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Distribution of Plant Communities Across Al Abna Escarpment, SW Saudi Arabia

By

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With 6 Figures

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Summary

El Karemy Z. A. R. & Zayed K. M. 1992. Distribution of plant communities across Al Abna escarpment, SW Saudi Arabia. – Phyton (Horn, Austria) 32 (1): 79–101, with 6 figures. – English with German summary.

Al Abna, "Al Abna'a", latitude 19° 52′ North and longitude 42° 30′ East, is one of the major escarpments of Asir mountains (SW Saudi Arabia), extending for a distance of 65 kms with a sharp rise from 280 to 2000 m above sea level. Due to local physiographic factors, three altitudinal sectors could be distinguished along the course of the escarpment. 141 species of vascular plants are recorded in the following fifteen plant communities dominated by *Juniperus excelsa, J. excelsa-Oleo europaea-Acacia negrii, Hyparrhenia hirta, Barleria prionitis, Ficus salicifolia-F. sur, Acacia asak, Ziziphus spina-christi, Anisotes trisulcus, Cissus rotundifolius-Acacia ehrenbergiana, Caralluma russeliana, Cassia italica, Leptadenia pyrotechnica, Acacia ehrenbergiana, Suaeda monoica* and *Arnebia hispidissima* respectively.

Zusammenfassung

El Karemy Z. A. R. & Zayed K. M. 1992. Verbreitung von Pflanzengemeinschaften entlang der Al Abna-Route in SW Saudi-Arabien. – Phyton (Horn, Austria) 32 (1): 79–101, 6 Abbildungen. – Englisch mit deutscher Zusammenfassung.

Al Abna, "Al Abna'a", liegt bei 42°30′ östlicher Länge und 19°52′ nördlicher Breite und ist eine der wichtigeren Routen des Asir Gebirges in Südwest-Saudi-Arabien. Sie erstreckt sich über eine Länge von 65 km und steigt rasch von 280 auf 2000 m s. m. an. Aufgrund der lokalen physiogeographischen Verhältnisse können

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entlang der Route drei Höhenzonen unterschieden werden. 141 Gefäßpflanzen-Arten wurden im Gebiet registriert. 15 Pflanzengemeinschaften, jeweils durch die im folgenden genannte(n) Art(en) dominiert und danach benannt, werden unterschieden: *Juniperus excelsa-, J. excelsa-Olea europaea-Acacia negrii-, Hyparrhenia hirta-, Barleria prionitis-, Ficus salicifolia–F. sur-, Acacia asak-, Ziziphus spina-christi-, Anisotes trisulcus-, Cissus rotundifolius-Acacia ehrenbergiana-, Caralluma russeliana-, Cassia italica-, Leptadenia pyrotechnica-, Acacia ehrenbergiana-, Suaeda monoica-* und *Arnebia hispidissima*-Gemeinschaft.

1. Introduction

Al Abna, "Al Abna'a" in arabic, means sons. It is one of the major escarpments of Asir mountains within the Baha area, SW Saudi Arabia. It was till quite recently, one of the main roads connecting Baha area, in the upper west, with the Red Sea coastal plain, in the lower east. In connection with the rapid development of the whole area, a recent alternative road was constructed. However Al Abna escarpment is still in use, without effective capacity.

The present account is a documentary study to the area in connection of rapid deterioration of Al Abna escarpment road.

Earlier contributions to our knowledge of the area are those of VESEY-FITZGERALD 1957 a, b, MANDAVILLE 1965, MIGAHID 1978, BATANOUNY 1979, BATANOUNY & BAESHIN 1983, ZAHRAN 1983, BAIERLE, EL-SHEIKH & FREY 1985, COLLENETTE 1985 and ZAYED & EL KAREMY 1989.

2. Study Area

Al Abna escarpment is located 45 km south of Baha (latitude 19° 52′ North and longitude 42°30′ East of Greenw.) and extending a distance of 65 km east of Al Abna village (Fig. 1). The lowest part of the escarpment lies at the level of 280 m above sea level at Jeddah-Gizan coastal road. It rises sharply to reach 2000 m at Al Abna village (Fig. 2). Regarding altitudinal variation, biotic and edaphic attributes, three sectors could be distinguished.

1. Tehama sector (less than 600 m)

„Tehama" in arabic, means hot place. This sector is a part of the Red Sea coastal plain which lies immediatly below the spurs of the foothills. It is gravelly near the range and gritly further away, with wide areas of quite firm, deep and fine-textured soil (Fig. 4 c).

2. Gentle-slope sector (600–900 m)

These slopes extends for about 15 kms east of Tehama sector. Numerous runnels and narrow wadis are located. The slopes are covered by rocks and boulders; with coarse-textured and shallow soil (Fig. 4 b).

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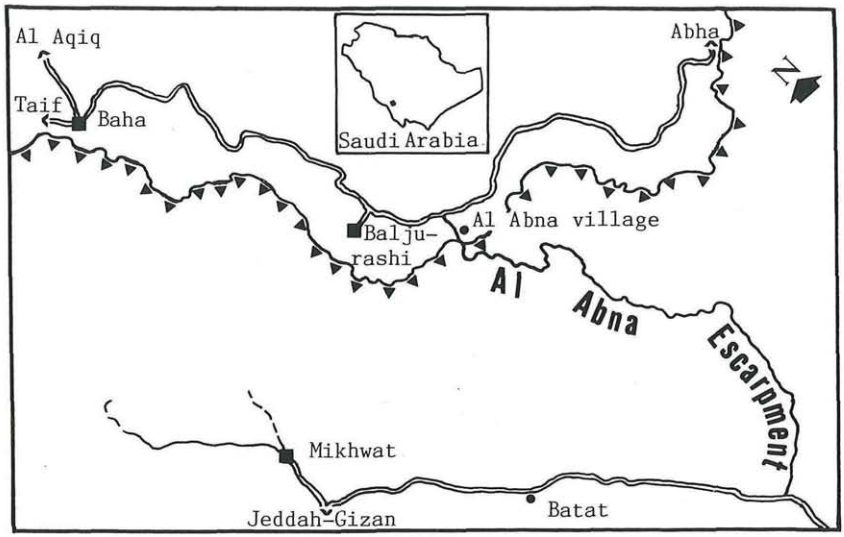

Fig. 1. Geographical situation of the study area.

