-17.

<sup>47</sup> S. Daris, “I quartieri di Arsinoe in età romana,” *Aegyptus* 61 (1981) 43-54.

<sup>48</sup> Livy 2.9.6 – the sale of salt was taken over by the Roman state as individuals were charging too much for it.

<sup>49</sup> *P. Mich.* 5.245 (AD 47), with A. Boak, “The Organization of Gilds in Graeco-Roman Egypt,” *TAPA* 68 (1937) 212-220 and Gibbs (n. 16).

<sup>50</sup> *P. Mich.* 2.123 (AD 46).

that different villages had their own salt merchants. The salt tax as a capitation tax in the Roman period is little understood, and at any rate, seems to vanish during the second century AD; its importance though needs to be stressed.<sup>51</sup> Davies has pointed out that in British India in the early 20th century, ‘next to land, salt contributed the largest share to the Indian revenue’.<sup>52</sup> As noted, its ubiquity and importance as a condiment and preservative made it a perfect target for regulation and taxation.

There is little evidence for natron in the papyri.<sup>53</sup> Its sources were much the same, the Western desert, and most obviously the Wadi Natrun.<sup>54</sup> That this resource too was carefully regulated like alum and salt is clear. A text of AD 159, of unknown provenance, but most likely Oxyrhynchos, preserves an account drawn up by ἐπιτηρητοί of the transport tax on natron.<sup>55</sup> In the period of one month, five ships, each carrying 100 slabs of natron, were assessed. As the natron seems to be unprocessed, it is likely it is being shipped, possibly to Oxyrhynchos, perhaps for processing for use in making textiles.<sup>56</sup> Salt and natron were both sold in the market at Oxyrhynchus, which we know from an important document concerning market

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<sup>51</sup> Wallace (n. 7) 183-184; D. Rathbone, “Egypt, Augustus, and Roman Taxation.” *CCG* 4 (1993) 81-112 and M. Sharp, “Shearing Sheep: Rome and the Collection of Taxes in Egypt, 30 BC-AD 200,” in W. Eck (ed.), *Lokale Autonomie und römische Ordnungsmacht in den kaiserzeitlichen Provinzen vom 1. bis 3. Jahrhundert* (Oldenbourg 1999) 213-241 on taxation generally.

<sup>52</sup> Davies (n. 41) 25, quoting *Encyclopedia Britannica* 11th ed. 14. 388b.

<sup>53</sup> *P. Col.* 4.113 (275-226BC); *SB* 16.12,695 (AD 143); *P. Mert.* 2.70 (AD 159); *BGU* 13.2359 (late third century); *P. Abinn.* 9 (mid fourth century).

<sup>54</sup> Lucas, Harris (n. 13) 263-267 and Nicholson and Shaw (n. 8) *SV.* natron.

<sup>55</sup> *P. Mert.* 2. 70 (AD 159).

<sup>56</sup> P. Van Minnen, “The Volume of the Oxyrhynchite Textile Trade,” *MBAH* 5 (1986) 88-95.

taxes.<sup>57</sup> Finally, a text from the fourth century archive of Abinnaeus preserves a letter written to Abinnaeus from a man who was presumably an overseer of the natron monopoly. It concerns the impounding of smuggled natron, and the arrest and detention of the smugglers and their camels.<sup>58</sup>

### *Fish and fishing*

The river Nile not only provided water for irrigation, supplying permanent canals and irrigation channels as well, but also fish in great quantity. Lakes and marshes in the Fayum and Delta also yielded fish. Both fresh and preserved fish are mentioned frequently in the papyri, especially in private letters and accounts. The importance of fish and fishing, and its clear link with the production and sale of salt for preserving them, has received scholarly attention, but it is worth setting out some important issues here.<sup>59</sup> Papyrological evidence is central to our understanding

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<sup>57</sup> *SB* 16.12,695. Natron is taxed at 6 dr. per 100 artabas.

<sup>58</sup> *P. Abinn.* 9 (AD 346).

