

COTTON IN ROMAN EGYPT: SOME PROBLEMS OF ORIGIN

John-Peter WILD*

The caves of At-Tar on the western scarp of the Kerbala Plateau, a short distance east of the Euphrates, presented Professor Hideo Fujii with an exceptional archaeological challenge. The At-Tar monographs (Fujii 1976; Fujii 1980) and subsequent articles in *Al-Rāfidān* are testimony to his ability to rise to the occasion. The caves contained inhumation burials, broadly of late Hellenistic and early Roman date, furnished with some very well preserved textiles and matting in a wide range of decorative techniques. Research at the site and in the laboratory has enabled Professor Fujii, Mrs Kazuko Sakamoto and their colleagues to demonstrate the pivotal position of the textile assemblage in the study of the technological relationships between the Mediterranean and Western and Central Asia in antiquity (Fujii 1980: 44–76, fig.I-54, table I-6).

In tribute to Professor Fujii this paper sets out to explore some East-West textile problems that turn on the place of cotton in Roman Egypt and the Red Sea trade (Fig. 1). The starting point for the enquiry is the port of Berenike on the Red Sea coast of Egypt, an important staging post in Rome's trade with South Arabia and India (Meredith 1957; Sidebotham 1991). Founded by Ptolemy II Philadelphus in 275 BC (Strabo, XVII.1.45; Pliny, *Naturalis Historia* VI.23.103), it was at the height of its commercial success in the early imperial period when it was well known to the anonymous shipper and author of the *Periplus Maris Erythraei* (Casson 1989: 94–7, 143–4; *Periplus ME* 1–2). Although the Roman government maintained a strategic road link from Berenike to Coptos in the Nile Valley (Raschke 1978: 648; Sidebotham, Zitterkopf 1995), by land the site had much attenuated lines of communication and its resident community must have been extremely sensitive to any fluctuations in the economic climate, not to mention local security. Nonetheless, recent fieldwork and excavation at Berenike by S.E.Sidebotham and W.Z.Wendrich (Sidebotham, Wendrich 1995) has demonstrated that the town still had a thriving population until about AD 500.

The first two seasons of excavation (1994, 1995) have yielded over 400 textile fragments, most of them from the midden deposits that accumulated during the fourth-fifth century occupation (van Waveren 1995; Wild, Wild 1996). Approximately 48% of the rags could be identified under the microscope as being of cotton - an unexpectedly high proportion for a Roman-period site.

The cottons themselves could be separated into two groups. The first, amounting to just under half of the collection, was woven in 1/1 plain tabby exclusively from Z-spun (clockwise-spun) yarns - termed Z/Z below. (For explanation of ancient textile technology see Wild 1970; Wild 1988.) Most had no special features and were of medium to fine quality. A number carried an overall check pattern, alternating stripes of blue-dyed with undyed yarn in both warp and weft. Some had self-bands, bundles of weft forming prominent ribs at intervals down the cloth, and at least one showed remains of a cut pile. One piece, perhaps two, carried a narrow tapestry band from which most of the dyed wool had disintegrated. Most striking of all were scraps of at least two resist-dyed cottons, decorated with floral patterns (van Waveren, Wendrich 1995: 66 pl.32). The latter were achieved by painting the design on the cloth with a resist medium such as wax and then dyeing it blue, presumably with indigotin derived either from woad or indigo.

The second group was woven from S-spun yarns (S/S) and there were a few basket weaves (paired warp and weft) and half-basket weaves (paired warp *or* weft) among the simple tabbies. Again, most

* Department of Archaeology, University of Manchester, Oxford Road, Manchester M13 9PL, England