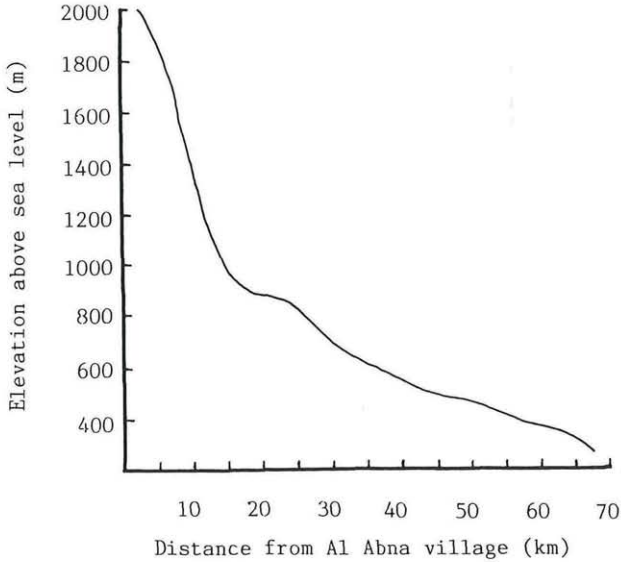

Fig. 2. Profile across Al Abna escarpment.

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3. Steep-slope sector (900–2000 m)

This sector comprises a wilderness of rocky wadis and eroded stony slopes which rises to jagged spurs (Fig. 4 a).

3. Climate

The available climatic data were collected from the stations of Baha and Mikhwat.

The average annual rainfall varies greatly, being 361.1 mm at Baha and 53.8 mm at Mikhwat. Rainfall at Baha occurs all the year round, with higher

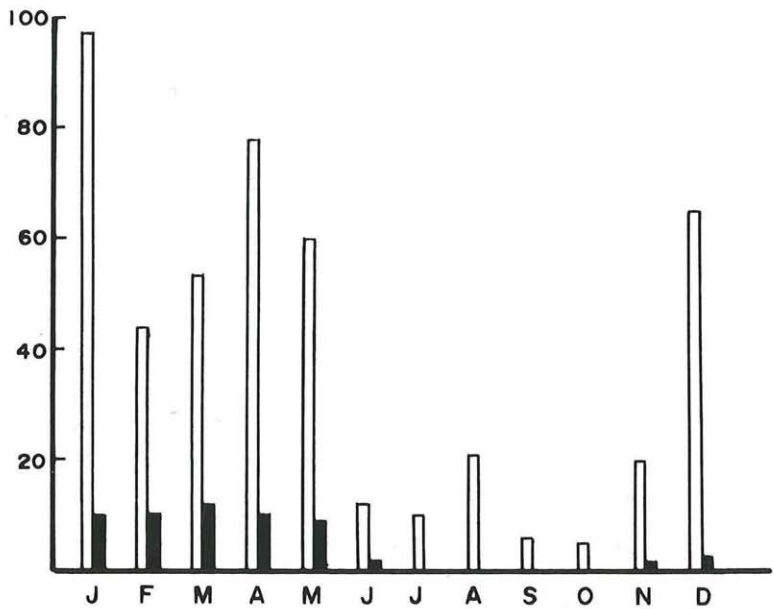

Fig. 3. Monthly rainfall in mm at Baha (□) and Mikhwat (■), average of 10 years.

values in winter and spring; mean monthly values were: 97.9, 74.3, 10.0 and 5.4 mm in January, April, July and October respectively. At Mikhwat station, a long rainless period extends from July to November; mean monthly values are much lesser than those recorded in Baha (Fig. 3).

Data of air temperature were available only from Baha where the mean monthly temperature ranges between 10.8° C in January and 29.2° C in July. The mean of maximum and minimum temperatures are 35.8° C and 22.6° C in July. Due to lower elevation, higher temperatures could be expected in the western sector of the study area.

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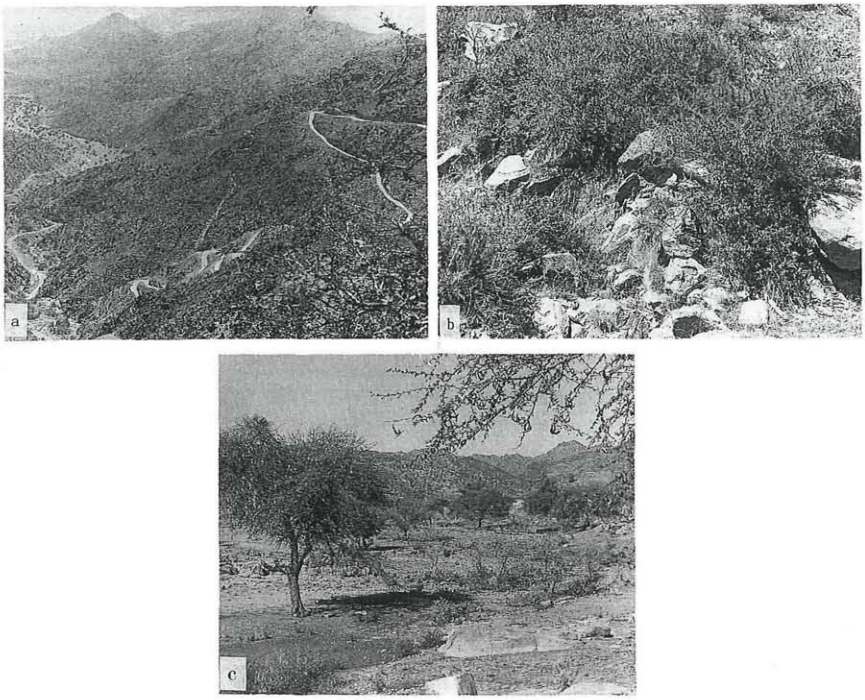

Fig. 4. Some stands in the area representing the different sectors:
a Steep-slope sector. – b Gentle-slope sector. – c Tehama sector.

4. Methods and Techniques

Fourty five stands were choosen where variations in vegetation were observed. In each of these stands the species were rated according to BRAUN-BLANQUET 1964. Two scales are used: abundance-dominance (combining the abundance and cover of the species) and sociability (measure of grouping).

