The Eocene megafossil flora of Nerriga, New South Wales.

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Volume 2.

APPENDIX I A

Pearson product-moment correlation coefficients for characters 1 - 31 in chapter 4. Those characters marked with an asterisk are the 14 removed due to high correlation.

Character number	1	*2	3	*4	*5	6
*2	0.375					
3	-0.246	-0.276				
*4	-0.011	-0.020	0.137			
*5	-0.197	-0.400	0.132	-0.836		
6	0.234	0.523	-0.390	0.142	-0.354	
7	-0.037	-0.361	0.142	-0.024	0.195	0.134
8	0.127	0.374	0.253	0.286	-0.309	0.430
*9	0.044	0.251	-0.380	0.297	-0.424	0.613
10	-0.047	0.150	0.604	0.172	-0.045	0.028
11	0.292	0.226	-0.379	0.347	-0.451	0.588
*12	-0.138	-0.036	0.041	0.245	-0.247	0.336
13	-0.016	-0.069	-0.071	0.320	-0.259	0.102
14	-0.369	-0.056	0.051	0.213	-0.180	0.216
15	-0.034	0.006	-0.005	0.193	-0.216	0.176
16	-0.064	0.033	0.047	0.277	-0.282	0.099
*17	-0.053	0.173	0.279	-0.219	0.195	-0.049
18	-0.108	-0.107	0.139	0.017	-0.050	-0.107
*19	-0.064	-0.293	-0.082	-0.147	0.162	-0.176
20	-0.250	-0.122	0.380	0.330	-0.263	-0.329
*21	0.485	-0.494	0.091	0.144	0.092	-0.200
*22	0.431	0.950	-0.420	0.145	-0.303	0.547
*23	0.187	0.074	-0.916	-0.016	-0.144	0.309
*24	0.075	0.515	-0.183	0.354	-0.515	0.756
*25	-0.048	-0.178	-0.095	-0.211	0.195	-0.299
26	0.057	-0.010	-0.126	0.240	-0.213	0.123
27	-0.182	-0.032	0.120	0.344	-0.287	0.290
*28	-0.130	-0.194	0.230	0.078	-0.019	-0.248
29	-0.153	-0.267	0.183	0.129	-0.040	-0.256
*30	-0.079	-0.041	-0.044	0.143	-0.149	-0.090
31	0.090	-0.149	-0.372	-0.270	0.199	0.058

7	8	*9	10	11	*12	13
-0.053						
0.133	0.104					
-0.150	0.562	-0.063				
0.249	0.171	0.520	-0.086			
0.247	0.228	0.440	-0.076	0.248		
0.195	0.092	-0.104	-0.265	0.028	0.058	
0.201	0.279	0.168	0.031	0.037	0.682	0.174
-0.081	-0.151	-0.286	-0.145	-0.289	-0.376	0.635
0.099	-0.038	-0.043	0.105	0.070	-0.064	0.071
-0.015	0.289	-0.010	0.302	-0.124	0.374	-0.512
-0.126	-0.442	-0.088	-0.197	-0.100	-0.121	0.248
-0.121	-0.441	-0.002	-0.493	-0.127	-0.009	0.215
-0.249	-0.046	-0.310	0.144	-0.172	0.011	0.176
0.226	-0.052	-0.175	-0.069	0.113	-0.113	0.174
-0.354	0.242	0.248	0.016	-0.231	-0.089	-0.095
0.248	-0.248	0.368	-0.624	0.420	-0.016	0.142
-0.113	0.566	0.747	0.234	0.571	0.456	-0.090
-0.197	-0.636	-0.152	-0.378	-0.060	-0.244	-0.083
0.201	0.081	-0.116	-0.277	-0.007	-0.018	0.961
0.083	0.387	0.139	0.069	0.024	0.485	0.351
0.045	-0.275	-0.306	-0.043	-0.307	-0.179	0.486
0.046	-0.249	-0.268	-0.080	-0.249	-0.203	0.500
-0.041	-0.139	-0.260	-0.222	-0.266	-0.327	0.709
0.022	-0.336	0.267	-0.546	0.099	0.058	0.098

14	15	16	*17	18	*19	20
-0.169						
-0.043	0.392					
0.282	-0.696	-0.281				
-0.166	0.521	0.214	-0.416			
0.151	0.160	-0.330	-0.260	0.535		
0.212	0.372	0.298	-0.045	0.412	0.003	
-0.255	0.029	-0.062	-0.284	-0.034	0.158	-0.012
-0.132	-0.008	-0.025	0.120	-0.084	-0.203	-0.222
-0.053	0.028	0.053	-0.370	-0.174	0.041	-0.349
0.253	-0.357	0.038	0.189	-0.250	-0.272	-0.247
-0.390	0.088	0.042	-0.251	0.393	0.462	-0.170
0.079	0.668	0.049	-0.529	0.247	0.207	0.086
0.704	0.023	-0.104	0.053	-0.100	-0.125	0.070
0.047	0.776	0.309	-0.490	0.688	0.263	0.413
0.045	0.755	0.260	-0.532	0.665	0.348	0.406
-0.113	0.921	0.097	-0.692	0.518	0.315	0.319
-0.101	-0.130	-0.434	-0.159	0.221	0.785	-0.385

*21	*22	*23	*24	*25	26	27
-0.472						
0.080	0.196					
-0.287	0.459	0.161				
-0.057	-0.066	0.072	-0.334			
0.152	-0.012	0.176	-0.106	-0.075		
-0.102	-0.081	-0.085	0.307	-0.338	0.302	
0.048	-0.214	-0.206	-0.434	0.186	0.486	0.164
0.117	-0.287	-0.154	-0.431	0.172	0.481	0.130
0.049	-0.042	0.041	-0.352	0.067	0.739	0.083
0.111	-0.032	0.318	-0.026	0.423	0.106	-0.068

*28 29 *30

0.932
0.723 0.731
-0.036 0.072 0.048

APPENDIX I B

Pearson product-moment correlation coefficients for characters 1 - 25 in chapter 5.

Character number	1	2	3	4	5	6
2	0.5493					
3	-0.0839	-0.7169				
4	0.1117	-0.1690	0.1603			
5	-0.2414	-0.8626	0.7935	0.1307		
6	0.0485	-0.1307	0.3521	0.2623	0.0537	
7	-0.1900	-0.2751	0.3597	0.2147	0.2672	0.5241
8	0.0503	-0.1088	0.1621	0.2622	0.1363	0.5347
9	0.0547	-0.0933	0.1222	0.1978	0.0800	0.7026
10	-0.1065	-0.2258	0.1476	0.0567	0.1954	0.4506
11	0.1750	0.2979	-0.2591	-0.1671	-0.3109	0.2261
12	0.0532	0.1457	-0.1446	-0.2748	-0.1201	-0.3656
13	0.2505	0.5336	-0.4974	0.0490	-0.5313	-0.3313
14	0.1897	0.4527	-0.4075	0.0272	-0.4762	-0.2228
15	0.2063	0.2814	-0.2954	0.0388	-0.2200	-0.2849
16	0.1690	0.1869	-0.2329	0.0135	-0.1688	-0.4274
17	0.1363	0.1610	-0.1774	0.0317	-0.1567	-0.3396
18	0.1066	0.1186	-0.2190	-0.0507	-0.0791	-0.3402
19	0.1370	0.4311	-0.2963	-0.0230	-0.4383	0.1472
20	0.0581	0.3545	-0.2998	-0.0340	-0.3910	0.1018
21	0.2186	0.3022	-0.2102	0.0717	-0.3104	-0.3039
22	0.1820	0.1396	-0.0907	0.1300	-0.1332	-0.2747
23	-0.0238	0.2415	-0.2123	-0.1319	-0.2822	-0.0916
24	-0.0517	0.0924	-0.0050	-0.1439	-0.0880	0.0373
25	0.1840	-0.1529	0.1587	0.1122	0.2157	-0.0361

7	8	9	10	11	12	13
0.5071						
0.3840	0.8313					
0.1533	0.1053	0.3453				
-0.1946	-0.1260	0.2916	0.2789			
-0.2800	-0.6165	0.5280	-0.1130	0.0952		
-0.1854	-0.1077	-0.2904	-0.4127	-0.1105	0.0731	
-0.0995	-0.1217	-0.2882	-0.3729	-0.1462	0.0865	0.9149
-0.2100	0.0479	-0.0217	-0.1841	-0.0849	-0.0489	0.3404
-0.1690	-0.2505	-0.4809	-0.4919	-0.2636	0.2493	0.6926
-0.1099	-0.2535	-0.4460	-0.4094	-0.2412	0.2666	0.6626
-0.1800	-0.0199	-0.1712	-0.3315	-0.1012	-0.0538	0.2204
-0.0450	0.1733	0.2403	0.0968	0.2235	-0.1879	0.3028
-0.0465	0.1931	0.2102	0.0338	0.1306	-0.2396	0.2504
-0.1317	-0.3263	-0.5004	-0.4882	-0.2560	0.2328	0.5976
-0.1601	-0.2856	-0.4018	-0.4511	-0.2438	0.2653	0.4265
0.0298	-0.0888	-0.2235	-0.0509	-0.0470	-0.0808	0.2584
-0.2246	-0.1003	0.0886	0.2238	0.1981	0.1244	-0.1970
0.0014	0.0757	0.0369	-0.1209	-0.0942	0.0171	0.1067

14	15	16	17	18	19	20
-0.0586						
0.6962	0.1238					
0.7237	-0.0159	0.9383				
0.0676	0.4095	0.3245	-0.0154			
0.1984	0.2433	-0.4126	-0.3995	-0.0720		
0.2582	-0.0155	-0.3726	-0.4517	0.1960	0.8281	
0.6553	-0.0293	0.7025	0.6810	0.1960	-0.1297	-0.0583
0.4971	-0.0803	0.6703	0.6520	0.1648	-0.2777	-0.1908
0.2181	0.1261	0.0764	0.0579	0.0901	0.1925	0.1533
-0.1815	-0.1116	-0.4917	-0.3891	-0.3547	0.3518	0.3002
0.1299	0.0155	0.3550	0.3651	0.0249	-0.2980	-0.3485

21	22	23	24
0.8896			
0.0899	-0.3444		
-0.0690	-0.0200	-0.2601	
0.0255	0.1511	-0.2243	-0.3435

APPENDIX II

Data matrix for 112 fossil OTUs.

Specimen number	OTU number	Character Number 1	2	3	4	5	6	7	8	9	10	11	12
N 0001	1	2.7	1.1	2.45	48.7	81.1	17	29.4	55.9	28.8	2.6	48.2	56.0
N 0002	2	4.3	1.4	3.07	46.3	82.6	18	22.2	57.6	39.6	2.1	50.2	47.5
N 0003	3	5.4	1.6	3.28	65.5	81.8	26	42.3	65.5	45.5	2.3	58.2	66.5
N 0004	4	6.5	2.3	2.83	47.7	79.8	24	45.8	60.2	43.3	2.3	58.9	72.0
N 0005	5	5.7	2.5	2.28	46.9	79.5	21	95.2	69.3	40.4	2.8	49.1	70.5
N 0006	6	5.9	2.2	2.68	50.0	82.1	24	16.7	58.7	41.2	2.6	49.0	76.5
N 0007	7	3.0	1.5	2.00	43.7	73.1	14	57.1	50.4	35.2	2.2	56.3	67.5
N 0008	8	2.3	0.6	3.83	46.4	93.8	10	90.0	47.3	15.3	1.3	32.9	57.0
N 0009	9	5.2	2.4	2.17	59.2	76.6	16	50.0	67.3	41.8	2.2	62.1	68.0
N 0010	10	6.5	2.8	2.32	39.7	79.4	9	11.1	44.4	22.8	1.6	43.1	78.5
N 0011	11	8.2	2.1	3.90	59.5	84.4	26	7.7	67.3	41.8	2.6	40.8	56.0
N 0013	12	6.9	4.6	1.50	44.4	69.5	11	81.8	69.5	44.2	2.0	43.7	52.5
N 0014	13	6.5	2.5	2.60	46.8	82.2	10	10.0	48.1	23.9	2.0	48.1	71.5
N 0015	14	3.5	1.1	3.18	44.9	84.0	16	18.8	54.3	32.5	1.9	39.9	77.5
N 0016	15	3.3	1.3	2.54	49.0	76.9	13	15.4	68.6	36.7	1.9	41.0	34.0
N 0017	16	8.4	3.6	2.33	48.5	79.3	10	0	43.3	17.1	2.0	43.0	85.5
N 0018	17	11.0	3.7	2.97	55.6	81.4	11	0	50.5	24.7	1.9	36.0	83.5
N 0019	18	2.7	1.0	2.70	49.1	83.2	17	29.4	68.9	45.5	2.1	45.8	54.5
N 0020	19	4.0	1.7	2.35	58.5	77.5	10	0	42.1	19.3	2.0	48.0	82.5
N 0021	20	5.0	2.0	2.50	45.1	81.2	6	0	57.3	29.3	1.3	58.7	97.0
N 0022	21	3.3	1.0	3.30	44.2	88.8	7	85.7	65.0	22.6	1.3	29.9	67.0
N 0023	22	3.5	1.0	3.50	42.0	89.0	16	31.3	48.6	29.7	2.3	57.6	63.0
N 0024	23	5.7	1.3	4.38	54.2	86.9	8	0	27.3	12.9	1.8	65.4	90.0
N 0025	24	4.8	1.7	2.82	39.5	81.6	17	29.4	55.9	34.7	2.0	53.3	66.0
N 0026	25	4.2	1.8	2.33	43.5	79.1	22	50.0	64.2	45.1	2.2	55.8	61.5
N 0027	26	3.8	1.1	3.45	37.3	81.9	24	41.7	49.1	39.2	2.1	68.0	78.5
N 0033	27	13.1	3.1	4.23	39.5	80.1	11	0	42.6	22.4	1.7	54.8	81.0
N 0036	28	8.0	2.9	2.76	37.7	84.1	15	80.0	63.9	35.2	1.9	48.0	64.5
N 0037	29	7.3	3.1	2.36	34.6	76.3	25	28.0	58.8	46.9	3.1	68.2	53.5
N 0038	30	7.9	2.9	2.72	50.0	84.5	23	60.9	56.9	41.5	2.6	61.1	72.0

Character Number

OTU number	13	14	15	16	17	18	19	20	21	22	23	24	25
1	26.6	18.0	1.48	29.5	17.8	1.66	0.90	1.01	12.6	7.0	1.80	2.0	12.2
2	23.5	16.5	1.42	19.3	13.4	1.44	0.86	1.23	16.0	15.8	1.01	5.5	7.6
3	26.5	18.6	1.42	18.4	14.9	1.23	1.01	1.25	19.4	17.3	1.12	6.3	6.5
4	23.3	18.0	1.29	20.1	13.9	1.45	1.16	1.29	19.9	18.9	1.05	5.5	8.7
5	33.5	22.3	1.50	33.4	19.6	1.70	1.00	1.14	19.4	16.5	1.18	3.0	6.4
6	23.3	16.4	1.42	20.8	12.9	1.61	1.12	1.27	17.5	17.3	1.01	5.3	5.6
7	24.6	18.6	1.32	22.6	13.5	1.67	1.09	1.34	21.0	20.5	1.02	5.2	7.7
8	15.6	11.1	1.41	21.6	12.0	1.80	0.72	0.93	18.8	12.8	1.47	3.8	4.3
9	28.0	17.0	1.65	22.0	11.1	1.98	1.27	1.53	20.5	18.5	1.11	4.8	7.4
10	30.6	22.8	1.34	31.6	19.3	1.64	0.97	1.18	24.8	22.4	1.11	5.4	11.0
11	24.3	17.3	1.40	21.5	15.0	1.43	1.13	1.15	20.5	19.5	1.05	6.5	9.4
12	33.0	20.9	1.58	26.3	15.5	1.70	1.26	1.35	18.9	16.0	1.18	4.3	11.9
13	29.4	22.3	1.32	34.6	20.8	1.66	0.85	1.07	28.3	27.1	1.04	5.1	10.1
14	22.0	15.6	1.41	20.8	12.1	1.72	1.06	1.29	20.3	19.0	1.07	5.5	6.0
15	23.8	16.0	1.49	17.3	9.6	1.80	1.38	1.67	21.5	19.8	1.09	5.3	9.4
16	37.0	24.3	1.52	42.6	23.5	1.81	0.87	1.03	29.3	28.1	1.04	4.8	14.0
17	28.6	21.8	1.31	33.3	21.1	1.58	0.86	1.03	28.3	25.9	1.09	5.0	10.5
18	31.8	21.6	1.47	28.5	17.3	1.65	1.12	1.25	20.9	18.9	1.11	5.1	10.3
19	32.8	23.4	1.40	34.9	21.8	1.60	0.94	1.11	25.8	25.5	1.01	5.1	11.3
20	31.1	20.6	1.51	38.8	23.1	1.68	0.80	0.89	20.5	22.8	0.90	4.5	20.0
21	25.1	18.6	1.35	31.4	20.0	1.57	0.80	0.93	24.8	23.9	1.04	4.9	10.7
22	24.6	18.0	1.37	23.3	13.9	1.68	1.06	1.29	22.1	18.6	1.19	5.3	8.8
23	22.4	16.5	1.36	22.5	14.1	1.60	1.00	1.17	19.1	20.1	0.95	5.3	10.2
24	27.6	20.4	1.35	23.8	14.8	1.61	1.16	1.38	21.6	20.6	1.05	5.3	8.1
25	26.4	18.5	1.43	20.5	14.0	1.46	1.29	1.32	18.1	17.0	1.06	4.8	8.6
26	26.0	18.1	1.44	23.4	15.1	1.55	1.11	1.20	21.3	18.1	1.18	5.7	9.9
27	30.5	20.6	1.48	32.6	18.5	1.76	0.94	1.11	29.4	24.9	1.18	4.8	15.0
28	35.0	26.3	1.33	35.0	21.5	1.63	1.00	1.22	24.8	20.9	1.19	4.6	12.5
29	24.5	17.3	1.42	20.1	12.6	1.60	1.22	1.37	18.9	15.8	1.20	5.4	8.6
30	25.6	17.1	1.50	21.1	14.5	1.46	1.21	1.18	19.1	19.9	0.96	5.3	12.7

		1	2	3	4	5	6	7	8	9	10	11	12
N 0041	31	7.0	2.1	3.33	55.5	86.9	24	79.2	64.6	41.9	2.1	53.6	73.0
N 0044	32	6.9	2.6	2.65	52.1	81.6	30	46.7	59.0	44.2	3.3	66.3	72.0
N 0045	33	8.2	2.2	3.73	60.5	78.9	21	47.6	54.9	30.8	2.4	43.1	71.0
N 0047	34	8.0	4.0	2.00	50.9	74.5	11	0	34.0	17.8	2.2	62.1	72.0
N 0048	35	11.9	5.3	2.25	54.3	77.8	21	14.3	63.4	49.8	2.1	73.7	54.0
N 0049	36	4.5	1.6	2.81	44.3	87.2	16	25.0	62.5	43.3	1.7	50.0	41.5
N 0050	37	9.0	5.7	1.58	36.4	68.2	11	0	41.8	30.0	2.6	67.0	61.0
N 0051	38	3.3	1.2	2.75	67.2	81.9	11	81.8	58.8	32.2	2.0	34.0	52.0
N 0052	39	4.8	1.6	3.00	43.3	79.6	30	70.0	65.8	45.0	2.4	51.1	54.0
N 0053	40	8.3	3.1	2.68	43.5	77.9	25	32.0	61.9	44.3	2.9	59.0	85.5
N 0054	41	5.9	1.6	3.68	52.6	85.0	30	70.0	66.8	46.7	2.2	48.9	63.5
N 0055	42	4.8	1.7	2.82	52.0	79.9	23	65.2	59.3	38.5	2.6	51.4	68.0
N 0056	43	8.1	2.5	3.24	51.9	81.7	9	55.6	44.8	14.8	1.6	37.1	87.0
N 0057	44	5.8	2.2	2.64	54.3	81.1	9	11.1	47.3	21.9	1.8	38.8	73.5
N 0058	45	6.4	2.1	3.05	59.8	82.4	20	30.0	53.3	36.1	2.7	47.6	66.0
N 0059	46	6.8	5.3	1.28	33.9	63.9	11	0	50.6	29.3	2.8	57.2	66.0
N 0060	47	8.0	10.2	0.78	24.7	49.7	15	6.7	44.5	23.9	2.2	59.2	81.0
N 0061	48	6.1	1.9	3.21	44.1	84.2	21	42.9	61.9	43.5	2.5	71.0	61.5
N 0062	49	5.0	1.9	2.63	50.8	80.0	11	18.2	57.3	23.4	2.3	33.5	56.5
N 0063	50	7.5	2.6	2.88	60.8	81.0	31	74.2	67.5	53.7	2.8	63.1	64.5
N 0064	51	7.8	3.4	2.29	47.7	79.3	11	27.3	45.6	23.7	2.1	50.1	91.0
N 0067	52	10.5	3.5	3.00	65.5	80.4	16	6.3	66.5	36.3	1.8	40.6	57.5
N 0068	53	8.8	3.8	2.32	50.5	79.2	9	11.1	43.1	21.8	2.1	48.8	71.0
N 0069	54	7.0	7.7	0.91	36.2	48.6	14	7.1	45.3	24.7	1.7	62.2	82.5
N 0070	55	6.1	2.0	3.05	51.1	84.9	22	45.2	54.1	35.7	2.5	52.5	70.0
N 0071	56	6.8	3.0	2.27	47.3	78.4	10	30.0	36.7	18.3	2.1	49.9	91.5
N 0072	57	8.6	3.5	2.46	53.6	78.9	16	18.8	56.3	40.6	1.9	67.6	60.0
N 0073	58	4.5	1.0	4.50	43.3	88.3	11	81.8	57.5	21.0	1.6	32.4	66.0
N 0074	59	4.2	1.5	2.80	56.0	79.6	25	60.0	59.5	45.9	2.8	55.4	65.5
N 0075	60	4.5	1.7	2.65	52.6	79.8	25	56.9	60.7	46.1	2.6	60.2	59.0
N 0076	61	5.8	1.7	3.41	52.5	89.2	17	88.2	61.2	29.3	2.4	38.7	69.5
N 0077	62	5.6	1.9	2.95	53.0	77.3	10	50.0	50.0	15.6	2.0	36.2	86.0
N 0078	63	5.9	2.8	2.11	46.8	76.6	4	0	62.0	47.0	1.1	50.0	88.0
N 0079	64	6.9	2.6	2.65	38.6	79.6	24	37.5	62.5	46.4	2.6	55.0	54.0
N 0082	65	5.3	5.1	1.04	36.6	63.7	12	8.3	59.0	39.8	1.8	57.0	88.0

	13	14	15	16	17	18	19	20	21	22	23	24	25
31	20.3	15.0	1.35	19.8	12.3	1.61	1.03	1.22	18.1	17.0	1.06	5.0	6.9
32	21.1	15.6	1.35	19.3	13.4	1.44	1.09	1.16	20.3	17.9	1.13	5.9	10.5
33	24.9	17.8	1.40	22.4	15.8	1.42	1.11	1.13	21.6	18.4	1.17	5.6	9.4
34	22.9	15.9	1.44	22.3	14.5	1.54	1.03	1.10	18.8	16.8	1.12	5.3	7.2
35	26.4	15.8	1.67	21.3	12.3	1.73	1.24	1.28	18.8	17.0	1.11	5.2	11.7
36	27.8	19.9	1.40	22.9	15.3	1.50	1.21	1.30	18.6	16.4	1.13	5.5	8.8
37	34.3	26.3	1.30	27.6	19.1	1.45	1.24	1.38	21.4	18.9	1.13	5.0	10.4
38	49.6	31.9	1.55	32.6	22.0	1.48	1.52	1.45	28.5	21.6	1.32	5.5	9.1
39	22.5	14.9	1.51	22.4	13.6	1.65	1.00	1.10	18.9	16.1	1.17	5.4	9.9
40	24.9	17.5	1.42	19.9	13.1	1.52	1.25	1.34	15.5	13.0	1.19	5.0	4.7
41	20.3	13.4	1.51	21.8	15.1	1.44	0.93	0.89	16.3	15.4	1.06	5.2	12.8
42	24.6	17.0	1.45	21.6	12.9	1.67	1.14	1.32	19.8	18.3	1.08	5.1	9.7
43	32.4	22.3	1.45	26.0	17.5	1.49	1.25	1.27	27.6	23.0	1.20	5.1	11.1
44	31.5	19.4	1.62	28.6	15.3	1.87	1.10	1.27	22.1	20.1	1.10	4.0	9.8
45	22.4	16.4	1.37	22.9	14.3	1.60	0.98	1.15	18.5	18.3	1.01	6.0	12.3
46	31.5	19.3	1.64	27.1	17.3	1.57	1.16	1.11	19.8	15.3	1.29	5.3	12.5
47	35.5	24.4	1.45	24.3	15.8	1.54	1.46	1.54	23.8	18.4	1.29	5.9	5.4
48	23.5	16.6	1.42	23.1	12.5	1.85	1.02	1.33	19.1	16.9	1.13	5.1	10.8
49	33.8	23.1	1.46	28.5	17.3	1.65	1.19	1.34	27.0	18.4	1.47	5.4	5.4
50	22.1	15.8	1.40	20.0	14.0	1.43	1.11	1.13	17.4	17.0	1.02	5.2	9.8
51	30.1	20.4	1.48	31.8	19.5	1.63	0.95	1.05	27.3	25.0	1.09	5.0	8.8
52	33.5	22.4	1.50	22.4	13.9	1.61	1.50	1.61	21.8	19.3	1.13	5.0	13.6
53	27.4	18.0	1.52	31.3	20.9	1.50	0.88	0.86	28.0	27.1	1.03	4.8	5.1
54	30.1	18.5	1.63	21.4	14.9	1.44	1.41	1.24	22.1	15.8	1.40	6.0	4.7
55	23.0	16.6	1.39	20.5	14.1	1.45	1.12	1.18	18.5	18.3	1.01	5.0	8.7
56	32.8	24.5	1.34	35.0	22.5	1.56	0.94	1.09	28.9	25.9	1.12	4.8	14.2
57	30.8	17.5	1.76	22.4	13.1	1.71	1.38	1.34	19.8	16.6	1.19	5.0	11.0
58	30.0	16.6	1.81	34.9	21.4	1.63	0.86	0.78	27.9	26.8	1.04	4.6	8.8
59	25.1	17.8	1.41	20.5	13.3	1.54	1.22	1.34	18.0	16.8	1.07	5.1	10.6
60	19.3	14.4	1.34	17.4	12.5	1.39	1.11	1.15	18.1	16.9	1.07	5.3	13.0
61	30.0	21.3	1.41	24.6	15.1	1.63	1.22	1.41	19.0	16.4	1.16	4.0	11.2
62	36.3	28.0	1.30	38.5	24.0	1.60	0.94	1.17	23.9	20.5	1.17	4.7	14.0
63	27.0	17.6	1.53	34.0	20.0	1.70	0.79	0.88	19.9	20.5	0.97	4.3	17.9
64	20.3	14.9	1.36	18.6	10.3	1.81	1.09	1.45	17.3	16.4	1.05	5.1	7.9
65	31.1	21.0	1.48	21.4	13.5	1.59	1.45	1.56	20.6	19.8	1.04	5.9	5.4

		1	2	3	4	5	6	7	8	9	10	11	12
N 0084	66	7.3	9.7	0.75	52.9	50.7	9	11.1	41.1	21.9	2.0	67.7	80.0
N 0085	67	5.2	2.0	2.60	47.4	73.9	13	23.1	60.6	37.2	2.1	51.0	56.5
N 0086	68	9.5	4.1	2.32	65.8	73.7	17	17.6	68.6	41.6	2.6	34.0	48.5
N 0088	69	8.3	2.3	3.61	40.2	89.3	26	53.8	63.2	44.7	2.3	54.8	70.5
N 0089	70	5.4	2.3	2.35	42.0	74.1	10	0	44.8	27.8	2.3	72.4	76.5
N 0090	71	3.4	1.0	3.40	47.0	82.2	24	25.0	61.4	40.0	2.3	46.5	56.0
N 0092	72	4.8	1.3	3.69	42.2	78.1	24	54.2	57.7	35.2	2.6	46.7	73.0
N 0094	73	5.3	1.9	2.79	50.0	81.0	19	63.2	41.8	29.1	2.6	57.2	92.5
N 0095	74	5.3	2.2	2.41	44.9	81.1	12	16.7	56.4	34.3	1.8	44.3	62.0
N 0096	75	4.9	4.4	1.11	45.8	59.1	11	9.1	43.3	23.7	1.8	69.1	87.0
N 0097	76	6.7	2.2	3.05	52.3	79.7	17	58.8	70.8	35.2	1.9	44.2	34.5
N 0098	77	4.5	1.6	2.81	46.5	82.3	23	78.3	56.1	36.8	2.9	50.5	80.5
N 0099	78	8.3	4.1	2.02	58.6	75.1	16	18.8	63.1	39.3	2.3	51.7	44.5
N 0100	79	7.2	3.0	2.40	46.3	77.3	8	25.0	40.3	19.6	1.7	48.8	87.0
N 0101	80	6.4	2.6	2.46	50.8	79.2	8	37.5	42.1	20.9	2.0	48.8	84.5
N 0102	81	7.8	8.8	0.89	38.4	57.1	14	14.3	56.2	29.2	2.1	56.7	86.5
N 0103	82	5.4	2.2	2.45	44.0	80.1	10	0	59.2	36.6	1.6	44.1	81.5
N 0104	83	8.1	4.8	1.69	53.9	76.7	16	37.5	69.4	41.7	2.1	47.6	53.5
N 0105	84	7.8	3.4	2.29	52.3	79.3	8	25.0	43.0	20.8	2.3	47.7	91.0
N 0109	85	5.9	2.2	2.68	52.8	82.8	25	52.0	66.0	49.3	2.5	59.9	56.5
N 0112	86	9.5	10.6	0.90	34.0	56.1	12	25.0	52.3	25.0	1.7	53.4	88.0
N 0118	87	4.5	1.2	3.75	47.8	86.3	27	51.9	64.8	42.0	2.6	43.7	52.0
N 0119	88	8.5	4.0	2.13	56.6	76.4	15	46.7	70.2	49.2	2.0	56.5	53.5
N 0120	89	7.4	2.3	3.22	57.1	85.7	31	64.5	72.4	49.3	3.1	48.6	67.5
N 0122	90	9.0	3.5	2.57	32.5	74.9	12	8.3	50.4	27.0	1.7	51.8	73.5
N 0123	91	8.6	4.3	2.00	49.2	78.3	18	22.2	64.8	43.9	2.5	84.9	66.0
N 0124	92	10.3	3.2	3.22	51.9	82.1	17	52.9	65.1	35.1	1.7	43.9	69.5
N 0125	93	6.0	2.0	3.00	37.5	80.8	32	43.8	65.1	49.1	2.7	56.2	60.0
N 0127	94	5.4	2.8	1.93	53.4	74.1	10	60.0	65.8	41.0	1.8	43.9	55.5
N 0132	95	11.6	2.7	4.30	63.8	80.1	40	90.0	75.0	60.2	2.4	71.0	55.0
N 0136	96	8.1	6.2	1.31	88.5	49.0	50	76.0	67.3	44.3	1.6	49.0	50.0
N 0137	97	7.8	8.9	0.88	45.7	47.9	40	86.0	69.4	50.6	1.3	65.0	48.0
N 0144	98	4.1	1.4	2.93	53.2	85.2	23	65.2	63.2	40.5	2.4	40.9	69.0
N 0146	99	10.2	3.9	2.62	53.5	79.9	13	23.1	55.0	32.2	1.8	50.8	66.0
N 0149	100	5.7	1.9	3.00	50.0	79.6	26	38.5	60.9	43.3	2.8	57.0	74.5

	13	14	15	16	17	18	19	20	21	22	23	24	25
66	46.8	28.1	1.67	29.0	18.0	1.61	1.61	1.56	25.0	20.3	1.23	6.0	5.3
67	30.8	21.8	1.41	29.4	18.5	1.59	1.05	1.18	22.9	22.0	1.04	5.4	6.4
68	29.4	18.3	1.61	22.9	14.4	1.59	1.28	1.27	19.8	17.8	1.11	4.8	13.2
69	27.6	17.8	1.55	22.4	13.8	1.62	1.23	1.29	15.6	14.4	1.08	4.8	8.3
70	33.0	22.3	1.48	28.4	17.8	1.60	1.16	1.25	18.9	16.8	1.13	5.1	6.9
71	28.0	19.6	1.43	24.5	15.9	1.54	1.14	1.23	20.8	20.5	1.01	5.3	11.8
72	21.6	17.4	1.24	17.6	11.3	1.56	1.23	1.54	19.9	17.8	1.12	5.5	9.6
73	19.4	14.4	1.35	21.3	14.0	1.52	0.91	1.03	19.0	19.1	0.99	5.4	14.0
74	31.3	19.8	1.58	26.1	15.6	1.67	1.20	1.27	19.4	19.4	1.00	4.9	11.9
75	32.6	21.9	1.49	21.8	12.9	1.69	1.50	1.70	25.8	19.1	1.35	6.2	2.5
76	29.5	22.5	1.31	29.6	18.6	1.59	1.00	1.21	20.0	18.5	1.08	4.2	10.9
77	24.8	15.8	1.57	22.4	13.9	1.61	1.11	1.14	19.1	19.0	1.01	6.1	9.9
78	34.4	20.4	1.69	27.3	13.6	2.01	1.26	1.50	21.1	19.6	1.08	4.5	12.0
79	28.6	22.3	1.28	32.0	17.0	1.88	0.89	1.31	27.6	23.6	1.17	4.6	7.4
80	28.5	20.9	1.36	33.3	21.0	1.59	0.86	1.00	27.3	24.1	1.13	4.7	13.4
81	35.5	22.5	1.58	27.9	15.9	1.75	1.27	1.42	22.5	19.1	1.18	5.6	3.4
82	31.8	21.5	1.48	31.3	19.6	1.60	1.02	1.10	25.0	23.5	1.06	4.9	9.9
83	24.8	17.6	1.41	19.6	11.5	1.70	1.27	1.53	21.0	19.1	1.10	5.4	9.8
84	31.4	22.4	1.40	32.0	19.9	1.61	0.98	1.13	27.0	23.5	1.15	4.8	13.0
85	30.0	19.8	1.52	25.1	15.3	1.64	1.20	1.29	19.3	18.8	1.03	4.9	10.7
86	32.8	22.4	1.46	21.0	13.3	1.58	1.56	1.68	22.0	18.1	1.22	6.2	3.4
87	20.5	15.8	1.30	20.0	13.0	1.54	1.03	1.22	19.1	18.0	1.06	5.4	9.7
88	25.0	15.8	1.58	20.8	10.9	1.91	1.20	1.45	21.3	20.0	1.07	5.3	9.0
89	27.3	20.4	1.34	26.8	16.3	1.64	1.02	1.25	18.8	17.3	1.09	5.1	14.5
90	28.4	18.6	1.53	26.6	14.5	1.83	1.07	1.28	18.6	16.9	1.10	4.6	14.2
91	24.3	16.0	1.52	24.8	16.6	1.49	0.98	0.96	17.9	16.1	1.11	5.0	13.8
92	35.4	23.6	1.50	30.3	18.0	1.68	1.17	1.31	18.4	17.1	1.08	4.7	11.9
93	24.9	17.8	1.40	22.3	15.0	1.49	1.12	1.19	18.1	16.8	1.08	5.7	9.8
94	28.9	17.4	1.66	22.4	13.1	1.71	1.29	1.33	19.1	16.8	1.14	4.9	11.3
95	21.0	14.9	1.41	19.0	13.6	1.40	1.11	1.10	20.5	18.3	1.12	4.8	5.9
96	39.4	27.4	1.44	37.3	21.5	1.73	1.06	1.27	30.6	27.0	1.13	3.2	8.6
97	43.5	35.1	1.24	37.3	25.0	1.49	1.17	1.40	31.9	26.5	1.20	3.9	16.6
98	21.8	17.6	1.24	18.4	13.4	1.37	1.19	1.31	18.1	16.8	1.08	5.4	6.0
99	34.3	21.5	1.60	26.9	17.8	1.51	1.28	1.21	16.4	14.6	1.12	4.3	21.4
100	22.3	15.8	1.41	18.1	12.5	1.45	1.23	1.26	17.4	15.3	1.14	5.0	8.8

		1	2	3	4	5	6	7	8	9	10	11	12
N 0156	101	3.7	1.7	2.18	44.7	79.0	16	37.5	52.2	37.4	2.9	59.4	80.0
N 0159	102	6.3	1.1	5.73	45.0	88.6	49	65.3	60.1	45.5	2.3	58.7	59.5
N 0232	103	7.0	2.3	3.04	43.2	82.4	17	52.9	63.1	26.7	2.0	40.6	75.0
N 0234	104	2.1	1.2	1.75	39.3	77.7	17	29.4	37.6	19.1	2.6	49.6	105.0
N 0236	105	4.2	1.1	3.82	56.0	83.9	21	47.6	47.6	30.5	2.7	58.3	65.5
N 0238	106	3.8	1.8	1.89	48.0	78.9	12	8.3	32.9	18.9	3.0	65.9	71.0
N 0239	107	7.5	3.0	2.50	49.7	76.6	11	9.1	41.2	19.3	2.0	61.2	65.5
N 0240	108	6.2	1.6	3.88	51.6	83.0	26	38.5	53.0	32.9	2.7	51.6	77.5
N 0241	109	9.3	4.9	1.90	45.3	74.7	11	18.2	47.6	21.6	2.1	47.4	66.0
N 0262	110	5.1	1.3	3.92	55.0	86.5	26	57.7	57.8	34.7	2.6	44.1	55.5
N 0503	111	8.1	1.6	5.06	40.1	85.0	31	80.6	63.2	38.8	2.4	38.7	68.5
N 0555	112	4.5	1.7	2.65	53.4	80.2	18	27.8	55.9	36.1	2.7	45.0	48.5

	13	14	15	16	17	18	19	20	21	22	23	24	25
101	24.5	16.4	1.49	20.0	14.0	1.43	1.23	1.17	16.4	15.8	1.04	5.2	10.6
102	20.4	15.4	1.32	17.8	11.4	1.56	1.46	1.35	18.6	16.8	1.11	5.0	10.8
103	32.0	22.5	1.42	33.3	21.0	1.59	0.96	1.07	25.6	21.1	1.21	4.2	13.8
104	21.6	16.1	1.34	21.9	15.1	1.45	0.99	1.07	19.9	18.1	1.10	5.0	12.0
105	21.5	16.4	1.31	19.8	13.6	1.46	1.09	1.21	19.1	18.1	1.06	5.1	11.5
106	27.5	18.5	1.49	25.0	16.0	1.56	1.10	1.16	19.5	17.9	1.09	5.1	5.6
107	31.1	20.4	1.52	34.8	20.9	1.67	1.15	1.15	25.1	23.5	1.07	4.2	10.8
108	22.9	14.9	1.54	19.9	13.0	1.53	0.89	0.98	17.5	16.0	1.09	5.2	12.8
109	34.0	20.4	1.67	33.8	17.6	1.92	1.01	1.16	26.0	22.8	1.14	4.6	10.1
110	26.6	21.9	1.21	20.0	14.1	1.42	1.33	1.55	21.3	19.8	1.08	5.9	10.3
111	23.8	17.9	1.33	20.3	14.4	1.41	1.17	1.24	20.9	19.4	1.08	5.0	10.9
112	21.5	16.1	1.34	20.9	13.6	1.54	1.03	1.18	18.4	17.9	1.03	5.6	7.7

The units for each character are as follows :

1 = cm.
2 = cm.
3 = ratio (no units)
4 = %
5 = ratio (no units)
6 = no units
7 = %
8 = degrees
9 = degrees
10 = ratio (no units)
11 = %
12 = degrees

13 = um
14 = um
15 = ratio (no units)
16 = um
17 = um
18 = ratio (no units)
19 = ratio (no units)
20 = ratio (no units)
21 = um
22 = um
23 = ratio (no units)
24 = no units
25 = no units

APPENDIX III

Figures 18 to 561.

FIGURE 18. Specimen N 0085, Parataxon NER/001.

FIGURE 19. Specimen N 0095, parataxon NER/001.

FIGURE 20. Specimen N 0124, Parataxon NER/001.

FIGURE 21. Specimen N 0013, Parataxon NER/002.

FIGURE 22. Specimen N 0016, Parataxon NER/003.

FIGURE 23. Specimen N 0009, Parataxon NER/004.

FIGURE 24. Specimen N 0072, Parataxon NER/004.

Scale = 2 cm.

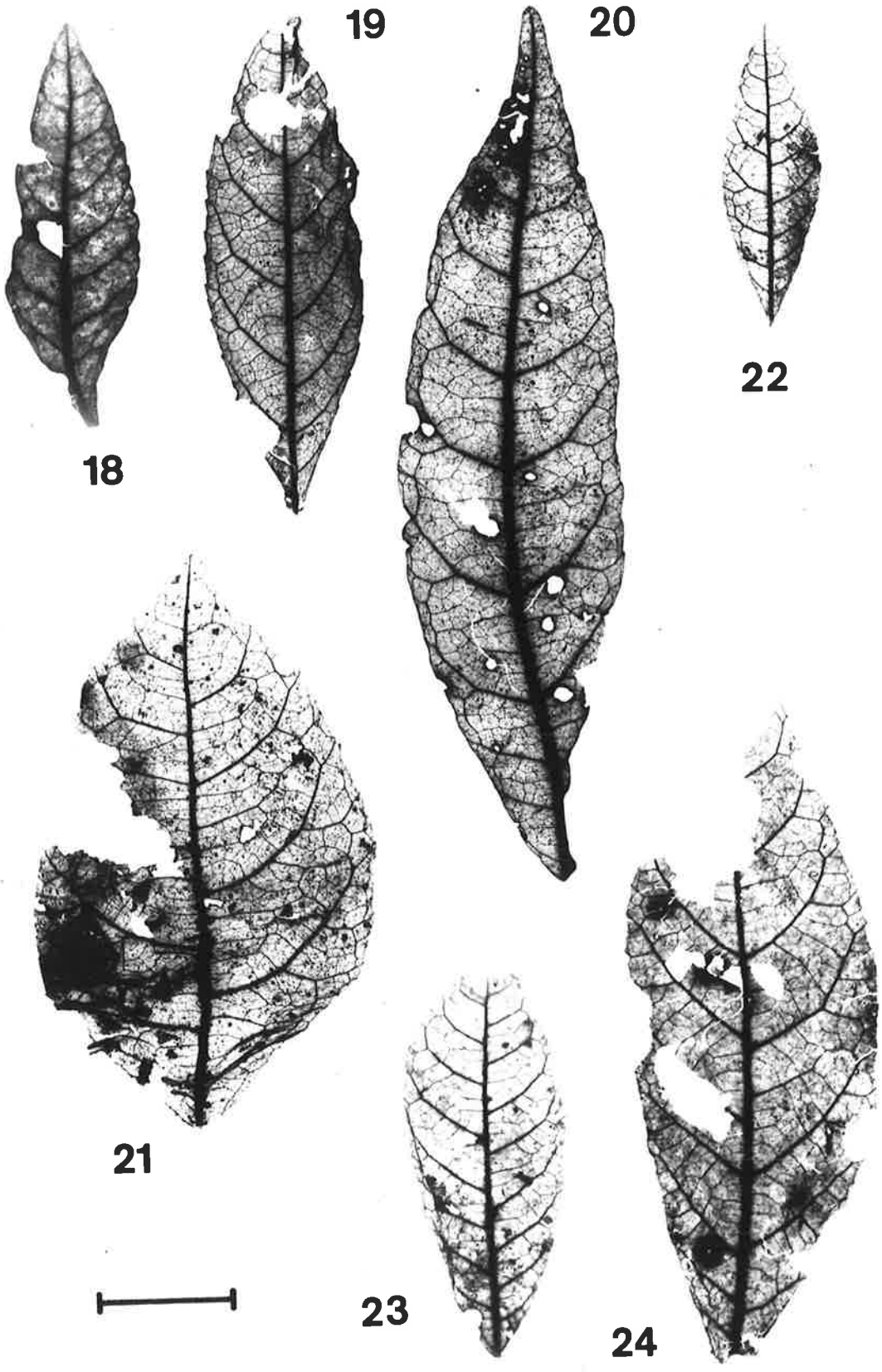
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FIGURE 25. Specimen N 0048, Parataxon NER/004.

FIGURE 26. Specimen N 0086, Parataxon NER/004.

FIGURE 27. Specimen N 0099, Parataxon NER/004.

FIGURE 28. Specimen N 0127, Parataxon NER/004.

FIGURE 29. Specimen N 0123, Parataxon NER/004.

Scale = 2 cm.

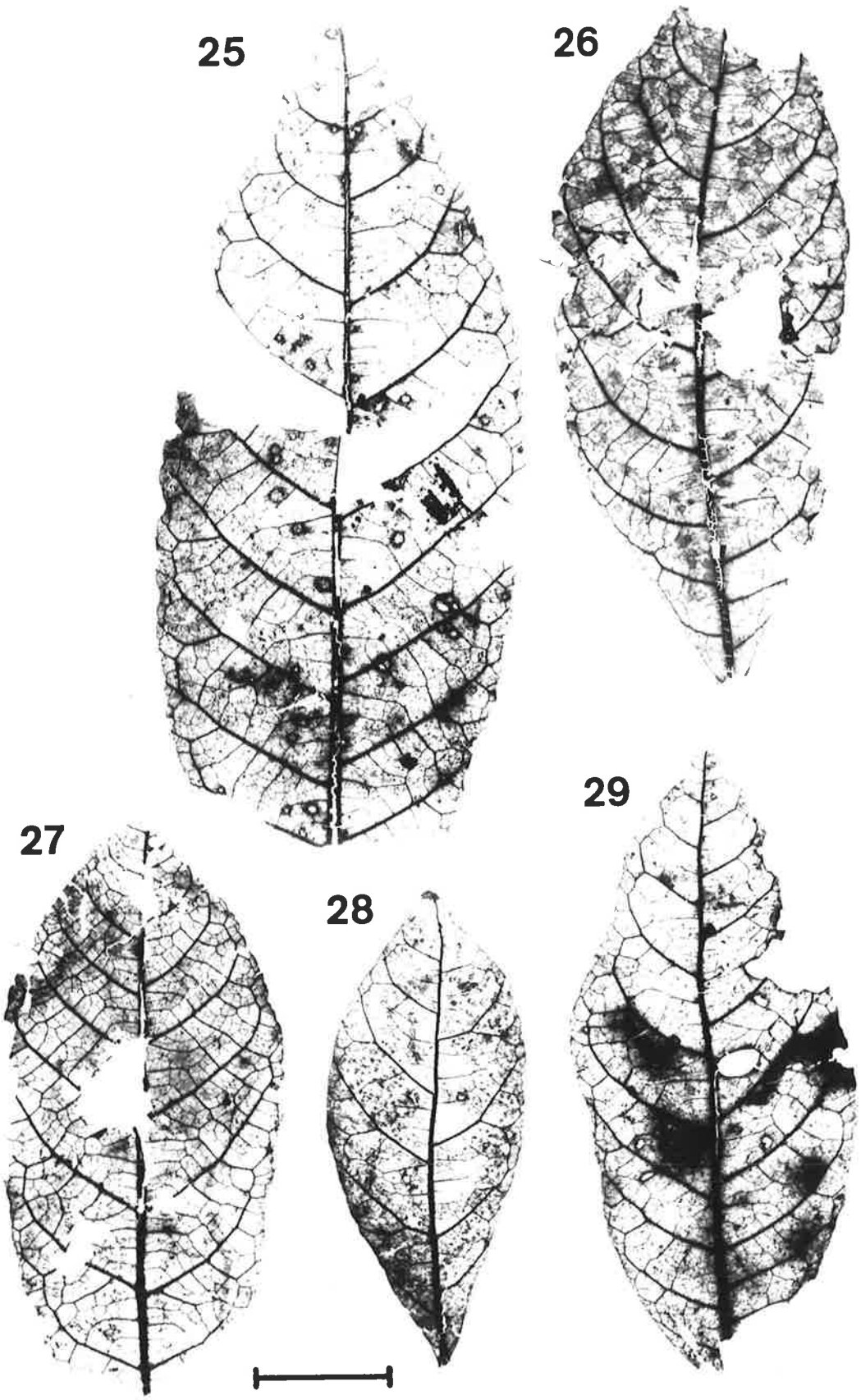
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FIGURE 30. Specimen N 0104, Parataxon NER/004.

FIGURE 31. Specimen N 0119, Parataxon NER/004.

FIGURE 32. Specimen N 0146, Parataxon NER/006.

FIGURE 33. Specimen N 0067, Parataxon NER/005.

Scale = 2 cm.

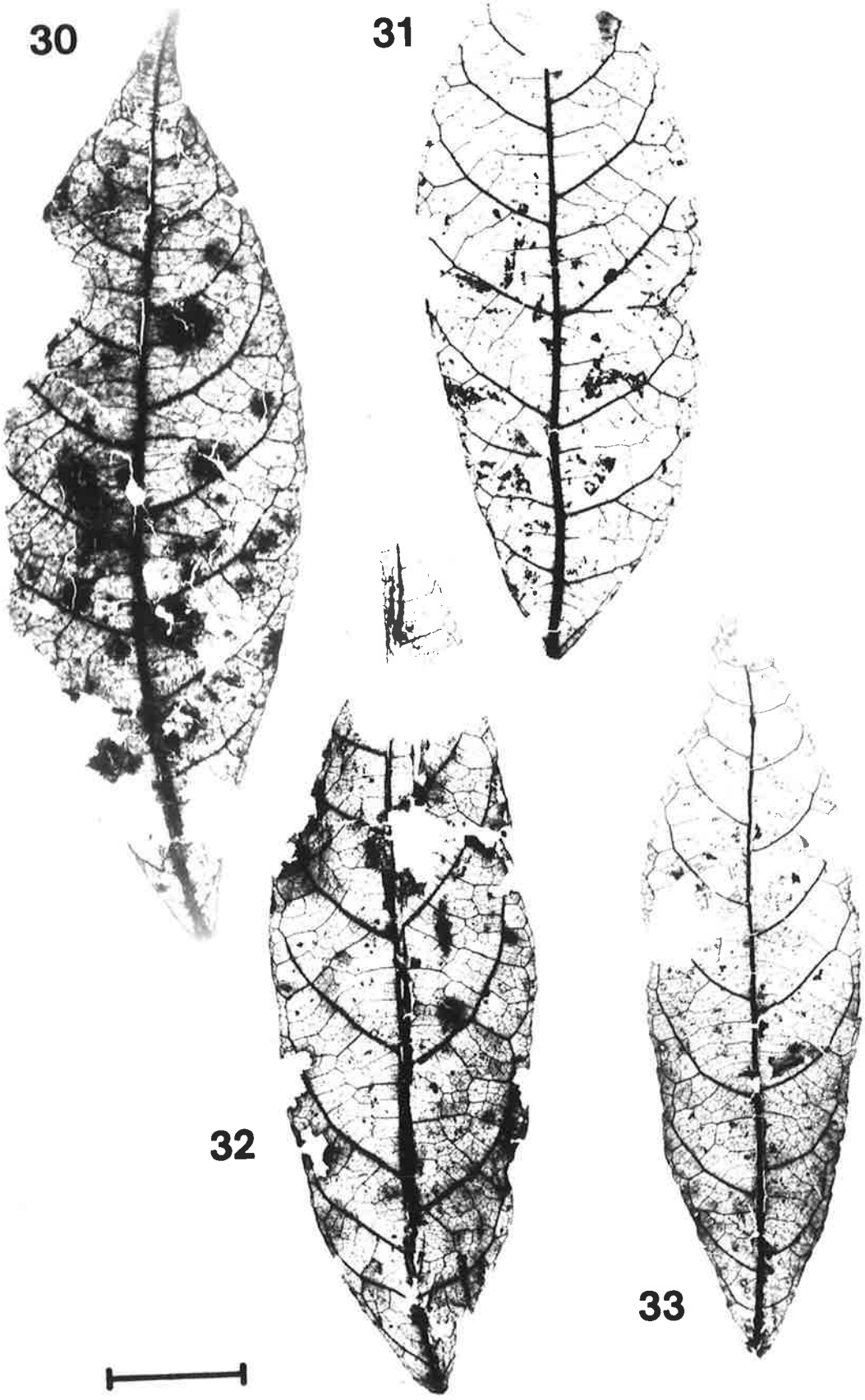
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FIGURE 34. Specimen N 0036, Parataxon NER/007.

FIGURE 35. Specimen N 0232, Parataxon NER/007.

FIGURE 36. Specimen N 0051, Parataxon NER/008.

FIGURE 37. Specimen N 0008, Parataxon NER/012.

FIGURE 38. Specimen N 0005, Parataxon NER/011.

FIGURE 39. Specimen N 0076, Parataxon NER/011.

FIGURE 40. Specimen N 0001, Parataxon NER/013.

FIGURE 41. Specimen N 0019, Parataxon NER/014.

FIGURE 42. Specimen N 0062, Parataxon NER/015.

FIGURE 43. Specimen N 0025, Parataxon NER/014.

FIGURE 44. Specimen N 0023, Parataxon NER/018.

FIGURE 45. Specimen N 0097, Parataxon NER/017.

FIGURE 46. Specimen N 0073, Parataxon NER/019.

FIGURE 47. Specimen N 0022, Parataxon NER/020.

Scale = 2 cm.