<sup>59</sup> Apart from brief discussions in general works, the most useful treatments are M.C. Besta, "Pesca e pescatori nell'Egitto Greco-romano," *Aegyptus* 2 (1921) 67-74, Johnson (n. 4) 335 and 375-378, H. Henne, "PSI 901 et la police de la pêche dans l'Égypte gréco-romaine dans ses rapports avec la religion," *Aegyptus* 31 (1951) 184-191, J. Dumont, "La pêche dans le Fayoum hellénistique: traditions et nouveautés d'après le Papyrus Tebtynis 701," *CdÉ* 52 (1977) 125-142, C.A. Nelson, "Official documents from the Berlin Museum. Report from Supervisors of Fishing," *MPL* 2 (1977) 233-243, D.J. Brewer and R.F. Friedman, *Fish and Fishing in Ancient Egypt* (Warminster 1989), and H. Melaerts, "Pêche et pêcheurs à Tebtynis à l'époque romaine," in L. Criscuolo and G. Geraci (eds.), *Egitto e storia antica dell'ellenismo all'età araba: bilancio di un confronto* (Bologna, 1989) 559-564. There is a useful discussion in R.I. Curtis, *Garum and Salsamenta: Production and Commerce in Materia Medica* (Leiden 1991) 131-141. On taxes, see Wallace (n. 7) 219-221 and Taubenschlag (n. 7) 664-666. Also H. Chaouliara-Raiou, *Η αλιεία στην Αίγυπτο υπό το φως των ελληνικών παπύρων* (= *La pêche en Égypte d'après*

of fishing and fish processing, but texts are not plentiful, and archaeology, as with the other resources discussed here, reveals almost nothing at all. While the papyri may mention fish and fish products, they offer only a patchy picture of the industry. Yet more difficult to establish is how the state regulated or controlled fishing. Like other resources, fishing lent itself to state regulation, and provided considerable revenue to the state from taxes, and from the sale of fishing rights and license fees for selling fish. As with our other resources, questions are opened up about the ownership and use of marginal land and waterways.

A number of salient points about fishing and fishing rights arise. In the Ptolemaic period all waterways were the property of the king, and thus fishing was a royal monopoly. In the Roman period, with private ownership of land, the situation was somewhat different, but still highly regulated. There is evidence for private fishing rights, and for fishing rights being granted to the tenants of landed property with attached waterways.<sup>60</sup> Our evidence for fishing largely comes from the Fayum. Here the state owned stretches of marsh and shore land on Lake Moeris, among other places, and leased out fishing concessions or issued licenses to individuals. It was also possible for such land to be privately owned, as we know the Appianus estate of the third-century AD leased fishing rights on its land along the shore-land of Lake Moeris in the Fayum. As marshland was important for hunting and growing papyrus, leases could include the rights to these using resources and collecting revenues from fishing.<sup>61</sup> Reservoirs, too, were leased.<sup>62</sup> Like other

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*les papyrus grecs*), vol. I: *Les statuts, l'organisation et les impôts de la pêche en Égypte pharonique, romaine, et byzantine*; vol. II: *Corporations professionnelles halieutiques* (Ionnina 2003).

<sup>60</sup> *BGU* 3.1123 (AD 14), the early date is noteworthy. See also *SB* 18.13,150 (second century) mentioning fish caught in a privately owned hatchery, see G. Parássoglou, "A Lease of Fishing Rights," *Aegyptus* 67 (1987) 89-93.

<sup>61</sup> See *P. Giss. Univ.* 1.12 (AD 87/8) a lease of the concession to hunt, fish and gather papyrus, and licenses applied for in *P. Ryl.* 2.98a (AD 154/5) and *PSI* 5.458

resources - particularly alum and salt - the officials overseeing the granting of licenses and collecting the revenues were ἐπιτηρηταί, who similarly had to submit penthemeral reports every five days to the royal scribes or *strategoï* of the nome, and to submit copies to the public registry offices – the nomarch, a contractor in the nome, as demonstrated by Reiter, is also recorded as having responsibility.<sup>63</sup> Other private contractors, bidding for the right to collect certain revenues appear to have operated alongside them. By the fourth century, however, ἐπιτηρηταί seem to disappear.<sup>64</sup> It seems that the state was not always greatly troubled by processes, but more concerned with proceeds. This is further suggested by one document preserving a petition to the prefect of Egypt by fishermen who for some time had enjoyed the concession to fish in an Arsinoite village, but who had lost the

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(AD 155) for examples. *P. Tebt.* 2.359 (AD 126) records a payment of 336 drachmas per month for the concession to fish the marshes at Tebetnu and Kerkesis. The slightly later *P. Tebt.* 2.329 (AD 139) records the rights to collect the revenues from fishing for two years in the region of Tebtunis.