Two complete sets of specimens collected are deposited in the Herbarium of Cairo University (CAI) and the Herbarium of Assiut University. The specimens, identified mainly according to MIGAHID 1978, COLLENETTE 1985 and MANDAVILLE 1990 and duplicate specimens were checked for identification (BOULOS 1985) and deposited also at the Herbarium of National Research Centre, Cairo (CAIRC).

P = presence value in%; AB = Abundance-dominance (combined scale of six grades + to 5. Species of neglegible abundance-dominance values are listed under associates.

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5. Results

The following plant communities are recognised and arranged according to their distribution up-down-wards.

5.1. *Juniperus excelsa* Community

The community dominated by *Juniperus excelsa* is widely spread at the lip of the escarpment and represents the climax stage of vegetation in the area higher than 1900 m. The soil supporting this assemblage is compact and fine-textured. The plant cover is about 30 % (compare also BATANOUNY 1987).

Floristic Composition:
Total cover = 30 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Juniperus excelsa M. BIEB. [Syn.: *J. procera* HOCHST. ex ENDL.]	100	2.1
b. Shrub layer		
Periploca aphylla DECNE.	33	+.1
c. Dwarf shurbs and perennial herbs		
Pulicaria incisa (LAM.) DC.	100	1.1
Astragalus atropilosus (HOCHST.) BUNGE	67	1.1
Lavandula pubescens DECNE.	67	1.1
Otostegia fruticosa (FORSSK.) SCHWEINF. ex PENZIG subsp. *schimperi* (BENTH.) SEBALD	67	+.1
Themeda triandra FORSSK.	33	+.2
Hyparrhenia hirta (L.) STAPF	33	+.2
Solanum incanum L.	33	+.1
Felicia abyssinica A. RICH.	33	+.1
Euphorbia schimperi PRESL	33	+.1
d. Associates		
Ceterach officinarum DC.		
Cheilanthes vellea (AIT.) F. MUELLER		
Umbilicus intermedius BOISS.		

5.2. *Juniperus excelsa – Olea europaea – Acacia negrii* Community

This plant assemblage prevail at levels ranging from 1870 to 2000 m and usually inhabits the runnels crossing the rocky steep slopes and vallies receiving adequate water supply. The soil is relatively deep and fine-textured, while the ground surface is covered with fragmented rocks. Variation of the local topography affects greatly both of the cover percentage (30–50) and the relative dominance of the dominant trees.

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Juniperus excelsa dominate the elevated sites while *Acacia negrii* abounds on the relatively lower stands with deep fine-textured deposites whereas individuals of *Olea europaea* occupies intermediate positions.

Floristic Composition:
Total cover = 30–50 %; number of records = 2.

Species	P(%)	AB
a. Tree layer		
Juniperus excelsa M. BIEB.	100	2.1
Olea europaea L. subsp. *africana* (BURM. f.) P. S. GREEN	100	2.1
Acacia negrii PICHI-SERM.	100	2.1
b. Shrub layer		
Lycium shawii ROEM. & SCHULT.	100	1.1
Dodonaea viscosa L.	100	1.1
Rhamnus staddo A. RICH. var. *deflersii* (SCHWEINF.) CHIOV.	50	+.1
Ochradenus baccatus DELILE	50	+.1
c. Dwarf shrubs and perennial herbs		
Lavandula dentata L.	100	1.2
Hyparrhenia hirta (L.) STAPF	100	1.2
Cynodon dactylon (L.) PERS.	50	1.2
d. Annuals and ephemerals		
Sisymbrium irio L.	100	1.1
Picris longirostris SCH. BIP.	50	1.1
Oxalis corniculata L.	50	1.1
Asphodelus tenuifolius CAV.	50	1.1
Rumex vesicarius L.	50	+.1
Andrachne aspera SPRENG.	50	+.1
e. Associates		
Solanum sepicula DUN.		
Verbascum yemense DEFLERS (Fig. 6 d)		
Plectranthus asirensis J. R. I. WOOD		

5.3. *Hyparrhenia hirta* Community

Hyparrhenia hirta attains about one meter height. It is one of the important range grasses with wide ecological and sociological range in the surveyed escarpment. This assemblage abounds on shallow eroded water coarse at stony gullies, where the dominent plant may form pure stands. The habitat is subjected to water erosion and the plant cover is not homogenous. It ranges between 10 and 35 %. The soil supporting this community is shallow and coarse-textured, with fairly limited water revenue (compare also KASSAS & GIRGIS 1965).

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Floristic Composition:
Total cover = 10–35 %; number of records = 5.

Species	P(%)	AB
a. Tree layer		
Not represented		
b. Shrub layer		
Olea europaea L. subsp. *africana* (Burm. f.) P. S. GREEN	20	+.1
c. Dwarf shrubs and perennial herbs		
Hyparrhenia hirta (L.) STAPF	100	2.2
Dodonaea viscosa L.	60	1.1
Blepharis ciliaris (L.) B. L. BURTT	60	1.1
Indigofera spinoas FORSSK.	60	+.1
Psiadia punctulata (DC.) VATKE [Syn.: *P. arabica* JAUB. & SP.]	40	+.1
Rumex limoniastrum JAUB. & SP.	40	1.1
Otostegia fruticosa (FORSSK.) SCHWEINF. ex PENZIG subsp. *schimperi* (BENTH.) SEBALD	20	+.1
Aerva javanica (BURM. f.) JUSS. ex A. SCHULT.	20	+.1
Verbascum yemense DEFLERS	20	+.1
Conyza stricta WILLD. var. *pinnatifida* (D. DON) KITAMURA	20	+.1
Salvia merjamie FORSSK.	20	+.1
Commiphora sp.	20	+.1
d. Annuals and ephemerals		
Osteospermum vaillantii (DECNE.) NORL	40	1.1
Eragrostis barrelieri DAV.	20	1.1
e. Associates		
Ruta chalepensis L.		
Dianthus strictus BANKS & SOL.		
Stipa capensis THUNB.		
Polygala abyssinica R. BR.		

5.4. *Barleria prionitis* Community

The mountain country of the escarpment at altitudes of about 1660 m has very steep slopes dissected by frequent rocky runnels of various width and depth, together with the rocky ridges and hills forming ample rooms for the appearance of a vegetation dominated by *Barleria prionitis (Acanthaceae)*. The ground surface is covered by barren rocks and boulders of various sizes and shapes. The underneath and in crevices and pockets fine sediments are traped. The plant cover ist apparently rich attaining 40 %.

