NEW PLANT FOSSILS FROM THE UMIAS OF SAURASHTRA*

V. D. BORKAR & G. W. CHIPLONKAR
Maharashtra Association for the Cultivation of Science, Poona 4

ABSTRACT

This paper deals with new plant fossils collected recently from the Umias of Saurashtra (Kathiawar Beds). They include two new species, viz., *Elatocladus longifolia* sp. nov. and *Brachyphyllum regularis* sp. nov. Our collection has also revealed the presence of *Equisetum rajmahalensis* (Oldham & Morris) Feistmantel, *Gleichenia nordenskiöldi* Heer, *Araucarites macropterus* Feistmantel and *Pagiophyllum* cf. *P. divaricatum* (Bunbury) which were not so far known to occur in this region.

This series of Sandstones and Shales referred to as Kathiawar Beds by Oldham (1893) and Fox (1931), were placed by Fedden (1884) equivalent to Umias of Kutch and assigned Oolitic age. They are now generally regarded Wealden.

Rajnath's (1932) placing of the Bhuj stage (Umia Plant Beds of Kutch) in Middle Cretaceous would imply a similar position for these plant beds of Saurashtra, extending the time range of *Matonidium goepperti* (Etting.) into Middle Certaceous and perhaps also raising the Himmatnagar Sandstone to that level.

During our field work a new locality yielding an abundant and well preserved flora has been discovered near the famous temple of Tarnetar on Than-Dhrangadhra road.

INTRODUCTION

UMIAS of Saurashtra (Kathiawar Beds), the oldest exposed strata in Saurashtra, attain as reported by Fedden (1884, p. 79) a thickness of more than 500 metres and covers nearly 2500 sq. km. in Rajkot and Surendranagar Districts. The formation consists mostly of fine to medium grained, often obliquely laminated sandstones with intermittent beds of light and dark grey, weakly fissile shales.

After the pioneering work of Fedden (1884) and Feistmantel (1880), Rao & Vimal (1950), Roy (1965, 1967), Kasat (1969) and Varma & Rawat (1964, 1970) have made important contributions to the palaeobotany of these rocks, and discovered some new fossil yielding localities viz. Dhuli and Tartar.

The present collection of plant fossils was made from near Than, Songarh, where fossil yielding sections have already been known, and from a new locality discovered by us 1 km. north of the famous Tarnetar Temple on the Than-Dhrangadhra road.

It may be mentioned here that while collecting the fossils attention was paid to their position within the body of the beds with a view to a possible zonal sub-division of the strata. But detailed study of the fossils has not revealed any basis for establishing such zonal sub-division, so far as the megafossils are concerned.

Besides dealing here with new species brief remarks are given, where necessary, on those already known from these beds and on those known from elsewhere, but found by us for the first time to occur in this region. Also, we are giving illustrations of already known species in case of which we find our material better preserved than what was available to earlier workers.

LIST OF THE LOCALITIES REFERRED TO IN THE TEXT

Bansa —23°37′: 80°39′30″; Dhuli —40 kms towards north of Than; Kankawati — 25 km towards NW of Dhrangadhra; Patparha— 24°21′:81°52′; Songarh — 22°36′30″: 71°13′15″; Tarnetar — 22°39′: 71°13′15″; Tartar — 13 km towards north of Than; Than — 22°35′: 71°12′.

SYSTEMATIC DESCRIPTION

EQUISETALES

EQUISETACEAE

Genus *Equisetum* Linnaeus

Equisetum rajmahalensis (Oldham & Morris) Feistmantel

Pl. 1, Figs. 1-3

1967 — *Equisetum rajmahalense* (Oldham & Morris) Feistmantel: Bose & Sah, p. 18, Pl. 1, Figs. 1-6 (and synonymy given by them).

1967 — *Equisetum rajmahalense* (Oldham & Morris) Feistmantel: Roy, p. 108, Pl. 1, Figs. 1-2; Text-fig. 1.

Material — Twenty-two specimens.