<sup>62</sup> *P. Hamb.* 1.6 = *W. Chr.* 320 (AD 129), with Johnson (n. 4) 376-377. In this document the ἐπιτηρητής of two reservoirs near the village of Hephaestias in the Arsinoite nome reports that no fish had been caught.

<sup>63</sup> Abd-el-Ghany (n. 20) generally on these documents, and, specifically on fishing, Nelson (n. 59). On the role of the nomarch, see F. Reiter, *Die nomarchen des Arsinoites: Ein Beitrag zum Steuerwesen im römischen Ägypten* (Cologne 2004), and on fishing, 182-198. In *PSI* 8.901 an oath of fishermen is made to the nomarch in charge of the revenues of the Arsinoite nome, see also *P. Tebt.* 2.329. See also *PSI* 7.735 (AD 138), *PSI* 3.160 (AD 149), *P. Leit.* 14 (AD 148), and *P. Oslo* 3.91 (AD 149).

<sup>64</sup> *P. Oxy.* 46.3268 (second century) for ἐπιτηρηταί and fishing rights and *P. Oxy.* 46.3270 (AD 309) for contractors. For disappearance after AD 275, see N. Lewis, *The Compulsory Public Service of Roman Egypt* 2nd ed. (Florence 1997) 28.

concession.<sup>65</sup> It is reasonable to assume that a better price for the concession had been offered, and the contract awarded to others.

Oxyrhynchos, unsurprisingly, has yielded the most information on fishing rights outside of the Fayum.<sup>66</sup> One document mentions a lease to fish, and to catch as many fish as possible, from reservoirs in the Oxyrhynchite nome granted to three men in AD 161.<sup>67</sup> Often in these documents, we see that the catch was shared between the fishermen and the owners of the water, and rent could include fish and fish products. To judge from our documents, fishing around sluice gates, where fish might congregate, was popular. Finally, an Oxyrhynchite text shows that, as in the case of illegal processing of salt discussed above, illegal activity was a serious problem. In a petition to a centurion dating to AD 31, a landowner complains about poaching by a group of fishermen on his land, claiming that fish to the value of one talent had been caught illegally.<sup>68</sup> This is an extraordinary amount of fish. Based on first century price levels, it has been estimated that it might have been as many as 180,000 fish, depending on quality, and the equivalent of the cost of seven houses.<sup>69</sup> Either the reservoir was extraordinarily rich in fish, or they were of exceptional desirability, or, more likely, the landowner was exaggerating. Whatever the case, these fish were caught in reservoirs separate to the Nile or its connected waterways, suggesting that fish may have been bred in them, which adds to the context of the

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<sup>65</sup> *P. Laur.* 1.1 (AD 192/3).

<sup>66</sup> *P. Oxy.* 46.3267-3270 intro., with other references.

<sup>67</sup> *P. Turner* 25 (AD 161). See also *P. Wisc.* 1.6 = *SB* 12.11,234 (AD 210-211) recording an application for the rights to fish reservoirs. *P. Oxy.* 46.3267 (C. AD 37-41) is a lease to fish a pool.

<sup>68</sup> *P. Oxy.* 19.2234 (AD 31).

<sup>69</sup> B. Kelly, *Petitions, Litigation, and Social Control in Roman Egypt* (Oxford 2011) 54-55, who confirms the reading as one talent.

petition: the owner of the reservoirs would naturally have been concerned at the theft of fish he had bred.<sup>70</sup>

### *Timber*

The final resource to be treated here is timber.<sup>71</sup> It is well known that timber was scarce in Egypt, and so it was a valuable resource, important for a wide variety of purposes. Most important for the state was first, ship-building, and second, its use in the upkeep of irrigation works and construction of irrigation machines, not to mention its clear importance for building purposes.<sup>72</sup> In the well-known Ptolemaic papyrus recording the duties of an oikonomos, the following instructions are made:

Take care also that of the local trees the planting of the mature ones be done at the right season, namely for willows and mulberry-trees, and that of acacia and tamarisk about the month of Choiak. Of these the rest must be planted on the royal embankments, but the young ones must be planted in beds in

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<sup>70</sup> See *SB* 18.13,150 (second century) for a fish hatchery.