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Floristic Composition:
Total cover = 30–40 %; number of records = 2.

Species	P(%)	AB
a. Tree layer		
Phoenix dactylifera L.	50	+.1
Ziziphus spina-christi (L.) WILLD.	50	+.1
Ficus sur FORSSK.	50	+.1
b. Shrub layer		
Barleria prionitis L. subsp. *appressa* (FORSSK.) BRUMMITT & J. R. WOOD	100	3.1
Periploca aphylla DECNE.	50	+.1
Adenium obesum (FORSSK.) ROEM. & SCHULT. (Fig. 6 a)	50	+.1
Abutilon pannosum (FORST. f.) SCHLECHT.	50	+.1
c. Dwarf shrubs and perennial herbs		
Rumex limoniastrum JAUB. & SP.	100	1.1
Cluytia myricoides JAUB. & SP.	100	1.1
Indigofera spinosa FORSSK.	50	1.1
Trichodesma ehrenbergiana SCHWEINF.	50	+.1
Lotus arabicus L.	50	+.1
Dianthus strictus BANKS & SOL.	50	+.1
Helichrysum glumaceum DC.	50	+.1
Hyparrhenia hirta (L.) STAPF	50	+.2
Psiadia punctulata (DC.) VATKE	50	+.1
Otostegia fruticosa (FORSSK.) SCHWEINF. ex PENZIG subsp. *schimperi* (BENTH.) SEBALD	50	+.1
Pulicaria crispa (FORSSK.) BENTH. & HOOK. f.	50	+.1
Solanum incanum L.	50	+.1
Crotalaria emarginella VATKE (Fig. 6 c)	50	+.1
Triumfetta flavescens HOCHST. ex A. RICH.	50	+.1
Avena fatua L.	50	+.1
d. Annuals and ephemerals		
Eragrostis barrelieri DAV.	50	+.1
Umbilicus rupestris (SALISB.) DANDY	50	+.1
Kalanchoe alternans (VAHL) Pers	50	+.1
Echium longifolium Delile	50	+.1
e. Associates		
Hypoestes forskalei (VAHL) SOL. ex ROEM. & SCHULT. [Syn.: *H. verticillaris* (L. f.) SOL. ex ROEM. & SCHULT.]		
Pluchea dioscoridis DC.		
Zehneria scabra (L.) SOND.		
Scrophularia arguta SOLAND. ex AIT.		

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5.5. *Ficus salicifolia – F. sur* Community

The vegetation dominated by such trees commonly abounds on the warm vallies, rocky ridgs, cliffs and hills with large boulders at altitudes ranging between 1170 and 1410 m. The ground surface is covered with barren conglomerates and boulders. Water resources are more or less considerable, with a plant cover that reaches 30 % and where the dominant species contribute to most of it.

Floristic Composition:
Total cover = 30 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Ficus salicifolia VAHL	100	2.1
F. sur FORSSK.	100	2.1
F. palmata FORSSK.	33	+.1
Nuxia oppositifolia HOCHST.	33	+.1
b. Shrub layer		
Olea europaea L. subsp. *africana* (MILL.) P. S. GREEN	67	+.1
Barleria prionitis L. subsp. *appressa* (FORSSK.) BRUMMIT & J. R. WOOD	33	+.1
Abutilon pannosum (FORST. f.) SCHLECHT.	33	+.1
c. Dwarf shrubs and perennial herbs		
Dodonaea viscosa L.	67	+.1
Anarrhinum forskahlii (J. F. GMEL.) CUF. [Syn.: *A. orientale* BETTH.]	67	+.1
Hyparrhenia hirta (L.) STAPF.	67	1.2
Aerva javanica (BURM f.) JUSS. ex J. A. SCHULT.	33	+.1
Rumex limoniastrum JAUB. & SP.	33	1.1
Ecbolium viride (FORSSK.) ALSTON	33	+.1
Plectranthus asirensis J. R. I. WOOD	33	+.1
Capparis cartilaginea DECNE.	33	+.1
d. Annuals and ephemerals		
Sisymbrium irio L.	100	+.2
e. Associates		
Mentha longifolia L. subsp. *schimperi* (BRIQ.) BRIQ.		
Spergularia diandra (GUSS.) HELDR. & SART.		
Pluchea dioscoridis DC.		
Datura stramonium L.		
Amaranthus graecizans L.		
Xanthium spinosus L.		
Withania somnifera (L.) DUN.		
Cometes abyssinica R. BR.		

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5.6. *Acacia asak* Community

This community abounds on the stony slopes at levels ranging between 1450 and 1150 m. It is uncommon at lower levels (compare also VESEY-FITZGERALD 1957, BATANOUNY 1987, BAIERLE & al., 1985). The ground cover consists of cushion grasses and herbs, with a scanty plant cover, not exceeding 10 %. The soil supporting this community is coarse-textured with low water-retaining capacity.

Floristic Composition:
Total cover = 10 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Ficus salicifolia VAHL	33	+.1
b. Shrub layer		
Acacia asak (FORSSK.) WILLD.	100	2.1
Lycium shawii ROEM.	67	+.1
Commiphora sp.	33	+.1
Adenium obesum (FORSSK.) ROEM. & SCHULT.	33	+.1
c. Dwarf shrubs and perennial herbs		
Cenchrus ciliaris L.	67	1.2
Themeda triandra FORSSK.	67	1.2
Hyparrhenia hirta (L.) STAPF	33	1.1
Blepharis ciliaris (L.) B. L. BURITT	33	1.1
Bromus sp.	33	+.1
d. Annuals and ephemerals		
Morettia canescens BOISS.	33	+.1
Euphorbia granulata FORSSK.	33	+.1
e. Associates		
Cissus quadrangularis L.		
Indigofera spinosa FORSSK.		
Fagonia acerosa BOISS.		
Stachys sp. aff. *aegyptiaca* PERS.		
Farsetia longisiliqua DECNE.		
Teucrium polium L.		
Trichodesma calatiforme HOCHST.		

