

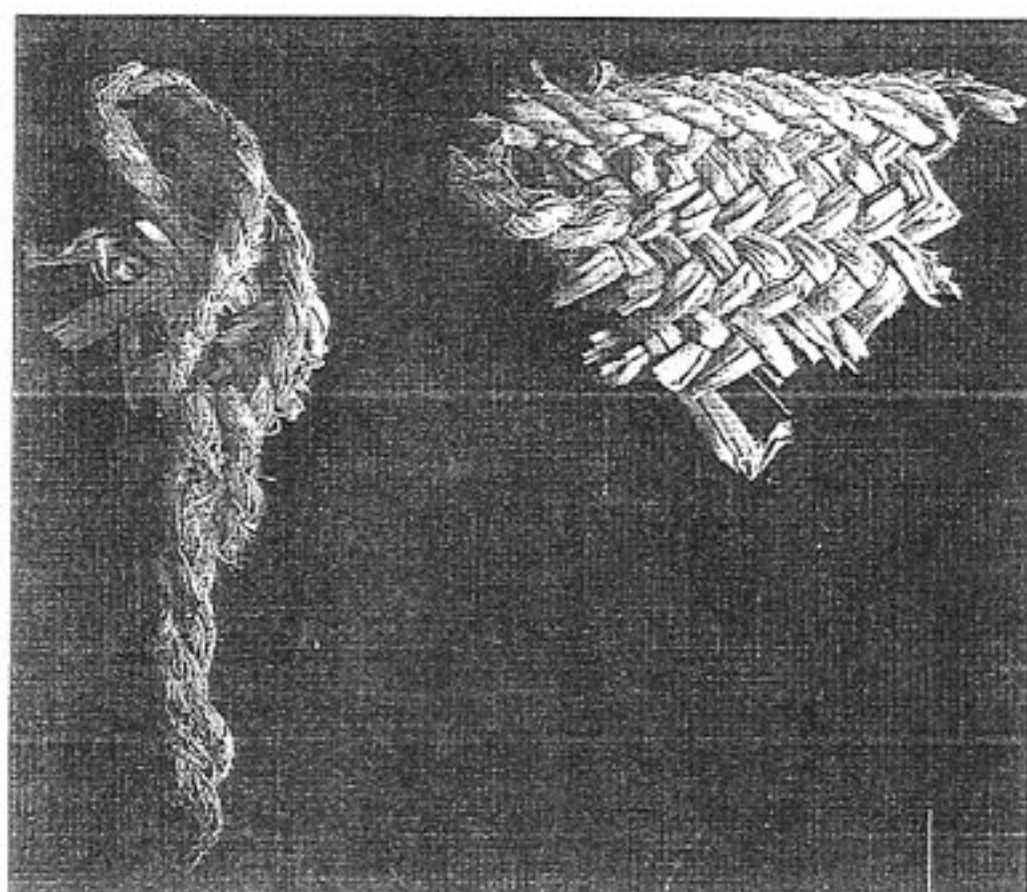
107



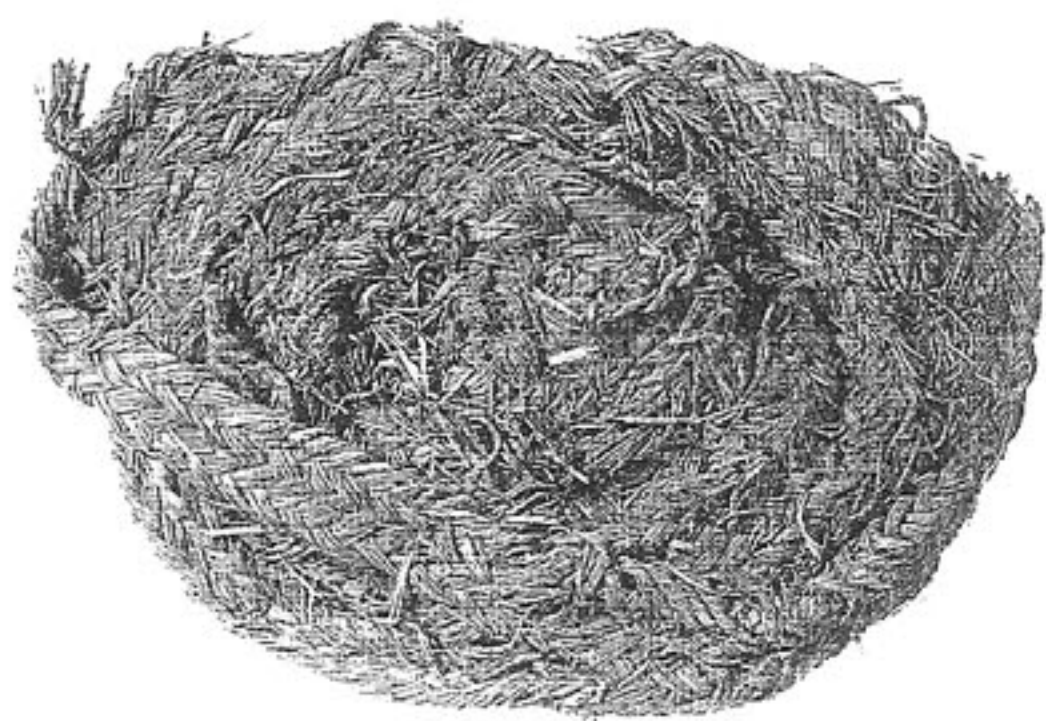
108



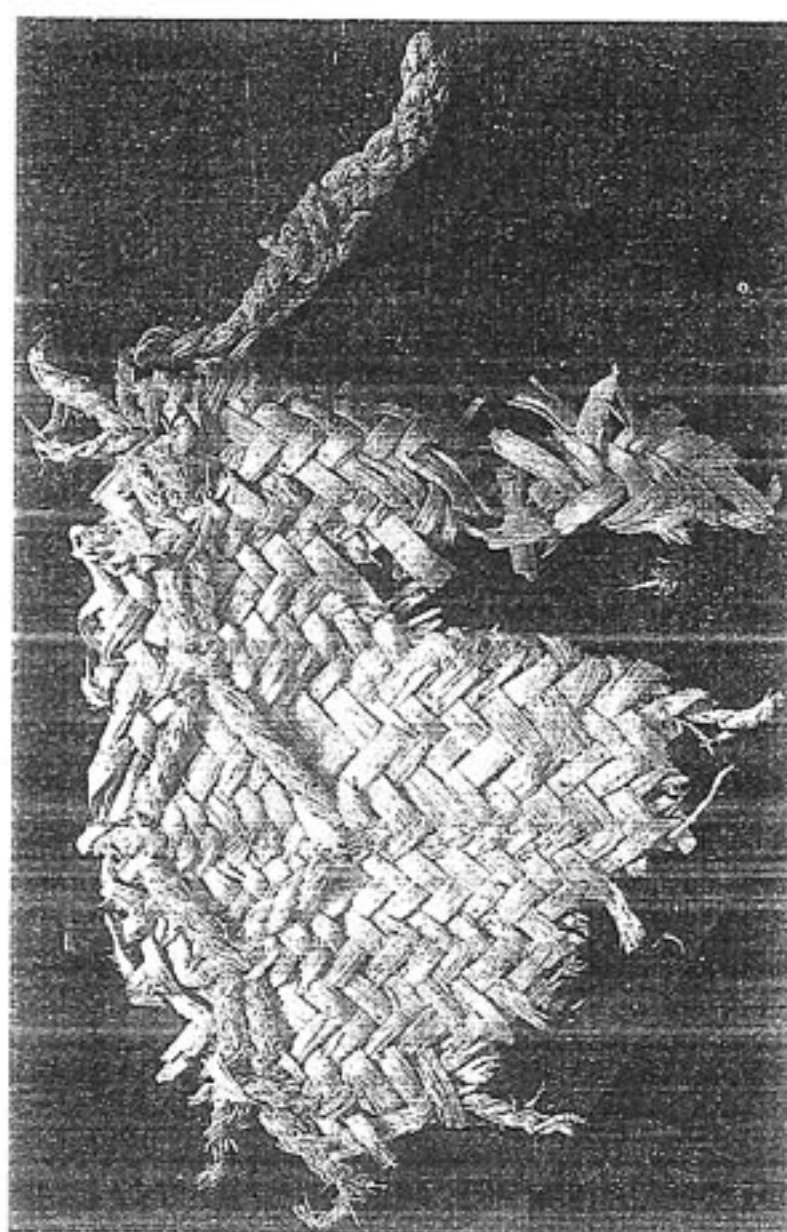
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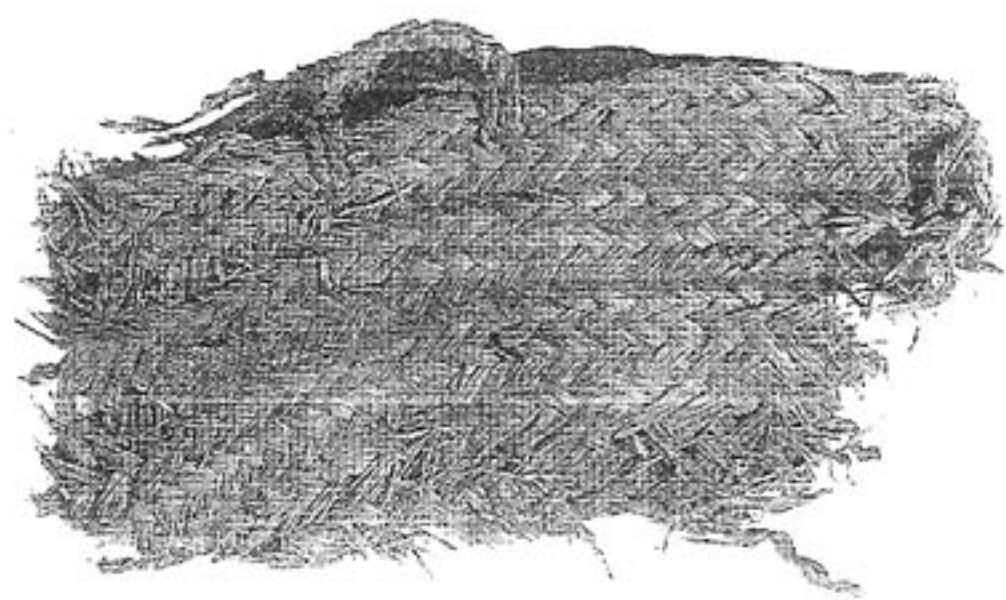
110



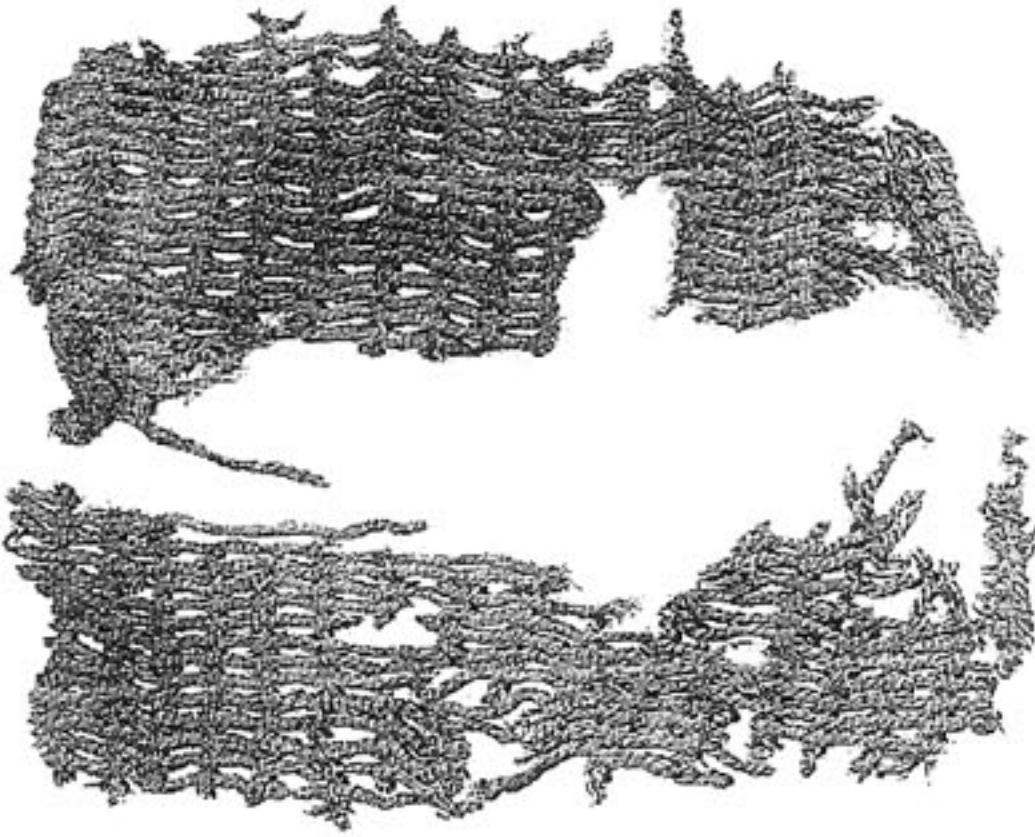
111



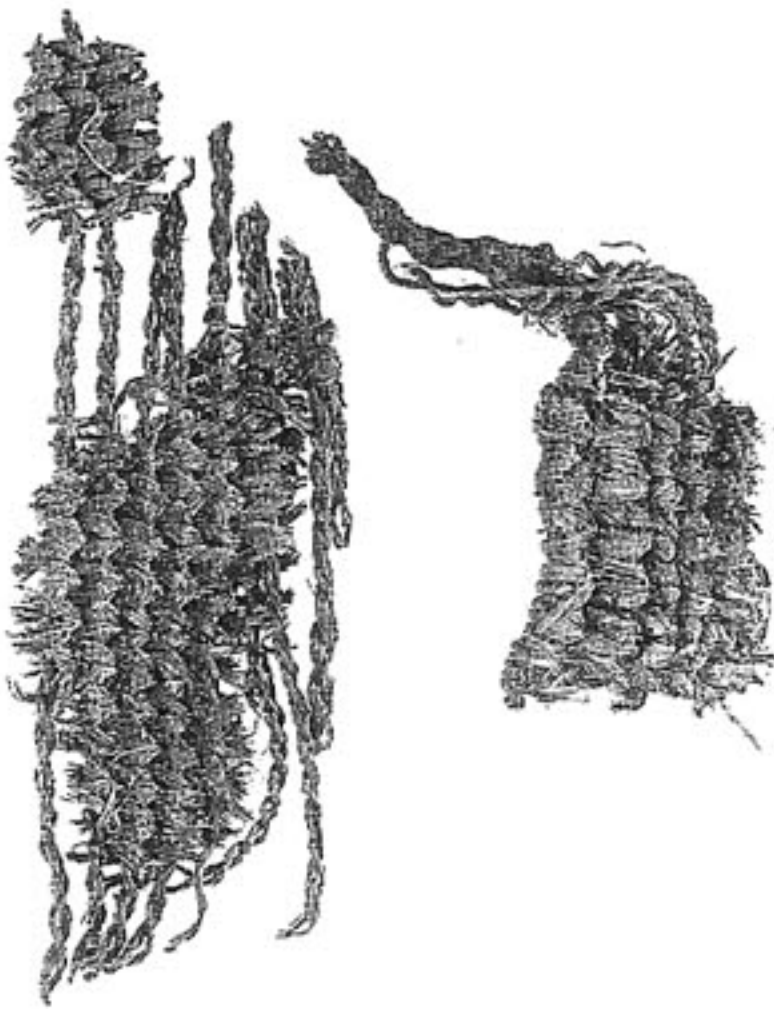
113



112



116



118

No. 117 (406/3).

Material: Unidentified.

7 × 21 cm. Close twining consisting of cords.

Warp: Completely covered by the wefts. Cords Z2S, diam. 0.6 cm, 6 elements per 10 cm.

Weft: Z-twisted; 5 elements per 10 cm.

Comm.: Fragment of a floor covering.

No. 118 (406/5). Several pieces of the same fragment Fig. 87.

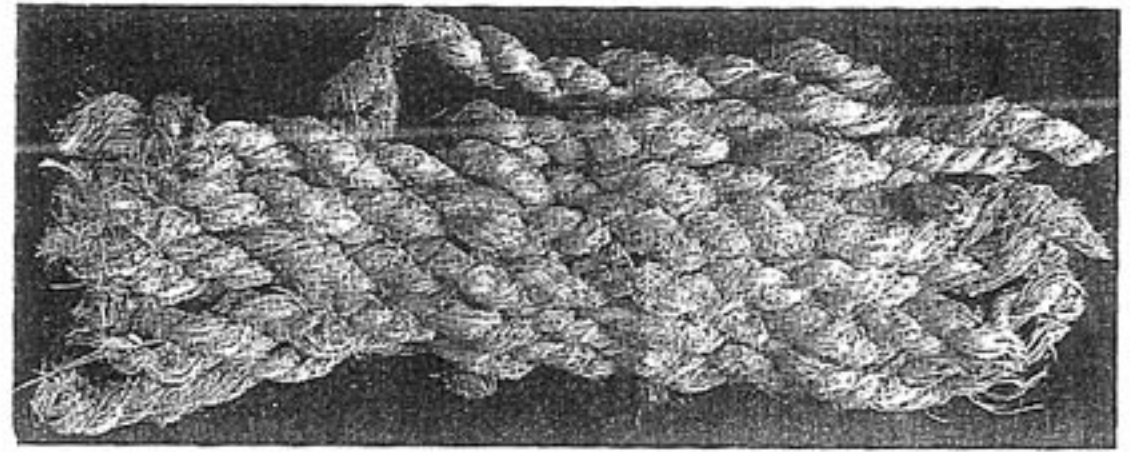
19 × 6 cm. "Countered weft twining."

Warp: Cords Z2S; diam. 0.6 cm; 11 elements per 10 cm. Material unidentified.

Weft: Date-palm leaflets not twisted; 16 elements per 10 cm.

Selv.: Z2S2Z warp cord; diam. 0.9 cm (Type B. Sheffer and Granger-Taylor 1994:169, Fig. 15).