<sup>71</sup> See generally the excellent study by R. Meiggs, *Trees and Timber in the Ancient Mediterranean World* (Oxford 1982). See also, B. Kramer, 'Arborikultur und Holzwirtschaft im griechischen, römischen und byzantinischen Ägypten', *APF* 41 (1995) 217-231, and W. Habermann, 'Brennstoffe im griechisch-römischen Ägypten (und darüber hinaus) I: Brennholz', in R. Eberhard, H. Kockelmann, St. Pfeiffer, and M. Schentuleit (eds.), '*... vor dem Papyrus sind alle gleich!*', *Papyrologische Beiträge zu Ehren von Bärbel Kramer (P. Kramer)* (Berlin-New York 2009) 32-71.

<sup>72</sup> *P. Lond.* 3.1177 (p. 186) (AD 131-132), where acanthus and sycamore wood is used in the construction of irrigation machines. See *P. Oxy.* 36.2778 (second or third century) for acanthus wood used in the construction of a water-wheel, similarly *P. Oxy.* 55.3805.102-3 (AD 566 or later), for wood used for an 'irrigator'. *P. Oxy.* 14.1674 (third century) is a private letter, which clearly indicates the importance of acacia trees to embankments.

order to have all possible attention during the time of watering, and when it is the proper time for planting, then let them ... set them in the royal embankments. The guarding of them must be done by the contractors in order that the plants suffer no damage from sheep or any other cause. In your further tours of inspection notice also whether any cut trees are left on the embankments or in the fields and make a list of them.<sup>73</sup>

In the Roman period, the situation was similar. Planting and use were carefully regulated. The felling of trees was controlled, as was the transport and sale of timber. A number of documents from Oxyrhynchus serve to illustrate this. An early first century papyrus records the sale through auction by the state of acanthus and persea wood felled on embankments, and a later second-century text preserves details of the purchase of wood in similar circumstances.<sup>74</sup> In both cases, the trees were on land which was under control of the *idios logos*, and was thus either ownerless, had reverted to the state from individuals who had died intestate, or had been confiscated. Two points follow, that this was an important way for the state to derive extra income from resources from otherwise unproductive land, and it shows the lengths the state was prepared to go to do so. In the first-century text, a series of reports from various individuals tasked to investigate the wood on such land seems drastically to outweigh its value of 18 drachmas. A fourth century text reveals interesting details on the use of wood for repairs to city buildings; it is a report from the president of the guild of carpenters to the *logistes* (an official in charge of city finances), concerning a persea tree in the city which no longer bore fruit, and could presumably be felled to provide timber.<sup>75</sup>

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<sup>73</sup> *P. Tebt.* 3.703.191-211 (210 BC).

<sup>74</sup> *P. Oxy.* 9.1188 (AD 13) and *P. Oxy.* 8.1112 (AD 188).

<sup>75</sup> *P. Oxy.* 1.53 (AD 316). On the *logistes*, see A.K. Bowman, 'Some Aspects of the Reform of Diocletian in Egypt', *Akten des XIII. Internationalen Papyrologenkongresses* (Munich 1974) 43-51, esp. 43, with J. Lallemand,

There is little evidence for matters such as ship-building in the papyri, possibly because of its obvious proximity to the river Nile, and the unlikely preservation of papyri in a wet environment. However, in an important group of letters preserved in two papyri from the city of Panopolis, we have an unusually clear nugget of evidence:

Aurelius Isidorus, procurator of the Lower Thebaid, to the *strategoi* of the Procuratorial district, greeting. Let each of you compile a detailed list of the persea and acanthus wood which has been sent to the most illustrious city of Alexandria and to the city of Nikiu, and let it be sent immediately to the office of the procurator, specifying how much of each wood was sent down, and of what dimensions, and by what overseer or conductor, by what ship-captains, and on what day. For my lord Domnus, the most eminent *katholikos*, is anxious to have this information to compare with the production figures of the shipyards there.<sup>76</sup>

Control of the felling of trees extended, it seems, to a stockpiling of timber, cut to specific lengths, carefully recorded by officials, and transported by liturgists. More interesting still is the measurement of this against production figures. What we have here is an interesting interplay between the public and private spheres in Roman Egypt, which is one of the curious features of the province. More information would enable us to look at ways in which the production of resources fed into linked industries.