Plesiotype — TR 27/71.

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Remarks — This species is represented in our collection by vegetative stems and nodal diaphragms. Our specimens agree in all respects with *E. rajmahalensis* (Oldham & Morris) Feistmantel as described by many authors from Rajmahal Series of Rajmahal Hills and also described by Roy from the Umias of Kutch.

This species is of wide occurrence in the Mesozoic rocks of India including the Punjab Salt Range, Pakistan. *E. rajmahalensis* shows a close resemblance with *E. münsteri* Sternburg. An allied form occurs in the Jurassic of Australia (Surange, 1964). *E. rajmahalensis* may be closely allied to *E. ferganensis* Seward from the Middle Jurassic of Afganistan and Turkistan (Sahni & Rao, 1933) and *E. liassinum* Heer from the Liassic of Switzerland (Feistmantel, 1876, p. 13).

Occurrence — Shale horizon at Tarnetar. A few doubtful specimens of this species have also been collected from a white clayey sandstone near Kankawati.

FILICALES

GLEICHENIACEAE

Genus *Gleichenia* Smith

Gleichenia nordenskiöldi Heer

Pl. 1, Figs. 4-7

1969 — *Gleichenia nordenskiöldi* Heer: Sukh-Dev, p. 197, Pl. 1, Figs. 1-5; Text-figs. 1A-D (and synonymy given by him).

Material — Sixty specimens.

Plesiotype — SN 76/70.

Remarks— By their fleshy pinnules sinuous at their basal acroscopic margins to accommodate the basal basiscopic lobes of the pinnules on the opposite side of the rachis, the basal two pinnules of each pinna slightly bigger than the rest bent towards the central rachis, the venetion and the arrangement of sori, our specimens agree in all respects with *G. nordenskiöldi* Heer from Wealden of Greenland, and Jabalpurs of Madhya Pradesh.

The large number of specimens of this species in our collection suggests that it thrived in this area during Umia times with luxurient growth and perhaps was the most common fern.

During a personal talk Dr. Sukh-Dev informed us that this species is abundantly represented also in the Jabalpurs at Bansa and Patparha, Madhya Pradesh.

Probably the same species was described by Feistmantel (1876, p. 26, Pl. 3, Fig. 7) under the name *Pecopteris tenera* from the Umias of Kutch.

Occurrence — Shale horizon at Tarnetar and Songarh.

MATONIACEAE

Genus *Matonidium* Schenk

Matonidium goepperti (Ettingshausen) Schenk

Pl. 3, Figs. 19-22; Text-fig. 1

1846 — *Pecopteris althausi* Dunker, p. 5, Pl. II, Fig. 2.

1852 — *Alethopteris goepperti* Ettingshausen, p. 17, Pl. 5, Figs. 1-7.

1871 — *Matonidium goepperti* (Ettingshausen) Schenk, p. 220, Pl. 27, Figs. 5, 5a, Pl. 28, Figs. 1, 1a-d; Pl. 30, Fig. 3.

1911 — *Matonidium goepperti* (Ettingshausen): Seward, p. 662, Pl. 2, Figs. 25-26.

1936 — *Matonidium althausi* (Dunker): Ferdinande, p. 15.

1936 — *Matonidium indicum* Sahni, p. 153, Pl. 20, Figs. 1-7; Pl. 21, Figs. 1-6; Pl. 22, Figs. 1-4; Pl. 24, Fig. 1.

1964 — *Matonidium indicum* Sahni: Surange, p. 111, Figs. 71A-B et Frontispiece.

1967 — *Matonidium goepperti* (Ettingshausen) Schenk: Roy, p. 108, Pl. 1, Figs. 3-5, Text-figs. 2-3.

1970 — *Matonidium indicum* Sahni: Varma & Rawat, p. 62.

Material — Sixty specimens.

Plesiotype — SN 1/70.

Remarks — This species was described by Sahni from India for the first time under the name *Matonidium indicum*, from Himmatnagar Sandstone, considered by him of Wealden age (Sahni, 1936).