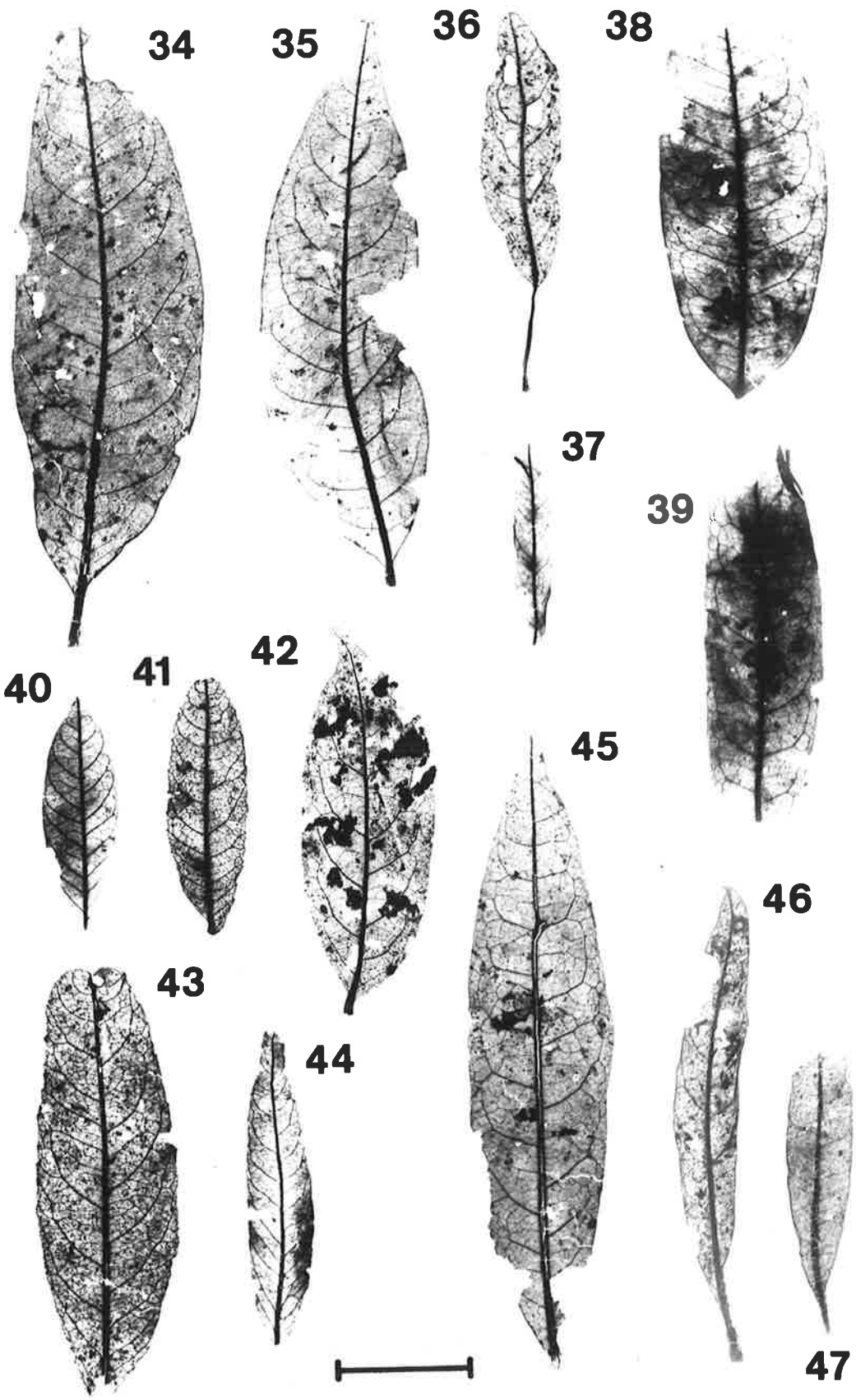
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FIGURE 48. Specimen N 0024, Parataxon NER/021.

FIGURE 49. Specimen N 0077, Parataxon NER/022.

FIGURE 50. Specimen N 0057, Parataxon NER/024.

FIGURE 51. Specimen N 0021, Parataxon NER/023.

FIGURE 52. Specimen N 0078, Parataxon NER/023.

FIGURE 53. Specimen N 0047, Parataxon NER/024.

FIGURE 54. Specimen N 0059, Parataxon NER/024.

FIGURE 55. Specimen N 0089, Parataxon NER/024.

FIGURE 56. Specimen N 0122, Parataxon NER/024.

FIGURE 57. Specimen N 0238, Parataxon NER/024.

Scale = 2 cm.

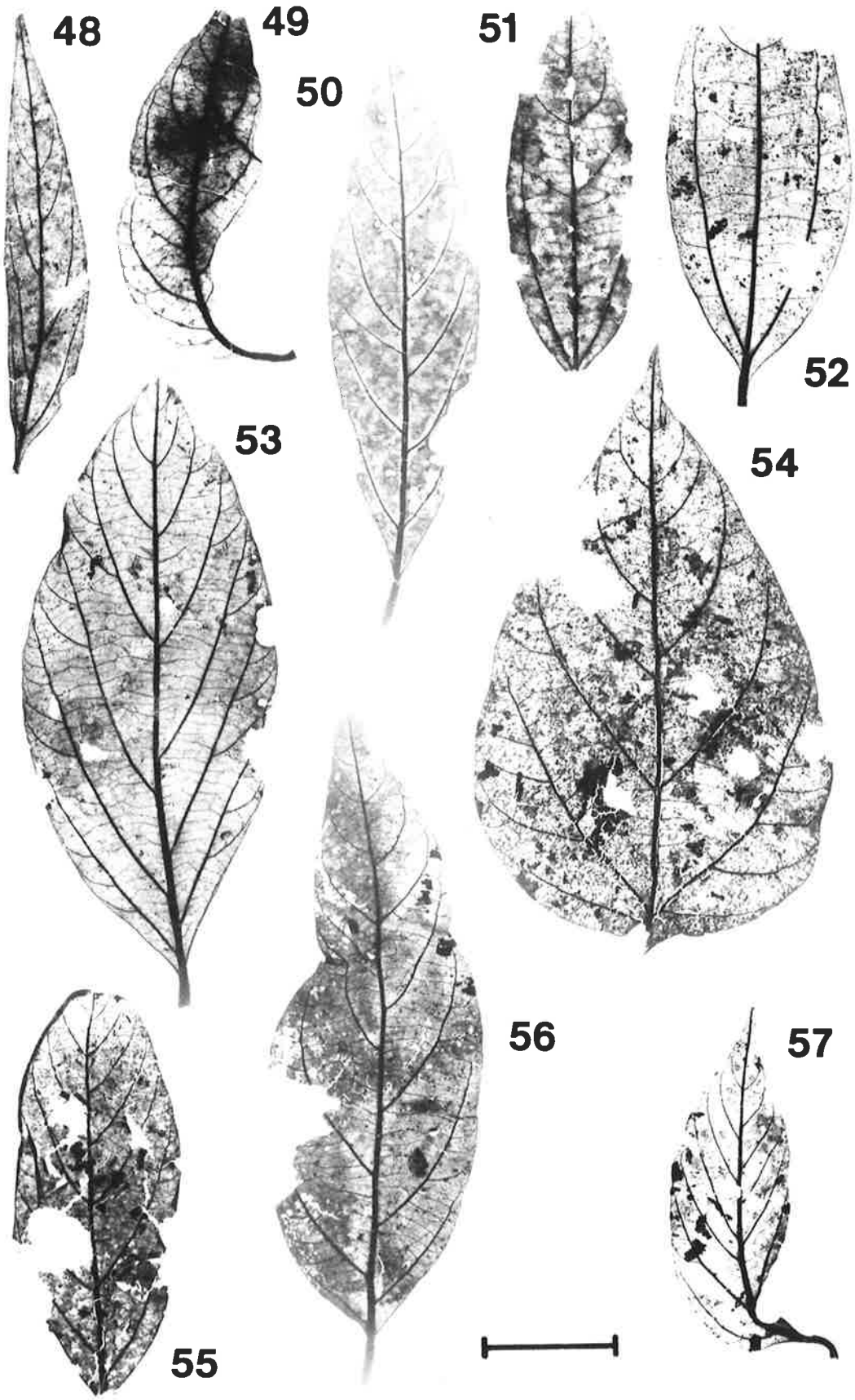
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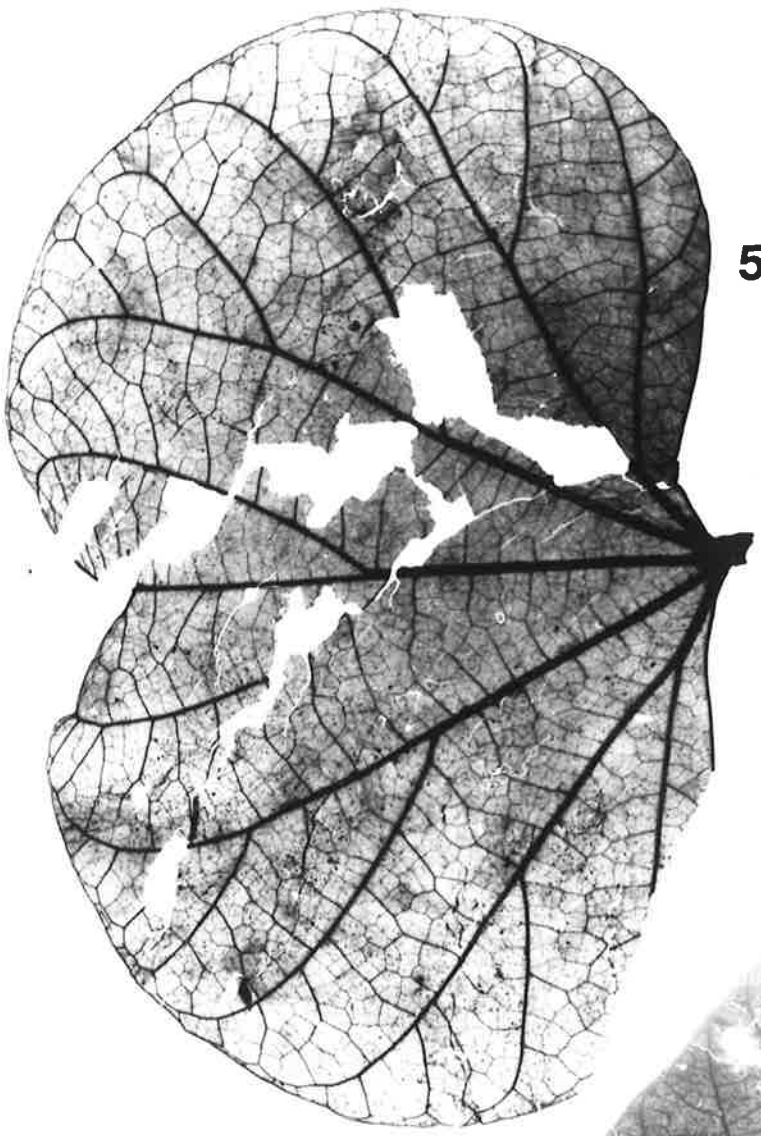
FIGURE 58. Specimen N 0084, Parataxon NER/025.

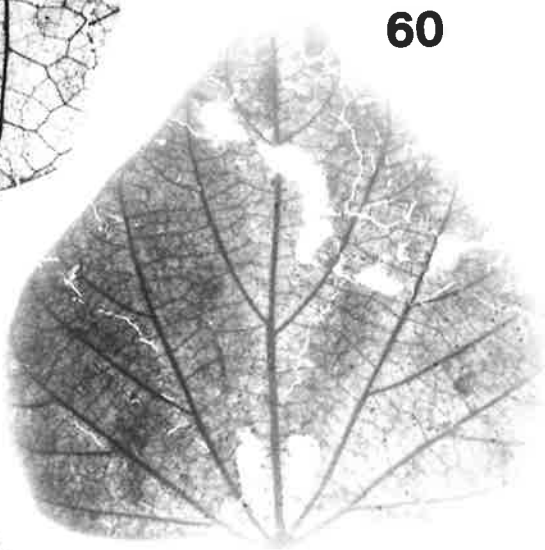
FIGURE 59. Specimen N 0112, Parataxon NER/025.

FIGURE 60. Specimen N 0069, Parataxon NER/025.

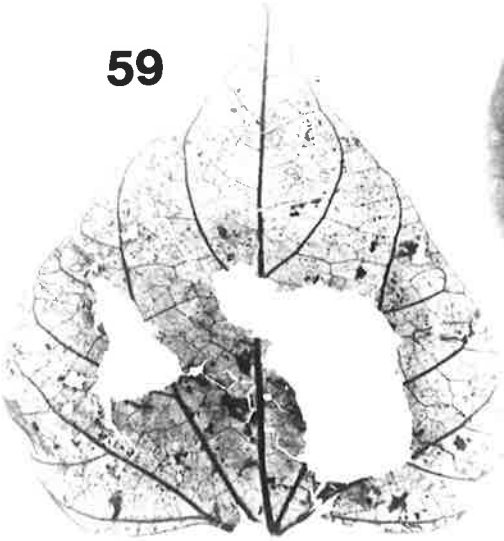
Scale = 2 cm.



58



60



59

FIGURE 61. Specimen N 0102, Parataxon NER/025.

FIGURE 62. Specimen N 0096, Parataxon NER/025.

FIGURE 63. Specimen N 0060, Parataxon NER/025.

FIGURE 64. Specimen N 0082, Parataxon NER/025.

Scale = 2 cm.

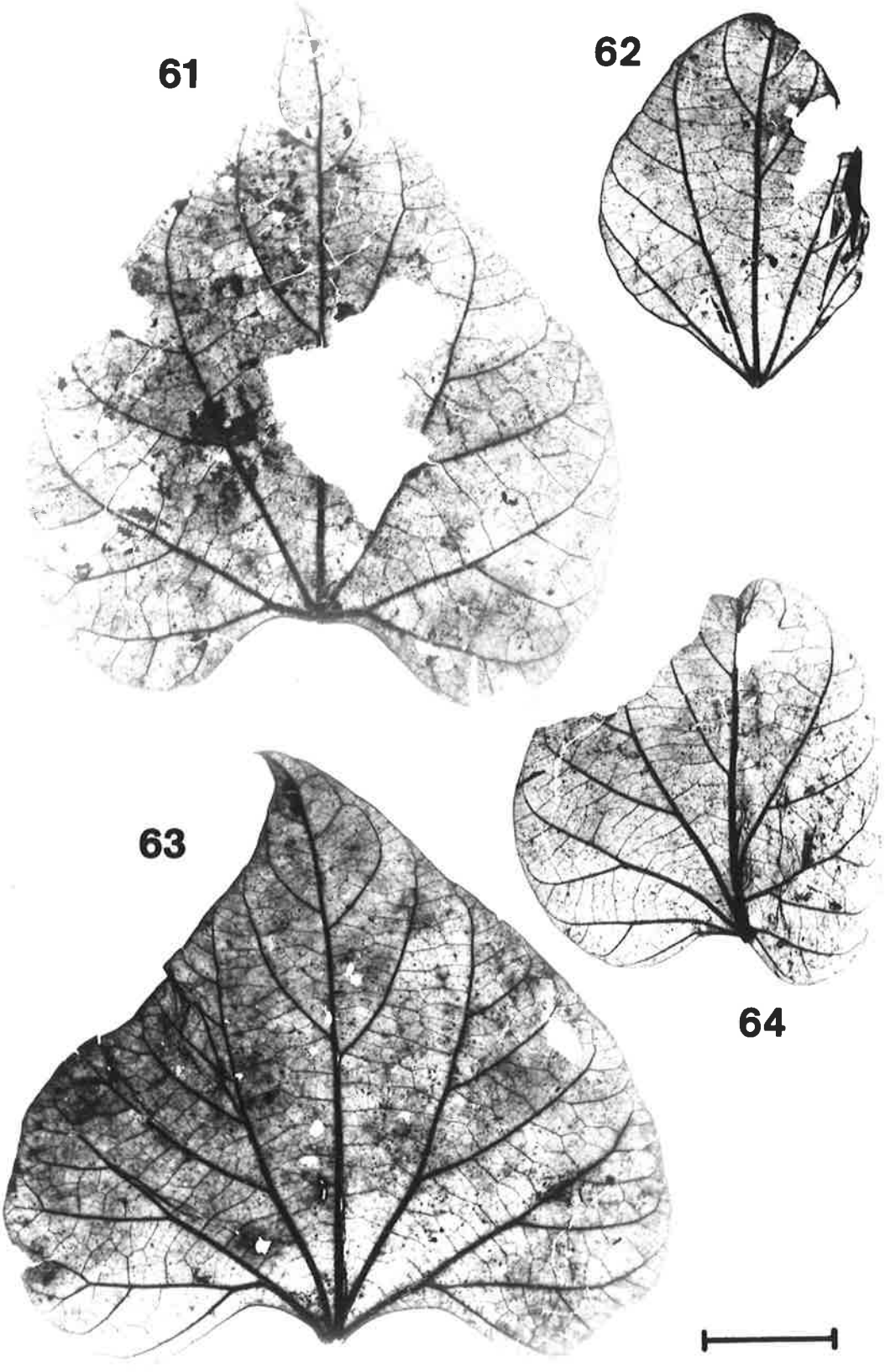

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FIGURE 65. Specimen N 0010, Parataxon NER/026.

FIGURE 66. Specimen N 0014, Parataxon NER/026.

FIGURE 67. Specimen N 0017, Parataxon NER/026.

FIGURE 68. Specimen N 0020, Parataxon NER/026.

FIGURE 69. Specimen N 0018, Parataxon NER/026.

FIGURE 70. Specimen N 0033, Parataxon NER/026.

FIGURE 71. Specimen N 0064, Parataxon NER/026.

FIGURE 72. Specimen N 0056, Parataxon NER/026.

Scale = 2 cm.

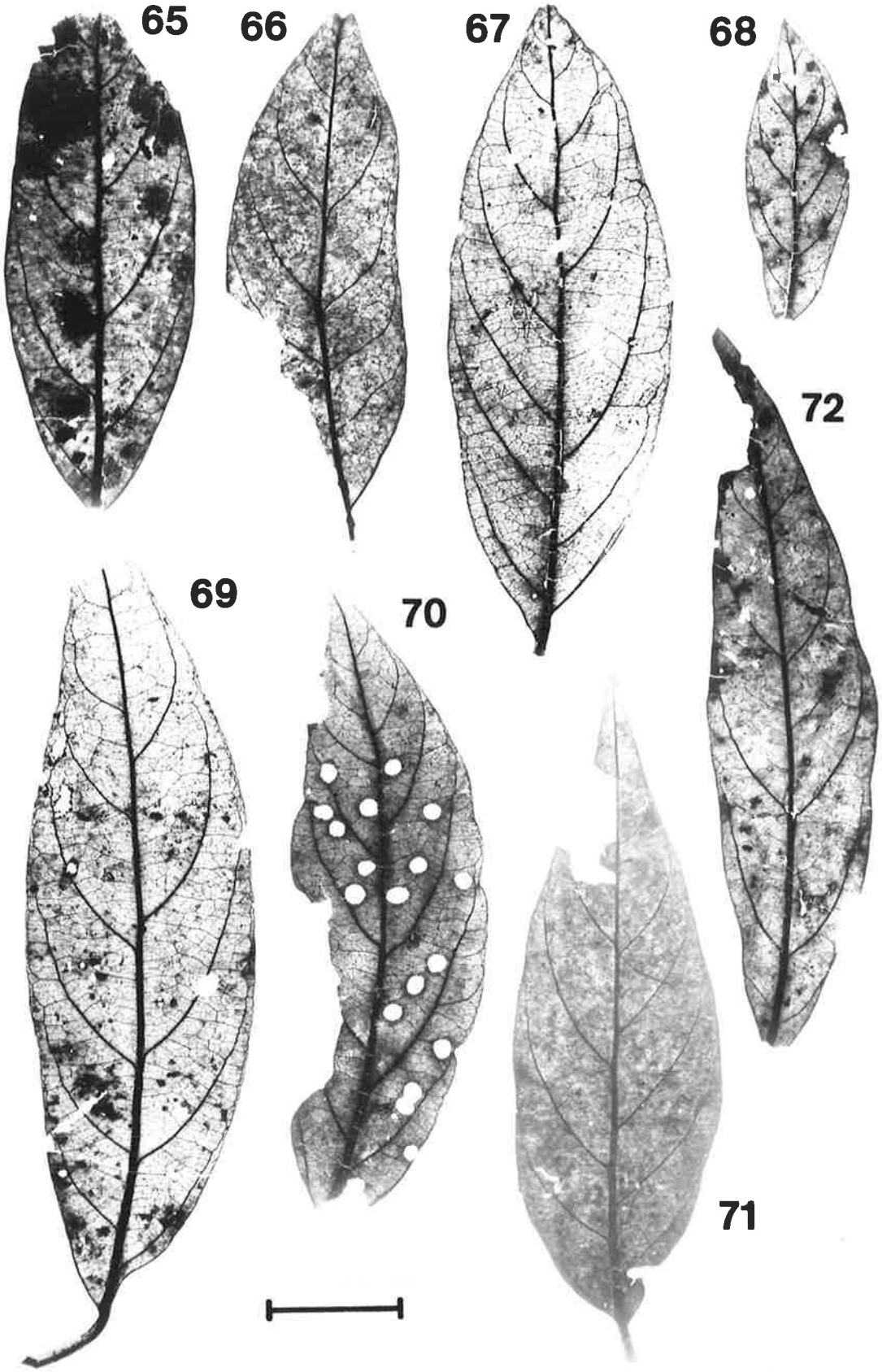
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FIGURE 73. Specimen N 0068, Parataxon NER/026.

FIGURE 74. Specimen N 0071, Parataxon NER/026.

FIGURE 75. Specimen N 0239, Parataxon NER/026.

FIGURE 76. Specimen N 0101, Parataxon NER/026.

FIGURE 77. Specimen N 0100, Parataxon NER/026.

FIGURE 78. Specimen N 0105, Parataxon NER/026.

FIGURE 79. Specimen N 0103, Parataxon NER/026.

FIGURE 80. Specimen N 0241, Parataxon NER/026.

Scale = 2 cm.

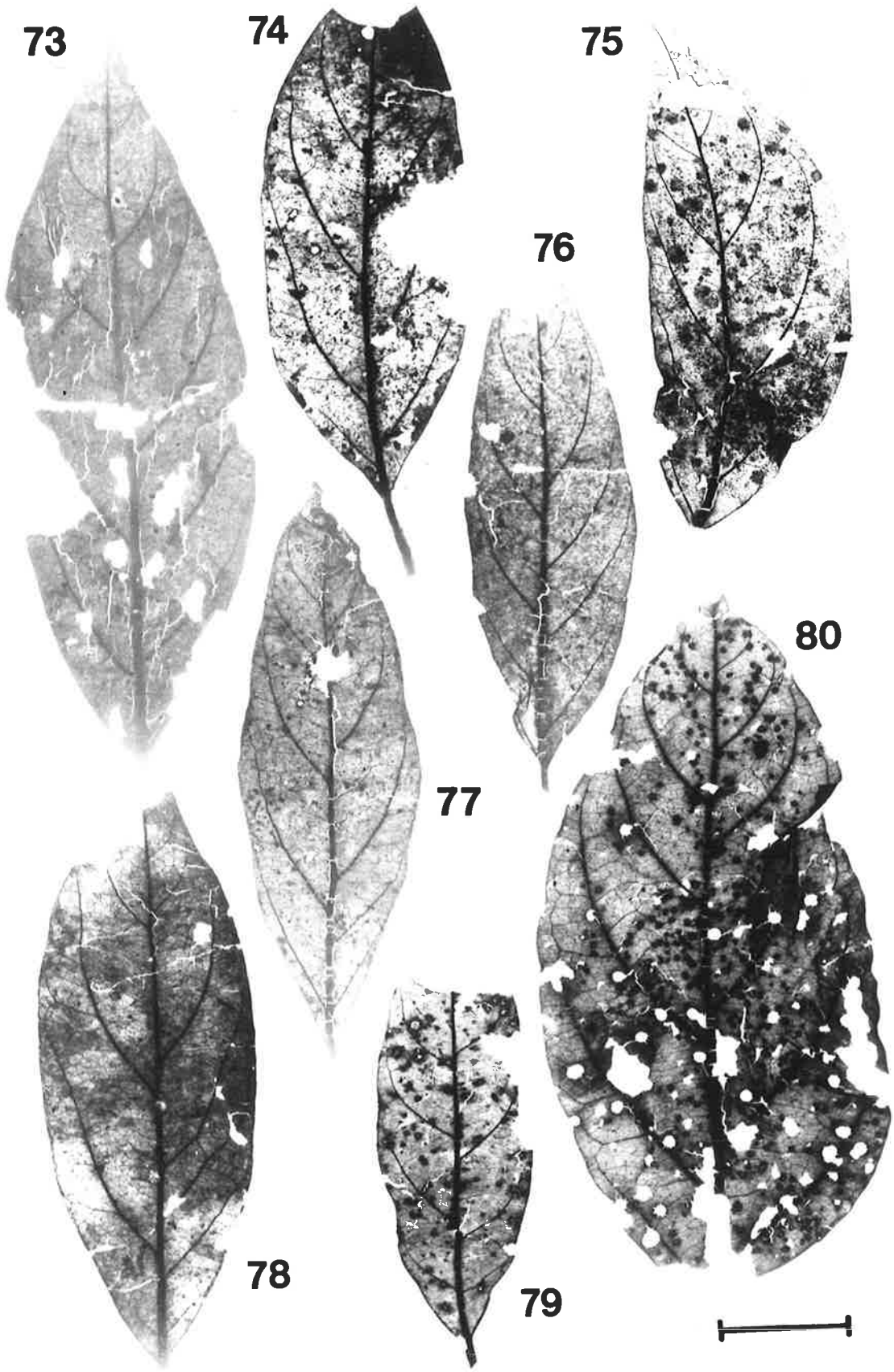
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FIGURE 81. Specimen N 0002, Parataxon NER/027.

FIGURE 82. Specimen N 0003, Parataxon NER/027.

FIGURE 83. Specimen N 0004, Parataxon NER/027.

FIGURE 84. Specimen N 0006, Parataxon NER/027.

FIGURE 85. Specimen N 0007, Parataxon NER/027.

FIGURE 86. Specimen N 0011, Parataxon NER/027.

FIGURE 87. Specimen N 0026, Parataxon NER/027.

FIGURE 88. Specimen N 0038, Parataxon NER/027.

FIGURE 89. Specimen N 0015, Parataxon NER/027.

FIGURE 90. Specimen N 0027, Parataxon NER/027.

FIGURE 91. Specimen N 0037, Parataxon NER/027.

FIGURE 92. Specimen N 0041, Parataxon NER/027.

Scale = 2 cm.

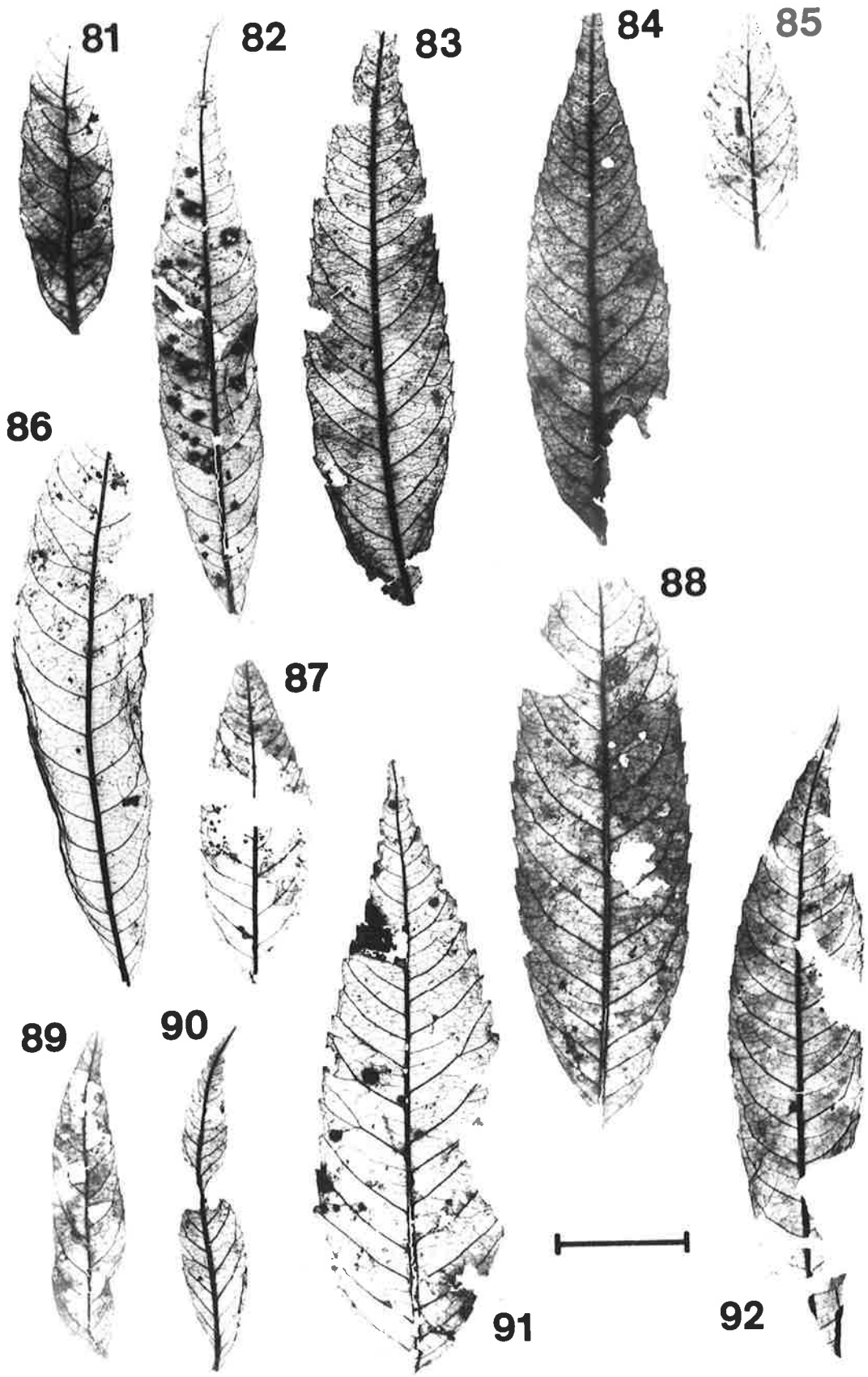
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FIGURE 93. Specimen N 0044, Parataxon NER/027.

FIGURE 94. Specimen N 0045, Parataxon NER/027.

FIGURE 95. Specimen N 0052, Parataxon NER/027.

FIGURE 96. Specimen N 0053, Parataxon NER/027.

FIGURE 97. Specimen N 0054, Parataxon NER/027.

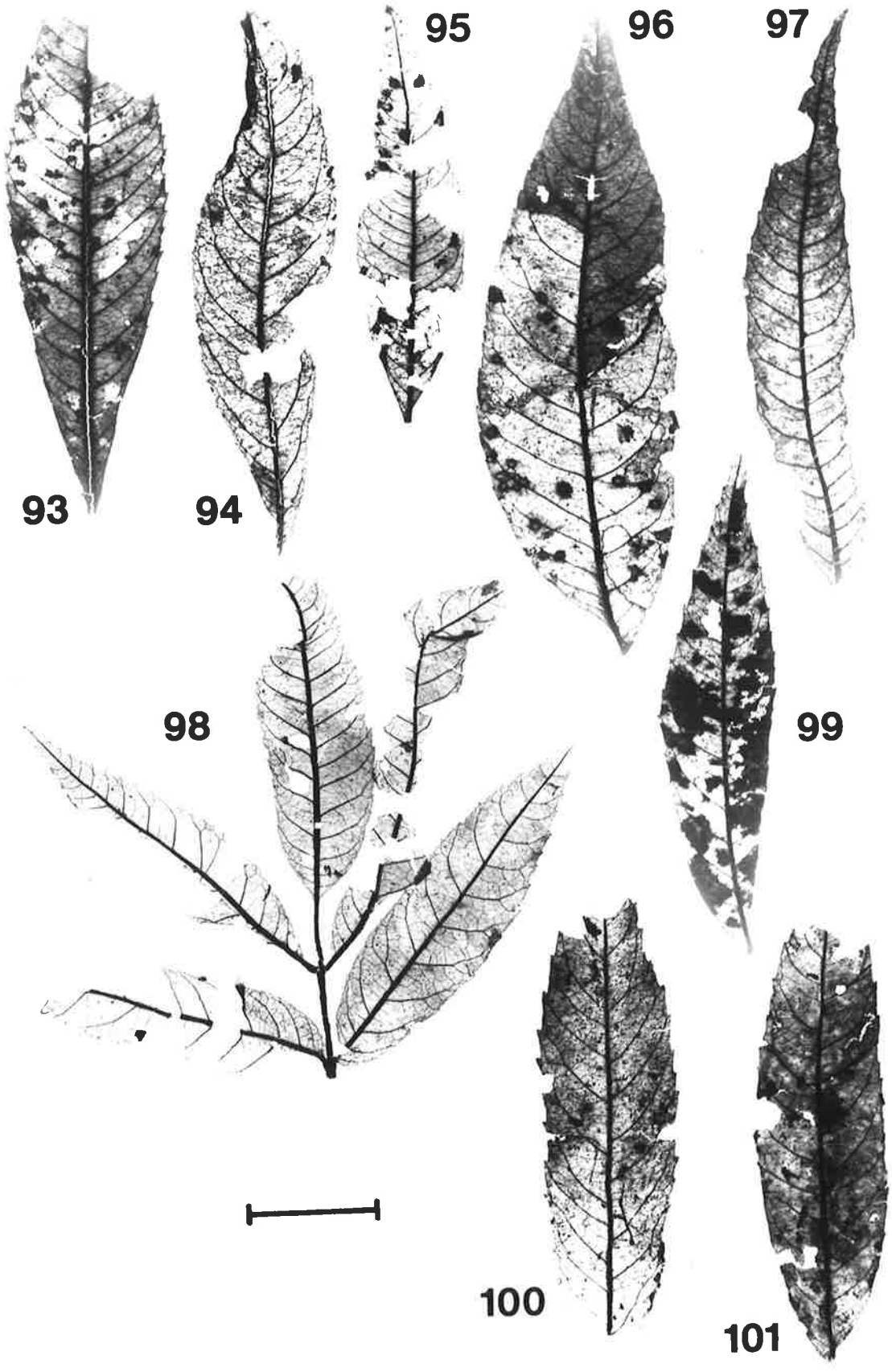
FIGURE 98. Specimen N 0049, Parataxon NER/027.

FIGURE 99. Specimen N 0055, Parataxon NER/027.

FIGURE 100. Specimen N 0058, Parataxon NER/027.

FIGURE 101. Specimen N 0061, Parataxon NER/027.

Scale = 2 cm.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101

FIGURE 102. Specimen N 0063, Parataxon NER/027.

FIGURE 103. Specimen N 0070, Parataxon NER/027.

FIGURE 104. Specimen N 0074, Parataxon NER/027.

FIGURE 105. Specimen N 0075, Parataxon NER/027.

FIGURE 106. Specimen N 0079, Parataxon NER/027.

FIGURE 107. Specimen N 0092, Parataxon NER/027.

FIGURE 108. Specimen N 0094, Parataxon NER/027.

FIGURE 109. Specimen N 0090, Parataxon NER/027.

FIGURE 110. Specimen N 0088, Parataxon NER/027.

FIGURE 111. Specimen N 0098, Parataxon NER/027.

FIGURE 112. Specimen N 0109, Parataxon NER/027.

FIGURE 113. Specimen N 0118, Parataxon NER/027.

Scale = 2 cm.

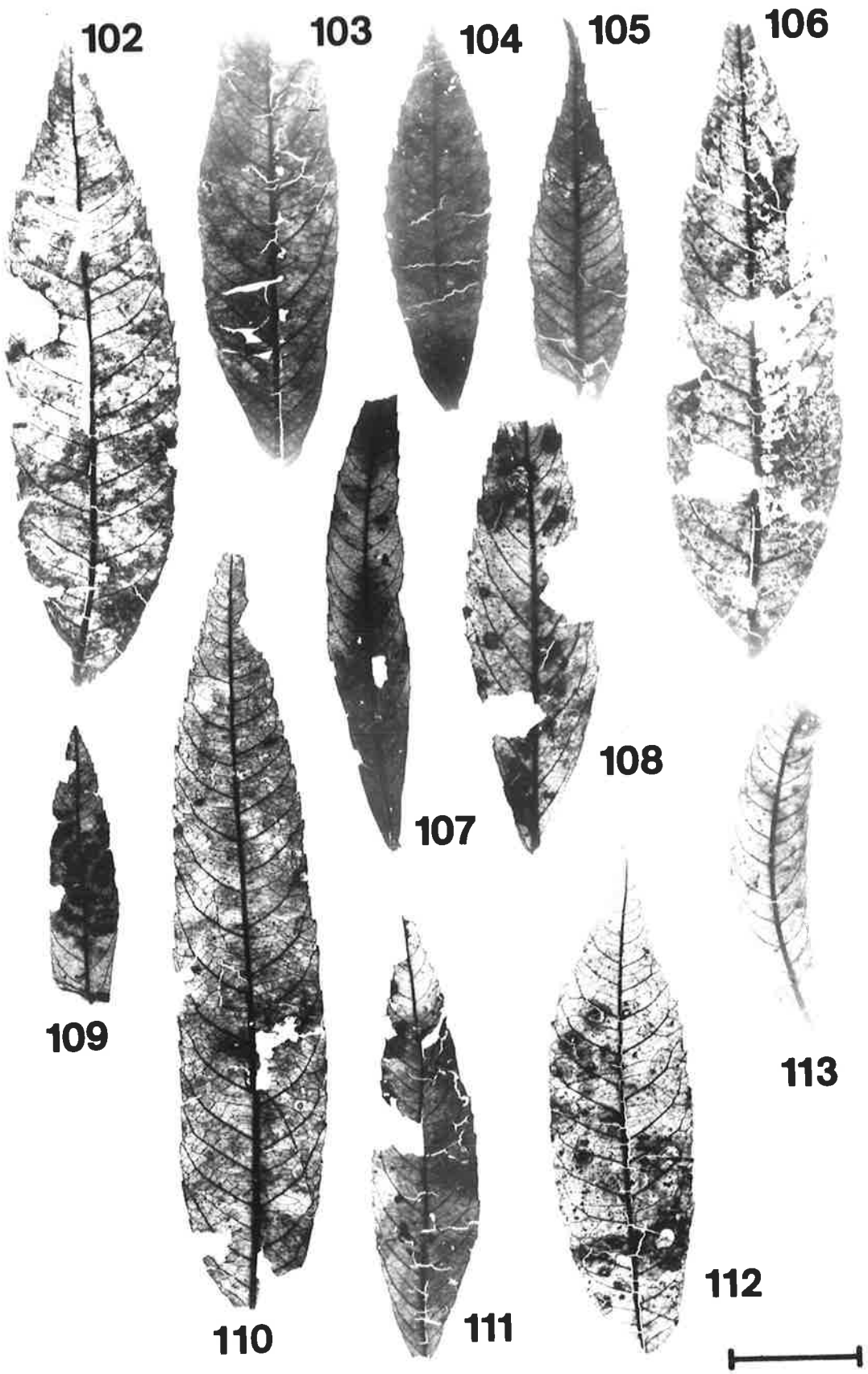
102
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FIGURE 114. Specimen N 0120, Parataxon NER/027.

FIGURE 115. Specimen N 0125, Parataxon NER/027.

FIGURE 116. Specimen N 0144, Parataxon NER/027.

FIGURE 117. Specimen N 0149, Parataxon NER/027.

FIGURE 118. Specimen N 0156, Parataxon NER/027.

FIGURE 119. Specimen N 0159, Parataxon NER/027.

FIGURE 120. Specimen N 0262, Parataxon NER/027.

FIGURE 121. Specimen N 0236, Parataxon NER/027.

FIGURE 122. Specimen N 0234, Parataxon NER/027.

FIGURE 123. Specimen N 0503, Parataxon NER/027.

FIGURE 124. Specimen N 0555, Parataxon NER/027.

FIGURE 125. Specimen N 0240, Parataxon NER/027.

Scale = 2 cm.

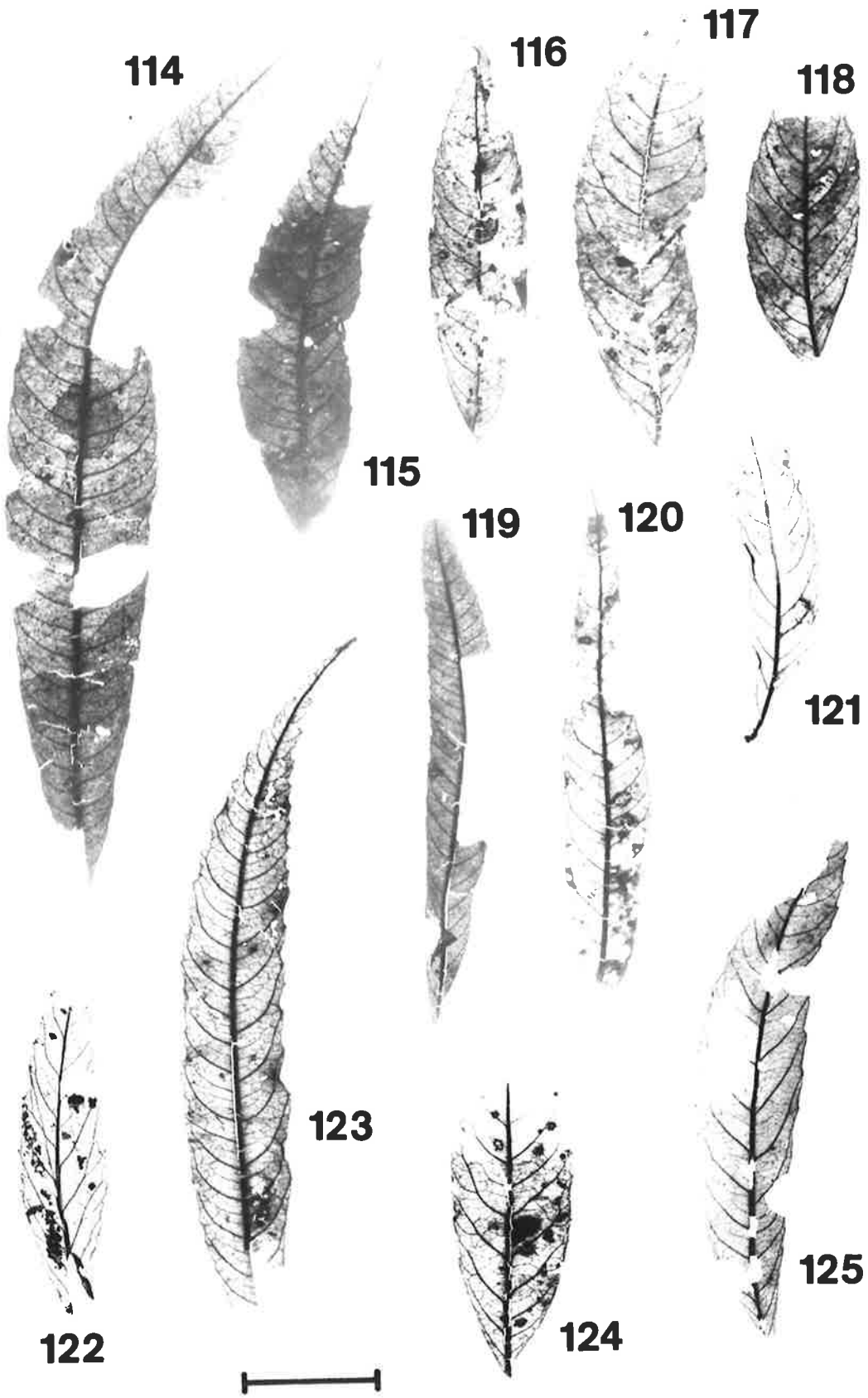
114
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FIGURE 126. Specimen N 0246, Parataxon NER/028.

FIGURE 127. Specimen N 0403, Parataxon NER/029.

FIGURE 128. Specimen N 0373, Parataxon NER/030.

FIGURE 129. Specimen N 0362, Parataxon NER/030.

FIGURE 130. Specimen N 0150, Parataxon NER/031.

FIGURE 131. Specimen N 0184, Parataxon NER/033.

FIGURE 132. Specimen N 0575, Parataxon NER/034.

FIGURE 133. Specimen N 0575, Parataxon NER/034. (x3.5).

FIGURE 134. Specimen N 0470, Parataxon NER/036.

FIGURE 135. Specimen N 0476, Parataxon NER/035.

FIGURE 136. Specimen N 0437, Parataxon NER/037.

FIGURE 137. Specimen N 0356, Parataxon NER/038.

FIGURE 138. Specimen N 0029, Parataxon NER/039.

FIGURE 139. Specimen N 0066, Parataxon NER/040.

FIGURE 140. Specimen N 0121, Parataxon NER/041.

Scale = 2 cm. (except Fig. 133).

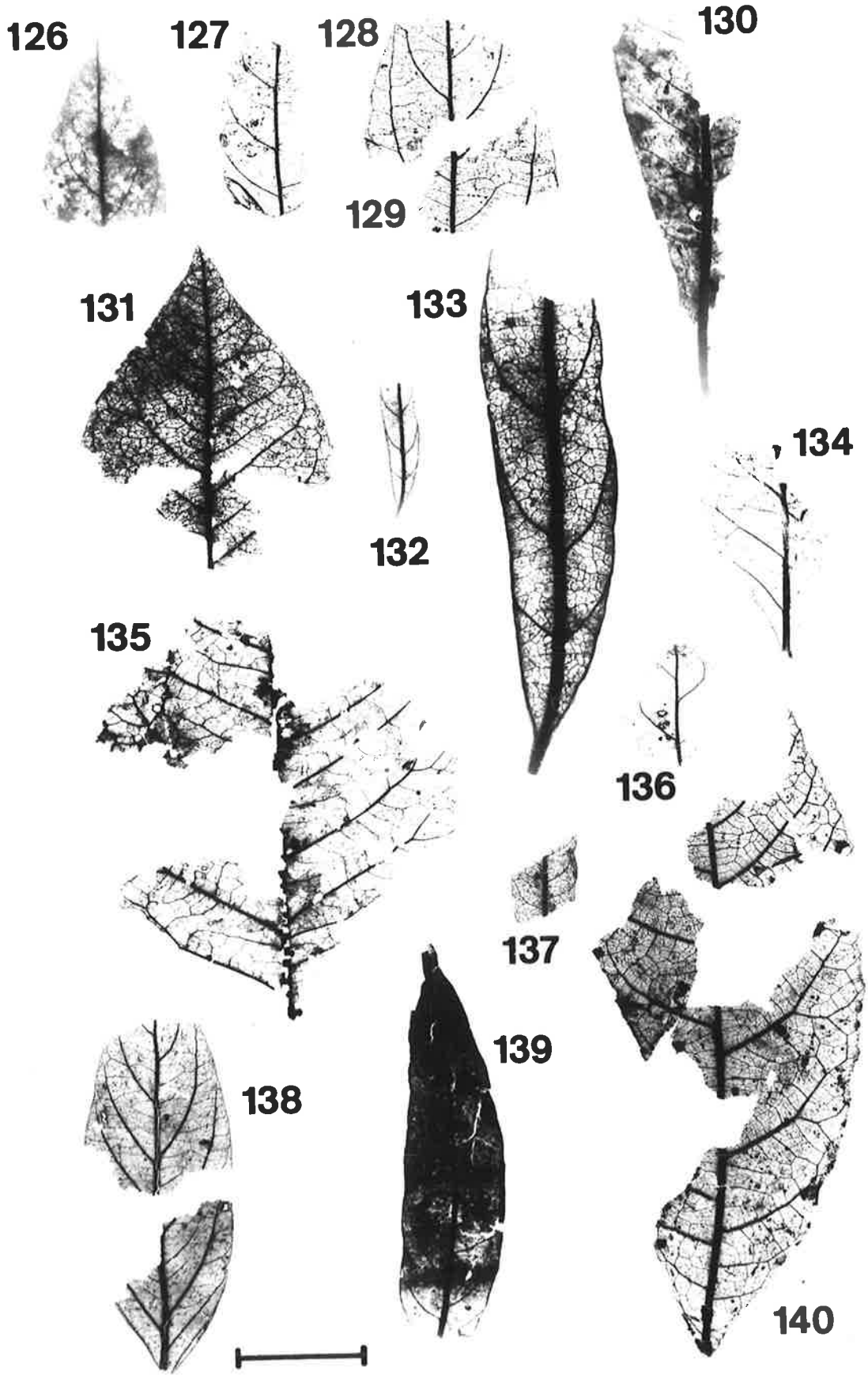
126
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FIGURE 141. Specimen N 0495, Parataxon NER/042.

FIGURE 142. Specimen N 0263, Parataxon NER/043.

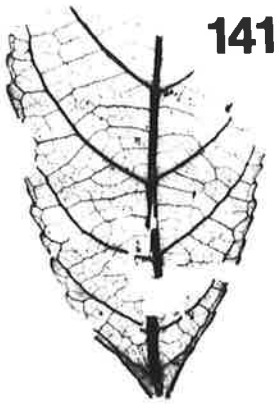
FIGURE 143. Specimen N 0263, Parataxon NER/043. (× 3.5).

FIGURE 144. Specimen N 0283, Parataxon NER/044.

FIGURE 145. Specimen N 0050, Parataxon NER/024.

FIGURE 146. Specimen N 0083, Parataxon NER/032.

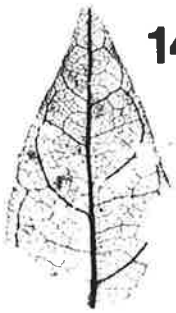
Scale = 2 cm. (except Fig. 143).



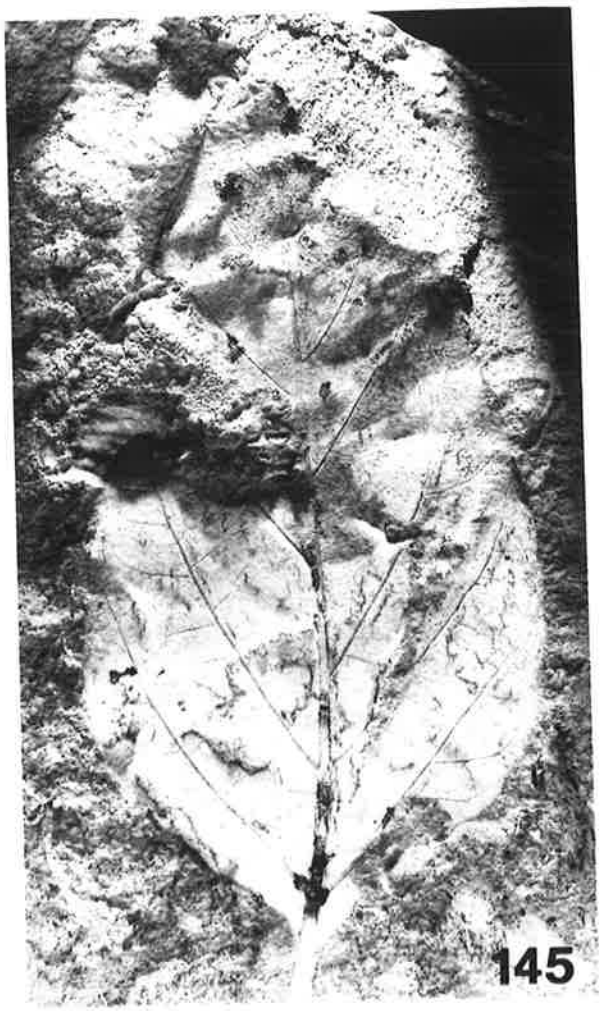
141

142

143



144



145

146

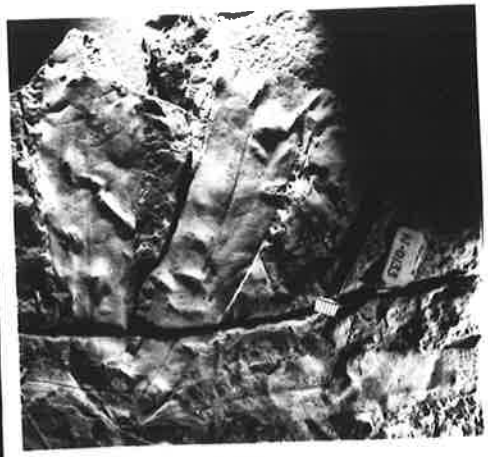
FIGURE 147. Specimen N 0132, Parataxon NER/016.

FIGURE 148. Specimen N 0133 (counterpart of N 0132), Parataxon NER/016.

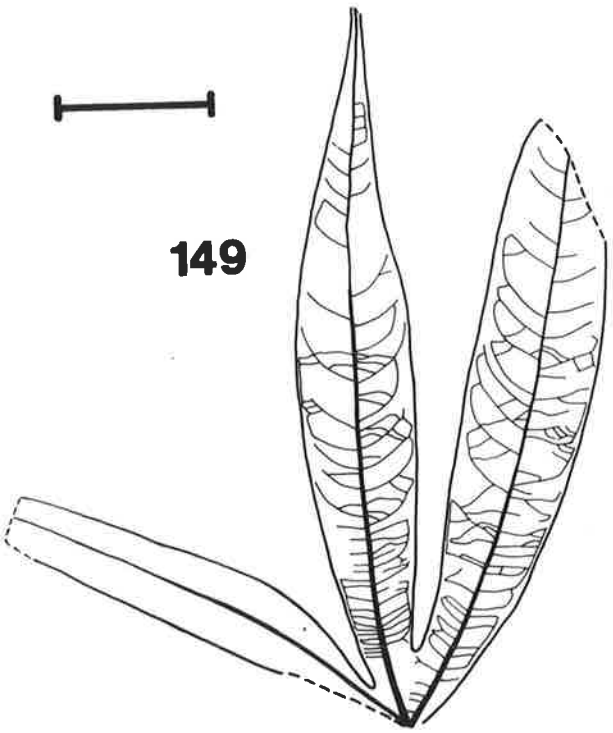
FIGURE 149. Drawing of Parataxon NER/016.

Scale = 3.5 cm.

147



148



149

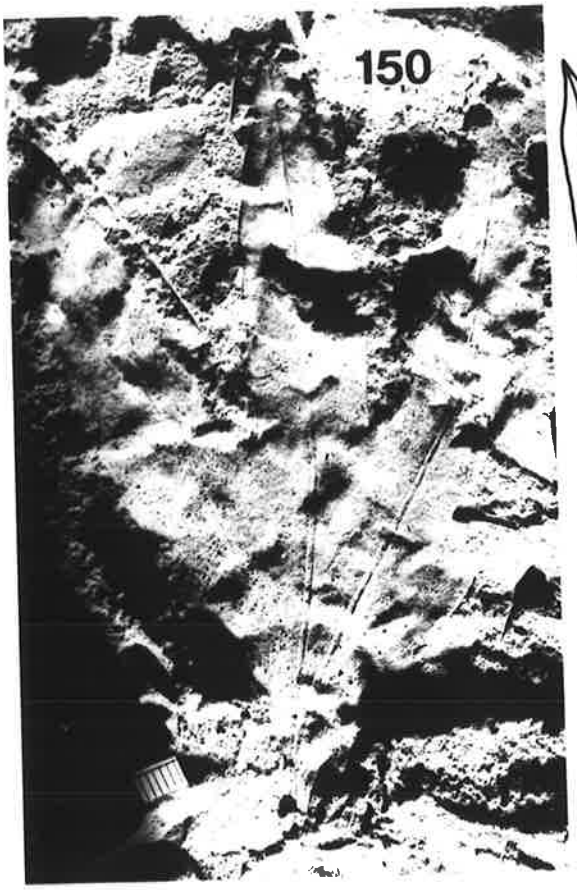
FIGURE 150. Specimen N 0136, Parataxon NER/009.