Comm.: Close twining. The warp is completely covered by the weft. The direction of the twist alternates



117



119

in the weft rows, resulting in a chain-like formation (Schick 1988:37). Fragment of a mat.

Simple Plaiting

No. 119 (303/6).

(a) 43 × 46; (b) 63 × 28 cm. Weft-faced.

Material: Date-palm fibers (Shimony, this volume).

Warp: 2S cords; 10 elements per 10 cm.

Weft: S-twisted; 18 elements per 10 cm.

Sewing: Two cords of Z2S; overcast.

Comm.: Simple selvedge. (a) and (b) are stitched together.

No. 120 (303/8).

19 × 30 cm. Weft faced.

Material: Unidentified.

Warp: Z2S cords; diam. 0.6 cm; 3 elements per 10 cm.

Weft: Z-twisted; 28 elements per 10 cm.

No. 121 (402/180).

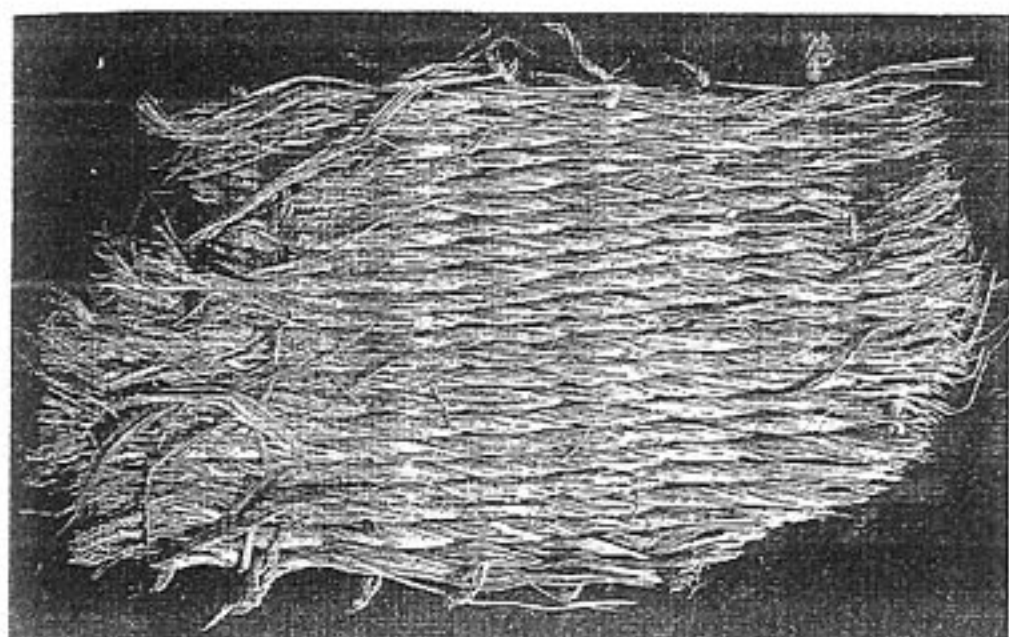
38 × 19 cm. Weft faced.

Material: *Typha domingensis* (identified by C. Shimony).

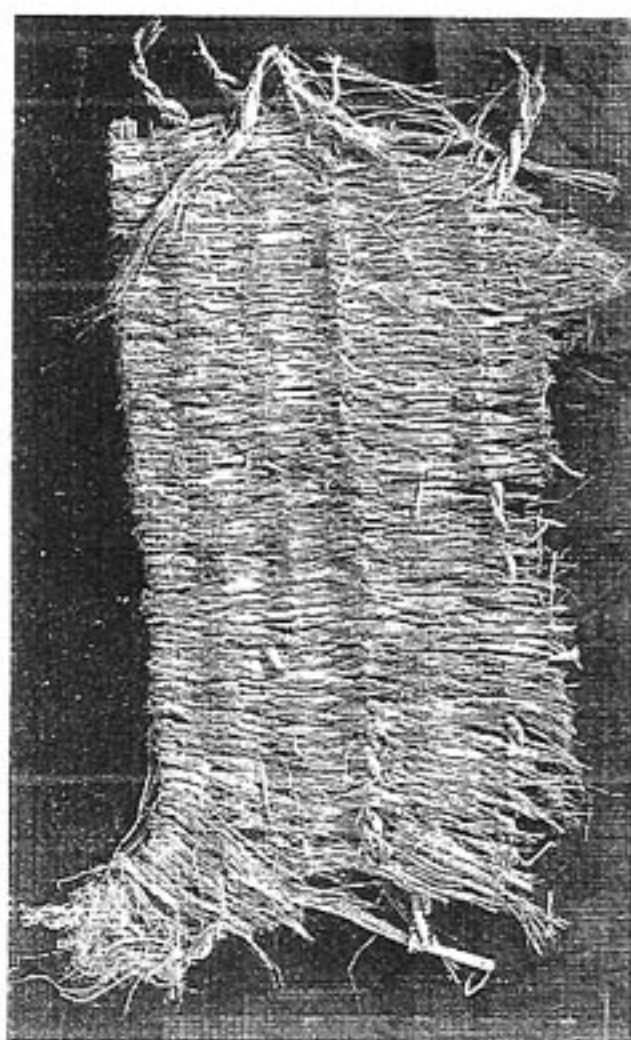
Warp: Z2S cords; diam. 0.6 cm; 4 elements per 10 cm.

Weft: Rushes; 58 elements per 10 cm.

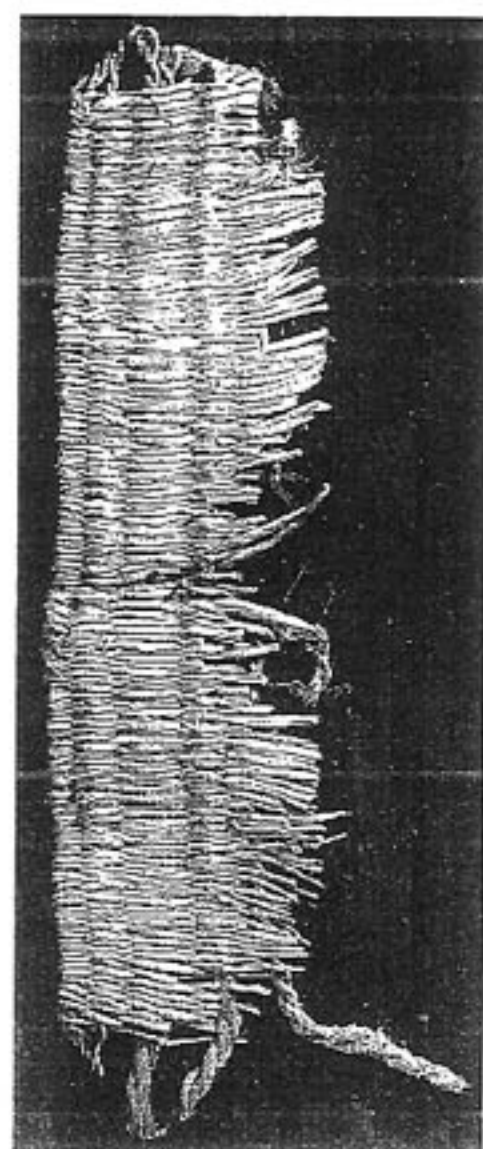
Comm.: The selvedge is made of two Z2S strands.



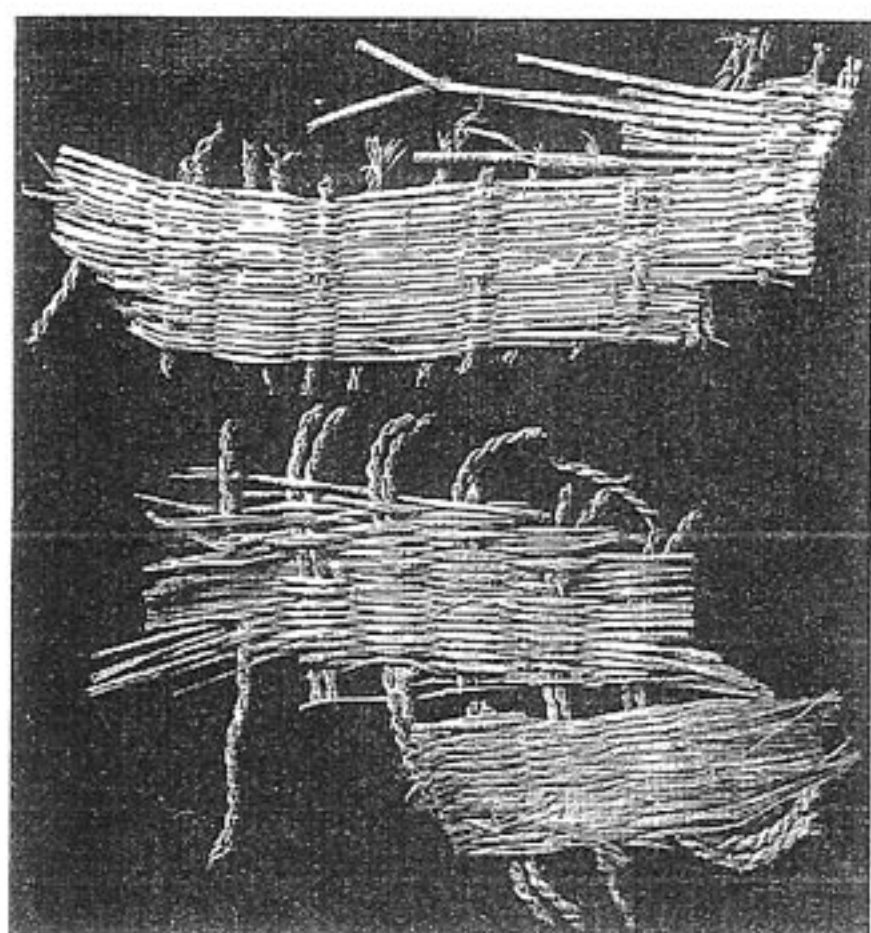
120



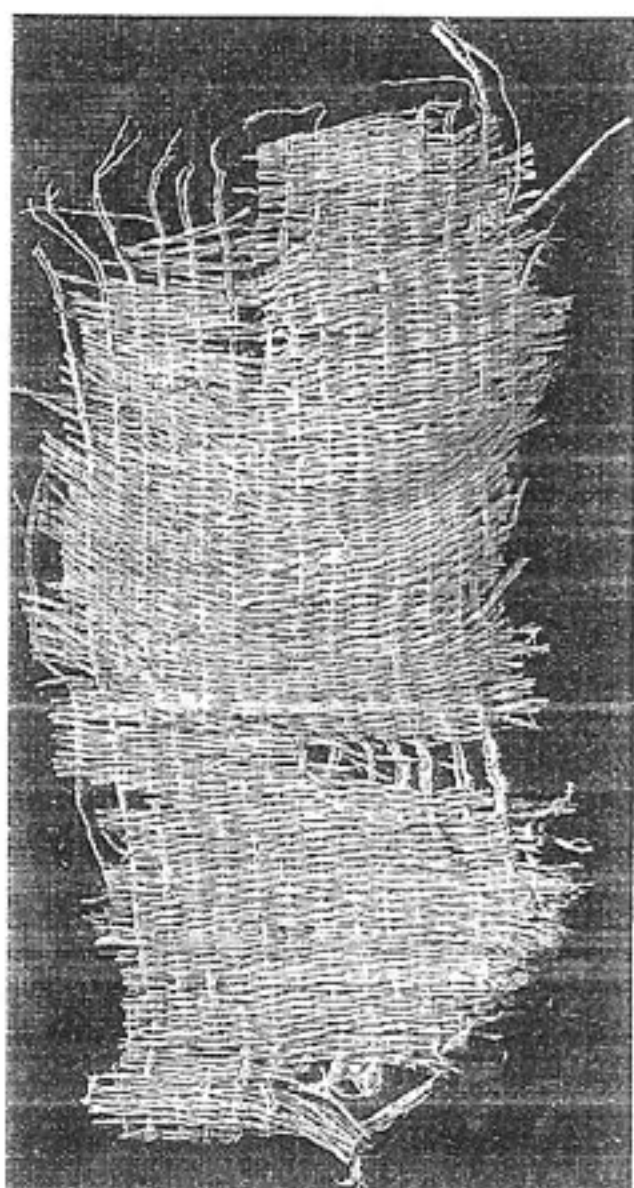
121



122



123



124

No. 122 (405/4).

45 × 12 cm. Weft faced.

Warp: Z2S and 2(Z2S) cords; diam. 0.6 cm; 4 elements per 10 cm.

Weft: Untwisted rushes; 74 elements per 10 cm.

Patt.: Stripes due to alternating smaller and greater distance between the warps.

Comm.: The selvedge is made of two Z2S strands.

No. 123 (406/2).

15 × 38 cm. Weft faced.

Warp: Z2S and 2(Z2S) cords like No. 405/4; diam. 0.4 cm; 2.5 elements per 10 cm.

Weft: Untwisted rushes; 60 elements per 10 cm.

Patt.: Stripes due to alternating smaller and larger distances between the warps.

Comm.: The selvedge is made of two Z2S strands.

Cf.: No. 122, similar warp and pattern.

No. 124 (910/2).

27 × 13 cm. Weft faced.

Warp: Linen (identified by C. Shimony); elements of 2 cords Z2S each, 14 elements per 10 cm.

Weft: Juncus (identified by C. Shimony); untwisted thin rushes, 50 elements per 10 cm.

Comm.: Very delicate, not suitable to be used as a mat.

NETTING

No. 125 (402/181b).

Size: 34 × 38 cm.

Threads: Linen (identified by C. Shimony); S2Z; diam. 1 mm. Mesh knots form squares c. 3 × 3 cm.

Comm.: Very delicate net.

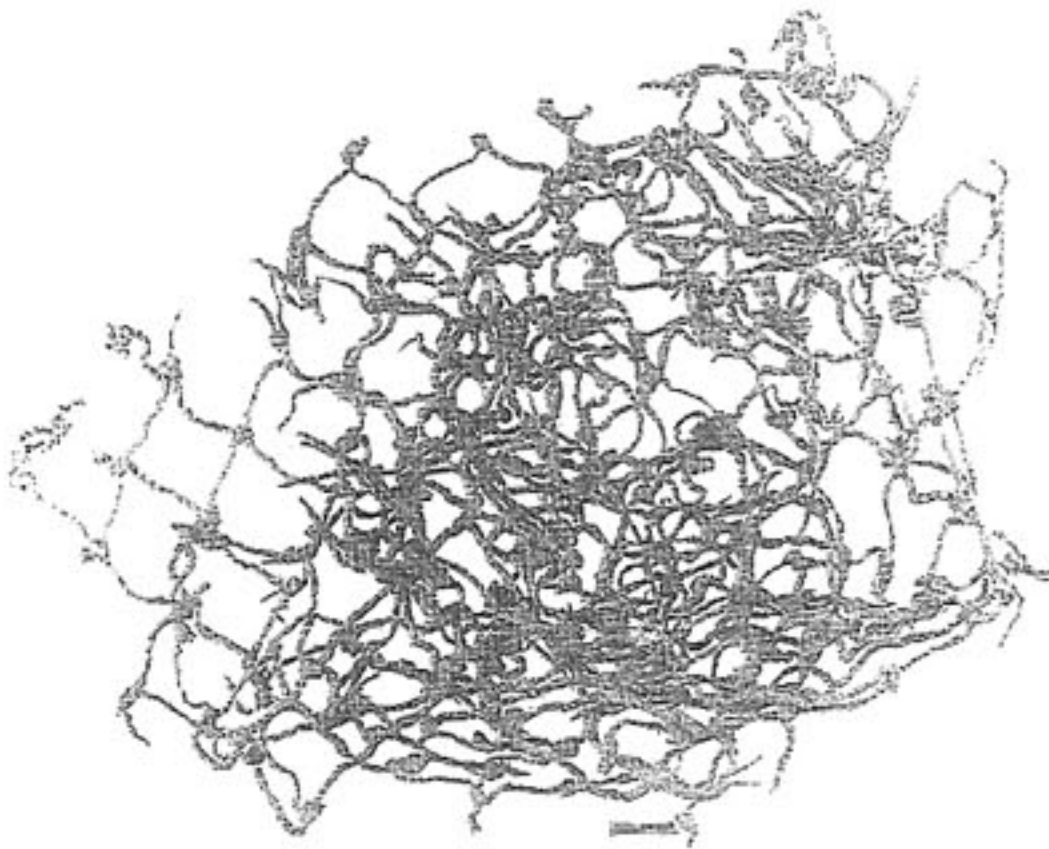
No. 126 (402/181c).

41 × 28 cm.

Threads: Linen (identified by C. Shimony); S2Z; diam. 2 mm. Mesh knots form squares c. 2.5 × 3 cm.

Comm.: Crude net.

Cf.: No. 402/181a (37 × 18 cm, not published).



125

CORDAGE

No. 127 (303/9). Two ropes knotted together.

(a) Date-palm fibers; 74 cm long; diam. 0.8 cm; Z2S2Z; 4 twists per 10 cm.

(b) Date-palm fibers; 21 cm long; diam. 2.1 cm; Z2S3Z; 6 twists per 10 cm.

Comm.: (a) is made of a strand Z2S which was folded in two. (b) was drawn through the loop which was thus formed. (b) is composed of a strand Z2S which was folded in three, also forming a loop. One of its strands was twisted and wrapped around (a), while the other two formed another loop. The edge of (b) is secured by a knot.

Comm.: Rope with a knotted loop.

No. 128 (402/129). Two strings.

Length: (a) 27 cm; (b) 23 cm.

Diam.: 0.5 cm; Z2S.

Material: Date-palm fibers.

Comm.: (a) and (b) are tied with a square knot.

No. 129 (402/131). Cord.

Length: 18.5 cm.

Diam.: 0.8 cm.

Material: Date-palm fibers; Z2S4Z.

Comm.: The cord is composed of four strands Z2S each, part of it unraveled.

No. 130 (402/132). Strings bound together.

Length: 10 cm.

Diam.: 1.7 cm.

Material: Date-palm fibers.

Comm.: About 10 strings bound with 2 strings, 3 cm between them. All strings are date-palm fibers, Z2S, 0.3 cm in diam; 19 twists per 10 cm.