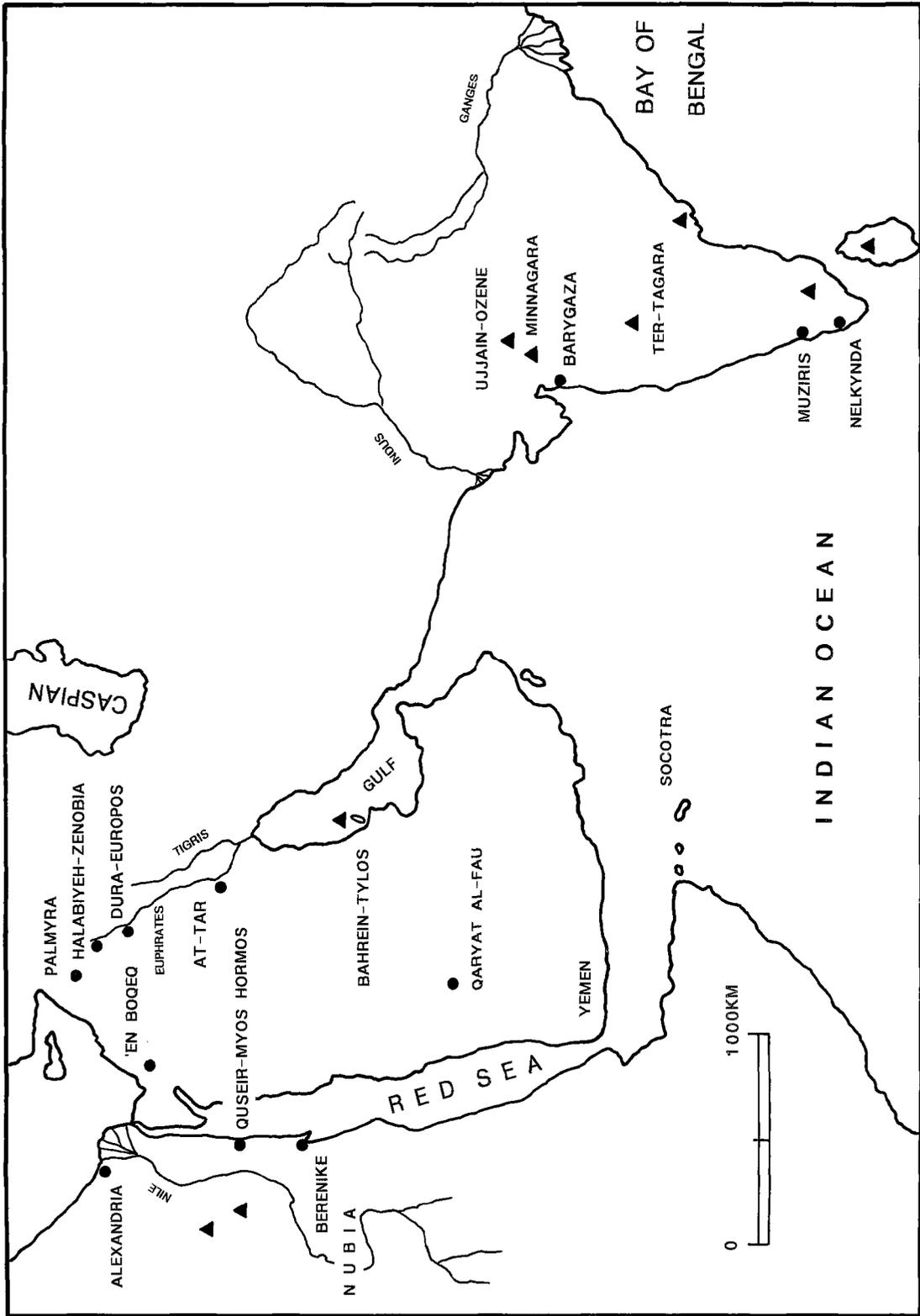


Fig. 1 Key findspots and production centres of cotton in the Roman Empire and beyond. (Filled triangles denote attested centres of cotton growing.)

fabrics were of medium quality or better; there were a few checks and self-bands, and one instance of looped pile decoration.

Spin direction was the most obvious, but not the only, distinguishing factor. The Z/Z cottons had medium to hard spun yarns whilst those of the S/S fabrics were sometimes so over-spun as to give a crêpe-like effect. The Z/Z cottons by and large were well preserved, whilst the S/S cottons had a soapy feel and had begun to deteriorate.