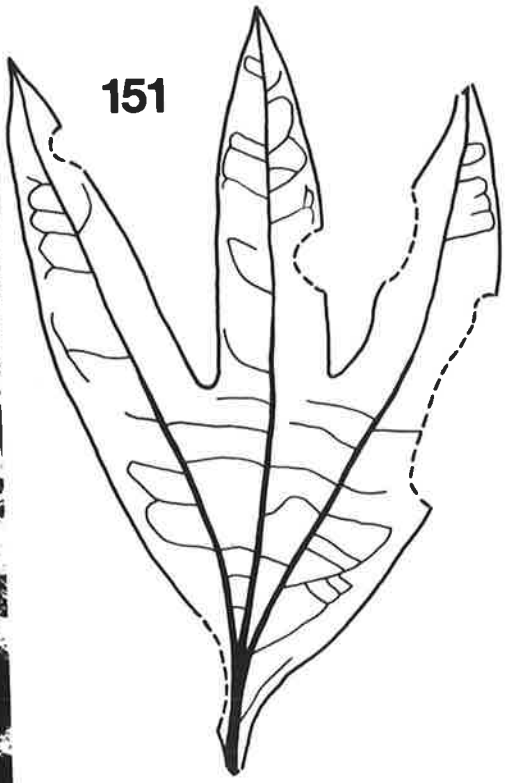
FIGURE 151. Drawing of Parataxon NER/009.

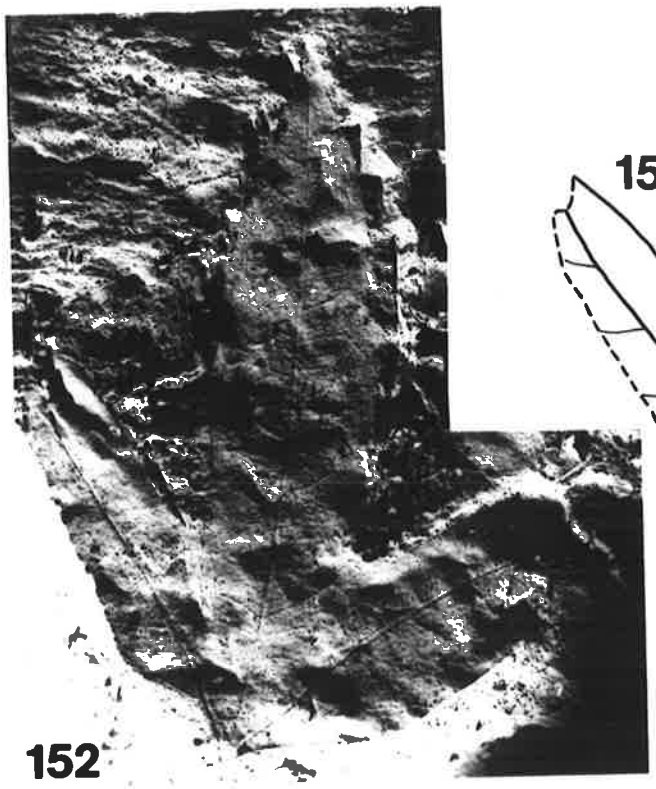
FIGURE 152. Specimen N 0137, Parataxon NER/010.

FIGURE 153. Drawing of Parataxon NER/010.

Scale = 2 cm.


150


151


152

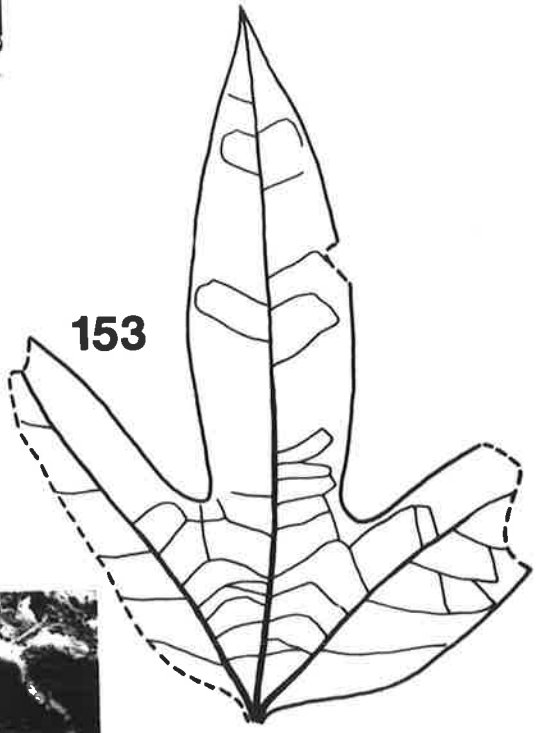

153

FIGURE 154. Specimen N 0085, Parataxon NER/001 :
Lower epidermis

FIGURE 155. Specimen N 0085, Parataxon NER/001 :
Upper epidermis

FIGURE 156. Specimen N 0095, Parataxon NER/001 :
Lower epidermis

FIGURE 157. Specimen N 0095, Parataxon NER/001 :
Upper epidermis

FIGURE 158. Specimen N 0124, Parataxon NER/001 :
Lower epidermis

FIGURE 159. Specimen N 0124, Parataxon NER/001 :
Upper epidermis

Scale = 100 um.

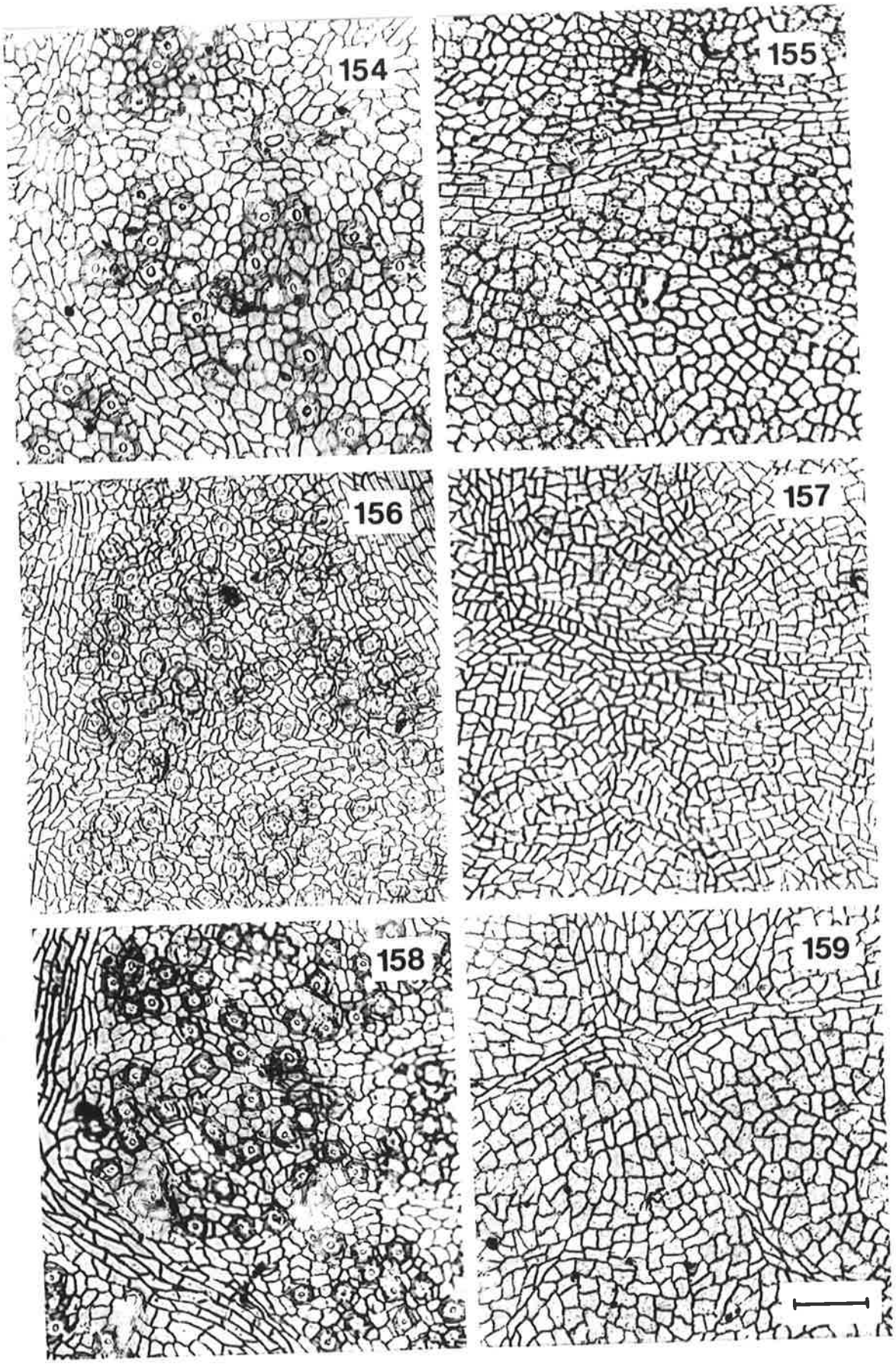

154
155
156
157
158
159

FIGURE 160. Specimen N 0013, Parataxon NER/002 :
Lower epidermis

FIGURE 161. Specimen N 0013, Parataxon NER/002 :
Upper epidermis

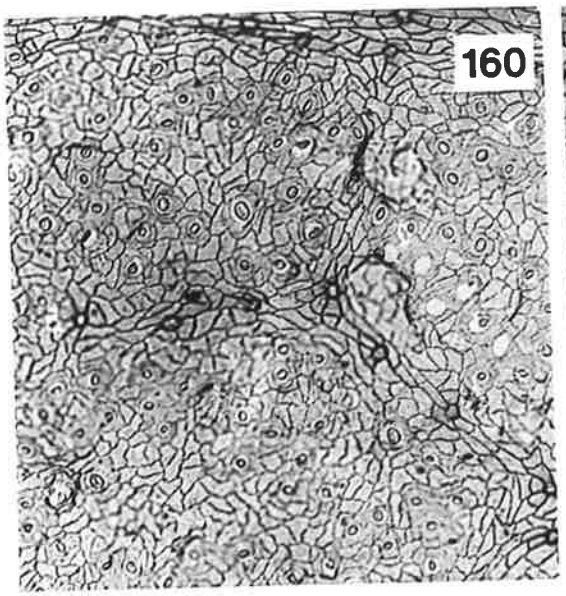
FIGURE 162. Specimen N 0016, Parataxon NER/003 :
Lower epidermis

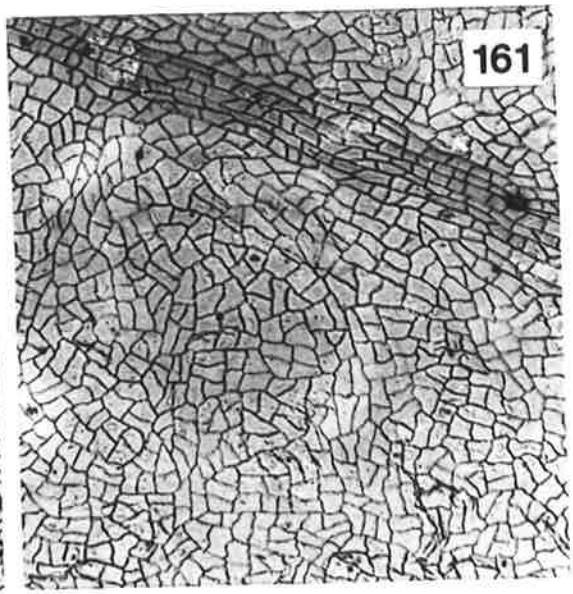
FIGURE 163. Specimen N 0016, Parataxon NER/003 :
Upper epidermis

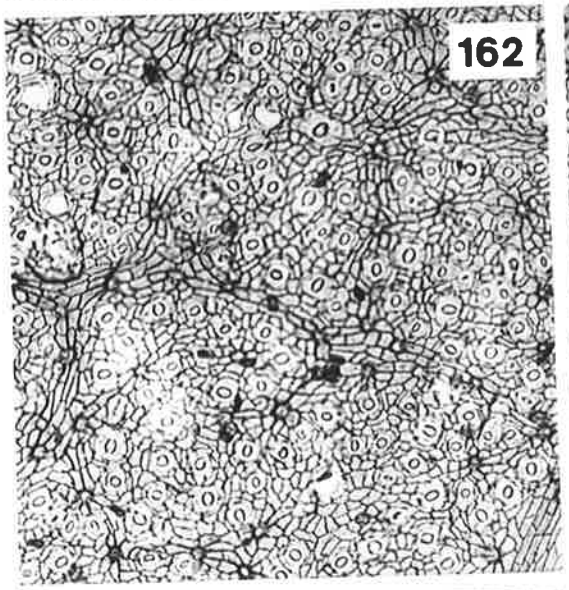
FIGURE 164. Specimen N 0067, Parataxon NER/005 :
Lower epidermis

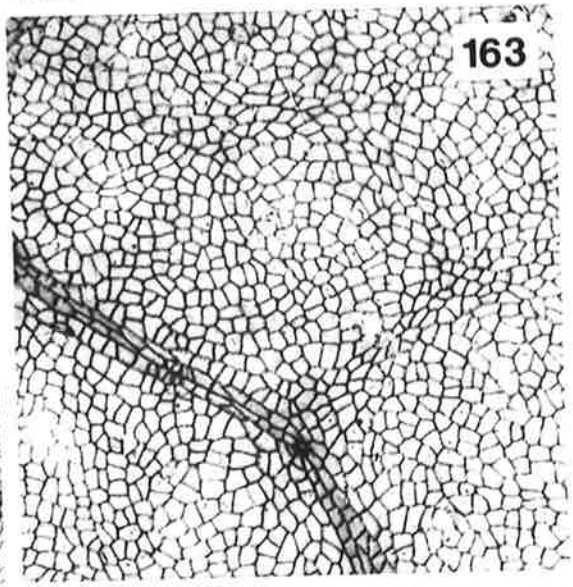
FIGURE 165. Specimen N 0067, Parataxon NER/008 :
Upper epidermis

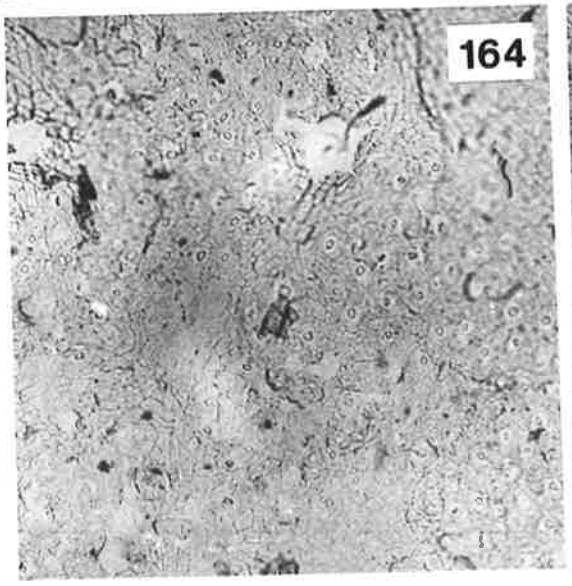
Scale = 100 um.


160


161


162


163


164

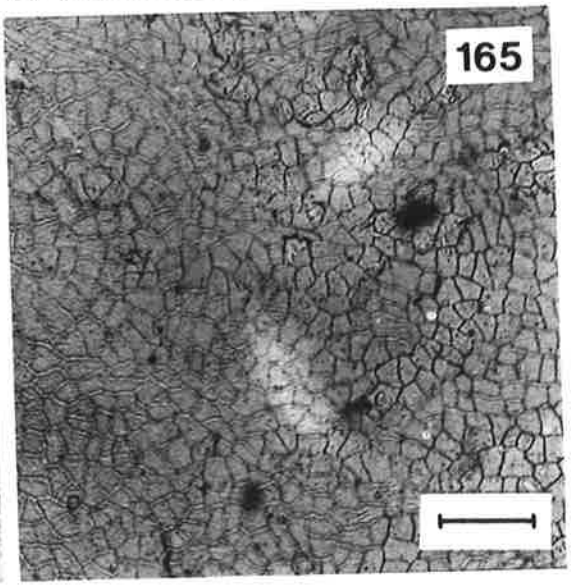

165

FIGURE 166. Specimen N 0085, Parataxon NER/001 :
Stomate over vein, lower epidermis.

FIGURE 167. Specimen N 0095, Parataxon NER/001 :
Stomate over vein, lower epidermis.

FIGURE 168. Specimen N 0085, Parataxon NER/001 :
Stomate over areole, lower epidermis.

FIGURE 169. Specimen N 0085, Parataxon NER/001 :
Trichome base over vein, lower epidermis.

FIGURE 170. Specimen N 0013, Parataxon NER/002 :
Stomate over vein, lower epidermis.

FIGURE 171. Specimen N 0013, Parataxon NER/002 :
Stomate over areole, lower epidermis.

FIGURE 172. Specimen N 0013, Parataxon NER/002 :
Trichome base over vein, lower epidermis.

FIGURE 173. Specimen N 0013, Parataxon NER/002 :
Non-cutinised apex of serration.

Scale = 20 um (figs. 166 - 172), 100 um (fig. 173).

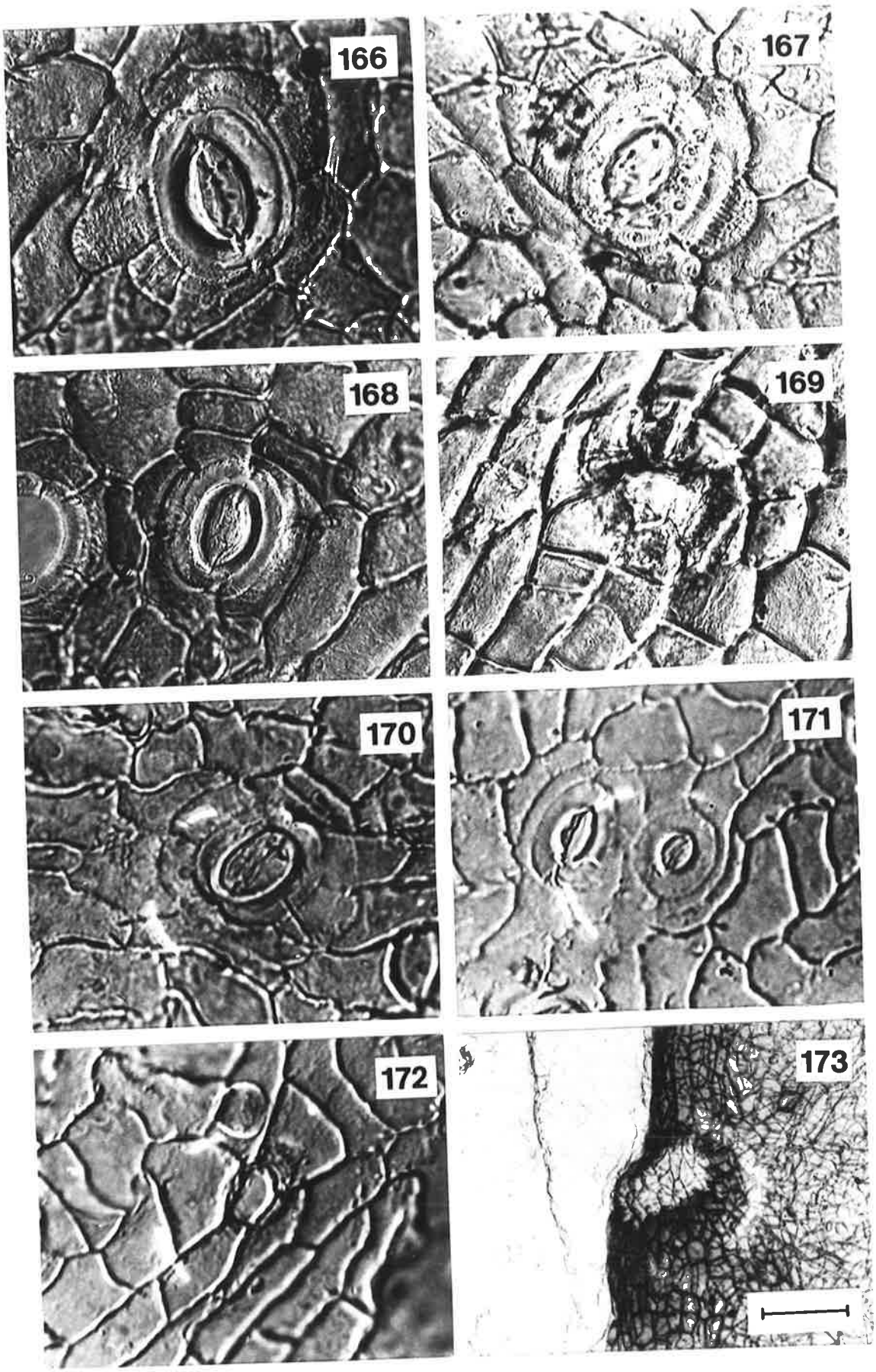

166
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FIGURE 174. Specimen N 0009, Parataxon NER/004 : Lower epidermis

FIGURE 175. Specimen N 0009, Parataxon NER/004 : Upper epidermis

FIGURE 176. Specimen N 0048, Parataxon NER/004 : Lower epidermis

FIGURE 177. Specimen N 0048, Parataxon NER/004 : Upper epidermis

FIGURE 178. Specimen N 0072, Parataxon NER/004 : Lower epidermis

FIGURE 179. Specimen N 0072, Parataxon NER/004 : Upper epidermis

Scale = 100 um.

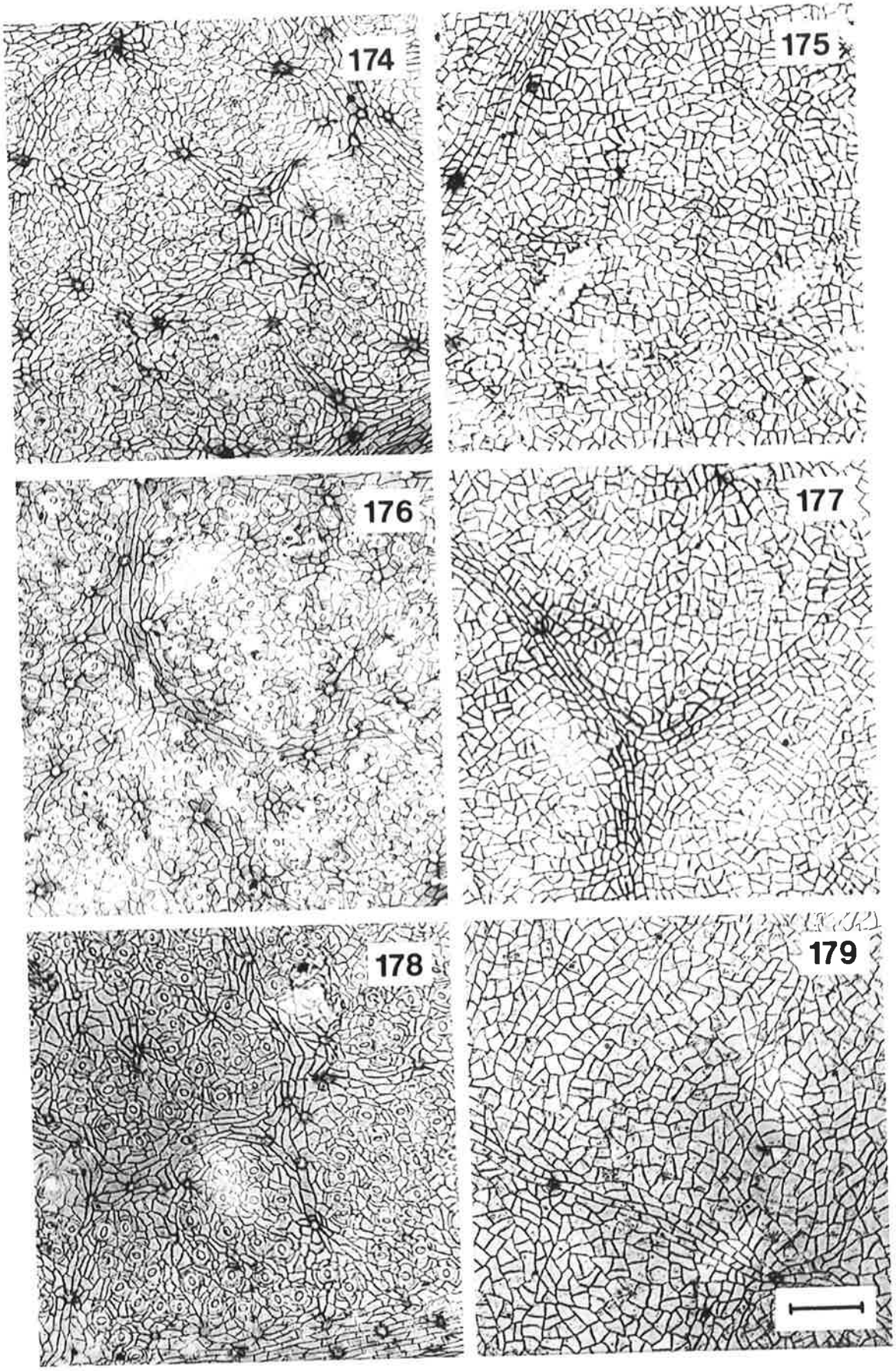
174
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FIGURE 180. Specimen N 0086, Parataxon NER/004 : Lower epidermis

FIGURE 181. Specimen N 0086, Parataxon NER/004 : Upper epidermis

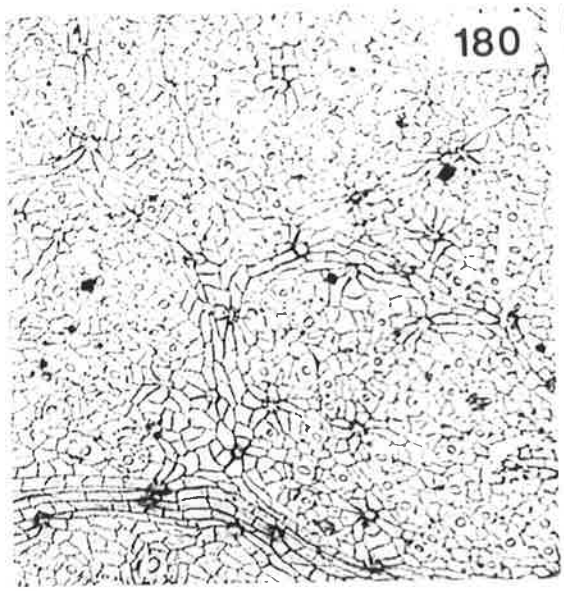
FIGURE 182. Specimen N 0099, Parataxon NER/004 : Lower epidermis

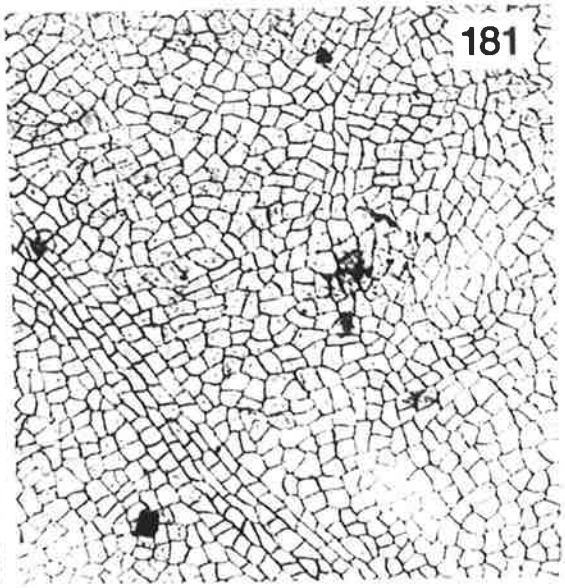
FIGURE 183. Specimen N 0099, Parataxon NER/004 : Upper epidermis

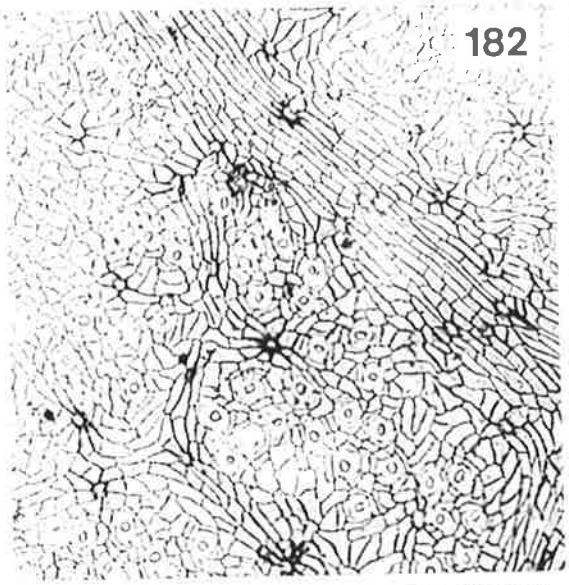
FIGURE 184. Specimen N 0104, Parataxon NER/004 : Lower epidermis

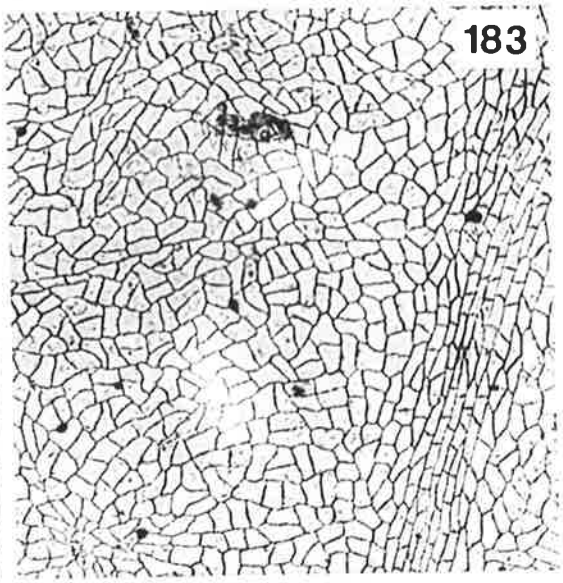
FIGURE 185. Specimen N 0104, Parataxon NER/004 : Upper epidermis

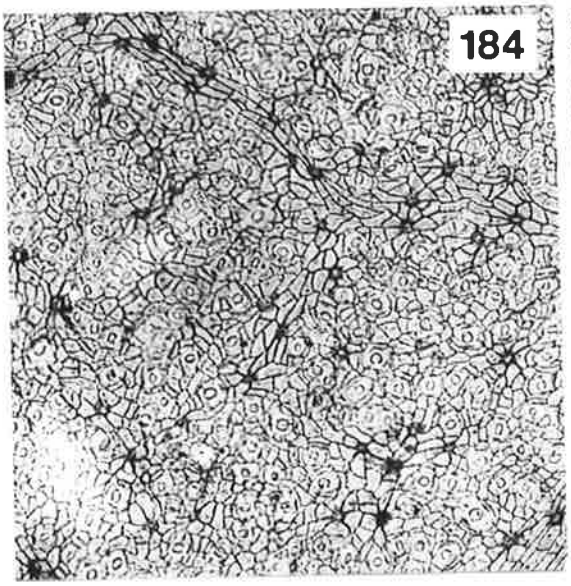
Scale = 100 um.


180


181


182


183


184

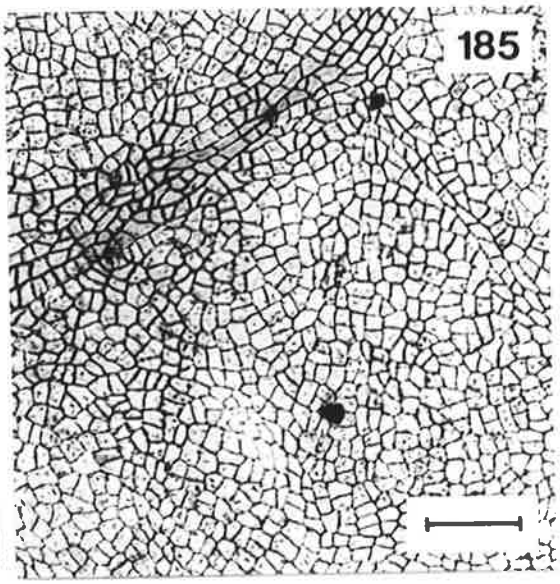

185

FIGURE 186. Specimen N 0119, Parataxon NER/004 :
Lower epidermis

FIGURE 187. Specimen N 0119, Parataxon NER/004 :
Upper epidermis

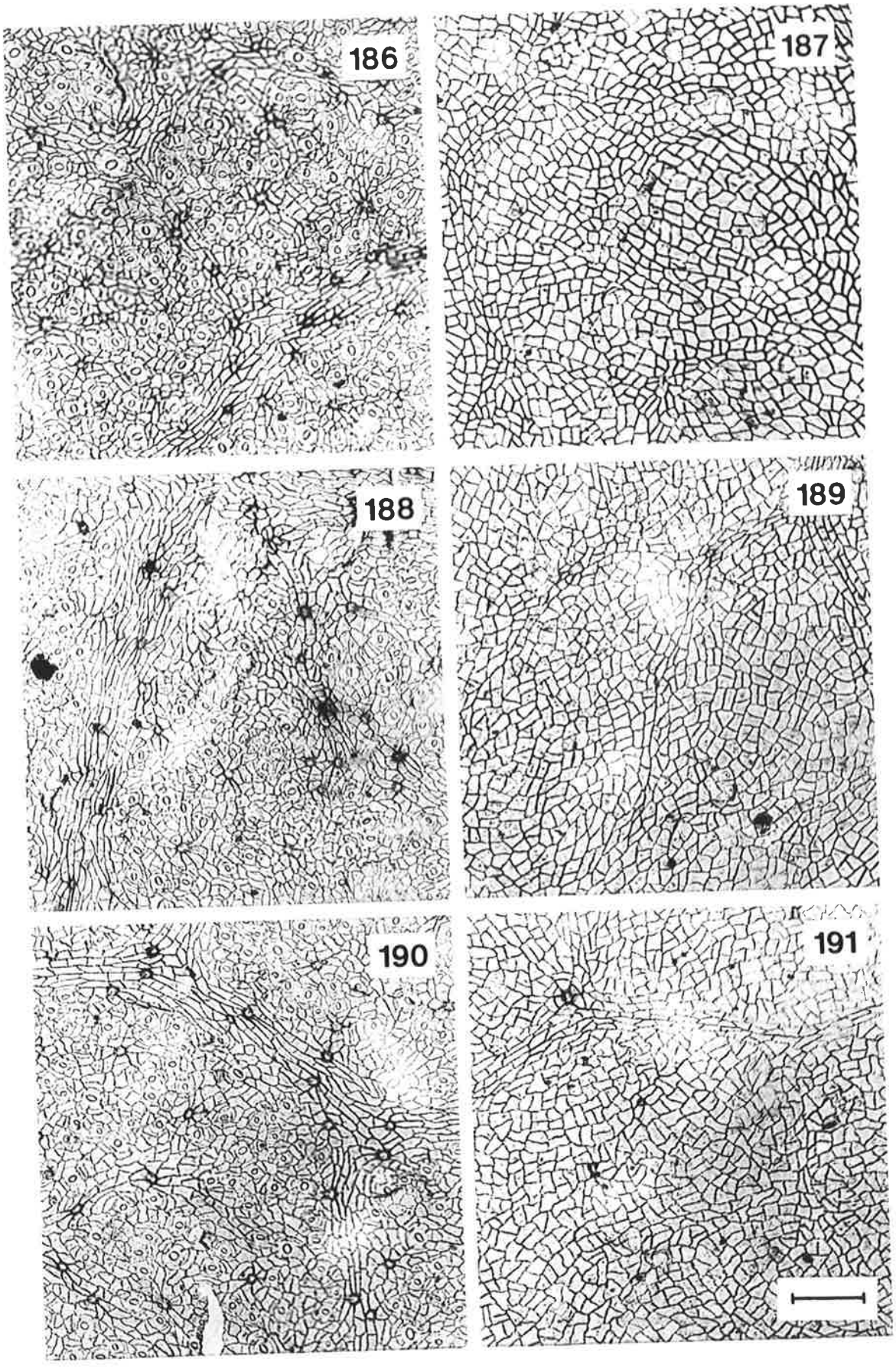
FIGURE 188. Specimen N 0123, Parataxon NER/004 :
Lower epidermis

FIGURE 189. Specimen N 0123, Parataxon NER/004 :
Upper epidermis

FIGURE 190. Specimen N 0127, Parataxon NER/004 :
Lower epidermis

FIGURE 191. Specimen N 0127, Parataxon NER/004 :
Upper epidermis

Scale = 100 um.


186
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191

FIGURE 192. Specimen N 0016, Parataxon NER/003 : Stomate over vein, lower epidermis.

FIGURE 193. Specimen N 0016, Parataxon NER/003 : Stomate over areole, lower epidermis.

FIGURE 194. Specimen N 0016, Parataxon NER/003 : Trichome base over vein, lower epidermis.

FIGURE 195. Specimen N 0048, Parataxon NER/004 : Stomate over vein, lower epidermis.

FIGURE 196. Specimen N 0009, Parataxon NER/004 : Stomates over areole, lower epidermis.

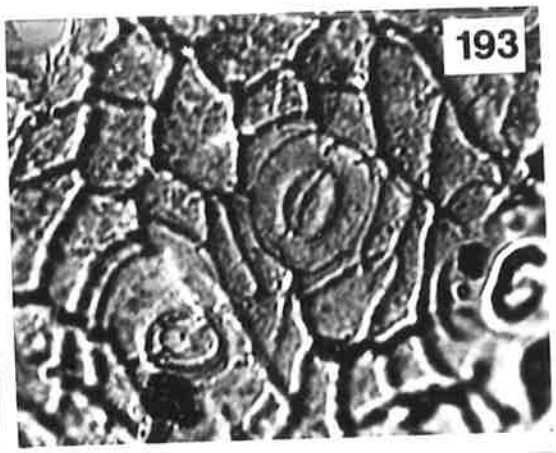
FIGURE 197. Specimen N 0009, Parataxon NER/004 : Trichome base over vein, lower epidermis.

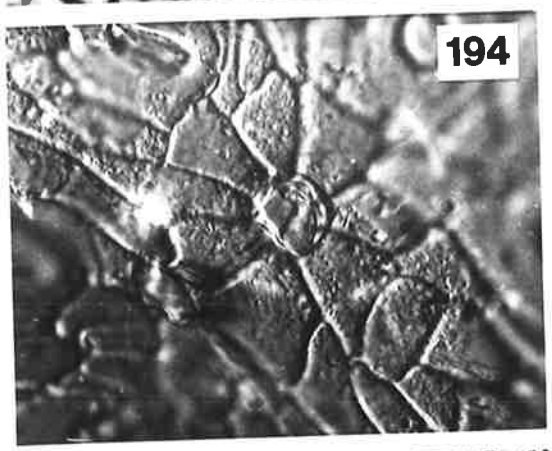
FIGURE 198. Specimen N 0009, Parataxon NER/004 : Unicellular trichomes over a vein, lower epidermis.

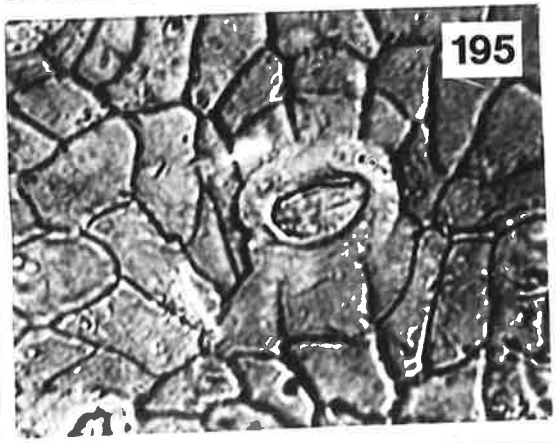
FIGURE 199. Specimen N 0099, Parataxon NER/004 : Non-cutinised apex of a serration.

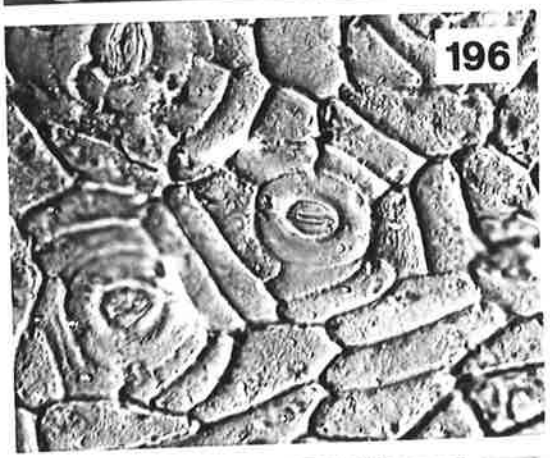
Scale = 20 um (figs. 192 - 198), 100 um (fig. 199).

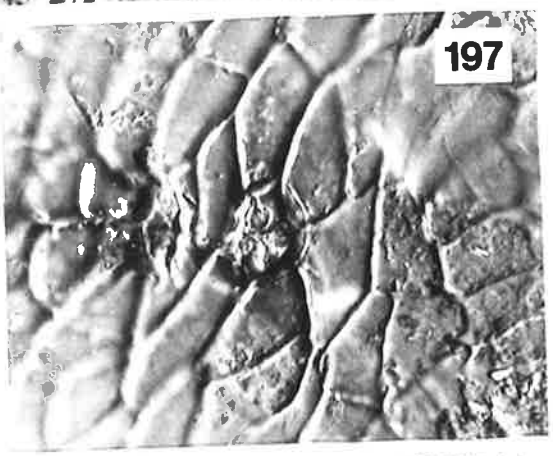

192

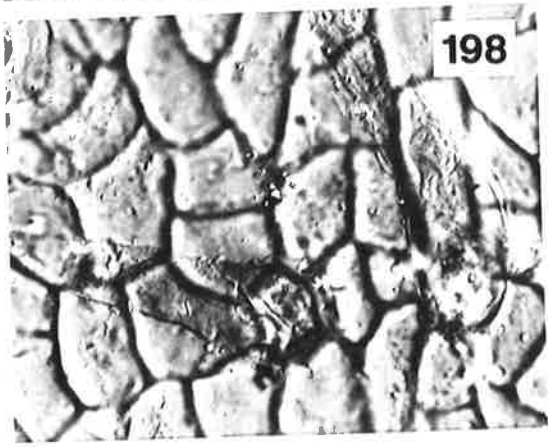

193


194


195


196


197


198

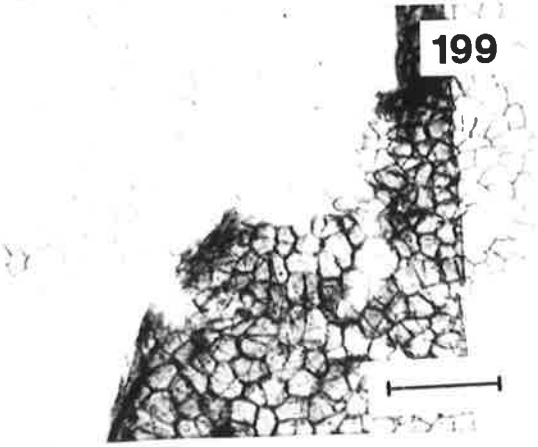

199

FIGURE 200. Specimen N 0146, Parataxon NER/006 :
Lower epidermis

FIGURE 201. Specimen N 0146, Parataxon NER/006 :
Upper epidermis

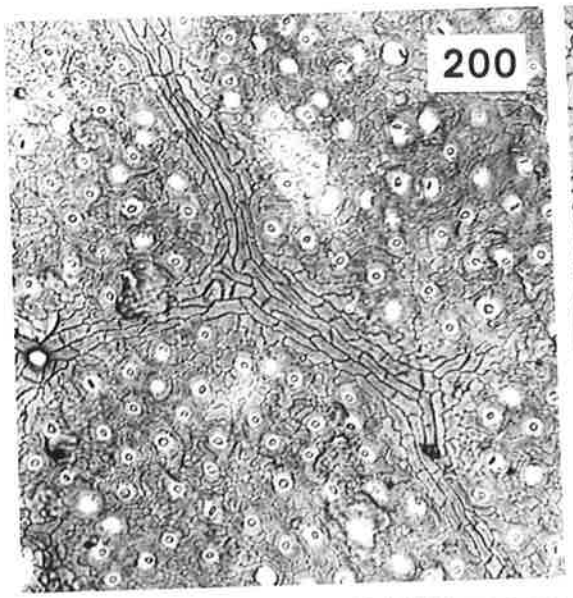
FIGURE 202. Specimen N 0036, Parataxon NER/007 :
Lower epidermis

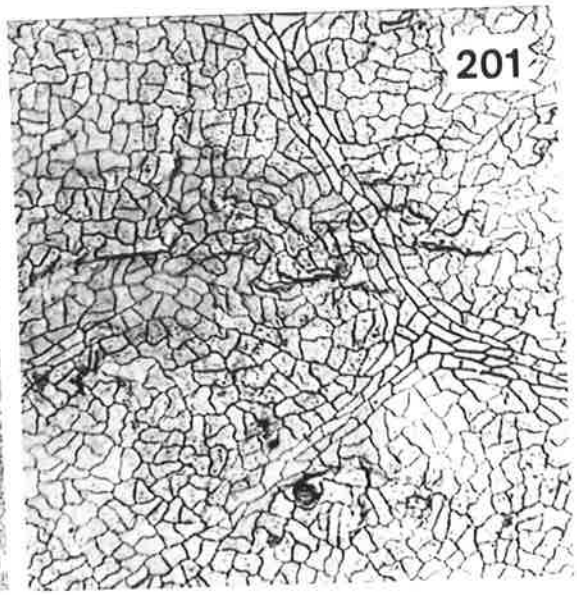
FIGURE 203. Specimen N 0036, Parataxon NER/007 :
Upper epidermis

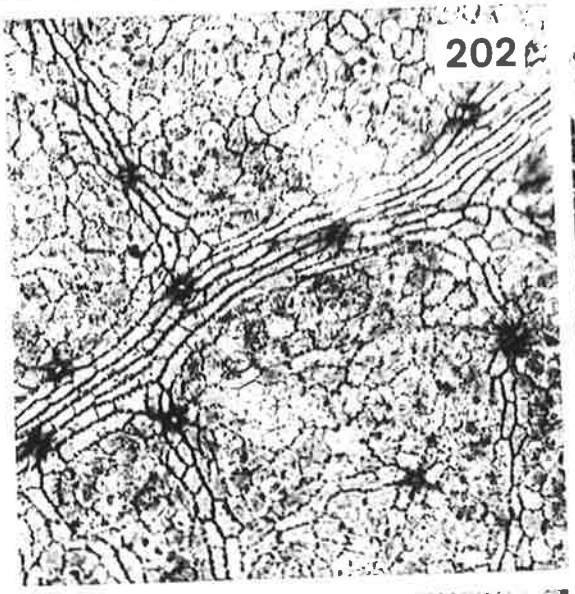
FIGURE 204. Specimen N 0232, Parataxon NER/007 :
Lower epidermis

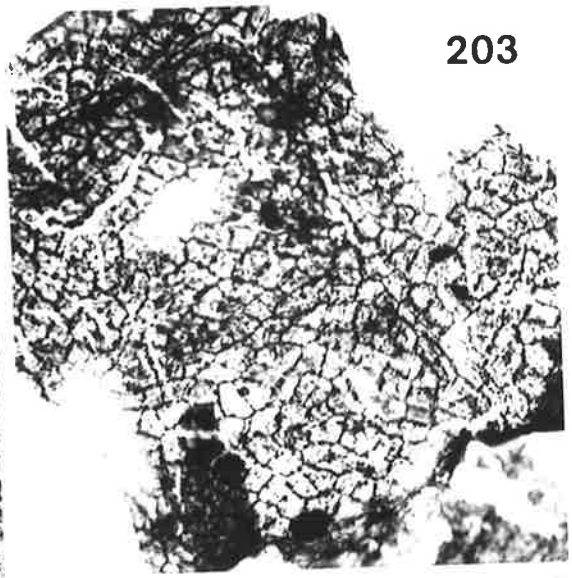
FIGURE 205. Specimen N 0232, Parataxon NER/007 :
Upper epidermis

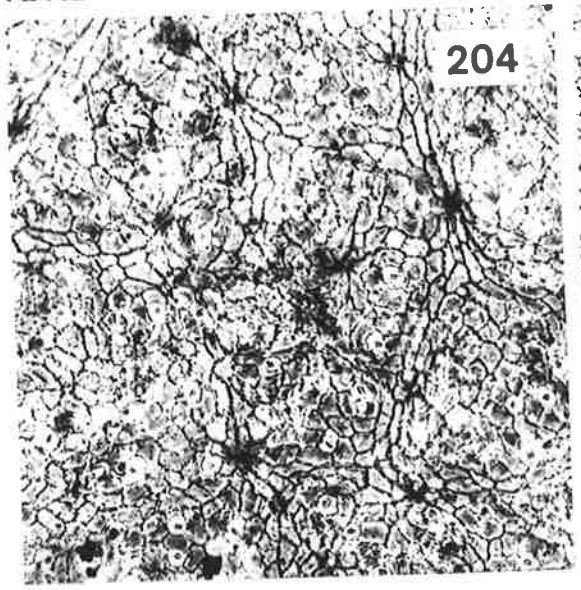
Scale = 100 um.


200


201


202


203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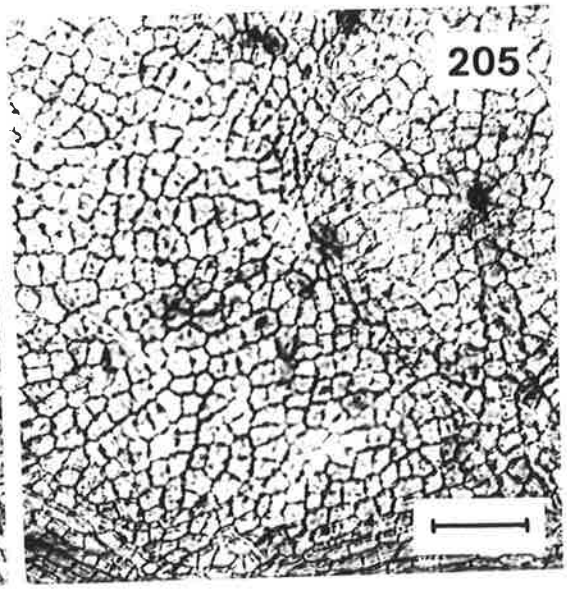
205

FIGURE 206. Specimen N 0067, Parataxon NER/005 :
Stomate over vein, lower epidermis.

FIGURE 207. Specimen N 0067, Parataxon NER/005 :
Stomates over areole, lower epidermis.

FIGURE 208. Specimen N 0067, Parataxon NER/005 :
Trichome base over vein, lower epidermis.

FIGURE 209. Specimen N 0146, Parataxon NER/006 :
Stomates over areole, lower epidermis.

FIGURE 210. Specimen N 0146, Parataxon NER/006 :
Trichome base over vein, lower epidermis.

FIGURE 211. Specimen N 0232, Parataxon NER/007 :
Trichome base over vein, lower epidermis.

FIGURE 212. Specimen N 0232, Parataxon NER/007 :
Stomate over areole, lower epidermis.

FIGURE 213. Specimen N 0036, Parataxon NER/007 :
Stomate over areole, lower epidermis.

Scale = 20 um.