5.7. *Ziziphus spina-christi* Community

The vegetation of this community was recorded along the wide wadis crossing the rocky slopes and ringes, below 1000 m. The soil supporting this community is of alluvial origin formed of alluvial parent material transported by run-off water from the adjacent slopes. It is medium-

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textured and fertile. Consequently, plant cover is relatively dense (about 30 %). However the vegetation dominated with *Ziziphus* trees has a limited range of ecological distribution in the surveyed area (Fig. 5 a).

Floristic Composition:
Total cover = 30 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Ziziphus spina-christi (L.) WILLD.	100	3.1
Ficus palmata FORSSK. [Syn.: *F. pseudosycomorus* DECNE.]	33	+.1
b. shrub layer		
Grewia erythraea SCHWEINF.	33	+.1
Anisotes trisulcus (FORSSK.) VAHL	33	+.1
Cissus rotundifolius (FORSSK.) VAHL (Fig. 6b)	33	+.1
Acacia asak (FORSSK. WILLD.	33	+.1
Acacia hamulosa BENTH.	33	+.1
c. Dwarf shrubs and perennial herbs		
Solanum incanum L.	100	1.1
Caralluma sinaica (DECNE.) BENTH.	67	+.1
Heliotropium longiflorum HOCHST. & STEUD.	33	1.1
Echinops sp.	33	+.2
Salvia merjamie FORSSK.	33	+.1
Boerhavia repens L.	33	+.1
Lindenbergia sinaica (DECNE.) BENTH.	33	+.1
Cenchrus ciliaris L.	33	+.2
Micromeria sp.	33	+.1
d. Annuals and ephemerals		
Arnebia hispidissima (LEHM.) DC.	67	1.1
Pulicaria arabica (L.) CASS.	33	1.1
Andrachne aspera SPRENG.	33	1.1
Senecio flavus (DECNE.) SCH. BIP.	33	1.1
e. Associates		
Aerva javanica (BURM. f.) SPRENG.		
Rumex vesicarius L.		

5.8. *Anisotes trisulcus* Community

The drainage system within the foothills and wide watercourses of the study area are the favourable habitats for the development of vegetation dominated by *Anisotes trisulcus (Acanthaceae)*. This species has a wide sociological range especially on the western slopes located at elevations

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ranging from 920 to 1380 m. Soil supporting this community is relatively deep, fine-textured and covered by stones and loose boulders. The vegetation is luxuriant and varied with high coverage ranging between 30 and 50 % (Fig. 5 b).

Floristic Composition:
Total cover = 30–50 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Ziziphus spina-christi (L.) WILLD.	33	+.1
b. Shrub layer		
Anisotes trisulcus (FORSSK.) VAHL	100	3.1
Acacia ehrenbergiana HAYNE	67	+.1
A. tortilis (Forssk.) HAYNE	33	+.1
A. nubica BENTH.		
Leptadenia pyrotechnica (FORSSK.) DECNE.	33	1.1
Cissus quadrangularis L.	33	1.1
Pergularia daemia (FORSSK.) CHIOV.	33	1.1
c. Dwarf shrubs and perennial herbs		
Cassia italica (MILL.) LAM. ex STEUD.	100	1.1
Solanum incanum L.	67	1.1
Heliotropium arbainense FRESEN	33	1.1
Tribulus terrestris L.	33	1.1
Panicum turgidum FORSSK.	33	1.2
Blepharis ciliaris (L.) B. L. BURTT	33	1.1
Aerva javanica (BURM. f.) JUSS. ex J. A. SCHULT.	33	+.1
Indigofera spinosa FORSSK.	33	1.2
d. Annuals and ephemerals		
Aizoon canariense L.	100	1.1
Cucumis prophetarum L.	33	+.1
Paronychia sp.	33	+.1
e. Associates		
Caralluma russeliana (CORUB. ex BRONGN.) CUFOD.		
Euphorbia granulata FORSSK.		
Boerhavia coccinea MILL.		
Fagonia indica BURM. f.		

5.9. *Cissus rotundifolius – Acacia ehrenbergiana* Community

This community has a restricted ecological and sociological range in Al Abna escarpment. It is common only about half way the surveyed area on

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the steep hillsides and sandy plains with more or less limited water revenue. The soil supporting this community is shallow and medium-textured, while the ground surface is mostly covered with rock fragments. The plant cover is about 15 %, mainly due to dominant species.

Floristic Composition:
Total cover = 15 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Ficus salicifolia VAHL	33	+.1
b. Shrub layer		
Acacia ehrenbergiana HAYNE	100	2.1
Cissus rotundifolius (FORSSK.) VAHL	100	2.1
Leptadenia pyrotechnica (FORSSK.) DECNE.	33	+.1
Euphorbia cuneata VAHL	33	+.1
c. Dwarf shrubs and perennial herbs		
Tetrapogon villosus DESF.	33	+.1
Themeda triandra FORSSK.	33	+.1
Solanum sepicula DUN.	33	+.1
Caylusea hexagyna (FORSSK.) M. L. GREEN	33	+.1
Boerhavia repens L.	33	+.1
Caralluma russeliana (COURB. ex BRONGN.) CUFOD.	33	+.1
Stipa capensis THUNB.	33	+.2
Commelina forsskahlei VAHL	33	+.2
d. Annuals and ephemerals		
Arnebia hispidissima (LEHM.) DC.	67	1.1
Euphorbia granulata FORSSK.	33	1.1
e. Associates		
Andrachne aspera SPRENG.		
Tribulus terrestris L.		
Hypoestes forskalei (VAHL) ROEM. & SCHULT.		

5.10. *Caralluma russeliana* Community

This assemblage flourishes among rocks of gentle slopes, about one third the way up the escarpment. Deep alluvial deposites support the growth of such *Caralluma* species. The habitat is subjected to remarkable wind and water erosion. Plant cover is sparse, not exceeding 5 %.

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Floristic Composition:
Total cover = 5 %; number of records = 2.