Our material comes from the same locality from which it was described and figured by Roy (1967). Our specimens show gradation in the extent of fusion of the pinnae towards their base, and so we agree with Roy that this fusion is a variable feature and not a character to make it a new species. Thus

TABLE 1 — SHOWING DISTRIBUTION OF SAURASHTRA PLANT FOSSILS AND THEIR ALLIED FORMS

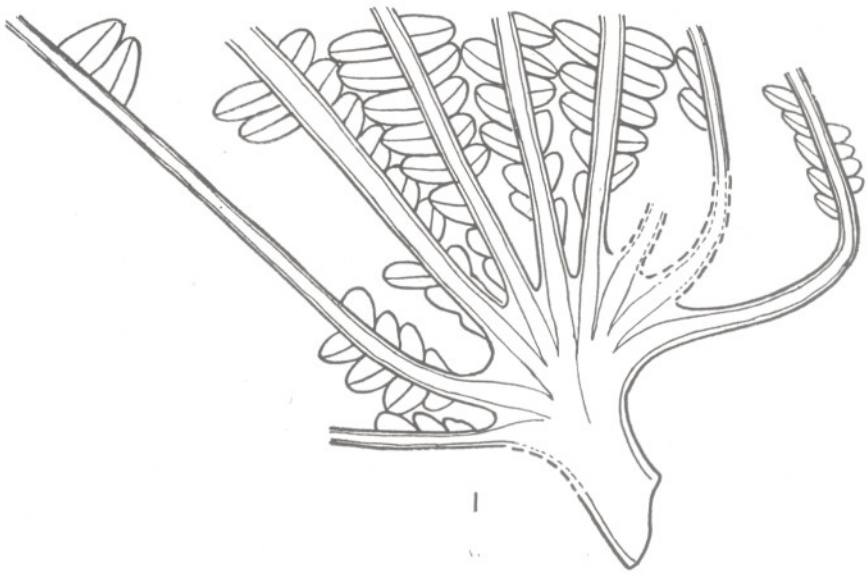
No.	Plant fossils occurring in the Umias of Saurashtra (= Kathiawar Beds)	Umias of Kutch	Jabalpur	Kotas of Pranhita-Godavari Valley	Rajmahals of Rajmahal-Hills	East coast Gondwanas*				Elsewhere in India and Outside
						Raghavpuram	Vemavaram	Sripermatur	Sivaganga	
1	2	3	4	5	6	7	8	9	10	11
	EQUISETALES									
1.	*Equisetum rajmahalensis* (Oldham & Morris) Feistmantel.	P	—	—	P	—	—	—	—	Occurs in the Punjab Salt Range of Pakistan; a comparable form recorded from Jurassic of Australia; closely allied to *E. muensteri* from Rhaetic and (?) Liassic of Europe, *E. liassinum* Heer, from Liassic of Switzerland and *E. ferganensis* Seward from M. Jurassic of Afghanistan-Turkey.
	FILICALES									
2.	*Todites indicus* (Oldham & Morris) Bose & Sah	—	P	P	P	—	P	P	—	Known from Athgarh and Golapilli Sandstones and Uttattur plant beds of East Coast Gondwanas, Jurassic of S. America; closely allied to *Cladophlebis denticulata* (Brongniart) Fontain from Jurassic of England, Australia, S. Africa, Afghanistan, Turkey.
3.	*Gleichenia nordenskiöldi* Heer**	?	P	—	A	—	—	—	—	Occurs in Wealden of Greenland. The allied form *G. gleichenoides* (Oldham & Morris) Seward & Sahni also occurs in Athgarh Sandstone.
4.	*Matonidium goepperti* (Ettingshausen) Schenk	P	—	—	—	—	—	—	—	Occurs in Himmatnagar Sandstone of W. India, L. Oolitic of Yorkshire; Kimmeridgian of Sutherland; Wealden of England, Belgium & Germany and Mesozoic of U.S.S.R.
5.	*Phlebopteris polypodioides* (Brongniart) Seward	—	P	—	—	—	A	—	—	L. Jurassic of Korea, Rhaetic of Greenland; Widespread in Europe from Rhaetic to M. Jurassic.
6.	? *Phlebopteris* sp.	—	—	—	A	A	—	—	—	Allied to *P. polypodioides* (Brongniart) Seward.
7	*Weichselia reticulata* (Stokes & Webb) Ward.	—	P	—	—	—	—	—	—	Occurs in Himmatnagar Sandstone of W. India, Neocomian to Barremian of England, France, Germany, Austria, Belgium, Poland, U.S.S.R., U.S.A., Columbia, Sudan, Syria, Transjordania, ? Sweden, ? Feru; Aptian & Albian of England & U.S.S.R.; Albian of Germany; Cenomanian of Egypt.