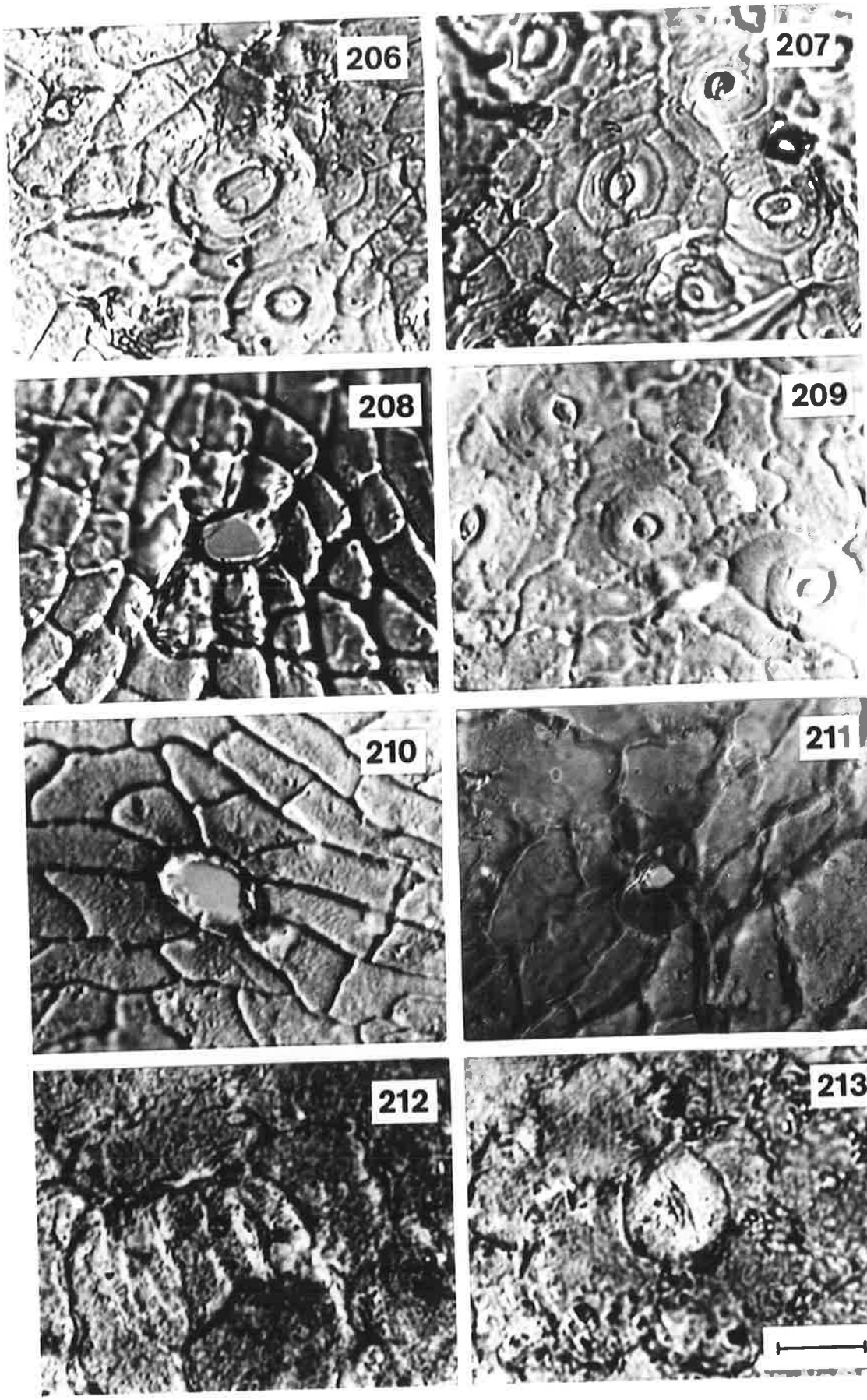
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FIGURE 214. Specimen N 0051, Parataxon NER/008 : Lower epidermis

FIGURE 215. Specimen N 0051, Parataxon NER/008 : Upper epidermis

FIGURE 216. Specimen N 0136, Parataxon NER/009 : Lower epidermis

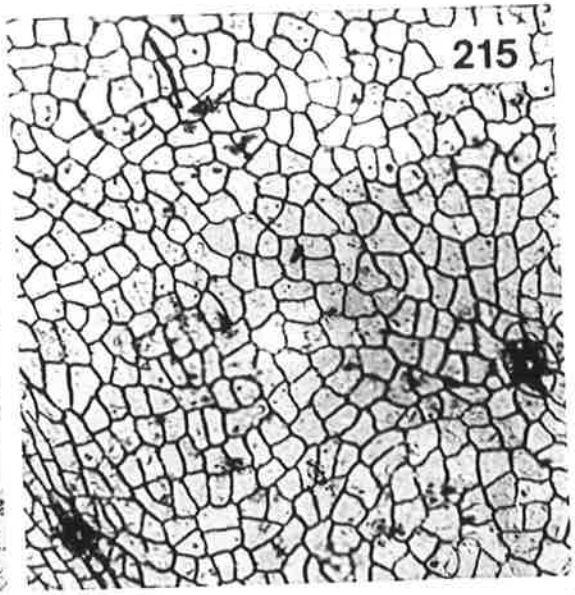
FIGURE 217. Specimen N 0136, Parataxon NER/009 : Upper epidermis

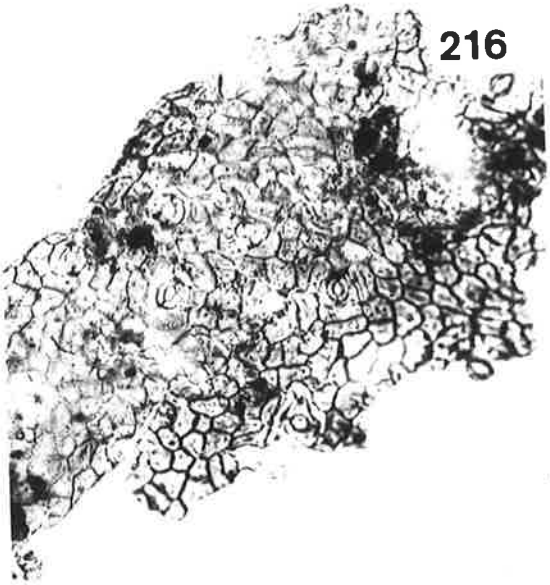
FIGURE 218. Specimen N 0137, Parataxon NER/010 : Lower epidermis

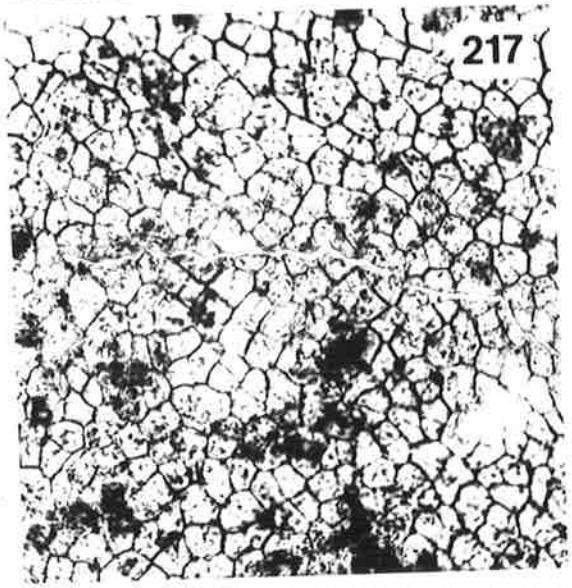
FIGURE 219. Specimen N 0137, Parataxon NER/010 : Upper epidermis

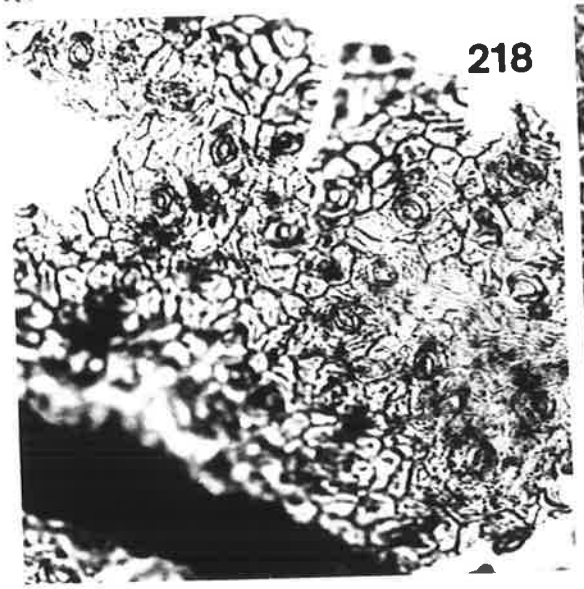
Scale = 100 um.


214


215


216


217


218

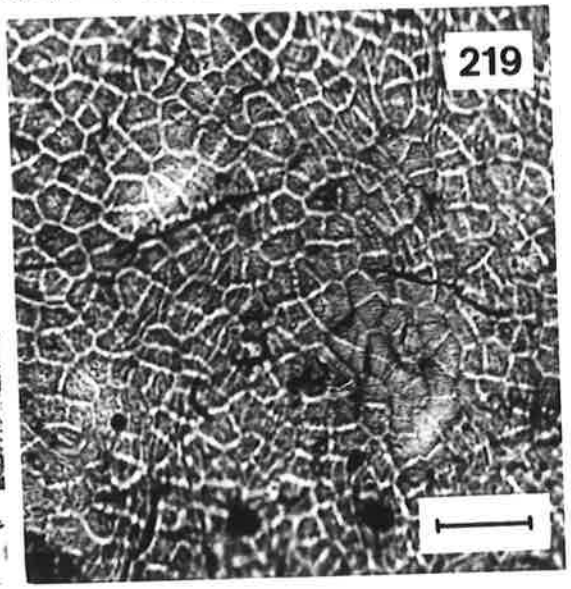

219

FIGURE 220. Specimen N 0005, Parataxon NER/011 :
Lower epidermis

FIGURE 221. Specimen N 0005, Parataxon NER/011 :
Upper epidermis

FIGURE 222. Specimen N 0005, Parataxon NER/011 :
Upper epidermis

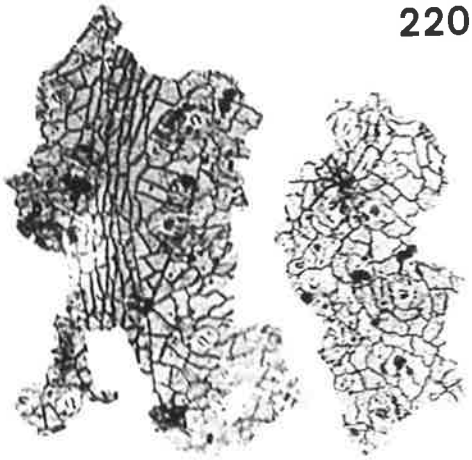
FIGURE 223. Specimen N 0076, Parataxon NER/011 :
Lower epidermis

FIGURE 224. Specimen N 0076, Parataxon NER/011 :
Upper epidermis

FIGURE 225. Specimen N 0076, Parataxon NER/011 :
Upper epidermis

Scale = 100 um.

220



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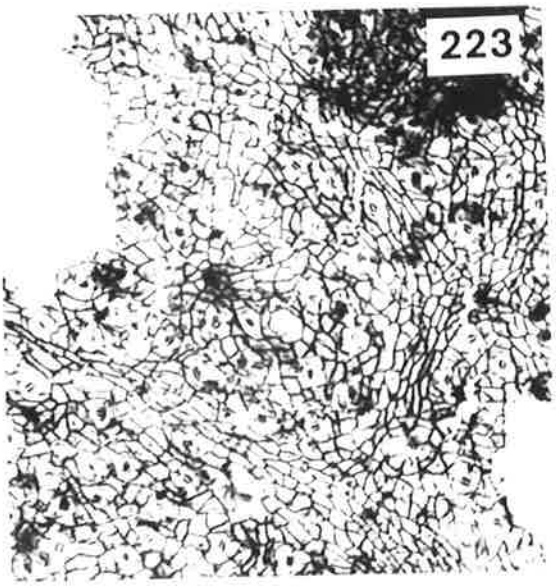
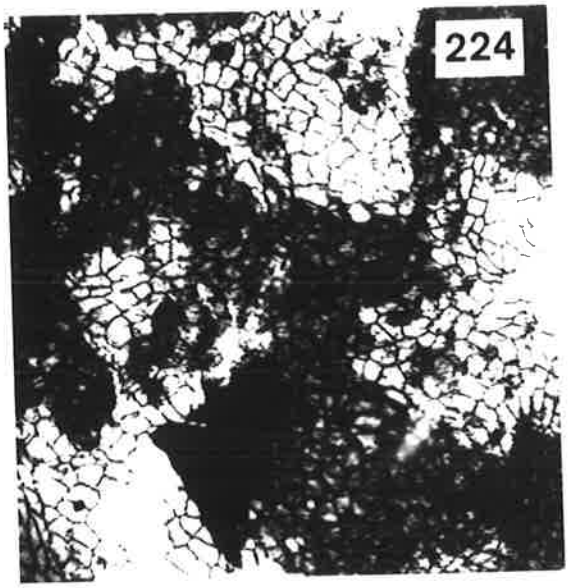


224



225

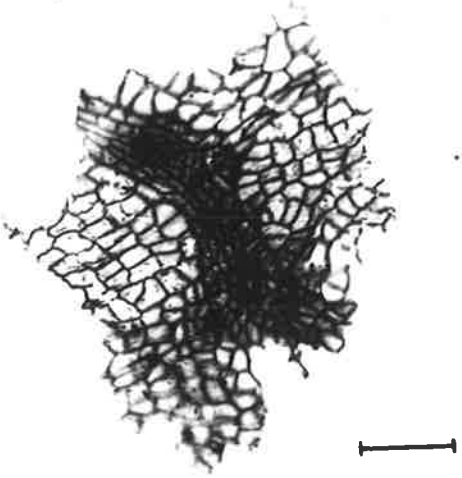


FIGURE 226. Specimen N 0051, Parataxon NER/008 : Stomate over areole, lower epidermis.

FIGURE 227. Specimen N 0051, Parataxon NER/008 : Trichome base over vein, lower epidermis.

FIGURE 228. Specimen N 0136, Parataxon NER/009 : Stomate over areole, lower epidermis.

FIGURE 229. Specimen N 0137, Parataxon NER/010 : Stomate over areole, lower epidermis.

FIGURE 230. Specimen N 0076, Parataxon NER/011 : Stomate over areole, lower epidermis.

FIGURE 231. Specimen N 0076, Parataxon NER/011 : Stomate over areole, lower epidermis. The same stomate as in fig. 230, focussed to show the cuticle extending into the stomatal cavity.

FIGURE 232. Specimen N 0076, Parataxon NER/011 : Trichome base over vein, lower epidermis.

FIGURE 233. Specimen N 0008, Parataxon NER/012 : Stomate over areole, lower epidermis.

Scale = 20 um.

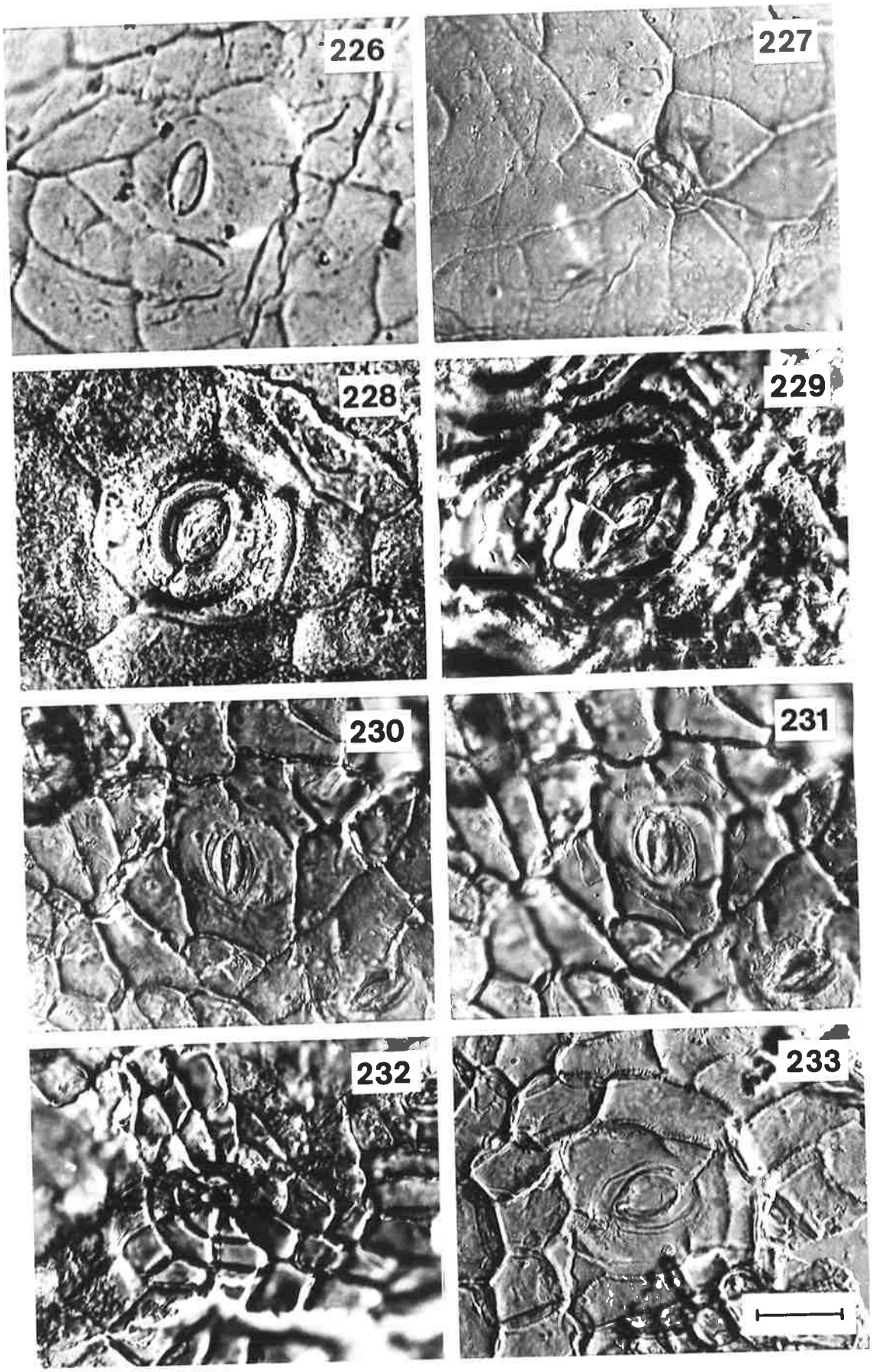

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FIGURE 234. Specimen N 0008, Parataxon NER/012 :
Lower epidermis

FIGURE 235. Specimen N 0008, Parataxon NER/012 :
Lower epidermis

FIGURE 236. Specimen N 0008, Parataxon NER/012 :
Lower epidermis

FIGURE 237. Specimen N 0008, Parataxon NER/012 :
Upper epidermis

FIGURE 238. Specimen N 0001, Parataxon NER/013 :
Lower epidermis

FIGURE 239. Specimen N 0001, Parataxon NER/013 :
Upper epidermis

Scale = 100 um.

234

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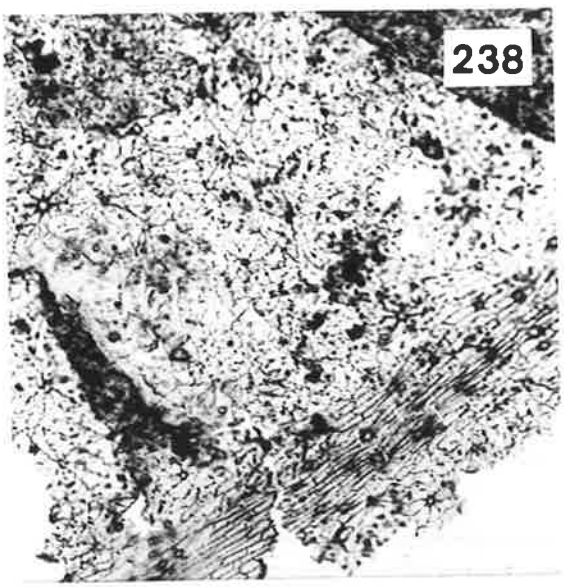


FIGURE 240. Specimen N 0019, Parataxon NER/014 :
Lower epidermis

FIGURE 241. Specimen N 0019, Parataxon NER/014 :
Upper epidermis

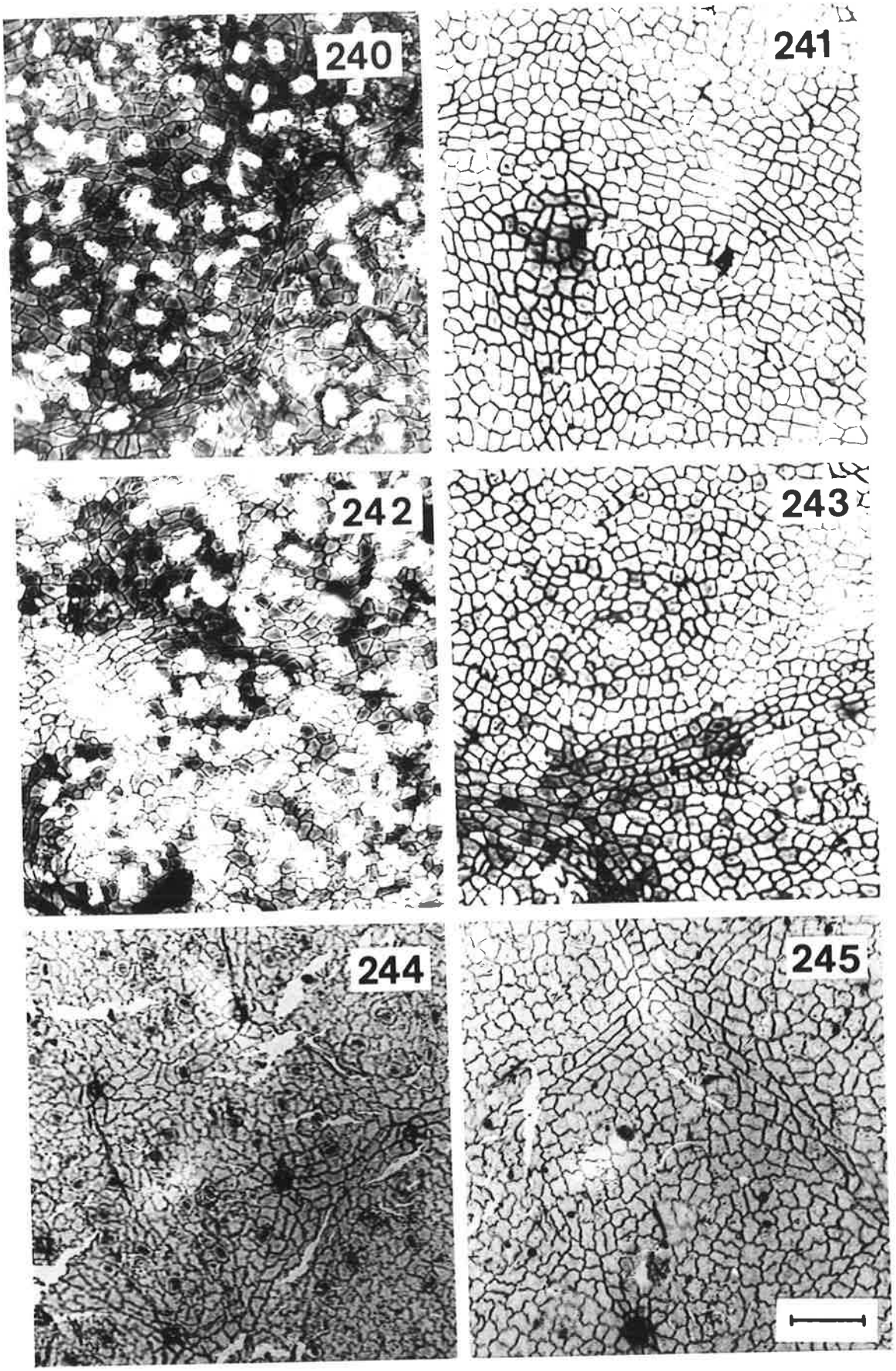
FIGURE 242. Specimen N 0025, Parataxon NER/014 :
Lower epidermis

FIGURE 243. Specimen N 0025, Parataxon NER/014 :
Upper epidermis

FIGURE 244. Specimen N 0062, Parataxon NER/015 :
Lower epidermis

FIGURE 245. Specimen N 0062, Parataxon NER/015 :
Upper epidermis

Scale = 100 um.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245

FIGURE 246. Specimen N 0008, Parataxon NER/012 : Trichome base over major vein, lower epidermis.

FIGURE 247. Specimen N 0001, Parataxon NER/013 : Trichome base over vein, lower epidermis.

FIGURE 248. Specimen N 0001, Parataxon NER/013 : Stomate (s) over areole, lower epidermis. The pore between the two guard cells and the two paracytic subsidiary cells can be seen clearly, but the remainder of the guard cells are difficult to observe.

FIGURE 249. Specimen N 0025, Parataxon NER/014 : Stomate over areole, lower epidermis.

FIGURE 250. Specimen N 0025, Parataxon NER/014 : Trichome base over vein, lower epidermis.

FIGURE 251. Specimen N 0019, Parataxon NER/014 : Gland over vein on lower epidermis. Note that the thinly cutinised cells covering the gland have not been preserved.

FIGURE 252. Specimen N 0062, Parataxon NER/015 : Stomate over areole, lower epidermis.

FIGURE 253. Specimen N 0062, Parataxon NER/015 : Trichome base over vein, lower epidermis.

Scale = 20 um.

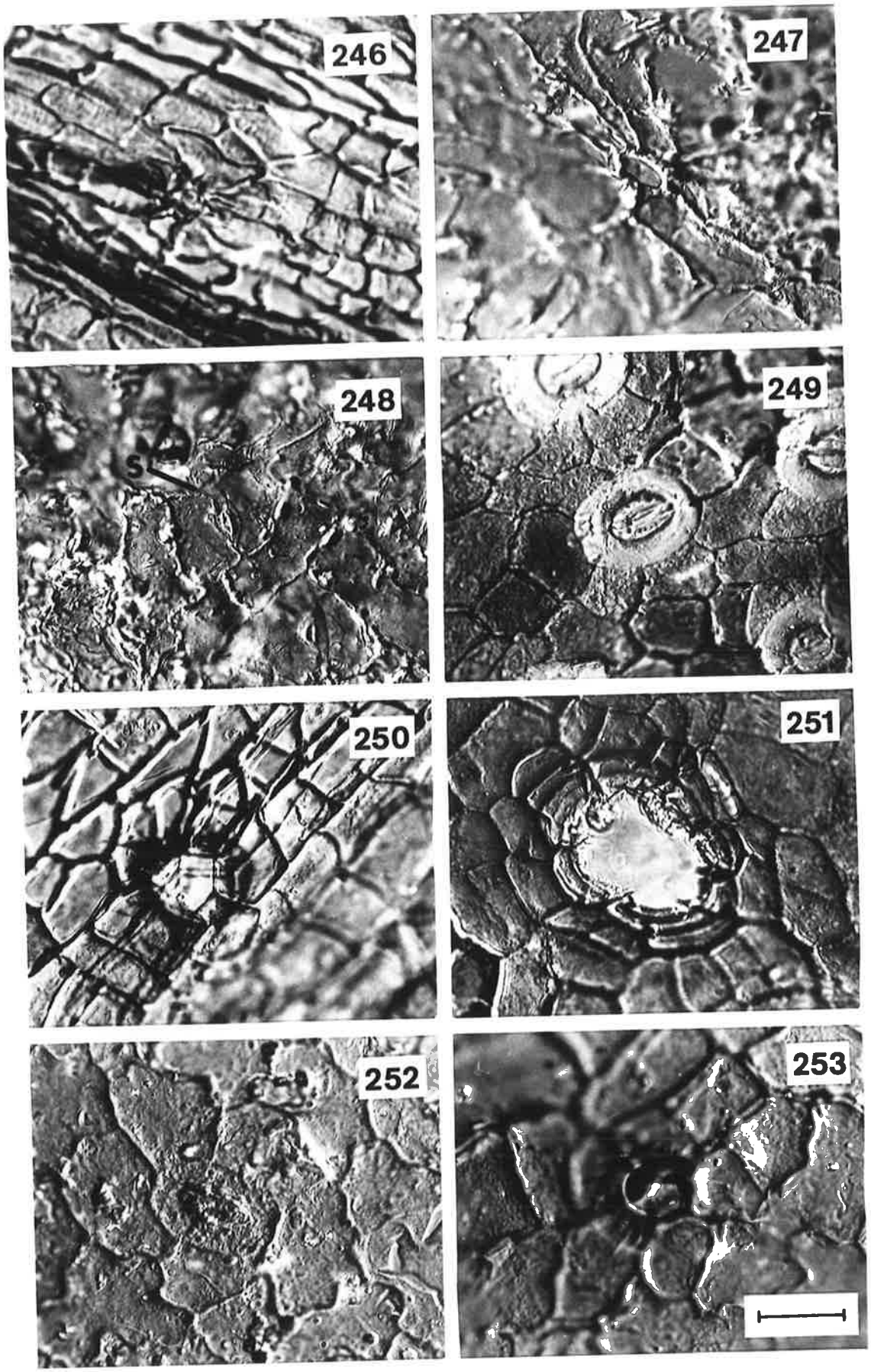
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FIGURE 254. Specimen N 0132, Parataxon NER/016 : Lower epidermis

FIGURE 255. Specimen N 0132, Parataxon NER/016 : Upper epidermis

FIGURE 256. Specimen N 0097, Parataxon NER/017 : Lower epidermis

FIGURE 257. Specimen N 0097, Parataxon NER/017 : Upper epidermis

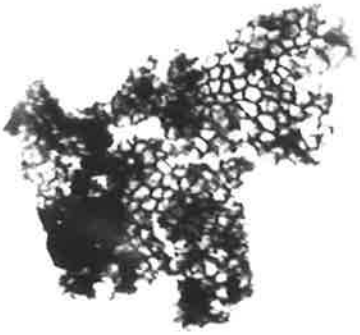
FIGURE 258. Specimen N 0023, Parataxon NER/018 : Lower epidermis

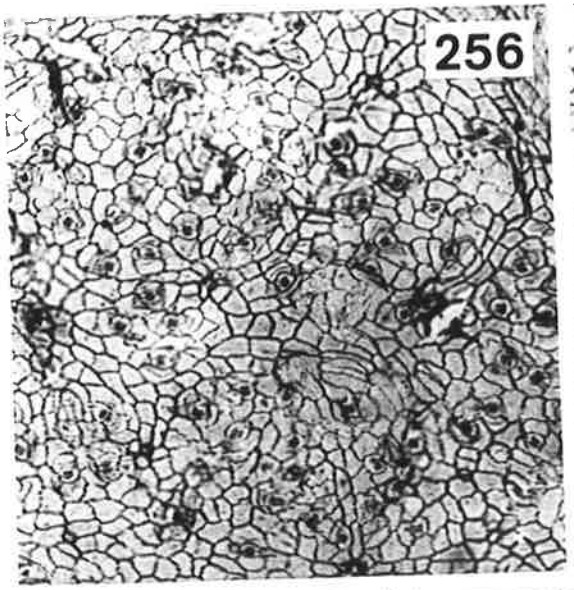
FIGURE 259. Specimen N 0023, Parataxon NER/018 : Upper epidermis

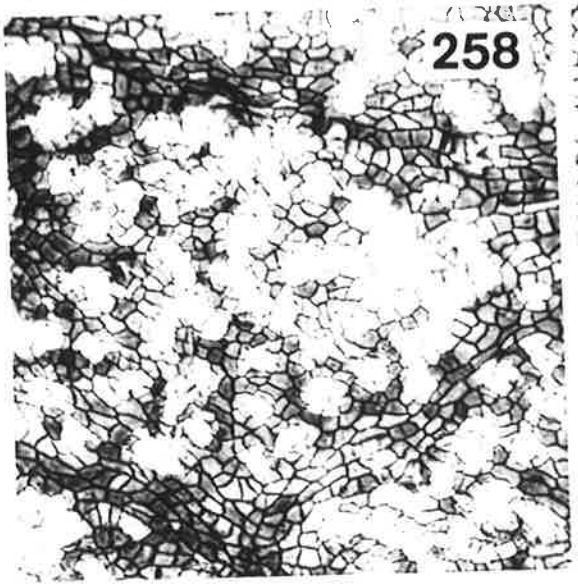
Scale = 100 um.

254

255







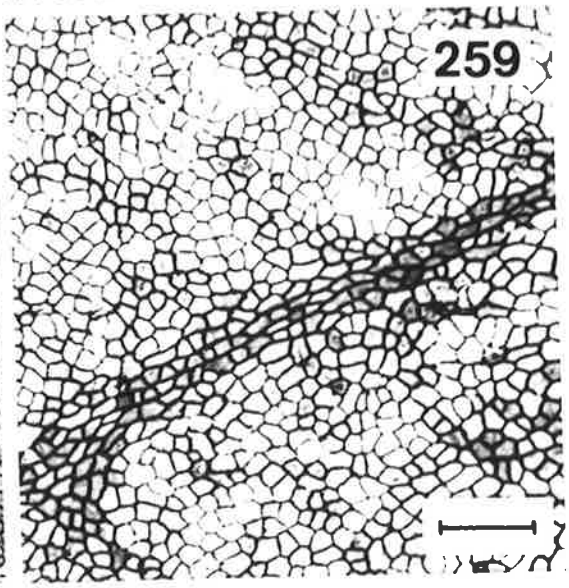


FIGURE 260. Specimen N 0132, Parataxon NER/016 :
Stomate (s) over areole, lower epidermis.
The cuticle is extremely fragmentary and the guard cells are difficult to observe.

FIGURE 261. Specimen N 0132, Parataxon NER/016 :
Lower epidermis showing striated surface.

FIGURE 262. Specimen N 0097, Parataxon NER/017 :
Stomates over areole, lower epidermis.

FIGURE 263. Specimen N 0097, Parataxon NER/017 :
Stomates over areole, lower epidermis. The same stomates as in fig. 262, focussed to show the cuticle extending into the stomatal cavity.

FIGURE 264. Specimen N 0097, Parataxon NER/017 :
Trichome base over vein, lower epidermis.

FIGURE 265. Specimen N 0023, Parataxon NER/018 :
Stomate over areole, lower epidermis.

FIGURE 266. Specimen N 0023, Parataxon NER/018 :
Trichome base over vein, lower epidermis.

FIGURE 267. Specimen N 0023, Parataxon NER/018 :
Gland over vein on lower epidermis. Note that the thinly cutinised cells covering the gland have not been completely preserved.

Scale = 20 um.

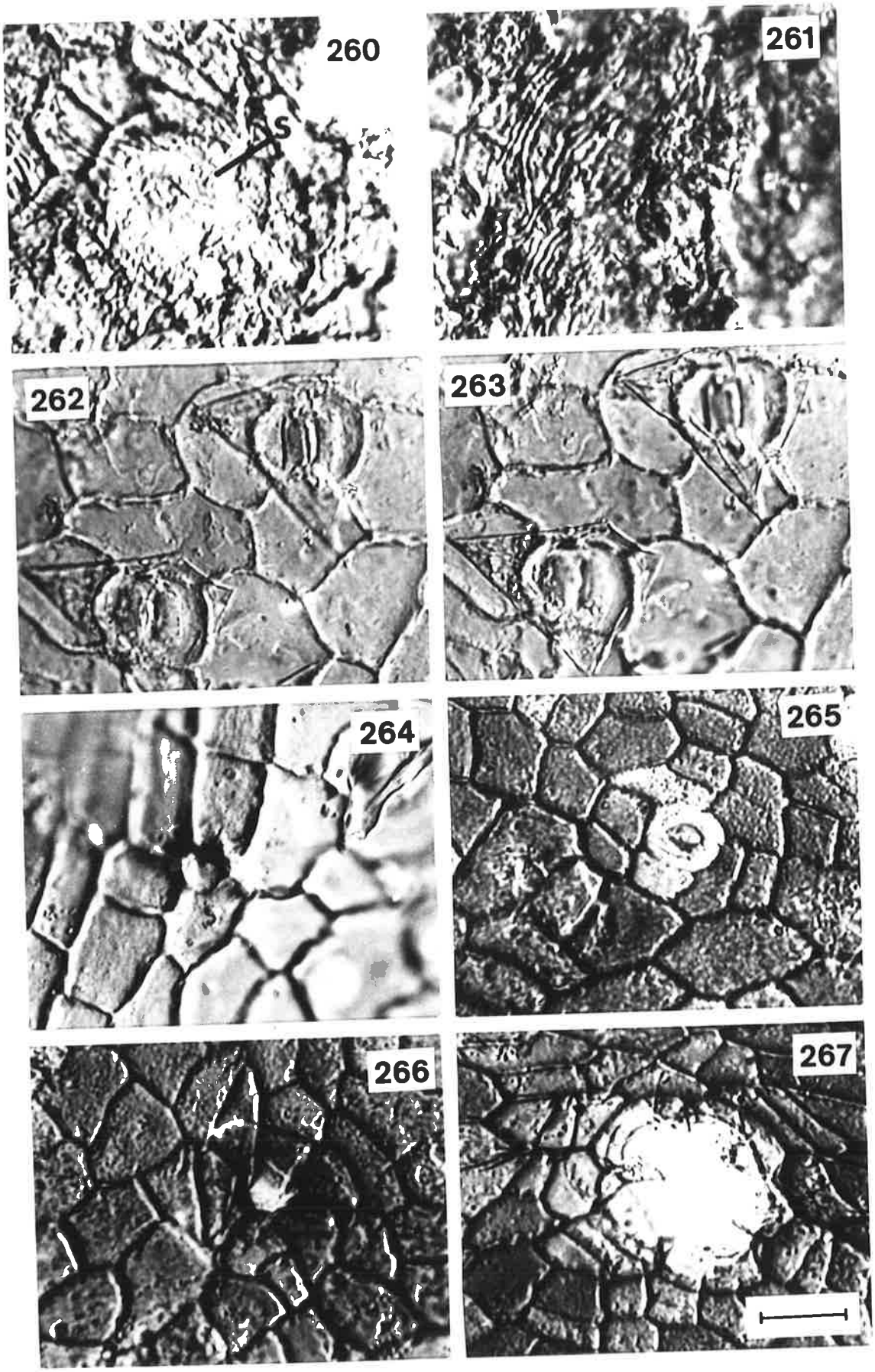

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FIGURE 268. Specimen N 0073, Parataxon NER/019 :
Lower epidermis

FIGURE 269. Specimen N 0073, Parataxon NER/019 :
Upper epidermis

FIGURE 270. Specimen N 0022, Parataxon NER/020 :
Lower epidermis

FIGURE 271. Specimen N 0022, Parataxon NER/020 :
Upper epidermis

FIGURE 272. Specimen N 0024, Parataxon NER/021 :
Lower epidermis

FIGURE 273. Specimen N 0024, Parataxon NER/021 :
Upper epidermis

Scale = 100 um.

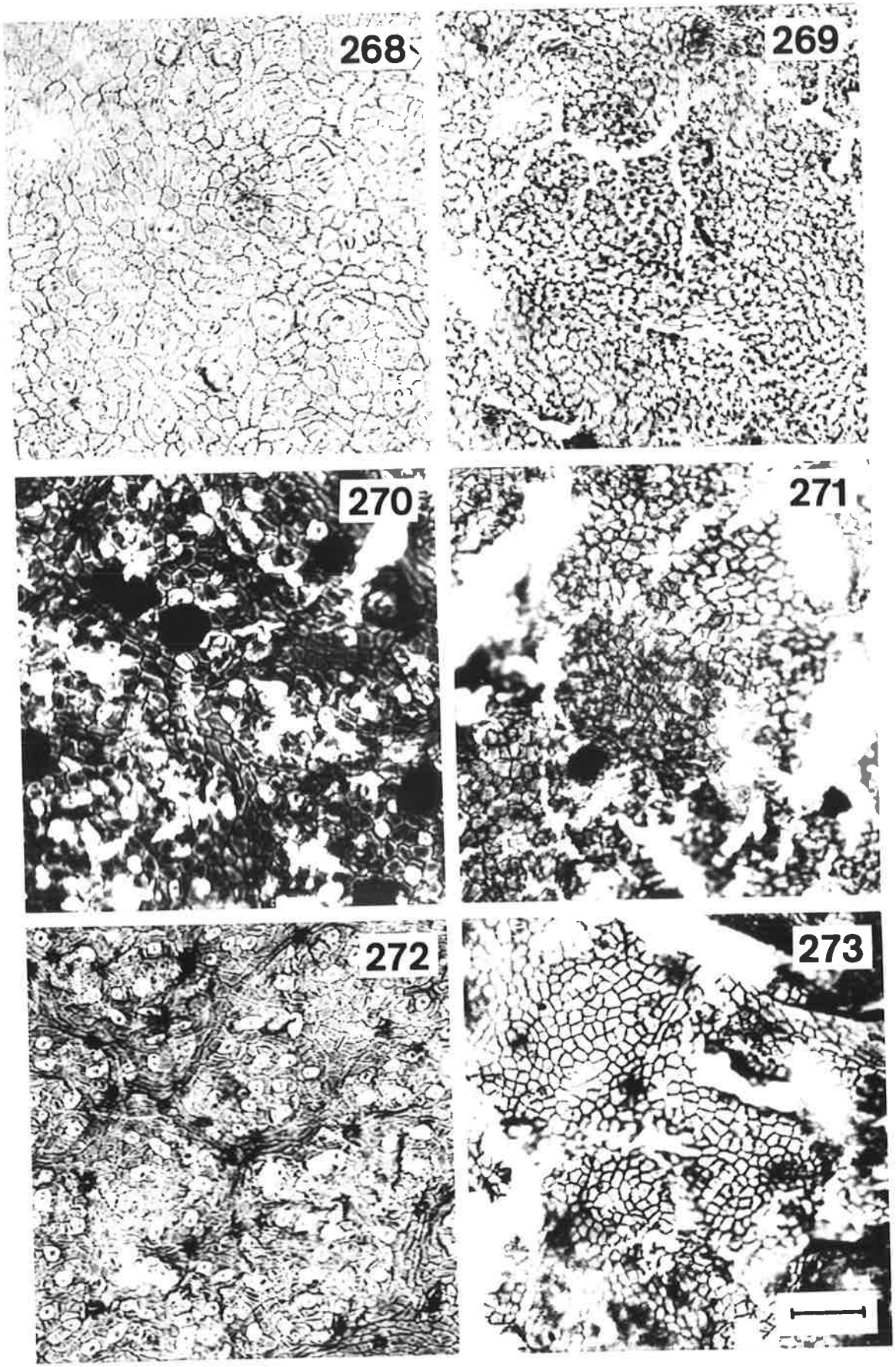
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FIGURE 274. Specimen N 0077, Parataxon NER/022 : Lower epidermis

FIGURE 275. Specimen N 0077, Parataxon NER/022 : Upper epidermis

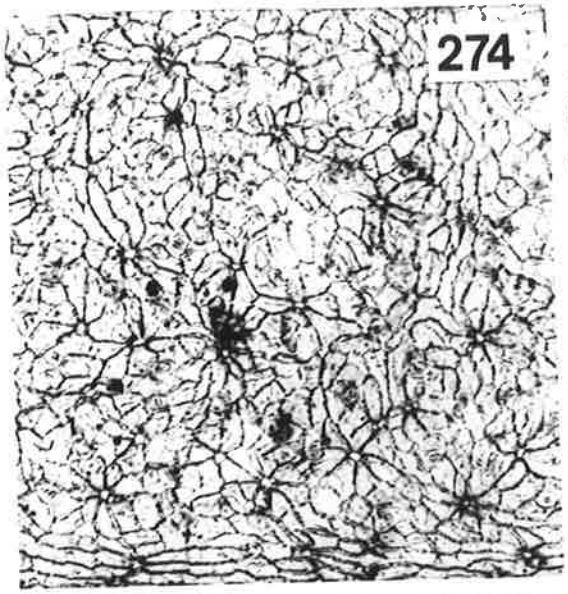
FIGURE 276. Specimen N 0021, Parataxon NER/023 : Lower epidermis

FIGURE 277. Specimen N 0021, Parataxon NER/023 : Upper epidermis

FIGURE 278. Specimen N 0078, Parataxon NER/023 : Lower epidermis

FIGURE 279. Specimen N 0078, Parataxon NER/023 : Upper epidermis

Scale = 100 um.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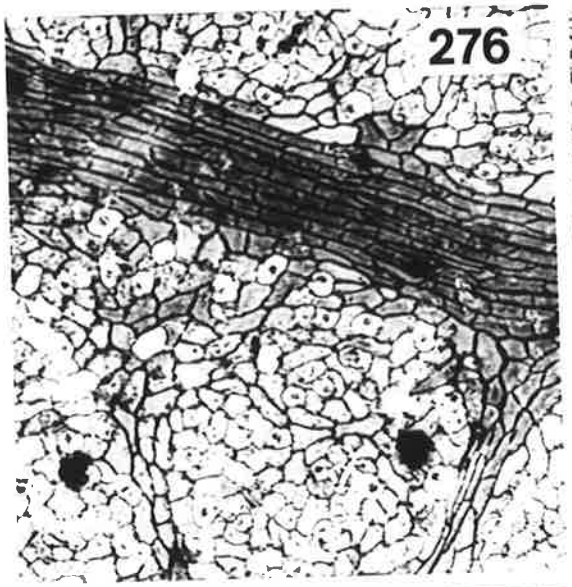
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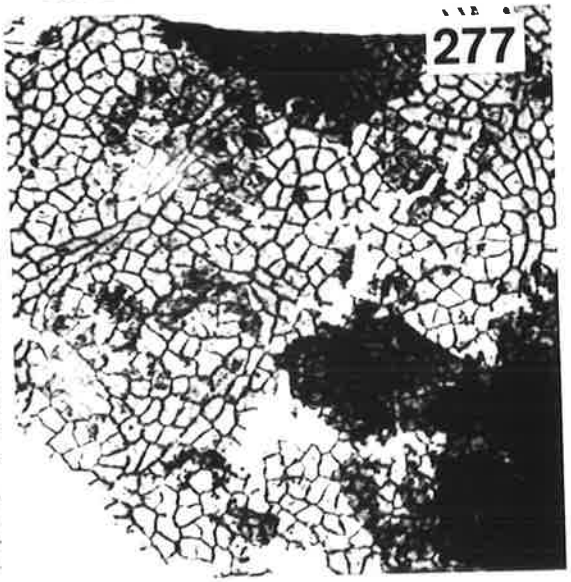
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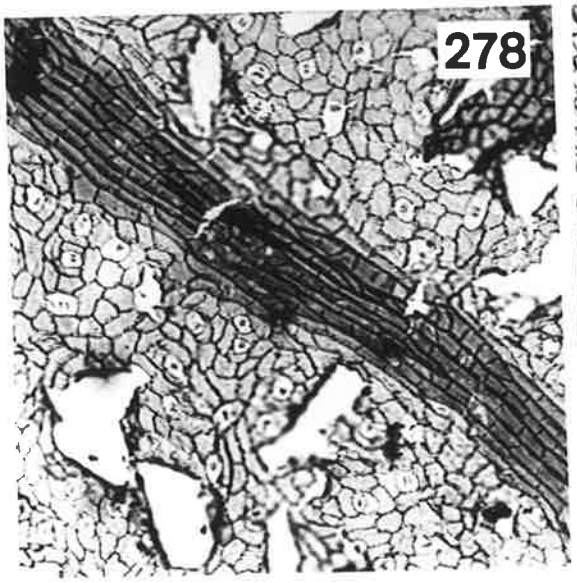
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FIGURE 280. Specimen N 0073, Parataxon NER/019 :
Stomate over areole, lower epidermis.

FIGURE 281. Specimen N 0073, Parataxon NER/019 :
Trichome base over vein, lower epidermis.

FIGURE 282. Specimen N 0022, Parataxon NER/020 :
Stomate over areole, lower epidermis.

FIGURE 283. Specimen N 0022, Parataxon NER/020 :
Trichome base over vein, lower epidermis.

FIGURE 284. Specimen N 0024, Parataxon NER/021 :
Stomates over areole, lower epidermis.

FIGURE 285. Specimen N 0024, Parataxon NER/021 :
Trichome base over vein, lower epidermis.

FIGURE 286. Specimen N 0077, Parataxon NER/022 :
Stomate over areole, lower epidermis.

FIGURE 287. Specimen N 0077, Parataxon NER/022 :
Trichome base over vein, lower epidermis.

Scale = 20 um.

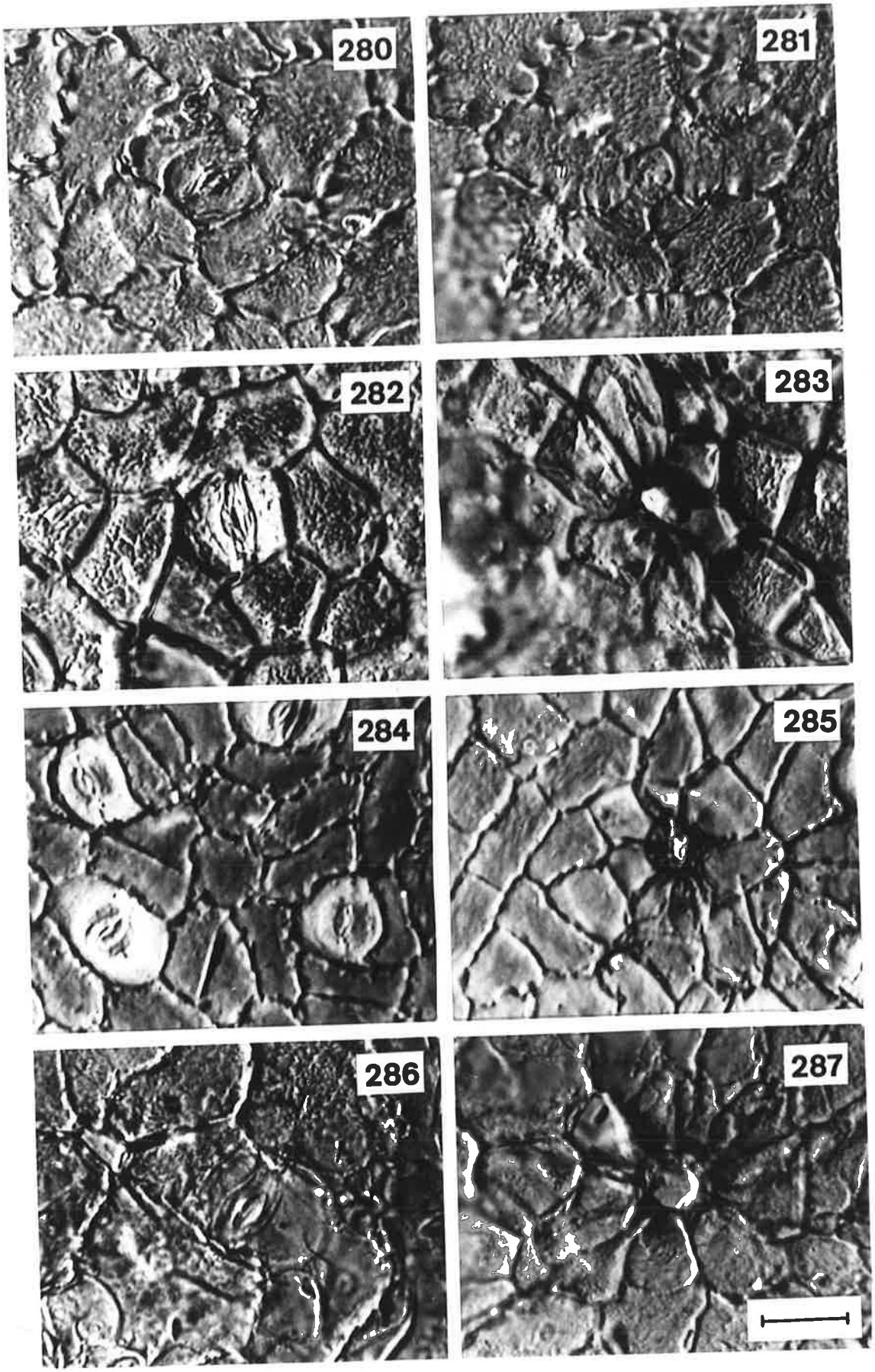
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FIGURE 288. Specimen N 0077, Parataxon NER/022 : Cuticle over upper epidermis, showing outline of epidermal cells.

FIGURE 289. Specimen N 0077, Parataxon NER/022 : Cuticle over upper epidermis, same field of view as in fig. 288, but focussed to show the cuticle outlining the mesophyll cells.

FIGURE 290. Specimen N 0021, Parataxon NER/023 : Stomate over areole, lower epidermis.

FIGURE 291. Specimen N 0021, Parataxon NER/023 : Trichome base over vein, lower epidermis.

FIGURE 292. Specimen N 0047, Parataxon NER/024 : Stomate over areole, lower epidermis.

FIGURE 293. Specimen N 0057, Parataxon NER/024 : Stomate over areole, lower epidermis.

FIGURE 294. Specimen N 0050, Parataxon NER/024 : Trichome base over vein, lower epidermis.

FIGURE 295. Specimen N 0057, Parataxon NER/024 : Trichome base over vein, lower epidermis.

Scale = 20 um.

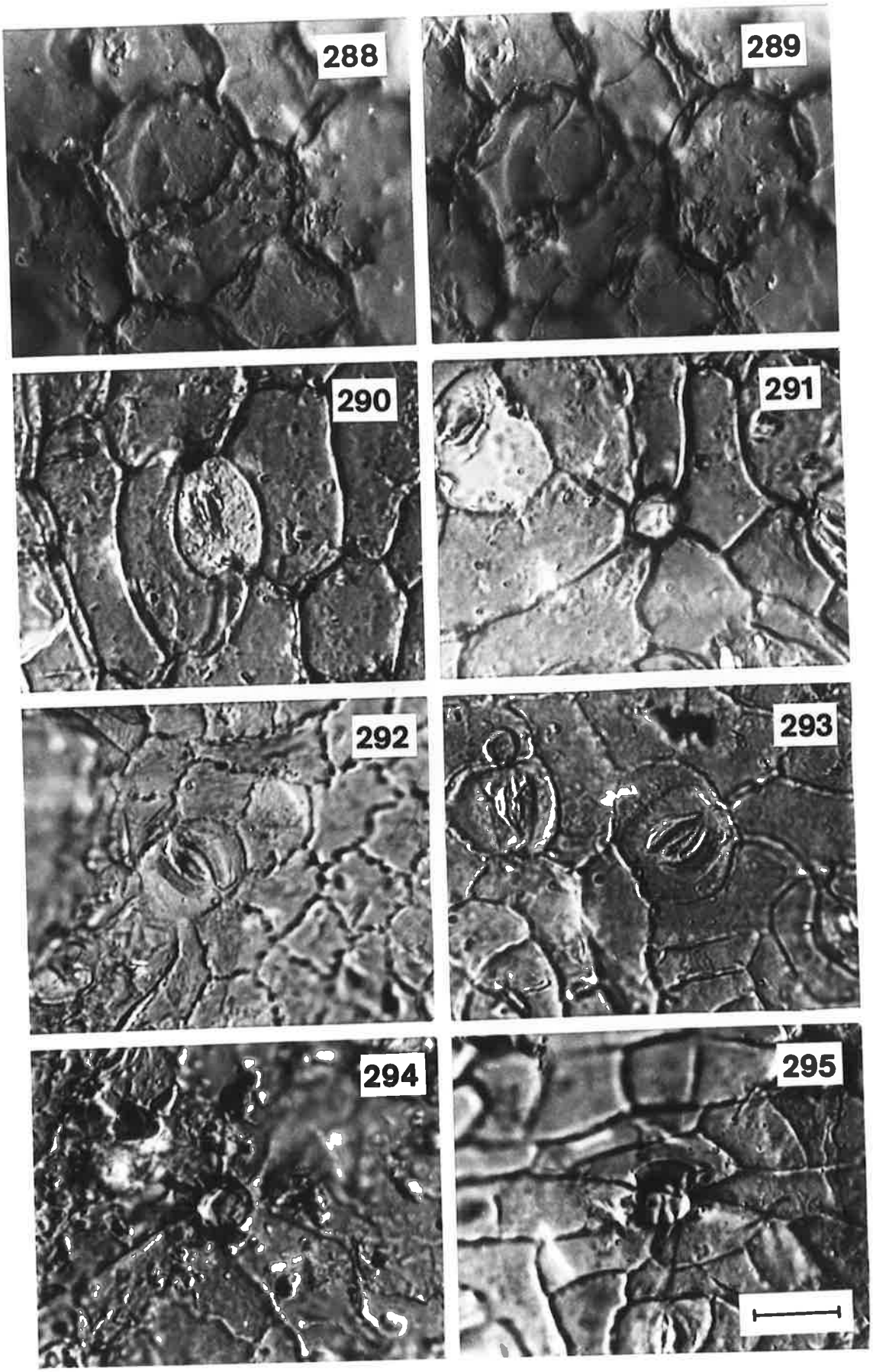
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FIGURE 296. Specimen N 0047, Parataxon NER/024 : Lower epidermis

FIGURE 297. Specimen N 0047, Parataxon NER/024 : Upper epidermis

FIGURE 298. Specimen N 0050, Parataxon NER/024 : Lower epidermis

FIGURE 299. Specimen N 0050, Parataxon NER/024 : Upper epidermis

FIGURE 300. Specimen N 0057, Parataxon NER/024 : Lower epidermis

FIGURE 301. Specimen N 0057, Parataxon NER/024 : Upper epidermis

Scale = 100 um.