No. 131 (402/133). Date-palm leaflets.

Length: 59 cm.

Diam.: 1.5 cm.

Comm.: Date-palm leaflets tied into a granny-knot loop.

No. 132 (402/137). Three rope fragments.

Length: (a) 29 cm; (b) 52 cm; (c) 22 cm.

Diam.: 1.3 cm.

Material: Date-palm leaflets; S3Z; 5–6 twists per 10 cm.

Comm.: Fragment of a rope. (b) is wrapped around (a). They might have been connected, forming a large loop.

No. 133 (405/6). Cable.

Length: 54 cm.

Diam.: 5.5 cm.

Material: Date-palm fibers? Z3S3Z; 1.5 twists per 10 cm.

Comm.: A very thick cable made of 3 strands about 2 cm in diam. each. It might have been used for securing a boat or an anchor. There are several more pieces of the same cable from the same locus.

Cf.: Nos. 140, 141.

No. 134 (406/7). A cord tied to a rod.

(a) Cord.

Length: 19 cm.

Diam.: 0.7 cm.

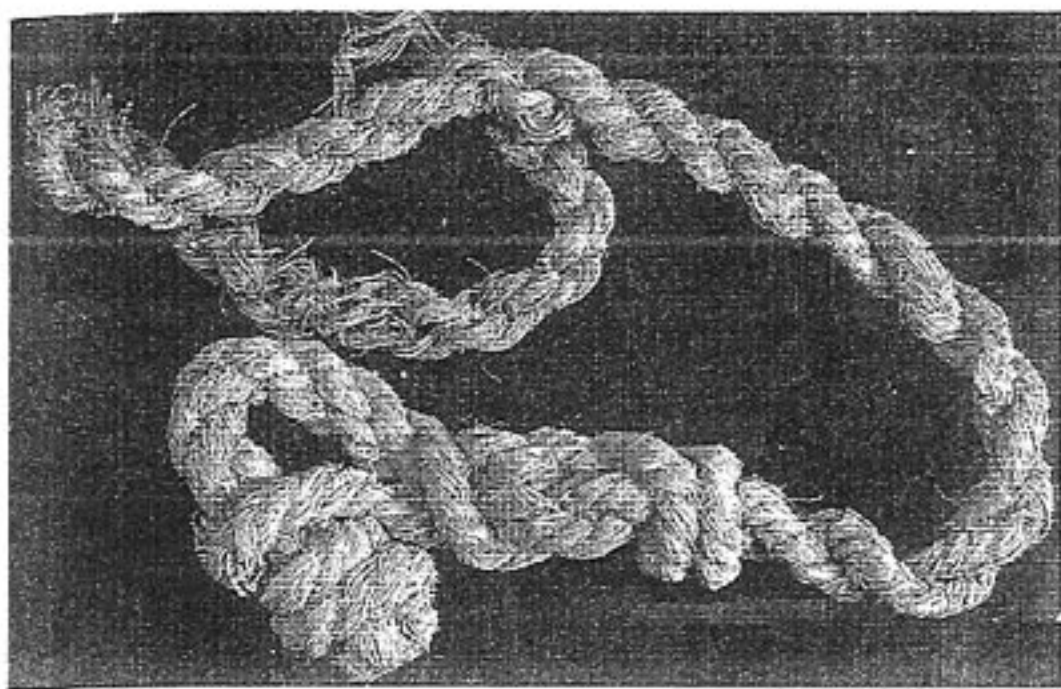
Material: Date-palm fibers; Z3S, 11 twists per 10 cm.

(b) Rod: Wood.

Length: 16 cm

Diam.: 1.4 cm.

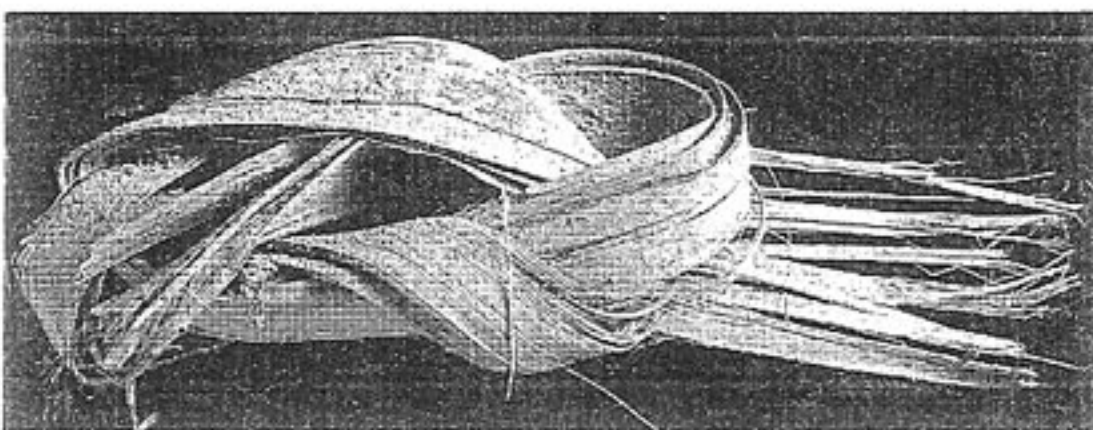
Comm.: The cord is tied to the rod with an overhand knot.



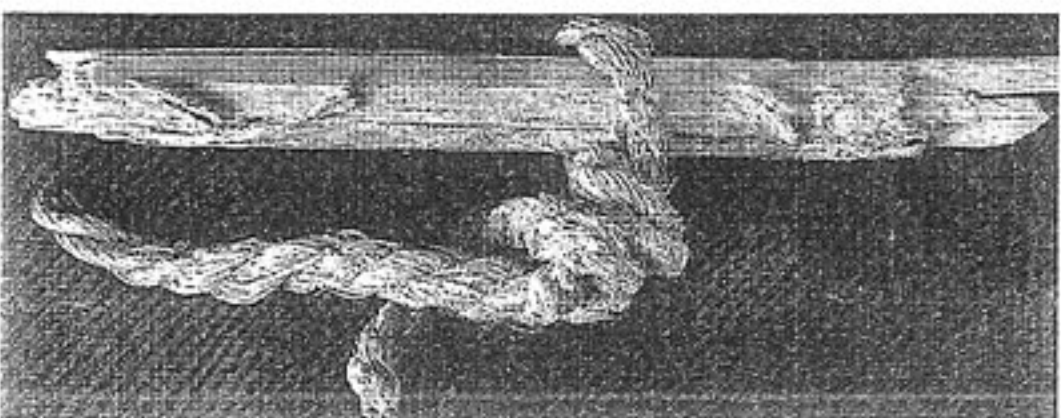
127



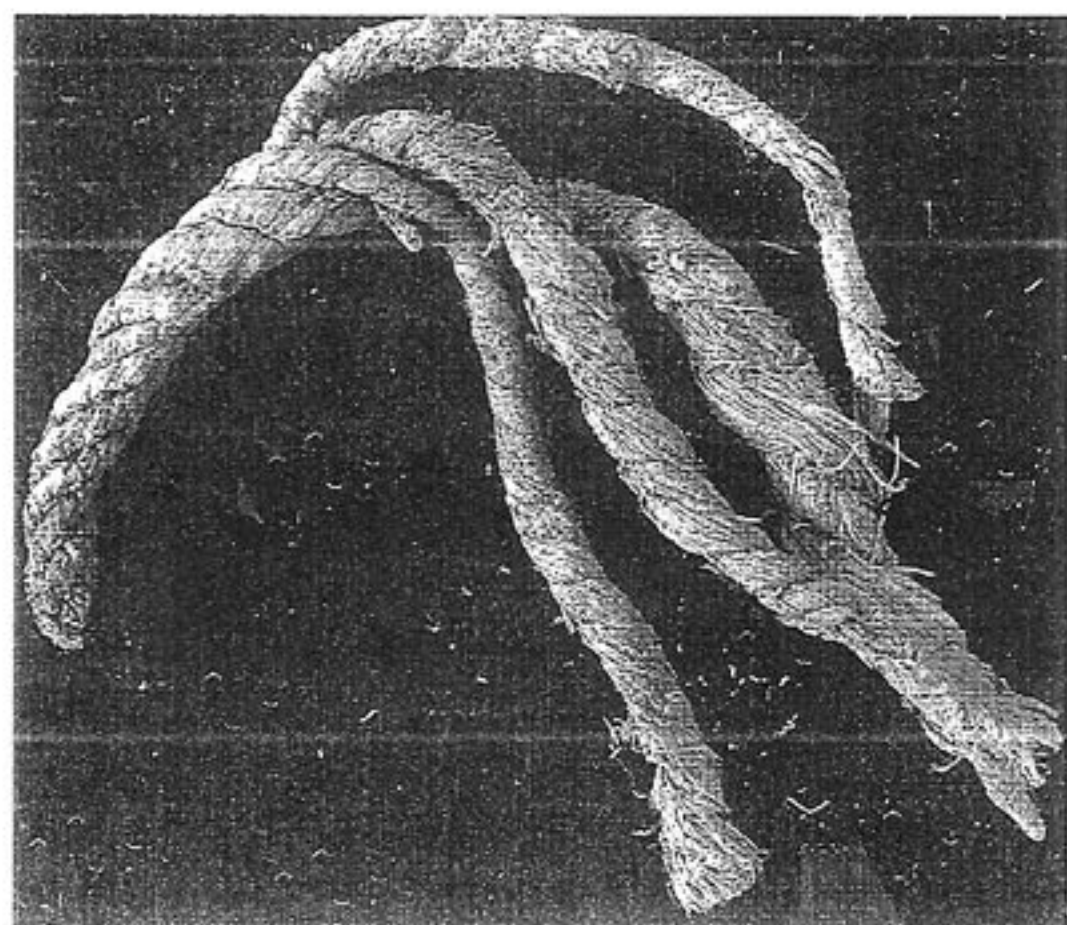
130



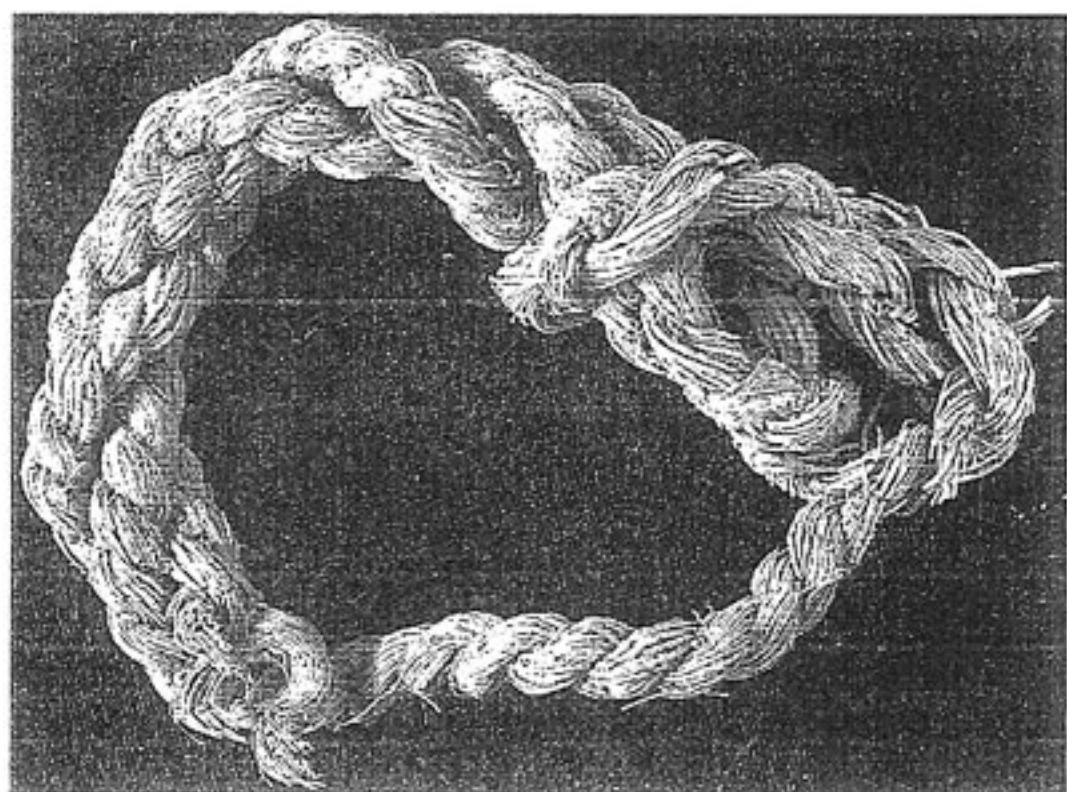
131



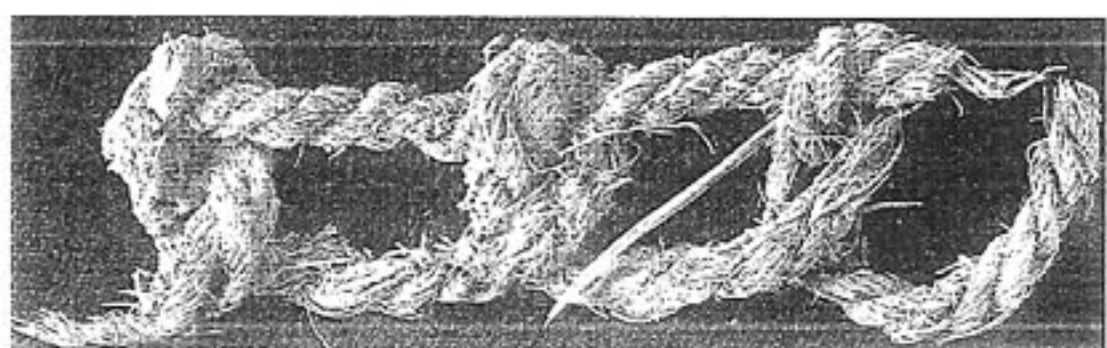
134



129



135



137

No. 135 (406/9). String.

Length: 23 cm. *Diam.:* 1.1 cm.

Material: Date-palm fibers; Z2S3Z; 7 twists per 10 cm.

Comm.: Fragment of a string with a loop. A cord Z2S was folded in thirds and one cord was drawn into a loop formed by the two other cords, thus forming a secured loop, which was probably intended to hold a rod or another string.

No. 136 (406/10). String.

Length: 23 cm.

Diam.: 0.9 cm.

Material: Date-palm fibers; Z2S3Z; 11 twists per 10 cm.

Comm.: String with two loops. A cord Z2S was folded in thirds. At one end is a loop consisting of two cords into which the third cord is drawn, this loop securing the twist of the string. At the other end a similar loop was formed, but the cord continues and forms an additional loop which is tied with a knot. This double loop was probably intended to hold a rod or another string.

No. 137 (406/13). Two strings.

Length: (a) 14 cm; (b) 47 cm.

Diam.: 0.7 cm.

Material: Date-palm leaflets; Z3S; 14 twists per 10 cm.

Comm.: A string with 3 loops consisting of 2 fragments. (b) is looped around (a).

Cf.: Nos. 137 and 406/12 not published.

No. 138 (406/14). Three fragments. Cable.

Length: (a) 20 cm; (b) 20 cm; (c) 8 cm.

Diam.: 1.7 cm.

Material: Date-palm leaflets; Z2S3Z; 6 twists per 10 cm.

Comm.: The cord is folded in thirds and twisted, forming a loop at the fold. (c) is drawn through the loop of (b).

No. 139 (406/16). String.

Length: 7 cm.

Diam.: 0.9 cm.

Material: Date-palm fibers; Z2S2Z; 8 twists per 10 cm.

Comm.: A string Z2S folded in two and Z twisted (Z2S2Z). Wrapped with a date-palm leaflet.

No. 140 (650/21/1). Cable.

Length: 58 cm.

Diam.: 6.7 cm.

Material: Date-palm fibers? 3S.

Comm.: As No. 133.

Cf.: Nos. 133, 141.

No. 141 (650/21/2). Cable.

Length: 15 cm.

Diam.: 5.5 cm.

Material: Date-palm fibers? Z3S3Z; 2 twists per 10 cm.

Comm.: As No. 133.

Cf.: Nos. 133, 140.

No. 142 (402/128). Plait.

Length: 26 cm.

Diam.: 0.6 cm; 17 twists per 10 cm.

Comm.: Very tight plait, unidentified bast fibers.

No. 143 (402/121). Thread.

Length: 13 cm.

Diam.: 0.2 cm.

Material: Linen; Z2S; 37 twists per 10 cm.

Comm.: A thread with a blue faience bead, diam. 0.5 cm. Probably an amulet.

No. 144 (402/122). Tassel.

Length: 2 cm.

Diam.: 0.6 cm.

Material: Old gold silk; Z2S.

Comm.: Tassel tied with the same threads and decorated with a red and an undyed cream linen thread S2Z. It is attached to an old gold silk braid with a knot. It probably embellished a garment.

No. 145 (402/93). Threads.

4 × 3.5 cm.

Material: Cotton; undyed cream; Z4Z25, 9 per cm.

Comm.: Three layers connected (glued) in opposite directions with a gray substance (asphalt?).

No. 146 (402/123). String.

Length: 5.5 cm.

Diam.: 0.4 cm.

Material: Wool; multicolored.

Comm.: Made of 3 red Z-spun threads, 2 blue Z-spun threads, 2 beige Z2S threads.

No. 147 (405/7). String.

Length: 8.5 cm.

Diam.: 0.3 cm.

Material: Red wool; S2Z2S; tight twisted 24 per 10 cm.

No. 148 (402/125). Bundle of threads.

Length: 5 cm.

Diam.: 0.7 cm.

Material: Goat hair; 4 threads of dark pigmented brown and cream; 7 threads dark pigmented brown and red, Z2S11Z.

Comm.: Probably a fragment of a string. Very small and fragmentary.

No. 149 (406/15). String.

Length: 29 cm.

Diam.: 0.8 cm.

Material: Goat hair, pigmented dark brown; Z2S10Z, 12 twists per 10 cm.

Comm.: The string is knotted into a loop by two overhand knots.

No. 150 (402/136). Plait.

Length: 7 cm.

Diam.: 1 cm.

Material: Goat hair.