Species	P(%)	AB
a. Tree layer		
Ficus salicifolia VAHL	50	+.1
b. Shrub layer		
Acacia ehrenbergiana HAYNE	50	+.1
Leptadenia pyrotechnica (FORSSK.) DECNE.	50	+.1
c. Dwarf shrubs and perennial herbs		
Caralluma russeliana (COURB. ex BRONGN.) CUFOD.	100	2.1
Blepharis ciliaris (L.) B. L. BURTT	100	1.1
Triumfetta flavescens HOCHST. ex A. RICH.	50	+.1
Fagonia acerosa BOISS.	50	+.1
Euphorbia arabica HOCHST. & STEUD. ex BOISS.	50	1.1
d. Annuals and ephemerals		
Senecio hoggariensis BENTH.	50	+.1
c. Associates		
Indigofera spinosa FORSSK.		
Pergularia tomentosa L.		

5.11. *Cassia italica* Community

This community has a narrow range of distribution in Al Abna escarpment. It occurs on depressions among sand plains below 600 m. The soil supporting the growth of *Cassia italica* community is relatively fine and deep. The habitat is subjected to wind erosion and grazing effect is obvious, the plant cover is therefore thin and not exceeding 5 %.

Floristic Composition:
Total cover = 5 %; number of records = 2.

Species	P(%)	AB
a. Tree layer		
Ziziphus spina-christi (L.) WILLD.	50	+.1
b. Shrub layer		
Calotropis procera (AIT.) AIT. f.	50	+.1
Leptadenia pyrotechnica (FORSSK.) DECNE.	50	+.1
Cissus rotundifolius (FORSSK.) VAHL	50	+.1

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Species	P(%)	AB
c. Dwarf shrubs and perennial herbs		
Cassia italica (MILL.) LAM. ex STEUD.	100	2.1
Panicum turgidum FORSSK.	50	1.2
Dipterygium glaucum DECNE.	50	1.2
Onopordon heteracanthum C.A. MEY.	50	+.1
Caralluma russeliana (COURB. ex BRONGN.) CUFOD.	50	+.1
d. Annuals and ephemerals		
Echium longifolium DELILE	50	1.1
Citrullus colocynthis (L.) SCHRAD.	50	1.2
Tribulus terrestris L.	50	1.2
e. Associates		
Euphorbia granulata FORSSK.		
Fagonia indica BURM. f.		
Aizoon canariense L.		

5.12. *Leptadenia pyrotechnica* Community

This community inhabits deep sand plains below 600 m. Species population, in this plant assemblage, is remarkably low. *Leptadenia pyrotechnica* together with *Acacia* species are extensively browsed by camels and cut for fuel. As a result, the plant cover is thin, ranging from 5 to 15 %. The soil supporting this leefless shrub is deep and medium-textured. Dunes of variable sizes are formed by the deposition of wind-blown sand around the dominant plant (compare also KASSAS & GIRGIS 1970.)

Floristic Composition:
Total cover = 30 %; number of records = 2.

Species	P(%)	AB
a. Tree layer		
Phoenix dactylifera L.	10	+.1
b. Shrub layer		
Leptadenia pyrotechnica (FORSSK.) DECNE.	100	2.2
Calotropis procera (AIT.) AIT. f.	50	+.1
Acacia tortilis (FORSSK.) HAYNE	50	+.1
A. ehrenbergiana HAYNE	50	2.1
c. Dwarf shrubs and perennial herbs		
Cassia italica (MILL.) LAM. ex STEUD.	50	1.1
Panicum turgidum FORSSK.	50	1.2
Dipterygium glaucum DECNE.	50	1.1
d. Associates		
Reichardia tingitana (L.) ROTH		
Morettia canescens BOISS.		

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5.13. *Acacia ehrenbergiana* Community

The community dominated by *Acacia ehrenbergiana* was previously recorded by KASSAS & GIRGIS 1970. It could be divided, in the study area, on ecological and floristic bases, into two subtypes as follows:

a. The first subtype abounds on deep alluvial deposites in wadis below 500 m. The precipitation at this lower elevation is minimised, but the wadis benifit from runn-off water of the higher slopes. Plant cover is relatively thick (about 30 %).

Floristic Composition:
Total cover = 30 %; number of records = 2.

Species	P(%)	AB
a. Tree layer		
Not represented		
b. Shrub layer		
Acacia ehrenbergiana HAYNE	100	3.1
Abutilon pannosum (FORST f.) SCHLECHT.	50	1.1
Adenium obesum (FORSSK.) ROEM. & SCHULT.	50	+.1
Leptadenia pyrotechnica (FORSSK.) DECNE.	50	+.1
Calotropis procera (AIT.) AIT. f.	50	1.1
c. Dwarf and perennial herbs		
Panicum turgidum FORSSK.	50	1.2
Trichodesma ehrenbergii SCHWEINF.	50	+.1
Cassia italica (MILL.) LAM. ex STEUD.	50	+.1
Euphorbia sp.	50	+.1
Rhazya stricta DECNE.	50	1.1
Argemone mexicana L.	50	1.1
Peganum harmala L.	50	+.1
d. Annuals and ephemerals		
Asphodelus tenuifolius CAV.	100	1.1
Aizoon canariense L.	50	1.2
Cucumis prophetarum L.	50	1.1
e. Associates		
Solanum sepicula DUN.		
Boerhavia repens L.		
Stipa capensis THUNB.		

b. The second subtype inhabits the gravelly terraces and the foots of stony ridges at higher elevations, up to 900 m. The soil is more shallow and plant cover is much thinner in the first subtype.

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Floristic Composition:
Total cover = 5–10 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Not represented		
b. Shrub layer		
Acacia ehrenbergiana HAYNE	100	3.1
Lycium shawii ROEM. & SCHULT.	67	1.1
Pergularia tomentosa L.	33	+.1
Euphorbia cuneata L.	33	+.1
c. Dwarf shrubs and perennial herbs		
Cleome brachycarpa VAHL	67	1.1
Caralluma quadrangula (FORSSK.) N. E. BR.	26	+.1
d. Annuals and ephemerals		
Sisymbrium irio L.	100	1.2
Malva parviflora L.	100	1.2
Morettia parviflora BOISS.	33	+.1
e. Associates		
Stipa capensis THUNB.		
Euphorbia granulata FORSSK.		
Argemone mexicana L.		
Themeda triandra FORSSK.		

5.14. *Suaeda monoica* Community

The community colonized by this succulent and shrubby chenopod abounds on the foot hills where the watercourses debouches on the wide coastal plain. The soil is compact, deep, fine-textured and slightly salinized, while the ground surface is overlain by eolian sand. *Suaeda monoica* forms almost pure stands of dense cover that may reach 80 % (Fig. 5 d). The few recorded associate species were observed on the elevated bands which delimit and interrupt the dense stands of *Suaeda* (compare also KASSAS & ZAHRAN 1965).