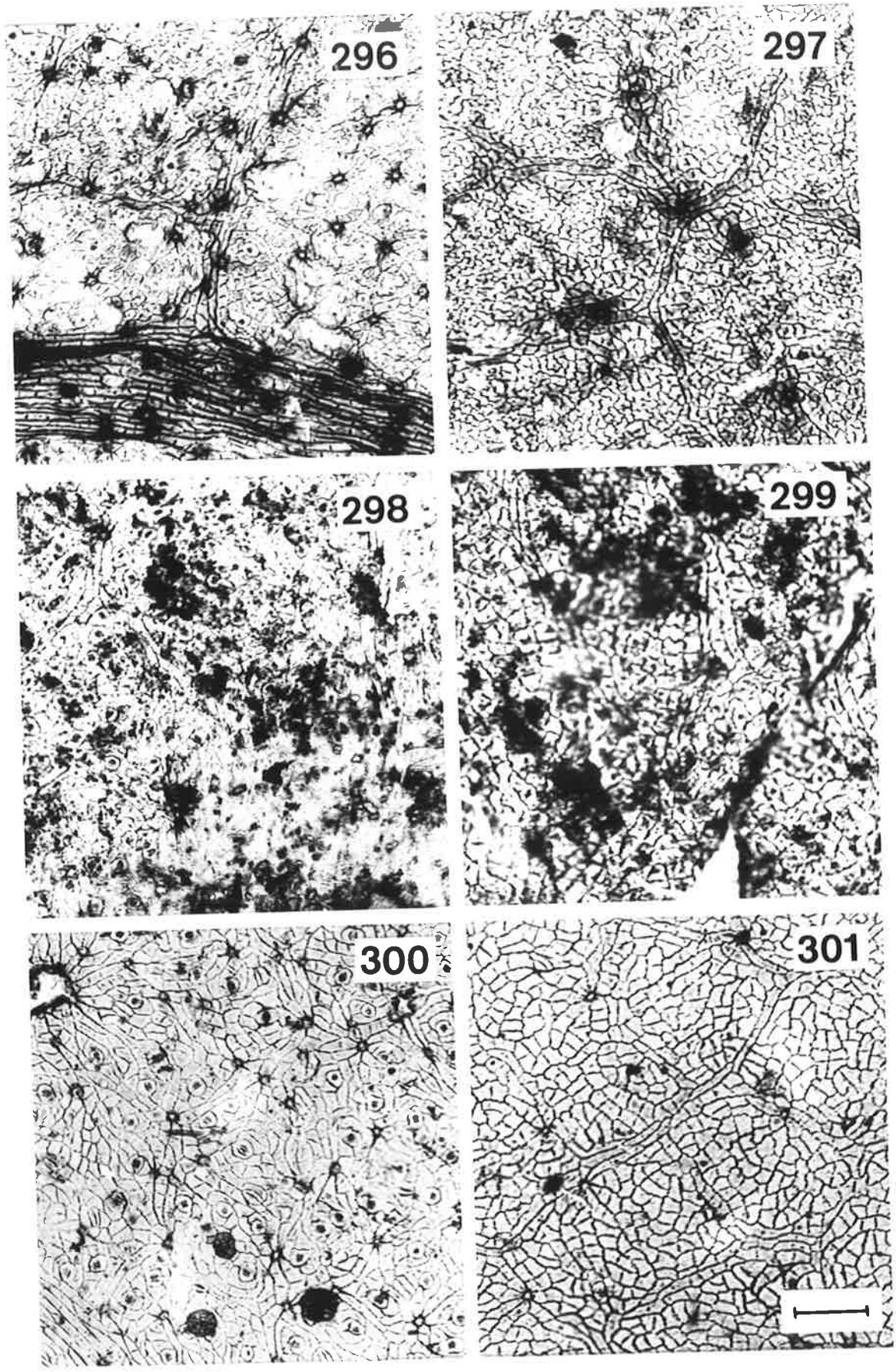
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FIGURE 302. Specimen N 0059, Parataxon NER/024 : Lower epidermis

FIGURE 303. Specimen N 0059, Parataxon NER/024 : Upper epidermis

FIGURE 304. Specimen N 0089, Parataxon NER/024 : Lower epidermis

FIGURE 305. Specimen N 0089, Parataxon NER/024 : Upper epidermis

FIGURE 306. Specimen N 0122, Parataxon NER/024 : Lower epidermis

FIGURE 307. Specimen N 0122, Parataxon NER/024 : Upper epidermis

Scale = 100 um.

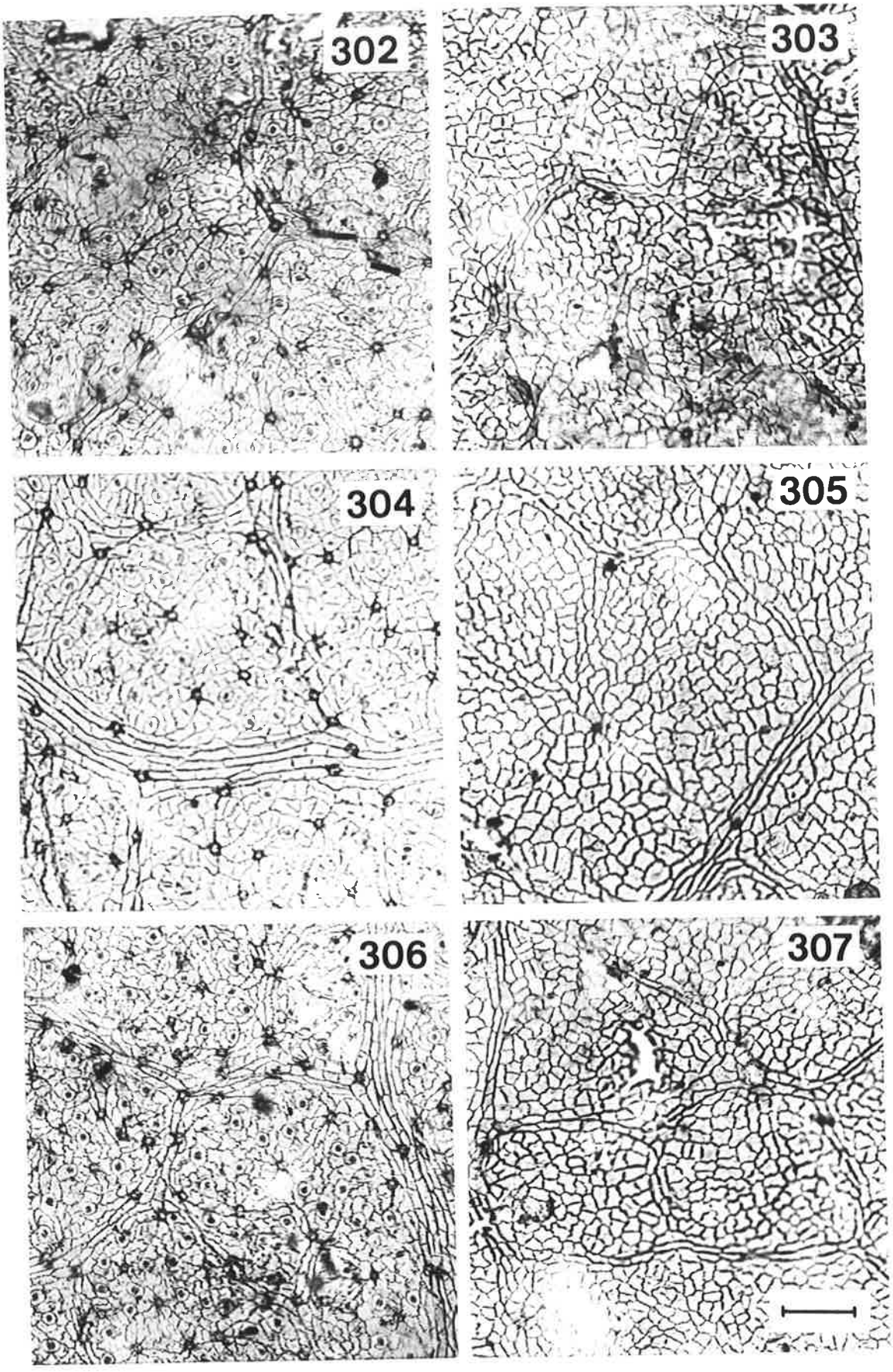
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FIGURE 308. Specimen N 0238, Parataxon NER/024 : Lower epidermis

FIGURE 309. Specimen N 0238, Parataxon NER/024 : Upper epidermis

FIGURE 310. Specimen N 0060, Parataxon NER/025 : Lower epidermis

FIGURE 311. Specimen N 0060, Parataxon NER/025 : Upper epidermis

FIGURE 312. Specimen N 0069, Parataxon NER/025 : Lower epidermis

FIGURE 313. Specimen N 0069, Parataxon NER/025 : Upper epidermis

Scale = 100 um.

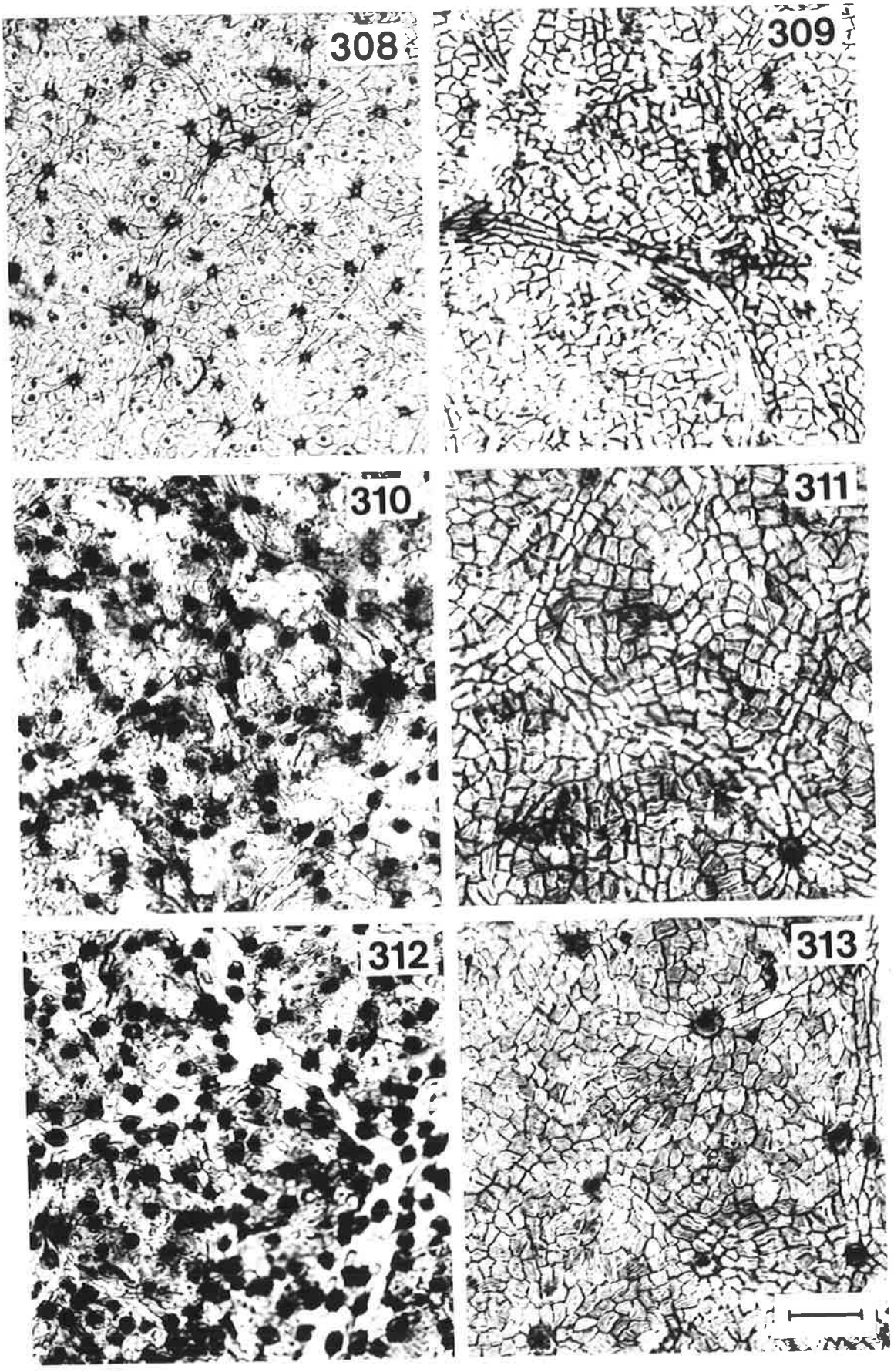
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FIGURE 314. Specimen N 0082, Parataxon NER/025 :
Lower epidermis

FIGURE 315. Specimen N 0082, Parataxon NER/025 :
Upper epidermis

FIGURE 316. Specimen N 0084, Parataxon NER/025 :
Lower epidermis

FIGURE 317. Specimen N 0084, Parataxon NER/025 :
Upper epidermis

FIGURE 318. Specimen N 0096, Parataxon NER/025 :
Lower epidermis

FIGURE 319. Specimen N 0096, Parataxon NER/025 :
Upper epidermis

Scale = 100 um.

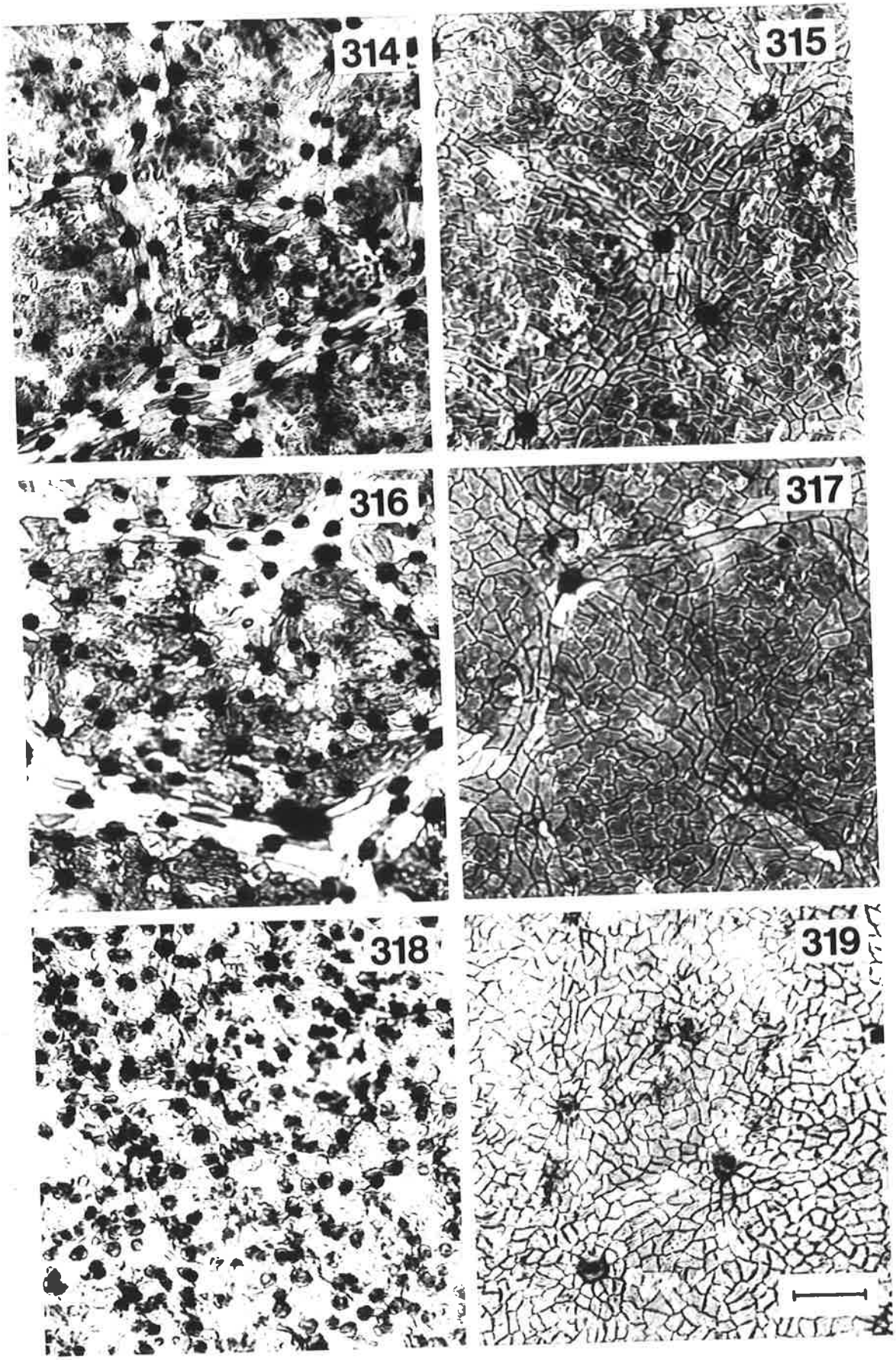
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FIGURE 320. Specimen N 0102, Parataxon NER/025 :
Lower epidermis

FIGURE 321. Specimen N 0102, Parataxon NER/025 :
Upper epidermis

FIGURE 322. Specimen N 0112, Parataxon NER/025 :
Lower epidermis

FIGURE 323. Specimen N 0112, Parataxon NER/025 :
Upper epidermis

FIGURE 324. Specimen N 0010, Parataxon NER/026 :
Lower epidermis

FIGURE 325. Specimen N 0010, Parataxon NER/026 :
Upper epidermis

Scale = 100 um.

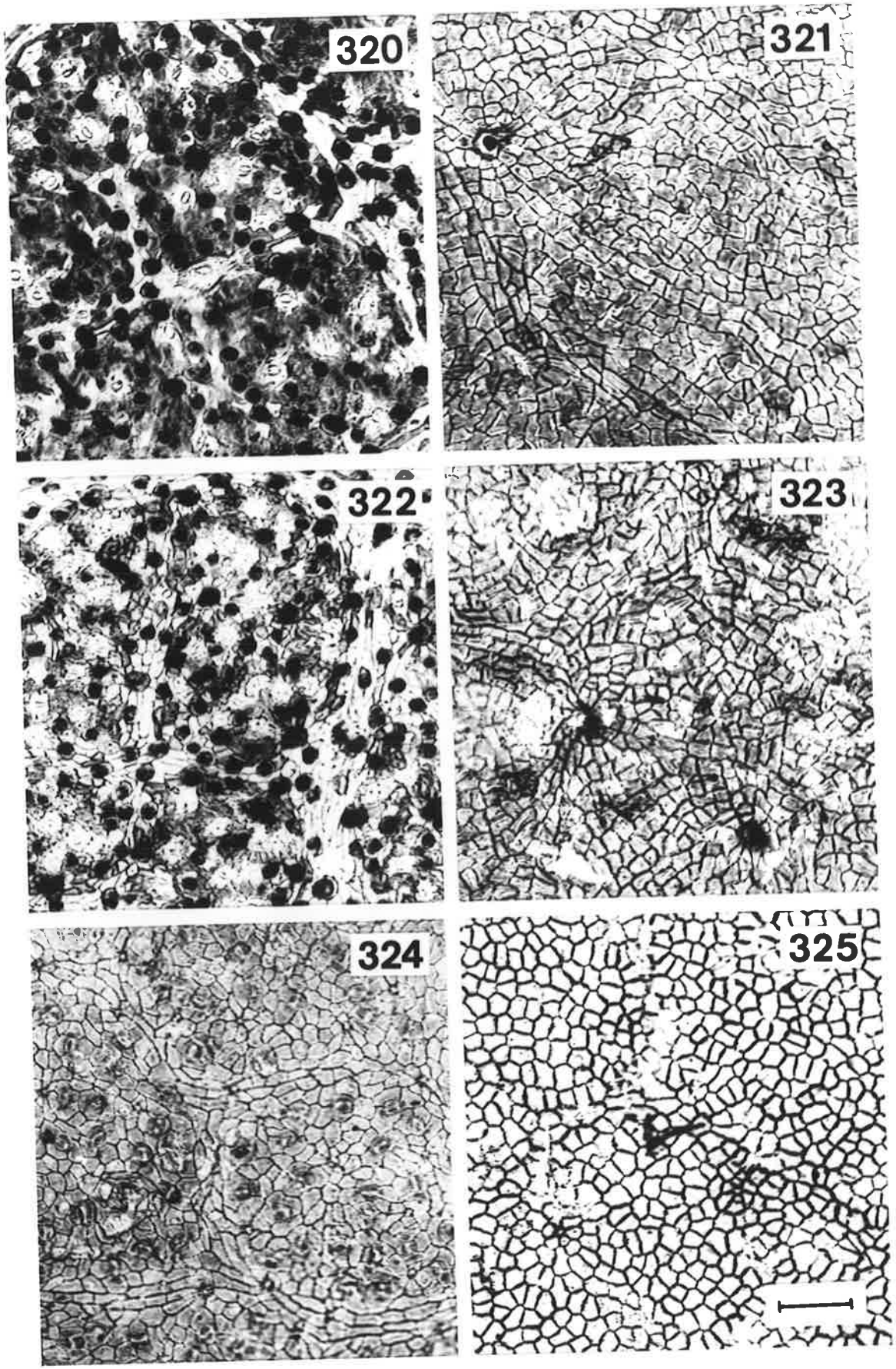
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FIGURE 326. Specimen N 0102, Parataxon NER/025 : SEM of lower epidermis, outer surface of cuticle showing small, heavily cutinised trichomes over and between veins (Scale = 25 um).

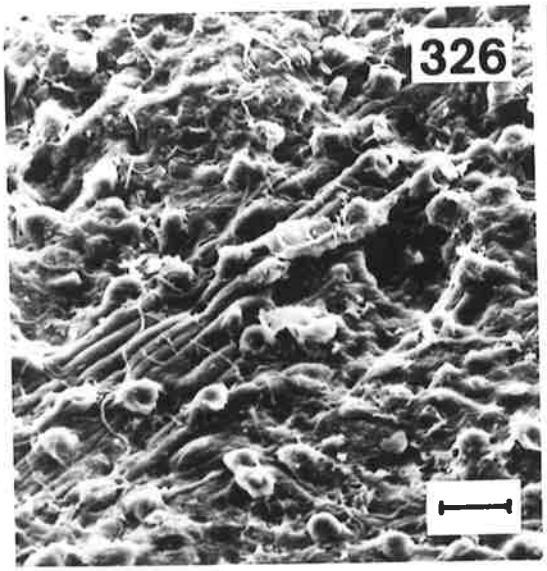
FIGURE 327. Specimen N 0102, Parataxon NER/025 : SEM of lower epidermis, outer surface of cuticle, showing one trichome. Note filamentous epiphyllous fungus. (Scale = 10 um).

FIGURE 328. Specimen N 0102, Parataxon NER/025 : SEM of lower epidermis, inner surface of cuticle, showing trichome bases over and between veins (Scale = 40 um).

FIGURE 329. Specimen N 0102, Parataxon NER/025 : SEM of lower epidermis, inner surface of cuticle, showing one trichome base (Scale = 10 um).

FIGURE 330. Specimen N 0102, Parataxon NER/025 : SEM of lower epidermis, inner surface of cuticle, showing a stomate. (Scale = 10 um).

FIGURE 331. Specimen N 0102, Parataxon NER/025 : SEM of upper epidermis, inner surface of cuticle. (Scale = 40 um).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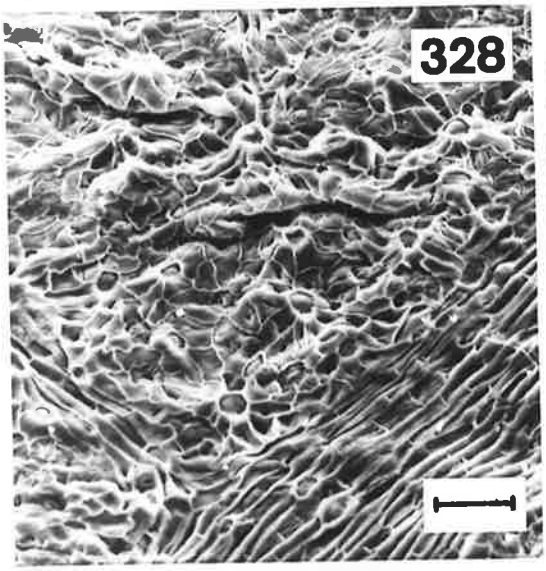
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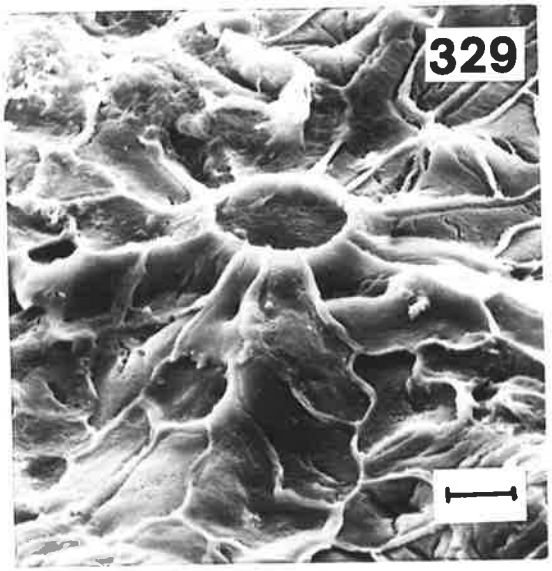
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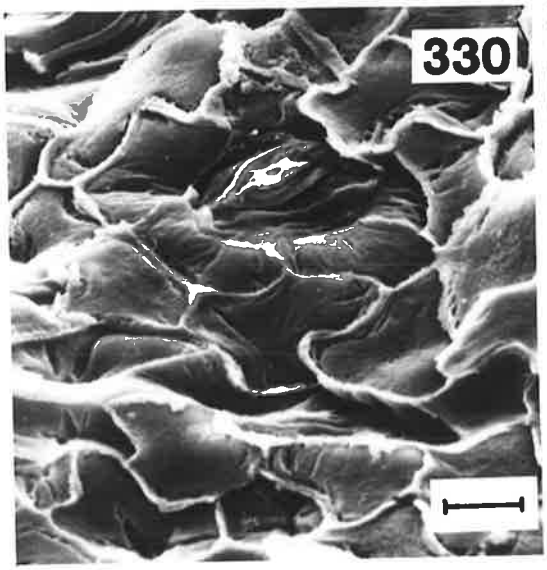
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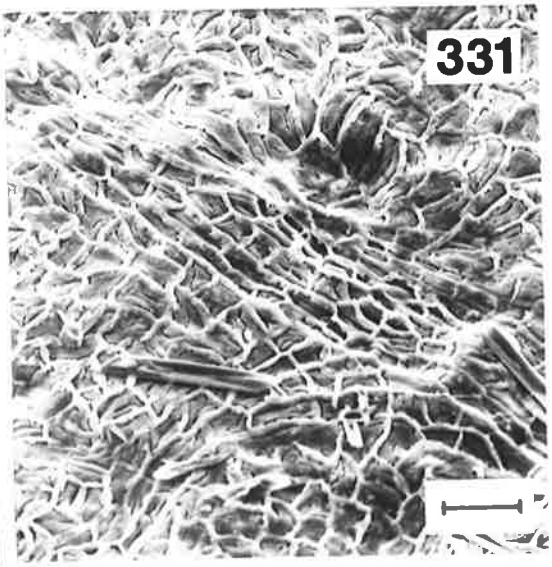
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FIGURE 332. Specimen N 0014, Parataxon NER/026 : Lower epidermis

FIGURE 333. Specimen N 0014, Parataxon NER/026 : Upper epidermis

FIGURE 334. Specimen N 0017, Parataxon NER/026 : Lower epidermis

FIGURE 335. Specimen N 0017, Parataxon NER/026 : Upper epidermis

FIGURE 336. Specimen N 0018, Parataxon NER/026 : Lower epidermis

FIGURE 337. Specimen N 0018, Parataxon NER/026 : Upper epidermis

Scale = 100 um.

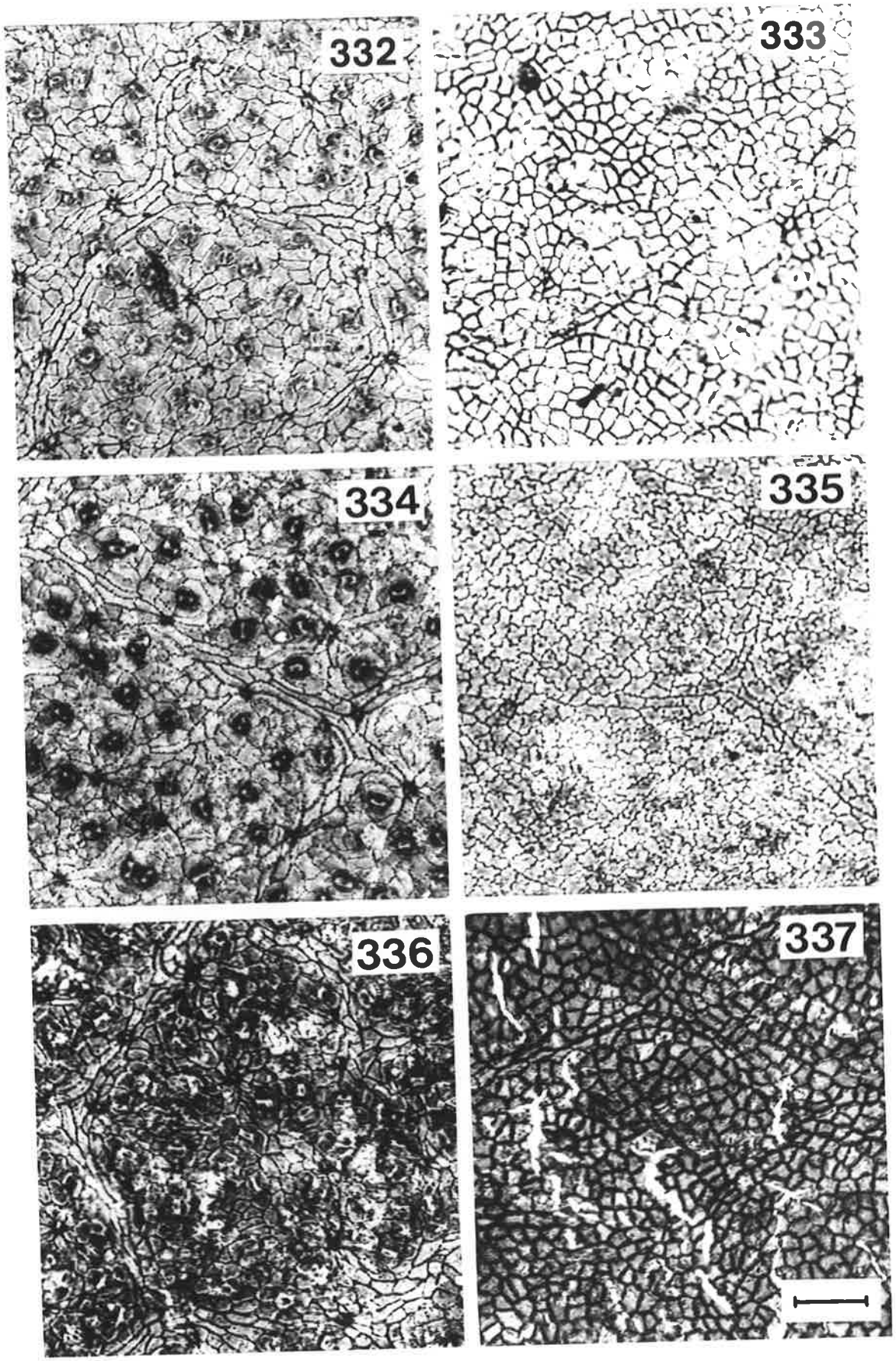
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FIGURE 338. Specimen N 0020, Parataxon NER/026 : Lower epidermis

FIGURE 339. Specimen N 0020, Parataxon NER/026 : Upper epidermis

FIGURE 340. Specimen N 0033, Parataxon NER/026 : Lower epidermis

FIGURE 341. Specimen N 0033, Parataxon NER/026 : Upper epidermis

FIGURE 342. Specimen N 0056, Parataxon NER/026 : Lower epidermis

FIGURE 343. Specimen N 0056, Parataxon NER/026 : Upper epidermis

Scale = 100 um.

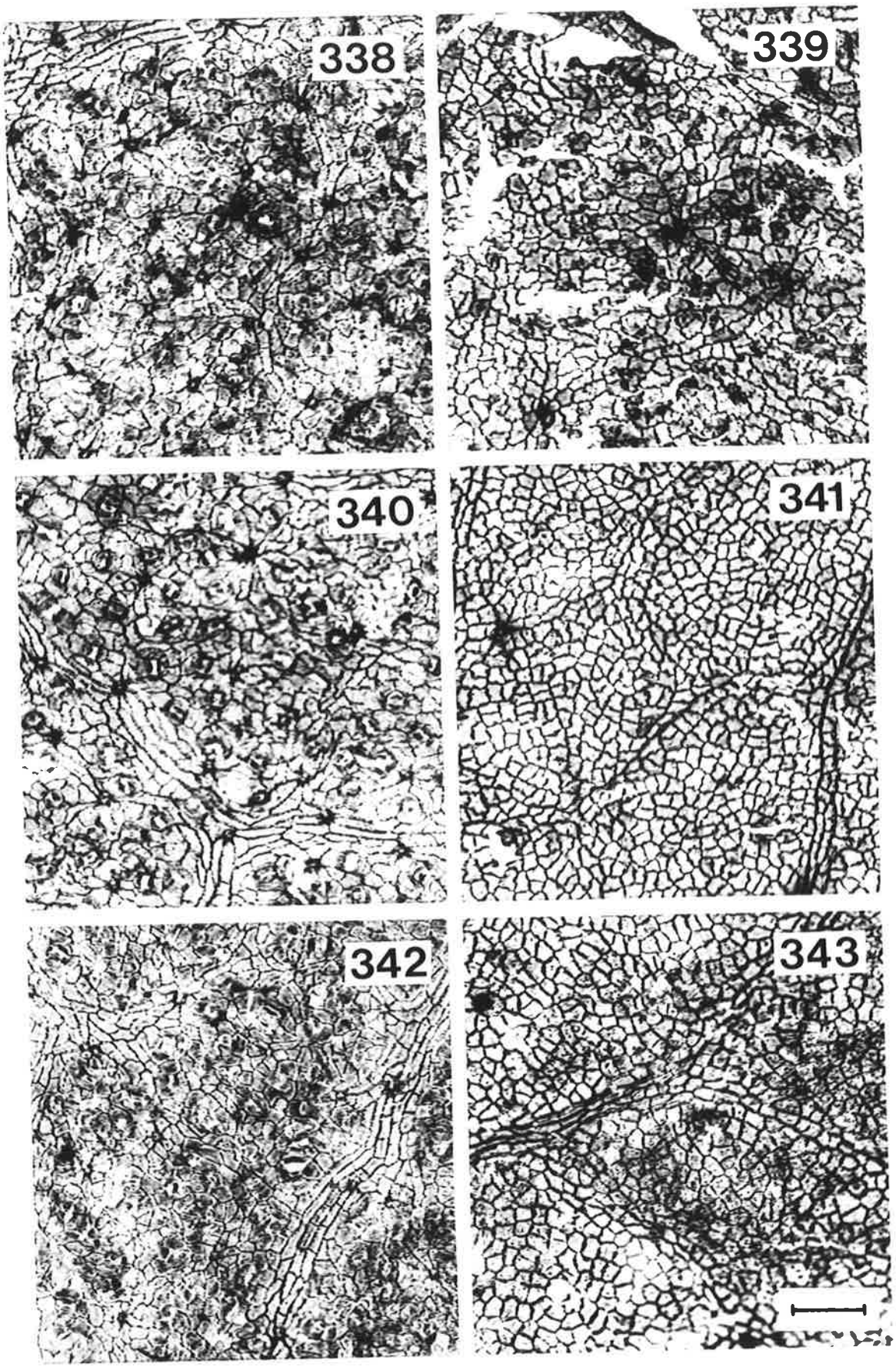
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FIGURE 344. Specimen N 0064, Parataxon NER/026 :
Lower epidermis

FIGURE 345. Specimen N 0064, Parataxon NER/026 :
Upper epidermis

FIGURE 346. Specimen N 0068, Parataxon NER/026 :
Lower epidermis

FIGURE 347. Specimen N 0068, Parataxon NER/026 :
Upper epidermis

FIGURE 348. Specimen N 0071, Parataxon NER/026 :
Lower epidermis

FIGURE 349. Specimen N 0071, Parataxon NER/026 :
Upper epidermis

Scale = 100 um.

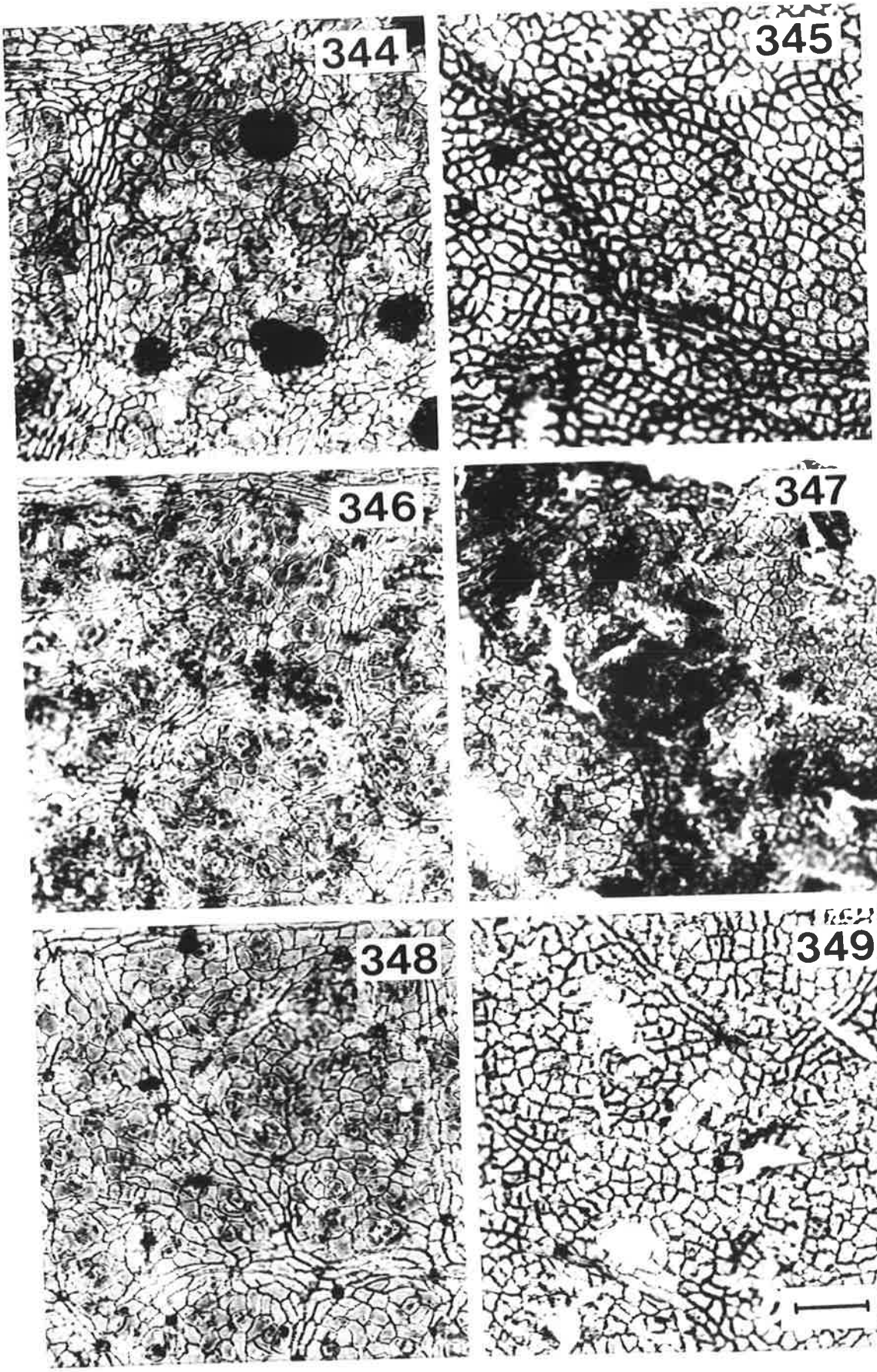
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FIGURE 350. Specimen N 0100, Parataxon NER/026 :
Lower epidermis

FIGURE 351. Specimen N 0100, Parataxon NER/026 :
Upper epidermis

FIGURE 352. Specimen N 0101, Parataxon NER/026 :
Lower epidermis

FIGURE 353. Specimen N 0101, Parataxon NER/026 :
Upper epidermis

FIGURE 354. Specimen N 0103, Parataxon NER/026 :
Lower epidermis

FIGURE 355. Specimen N 0103, Parataxon NER/026 :
Upper epidermis

Scale = 100 um.

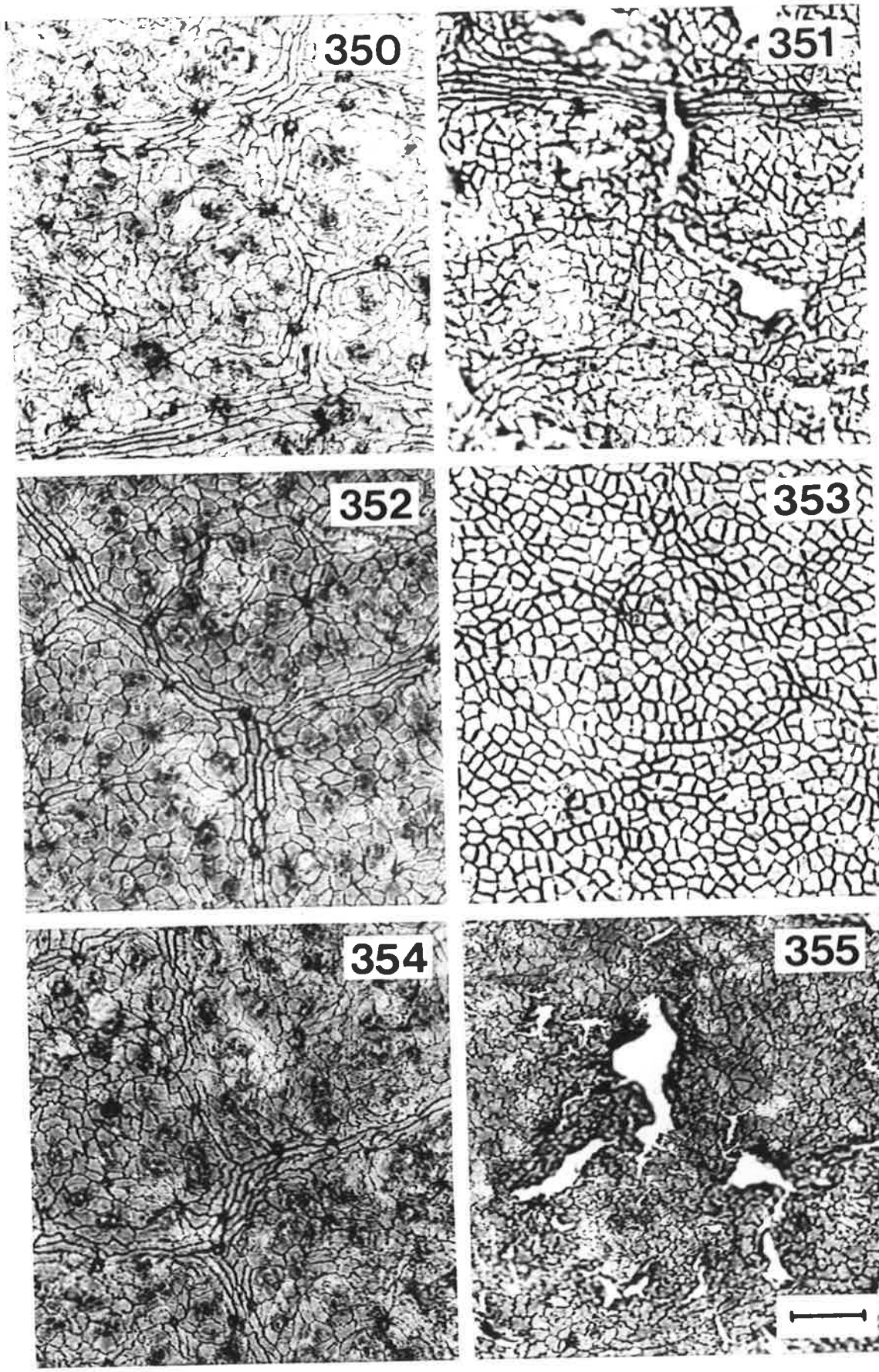
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FIGURE 356. Specimen N 0105, Parataxon NER/026 :
Lower epidermis

FIGURE 357. Specimen N 0105, Parataxon NER/026 :
Upper epidermis

FIGURE 358. Specimen N 0239, Parataxon NER/026 :
Lower epidermis

FIGURE 359. Specimen N 0239, Parataxon NER/026 :
Upper epidermis

FIGURE 360. Specimen N 0241, Parataxon NER/026 :
Lower epidermis

FIGURE 361. Specimen N 0241, Parataxon NER/026 :
Upper epidermis

Scale = 100 um.

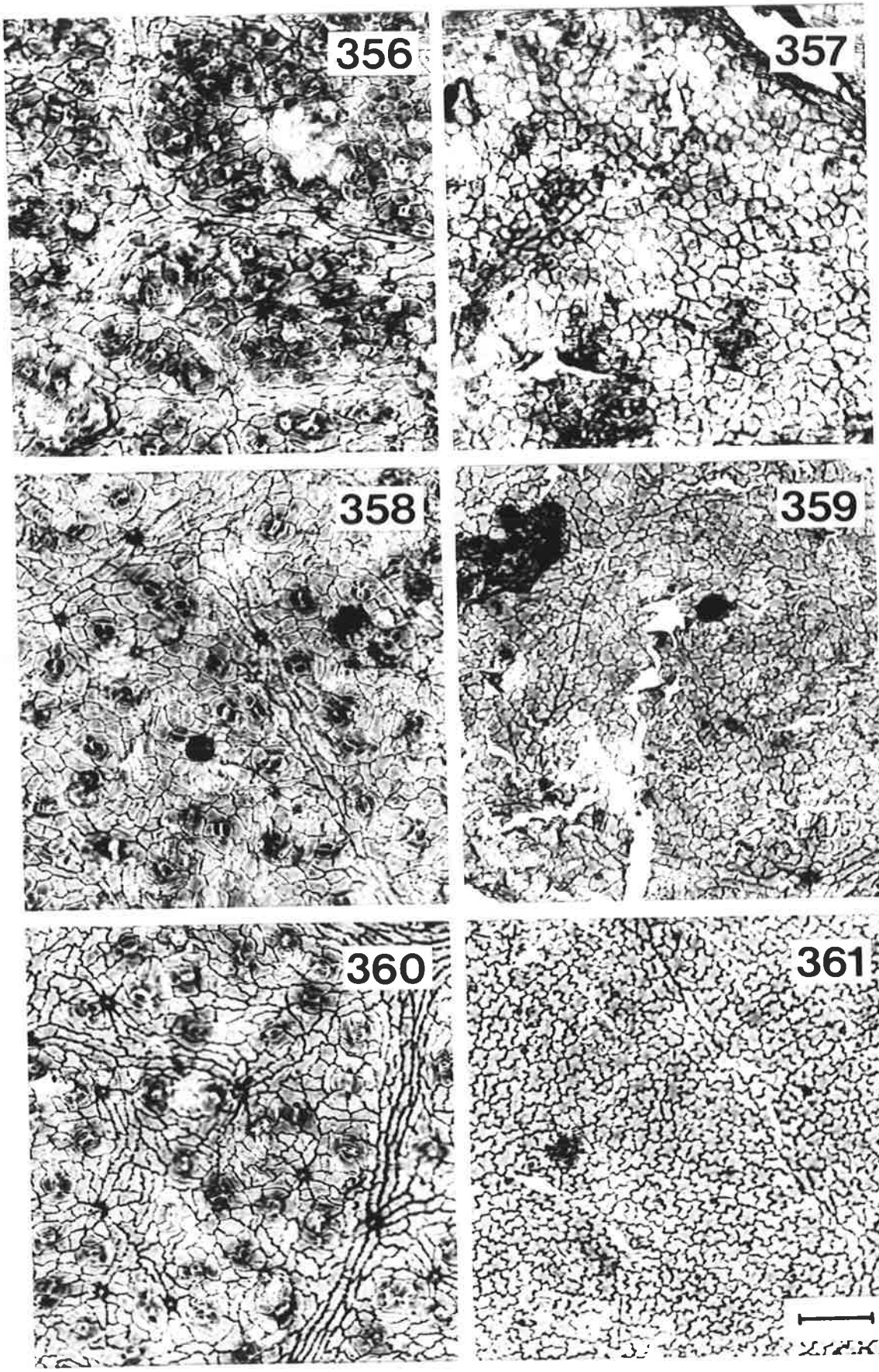
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FIGURE 362. Specimen N 0010, Parataxon NER/026 : Stomate over areole, lower epidermis.

FIGURE 363. Specimen N 0056, Parataxon NER/026 : Stomate over areole, lower epidermis.

FIGURE 364. Specimen N 0010, Parataxon NER/026 : Trichome base over vein, lower epidermis.

FIGURE 365. Specimen N 0026, Parataxon NER/027 : Stomate over areole, lower epidermis.

FIGURE 366. Specimen N 0026, Parataxon NER/027 : Trichome base over vein, lower epidermis.

FIGURE 367. Specimen N 0038, Parataxon NER/027 : Gland over vein on lower epidermis. The thinly cutinised cells covering the gland are completely preserved.

FIGURE 368. Specimen N 0045, Parataxon NER/027 : Gland over vein on lower epidermis. The thinly cutinised cells covering the gland are only partially preserved.

FIGURE 369. Specimen N 0011, Parataxon NER/027 : Gland over vein on lower epidermis. The thinly cutinised cells covering the gland are not preserved.

Scale = 20 um.

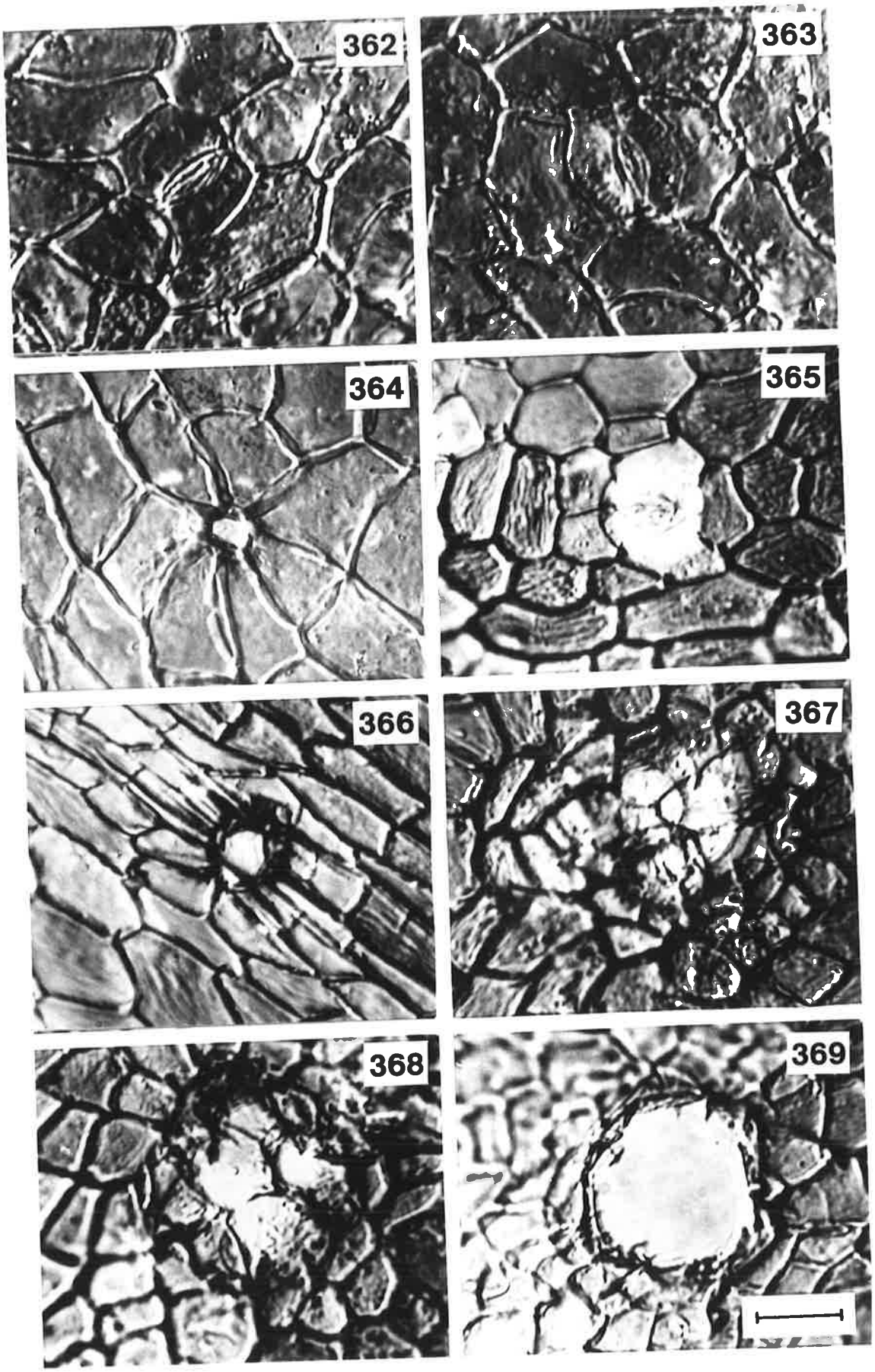
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FIGURE 370. Specimen N 0002, Parataxon NER/027 : Lower epidermis

FIGURE 371. Specimen N 0002, Parataxon NER/027 : Upper epidermis

FIGURE 372. Specimen N 0003, Parataxon NER/027 : Lower epidermis

FIGURE 373. Specimen N 0003, Parataxon NER/027 : Upper epidermis

FIGURE 374. Specimen N 0004, Parataxon NER/027 : Lower epidermis

FIGURE 375. Specimen N 0004, Parataxon NER/027 : Upper epidermis

Scale = 100 um.