It is difficult to avoid the conclusion that these two groups of cotton textiles reached Berenike from different sources. The problem lies in identifying those sources. The contrasting spin-directions of the yarns give the first hint; for Ptolemaic and Roman spinners in the Nile Valley preferred to twist textile fibres in an anticlockwise (S) direction (Bergman 1975: 13; Mayer Thurman, Williams 1979: 38) and the same holds good for Roman Syria and Mesopotamia. Where Z-spun yarn is used, it tends to be in some specialised context (Wild 1994: 14–15) or (outside Egypt) employed as weft, as at At-Tar (Ogawa, Naruse 1976: 120–201). While it would be logical, therefore, to look to the Nile Valley for the origin of the S/S spun cottons at Berenike, one would have to cast the net wider to discover the provenance of the Z/Z spun group.

There is mounting evidence in the documentary and papyrological record for the wearing of cotton clothing and, more significant, the cultivation of cotton in Egypt. The ambiguity of the Greek and Latin terms for fine cloth of vegetable origin, especially βύσσος/*byssus* and κάρπασος/*carbasus* (Isidore, *Orig.* XIX,27; Pollux VII,76; Pausanias VI,26,6; V,5,2; *Periplus ME* 41; Curtius Rufus VIII,9; Wipszycka 1965: 40) is frustrating, but where the word ἐπιόξυλον, ‘wool from wood’, appears as a substantive or adjective, there is little room for doubt. Pliny (*Naturalis Historia* XIX,1(3)) describes the cotton plant (which he calls *gossypion*), its boll and ‘cotton wool’, and states that it grows on the Arabian side of Upper Egypt. Pollux (VI,75), writing somewhat later under the Antonines, comments on the ‘cotton tree’, its fruit and the characteristics of cotton cloth, but does not pin-point its cultivation within Egypt precisely.

Local documents are more specific. Farmers near Kysis in the Kharga Oasis were raising cotton as a crop in the second century (*P. Iand.* VII, 142, II, 8) and still investing in it in the fourth (*O. Douch* 51). It also figures in a fourth-century farming account from Ismant al-Kharab (Kellis) in the Dakhla Oasis (Jenkins, Wagner, forthcoming; Wagner 1987: 291–3).

More numerous are the references to cotton shirts and even outer garments. Letters sent to Oxyrhynchus and Karanis in the second century (Winter, Youtie 1944) mention respectively a cotton shirt (*P. Ox.* LIX,3991) and ‘cottons’ (*P. Mich.* VIII,500,7). Unprovenanced papyri describe the search for a cotton shirt (*SB* VI,9025) and cotton outer garments for working in the fields (*SB* VI,9026) and another (*P. Lond.* III,928) lists cotton yarn (?). Pollux (VII,75) speaks of cloth with cotton weft and linen warp, and at least one of the papyri seems to echo him (*SB* VI,9026). Such union fabrics are rare among Roman finds (Sheffer, Tidhar 1991: 22), but became very popular in the Middle Ages as fustian (Lamm 1937; Watson 1983: 39, 165).

On the Upper Nile, south of the Dodecaschoenos, Pliny notes that cotton ‘trees’ were grown in ‘Aethiopia’ (*NH* XIII,90). Finds of cotton seeds and lint dating to the early third millennium BC at Afia in Lower Nubia may attest an early stage in the evolution from a wild to a cultivated plant and suggest that cotton was an old established crop in that region (Chowdhury, Buth 1971). (The botanical definition and distribution of the varieties of cotton known in antiquity is debatable and need not concern us here (Watson 1977).) For the Roman period Pliny’s statement is supported by regular finds of cotton textiles on archaeological sites in Nubia. Grace Crowfoot and F.L.Griffiths in a classic paper (1934) drew attention to cotton cloth discovered at Karanog and Meroë, and recent rescue excavations at Qasr Ibr im (Crowfoot 1977: 46; 1979) and at a string of cemeteries further upstream (Mayer Thurman, Williams 1979: 37; Bergman 1975: 13) strengthen the impression that locally grown cotton was commonly worn (*pace* Gervers 1990: 13–16). Miss E.C.Crowfoot (pers. comm.) has described the character of

the cottons in almost exactly the same terms that we used for the S/S cottons at Berenike. S-spin, moreover, is the rule on the Upper Nile, and the occasional Z-spin cottons in the tombs mostly date to after the Arab conquest (Bergman 1975: 13).