Comm.: A plait made of many threads S2Z, three groups of 8 threads each terminated with fringes tied twice with the same threads as the plait.

No. 151 (402/120). Plait.

Length: 13 cm

Diam.: 0.4 cm.

Material: Red silk; Z3S.

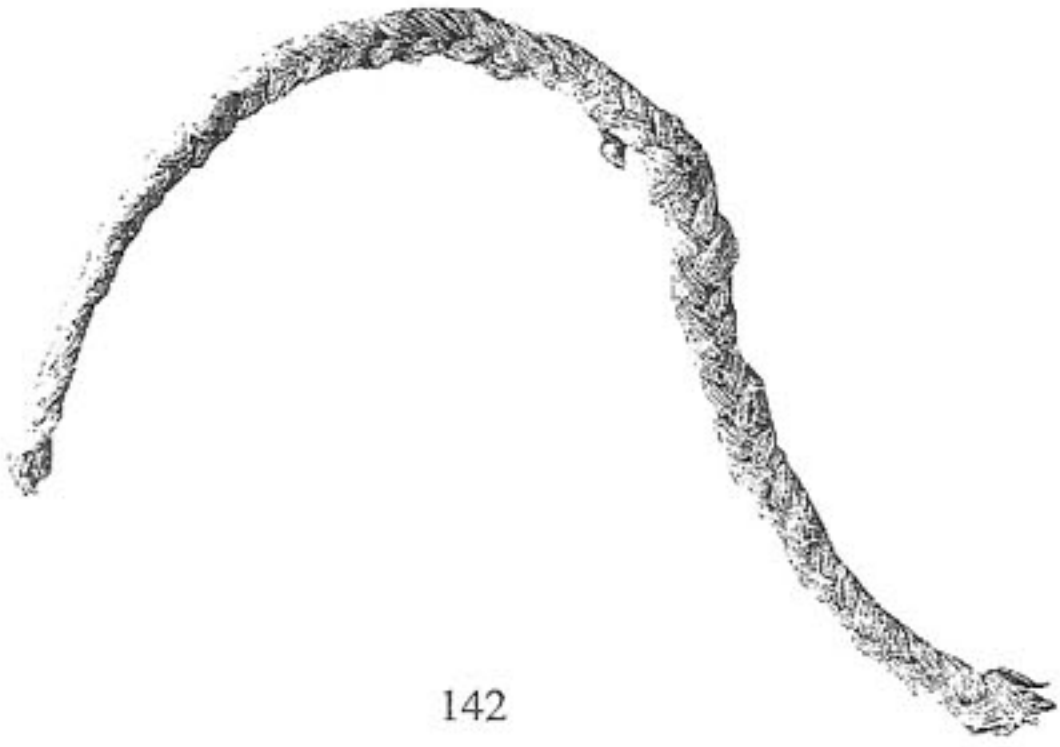
Comm.: Made of 3 strands. One has 6 threads, the second 7 threads and the third 10 threads. The plait is terminated by an overhand knot. It was probably part of a garment.



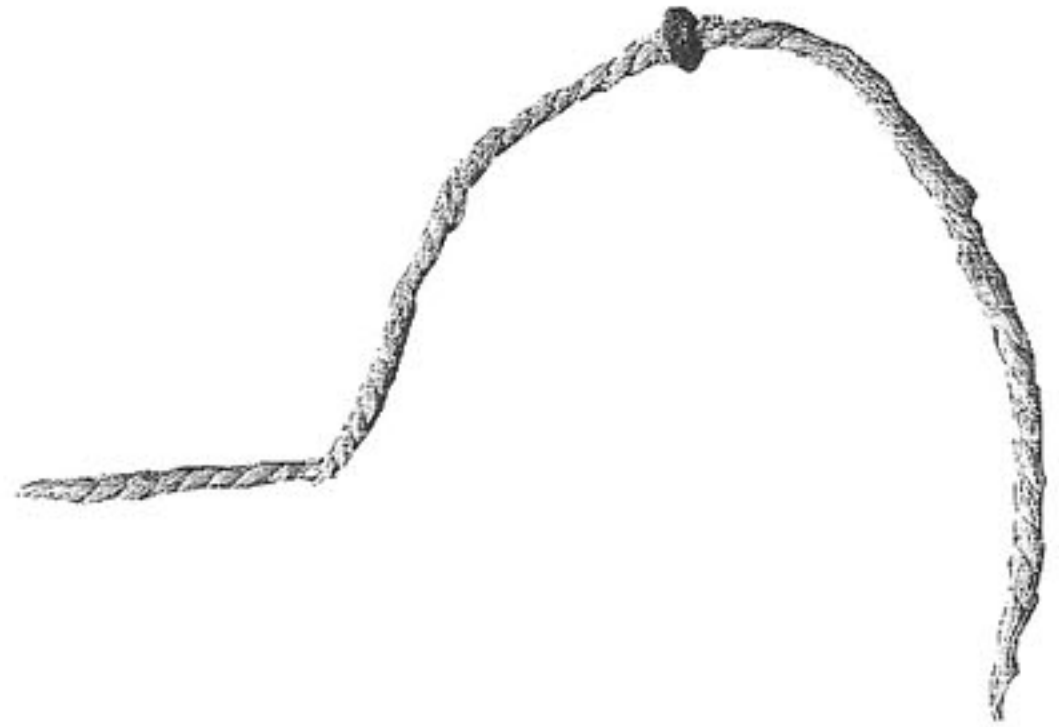
138



140



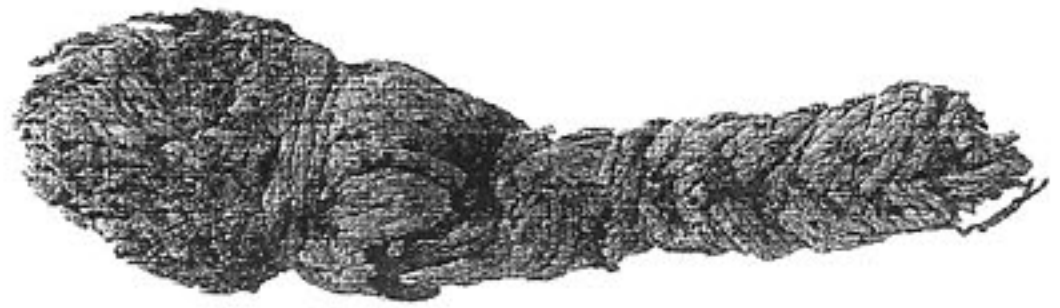
142



143



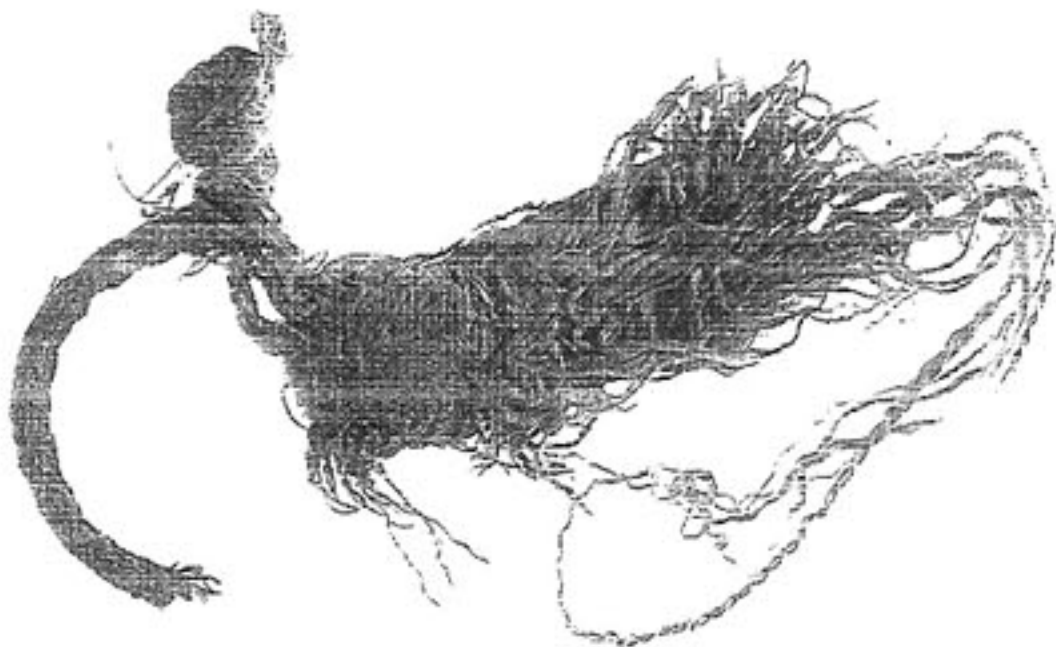
148



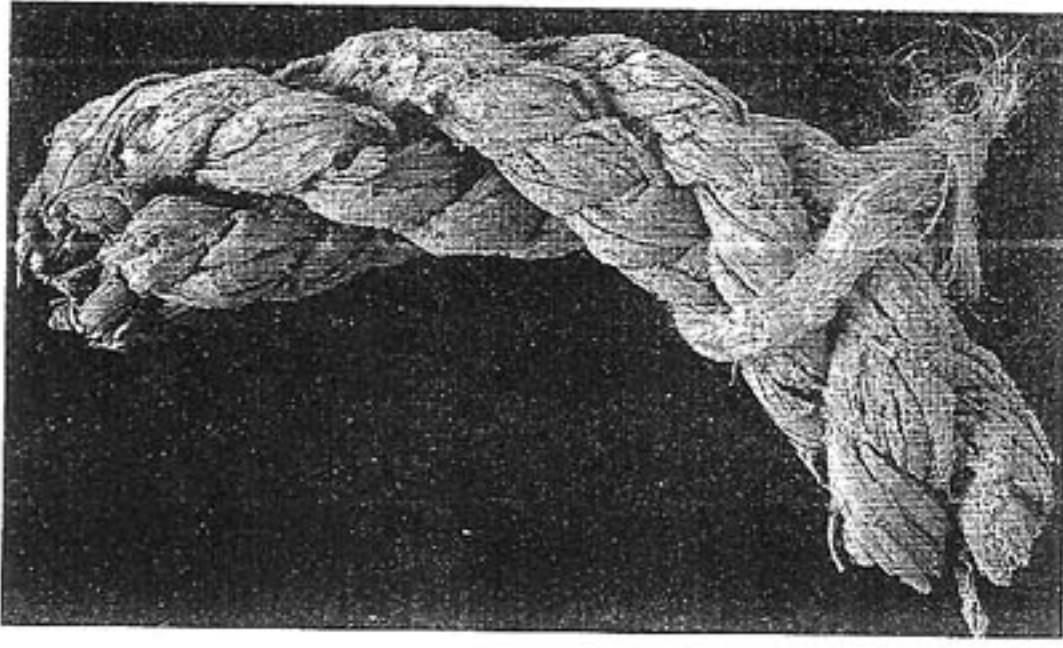
149



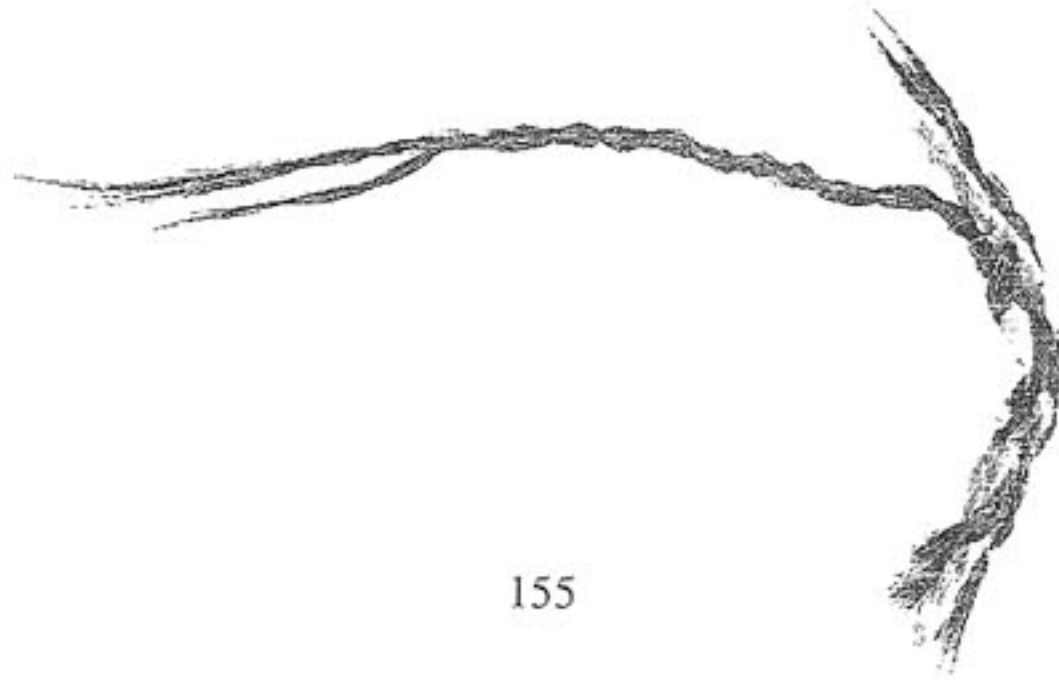
150



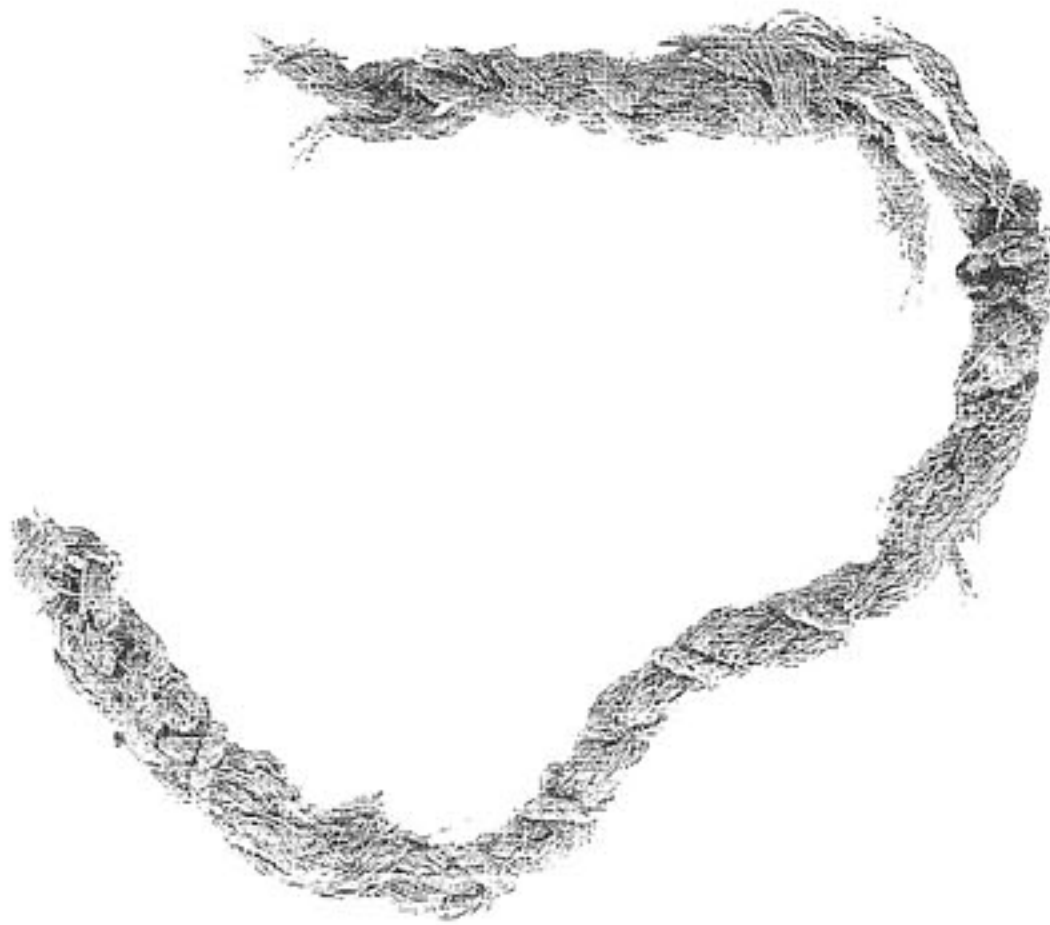
151



153



155



156

No. 152 (402/126). Thread.
 Length: 11 cm.
 Diam.: 0.2 cm.
 Material: Red silk; Z2S4S2Z.

No. 153 (406/8). Rope with a string tied around it.
 (a) Rope.
 Length: 12 cm.
 Diam.: 2 cm.
 Material: Date-palm leaflets? Z2S3Z; 5 twists per 10 cm.
 (b) String.



154

Length: 9 cm.
 Diam. : 0.4 cm.
 Material: Linen? S3Z; 25 twists per 10 cm.
 Comm.: Fragment of a rope with a string tied around it with an overhand knot.

No. 154 (406/421/1). Rushes and rope.

(a) Rushes.
 Length: 27 cm.
 Diam. : 3.2 cm.
 Material: Unidentified.
 (b) Rope.
 Length: 19 cm
 Diam.: 0.8 cm.
 Material: Date-palm fibers; Z3S; 10 twists per 10 cm.
 Comm.: A bundle of rushes tyed with a rope. Two knots, one forming a loop.

No. 155 (402/124). Plait.

Length: 19 cm.
 Diam.: 0.7 cm.
 Material: Goat hair and wool. The plait is made of 2 strands of goat hair S2Z2S and one of goat hair and wool fibers Z2S.

No. 156 (402/130). A rope with a plait wrapped around it.

(a) Rope, date-palm fibers; Z2S3S.

Length: 48 cm.

Diam.: 1.4 cm.

(b) Plait, goat hair.

Length: 62 cm.

Diam.: 0.5 cm.

Comm.: The plait was covered with a black substance (asphalt?), then wrapped around the rope in the Z direction and tied with a granny knot wrapping 32 cm of the rope. The continuation of the rope is wrapped with a date-palm fiber string Z2S.

No. 157 (402/185). Two fragments knotted together.

Length: (a) 12 cm; (b) 19 cm.

Diam.: 0.5 cm.