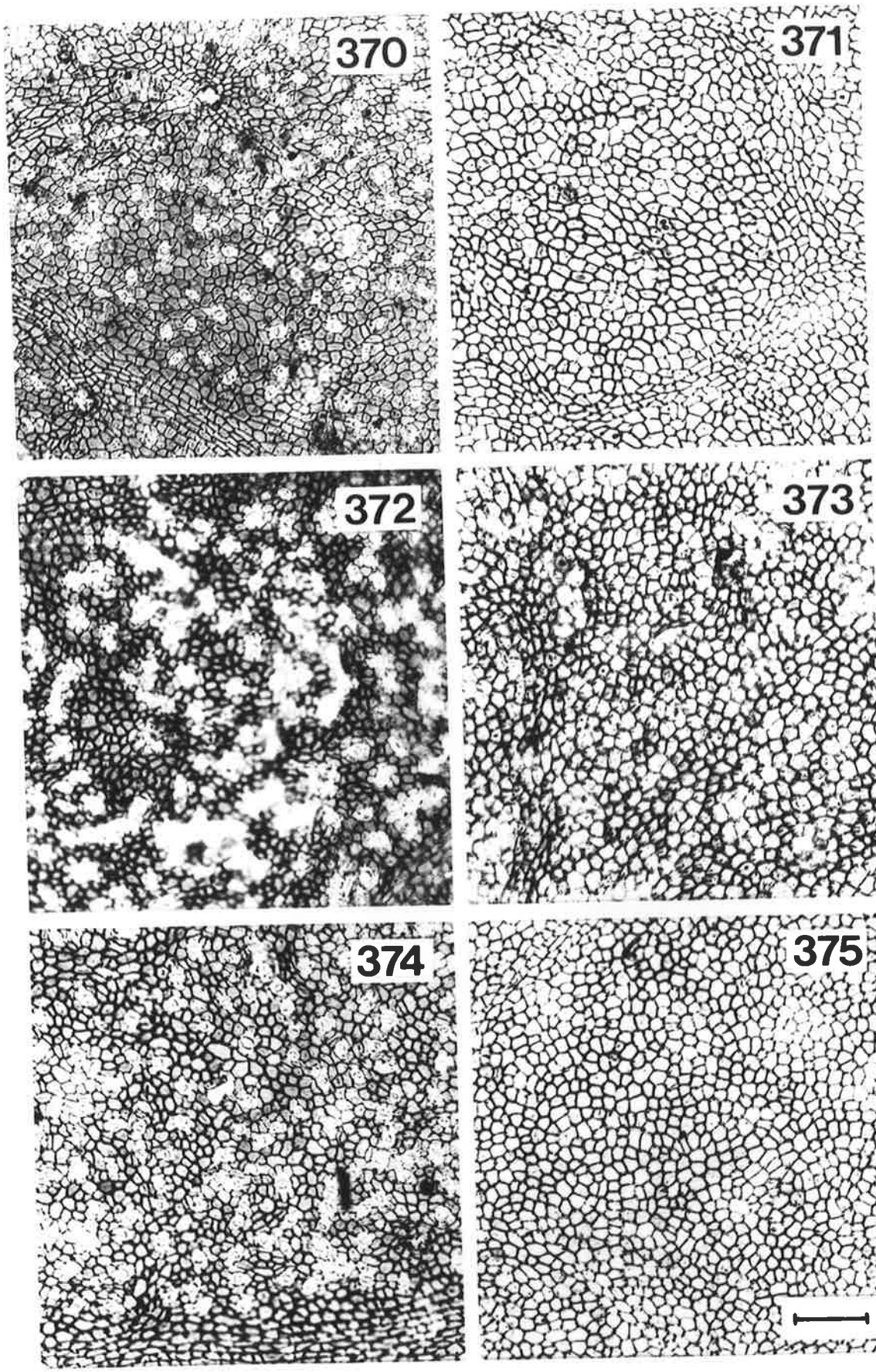
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FIGURE 376. Specimen N 0006, Parataxon NER/027 :
Lower epidermis

FIGURE 377. Specimen N 0006, Parataxon NER/027 :
Upper epidermis

FIGURE 378. Specimen N 0007, Parataxon NER/027 :
Lower epidermis

FIGURE 379. Specimen N 0007, Parataxon NER/027 :
Upper epidermis

FIGURE 380. Specimen N 0011, Parataxon NER/027 :
Lower epidermis

FIGURE 381. Specimen N 0011, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

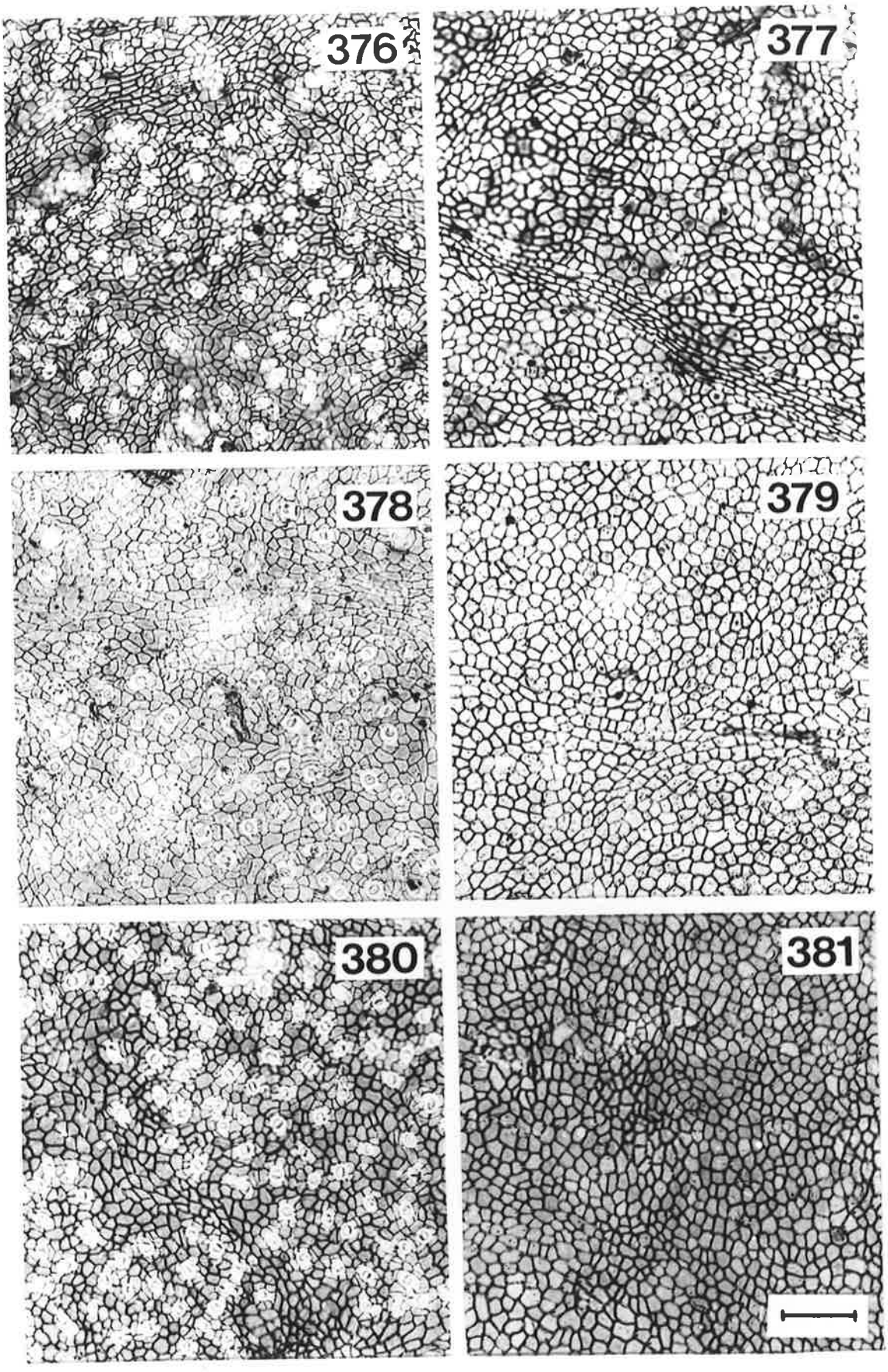
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FIGURE 382. Specimen N 0015, Parataxon NER/027 :
Lower epidermis

FIGURE 383. Specimen N 0015, Parataxon NER/027 :
Upper epidermis

FIGURE 384. Specimen N 0026, Parataxon NER/027 :
Lower epidermis

FIGURE 385. Specimen N 0026, Parataxon NER/027 :
Upper epidermis

FIGURE 386. Specimen N 0027, Parataxon NER/027 :
Lower epidermis

FIGURE 387. Specimen N 0027, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

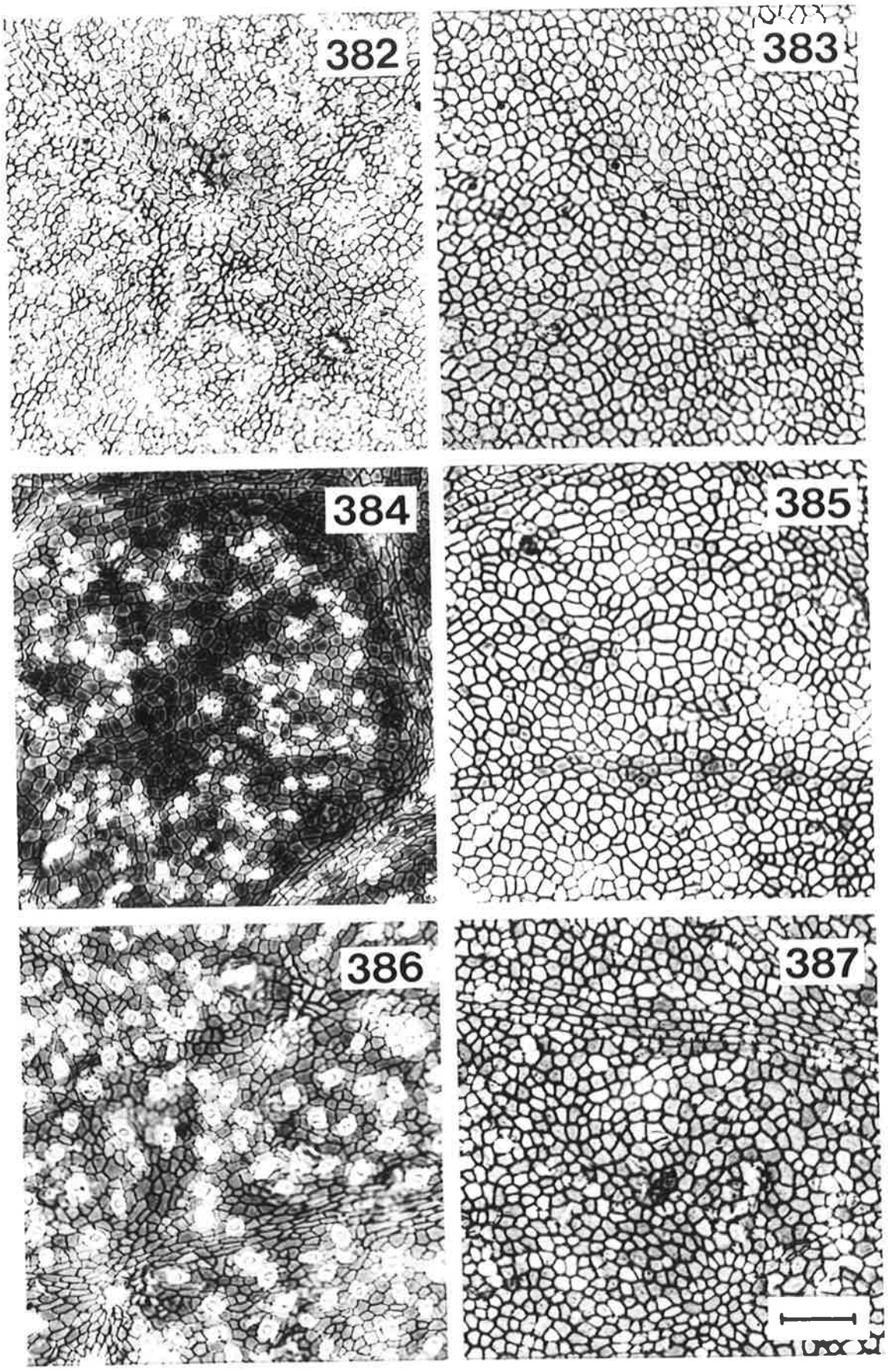
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FIGURE 388. Specimen N 0037, Parataxon NER/027 :
Lower epidermis

FIGURE 389. Specimen N 0037, Parataxon NER/027 :
Upper epidermis

FIGURE 390. Specimen N 0038, Parataxon NER/027 :
Lower epidermis

FIGURE 391. Specimen N 0038, Parataxon NER/027 :
Upper epidermis

FIGURE 392. Specimen N 0041, Parataxon NER/027 :
Lower epidermis

FIGURE 393. Specimen N 0041, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

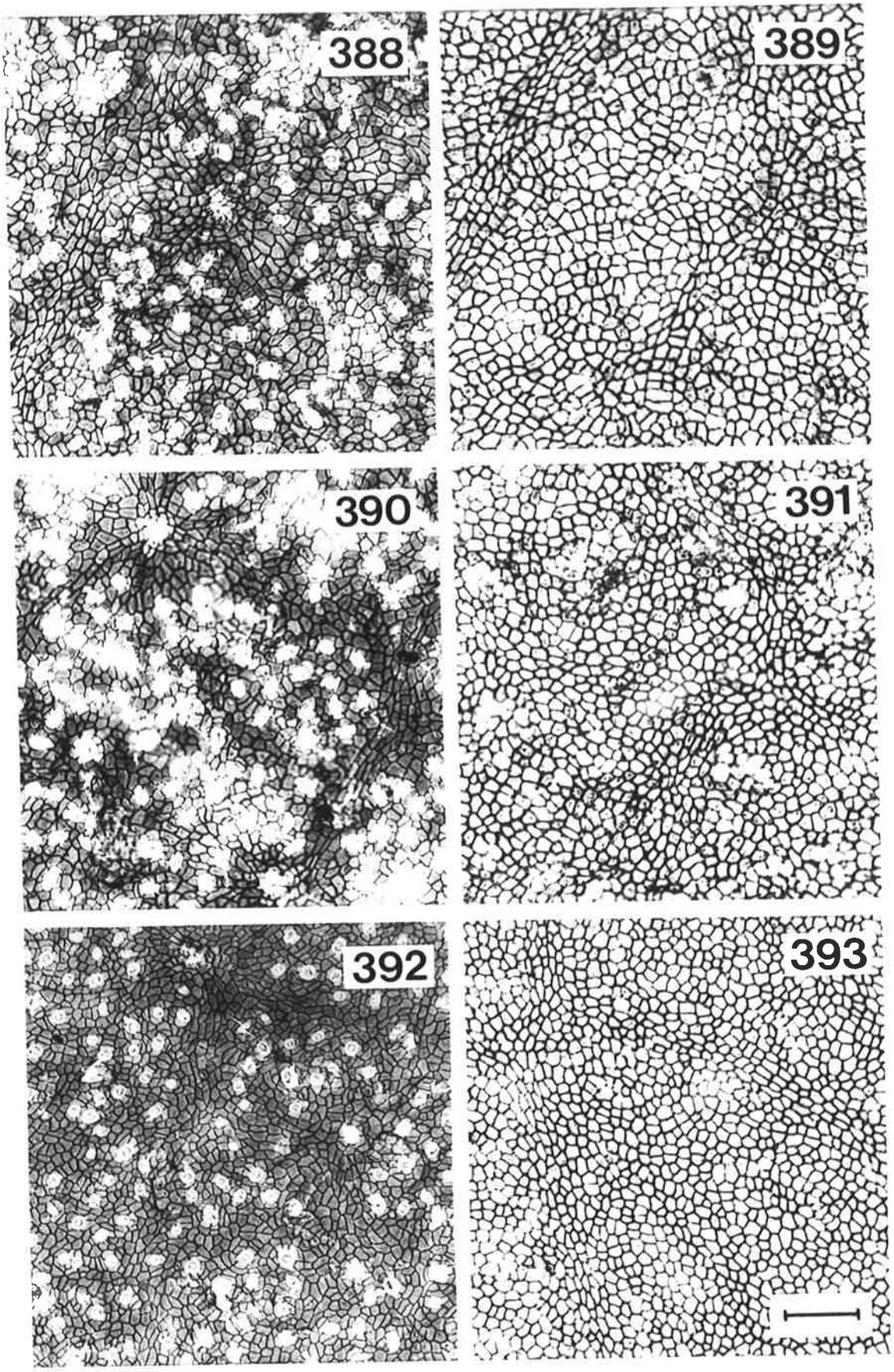
388
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FIGURE 394. Specimen N 0044, Parataxon NER/027 : Lower epidermis

FIGURE 395. Specimen N 0044, Parataxon NER/027 : Upper epidermis

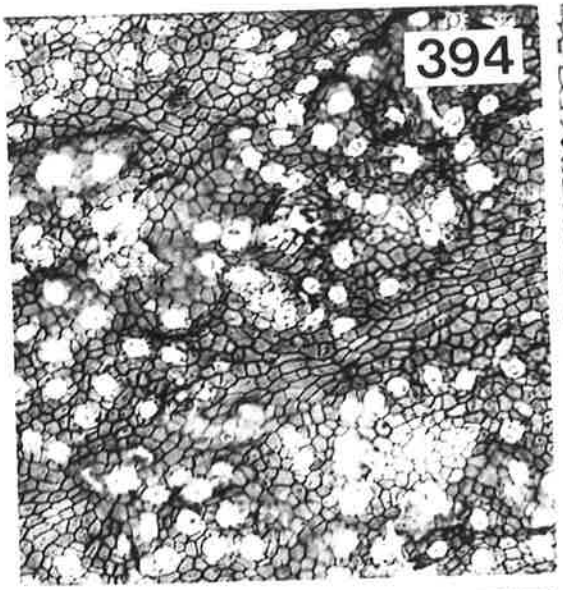
FIGURE 396. Specimen N 0045, Parataxon NER/027 : Lower epidermis

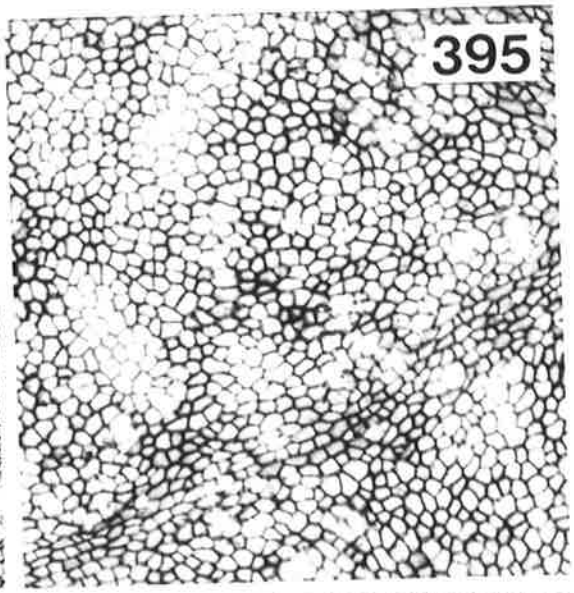
FIGURE 397. Specimen N 0045, Parataxon NER/027 : Upper epidermis

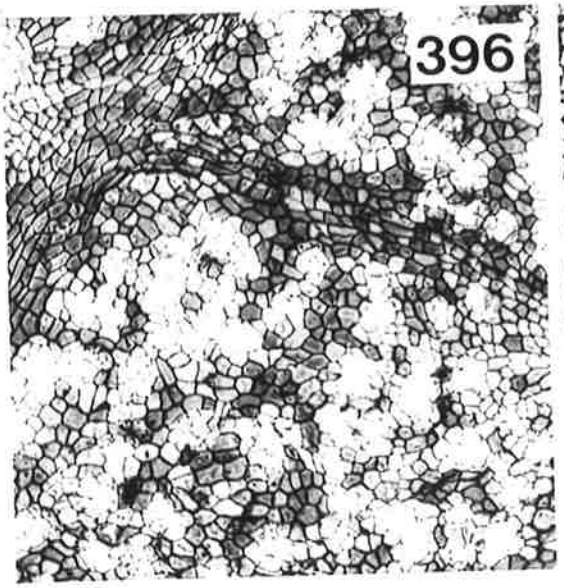
FIGURE 398. Specimen N 0049, Parataxon NER/027 : Lower epidermis

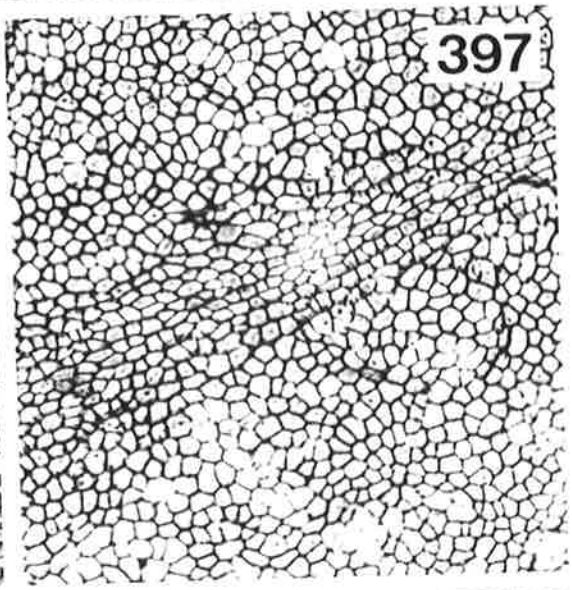
FIGURE 399. Specimen N 0049, Parataxon NER/027 : Upper epidermis

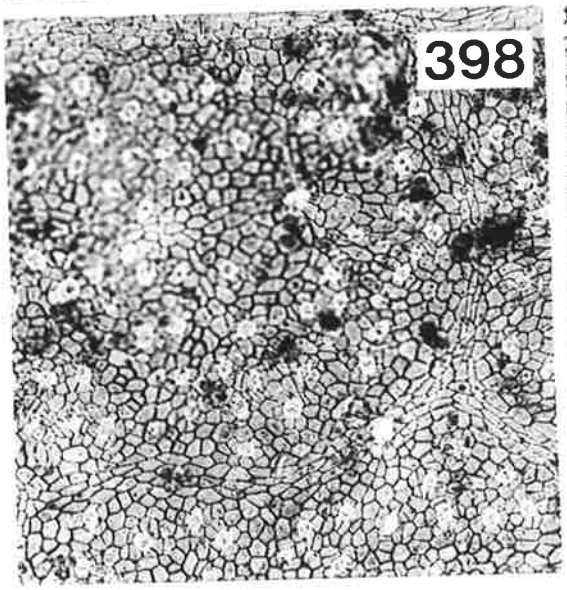
Scale = 100 um.


394


395


396


397


398

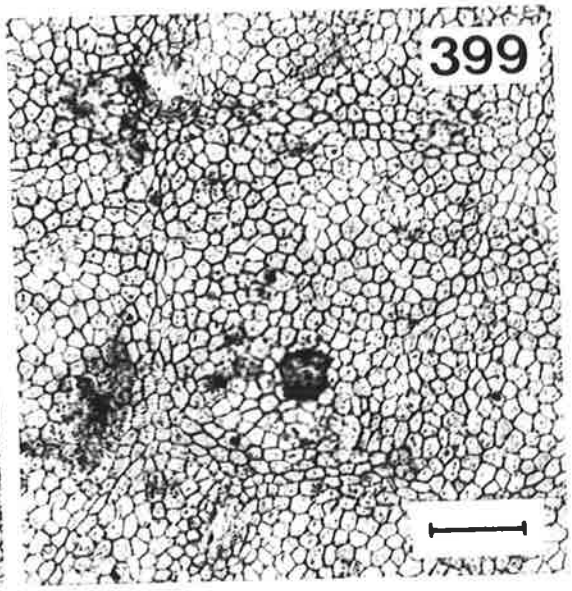

399

FIGURE 400. Specimen N 0052, Parataxon NER/027 : Lower epidermis

FIGURE 401. Specimen N 0052, Parataxon NER/027 : Upper epidermis

FIGURE 402. Specimen N 0053, Parataxon NER/027 : Lower epidermis

FIGURE 403. Specimen N 0053, Parataxon NER/027 : Upper epidermis

FIGURE 404. Specimen N 0054, Parataxon NER/027 : Lower epidermis

FIGURE 405. Specimen N 0054, Parataxon NER/027 : Upper epidermis

Scale = 100 um.

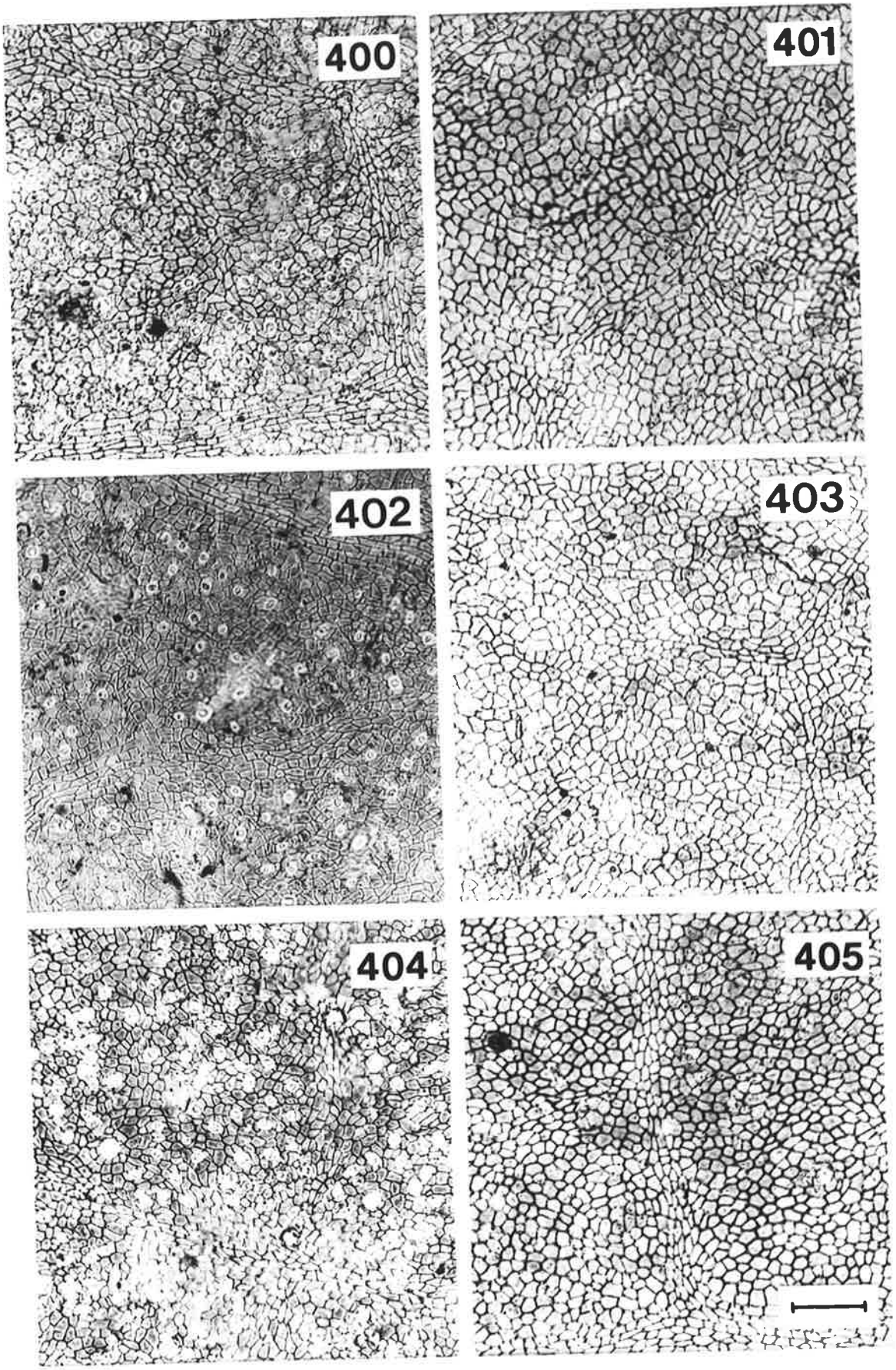

400
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FIGURE 406.. Specimen N 0055, Parataxon NER/027 :
Lower epidermis

FIGURE 407. Specimen N 0055, Parataxon NER/027 :
Upper epidermis

FIGURE 408. Specimen N 0058, Parataxon NER/027 :
Lower epidermis

FIGURE 409. Specimen N 0058, Parataxon NER/027 :
Upper epidermis

FIGURE 410. Specimen N 0061, Parataxon NER/027 :
Lower epidermis

FIGURE 411. Specimen N 0061, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

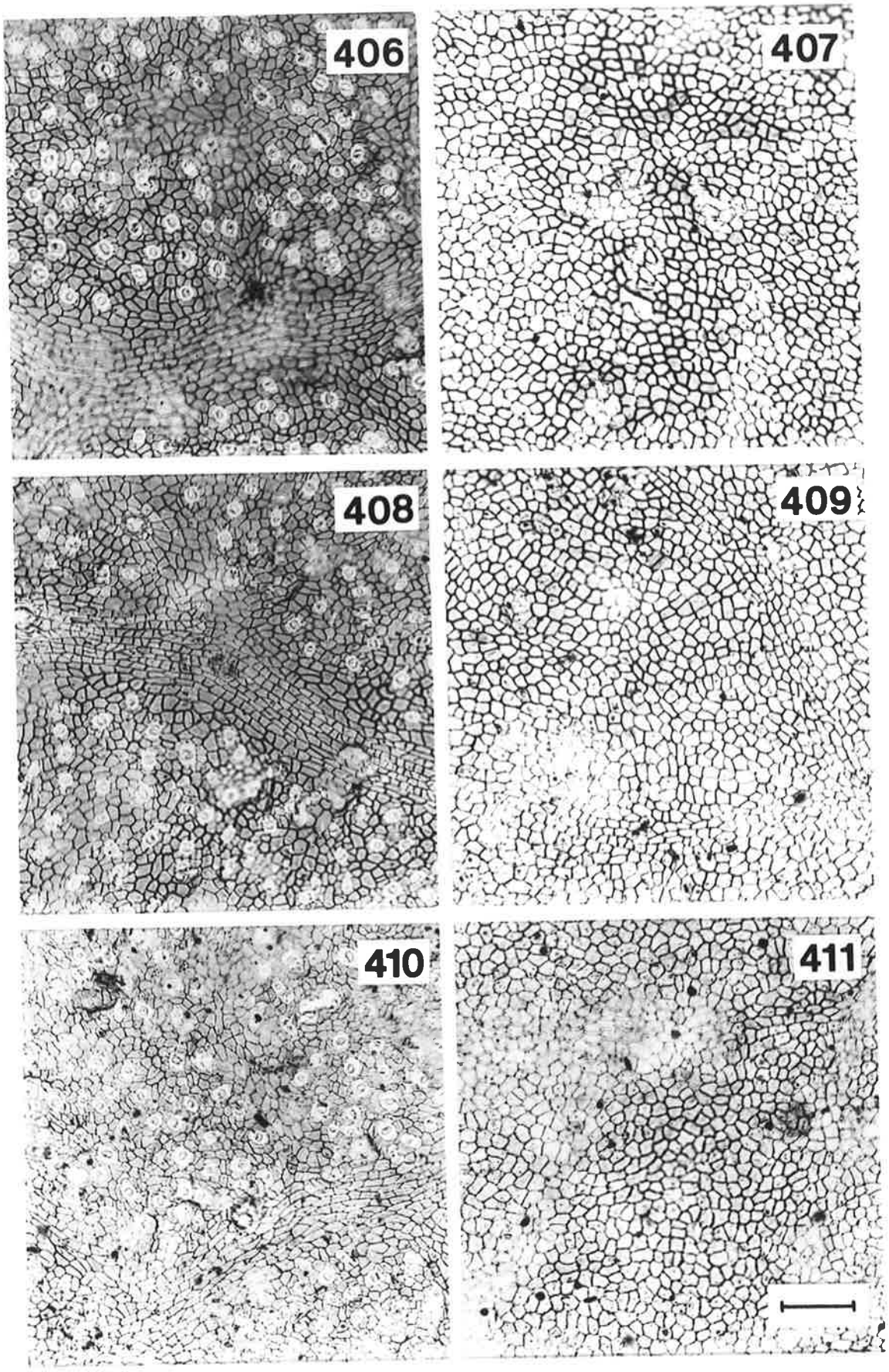
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FIGURE 412. Specimen N 0063, Parataxon NER/027 : Lower epidermis

FIGURE 413. Specimen N 0063, Parataxon NER/027 : Upper epidermis

FIGURE 414. Specimen N 0070, Parataxon NER/027 : Lower epidermis

FIGURE 415. Specimen N 0070, Parataxon NER/027 : Upper epidermis

FIGURE 416. Specimen N 0074, Parataxon NER/027 : Lower epidermis

FIGURE 417. Specimen N 0074, Parataxon NER/027 : Upper epidermis

Scale = 100 um.

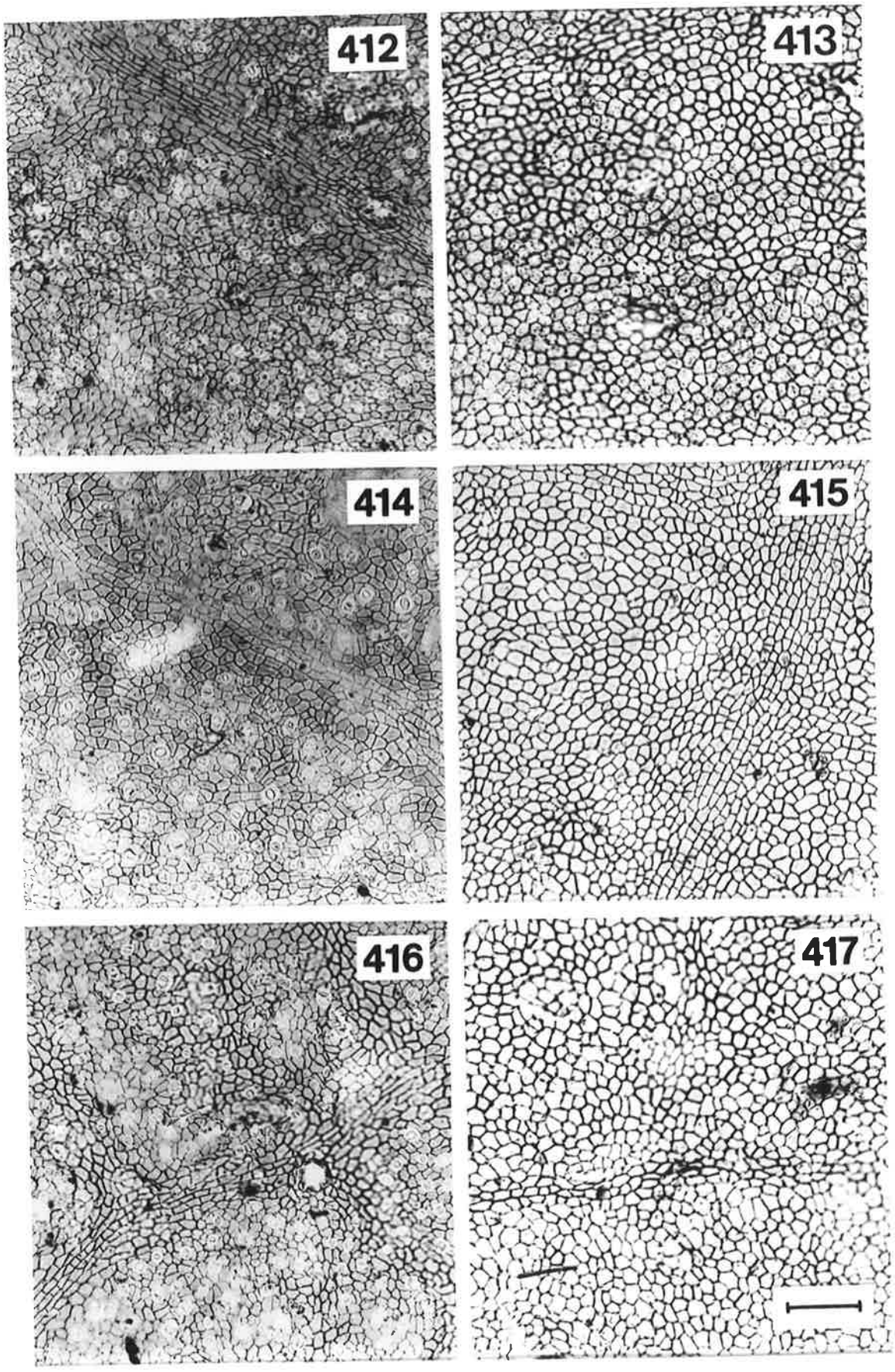
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FIGURE 418. Specimen N 0075, Parataxon NER/027 : Lower epidermis

FIGURE 419. Specimen N 0075, Parataxon NER/027 : Upper epidermis

FIGURE 420. Specimen N 0079, Parataxon NER/027 : Lower epidermis

FIGURE 421. Specimen N 0079, Parataxon NER/027 : Upper epidermis

FIGURE 422. Specimen N 0088, Parataxon NER/027 : Lower epidermis

FIGURE 423. Specimen N 0088, Parataxon NER/027 : Upper epidermis

Scale = 100 um.

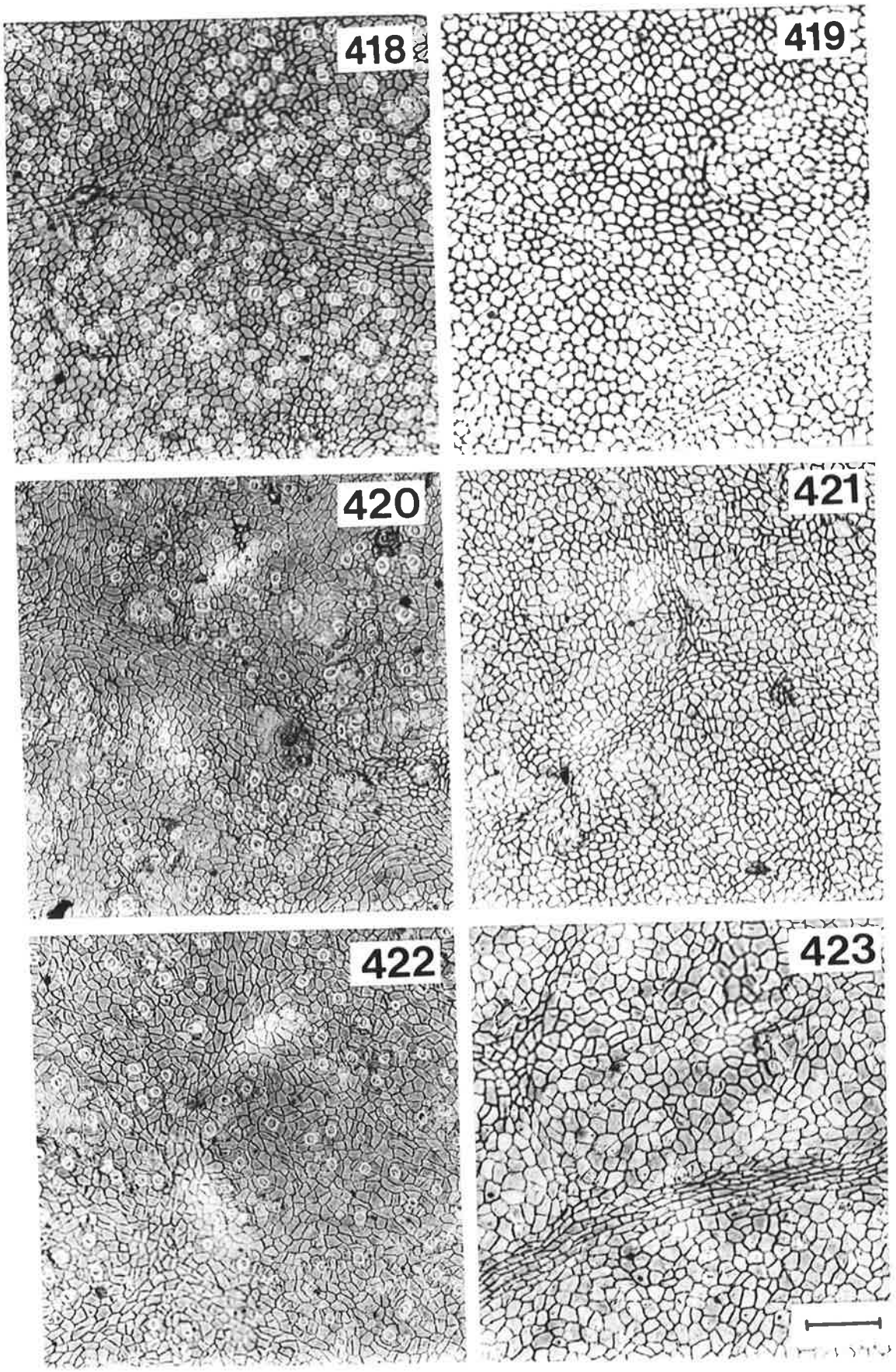
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FIGURE 424. Specimen N 0090, Parataxon NER/027 : Lower epidermis

FIGURE 425. Specimen N 0090, Parataxon NER/027 : Upper epidermis

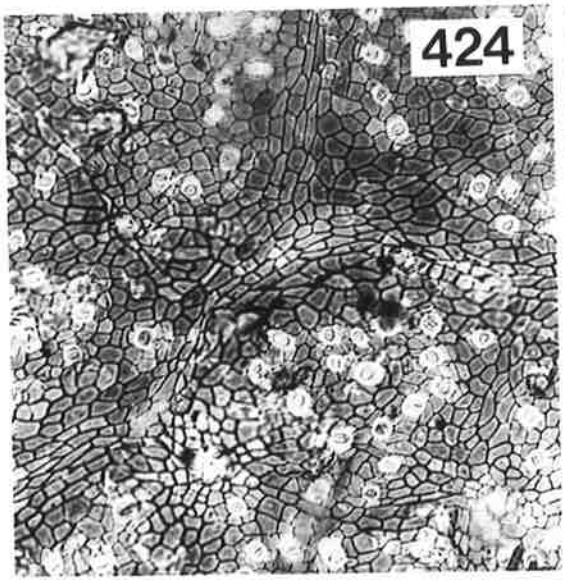
FIGURE 426. Specimen N 0092, Parataxon NER/027 : Lower epidermis

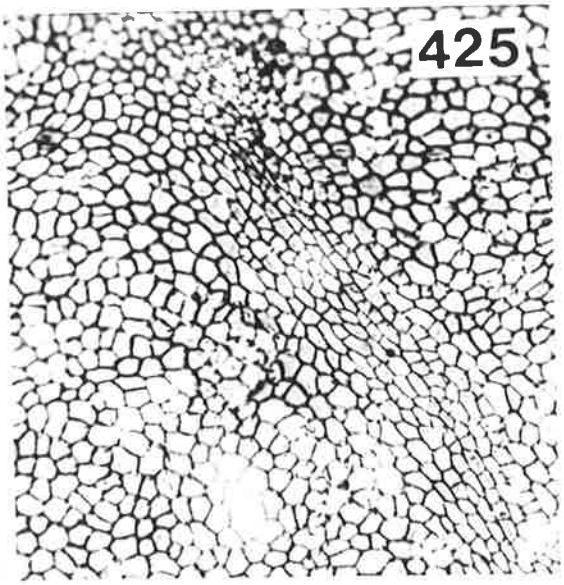
FIGURE 427. Specimen N 0092, Parataxon NER/027 : Upper epidermis

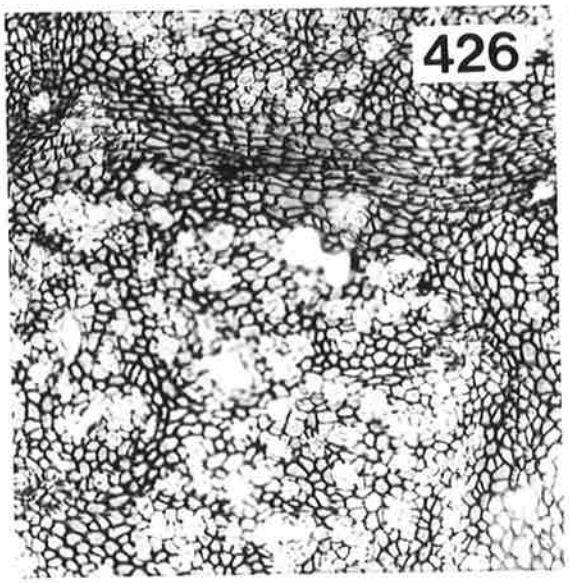
FIGURE 428. Specimen N 0094, Parataxon NER/027 : Lower epidermis

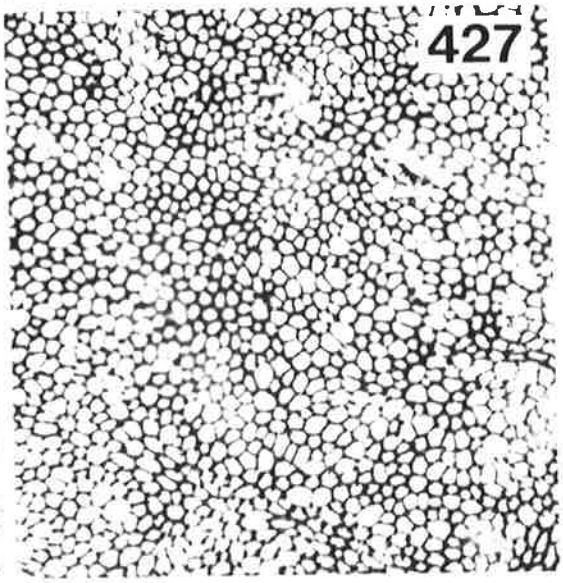
FIGURE 429. Specimen N 0094, Parataxon NER/027 : Upper epidermis

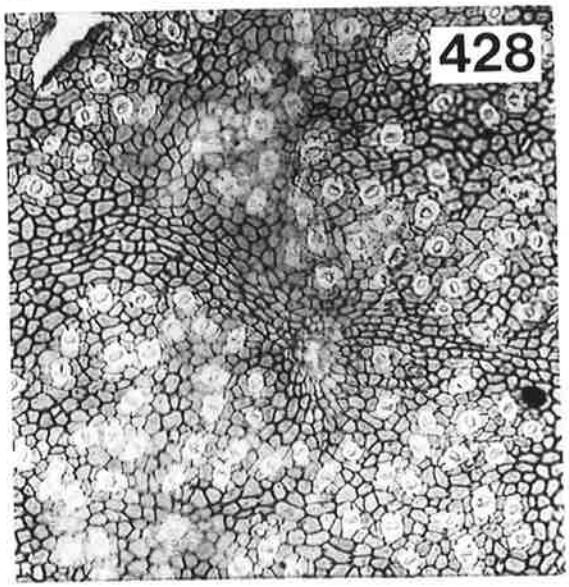
Scale = 100 um.


424


425


426


427


428

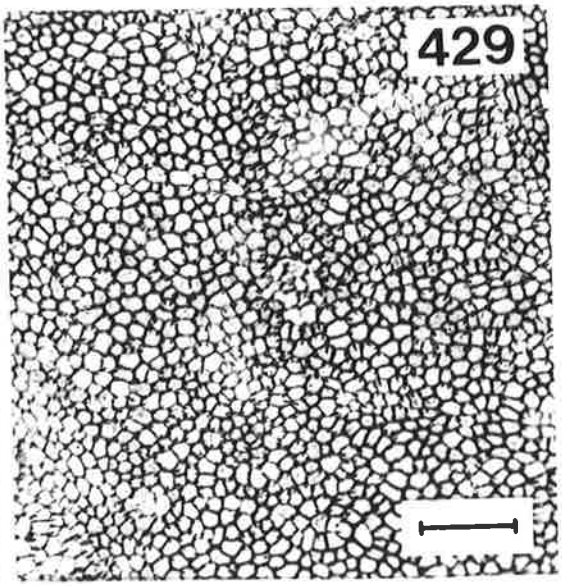

429

FIGURE 430. Specimen N 0098, Parataxon NER/027 : Lower epidermis

FIGURE 431. Specimen N 0098, Parataxon NER/027 : Upper epidermis

FIGURE 432. Specimen N 0109, Parataxon NER/027 : Lower epidermis

FIGURE 433. Specimen N 0109, Parataxon NER/027 : Upper epidermis

FIGURE 434. Specimen N 0118, Parataxon NER/027 : Lower epidermis

FIGURE 435. Specimen N 0118, Parataxon NER/027 : Upper epidermis

Scale = 100 um.

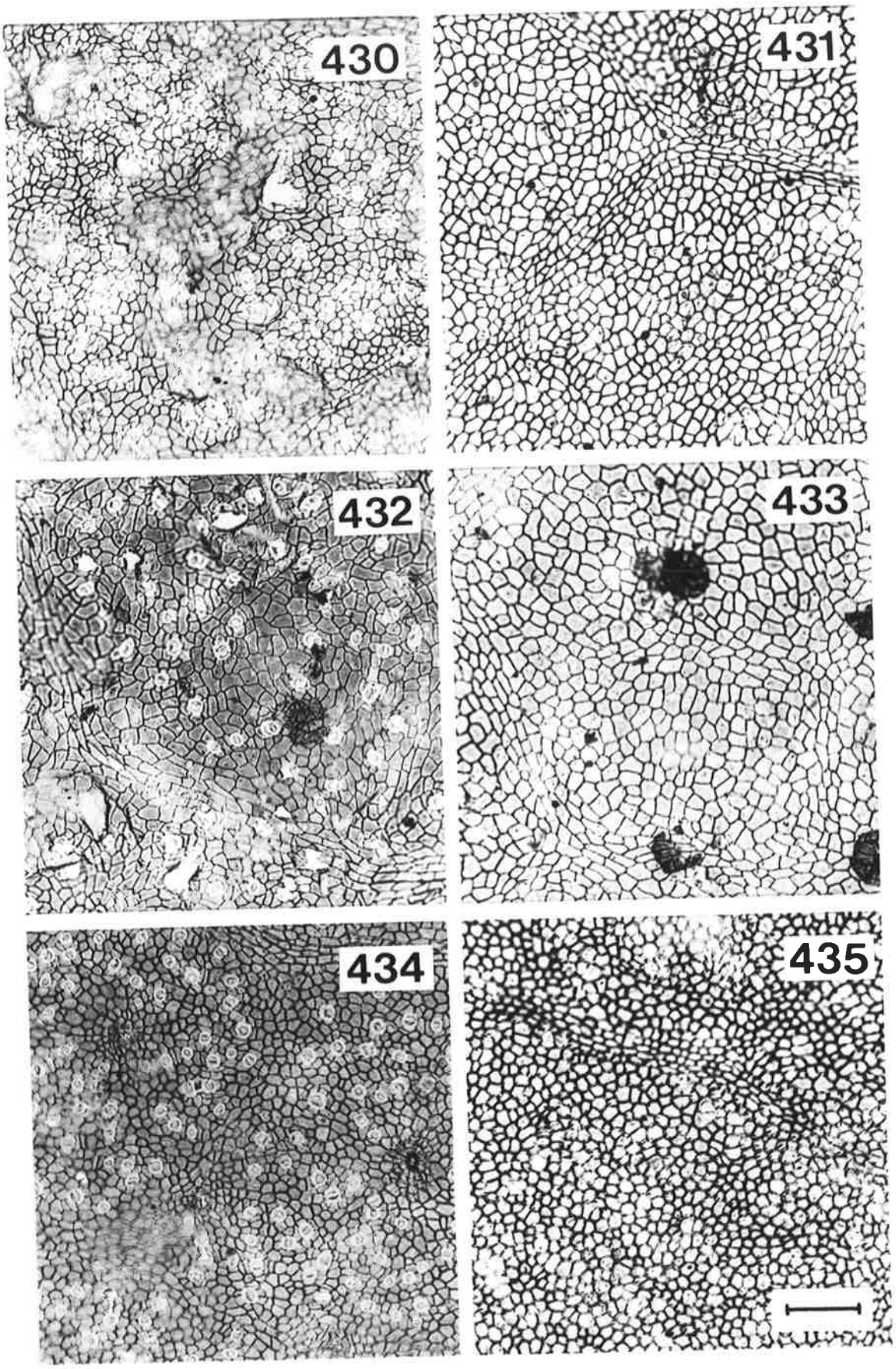

430
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FIGURE 436. Specimen N 0120, Parataxon NER/027 :
Lower epidermis

FIGURE 437. Specimen N 0120, Parataxon NER/027 :
Upper epidermis

FIGURE 438. Specimen N 0125, Parataxon NER/027 :
Lower epidermis

FIGURE 439. Specimen N 0125, Parataxon NER/027 :
Upper epidermis

FIGURE 440. Specimen N 0144, Parataxon NER/027 :
Lower epidermis

FIGURE 441. Specimen N 0144, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

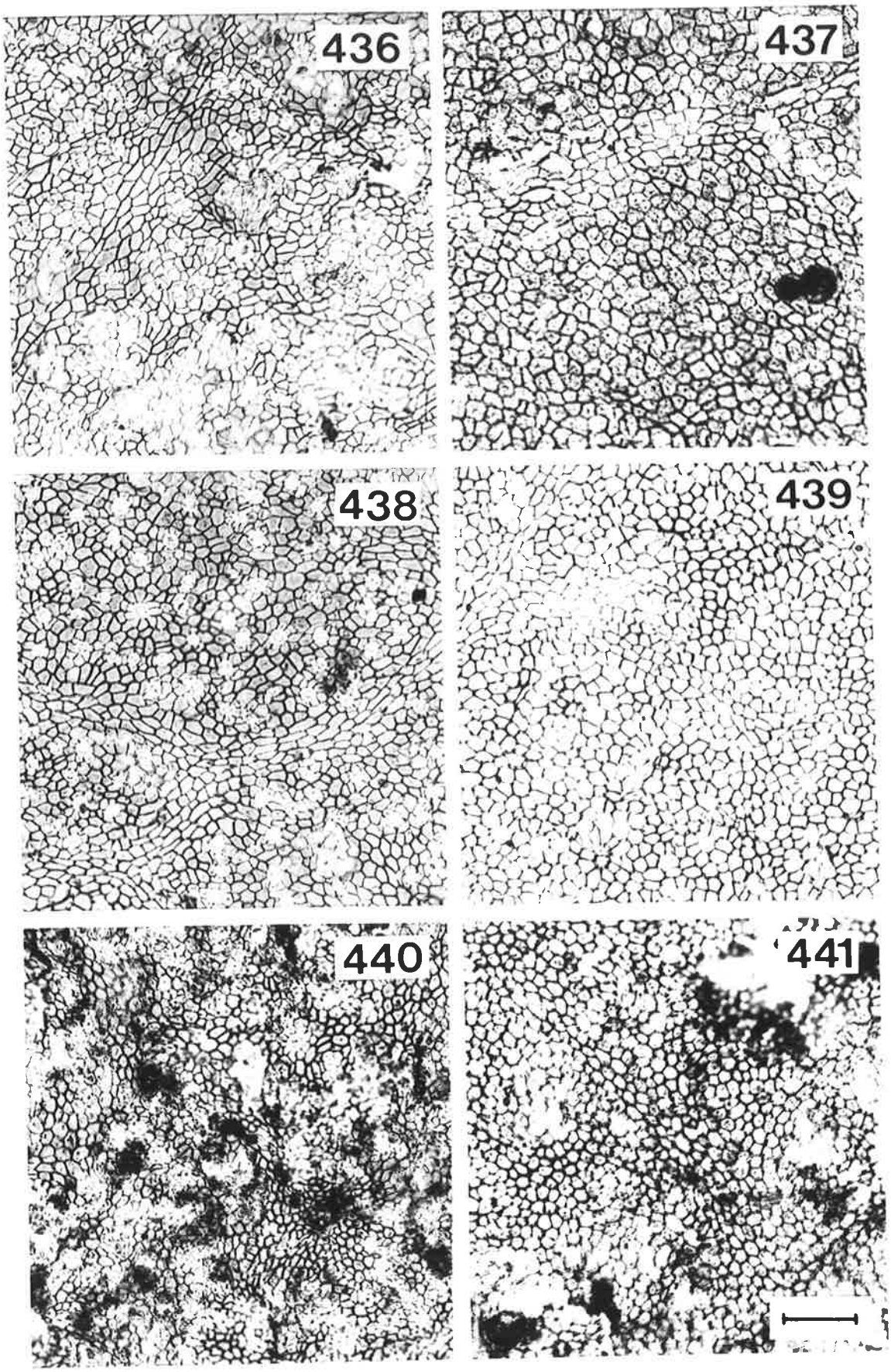
436
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FIGURE 442. Specimen N 0149, Parataxon NER/027 :
Lower epidermis

FIGURE 443. Specimen N 0149, Parataxon NER/027 :
Upper epidermis

FIGURE 444. Specimen N 0156, Parataxon NER/027 :
Lower epidermis

FIGURE 445. Specimen N 0156, Parataxon NER/027 :
Upper epidermis

FIGURE 446. Specimen N 0159, Parataxon NER/027 :
Lower epidermis

FIGURE 447. Specimen N 0159, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

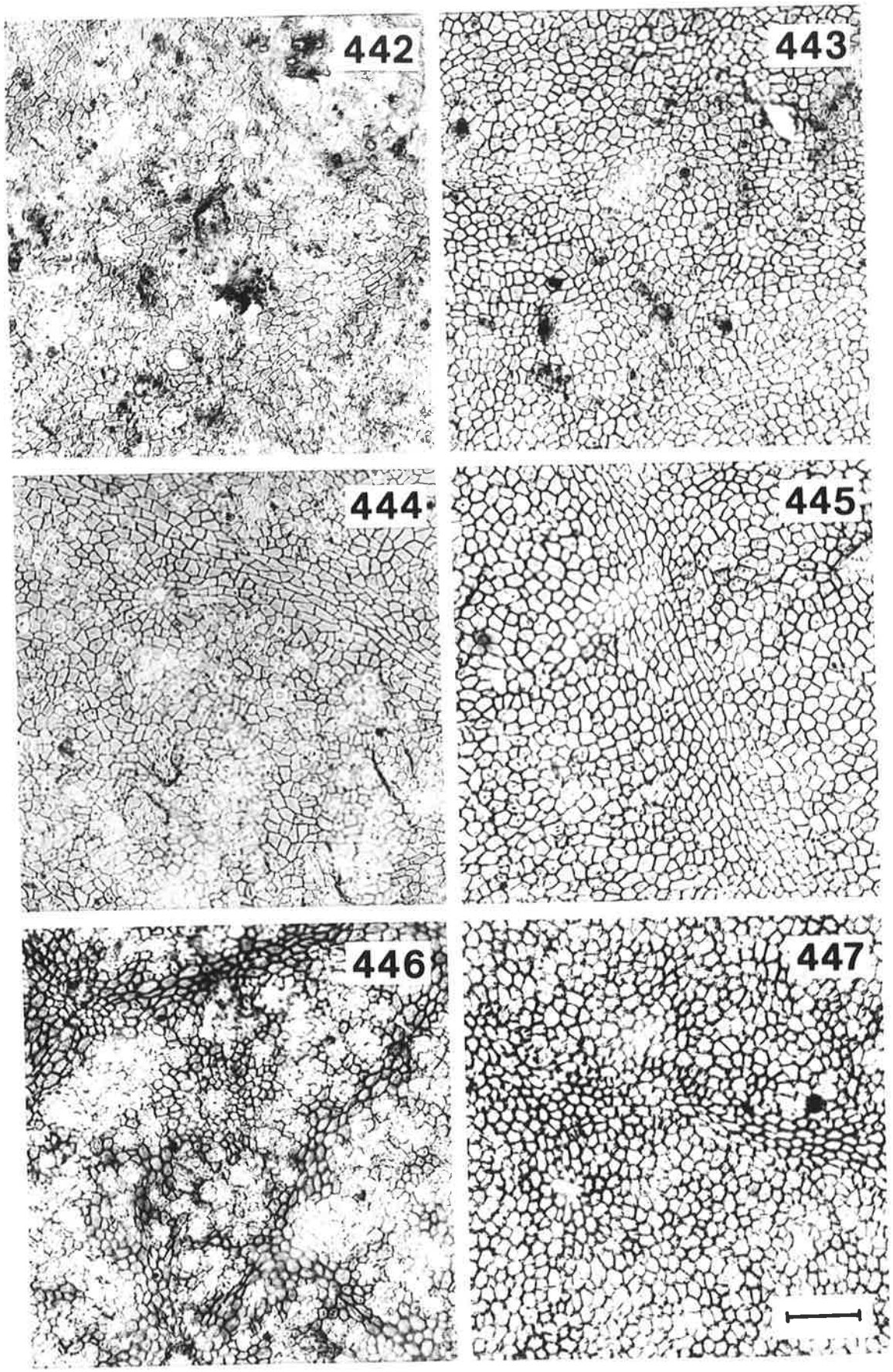
442
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FIGURE 448. Specimen N 0234, Parataxon NER/027 : Lower epidermis

FIGURE 449. Specimen N 0234, Parataxon NER/027 : Upper epidermis

FIGURE 450. Specimen N 0236, Parataxon NER/027 : Lower epidermis

FIGURE 451. Specimen N 0236, Parataxon NER/027 : Upper epidermis

FIGURE 452. Specimen N 0240, Parataxon NER/027 : Lower epidermis

FIGURE 453. Specimen N 0240, Parataxon NER/027 : Upper epidermis

Scale = 100 um.