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*L'administration civile de l'Égypte de l'avènement de Dioclétien à la création du diocèse (284-382)* (Brussels 1964) 108-111.

<sup>76</sup> *P. Panop. Beatty* 2.211-14 (AD 300). For more on these texts and ship-building, see N. Lewis, "In the World of P. Panop. Beatty: Ship Repair," *BASP* 38 (2001) 89-95 and C.E.P. Adams, "Nile Grain Transport under the Romans," in A.K. Bowman and A. Wilson (eds.), *Trade, Commerce, and the State in the Roman World* (Oxford forthcoming).

The transport of timber alluded to in the Panopolite papyrus is comparable to other cases and periods and seems largely to have been carried out in a similar way to the transport of tax grain for the *annona* or of military supplies – largely through liturgies. A papyrus from the Arsinoite nome is the only evidence we have, and again is part of the archive of the banker Sabinus.<sup>77</sup> In this document, the chairmen of the ναύκληροι of the Arsinoite nome are paid for transporting 22 logs of acanthus wood from the Polemon division of the nome to the village of Bukolon in the Themistos. It is not specifically stated whether this is a private matter or state business, but the banker Sabinus, we are told, was ‘authorized to pay’, and given that the other receipts all concern state business, it is likely to be the case here. The ναύκληρία was not a liturgy at this time, so transport was undertaken through contractual agreements between ναύκληροι and the state.<sup>78</sup> A third-century document from Oxyrhynchos suggests that wood owned by the government was transported on ships perhaps requisitioned for transport by the state: ‘From the *strategos* to the comarchs and officials of the villages of Taampemou and Seruphis. Send at once the acacia wood which has been cut at Ionthis to the ... ferry, and put it on board the state ship which is stationed there’.<sup>79</sup>

### *Conclusion*

The consideration of timber throws up similar patterns and questions encountered in our discussion of other resources. It is time now to go from particular evidence to some broader observations. We need a clearer understanding of the status of land on which natural resources such as natron were found, as well as the rights that the state had to sell the products of land that came into its ownership. It would be useful to have a better picture of how the state administered resources at a high level; the *procurator ad Mercurium* was involved in the different stages in production, transport and sale of some of these natural resources. Perhaps

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<sup>77</sup> *P. Col.* 1<sup>ro</sup> 4, col. 10 (AD 155).

<sup>78</sup> See Adams (n. 76).

<sup>79</sup> *P. Oxy.* 12.1421 (third century).

the reason for such high level administration was, as Wallace put it, that ‘it may be considered certain that any trade or occupation of any consequence was in some way made to yield revenue to the central administration of the country’.<sup>80</sup> What is clear also is that the administration and day-to-day running of these ‘monopolies’ was devolved, as always, onto the local population of Egypt through liturgies. This raises the further issue of the relationship between the public and private spheres: if contractors were indeed private individuals, they were increasingly overseen by liturgists, who were accountable to state officials. Interesting overlaps exist.

On top of this, the Roman state exacted taxes, and an important link existed between these natural resources and capitation taxes. The salt tax, for example, is well known in the Ptolemaic period, and now much better understood through work by Dorothy Thompson and Willy Clarysse. It allowed the state to collect taxes on trades associated with resources. Beyond taxes, the administration of natural resources offered more advantage to the state. It brought marginal and unproductive land, not into cultivation, but at least into profit generation. The same is true for ownerless or confiscated land, which may not be immediately or easily brought into cultivation. Additionally, it allowed the state to regulate these industries, control prices and limit competition. I hope to have shown that a full synthesis of the administration of natural resources in Roman Egypt would add considerably to our knowledge of the economy of this rich province.

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<sup>80</sup> Wallace (n. 7) 181.