Material: Wool and goat hair.

Comm.: Two threads of wool Z3S were plied together. During plying two Z3S goat-hair threads were alternated with each other. The same technique is used today by the Beduin.

No. 158 (405/8). Three fragments of a plait.

Length: (a) 12 cm; (b) 19 cm; (c) 19 cm.

Diam.: 2 cm.

Material: Cream wool and pigmented brown goat hair; 6 threads in each strand Z2S.

Comm.: Terminated by a knot.

No. 159 (405/9). Three ropes.

Length: (a) 7 cm; (b) 8 cm, goat hair; (c) 15 cm, wool.

Diam.: 0.8 cm.

Material: The ropes are made of two goat-hair strands Z2S2Z and one wool strand Z2S2Z each plied in the S direction to create Z2S2Z3S, 10 twists per 10 cm.

Comm.: The ropes are tied together with a knot.

No. 160 (650/6/1). Plait.

Length: 11 cm.

Diam.: 1 cm.

Material: Wool and goat hair. Each of the three strands is made of 5–6 threads of cream Z-spun wool and Z2S pigmented brown goat hair.

Abbreviations used in Table 1 (overleaf):

No. = Catalogue number

WA = Warp

WE = Weft

Material: C = Cotton; H = Goat Hair; L = Linen; S = Silk; W = Wool.

C = Condition: G = Good; M = Medium; P = Poor

ST = Spinning tightness: L = Loose; M = Medium; T = Tight

Weaving Technique: BAL = Balance Tabby; DT = Diamond twill; EX.T = Extended Tabby; T = Tabby;

WA.F = Warp-Faced Tabby; T2/1 = Twill 2/1; COMP = Compound

D = Density of weaving: D = Dense; M = Medium; L = Loose.

Color: B = Brown; BLA = Black; BE = Beige; BL = Blue; C = Cream; D = Dark; F = Faded; G = Green; GR = Grey; L = Light; LB = Light Brown; O = Orange; P = Pink; Pig. = Pigmented; PU = Purple; R = Red; T = Tan; U = Undyed+ Unpigmented; W = White; Y = Yellow; V = Violet.

Edge: CB = Closing Border; H = Hem; SB = Starting Border; PS = Plain selvedge; CS = Crowded selvedge; RS = Reinforced selvedge; RH = Rolled hem; SH = Slip hem.

Decoration Pattern: B = Band; BLOCK P = Block printed; CH = Checks; EMBR = Embroidery; GR = Geometric Pattern; PL = Plaid; SB:Self-band; SQ = Squares; ST = Stripe; TAPES = Tapestry.

Color decor: Altern = Alternative bands or stripes; CO = Coral; M = Mauve.

S = Sewing

F = Faults in weaving.

Comments: * = More details appear in comments; Dirct. I&II = Warp and weft cannot be determined; Sew = Sewing; over = overcast stitches; run = running stitches; r+f = run and fell stitches.

Cat No	Locus	Bas.	Material WA/WE	C		Size (cm)		Spin		ST		TPC		Weaving Tech.	D	Color		Edge	Decor & Pattern	Color Decor	S	Other Fragments	F	Comments
				WA	WE	WA	WE	WA	WE	WA	WE	WA	WE			WA	WE							
15	402	73a	C/C	2.5	10	Z	Z	M	M	14	48	WE,F	D	UC	FR,UC,BL	RH	B				-	See cat.	-	Embr? Cut.
57	402	71	W/W	2	4	S	S	M	M	5	26	WE,F	D	UC	PU,G	-	B				-	-	-	A cord, diam. 0.4 cm. Folded.
9	402	119	L/L	26	2	Z	Z	M	M	36	22	T	L	UBE	UBE	-	-				-	-	-	Cut.
	402	6	C/C	12	20	Z	Z	L	L	32	28	T	D	UC,BL	UC,BL	-	CH				-	10x2.5	-	
	402	137	W,H,S	32	2	Z	Z	T	T	16	15	T	M	UBE,Pig.B	UBE,Pig.B	-	TAPES				-	-	-	
56	402	66	L/C	46	38	S	S	M	M	14	11	T	D	UBE,BL	UBE	-	ST			BL	+	-	-	Folded purse? 23 x 19 cm.
10	402	13a	C/C	43	3	Z	Z	M	M	13	16	T	M	UBE	UBE	H	-				+	-	-	2 pieces (a+b), 43 x 16 cm. With finials.
95	402	86h	L/L	4	5.5	S	S	M	M	12	7	T	M	UC	UC	PS	-				+	-	-	Cut.
8	402	5	C/C	20	5.5	Z	Z	L	L	30	28	T	D	UT	UT	-	-				+	-	-	g as f.
95	402	86f	L/C	4	13	S	S	M	M	11	13	T	D	UC	UBE	-	-				+	-	-	Cut triangle. Sew: L,Z.
	402	74	W/W	2.5	4	S	S	M	M	13	16	T	M	Y	UY	-	-				+	-	-	Sew: C,Z2S.
	402	10	C/C	35	28.5	Z	Z	L	L	16	14	T	D	UT	UT	RH	-				+	-	-	2 pieces of a sleeve.
	402	91c	C/C	24	5.5	Z	Z	M	M	11	9	T	D	UC	UC	-	-				+	-	-	Nap.
22	402	94	C/C	7	23	S	S	M	M	12	14	T	D	UC	UC	-	-	PL			+	-	-	Nap, thick warp threads.
	402	104d	L/L	13	18	Z	Z	M	M	16	18	T	M	UC,BL	UC,BL	-	-				+	-	-	Crude.
	402	44	W/W	12.5	2	S	S	M	M	7	15	T2/1	D	DR	DR	-	-				+	-	-	Sew: L,S2Z.
61	402	42	W/W	5.5	5.5	S	S	M	M	9	9	T2/1	D	R-B	R-B	-	-			BLA	-	-	-	Cut, nap.
	402	98	L/L?	6	5	Z	Z	M	M	4	3x2	T2/1	M	UBE	UBE	-	-				-	-	-	6 pieces stitched. b,c,d same as a.
62	402	43a	W/W	2.5	12.5	S	S	M	M	10	10	T2/1	D	R	R	-	-				-	-	-	Cut strip.
	402	72	W/W	4	4	S	S	M	M	8	17	T2/1	D	G	G	-	-				+	-	-	*Z,L. Two edges of the textile knotted together. Sew: L,S2Z,run.
63	402	45	W/W	23	13	S	S	M	M	7	15	T2/1	D	DR-B	DR-B	CB	B				-	-	-	Cut. Sew: L,Z2S.
95	402	36a	C/C	3.3	1.2	Z	Z	L	L	17	26	T	D	O-R	O-R	-	-				-	-	-	A cord, diam. 0.5 cm. Folded.
	402	79	C/C	34	14	Z	Z	M	M	14	12	T	D	UBE	UBE	PS	-				+	-	-	Sew: L,S2Z.
	402	65	L/L,S	7	1.2	Z	Z	M	M	26	15	T	D	DBL	P	PS	-				-	-	-	A sleeve.
	402	65	L/L,S	3	18	Z	Z	M	M	18	30	T	D	UC	UC	-	B				+	-	-	Coif of 2 pieces. Direct. I&II.
	402	7a	C/C	6.5	4	Z	Z	L	L	12	14	T	D	BL	BL	CS	-				+	-	-	16 x 27 cm all over. Patch 18 x 12 cm. Sew: L,S2Z,r+f.
26	402	117	C/C	13	2	Z	Z	M	M	18	22	T	D	UC	UC	CB	-				+	-	-	3 pieces stitched 13.5 x 3.5 cm.
	402	114	L/L	20	4	Z	Z	M	M	21	16	T	D	UC	UC	-	-				+	-	-	Sew: L,S2Z,r+f.
101	402	108a	S/C	16.5	15.5	Z	Z	L	L	120	17x	EX.T	D	UBE,B	UBE	-	ST			B	+	-	-	
	402	116	C/C	21.5	28	Z	Z	M	M	22	20	W.A.F	M	UC	UC	-	-				+	-	-	
25	402	115	L/L	18	12	S	S	M	M	15	15	BAL	M	UC	UC	-	-				+	-	-	
	402	113	C/C	12	2	Z	Z	M	M	17	17	BAL	D	UC	UC	-	-				+	-	-	
	402	172	C/C	9.5	9.5	Z	Z	M	M	15	15	BAL	M	LR,UBE	LR,UBE	-	Block P				-	-	-	
19	402	170	H/H	8.5	5	Z	Z	M	M	25	25	BAL	L	Pig.B	Pig.B	-	-				-	-	-	
30	402	157	L/L	9	2	Z	Z	M	M	16	16	BAL	M	UC	UC	-	Brocade			Black*	-	-	-	
72	402	152	W/W	1.8	14.5	Z	Z	L	L	32	32	BAL	D	UBE	BL,UBE	-	B#			BL	-	-	-	Cut.
96	402	193a	C/C	8	2	Z	Z	M	M	17	17	BAL	D	UC	UC	-	-				-	-	-	*Point twill.
51	402	191	L/L	6	3	Z	Z	M	M	21	21	BAL	M	UC	UC	-	EMBR			B,Silk	+	-	-	
	402	112	C/C	46	33.5	Z	Z	M	M	10	10	BAL	M	UC	UC	PS	-				-	-	-	3 pieces stitched, 54 x 47 cm. Sew: L,S2Z.
	402	127	L/L	36	2.5	Z	Z	M	M	18	18	BAL	M	BL	BL	-	EMBR			Linen,S2Z	+	-	-	A plait, piece 18x0.7 cm. Folded.

Cat No	Locus	Bas.	Material WA/WE	C		Size (cm)		Spin		ST		TPC		Weaving Tech.	D	Color		Edge	Decor & Pattern	Color Decor	S	Other Fragments	F	Comments		
				WA	WE	WA	WE	WA	WE	WA	WE	WA	WE			WA	WE									
31	402	118	C/C	M	18	1.5	Z	Z	M	M	18	18	BAL	D	UC	UC	UB	-	-	-	-	-	-	A cord, diam. 0.5 cm. Folded.		
	402	177c	C/C	G	19	11	Z	Z	M	M	8	8	BAL	M	UC	UC	BL	-	-	-	-	-	-	-		
	402	7b	C/C	M	8	2.5	Z	Z	L	L	16	16	BAL	D	UC	UC	UC	-	-	-	-	-	-	-		
	402	27	C/C	M	1.7	13.5	Z	Z	L	L	11	11	BAL	D	DBL	DBL	DBL	PS	-	-	-	-	-	-	Cut.Sew:L,Z2S.	
	402	4	C/C	G	33	4	Z	Z	M	M	12	12	BAL	D	BL	BL	BL	CS	-	-	-	-	-	-	Cut.	
	402	14	L/L	M	10	29	Z	Z	M	M	16	16	BAL	M	UC	UC	UC	RS*	-	-	-	-	-	-	*7 x 2 cm.	
	402	12	C/C	M	9	6	Z	Z	M	M	20	20	BAL	D	UC	UC	UC	PS	-	-	-	-	-	-	Cut.	
98	402	23a	C/C	G	43	5	Z	Z	L	L	11	11	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	Cut.	
	402	24	L/L	M	16.5	6	Z	S	M	L	17	17	BAL	M	LBL	LBL	UC,LBL	-	B	-	-	-	-	-	Cut.	
37	402	166	W/W	P	4	2	Z	Z	T	L	20	20	BAL	D	UC	UC	UC	-	-	-	-	+	+	-	Knotted to R,BL,UC threads.	
	402	165	C/C	G	25	3	Z	Z	M	M	13	13	BAL	M	UC	UC	UC	-	-	-	-	-	-	-	A wick.	
80	402	176	S/S	G	4.5	2	Z	Z	L	L	37	37	BAL	D	R	R	R	-	-	-	-	-	-	-	Cut.Sew:L,Z2S,run.	
	402	1	C/C	G	19	8.5	Z	Z	L	L	9	9	BAL	D	UC	UC	UC	CS	-	-	-	-	-	-	Cut.	
402	402	3	C/C	G	37	4.5	Z	Z	L	L	14	14	BAL	D	UC	UC	UC	CS	-	-	-	-	-	-	Several pieces stitched.Sew:C,Z2S.	
	402	169	C/C	M	32	22	Z	Z	M	M	16	16	BAL	D	UC	UC	UC	-	-	-	-	+	+	-	Few pieces from the same material stitched, 19 x 21.5 cm.	
94	402	81a	L/L	G	19	21.5	S	S	L	L	16	16	BAL	M	BL,UC	BL,UC	BL,UC	-	PL	-	-	-	-	-	3 pieces joined to a gore or gusset 20 x 7 cm.	
	402	110a	C/C	G	13	4	Z	Z	M	M	16	16	BAL	D	UC	UC	UC	-	-	-	-	+	+	-	See cat.	
101	402	108b	C/C	G	16.5	15.5	Z	Z	M	M	16	16	BAL	M	UC	UC	UC	CS	-	-	-	-	-	-	-	
	402	107c	C/C	G	13	6	Z	Z	M	M	16	16	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	-	
100	402	107a	L/L	G	28	24	S	S	M	M	15	15	BAL	M	UC	UC	UC	CS	-	-	-	-	-	-	-	
	402	96	L/L	M	12.5	12.5	Z	Z	M	M	12	12	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	A sleeve.	
23	402	95	L/L	M	28	14	Z	Z	M	M	19	19	BAL	M	UC	UC	UC	-	-	-	-	-	-	-	Baby sleeve.	
	402	91a	C/C	G	23	11	S	S	M	M	13	13	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	Cut rectangle. Sew:L,Z2S.	
49	402	90b	L/L	M	17	2	S	S	M	M	18	18	BAL	D	UC,BL	UC,BL	UC,BL	-	GR	-	-	-	-	-	3 pieces 28 x 23 cm all over.Sew:L,S2Z.	
	402	90a	L/L	M	17	11	S,Z	S,Z	L	L	14	14	BAL	D	UC,BL	UC,BL	UC,BL	-	CH	-	-	-	-	-	-	
21	402	89a	C/C	G	44	9.5	Z	Z	M	M	13	13	BAL	D	UC	UC	UC	PS	-	-	-	-	-	-	5 pieces of a gore. 44x25 cm. overall.	
	402	88d	C/C	M	16	2	S	S	M	M	14	14	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	-	
20	402	88a	C/C	G	20.5	11.5	S	S	M	M	12	12	BAL	D	FBL	FBL	FBL	PS	B (on b)	DBL	-	-	-	-	Coif of 4 pieces.	
	402	87	L/L	G	22	11.5	Z	Z	M	M	22	22	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	Neck opening.	
17	402	82a	C/C	M	28	1.5	Z	Z	M	M	13	13	BAL	D	DBL,UC	DBL,UC	DBL,UC	RS*	Resist D	-	-	-	-	-	*Pairs 8x2.	
	402	81b	C/C	G	3.5	5	S	S	M	L	13	13	BAL	D	UC	UC	UC	-	-	-	-	-	-	-	triangle.	
43	402	60a	C/C	M	3.5	3	Z	Z	M	M	17	17	BAL	M	UC	UC	UC	-	-	-	-	-	-	-	2 pieces stitched together. Sewing: C,Z2S,run.	
	402	67	C/C	G	34.5	27	Z	Z	T	T	13	13	BAL	M	BL,UC	BL,UC	BL,UC	-	Resist dyed	-	-	-	-	-	-	Cut.
16	402	62a	C/C	M	12.5	12	Z	Z	M	M	15	15	BAL	D	UC	UC	UC	CS	-	-	-	-	-	-	-	
	402	83	C/C	M	11.5	17.5	Z	Z	T	T	13	13	BAL	M	UC,DBL	UC,DBL	UC,DBL	-	Resist D	-	-	-	-	-	-	Possibly remains of Arabic inscription.
47	402	47	W/W	G	18.5	2	Z	Z	L	L	20	20	BAL	D	R	R	R	-	-	-	-	-	-	-	Cut.2 pieces of the same fabric stitched together.	
	402	46	W+H/W+H	M	9	15	S	S	T	T	5	5	BAL	D	Pig.B,UC	Pig.B,UC	Pig.B,UC	-	PL	-	-	-	-	-	Cut.Sew:W,Z,run.	
47	402	84	L/L	G	17	23	S	S	M	M	13	13	BAL	M	UC	UC	UC	H	-	-	-	-	-	-	-	3 pieces joined to a sleeve, 23 x 30 cm all over.