It would be tempting to propose without further ado that the Berenike S/S cottons are of Nubian origin; pottery was being brought to Berenike in late antiquity from the Aswan area (Hayes 1995), and textiles could be regarded as an attractive parasitic cargo. Gervers (1990: 14) has argued that the heyday of cotton in Lower Nubia fell in the century and a half before the collapse of a strong Meroitic authority in the region c.AD 330-350 and drawn attention to the popularity of camel-hair fabrics at some sites thereafter. The situation is not clear-cut, however; for animal-hair fabrics are unlikely to have replaced cottons functionally. Nonetheless, the apparent decline of cotton-wearing - if not cotton growing - in Lower Nubia at just the time when Berenike might have been drawing on this area is a difficulty. The evidence for cotton as a crop in the oases, however, cited above, is more reliable. Whether the inhabitants of Berenike obtained their S/S cottons from there or from Nubia or from a source so far unrecognised is less important to establish than it is to admit the very strong probability that these fabrics were manufactured somewhere in the Nile Valley and not overseas.

Greater obscurity attaches to the source of the Z/Z cottons at Berenike. Cotton forms a very small proportion of the textile assemblages from sites within the Roman province of Egypt and Z/Z cottons are rarer still. Research on the unpublished fourth- and fifth-century textiles from Karanis in the Fayum has identified no Roman cottons so far (J. Batcheller, pers.comm.) and Wilson in her selection (1933: 50 no. 133) notes only a skein of red cotton yarn. There is a single find of plain Z/Z cotton tabby from Akoris in Middle Egypt (Kawanishi, Tatsuno 1995, 279), but it may not be securely stratified: after the Arab conquest Z/Z cottons are a familiar textile type (Brookner 1979; Pfister 1937a). Excavation at Abu Sha'ar (Bender Jørgensen, Vogelsang-Eastwood 1991: 3) yielded one Z/Z cotton, resist-dyed (see below). At Quseir al-Qadim, however, there are at least 13 Z/Z cottons from closed Roman contexts (Eastwood 1982: 302-304 nos 5, 22-23, 29-33, 35, 50-51, 150, 206) - a small percentage of the total corpus, but significant nevertheless. Quseir has now been convincingly identified as the Myos Hormos of the Graeco-Roman handbooks (Peacock 1993; Bülow-Jacobsen, Cuvigny, Fournet 1994), the second main Roman entrepot on the Red Sea coast; it may be more than coincidence that the findspots of both groups of Z/Z cottons are seaports engaged in the Red Sea trade.

Outside Egypt cotton turns up in the textile record of several sites in the Roman provinces of Arabia, Judaea and Syria, and just beyond the borders in Partho-Persian Mesopotamia; but its character varies greatly from place to place. The earliest find, with a *terminus ante quem* of the mid first century AD, is a piece of cotton netting from the 'tomb of Jason' in Jerusalem (Rahmani 1967: 93-4, pl.24A), which seems to comprise cords Z-plied from (possibly) S-spun yarn. Most cottons from Judaea/Palaestina, however, are late Roman: Nessana yielded three Z/Z and two S/S fabrics (Bellinger 1962: 92) and 'En Boqeq 14 plain S/S fragments and 3 union fabrics (8% of the assemblage) (Sheffer, Tidhar 1991: 22-23). A curious series of lepper burials (c.AD 800) at the monastery of John the Baptist near Jericho (Kasr al-Yahud) were wrapped in linen (75%) and cotton (25%) shrouds; but only 10 of the 60 cottons were Z/Z, the rest being either S/S or S/Z (Shamir, pers.comm.).