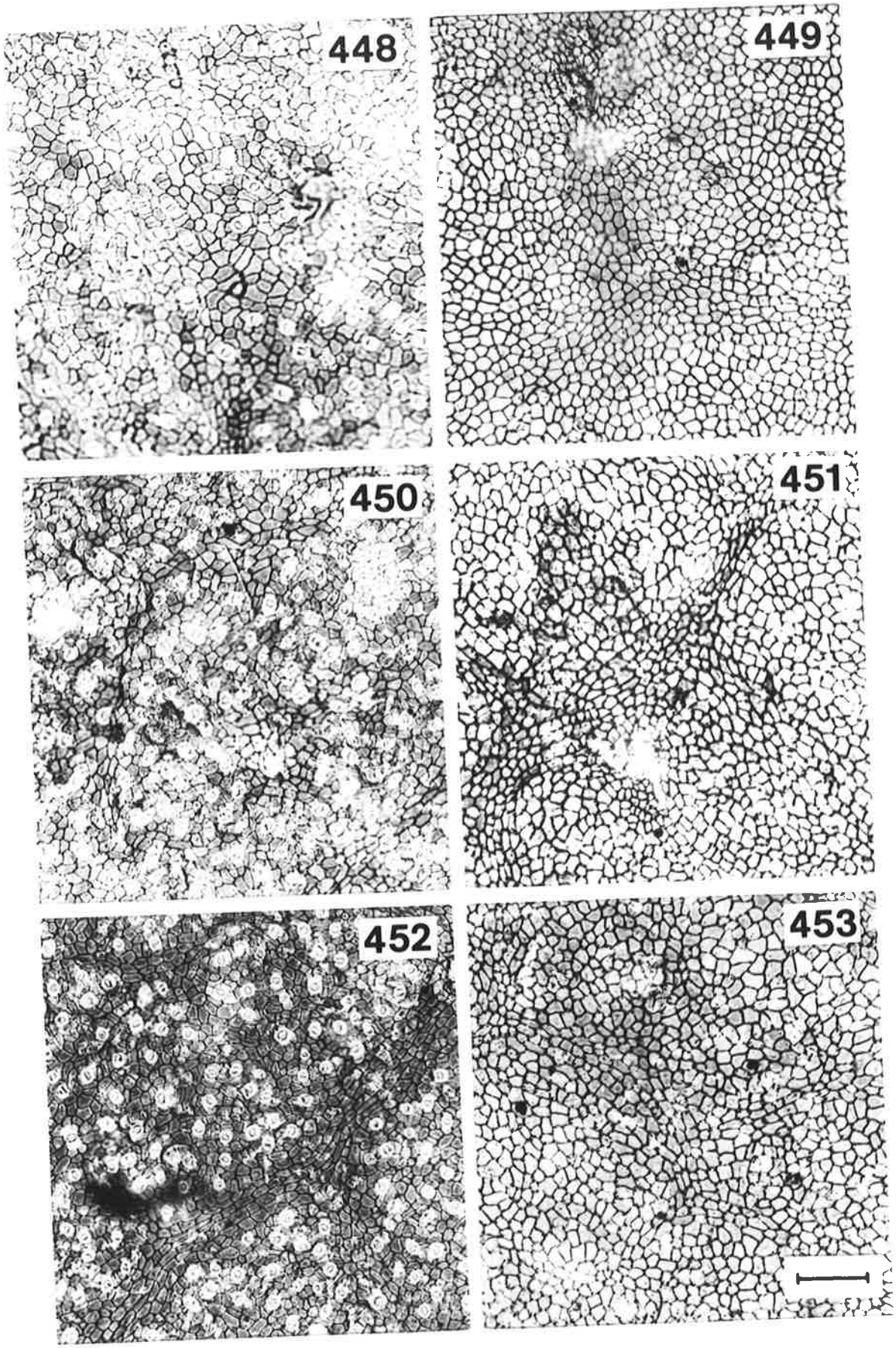
448
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FIGURE 454. Specimen N 0262, Parataxon NER/027 :
Lower epidermis

FIGURE 455. Specimen N 0262, Parataxon NER/027 :
Upper epidermis

FIGURE 456. Specimen N 0503, Parataxon NER/027 :
Lower epidermis

FIGURE 457. Specimen N 0503, Parataxon NER/027 :
Upper epidermis

FIGURE 458. Specimen N 0555, Parataxon NER/027 :
Lower epidermis

FIGURE 459. Specimen N 0555, Parataxon NER/027 :
Upper epidermis

Scale = 100 um.

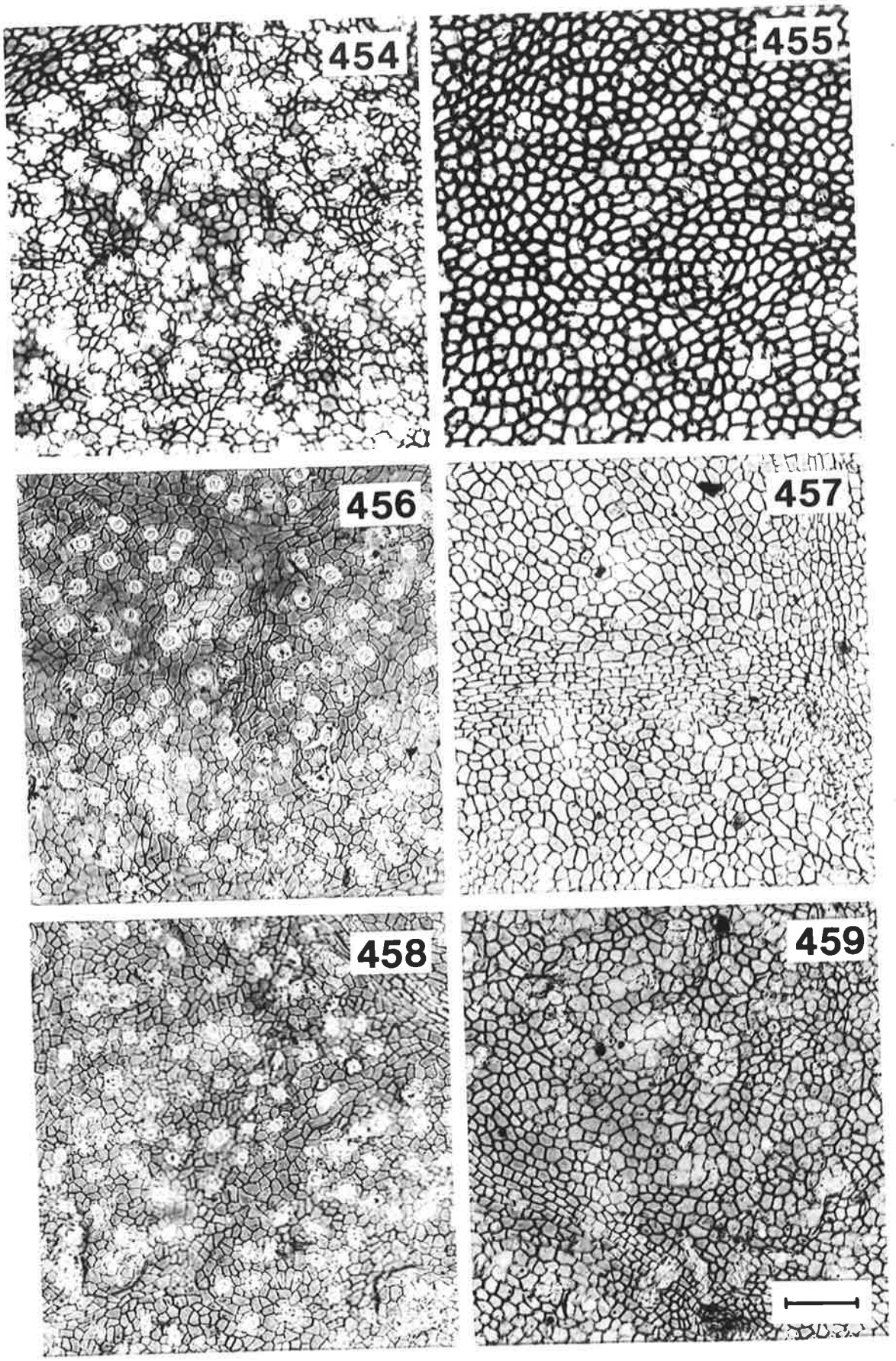
454
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FIGURE 460. Specimen N 0246, Parataxon NER/028 : Lower epidermis

FIGURE 461. Specimen N 0246, Parataxon NER/028 : Upper epidermis

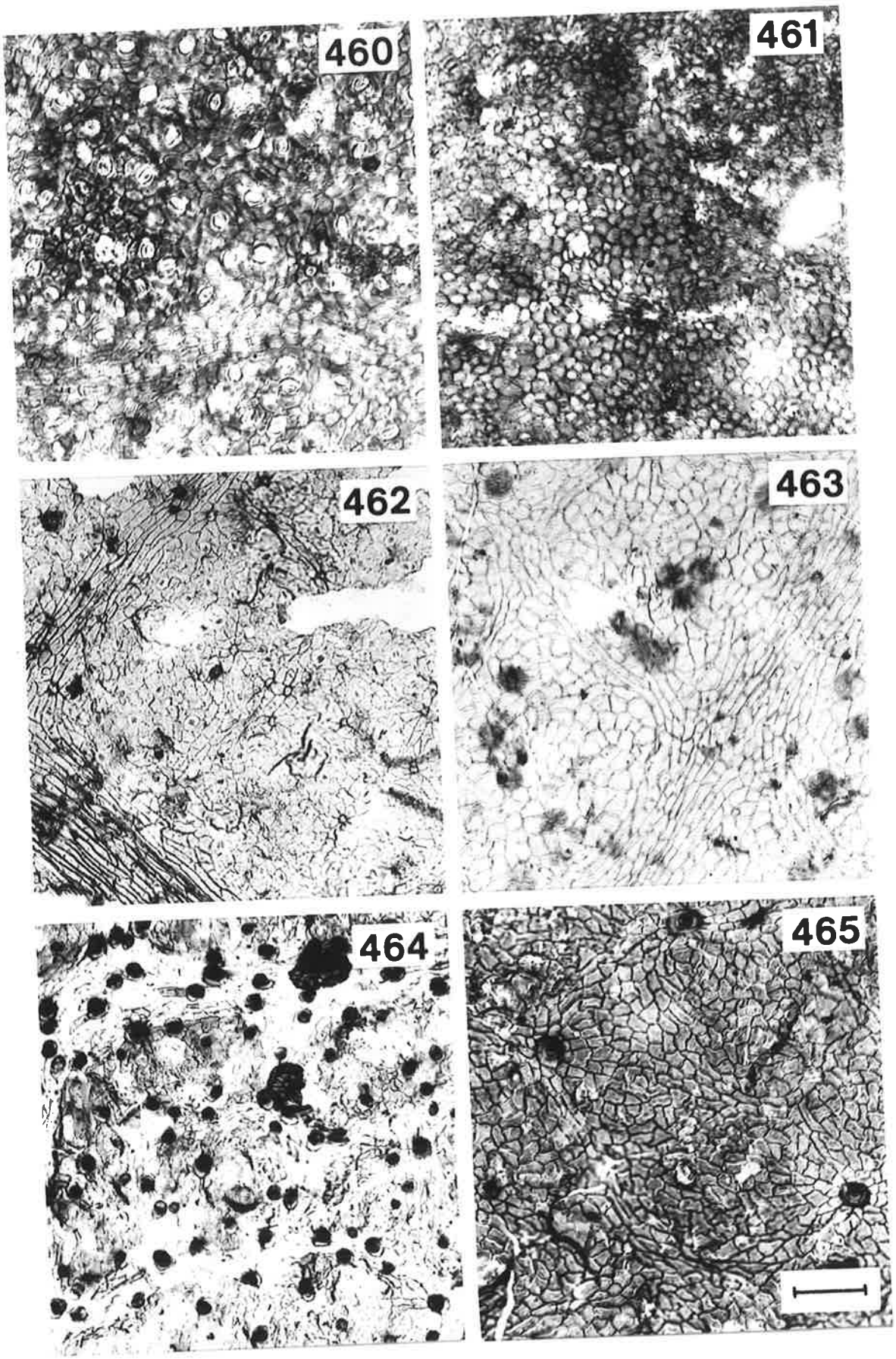
FIGURE 462. Specimen N 0403, Parataxon NER/029 : Lower epidermis

FIGURE 463. Specimen N 0403, Parataxon NER/029 : Upper epidermis

FIGURE 464. Specimen N 0150, Parataxon NER/031 : Lower epidermis

FIGURE 465. Specimen N 0150, Parataxon NER/031 : Upper epidermis

Scale = 100 um.


460
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464
465

FIGURE 466. Specimen N 0470, Parataxon NER/030 :
Lower epidermis

FIGURE 467. Specimen N 0362, Parataxon NER/030 :
Upper epidermis

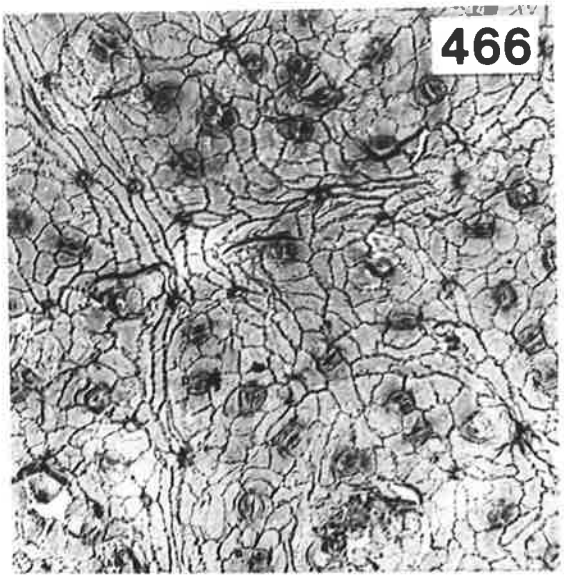
FIGURE 468. Specimen N 0373, Parataxon NER/030 :
Lower epidermis

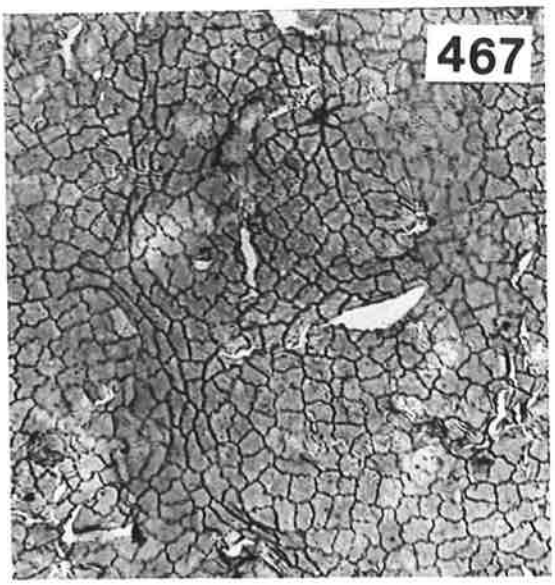
FIGURE 469. Specimen N 0373, Parataxon NER/030 :
Upper epidermis

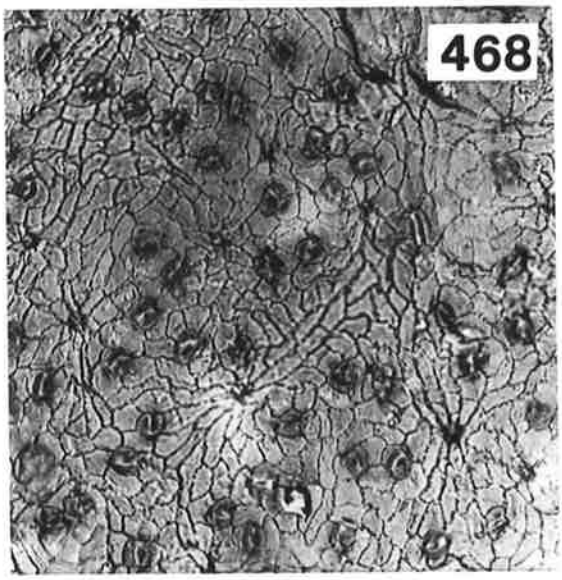
FIGURE 470. Specimen N 0083, Parataxon NER/032 :
Upper epidermis

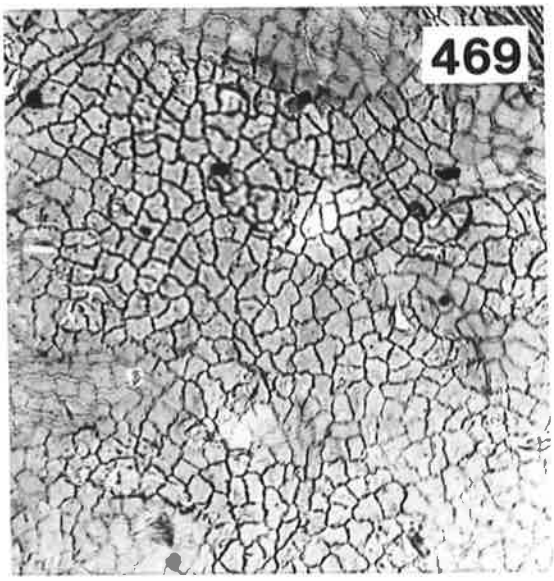
FIGURE 471. Specimen N 0083, Parataxon NER/032 :
Lower epidermis

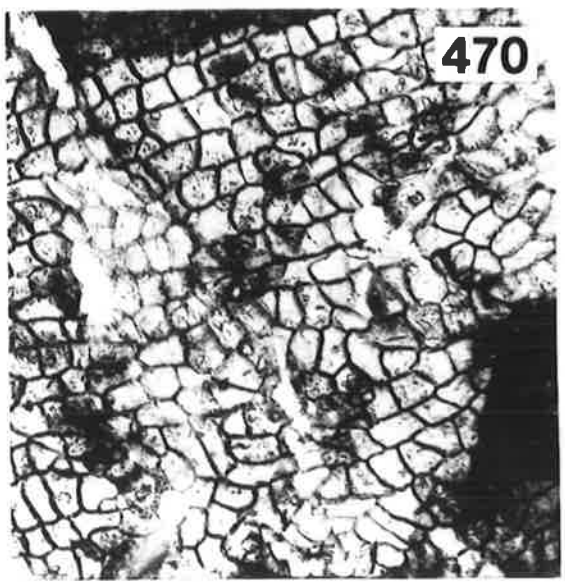
Scale = 100 um.


466


467


468


469


470

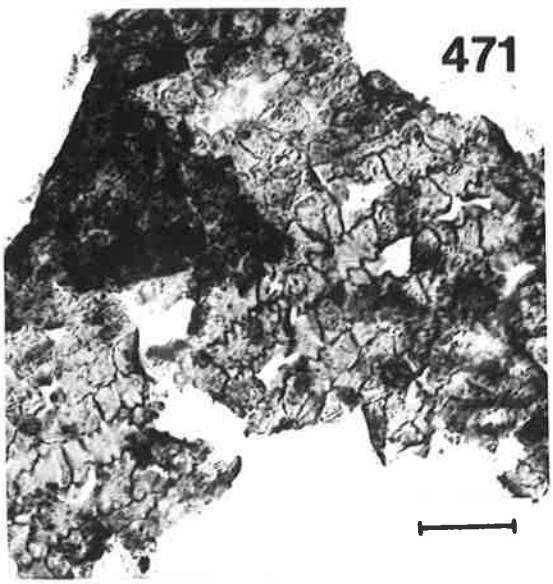

471

FIGURE 472. Specimen N 0246, Parataxon NER/028 : Stomate over areole, lower epidermis.

FIGURE 473. Specimen N 0246, Parataxon NER/028 : Stomate over areole, lower epidermis. (The same stomate as in fig. 472, in a different plane of focus).

FIGURE 474. Specimen N 0403, Parataxon NER/029 : Stomate over areole, lower epidermis.

FIGURE 475. Specimen N 0403, Parataxon NER/029 : Trichome bases over vein, lower epidermis.

FIGURE 476. Specimen N 0362, Parataxon NER/030 : Stomate over areole, lower epidermis.

FIGURE 477. Specimen N 0362, Parataxon NER/030 : Trichome base over vein, lower epidermis.

FIGURE 478. Specimen N 0150, Parataxon NER/031 : Stomate over areole, lower epidermis.

FIGURE 479. Specimen N 0083, Parataxon NER/032 : Stomate on upper epidermis. Note that the subsidiary cells almost completely cover the sunken guard cells.

Scale = 20 um.

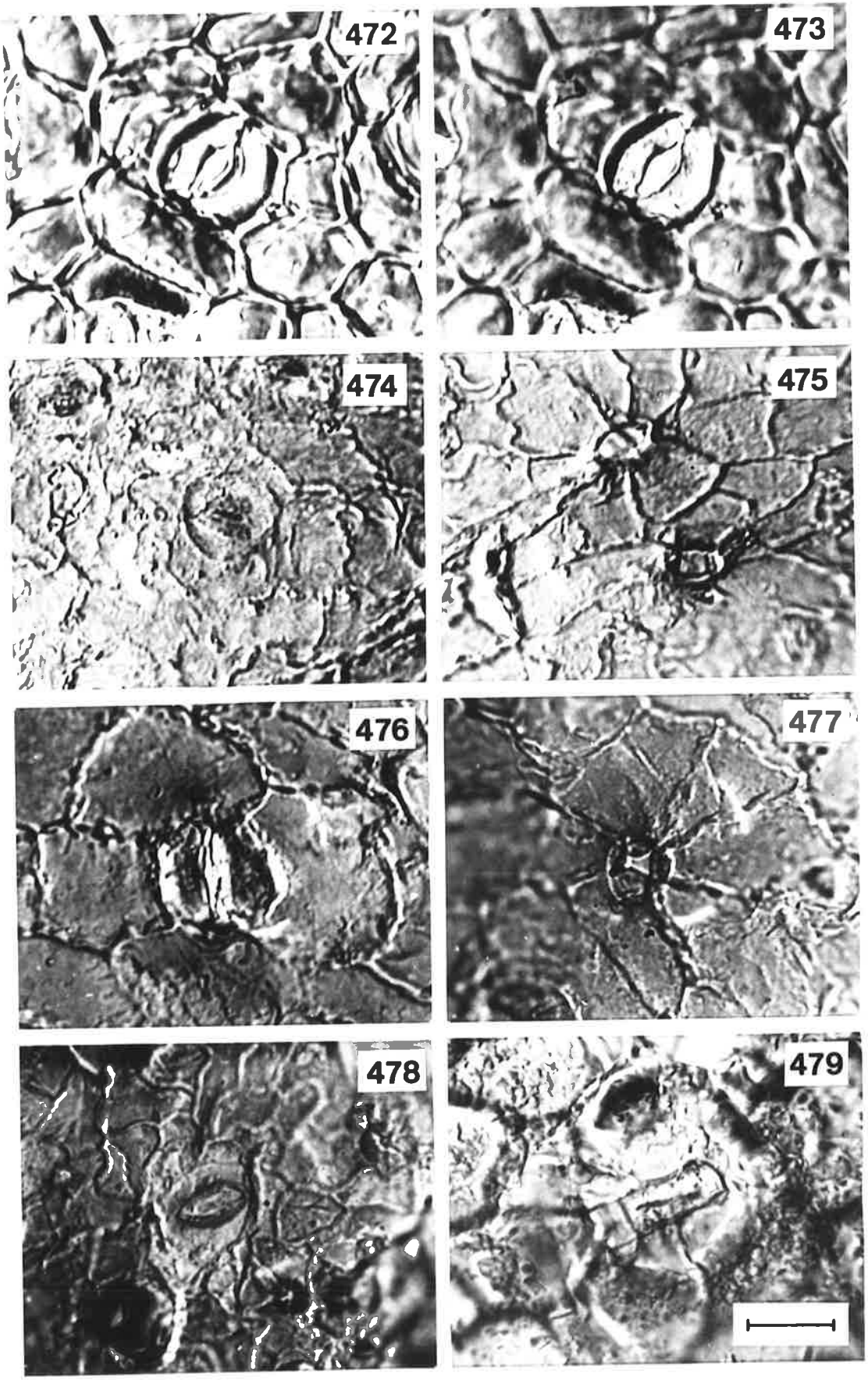

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FIGURE 480. Specimen N 0184, Parataxon NER/033 : Lower epidermis

FIGURE 481. Specimen N 0184, Parataxon NER/033 : Upper epidermis

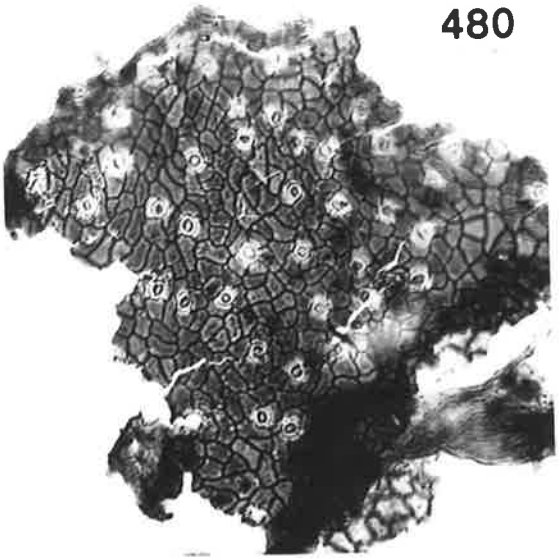
FIGURE 482. Specimen N 0575, Parataxon NER/034 : Lower epidermis

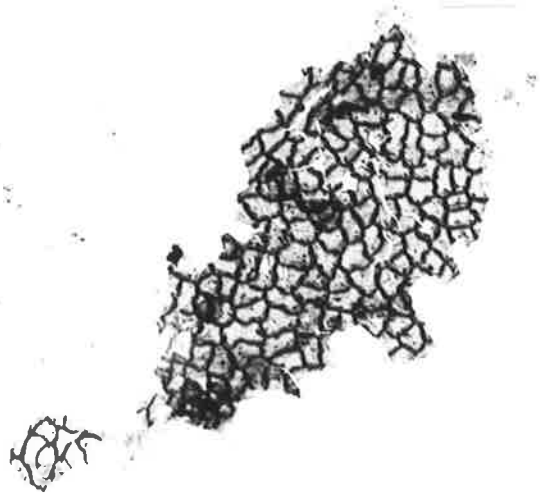
FIGURE 483. Specimen N 0575, Parataxon NER/034 : Upper epidermis

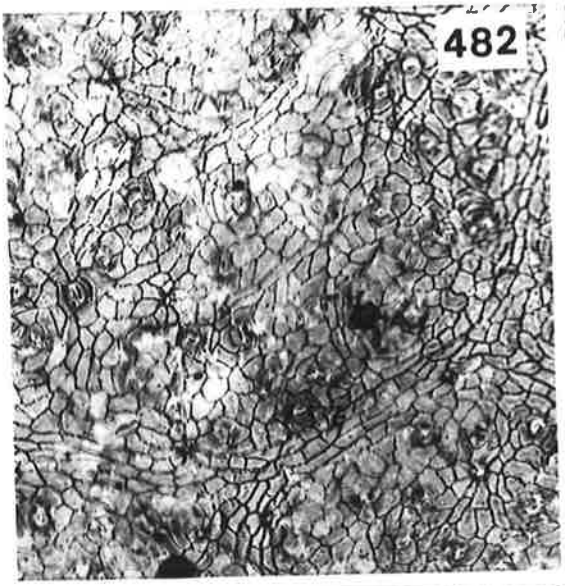
FIGURE 484. Specimen N 0476, Parataxon NER/035 : Lower epidermis

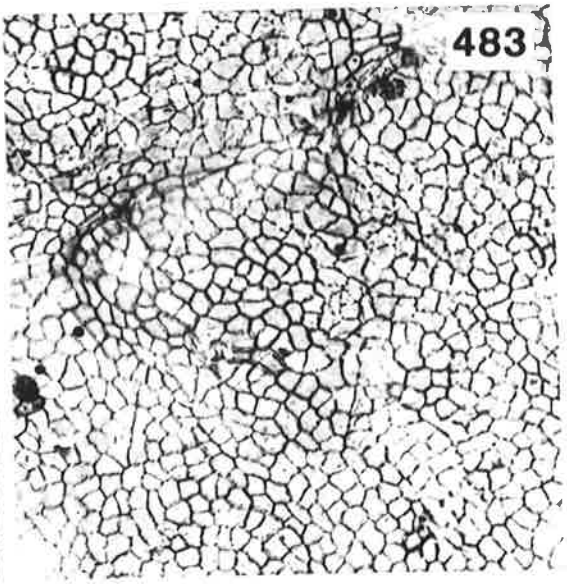
FIGURE 485. Specimen N 0476, Parataxon NER/035 : Upper epidermis

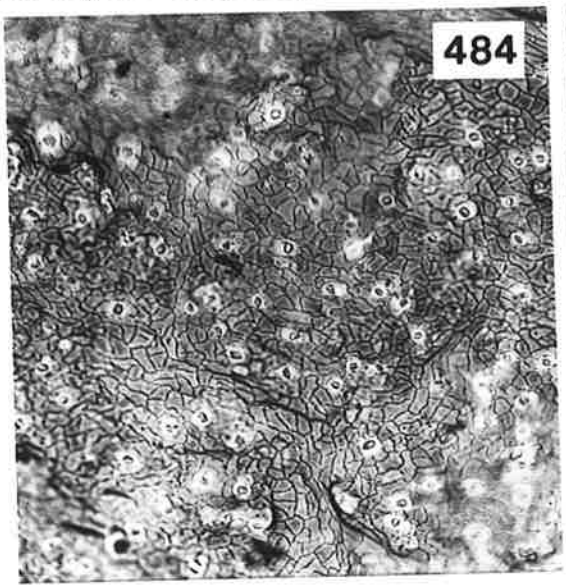
Scale = 100 um.


480


481


482


483


484

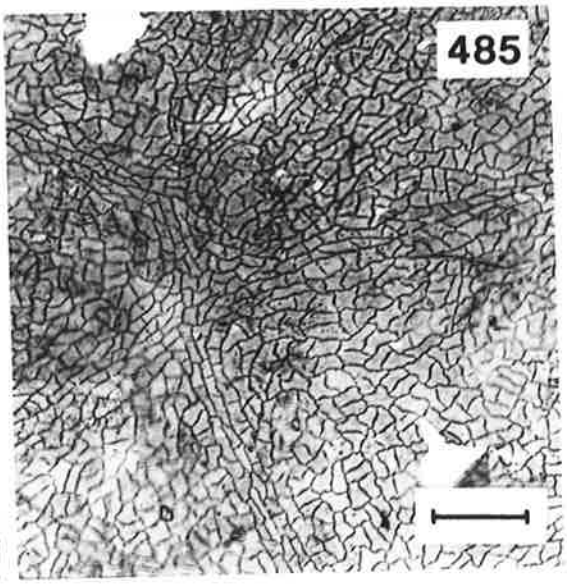

485

FIGURE 486. Specimen N 0470, Parataxon NER/036 : Lower epidermis

FIGURE 487. Specimen N 0470, Parataxon NER/036 : Upper epidermis

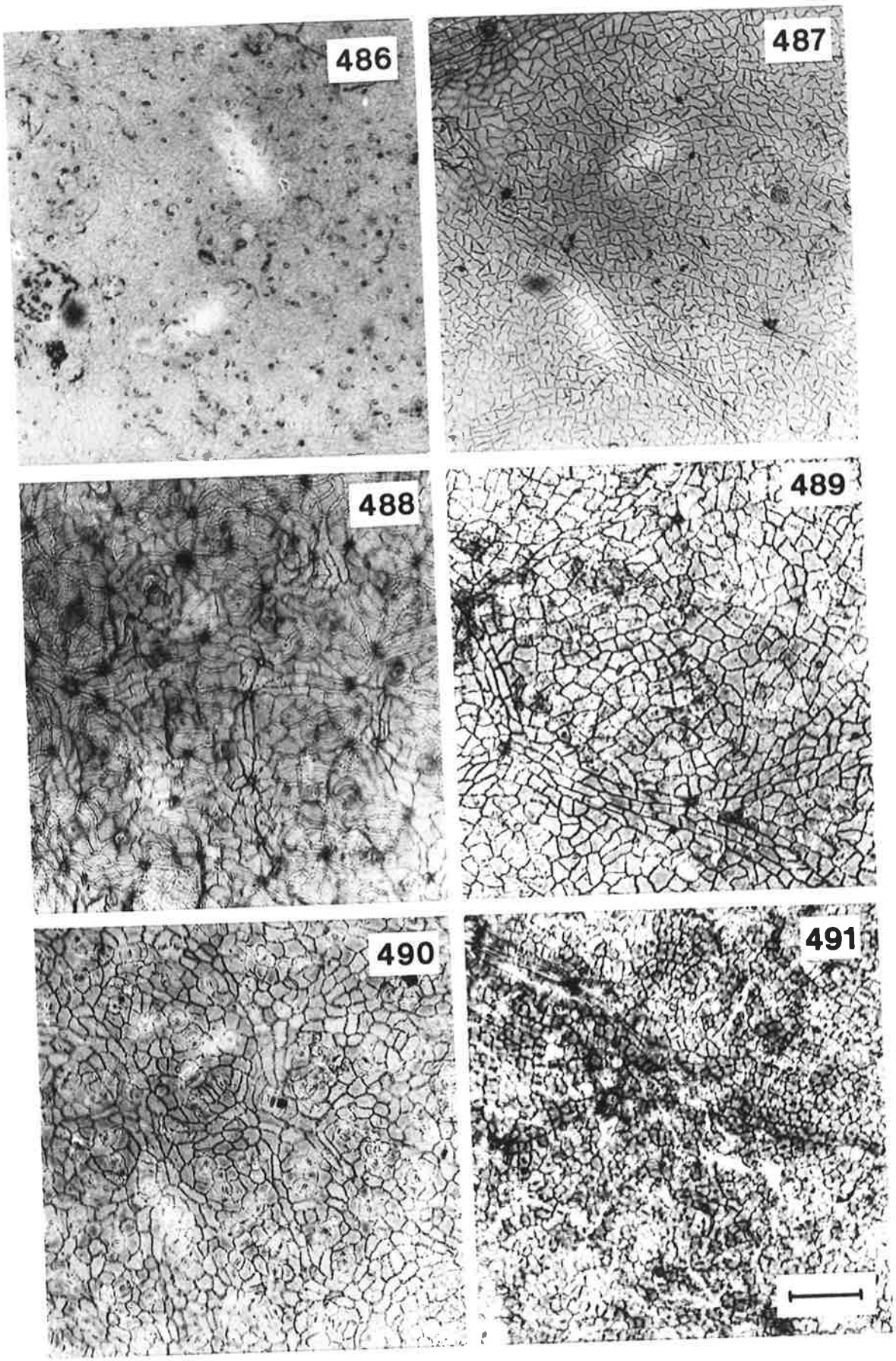
FIGURE 488. Specimen N 0437, Parataxon NER/037 : Lower epidermis

FIGURE 489. Specimen N 0437, Parataxon NER/037 : Upper epidermis

FIGURE 490. Specimen N 0356, Parataxon NER/038 : Lower epidermis

FIGURE 491. Specimen N 0356, Parataxon NER/038 : Upper epidermis

Scale = 100 um.


486
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491

FIGURE 492. Specimen N 0029, Parataxon NER/039 :
Lower epidermis

FIGURE 493. Specimen N 0029, Parataxon NER/039 :
Upper epidermis

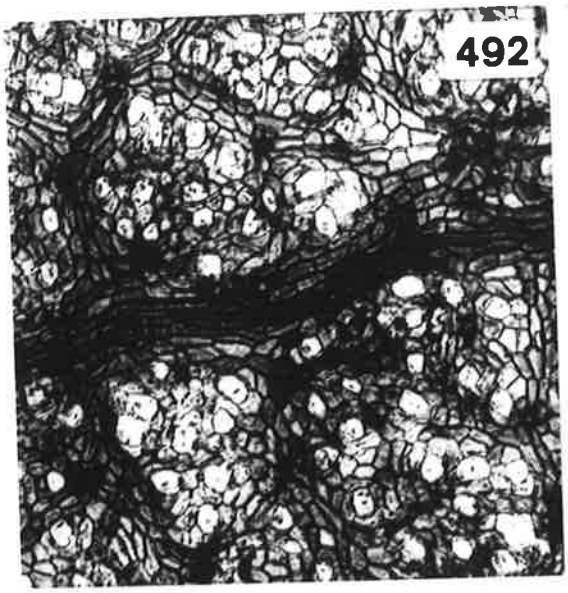
FIGURE 494. Specimen N 0066, Parataxon NER/040 :
Lower epidermis

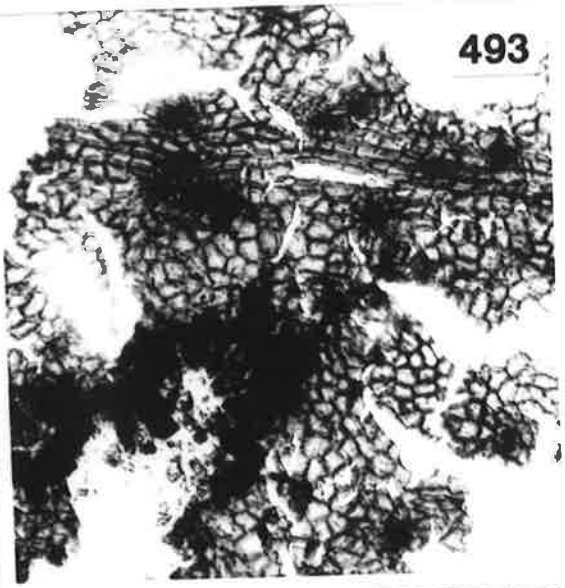
FIGURE 495. Specimen N 0066, Parataxon NER/040 :
Upper epidermis

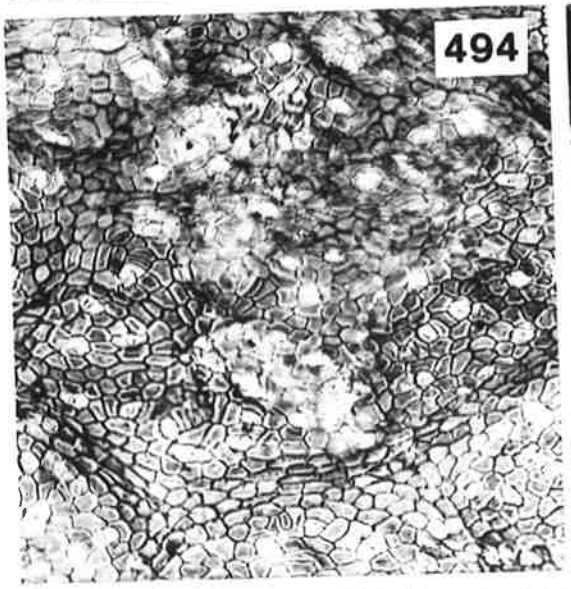
FIGURE 496. Specimen N 0121, Parataxon NER/041 :
Lower epidermis

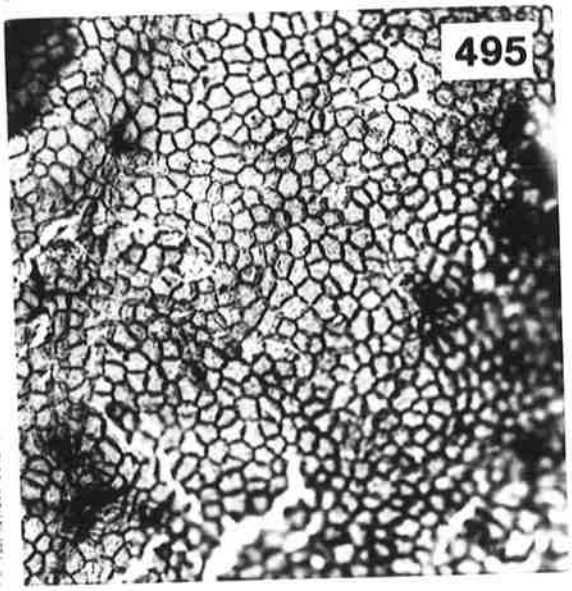
FIGURE 497. Specimen N 0121, Parataxon NER/041 :
Upper epidermis

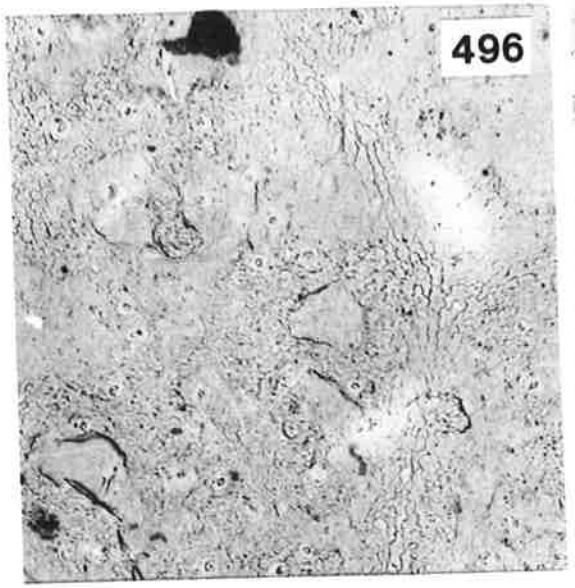
Scale = 100 um.


492


493


494


495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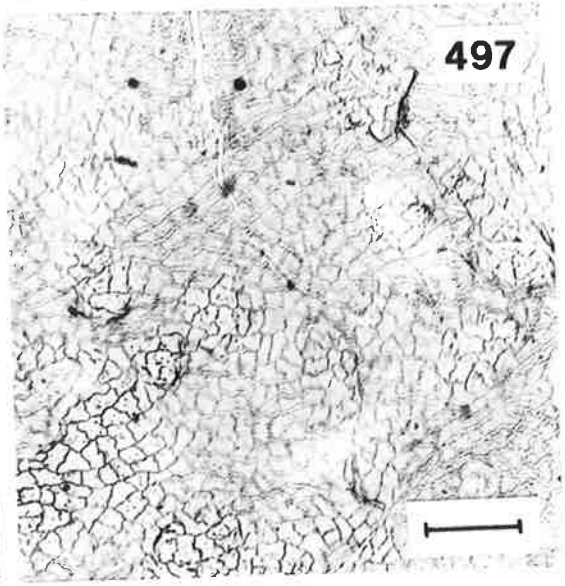
497

FIGURE 498. Specimen N 0495, Parataxon NER/042 : Lower epidermis

FIGURE 499. Specimen N 0495, Parataxon NER/042 : Upper epidermis

FIGURE 500. Specimen N 0263, Parataxon NER/043 : Lower epidermis

FIGURE 501. Specimen N 0263, Parataxon NER/043 : Upper epidermis

FIGURE 502. Specimen N 0283, Parataxon NER/044 : Lower epidermis

FIGURE 503. Specimen N 0283, Parataxon NER/044 : Upper epidermis

Scale = 100 um.

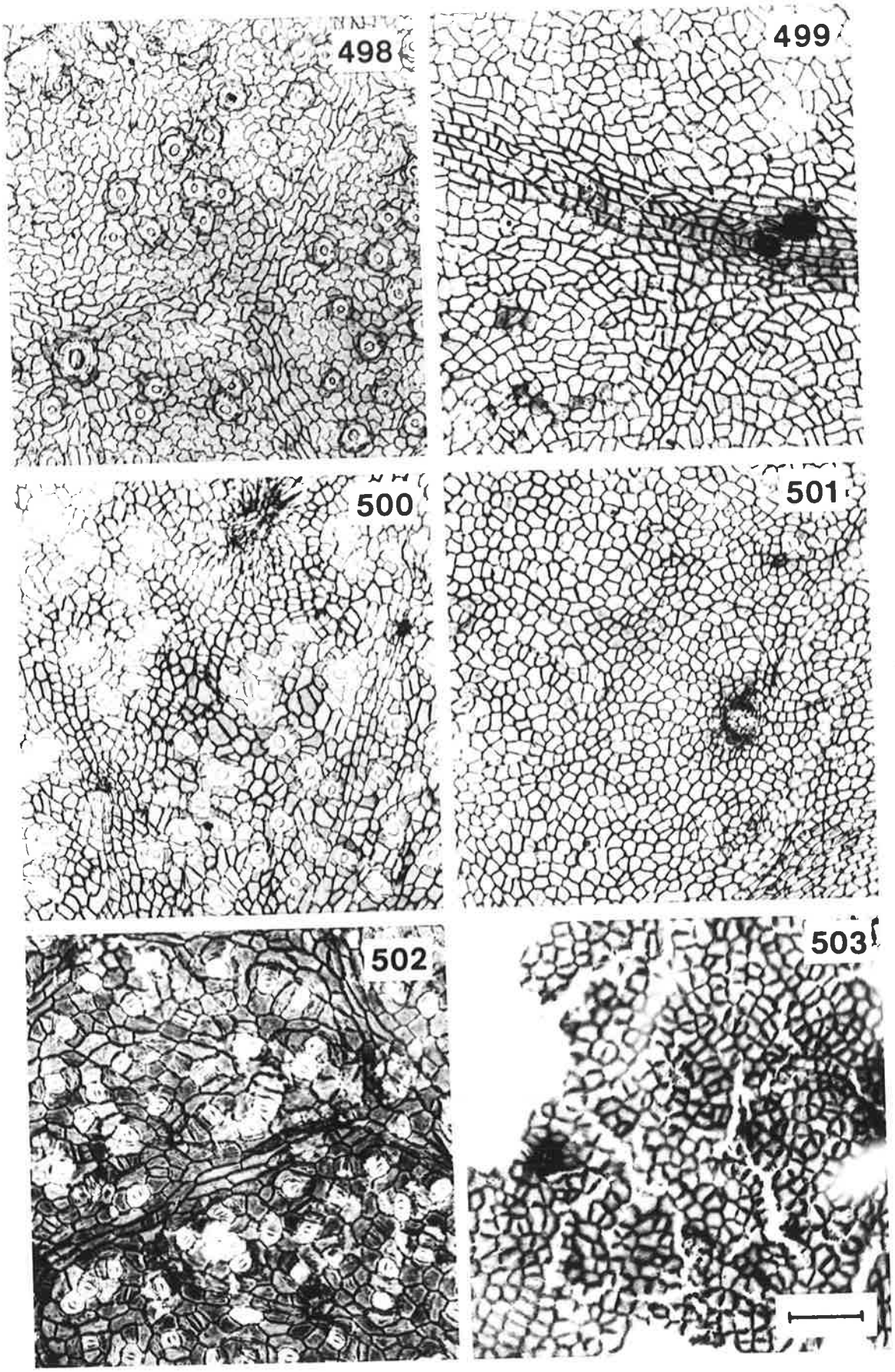
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FIGURE 504. Specimen N 0184, Parataxon NER/033 :
Stomate over areole, lower epidermis.

FIGURE 505. Specimen N 0575, Parataxon NER/034 :
Stomate over areole, lower epidermis.

FIGURE 506. Specimen N 0575, Parataxon NER/034 :
Trichome base over vein, lower epidermis.

FIGURE 507. Specimen N 0476, Parataxon NER/035 :
Stomate over areole, lower epidermis.

FIGURE 508. Specimen N 0470, Parataxon NER/036 :
Stomate over areole, lower epidermis.

FIGURE 509. Specimen N 0470, Parataxon NER/036 :
Trichome base over vein, lower epidermis.

FIGURE 510. Specimen N 0437, Parataxon NER/037 :
Stomate over areole, lower epidermis.

FIGURE 511. Specimen N 0437, Parataxon NER/037 :
Stomate over areole, lower epidermis.

Scale = 20 um.