Cat No	Locus	Bas.	Material WA/WE	C	Size (cm)		Spin		ST		TPC		Weaving Tech.	D	Color		Edge	Decor & Pattern	Color Decor	S	Other Fragments	F	Comments	
					WA	WE	WA	WE	WA	WE	WA	WE			WA	WE								WA
41	402	34	L/L	M	13	24	Z	Z	L	L	18	18	BAL	D	LBL,UC	LBL,UC	-	B,GR	BL	+	-	-	Cut.	
39	402	33	L/L	M	11	26	S	S	L	L	14	14	BAL	D	LBL,UC	LBL,UC	-	GR,ST	BL	-	-	-	-	
45	402	59	L/L	M	5	7.5	Z	S	M	L	16	16	BAL	D	BL	BL,W	-	B	BL	+	b. 5.5x5	-	-	
83	402	19a	S/C	M	8	6.5	Z	Z	L	L	70	14x	EX.T	D	UBE,B	UBE	-	ST	BL	-	-	-	Cut.	
	402	11	H/W+H	M	17	10	Z2S	Z2S	T	T	10	2x2	EX.T	D	Pig.B	Pig.B,UC	PS	-	BL	-	-	-	-	-
91	402	161	L/L	M	12	5	S2Z	Z	T	T	3	6x2	EX.T	D	UBE	UBE	SB	-	BL	-	-	-	-	-
	402	16	S/C	M	8	4.5	Z	Z	L	M	110	15x	EX.T	D	UY-B,DB	UY	-	ST	BL	-	-	+	Cut.	
85	402	21	S/C	M	2.5	8	Z	Z	L	L	80	19x	EX.T	D	UBE	LBL	-	ST	B	+	-	-	Cut.	
88	402	57	S/C	P	6.5	20	Z	Z	L	M	94	15x	EX.T	D	LR,UY	BL	-	ST	BL	-	-	-	Cut.	
	402	26	S/C	M	2	7	Z	Z	L	L	34	15x	EX.T	D	BL,UBE	BL	-	ST	BL	-	-	-	Cut.	
	402	22	S/C	M	4.5	10.5	Z	Z	L	L	88	19x	EX.T	D	B,UC,BL	LBL	-	ST	BL	+	-	-	Cut. Sew: W, S2Z.	
	402	20a	S/C	M	13	2	Z	Z	L	L	80	19x	EX.T	D	UBE,B	UBE	-	ST	BL	+	b. 1x13.5	-	Cut. Sew: Silk, S2Z, remains.	
30	402	76	C/C	M	15	5	Z	Z	M	M	11x	7	EX.T	D	BL	BL	PS	-	UC	-	-	-	Knotted.	
	402	78	C/C	G	5.5	6.5	Z	Z	M	L	11x	10	EX.T	D	BL	UC	PS	ST	UC	-	-	-	-	
65	402	85	W/W	G	6	7	S	S	T	L	4	14	COMP	D	UBE,BL	R,DBL	-	Pattern	UC	-	-	-	-	
4	402	178	C/C	G	20	10	Z	Z	M	M	13	14	DT	D	DBL	UC	-	-	UC	-	-	-	-	
	402	48	C/C	G	1	9	Z	Z	M	M	35x	16	EX.T	D	R	UC	-	-	UC	-	-	-	Cut.	
64	402	55	W/W	G	1.5	15.5	Z	Z	T	T	21	32x	EX.T	D	UBE	UBE,DBL	-	B	UC	-	-	-	Cut.	
31	402	177a	C/C	G	19	4	Z2S	Z	T	M	10	3x4	EX.T	D	UC	UC	PS	-	UC	+	12x4	-	A bag 19 x 12 cm, handle 27 cm.	
79	402	154	S/S	G	8.5	1.5	Z	Z	M	L	-	-	COMP	D	G,B,UBE	UGOLD,UBE	-	-	UC	-	-	-	Cut.	
	402	190	S/S	G	8	4	Z	Z	T	-	44*	92*	COMP	D	DY	R	-	-	UC	-	-	-	*In every layer.Cut triangle.	
40	402	29	L/L	G	18.5	10	S	S	M	M	16	16	BAL	D	LBL,UC	LBL	-	ST	Altern	-	-	-	Cut.	
38	402	30	L/L	G	13	43.5	S	S	M	M	14	14	BAL	M	LBL,UC	LBL,UC	H	GR	BL	+	-	-	Cut.	
87	402	51a	S/C	G	1.8	8	Z	Z	L	L	84	16x	EX.T	D	B,BL,UBE	UBE	-	ST,SQ	BL	-	b. 1x17	-	-	
35	402	8c	L/L	M	5	3.5	S	S	L	L	13	13	BAL	M	UC,BL	UC,BL	-	GR	BL	+	-	-	-	
100	402	107d	S/C	M	25	1.5	Z	Z	L	M	96	17x	EX.T	D	R,UC	BL	-	ST	BL	+	-	-	-	
35	402	8a	L/L	M	22	6.5	S	S	L	L	15	15	BAL	M	UC,BL	UC,BL	-	GR	BL	+	See cat.	-	Cut.	

Cat No	Locus	Bas.	Material WA/WE	C		Size (cm)		Spin		ST		TPC		Weaving Tech.	D	Color		Edge	Decor & Pattern	Color Decor	S	Other Fragments	F	Comments		
				WA	WE	WA	WE	WA	WE	WA	WE	WA	WE			WA	WE								WA	WE
36	402	9a	L/L	G	40	5	S	Z	L	L	13	13	BAL	M	BL,UW	BL,UW	-	CH	-	-	-	43x6	-	a+b knotted together.		
36	402	9b	L/L	M	20	5	S	S	L	L	18	18	BAL	T	UC	UC	-	-	-	-	-	-	-	Cut.		
402	402	53	S/C	P	5	23	Z	Z	L	M	84	21x	EX.T	D	LBL,UBE, BLA	LBL	-	ST	-	-	-	-	-	-	-	
99	402	50a	S/C	M	20.5	9.5	Z	Z	L	L	120	18x	EX.T	D	UBE,B,BL	LBL	RH, CS	ST	-	-	+	b. 2.5x4.5	-	A gore. Cut into triangle.		
73	402	105a	W/W,C	G	14	20	Z2S	Z	T	L	4	12x	COMP	D	Pig.B,UC	BL(wood),UW (cotton)	-	GR	-	-	-	b. 6x6	-	-		
10	402	13b	C/C	M	14	6	Z	Z	M	M	11	11	BAL	D	UBE	UBE	H	-	-	-	+	-	-	-		
86	402	49a	S/C	G	23	6.5	Z	Z	M	M	110	18x	EX.T	D	UBE,R	DBL	CS	ST	-	-	-	b. 6x12.5	-	Cut.		
81	402	150	S/C	G	2	5.3	Z	Z	L	T	90	20x	EX.T	D	BL,R	BL	-	ST,TAPES #	-	-	-	-	-	-	*Silk. 90 per cm.	
402	402	179	W/W,C	G	5.5	4	Z2S	Z	T	L	12*	12*	COMP	D	Pig.B,UBE	R,BL,UC	-	-	-	-	-	-	-	-	*2 layers of 6.Cut.	
403	403	314/10	S/L	G	22.5	0.8	Z	S	L	M	72x	20	EX.T	D	R	UC,LBL	CS	-	-	-	-	-	-	-	-	
97	403	314/2a	S/S	G	2.5	15.5	Z	Z	L	L	68	7x2	EX.T	D	Bl,B,P,UBE	UBE	PS	ST	-	-	+	-	-	-	-	
403	403	4	L/L	M	11.5	1.5	Z	Z	M	M	24	26	T	M	UBE	UBE	-	-	-	-	-	-	-	-	-	A wick.Direct. I&II
403	403	2	L/L	G	25	29	S	Z	L	L	16	14	T	M	BL,UC	BL,UC	-	CH	-	-	-	-	-	-	Cut.	
403	403	314/1	S/C	M	18	5	Z	Z	L	L	88	15x	EX.T	D	Shiny UBE,B	UBE	-	ST	-	-	-	-	-	-	Cut.Direct. I&II.	
403	403	3	C/C	M	5	2.5	S,Z	Z	T	T	20	11	W.A.F	D	BL,UC,P	BL	-	ST	-	-	-	-	-	-	Cut.	
403	403	314/4a	W/W	M	27	27	S	S	O	O	8	8	BAL	L	BL-G,P,Pig.B	BL-G,P,Pig.B	-	PL	-	-	-	b. 22.5x21	-	-	Direct. I&II.	
403	403	1	L/L	M	17	4.5	Z	Z	L	L	18	18	BAL	D	UC	UC	H	-	-	-	+	-	-	-	Cut.Direct. I&II.Sewing: C,Z2S.	
403	403	314/2b	C/C	M	15.5	3	Z	Z	M	L	19	15	T	M	UC	UC	-	-	-	-	+	-	-	-	-	
403	403	314/7	L/L,S	G	40.5	2	Z	Z	L	L	40	?	COMP	D	UOLD GOLD	UBE,UOLD GOLD	-	-	-	-	+	-	-	-	-	-
69	403	314/5	W/W	M	20	41	Z	Z	M	L	3	4	T	L	UBE,Pig.B	UBE,Pig.B	-	B	-	-	-	-	-	-	-	
53	403	6	L/L	G	7	6	Z	Z	M	M	20	20	BAL	M	UC	UC	-	EMBR	-	-	-	-	-	-	-	CO,DPU,U C
52	403	5	L/L	G	8.5	14	Z	Z	M	M	20	22	BAL	M	UC	UC	PS	EMBR*	-	-	-	-	-	-	-	*Silk,Z2S.
54	403	7	L/L	G	3.5	5	Z	Z	M	M	20	20	BAL	M	UC	UC	-	EMBR	-	-	-	-	-	-	-	CO,DPU,U C
403	403	314/9	W/W	M	16	17.5	Z	Z	T	L	11	18	T	D	UBE	UBE	-	-	-	-	-	-	-	-	-	Cut.Sew: L,S2Z.
403	403	314/3	W/W	G	7.5	7	S	Z	T	I	9	15	T2/I	D	G	G	-	-	-	-	+	-	-	-	-	Cut triangle.Direct. I&II.
405	405	529/2	L/L	M	33	40	Z	Z	L	L	18	18	BAL	M	UC	UC	-	-	-	-	-	-	-	-	-	Cut.Direct. I&II.Sew: C,Z2S.
405	405	529/1	C/C	M	6	17	Z	Z	L	L	18	18	BAL	D	UC	UC	H	-	-	-	+	-	-	-	-	A purse.
405	405	3	W/W	G	31	21.5	Z	Z	T	L	6	8	T	D	Y	UY	RS	EMBR	-	-	-	-	-	-	-	Direct I&II.Discoled.
406	406	545/3	C/C	M	5.5	4.5	Z	Z	M	M	16	22	T	M	R	R	-	-	-	-	-	-	-	-	-	Cut.Direct. I&II.
406	406	545/1	C/C	M	6	5.5	Z	Z	M	L	21	16	T	M	R	R	-	-	-	-	-	-	-	-	-	Cut.Folded in two and sewn.
406	406	545/2b	L/L,H	M	12	10	S	S	M	M	12	7	T	M	UC,R,BLA	UC	-	B	-	-	+	-	-	-	-	
406	406	545/2c	W/W,H	M	17	9	S	S	T	M	6	14	WE.F	D	UY,BL,Pig. BLA	BLA	-	B	-	-	+	-	-	-	-	

Cat No	Locus	Bas.	Material W/A/WE	C	Size (cm)		Spin		ST		TPC		Weaving Tech.	D	Color		Edge	Decor & Pattern	Color Decor	S	Other Fragments	F	Comments
					WA	WE	WA	WE	WA	WE	WA	WE			WA	WE							
102	406	545/2e	W/W,H	M	10	7	S	Z	T	M	5	16	WE.F	D	UC	UC	-	B		+	-		
102	406	545/2a	L/W,H	M	76	92	Z2S	Z2S	T	T	2	6	WE.F	M	UC	Y,UC,Pig.B, BLA	-	B		+	26x40	-	A rug, overall (a-j) 81x92 cm.
102	406	3	W/W	M	7	3	Z	Z	T	L	6	10	T	D	UBE	UBE	-	-		-	-	Coarse.	
102	406	545/2g	W/W	M	17	11	S	Z	T	M	7	9	T	D	UY	UY	-	-		+	-		
102	406	545/2h	W+H/W+H	M	21	21	S	Z	T	M	5	5	BAL	D	Pig.B,UC, RB	Pig.B,UC, RB	-	-		+	-		
102	406	545/2f	W/W	M	15	8	S	Z	T	L	6	14	WE.F	D	UC	UC	-	-		+	8x4	-	
102	406	545/2d	C/C	M	17	8	Z	S	M	L	12	12	BAL	D	UC	UC	-	-		+	-	-	
102	406	545/2i	W/W	M	11	8	S2Z	S	T	M	3	26	WE.F	D	UC	O-R, see cat.	-	-		+	-	-	
102	406	545/2j	W/W	M	30	15	S	Z	T	M	5	7	T	M	UC	UC	-	-		+	-	-	
102	406	545/4	W/W	M	14	7.5	S2Z	S	T	M	4	18	WE.F	D	UBE	R,BL,UBE	-	B		+	-	-	Sew:L,S2Z.
74	407	559	C/C	M	8	3.5	Z	Z	L	L	20	20	BAL	M	UC	UC	-	-		+	-	-	6 pieces of a wick,diam 0.5 cm.
74	650	29/1	W/W,C	G	23	17.5	Z2S	Z	T	L	4	12x	COMP	D	Pig.B,UC	R(wool),UW	-	GR		-	-	-	
92	651	26/2	L/L	M	13	8	Z	Z	M	M	3	3x2	EX.T	M	UBE	UBE	-	-		+	+	-	*Thick threads.
71	651	26/1	W/W	P	15	19	S	Z	T	L	3	4	T	M	UBE,Pig.B	UBE,Pig.B	-	B		+	-	-	
78	652	28/1	W/H	M	12	5	Z2S	S2Z	T	T	2	10	WE.F	D	UC	Pig.B,UC	-	-		-	-	-	*Remains.
652	652	28/2	H/H	M	6.5	7.5	Z	Z	L	L	10	16	T	L	Pig.B	Pig.B	-	-		-	-	-	Cut.
680	680	1	C/C	G	21	2.5	Z	Z	M	M	10	10	BAL	M	UW	UW	-	-		-	-	-	Cut.Bleached.
910	910	23/1	W/W	G	7.5	6	Z	Z	M	M	18	18	T2/2	D	G	G	-	-		-	-	-	

Table 2. Basketry

Cat. No.	Locus	Bas.	Size		Braid Width	No. of Elements Per Br	No. of Elements 10 cm	Elements Width	Twill or Checker Plating	Additional Fragments
			Hght	Width						
105	303	5	22	28	4.7	9	9	0.8	2/2	
103	303	7	24	10	12	9	4	1.4	1/1	
	402	182	20	58	4	5	7	1	1/1	
107	402	183	37	31	9.8	8	4.5	1.3	1/1	
	402	184	32	25	16.5	18?	9	0.7	2/2	
108	402	186	10	40	3	11	16	0.4	2/2	
	405	5	20	52	4.5	14	13	0.5	2/2	
109	405	10	16	23	5.5	9	10	0.8	2/2	
	406	4	11	25	5	9	8	0.9	2/2	
110	406	16	8	13	-	-	-	-	2/2	
	406	17	9	14	4	9	8	0.8	2/2	22 x 8 cm
104	406	19	24	16	5.4	6	7	1.2	1/1	
	406	20	65	50	5.8	6	6	1	1/1	57 x 44 cm.
111	406	21	36	50	7.1	9	6	1	2/2	26 x 50, 38 x 9 cm
112	406	22	24	140	6.3	9	9	1	2/2	
113	918	13/1	19	16	3-4.7	9	13	0.6	2/2	

NOTES

- ¹ Only the items described in the catalogue have a catalogue number; the data of the others are presented in tables which are arranged according to locus numbers.
- ² The materials were identified by the authors, unless stated otherwise. Technical terms are based on Burnham (1980).
- ³ This technique was used when colors needing mordants were required, such as the reds extracted

from madder roots. The mordant was printed on the fabric, which was then immersed in the color bath, and finally washed in hot water. The mordant-treated areas retained their color, while the color was washed out from the untreated areas, where the fabric retained its original color.

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PALM MATS AND BASKETS FROM JAZIRAT FARA'UN (CORAL ISLAND)

CARMELA SHIMONY

Samples from several mats and baskets from the excavations at Coral Island (Baginski and Shamir, this volume) were submitted for fiber identification. The results of those items identified as being made of palm are reported below.

A. *HYPHAENE THEBAICA*

Materials

Segments from the twill-braid plaited mat, No. 106 (402/184), were examined. Each flat element was about 10 mm in width (Baginski and Shamir this volume). Tangential and cross sections, hand cut with a razor blade, were examined, using a light microscope. Several sections were bleached in lactic acid. Observations of the leaf cross-sections and of the surface view of the epidermis were compared with similar sections of contemporary *Hyphaene thebaica* plants; Tomlinson (1961) and Greiss (1957) were consulted.

Results and Discussion

The material is in good condition. Microscopic examination revealed the samples to be made of isolateral plant leaves. The leaves were identified as *Hyphaene thebaica*, of the Palmae (order Borassinae).

This plant is distributed throughout tropical and subtropical Africa, Arabia, and Western Asia (Greiss 1957). The following morphological and anatomical features are based on the cross sections of the sample and its surface view.

Surface View.— The epidermis is similar on both adaxial and abaxial surfaces. Dark roundish areas (each about 200m in diameter) of wart-like appendages with velvet-like hairs are almost evenly distributed on both leaf sur-

faces (Fig. 1:1). Epidermis with non-sinuuous cell walls is differentiated into costal bands (over fiber clusters) up to 10 cells wide and wider intercostal bands (over chlorenchyma). The costal cells are narrow, more-or-less rectangular, longitudinally extended, and arranged in rows. The intercostal cells are irregular, those in the same files (rows) as the stomata being short and wide. The stomata appear in rows in the intercostal regions only (Fig. 1:1, 2). They are relatively large, and slightly sunken into the hypodermis tissue situated below. The stomata guard cells are bean shaped and accompanied by two parallel subsidiary cells, as well as two flattened or slightly roundish terminal cells. The latter are situated perpendicular to the slit of the stomata (Fig. 1:2). The observed hypodermis cells are wider and arranged perpendicularly to the direction of the above epidermis cells.

Cross Sections.— Two to three layers of the hypodermis follow the outer epidermis, on both sides of the leaf. Several layers of chlorenchyma, thin-walled palisade-like cells, are situated under the hypodermis between the sclerenchyma girders of the vascular bundles (Fig. 1:5).

The middle region of the leaf contains large and medium-sized collateral vascular bundles, with smaller ones between them (Fig. 1:3–5). The large and medium-sized vascular bundles have one or two wider metaxylem vessels. All of them are connected to the hypodermis with fibrous buttresses (girder-like bands) on both sides. The fibrous buttresses of the small vascular bundles are rectangular, 2–5 cells wide and about 15 cells high. Sometimes the abaxial girder is missing, and the bundle is connected only to the adaxial side.

The outer sheath cells of the vascular bundles are usually vertically extended. They form a complete sheath around the small veins, that are buttressed only to the adaxial surface, but they are present only in lateral position in the completely buttressed veins. The inner sheath of the vascular bundles forms a cup of thick-walled sclerenchyma fibers at the phloem level, and sclerotic parenchyma cells at the xylem level.

B. *PHOENIX DACTYLIFERA*

Three samples from typical baskets and mats were examined microscopically. Surface views and cross-sections were compared with early data from 'En Gedi (Shimony, Yucha, and Werker 1992), and were identified as *Phoenix dactylifera* palm leaflets and fibers.

Basket 406/17.— The braid and the rim cord were identified as being made of palm leaflets.