The tombs of the mercantile aristocracy at Palmyra, who enjoyed long-distance trading connections with the Indian Ocean before the city's fall in AD 273, contained surprisingly few cottons - just 3% (mostly Z/Z) on a recent count (Stauffer 1995: 59-60, Abb.100, 101). Pfister himself, however, who published most of them (Pfister 1937b: 15-16, 19-22; 1940: 11, 18-19), was sceptical of the Roman date of several pieces, perhaps unnecessarily. At Halabiyeh-Zenobia on the upper Euphrates (TAQ AD 610) coarse Z-spun cotton, blue and apparently hank-dyed, was frequently incorporated into tapestry-woven ornament; there is only one plain fabric, a tunic, and that is S/S spun (Pfister 1951: 55 and *passim*; Nockert 1988: 92-3). Further downstream at Dura-Europos (TAQ AD 256/7) the one example of cotton is recorded as S-spun weft in a wool textile (Pfister, Bellinger 1945: 52-3 no.262A). The

At-Tar burial caves closer to the mouth of the Euphrates contained more cotton fabrics (Fujii 1976, 130 Table IV-1; 1980, 181–198); at least 19 were Z/Z, 5 S/S and 8 S/Z, but they were greatly outnumbered by wool, linen and hair cloth fragments.

In sum: the intersite variability, coupled with the statistically small percentage of cotton fabrics and yarns in the textile corpora outside Egypt, distracts rather than helps the search for the origin of the Berenike Z/Z cottons. The regional liking for cloth with S-spun warp and Z-spun weft, evidenced at At-Tar in wool as well as cotton and possibly echoed in Judaea, indicates, if such fabrics were locally woven, that a trade in cotton yarn needs to be considered: this is borne out by the poorly dyed cotton weft employed at Halabiyeh. Spin direction alone therefore is not the sole key to this question of provenance. Before examining other criteria, however, it may be useful to review the areas in which cotton cultivation is attested in antiquity.

North-West India, Watson has cogently argued (1983: 31–32, map 3), was the principal home of Old World cotton. Prehistoric finds leave no doubt that it was an established crop there by the late third millennium BC (Kajale 1991; Betts et al. 1994: 496–7). Herodotus (III, 106; VII, 65, 1) in the fifth century BC and Theophrastus (*Historia Plantarum* IV, 4, 8) in the late fourth describe the fruit and cotton wool explicitly. Sennacherib's unsuccessful horticultural experiment with cotton at Nineveh during the early seventh century BC is arguably the first sign of the plant's diffusion westwards (Betts et al 1994: 497). By the fourth century BC cotton was also being cultivated successfully on Bahrein (Tylos) and 'in Arabia' (Theophrastus, *HP* IV, 7, 7–8; *pace* Calvet 1984: 344). Whether Pliny's comments about Bahreini cotton in the first century AD (*NH* XII, 10–12 (21–22)) add anything new is not apparent. In the late sixth century AD Gregory of Tours (*Liber in Gloria Martyrum* 17) speaks with convincing circumstantial detail of cotton growing near Jericho.

Commentators in the past, such as Pfister, assumed that all Roman cotton was an import from India, and it is hard to deny on the evidence of the *Periplus* that India was a major source. The author of that handbook frequently mentions the cotton cloth which could be obtained at the port of Barygaza (Broach) on the Gulf of Cambay. Barygaza served as the outlet for cottons from some far-flung regions of the hinterland - from Minnagara (possibly Baroda) (*Periplus Maris Erythraei* 41), from Ozene (Ujjain) some 200 miles north-east of Barygaza (*Periplus* 48) and from Tagara (?Ter) 300 miles to the south-east (*Periplus* 51). The term the writer uses for the fibre (κάρπασος) can in the context hardly mean anything except cotton (Gopal 1961: 61; Ernout, Meillet 1967: 99). From κάρπασος were made webs of cloth (ὀθόνια, σινδόνες) specified as 'ordinary'. If σινδόνες refer to cotton sheets (*pace* Casson 1989: 292–3), then Argalu (Argaru) at Trichinopoly near the southern tip of India (*Periplus* 59), the island of Sri Lanka (*Periplus* 61) and Masalia (Masulipatam) on the east coast (*Periplus* 62; Casson 1989: 232) were also cotton-producers. Casson (1989: 16) thinks that their wares were picked up by Roman shippers at one of the south-western ports such as Muziris (Cranganore) or Nelkynda (Pirakkād). The peppercorns found at Berenike in 1995 must also be South Indian.