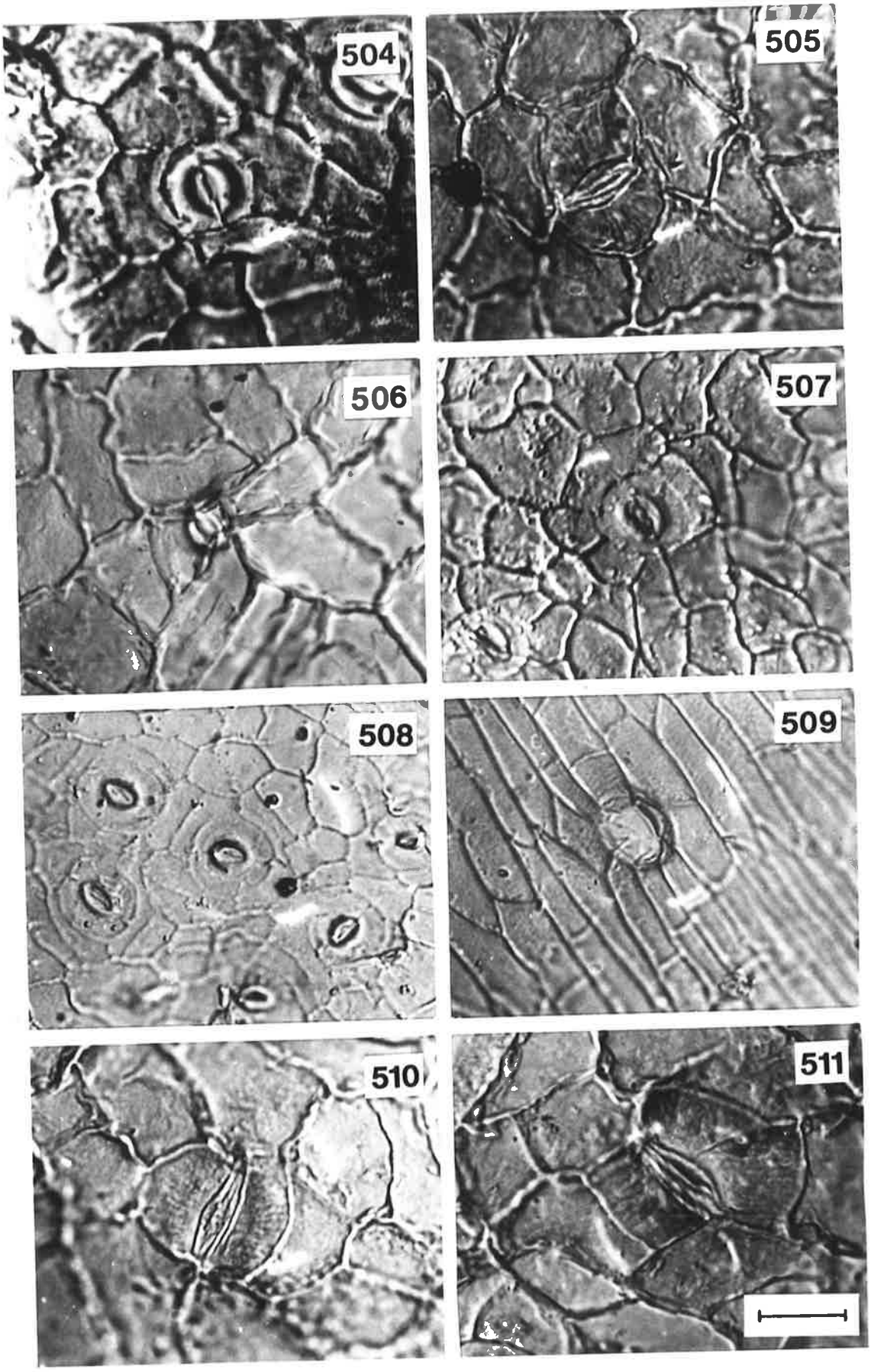
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FIGURE 512. Specimen N 0437, Parataxon NER/037 :
Trichome base over vein, lower epidermis.

FIGURE 513. Specimen N 0356, Parataxon NER/038 :
Stomate over areole, lower epidermis.

FIGURE 514. Specimen N 0356, Parataxon NER/038 :
Trichome base over vein, lower epidermis

FIGURE 515. Specimen N 0029, Parataxon NER/039 :
Stomate over areole, lower epidermis.

FIGURE 516. Specimen N 0029, Parataxon NER/039 :
Trichome base over vein, lower epidermis.

FIGURE 517. Specimen N 0066, Parataxon NER/040 :
Stomates over areole, lower epidermis.

FIGURE 518. Specimen N 0066, Parataxon NER/040 :
Trichome base over vein, lower epidermis.

FIGURE 519. Specimen N 0121, Parataxon NER/041 :
Stomate over areole, lower epidermis.

Scale = 20 um.

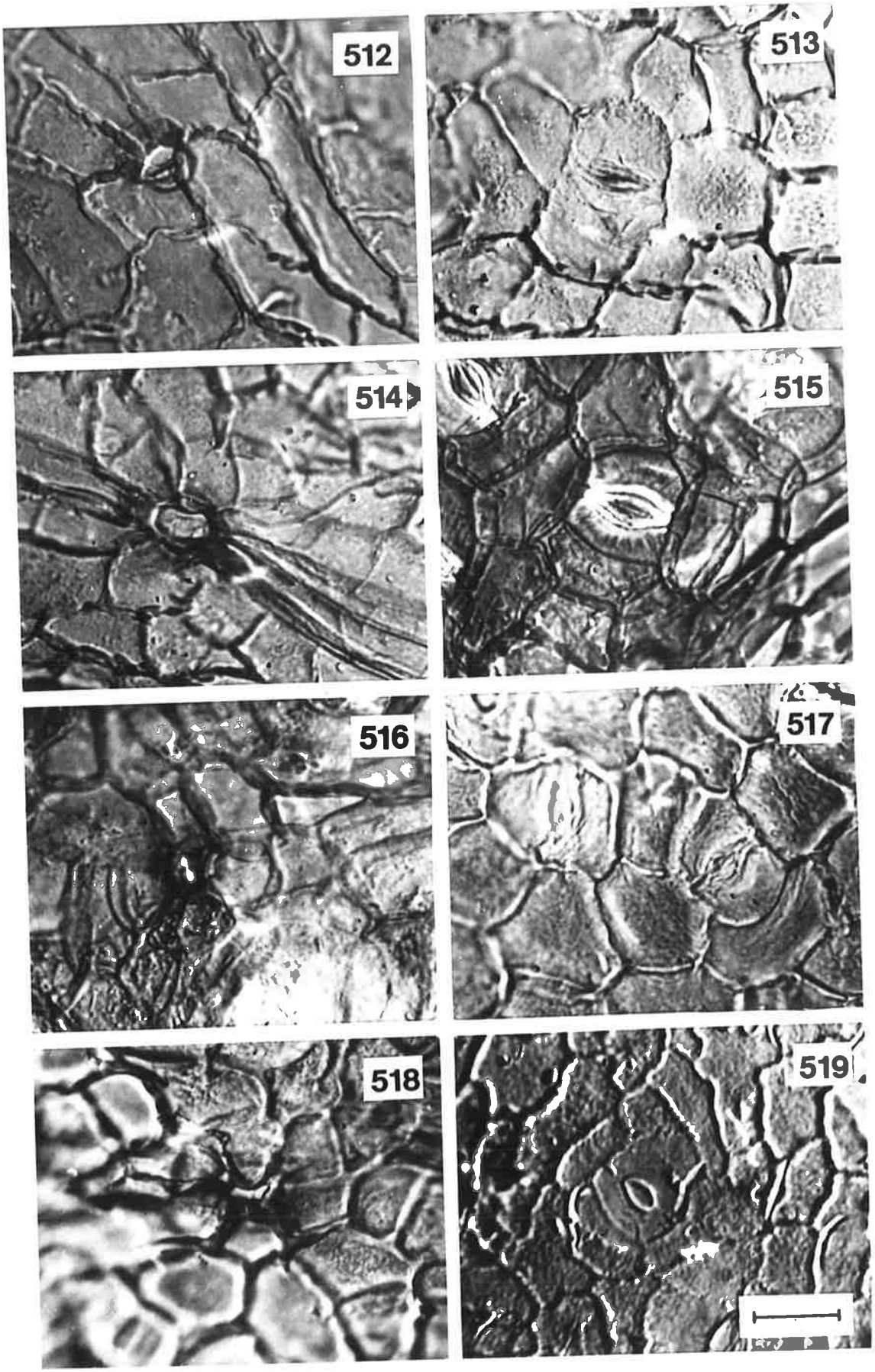
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FIGURE 520. Specimen N 0121, Parataxon NER/041 : Trichome base over vein, lower epidermis.

FIGURE 521. Specimen N 0495, Parataxon NER/042 : Stomate over areole, lower epidrmis.

FIGURE 522. Specimen N 0495, Parataxon NER/042 : Trichome base over vein, lower epidermis.

FIGURE 523. Specimen N 0263, Parataxon NER/043 : Stomate over areole, lower epidermis.

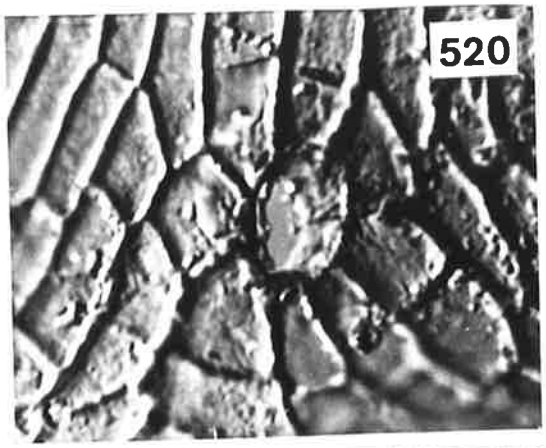
FIGURE 524. Specimen N 0263, Parataxon NER/043 : Trichome base over vein, lower epidermis.

FIGURE 525. Specimen N 0263, Parataxon NER/043 : Gland over vein on lower epidermis. The thinly cutinised cells covering the gland are completely preserved.

FIGURE 526. Specimen N 0283, Parataxon NER/044 : Stomate over areole, lower epidermis.

FIGURE 527. Specimen N 0283, Parataxon NER/044 : Trichome base over vein, lower epidermis.

Scale = 20 um.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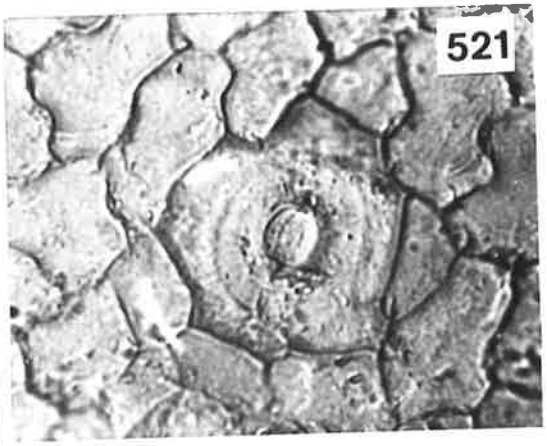
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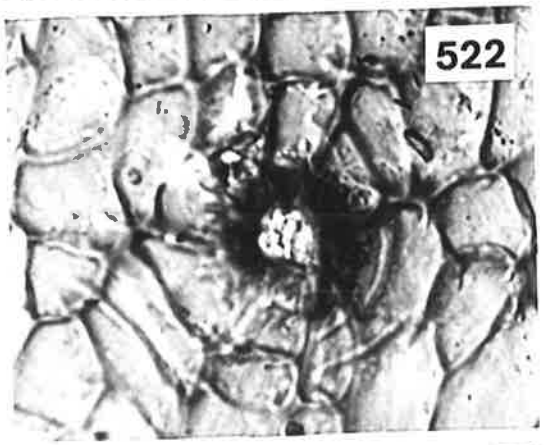
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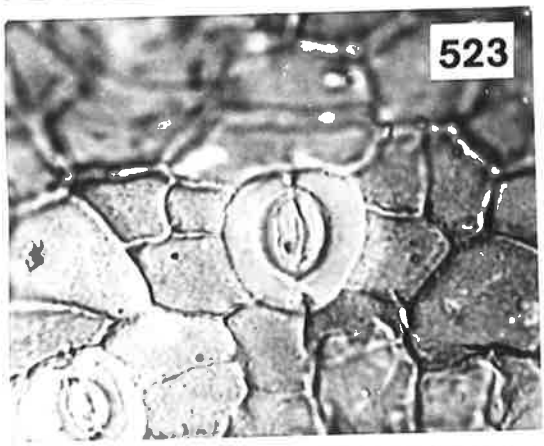
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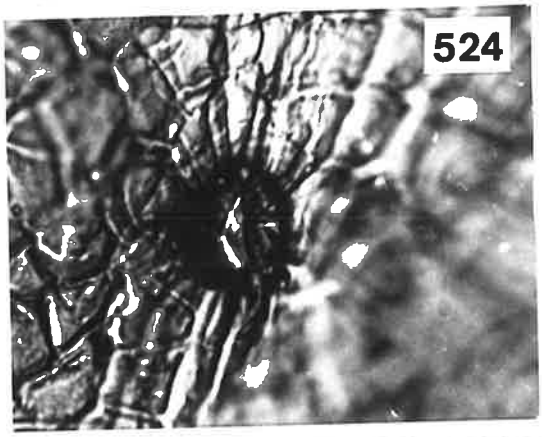
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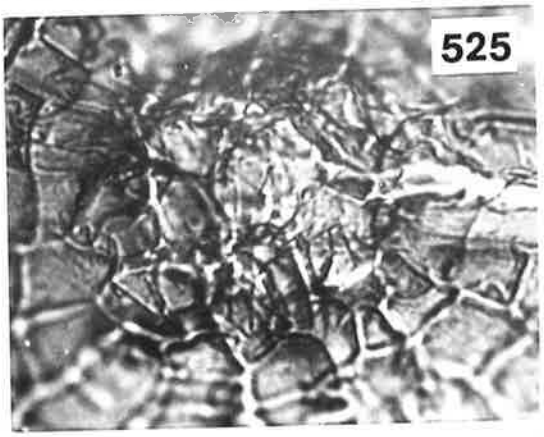
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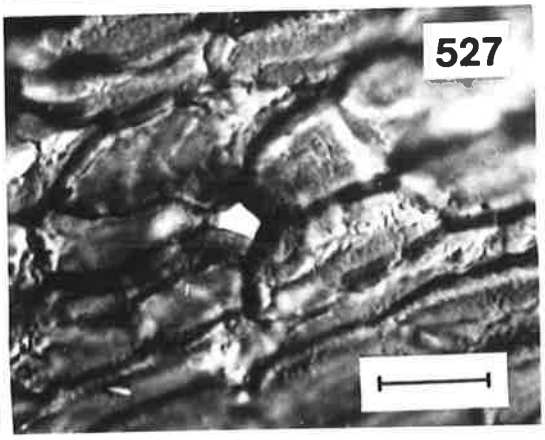
527

FIGURE 528. Grade $\overline{\underline{I}}$ "germling."

FIGURE 529. Grade $\overline{\underline{I}}$ "germlings."

FIGURE 530. Unidentified structure, not containing the small, central ring or dot characteristic of germlings.

FIGURE 531. Grade $\overline{\underline{I}}$ "germling."

FIGURE 532. Grade $\overline{\underline{II}}$ "germling."

FIGURE 533. Grade $\overline{\underline{II}}$ "germling."

FIGURE 534. Grade $\overline{\underline{II}}$ "germlings."

FIGURE 535. Grade $\overline{\underline{III}}$ "germling."

FIGURE 536. Grade $\overline{\underline{III}}$ "germling."

FIGURE 537. Grade $\overline{\underline{III}}$ "germling."

FIGURE 538. Grade $\overline{\underline{III}}$ "germling."

FIGURE 539. Grade $\overline{\underline{III}}$ "germling."

FIGURE 540. Grade $\overline{\underline{III}}$ "germling."

FIGURE 541. Grade $\overline{\underline{III}}$ "germling."

FIGURE 542. Grade $\overline{\underline{IV}}$ "germling."

FIGURE 543. Grade $\overline{\underline{IV}}$ "germling."

FIGURE 544. Grade $\overline{\underline{IV}}$ "germling."

FIGURE 545. Grade $\overline{\underline{IV}}$ "germling."

FIGURE 546. Grade $\overline{\underline{IV}}$ "germling."

FIGURE 547. Grade $\overline{\underline{V}}$ "germling."

FIGURE 548. Grade $\overline{\underline{V}}$ "germling."

FIGURE 549. Grade $\overline{\underline{V}}$ "germling."

FIGURE 550. Grade $\overline{\underline{V}}$ "germling."

FIGURE 551. Grade $\overline{\underline{V}}$ "germling."

Scale = 10 um.

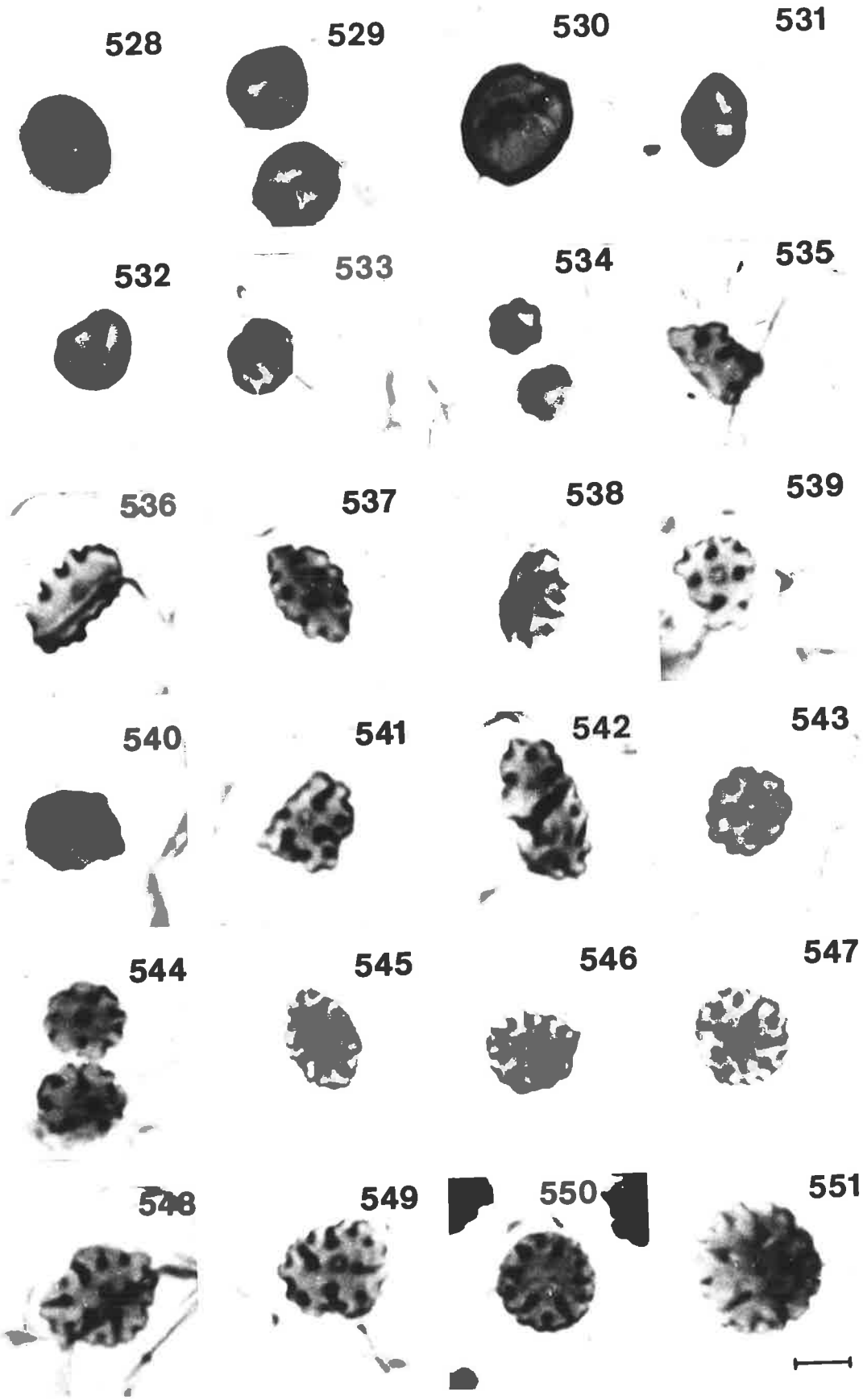
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FIGURE 552. General view of a lower epidermis showing frequency of fungal fruiting bodies (Scale = 100 um).

FIGURE 553. Unidentified fungal fruiting body, possibly belonging to family Microthyriaceae.

FIGURE 554. Unidentified fungal fruiting body, possibly belonging to family Microthyriaceae.

FIGURE 555. Unidentified fungal fruiting body, possibly belonging to family Microthyriaceae.

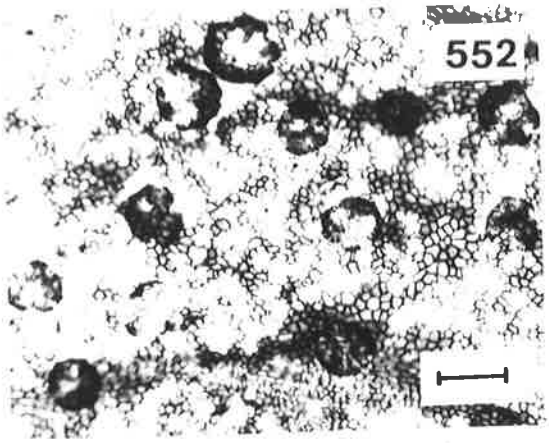
FIGURE 556. Unidentified fungal fruiting body.

FIGURE 557. Hyphae attached to a fruiting body similar to that in figure 556.

FIGURE 558. Agglomeration of fungal cells, possibly a fruiting body.

FIGURE 559. Unidentified fungal hyphae.

Scale for figs. 553 - 559 = 20 um.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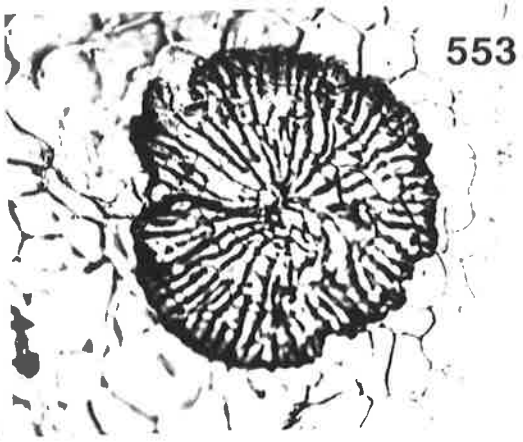
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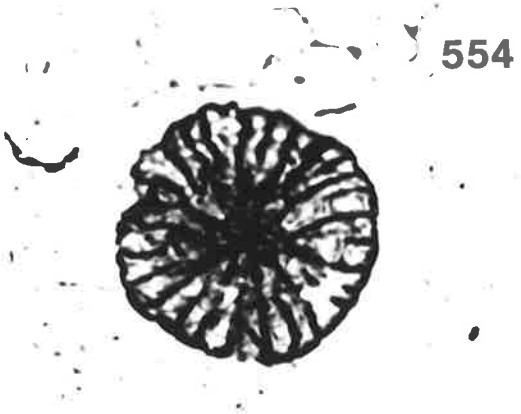
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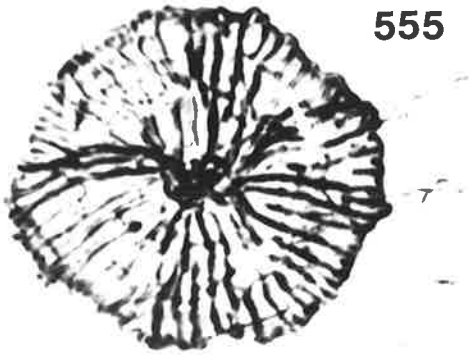
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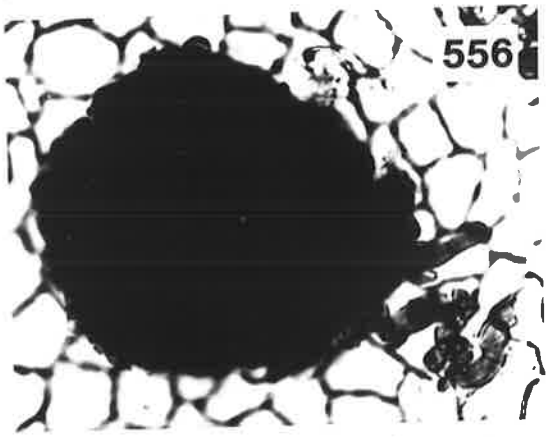
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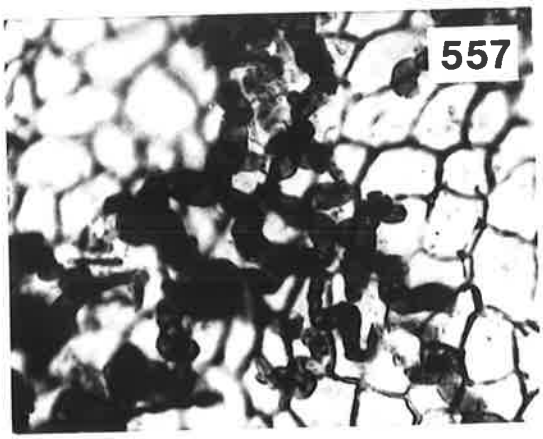
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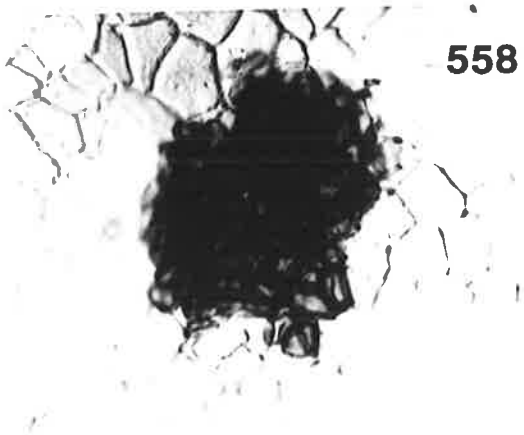
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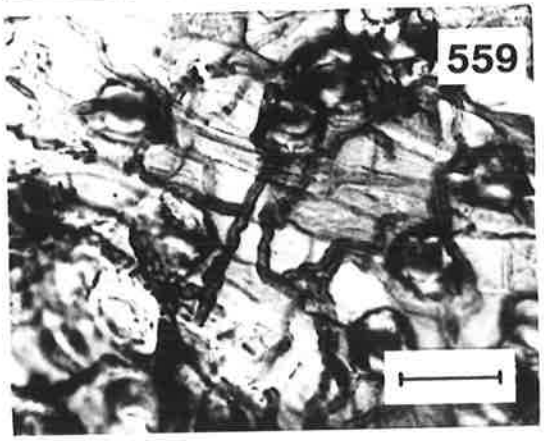
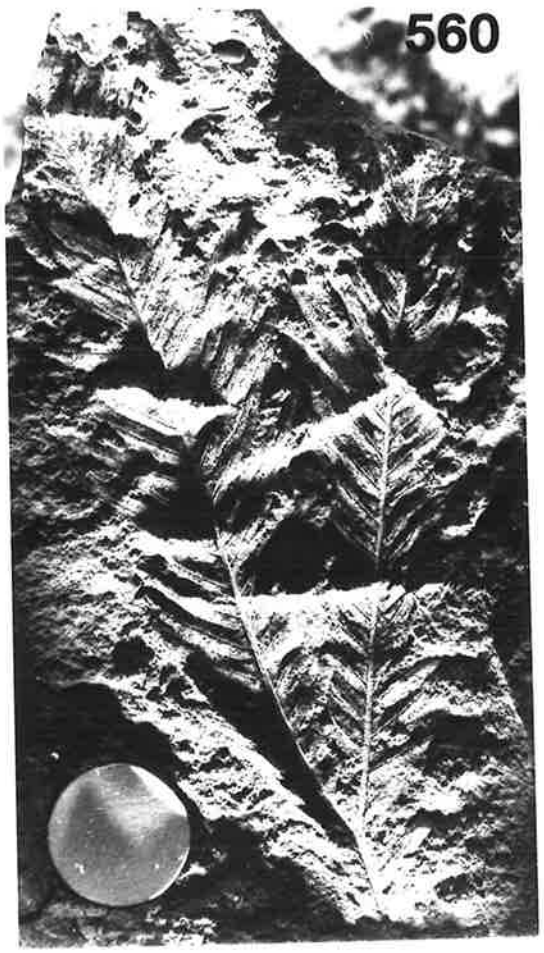

559

FIGURE 560. Specimen N 0600 : Impression of a fern frond.

FIGURE 561. Part of a frond of Sticherus flabellatus (R.Br.) St. John.

Scale = 1.5 cm.


560


561

APPENDIX IV

Material accepted for publication.

Hill, R. S. (1978). Two new species of *Bowenia* Hook, ex Hook, f. from the Eocene of eastern Australia. *Australian Journal of Botany, 26*(6), 837-846.

A STOPPING RULE FOR PARTITIONING DENDROGRAMS

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Running Title: Hill - Partitioning Dendrograms.

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ABSTRACT

The Ratkowsky and Lance criterion for determining the "optimum" number of groups in a dendrogram is applicable to both nominal and numeric data, is easy to calculate, and requires no prior knowledge of the identity of the operational taxonomic units. A modification of that criterion, described in this paper, maintains the advantages of the original criterion and overcomes the problems of the invalid use of phenon lines and lack of objectivity. Preliminary work also suggests that the modification gives improved results for the number of groups.

INTRODUCTION

Determination of the number of groups in a classification is one of the major problems in numerical taxonomy. Among the earliest approaches was the use of the "phenon line" (Sneath and Sokal 1973, p. 294). This required the drawing of a line across the dendrogram at a particular percentage of similarity and nominating all groups produced by that line as phenons.

There are two objections to this method. Firstly, without prior knowledge of the taxonomy of the operational taxonomic units (OTUs) there is no way of predicting where the phenon lines should be placed. Secondly, Clifford and Williams (1973) and Clifford (1976) showed that, unless the fusion strategy in use is strictly space conserving, the drawing of phenon lines is invalid due to group size dependence. The only completely space-conserving strategy which would allow the valid use of phenon lines is centroid (Clifford 1976), which is now rarely used.

To determine the number of groups in a classification, Ratkowsky and Lance (1978) defined a criterion that is applicable to nominal and numerical attribute types. It depends on the Cramér measure (Cramér 1946, p. 443) for the degree of association for nominal attributes and a corresponding measure for numeric attributes suggested by the analysis of variance.

According to Ratkowsky and Lance (1978), the Cramér measure, applied to the number of individuals in each of the states of the nominal attribute, after a total of N individuals have been classified in n groups, is:

$$C = \left[\frac{\chi^2}{N \min (s-1, n-1)}\right]^{\frac{1}{2}},$$

where χ^2 is the conventional chi-square measure of association in a contingency table, and min (s-1, n-1) signifies the smaller of the two quantities s-1 and n-1 (s = the number of states in the attribute). For numerical attributes, a corresponding measure is:

$$S = \left(\frac{B}{T}\right)^{\frac{1}{2}},$$

where B is the between-group sum of squares and T is the total sum of squares (Lance and Williams 1977). Both S and C are constrained between zero and unity and are fully compatible (Lance and Williams 1977). Ratkowsky and Lance (1978) proposed that the optimum number of groups in a classification is that value of n for which $\frac{\overline{C}}{n^{\frac{1}{2}}}$ has its maximum values ($\overline{C}$ is the average value obtained by applying C to each nominal attribute and S to each numeric attribute).

There are two disadvantages to this criterion. A phenon line must be applied to determine the groups for which $\overline{C}$ is calculated. The invalidity of the use of phenon lines has already been discussed. The second disadvantage concerns objectivity. Ratkowsky and Lance (1978 p. 117) found that the criterion should

be $\frac{\overline{C}}{(n-1)^{\frac{1}{2}}}$, but "as n was found to work better than n-1 in the examples studied, the final formula is $\frac{\overline{C}}{n^{\frac{1}{2}}}$." They also tried using C^2 rather than C but concluded that "this worked less well for the examples described herein." Although there is nothing invalid in manipulating this quasi-statistical criterion to give the "best" result, it would be preferable to have a more objective approach. A modification of the Ratkowsky and Lance criterion has been devised to overcome these two disadvantages.

MATERIAL AND METHODS

If the value of n is made constant, the Ratkowsky and Lance (1978) criterion can be reduced from $\frac{\overline{C}}{n^{\frac{1}{2}}}$ to $\overline{C}$. The following method restricts n to 2. Firstly, $\overline{C}$ is calculated for the two groups which are linked by the last fusion in the classification. These groups are then considered independently, and for each one, $\overline{C}$ is recalculated for the two groups within it which are linked by the last fusion. This continues for successive pairs of groups until the maximum value of $\overline{C}$ is attained for each group. This modification overcomes the disadvantages of the Ratkowsky and Lance criterion. By making n constant, the criterion can be reduced to $\overline{C}$, which is independent of n, and by considering successive pairs of groups independently of all other groups, a phenon line is not required.

Lance and Williams (1977) showed that the importance of an attribute to a classification can be assessed by considering the value of C or S for that attribute relative to the other attributes.

Therefore, the modification of the Ratkowsky and Lance criterion suggested in this paper proposes that a group should not be further divided after the maximum average attribute contribution has been attained i.e. for each group, splitting ceases when $\overline{C}_{max}$ is achieved.

This method is best explained with a small artificial example. The dendrogram (fig. 1) contains 12 OTUs. The first furcation of the dendrogram (A in fig. 1) splits the OTUs into two groups. One of these groups contains OTUs 1-9 and the other OTUs 10-12. $\overline{C}$ is calculated for these two groups (= $\overline{C}_A$). Each group is then considered independently. The group containing OTUs 1-9 next furcates at B, splitting the OTUs into two groups. One of these groups contains OTUs 1-5 and the other OTUs 6-9. $\overline{C}$ is calculated for these two groups (= $\overline{C}_B$). If $\overline{C}_B < \overline{C}_A$, no further calculation is required, since for this group of OTUs, $\overline{C}_{max}$ (= $\overline{C}_A$) has been attained, and OTUs 1-9 constitute one group. If $\overline{C}_B \geq \overline{C}_A$, as is the case in this example, $\overline{C}_{max}$ has not been attained and further calculations are necessary. Each group is again considered independently. The group containing OTUs 1-5 next furcates at C, splitting the OTUs into two groups (OTUs 1-3 and OTUs 4 and 5). $\overline{C}$ is calculated for these two groups (= $\overline{C}_C$), and $\overline{C}_C \geq \overline{C}_B \geq \overline{C}_A$. Therefore the maximum $\overline{C}$ value has still not been attained. $\overline{C}_D$ is then calculated for the two groups containing OTUs 1 and 2 and OTU 3, and $\overline{C}_D < \overline{C}_C \geq \overline{C}_B \geq \overline{C}_A$. Therefore, $\overline{C}_C$ is the maximum $\overline{C}$ value for this section of the dendrogram, and OTUs 1-3 represent one group (1 in fig. 1). For the other OTUs, $\overline{C}_E < \overline{C}_C \geq \overline{C}_B \geq \overline{C}_A$ gives OTUs 4 and 5 as group 2; $\overline{C}_F < \overline{C}_B \geq \overline{C}_A$ gives OTUs 6-9 as group 3, and $\overline{C}_G < \overline{C}_A$ gives OTUs 10-12 as group 4.

The value of any quasi-statistical method can only be assessed by application. One other example will be considered, both to illustrate the method and for comparison with the Ratkowsky and Lance (1978) criterion.

The example chosen was 100 angiosperm leaves representing 20 species (five leaves per species), scored for 31 numeric attributes, as presented by Hill (1980 in press). The attributes were standardised using the method of Blackburn (1978), and a similarity matrix of squared Euclidean distances was computed. The clustering strategy employed was Ward's error sum of squares, developed independently by Ward (1963) and Burr (1970). This fusion strategy is space dilating (Williams, Clifford, and Lance 1971), making phenon lines invalid.

RESULTS

All attributes in this example were numeric and therefore $S = (\frac{B}{T})^{\frac{1}{2}}$ was used exclusively. According to the Ratkowsky and Lance (1978) criterion, the optimum number of groups is four (table 1). A phenon line has been drawn at that level (fig. 2). Eighteen groups were delimited by calculation of $\overline{C}$ for successive pairs of groups (table 2). In this example it is impossible to draw a phenon line for all 18 groups (fig. 2).

DISCUSSION

The example chosen was useful because the taxonomic identity of the OTUs was known before the cluster analysis was performed, and all OTUs clustered tightly with other OTUs of the same species (see fig. 2). An ideal result for a stopping rule would be to separate all 20 species as individual clusters. Neither criterion did this, but the result of 18 groups, using the method described in this paper, is more satisfactory than the four clusters predicted by the Ratkowsky and Lance (1978) criterion.

This illustrates an undesirable feature of the Ratkowsky and Lance criterion. Since the values of C and S are bounded by zero and unity, as n increases, the maximum possible value of $C/n^{\frac{1}{2}}$ decreases. The graph of n against $C/n^{\frac{1}{2}}_{max}$ (fig. 3) asymptotes to the positive X axis. The decrease in the value of $C/n^{\frac{1}{2}}_{max}$ over the first few values of n is very marked. For example, from n = 2 to n = 5, $\frac{C}{n^{\frac{1}{2}}}_{max}$ decreases by 0.26 (0.707 to 0.447), compared with a further decrease of only 0.189 up to n = 15 (0.447 to 0.258). This substantial initial decrease in the value of $\frac{C}{n^{\frac{1}{2}}}_{max}$ indicates that it is unlikely that $\frac{\overline{C}}{n^{\frac{1}{2}}}$ could reach its maximum value at a high value of n because of its relatively low theoretical maximum. In the six examples given by Ratkowsky and Lance (1978), the optimum value of n was 2, 3, or 4. Several examples have been examined as part of this research with the same result. The example given in this paper illustrates that a low value for n is not always the optimum result.

Ratkowsky and Lance (1978) suggested that their criterion indicated "the maximum number of groups for which different classificatory algorithms are capable of agreeing broadly." The

data in the example presented in this paper was also clustered using the Nearest Neighbour and Average Linkage (UPGMA) algorithms. In no instance would a value as low as 4 for the optimum number of groups be justified, and if the modified criterion had been recalculated, it is possible that the same 18 groups could have been produced.

The stopping rule has been employed successfully in several examples, but there are two difficulties. Firstly, in very small clusters, particularly with a low number of attributes, the value of $\overline{C}$ can continue to increase until it has split the cluster into its individual OTUs. This is because small differences between OTUs take on relatively greater importance as group size decreases.

This stopping rule therefore produces the maximum number of groups rather than the optimum number, and other criteria may be required to fuse groups. The most successful application of this method is on dendrograms containing a large number of OTUs where the problem of small clusters rarely occurs (e.g. as in fig. 2). Secondly, the modification cannot be applied unless the attributes have been standardised. The method for determining attribute contributions to a classification proposed by Lance and Williams (1977) is only applicable if the assumption is made that each attribute potentially has the same contribution as any other attribute. This is not generally a problem, since in most classifications attributes are standardised.

CONCLUSION

The method proposed by Ratkowsky and Lance (1978) to determine the optimum number of groups in a classification has several valuable features. It is easy to apply; it requires no prior knowledge of the identity of the OTUs; and it generally gives an unambiguous result. It does, however, have three disadvantages: It requires the use of a phenon line, which is generally invalid; it lacks objectivity, having more than one form in which it can be applied; and it gives a low number of groups as the "optimum" result. This last disadvantage is probably the most objectionable to the numerical taxonomist, who may often reasonably expect a large number of groups in a classification.

The modification to the Ratkowsky and Lance criterion overcomes the disadvantages of that criterion while losing none of the advantages. In examples so far attempted, the optimum number of groups has varied between two and 18, and in all cases the result appeared to be satisfactory. Quasi-statistical methods must be applied with caution, and their value can only be shown by application. Two problems with this method have already been discussed and others may occur with further use. At present, the method appears to offer strong guidelines to assist in the determination of the number of groups in a dendrogram.

ACKNOWLEDGMENTS

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LITERATURE CITED

Blackburn, D.T. 1978. Numerical studies of leaf architecture of dicotyledons: *Saurauia* (Actinideaceae) as a test case. Unpubl. Ph.D. diss., University of Adelaide.

Burr, E.J. 1970. Cluster sorting with mixed character types. II. Fusion strategies. Australian Comput. J. 2: 98-103.

Clifford, H.T. 1976. Dendrograms and their interpretation. Pages 96-101 in W.T. Williams, ed. Pattern analysis in agricultural science. C.S.I.R.O., Melbourne and Elseview, Amsterdam.

Clifford, H.T. and W.T. Williams. 1973. Classificatory dendrograms and their interpretation. Australian J. Bot. 21: 151-162.

Cramér, H. 1946. Mathematical methods of statistics. Princeton University Press, Princeton.

Hill, R.S. 1980 in press. A numerical taxonomic approach to the study of angiosperm leaves. Bot. Gaz.

Lance, G.N. and W.T. Williams. 1977. Attribute contributions to a classification. Australian Comput. J. 9: 128-129.

Ratkowsky, D.A. and G.N. Lance. 1978. A criterion for determining the number of groups in a classification. Australian Comput. J. 10: 115-117.

Sneath, P.H.A. and R.R. Sokal. 1973. Numerical taxonomy. W.H. Freeman and Co., San Francisco.

Ward, J.H. 1963. Hierarchical grouping to optimize on objective function. J. Amer. Stat. Assoc. 58: 236-244.

Williams, W.T., H.T. Clifford, and G.N. Lance. 1971. Group-size dependence: a rationale for choice between numerical classifications. Comput. J. 14: 157-162.

TABLE 1

Values of the Ratkowsky and Lance criterion for increasing values of n. The maximum value occurs at n = 4.

n	$\overline{C}$	$\frac{\overline{C}}{n^{\frac{1}{2}}}$
2	0.307	0.217
3	0.462	0.267
4	0.586	0.293
5	0.637	0.285

TABLE 2

Values of $\overline{C}$ for each successive pair of clusters, calculated until the maximum value of $\overline{C}$ is passed in each case.

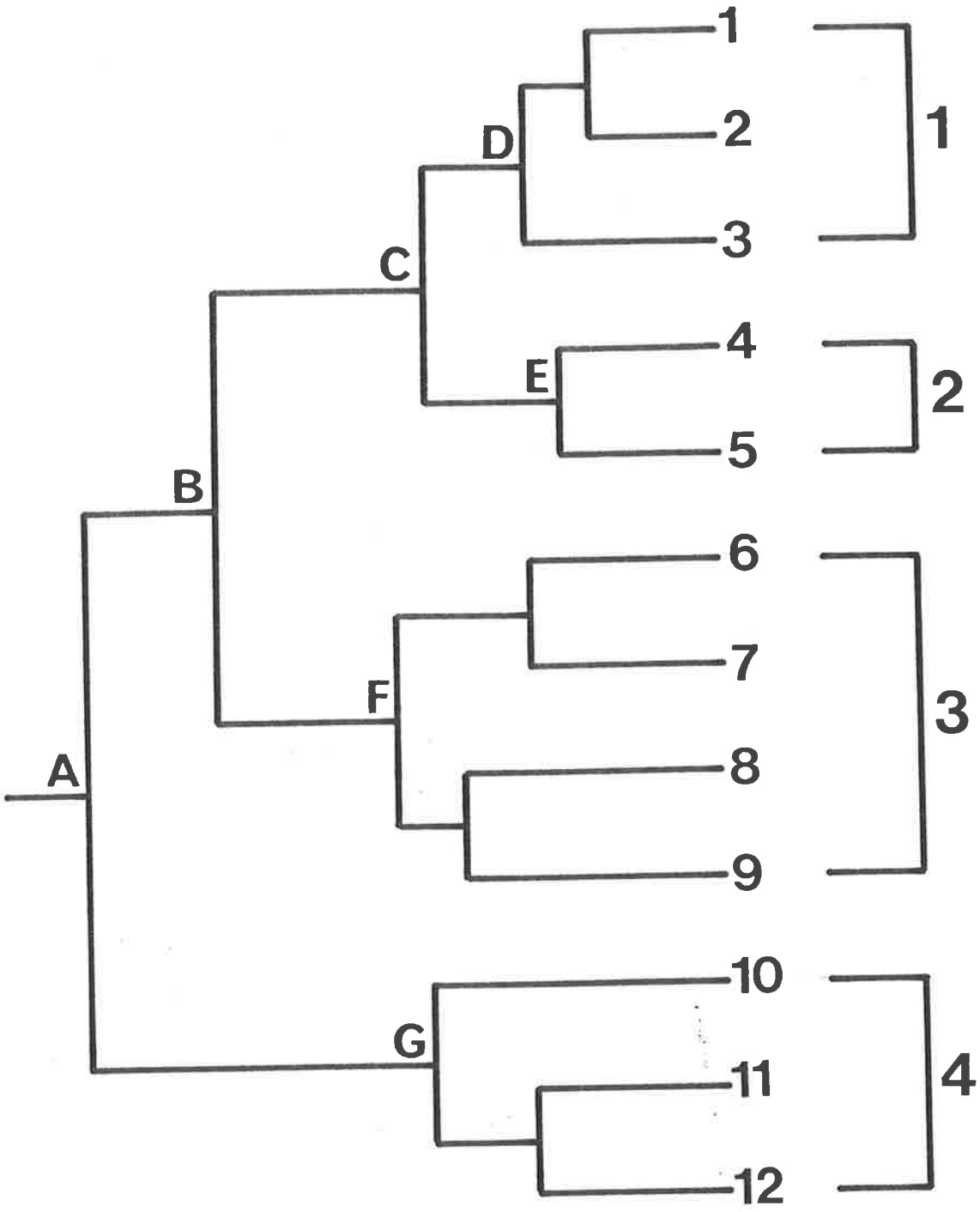
Cluster Number	$\overline{C}_1$	$\overline{C}_2$	$\overline{C}_3$	$\overline{C}_4$	$\overline{C}_5$	$\overline{C}_6$
1	0.307	0.422	0.546	0.694*	0.423	
2	0.307	0.422	0.546	0.694*	0.474	
3	0.307	0.422	0.546	0.759*	0.385	
4	0.307	0.422	0.546	0.759*	0.424	
5	0.307	0.422	0.459	0.500	0.656*	0.489
6	0.307	0.422	0.459	0.500	0.656*	0.402
7	0.307	0.422	0.459	0.500	0.553*	0.424
8	0.307	0.422	0.459	0.500	0.553*	0.532
9	0.307	0.422	0.459	0.630*	0.385	
10	0.307	0.422	0.459	0.630	0.669*	0.432
11	0.307	0.422	0.459	0.630	0.669*	0.474
12	0.307	0.385	0.697*	0.328		
13	0.307	0.385	0.697*	0.651		
14	0.307	0.385	0.454	0.494*	0.427	
15	0.307	0.385	0.454	0.494	0.570*	0.495
16	0.307	0.385	0.454	0.494	0.570*	0.527
17	0.307	0.385	0.454	0.632*	0.312	
18	0.307	0.385	0.454	0.632*	0.427	

Note - the cluster numbers refer to the numbers in fig. 2
(* = maximum value for each cluster).

Figure 1: Dendrogram of 12 OTUs which fall into four groups (marked on right hand side). The OTU numbers are shown at the terminal points of the dendrogram.

Figure 2: Dendrogram drawn using Ward's (1963) error sum of squares fusion strategy (after Hill (1980 in press)). The numbers beside the dendrogram refer to the OTU numbers. Each group of five OTUs represents one of 20 species. The phenon line (a) shows the four groups predicted by the method of Ratkowsky and Lance (1978). The other line (b) shows the 18 groups, numbered consecutively, predicted by the modification to the Ratkowsky and Lance criterion.

Figure 3: Graph of n against $\frac{C}{n^{\frac{1}{2}}}_{max}$, up to n = 15.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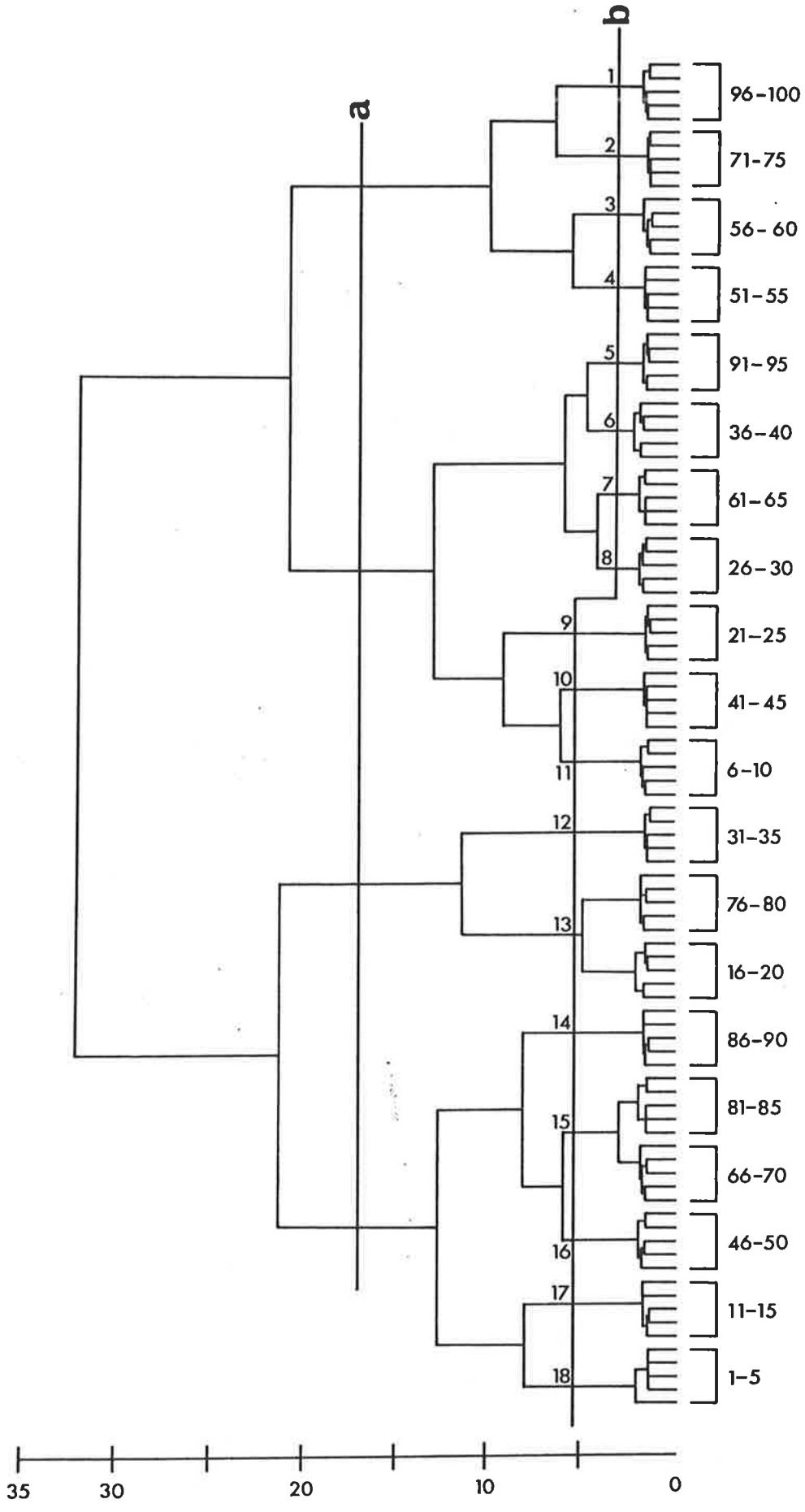
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16
17
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96-100
71-75
56-60
51-55
91-95
36-40
61-65
26-30
21-25
41-45
6-10
31-35
76-80
16-20
86-90
81-85
66-70
46-50
11-15
1-5
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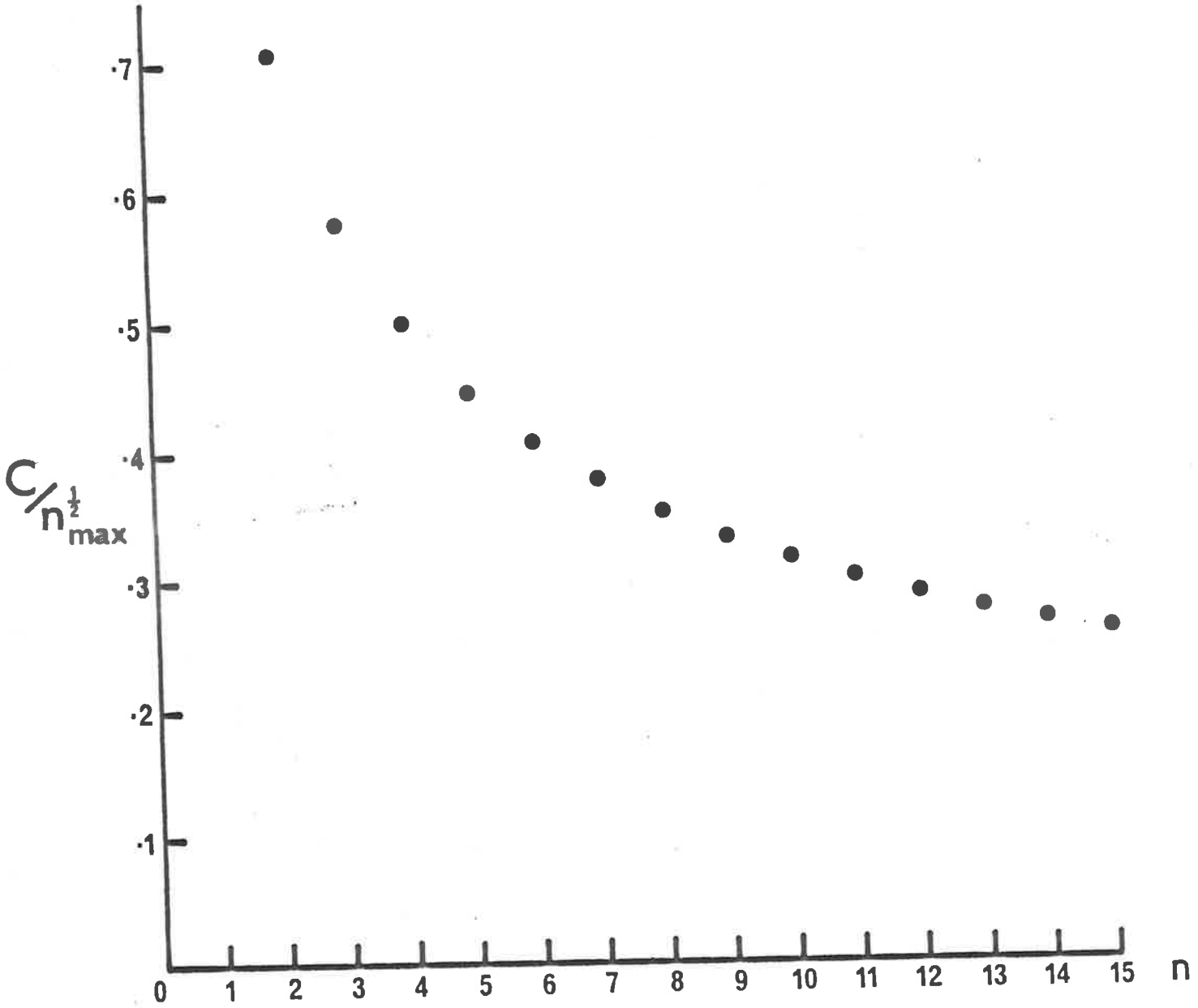
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$C/n^{\frac{1}{2}}_{max}$
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12
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14
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n