Surface view of the rim cord and the weft epidermis (Fig. 2:1–2) revealed rectangular longitudinally extended epidermis cells with slightly sinuous walls. The narrower costal bands (over fiber clusters), are comprised of regular cells, longer and wider than the broader intercostal bands. Rounded bean-shape stomata are restricted to intercostal bands. Crescent subsidiary cells run parallel to the guard cells, and terminal, very short, subsidiary cells are situated near the poles of the stomata (Tomlinson 1961). The cross-sections show a V-shaped isolateral

leaflet, including the midrib (Fig. 2:3–4). Medium and small veins could be detected. The veins are missing from the midrib zone; instead, it is occupied by a wide band of expansion cells (Fig. 2:3). Somewhat rounded clusters of fibers are scattered along both sides of the leaflets.

Mat 303/6.— This mat is made of palm fibers. Somewhat rounded clusters of fibers were situated near the surface. Veins with thick phloem caps were observed in the middle (Fig. 2:5).

Basket 402/182.— This basket is made of palm leaflets.

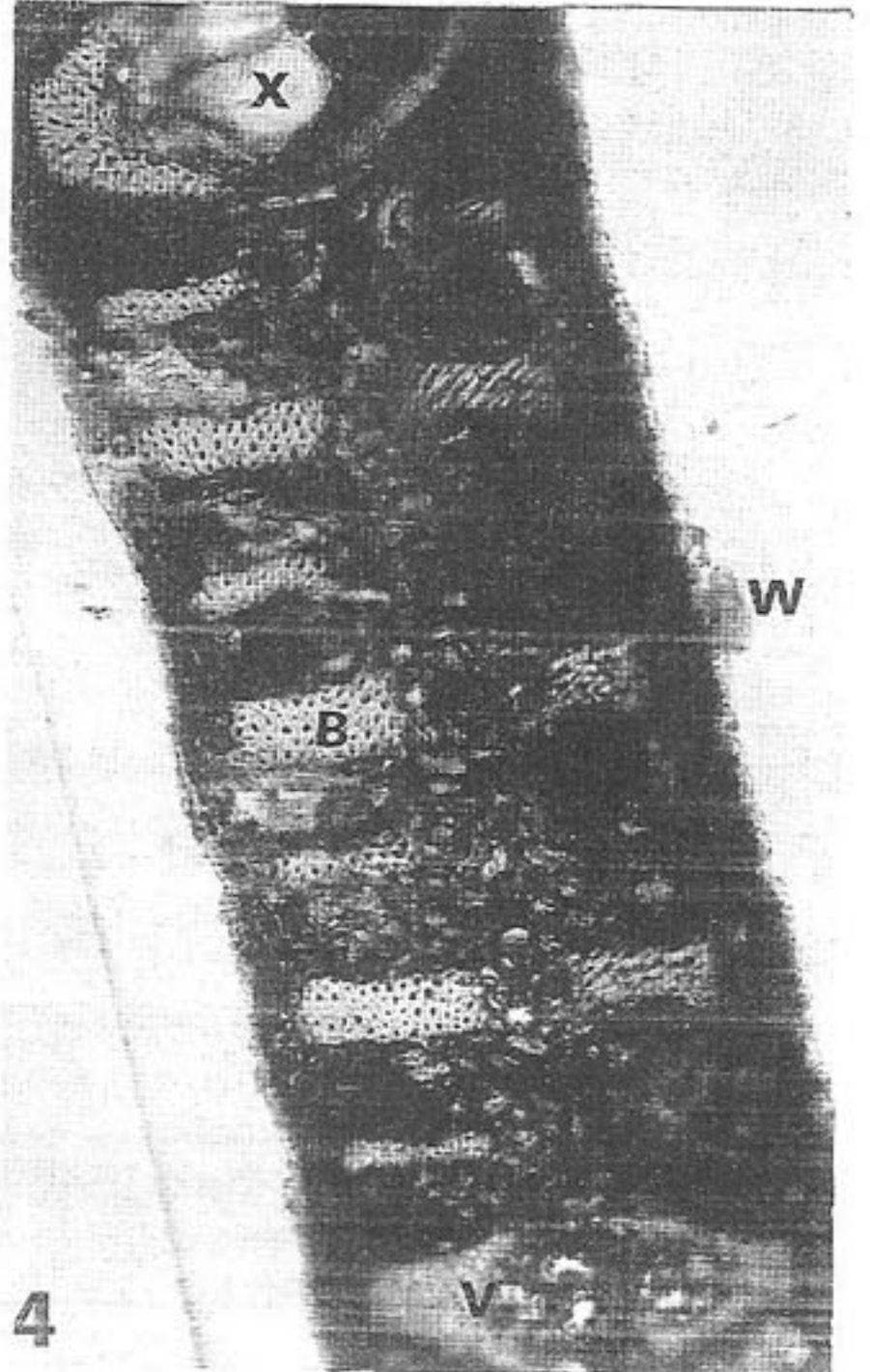
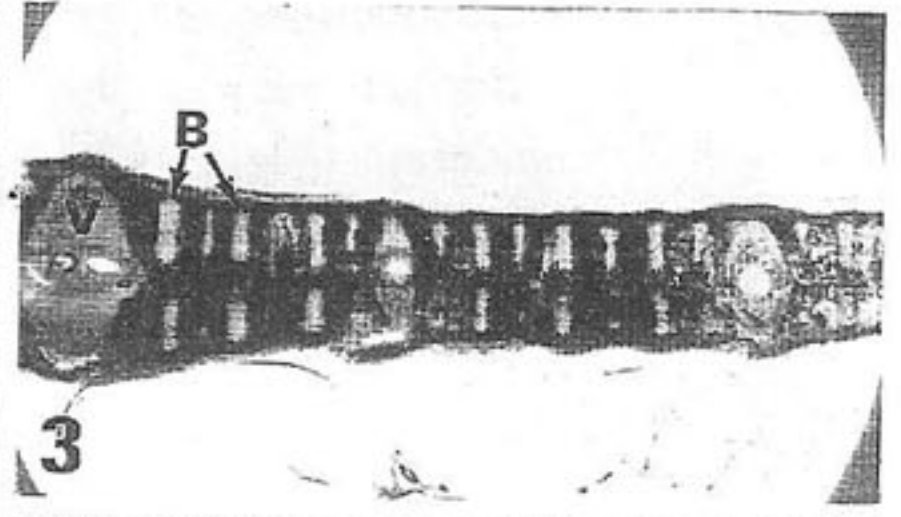
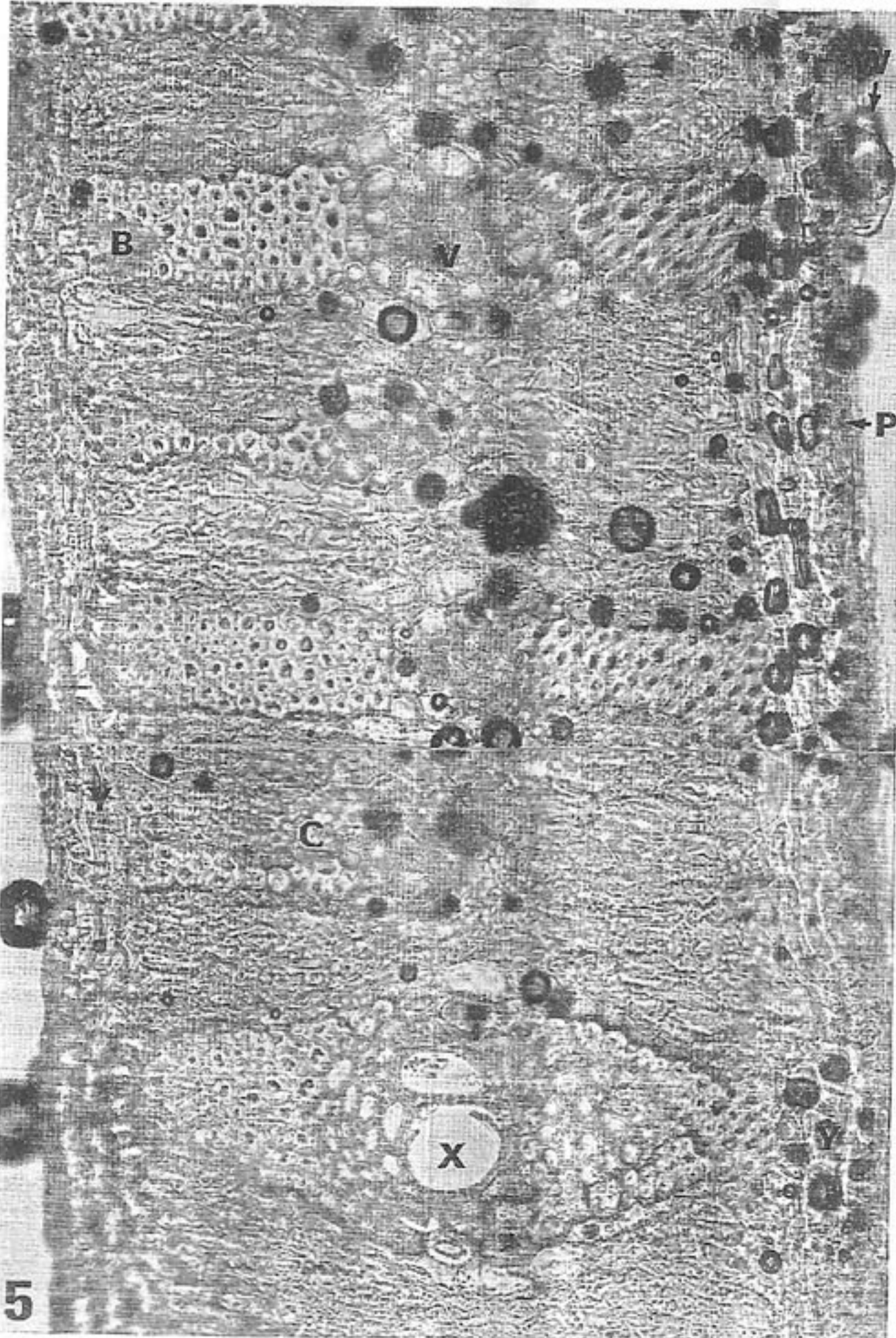
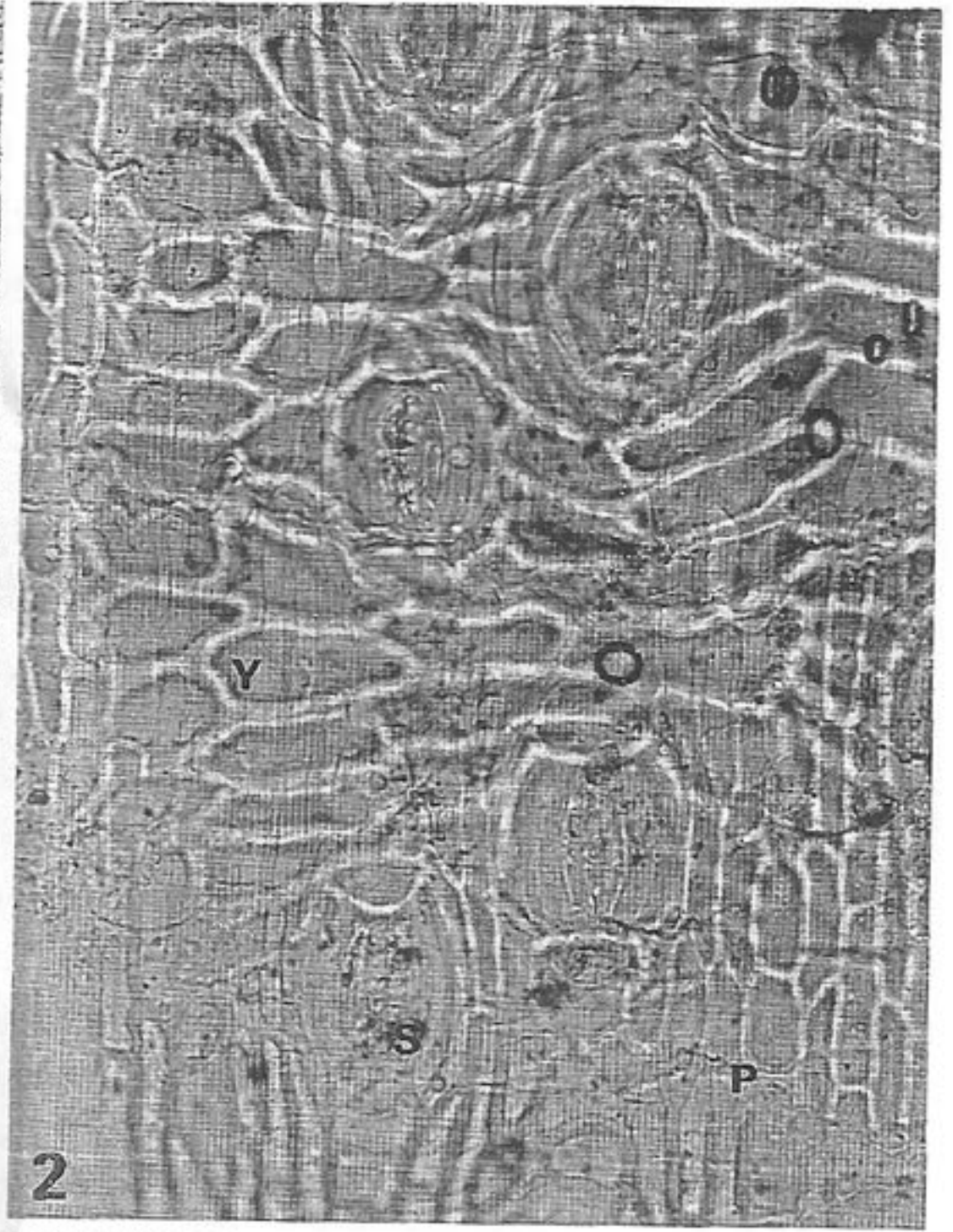
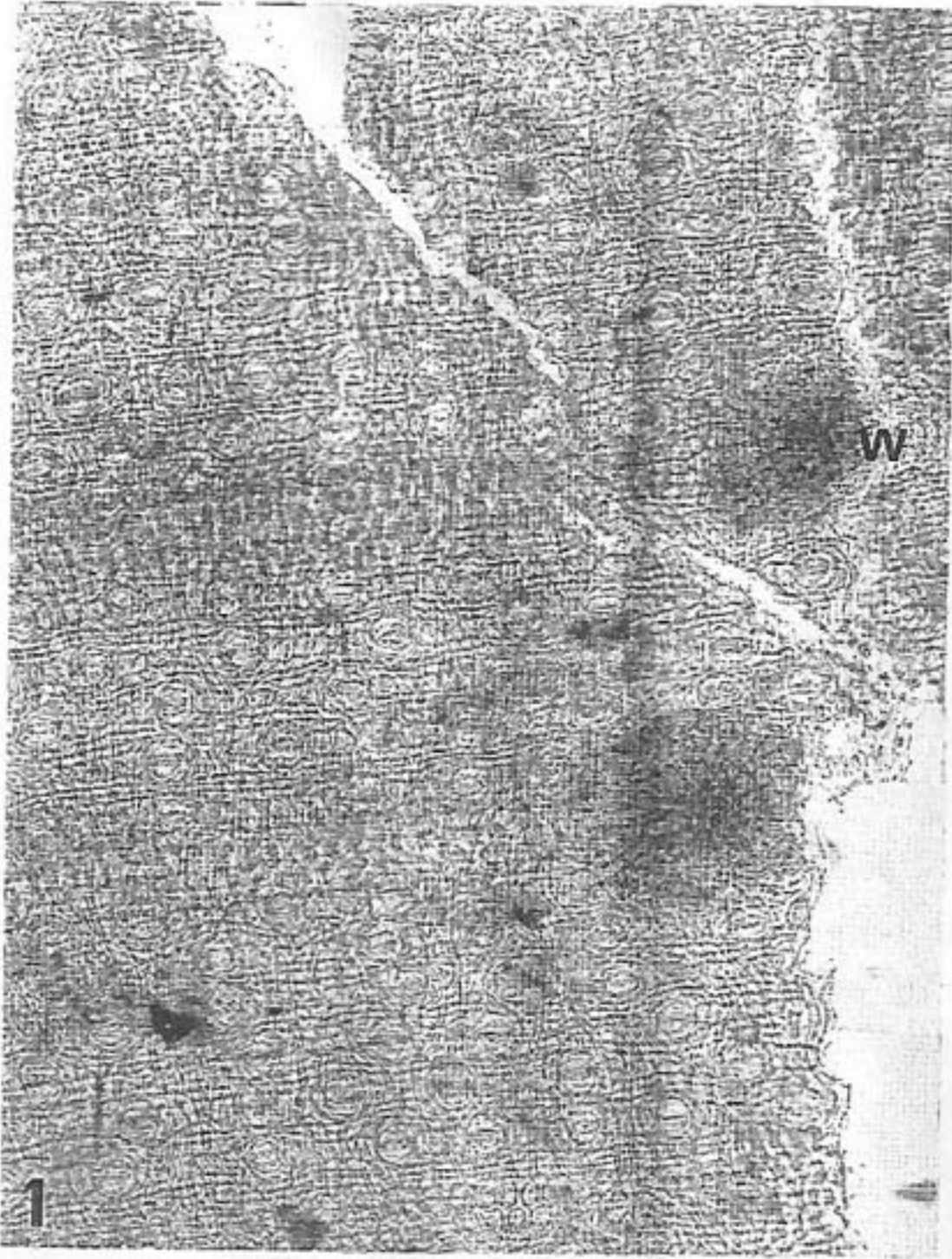
The surface view is the same as that described for Basket 406/17. The cross-section revealed a typical palm leaflet structure (Fig. 2:6). The large vein is surrounded by two thick, merging fiber caps of the phloem and xylem. Large thin-walled bundle sheath cells, with extensions on both leaf sides, surround this large vascular bundle. One large metaxylem vessel could also be detected inside. The small veins, more-or-less equidistant from both surfaces, lack the metaxylem large vessel and fiber caps. Somewhat rounded clusters of fibers were scattered along both sides of the leaflets.

ACKNOWLEDGMENTS

I would like to thank Prof. B. Tomlinson for his informative discussion of the subject.