Floristic Composition:
Total cover = 80 %; number of records = 1.

Species	AB
a. Tree layer	
Not represented	
b. Shrub layer	
Suaeda monoica FORSSK.	4.1
Acacia ehrenbergiana HAYNE	+.1
Leptadenia pyrotechnica (FORSSK.) DECNE.	+.1

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Species	AB
c. Dwarf shrubs and perennial herbs	
Cassia senna L.	1.1
Panicum turgidum FORSSK.	1.2
Indigofera spinosa FORSSK.	1.1
d. Annuals and ephemerals	
Aizoon canariense L.	1.1
Citrullus colocynthis (L.) SCHRAD.	+.1
e. Associates	
Chenopodium murale L.	
Spergularia sp.	

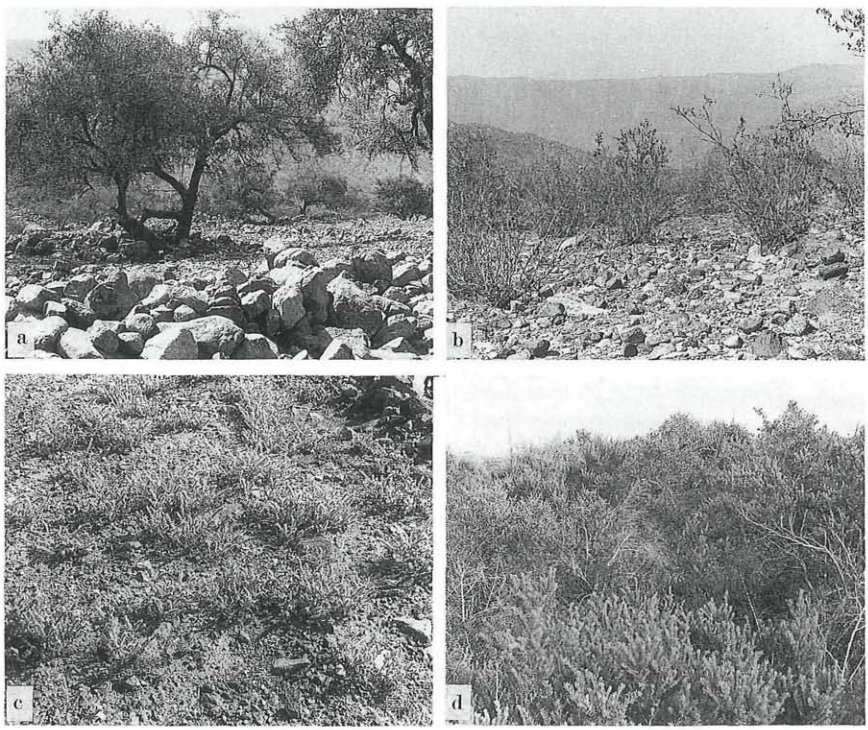

Fig. 5. Selected communities showing different vegetation patterns: a *Ziziphus spina-christi* community. – b *Anisotes trisulcus* community. – c *Arnebia hispidissima* community. – d *Suaeda monoica* community.

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5.15. *Arnebia hispidissima* Community

The community, which is dominated by such annual or biennial herbs, was widely spread on gravelly gentle slopes. Soils supporting the community are relatively shallow and formed mainly of fine sand, while the ground surface is overlain by fragmented rocks. Plant cover ranges from 30 to 60 % where the dominant species contribute most of it (Fig. 5 c).

Floristic Composition:
Total cover = 30–60 %; number of records = 3.

Species	P(%)	AB
a. Tree layer		
Not represented		
b. Shrub layer		
Acacia ehrenbergiana HAYNE	33	+.1
c. Dwarf shrubs and perennial herbs		
Aerva javanica (BURM. f.) JUSS. ex J. A. SCHULT.	66	1.1
Fagonia acerosa BOISS.	33	1.1
Blepharis ciliaris (L.) B. L. BURTT.	33	+.2
Caralluma sinaica (DECNE.) BENTH.	33	1.1
d. Annuals and ephemerals		
Arnebia hispidissima (LEHM.) DC.	100	3.3
Aizoon canariense L.	66	1.1
Citrullus colocynthis (L.) SCHRAD.	33	+.2
Chrozophora tinctoria (L.) A. JUSS. ex. SPRENG.	33	+.1
Tribulus terrestris L.	33	+.1
e. Associates		
Indigofera spinosa FORSSK.		
Fagonia indica BURM. f.		

6. Discussion

Water resources are a main factor affecting plant life, which are mainly influenced, in the study area, by combinations of various environmental conditions including elevation above sea level, physiographic features and edaphic factors.

Within the arid Tehama sector xeric conditions prevailed and the vegetation shows the restricted type (MONOD 1954). This vegetation is represented by different plant communities dominated by *Leptadenia pyrotechnica* on deep sandy soil; *Cassia italica* in depressions and along roadsides; *Acacia ehrenbergiana* in wadi beds and occasionally on rocky