Several of the Indo-Greek textile terms quoted by the author of the *Periplus* (*monache*, *sagmatogene*, *molochina*) are obscure, and there is no certainty that they refer to categories of cotton, although Casson has argued for that (1989: 249, 251). Whatever they may have meant, the cotton goods carried by Red Sea traders were evidently plain, undecorated, webs of cloth. Their character thus contrasts with that of traded textiles in the Mediterranean where transactions were almost entirely in recognisable garments or items of furnishing, in a finished or semi-finished state (*Edictum Diocletiani* XIX, XXVI).

A remarkable echo of the *Periplus* is to be found in *P. Vindob. G.* 40.822, a papyrus of the mid second century AD bought on the Egyptian antiquities market (Harrauer, Sijpesteijn 1985; Thür 1987; Casson 1990; Sidebotham 1991: 30–31). The verso lists the contents of a cargo of luxury goods - boxes of Gangetic nard, ivory tusks and sheets of cotton cloth - that on the strength of a loan raised at Muziris in India had been purchased and shipped to Egypt. The recto details an agreement for their safe transport by camel from the port of entry on the Red Sea coast overland to Coptos and thence down

the Nile to Alexandria.

The consignment of cotton is in the form of 54 *σχίδοι*, provisionally taken as 'sheets' (Harrauer, Sijpesteijn 1985: 148–9; Hesychius, s.v. *σχίδα*, *σχίδος*, *σχίδια*), each weighing about 23.16 Roman lbs or 7582g (*P. Vindob. G.* 40.822, col.2,16–25; Casson 1990: 198–199). Extrapolating from a formula of $1\text{m}^2 = 182\text{g}$, based on a modern medium-weight cotton bed sheet, each *σχίδος* would measure about 41.6m^2 . If a loom width of over 2m were supposed, the warp length on this showing would be 20.8m. While it would be unwise to claim that this is an impossible length on (say) a ground loom (Picton, Mack 1989: 46), it seems implausible. Accordingly, one is driven to conclude that the *σχίδοι* were not single webs of cloth like the *chartae singulae*, 'single sheets' of linen, sold as sailcloth in the time of Diocletian's Edict (Erim, Reynolds 1970, 130–1; *Edictum Diocletiani* XXVI, 264; Giacchero 1974, 202), but individual sheets parcelled up together for convenience.

The papyrus states that the Arabarchs at the port of entry had already claimed in custom's dues cloth weighing 22.75 minas (11755g), almost 3% of the consignment of textiles (Casson 1989: 199; Sidebotham 1986: 102–105). One must assume therefore that Indian cotton was off-loaded - and possibly subsequently sold - at either Berenike or Myos Hormos, the two main entrepôts. One cannot unfortunately decide in favour of the one or the other; for it is not certain that the commercial life of Quseir-Myos Hormos, known to be short, was over by the mid second century, the date at which the agreement was drawn up (Bagnall 1986: 4; D. Whitcomb, pers.comm.). Nevertheless there is a more than even chance that Berenike was the tax point and that Indian cotton is somewhere among the site's textiles.

At first sight this line of argument appears to support Pfister's contention about the Indian origin of all Roman cotton. There is no firm archaeological evidence yet, however, for the nature of Indian cotton cloth in its homeland at the period of the *Periplus*; but scholars assume that the Z spin-direction prevailed there in antiquity as in the later Middle Ages (Bellinger 1959: 2; Pfister 1951: 32). If so, the tradition would coincide with that of the spinners responsible for the Z/Z cottons at Berenike. It should be noted, however, that the imports listed in the two shippers' documents cited above are of sheets of plain cotton cloth. The Z/Z group at Berenike by contrast contains, not just plain tabby, but also self-band and cut-loop decoration, blue checks, resist-dyed fabrics and cloth incorporating tapestry-woven wool bands. These give pause for thought; for their distribution as presently known is limited geographically.