Fig. 1. *Hyphaene Thebaica*. 1. Surface view of the epidermis. Note arrangement of stomata at intercostal zones and two rounded dark cushions of hairs. The epidermis cells are arranged longitudinally (x 100). 2. Enlarged surface view showing stomata with parallel subsidiary cells and two terminal cells. Note hypodermis layer cell arrangement, perpendicular to epidermis longitudinal cell arrangement above it (x 400). 3. Cross-section of leaf lamina showing isolateral leaf with large and medium-sized vascular bundles. Observe girder-like vein buttress of the smaller vascular bundles between them (x 25). 4. Enlarged leaflet cross-section showing two medium-sized vascular bundles, and smaller vascular bundles in between. Observe the buttressed lignified fibers on both sides of three of them, and in alternating order, four that are connected to the adaxial side only (x 100). 5. Enlarged bleached cross-section, showing wart-like hairs on abaxial epidermis; 2–3 layers of hypodermis; palisade-like chlorenchyma cells are situated between the vascular bundles fibrous buttresses. Note the bundle sheath structure of small and larger veins (x 400).

B = fibrous buttresses; C = chlorenchyma; F = fibers; M = lamina midrib; P = epidermis; S = stomata; V = vein or vascular bundle; W = wart like hairs; X = xylem or metaxylem vessel; Y = hypodermis.



THE MAMLÛK-PERIOD JAZIRAT FARAU'N (CORAL ISLAND) TEXTILE DYEINGS

ZVI C. KOREN

Fifty-eight textile fragments dating to the Mamlûk period, *c.* thirteenth–fourteenth centuries (Carmi and Segal 1994), were analyzed for dyes. They were excavated primarily from a refuse dump in the fortress at Coral Island (Jazirat Fara'un) in the Gulf of Elat. The strategic importance of this small island, which guarded the harbor of Ayla, and the structural features and uses of these textiles have been discussed by Baginski and Shamir (this volume).

The dyeings were classified into color groups to facilitate analysis. The “red” group consisted of shades ranging from orange to purple (Table 1); the “yellow” group, those from beige to brown and black (Table 2); the “blue” group also included green dyeings (Table 3). Some of these textiles are shown in Color Plates 1–13.

The method of analysis employed was high-performance liquid chromatography (HPLC; for description see Koren 1994a). The red and blue groups were analyzed according to the method customarily used for madder-type and indigoid dyes (Koren 1994b; 1995). The yellow group was analyzed according to the method recently developed for yellow and brown dyes (Koren 1996).

The Red Dyeings

Most of the red dyeings excavated at Coral Island were obtained from the roots of the madder plant (*Rubia tinctorum* L.), which is typical of red-dyed textiles found in the Middle East (Table 1). In the Arabic-speaking world, this plant was known as *fuwwa* (Forbes 1964:103), and the red colorant extracted from it, *al-lizari* (Brunello 1973). The madder source was identified from the characteristic alizarin and purpurin dyes that were detected. In a few red textiles, purpurin was not detected, although alizarin was, indicat-

ing that young madder roots were used for these dyeings. This phenomenon was also observed in the first-century Masada textiles (Koren 1994a). In a number of reds, no identifiable dyes were detected because the sample analyzed was too small. In one sample (308/7), however, the traces of dyes detected indicated that the violet color was produced using neither madder nor scale insects, but from an unidentified plant source.

The Yellow, Brown, and Black Dyeings

The yellow, brown, and black dyeings contained varying amounts of flavonoids and tannins (Table 2). These two dye classes are generally responsible for yellow and brown colors, respectively. Black dyeings with tannin-producing dyestuffs were typically produced with an iron salt mordant. However, the specific vegetal provenance of the dyestuffs could not be definitely determined due to the abundance of plant sources producing these dyes. These dye classes are present in practically every plant in varying compositions. The dye classes were identified by comparing their retention times (R_t) against those of calibrated standard dyes (Table 4 and Fig. 1). The retention time of each component is the time that the dye is retained within the chromatographic separation column before eluting from the column. Two of the more important tannins that were detected were gallic acid and ellagic acid. These two acids are hydrolysis products of larger tannins—gallotannins and ellagitannins, respectively. Tannins are especially found in roots and woody parts of a plant or tree. Gallotannins and ellagitannins are typically found in gall nuts and pomegranate rinds, and gallotannins are present in sumac. These plant dyestuffs are native to the Middle East and could

Table 1. Dye Analysis of Red Dyeings

Field No.	Thread Type	Color of Thread	Fiber Material	Dyes Found ^a (and Relative Compositions)	Dyestuff Source
303/4	Weft	Red	Wool	Alizarin > Purpurin	Madder
308/7	Sewing thread	Violet	Cotton	(none identified) ^b	(Not madder) ^c
402 (3)		Purple-red	Wool	Alizarin > Purpurin	Madder
402 (4)		Red	Wool	Alizarin > Purpurin	Madder
402 (5)		Red	Silk	Alizarin \equiv Purpurin	Madder
402/18		Orange-red	Wool	Alizarin(?) ^b	Madder(?) ^d
402/40		Red	Cotton	Alizarin(?), Purpurin(?) ^b	Madder(?) ^d
402/42		Reddish brown	Wool	Alizarin > Purpurin	Madder
402/43	Warp	Red	Wool	Alizarin	Young madder
402/43	Weft	Red	Wool	Alizarin >> Purpurin	Young madder
402/44		Dark red	Wool	Alizarin > Purpurin	Madder
402/45	Weft	Dark red	Wool	Alizarin > Purpurin	Madder
402/47	Warp = weft	Red	Wool	Alizarin > Purpurin	Madder
402/48	Warp	Red	Cotton	Alizarin(?), Purpurin(?) ^b	Madder(?) ^d
402/57	Weft	Light red	Cotton	Alizarin > Purpurin	Madder
402/71	Weft	Purple-red	Wool	Alizarin > Purpurin	Madder
402/73	Weft	Red	Cotton	Alizarin	Young madder
402/109	Felt	Red	Wool	Alizarin > Purpurin	Madder
402/120		Red	Silk	Alizarin > Purpurin	Madder
402/x		Red	Cotton	Alizarin(?), Purpurin(?) ^b	Madder(?) ^d
405/3	Embroidery threads	Red	Wool	Alizarin >> Purpurin	Young madder
406/545/2a	Weft	Orange-brown	Wool	Alizarin > Purpurin	Madder
406/545/2b	Weft	Red	Wool	Alizarin > Purpurin	Madder
406/545/2h	Weft	Reddish brown	Wool	Alizarin(?), Purpurin(?) ^b	Madder(?) ^d
406/545/2i	Weft	Orange-red	Wool	Alizarin \equiv Purpurin	Madder
406/545/4	Weft	Red	Wool	Alizarin > Purpurin	Madder

^a High-performance liquid chromatographic (HPLC) method of analysis published in Koren (1994b; 1995).

^b Sample analyzed was too small.

^c Dyes detected, probably from a plant source, though sample was too small. No alizarin was detected, which indicates that the dyestuff is not madder.

^d Trace of alizarin and, where indicated, purpurin detected, which indicate the probable presence of madder.

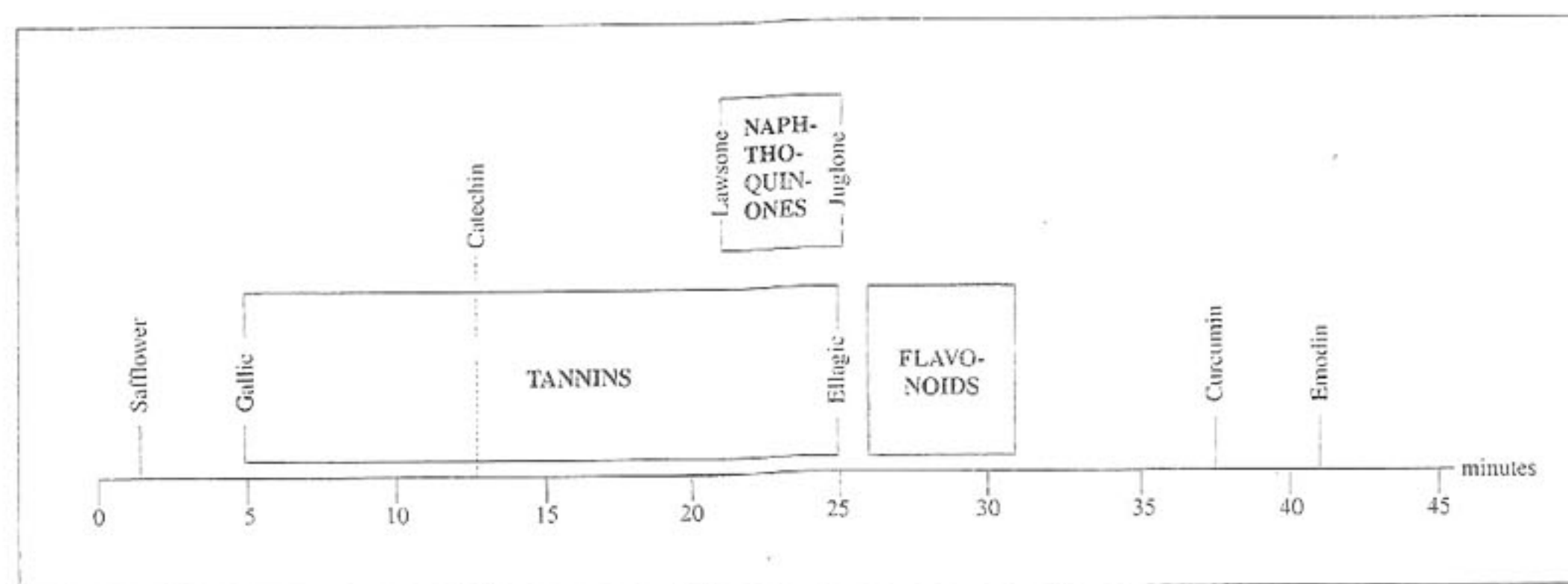


Fig. 1. Chromatographic separation regions based on retention times (R_1) of yellow brown dyes.

Table 2. Dye Analysis of Yellow, Brown and Black Dyeings

Field No.	Thread Type	Color of Thread	Fiber Material	Dyes Found ^{a,b}
402 (6)		Brown	Silk	Tannins (incl. Gallotannin), flavonoids
402 (7)		Brown	Silk	Tannins (incl. Gallotannin), flavonoids
402 (8)		Black	Cotton	Flavonoids, tannins
402 (9)	Warp	Beige	Silk	Undyed (traces of tannins + flavonoids)
402/16	Warp	Brownish yellow	Silk	Undyed
402/16	Warp	Dark brown	Silk	Tannins (incl. Ellagitannin); flavonoids
402/23b	Warp	Beige	Silk	Undyed
402/23b	Weft	Dark brown	Silk	Tannins (incl. Gallotannin + Ellagitannin) flavonoids
402/45	Band	Black	Wool	Tannins (incl. traces of Gallotannin), flavonoids
402/46		Brown	Brown goat hair plied with wool	Undyed wool (traces of tannins + flavonoids)
402/57	Warp	Yellow	Silk	Undyed
402/66	Weft	Beige	Cotton	Tannins (incl. Ellagitannin), flavonoids
402/74	Warp	Mustard yellow	Wool	Flavonoids, tannins
402/157	Weft brocade thread	Black	Silk	Tannins (incl. Ellagitannin), flavonoids
403/314/2a	Warp	Brown	Silk	Tannins (incl. Ellagitannin), flavonoids
403/314/2a	Warp	Yellow	Silk	Undyed (traces of tannins + flavonoids)
405/3	Threads	Yellow	Wool	Flavonoids , tannins
406/545/2a	Weft	Black	Animal hair	Undyed
406/545/2a	Weft	Yellow	Wool	Tannins, flavonoids

^a High-performance liquid chromatographic (HPLC) method of analysis published in Koren 1996.

^b First dye class listed is slightly more abundant. Dye class in bold is considerably more abundant.

Table 3. Dye Analysis of Blue and Green Dyeings

Field No.	Thread Type	Color of Thread	Fiber Material	Dyes Found ^{a,b} (other than Indigotin)
303/4	Weft	Blue	Wool	
402 (1)	Thread	Blue	Cotton	
402 (2)	Thread	Greenish blue ^c	Wool	Traces of tannins + flavonoids
402/8a		Greenish blue	Linen	
402/9a		Blue	Linen	
402/17	Weft	Greenish blue	Wool	Traces of tannins
402/36	Warp	Blue	Linen	Traces of tannins + flavonoids
402/36	Weft	Blue	Wool	
402/57	Weft	Blue	Cotton	
402/67		Blue	Cotton	
402/72		Blueish green	Wool	Tannins, flavonoids
402/73	Weft	Blue	Cotton	
402/75		Dark blue	Wool	

^a High-performance liquid chromatographic (HPLC) method of analysis published in Koren (1994b; 1995).

^b First dye class listed is slightly more abundant.

^c Yellowish (undyed) thread was plied with blue thread.

Table 4. Retention Times (R_t) and Relative Retention Times (RR_t) of Standard Yellow and Brown Dyes^a

Dye Classes						R_t	RR_t^b
<i>Tannins</i>	<i>Naphthoquinones</i>	<i>Flavanol</i>	<i>Flavonoids</i>	<i>Chalconoid</i>	<i>Anthraquinone</i>		
Gallic acid						4.9	0.39
		Catechin				12.6	1.00
	Lawsone					21.0	1.67
Ellagic acid						24.5	1.94
	Juglone ^c					25.3	2.01
			Myricetin, Fisetin, Morin			25.7	2.04
			Quercetin			27.7	2.20
			Genistein, Luteolin			28.6	2.27
			Kaempferol			30.3	2.40
			Apigenin			31.0	2.46
				Curcumin		36.9	2.93
					Emodin	39.8	3.16

^a HPLC analytical method published in Koren 1996.

^b Catechin used as internal standard; thus, $RR_t = R_t/R_{t,catechin}$.

^c Retention times for this dye estimated from a different HPLC elution scheme.

have been used in the Coral Island textiles. The dyes detected in the yellow, brown, and black dyeings are consistent with the colors produced from these colorants.

As seen in Table 2, a number of the yellowish and beige silk fibers were undyed. These colors, as currently observed, are the result of the natural yellowing of the textile fibers over many centuries of burial. In some of the undyed silks, traces of tannins and flavonoids were detected. The minute presence of these components in the textile fibers is undoubtedly due to the absorption of these compounds from the soil, which are present there as a result of the decomposition of vegetal matter. One undyed brown sample (402/46) consisted of an undyed wool thread plied together with a brown thread composed of naturally pigmented goat hairs. An undyed blackish sample (406/545/2a) was produced by using dark brown animal hairs.

The Blue and Green Dyeings

The blue dyeings were produced with the vat dye indigotin, which may be produced from

either woad (*Isatis tinctoria* L.) or indigo (*Indigofera tinctoria*) or from other indigotin-producing plants. This dye was known as *nil* in the Arabic world (Balfour-Paul 1992), and in an eleventh-century Persian manuscript the plant source of this colorant was termed *nileh* (Brunello 1973). Current analytical methods cannot determine the botanical provenance of dyeings that contain the indigotin dye. Either *isatis* or indigo could have been used during the Mamlûk period.

Only one green dyeing (402/72) showed definite signs of a double dyeing with indigotin and with a tannin- and flavonoid-producing yellow dyestuff. One interesting greenish textile, No. 402(2), was produced by plying an undyed beige thread with a blue-dyed thread. The greenish coloration of all other blue dyeings is due to the natural yellowing of the undyed fibers and the partial chemical and physical degradation of the blue pigment in the textiles over time. Thus, the combination of beige or yellowish fibers with blue fibers in the excavated archaeological textiles results in a greenish hue.

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CONCLUSIONS

The red and blue dyeings that were investigated showed uneven coloration along the length of each fiber, and poorly dyed or undyed inner fibers in the thread. This observation is not surprising for the cotton, silk, and linen dyeings, as these textiles would have been dyed "in the yarn" or "in the piece." Wool that is dyed "in the fleece" results in more uniform dyeings due to good penetration of the dye into the interior of the fibers. However, the Coral Island woolen dyeings also showed unevenness of color on the microscopic level, indicating that they too were dyed as threads.

These dyeings were, in general, of an inferior quality to those excavated at the Roman-period Judean Desert sites of the Cave of Letters (Abrahams and Edelstein 1963; Yadin 1963) and Masada (Koren 1994a; Sheffer and Granger-Taylor 1994), due, at least in part, to the utilization of the techniques mentioned here—yarn (or piece) dyeing, as compared to the fleece-dyeing practiced in the Roman period.

The blue textiles were more unevenly dyed than the red. This indicates that the dyers were somewhat more successful with mordant dyeing to produce the red colors than with the vat dyeing which yielded the blue indigotin pigment in the textiles.

That Coral Island was part of an active system of trade routes is attested by the textiles from many countries found at this site (Baginski and Shamir 1994, and this volume). It can also be assumed that many, if not all of the dyeings were imported. All the dyes investigated were indicative of a botanical provenance, and no red scale-insect or purple/violet/blue molluscan dyes were detected. "Fake" purple, which could have been derived from plants by using either madder and an iron mordant, or by double-dye-

ing with madder and indigotin, is absent from these textiles. This is not surprising as molluscan-purple was not fashionable for this period and thus a more economical alternate source for that dye was not sought. At least three different species of red-dye producing insects were available to the Islamic world of this period (Forbes 1964:102–107). These *Coccoidea* species included the oak kermes, breeding on *Quercus coccifera* trees found at high altitudes, Armenian cochineal (also known as *qirmiz*), breeding at the root tops of certain grassy weeds near Mount Ararat, and the lac-producing insect from India. However, these insects, and dyeings produced from them, were probably priced beyond the reach of the fort's residents. A scale-insect dye has not been detected on the Coral Island textiles examined.

The medieval Islamic textiles unearthed at Coral Island consist of a cornucopia of colors. However, the technical quality of the dyeings, as detected at the microscopic level, was not very high. The presence of only plant dyes, a relatively inexpensive dyestuff source, and the quality of these dyeings are testimonies to the simple economic status of the residents who inhabited this Red Sea garrison some seven centuries ago.

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