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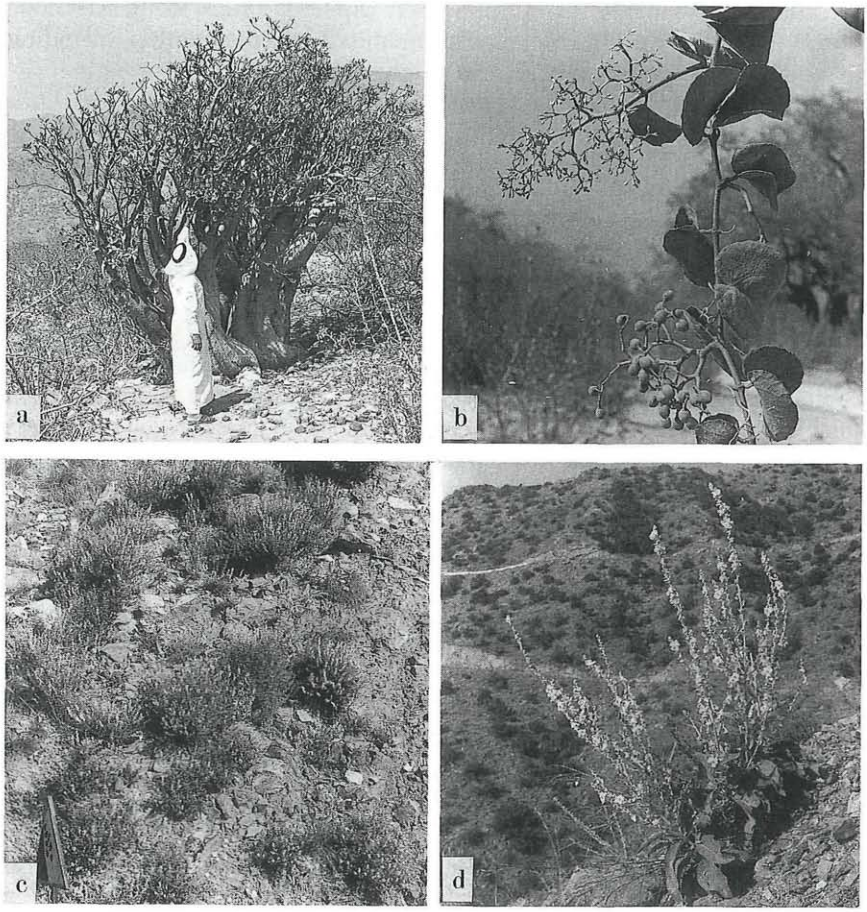

Fig. 6. Flourishing species in the vegetation of Al Abna escarpment:
a *Adenium obesum*. – b *Cissus rotundifolius*. –
c *Crotalaria emarginella*. – d *Verbascum yemense*.

terraces. The common *Caralluma russeliana* community is characteristic on deep alluvial deposits while those of *Suaeda monoica* has wide occurrence on relatively saline soil.

The steep slope sector is characterised by less arid conditions where considerable rainfall is combined with relatively low temperature. Within this sector a diffuse type of vegetation was observed (BATANOUNY 1987), and several plant communities were recorded and dominated by *Juniperus excelsa* (above 1900 m), *J. excelsa – Olea europaea – Acacia negrii* (1870–2000 m), *Barleria prionitis* (1600 m), *Acacia asak* (1150–1450 m) and *Ficus salicifolia – F. sur* (1170–1410 m).

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Intermediate climatic conditions were expected within the gentle-slope sector (600–900 m). This sector was inhabited by communities including those of *Anisotes trisulcus, Ziziphus spina-christi* and *Cissus rotundifolius – Acacia ehrenbergiana.* It is to be noted that *Juniperus excelsa, Olea europaea, Acacia negrii* and *A. ehrenbergiana* were identified by the authors (ZAYED & EL KAREMY 1989) either as dominant or codominant species in other related plant assemblages near Taif in SW Saudi Arabia.

The dominant woodland species, with poorly developed canopy (except that of *Juniperus)* show distinct stratification: large trees (8–15 m height) comprise *Juniperus excelsa, Ficus salicifolia, Ziziphus spina-christi* and *Acacia negrii,* small trees (4–6 m height) include *Acacia ehrenbergiana, A. asak* and *Leptadenia pyrotechnica.* A two meter high stratum is composed of the dominants *Anisotes trisulcus* and *Suaeda monoica* which tend to form thickets. Species from the undershrub and herb layer include *Barleria prionitis, Cassia italica, Caralluma russeliana* and *Hyparrhenia hirta.*

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CLAUGHER D. 1990. Scanning Electron Microscopy in Taxonomy and Functional Morphology. – The Systematics Association Special Volume No. 41. – Gr. 8°, XII + 312 Seiten, 240 Abbildungen, Ln. – Clarendon Press/Oxford University Press. £ 50,–. – ISBN 0-19-857714-1.

Inhalts (Testamöben, Bryozoa, parasitische Würmer, p. 235–296). Die übrigen 9 Arbeiten, also der größte Teil des Buches, sind wesentliche, reich bebilderte Beiträge zu botanischen Fragestellungen.

S. BLACKMORE & S. H. BARNES diskutieren in „Comparative studies of mature and developing pollen grains" die Möglichkeiten und Vorteile des REM-Einsatzes in der Palynologie (v. a. zum Auffinden von Entwicklungsstadien, zum Sichtbarmachen im TEM elektronendurchlässiger Strukturen und zur dreidimensionalen Darstellung der Pollenkornoberflächen) an Hand von Beispielen aus der Compositentribus *Lactuceae*. In „The significance of the SEM for character analysis of spores of the *Polypodiaceae (Filicales)*" sieht E. HENNIPMAN Exospor- und Perispor-Merkmale in Beziehung zur Phylogenie. „The role of the SEM in pollen morphology and plant systematics" von M. M. HARLEY & I. K. FERGUSON referiert allgemein vor allem Fragen der Präparationstechnik, der Präsentation und Bewertung der Ergebnisse und zitiert, um die Bedeutung für die Systematik zu unterstreichen, Beispiele, bei denen mit Hilfe des REM Strukturen aufgeklärt wurden, die im Lichtmikroskop nicht oder nur unbefriedigend nachweisbar waren. W. BARTHLOTT (Sanning electron microscopy of the epidermal surface in plants) ordnet die Oberflächenmerkmale vier Kategorien zu: Zellmuster, Zellgestalt („primäre Skulptur"), Relief der äußeren Zellwand („sekundäre Skulptur") und epikutikulare Sekrete („tertiäre Skulptur"). Letzterer Punkt wird am ausführlichsten behandelt, wobei die Wachsausscheidungen vom *Convallaria-, Strelitzia-* und *Aristolochia*-Typ abgebildet sind und deren Verbreitung im System dargestellt ist; schließlich werden noch mögliche ökologische Funktionen von Oberflächen-Skulpturen diskutiert. C. R. HILL & D. L. DILCHER (Scanning electron microscopy of the internal ultrastructure of plant cuticle) liefern eine umfangreiche Originalarbeit, in der an Hand von Schnitt- und Bruchflächen der Epidermis von *Agave americana* und *Clivia miniata* erstmals mittels REM-Technik der Kutikula-Ultrastruktur nachgegangen wird; auch Wachs-Bildung und Wachstransport werden

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