Self-bands, which give a subtle ribbed effect in the weft direction were an age-old feature of linens woven in the Nile Valley (van t'Hooft et al. 1994: 32–33) and it is no surprise to find them on cottons in the eastern Roman provinces (Sheffer, Tidhar 1991: 23 fig.28 Cat. n. 101). Whether the technique was practised further east is unknown. Looped pile in linen - less often cut than uncut - has a similar history in Egypt (Barber 1991: 149–150; van t'Hooft et al. 1994: 146 fig.9) and the eastern Mediterranean. Again, its eastward distribution is uncertain.

Check fabrics - usually in the form of a blue-dyed grid on a pale undyed ground, sometimes open, sometimes closer set, and supplemented occasionally by extra colours - were a popular component of the decorative repertoire of weavers both in the eastern Roman provinces and in the western part of the Parthian and Persian Empires. There are examples in cotton from Palmyra (Stauffer 1995: 64 Abb.100) and from At-Tar (Fujii 1980: 191 no.8, col.pl., no.9; 195 no.30; 197 nos 33, 34). Their Roman date has sometimes been regarded as suspect, as was noted above, largely because blue-check cottons were - and are - ubiquitous in the Islamic world. But there are now enough stratified pieces to allay those fears.

Discovery or recognition of resist-dyed fabrics of Roman date is a relatively recent development. In cotton there is a parallel to the Berenike pieces from Abu Sha'ar (Z/Z) (Bender Jørgensen, Vogelsang-Eastwood 1991: 3) and several more from the tombs of Kalabsha in Lower Nubia (Strouhal 1984: 248–9, pl.83). Less certainly pre-Islamic are three fragments from the tower-tomb of Elahbel at Palmyra showing floral designs in white (reserved) on red or green (Pfister 1937b: 16 nos T71, T72, T73, pl.IV),

and one (Z/S) from the tomb of Iamblichus has linear registers in blue and red (Stauffer 1995: 64 Abb.101; Pfister 1940: 18 no.T97). There is little doubt, however, about the Roman date of a white-on-blue floral resist-dyed Z/Z cotton from At-Tar (Fujii 1976: 189 no.167, col.pl.; 1980: 186 no.11). The South Arabian site of Qaryat al-Fau is also said to have yielded 'printed' fabrics with classically inspired decoration (*Illustrated London News* 273, April 1985: 52–3). Echoes of Mediterranean themes can also be discerned on a white-on-blue resist-dyed cotton from Tomb 1 at Niya-Minfeng on the Silk Road south of the Taklamakan Desert (Vogelsang-Eastwood 1990: I-III, 63 pl.2; von Wilckens 1993: 11–18, fig.1). It is of Eastern Han date (c.AD25–221) and may be added to the list of Hellenistically inspired textiles travelling from the west towards China (Wu Zhen 1989: 50–51).

Alongside the cottons is a series of resist-dyed linens, largely white on dark blue, degaged from late Roman graves in Egypt and manifestly parts of huge wall-hangings (Kötzsche 1979: 433–436; Flury-Lemberg 1988: 358–366 Cat.no.43; Lorquin 1992: 282–284 Cat.no.117, col.pl.). The earliest resist-dyed fabrics, however, are in wool, notably the examples from Mons Claudianus (Bender Jørgensen 1991: 93). It is apparent therefore that Egyptian dyers had a good deal of experience in resist-dyeing and there is no call to regard the art as exotic.

The fifth mode of decorating the Z/Z cotton fabrics found at Berenike was the insertion of tapestry-woven wool bands. Simple bands in a colour contrasting with the ground or more complex roundels and panels had a long history in the East Mediterranean (Wild 1967) and examples are to be found in virtually every excavated textile corpus in the Roman world. Parthian and Persian art within the former Seleucid kingdom indicates that there was an equally strong tradition of tapestry weaving there, too (al-As'ad, Schmidt-Colinet 1995: 28–53). A cotton cloak from At-Tar, for instance, has the familiar first- and second-century feature of a tapestry-woven 'edge rectangle', together with H-shaped inserts (Fujii 1980: 188 nos 15, 16, col.pl.); the warp of the ground is S-spun, the weft Z-spun, a regional trait.

Of the five decorative techniques reviewed above, three - self-bands, long pile and tapestry-woven inserts - can be found throughout the Graeco-Roman world. Blue checks and the practice of resist-dyeing are both attested in the eastern Roman provinces, but in later centuries at least they were endemic in, or carried to, the furthest corners of the Islamic world. Only tapestry weaving offers any foothold in the search for the origin of the Berenike Z/Z cottons; for on present knowledge it seems confined to those weavers and lands where Hellenistic culture was a living force.

In India there is no sign yet that local weavers had taken to the art of tapestry-weaving, although according to the author of the *Periplus* fancy textiles from Roman Egypt found a ready market in the Indian kingdoms (Casson 1989: 21–24). Eager reception of Graeco-Roman artefacts, however, did not necessarily lead to active production abroad of goods in the same style. Nonetheless there is a growing recognition that there were significant Hellenised communities in the Indian ports (Begley, De Puma 1991) and this fact might one day force a revision of the present disinclination to accept the idea of Indian tapestry weaving.

Much closer to Egypt the high reputation of Yemeni textiles in the Islamic East (Serjeant 1972: 122–134) may encourage one to speculate about their antecedents. But cotton growing in the Yemen on a commercial scale is not attested before the tenth century (Watson 1983: 39–41), and in the early Roman period the region was a net importer of Indian cotton (*Periplus* 31, 32). No cotton, moreover, was reported among the textiles at Qaryat al-Fau, capital of the South Arabian state of Kinda (al-Ansary 1982: 24).

Between South Arabia and India lies the Gulf, where cotton was already being grown on Bahrein in the fourth century BC, as was noted above. Much of that region was in the hands politically of the Hellenised Parthian and later Sasanian Persian rulers, but even in eastern Arabia outside their direct control there is evidence in the archaeological record for considerable Graeco-Roman influence (Boucharlat, Salles 1984: 341–350). Local weavers therefore could well have been familiar with tapestry. Given the climate and geography of the Gulf, however, it seems unlikely that it could have had an

indigenous cotton industry in antiquity based on home-grown fibre and capable of producing for export. The scale of Bahreini cotton growing must have been limited. Mesopotamia had a cotton industry in the later Middle Ages (Serjeant 1972: 39; Lombard 1978: 72–73), but there is no direct evidence for it at an earlier date.

It is by now apparent from this discussion that there can be no confident response to the question of where the Z/Z cottons at Berenike were made. To argue for on the spot production at Berenike from imported yarns merely pushes the problem away without solving it, and, given the nature of the site, is inherently improbable. At both At-Tar and at Kasr al-Yahud the yarns in the cotton textiles were recorded as S/S, S/Z and Z/Z in approximately equal numbers (see above). The position is almost identical at the early Islamic site of Nahal 'Omer in the Arava (Baginski, Shamir 1995: 23). It suggests that the sites were tapping directly several different sources and/or reflecting several different spinning and weaving traditions. What this means in real terms is a matter for debate.

The differences in character between the S/S and the Z/Z groups at Berenike (none are S/Z) may have given the misleading initial impression that identifying provenance should be a simple matter. Yet if Z/Z cottons from India are among the plain Z/Z fabrics at Berenike, as the wording of *P. Vindob. G 40.822* hints that they might be, we could not recognise them with our current field techniques of analysis and distinguish them from Z/Z textiles from a different region. Future progress may rest with analytical methods of provenancing which have not been tried in Egypt before.

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