	INCERTAE-SEDIS									
8.	*Onychiopsis psilotoides* (Stokes & Webb) Ward.	P	P	—	—	—	—	—	—	Wealden of England, Japan and Cape Colony.
9.	*Cladophlebis whitbyensis* Brongniart	P	P	—	—	—	P	P	—	Occurs in Narlia Plant Beds of Kutch, Athgarh Sandstone and Oolitic of Yorkshire.
10.	*Cladophlebis kathiawarensis* Roy	—	—	—	—	—	—	—	—	Closely allied to *Todites indicus* (Oldham & Morris) Bose & Sah and *Cladophlebis indica* Seward & Sahni.
11.	*Cladophlebis* sp.	—	—	—	A	—	—	—	—	Allied to *Cladophlebis longipennis* Seward from Wealden of England.
12.	*Cladophlebis* sp. cf. *C. longipennis* Seward	—	P	—	—	—	—	—	—	
13.	*Sphenopteris specifica* (Feistmantel) Roy	P	—	—	—	—	—	—	—	Closely allied to *Sphenopteris lanceolata* (Brongniart) Phillipsi from the Oolitic of Yorkshire.
14.	*Sphenopteris* sp. Roy	—	—	—	—	—	—	—	—	A closely allied form, *Sphenopteris* (*Coniopteris*) sp. Sahni occurs in Himmatnagar Sandstone of W. India.
	CYCADALES									
15.	*Ptilophyllum acutifolium* Morris	P	P	P	P	P	P	P	P	Occurs in Golapilli Sandstone, Uttattur Plant Eed, Tabbowa of Ceylon.
16.	*Cycasites cutchense* Feistmantel	P	—	—	—	—	—	—	—	
	CONIFERALES									
17.	*Araucarites cutchensis* Feistmantel	P	P	P	—	—	P	P	—	This species (and sometimes a comparable form) is recorded from Jurassic of Ceylon, Grahamland, New Zealand, New South Wales, Victoria, Uitenhage series of Cape Colonies, Patagonia, and L. Cretaceous of Qucensland.
18.	*Araucarites macropterus* Feistmantel**	P	P	—	P	—	—	P	—	
19.	*Elatocladus jabalpurensis* (Feistmantel) Seward & Sahni	—	P	P	—	—	P	P	—	Occurs in Maleri stage.
20.	*Elatocladus tenerrima* (Feistmantel) Seward & Sahni	P	P	P	P	—	—	P	—	
21.	*Elatocladus longifolia* sp. nov.	—	—	—	—	—	—	—	—	Closely allied to *E. elegans* (Corda) Halle from Lower Cretaceous of Greenland, Bohemia, Moravia, Westphalia & Upper Cretaceous of Bulgaria and North America.
22.	*Brachyphyllum expansum* (Sternburg) Seward	P	P	—	P	—	P	P	P	Occurs in many Jurassic localities of Europe, Turkey; allied forms in Jurassic of France.
25.	*Brachyphyllum regularis* sp. nov.	—	—	—	—	—	—	—	—	Closely related to *B. nepos* de Saporta & *B. gracilis* de Saporta from U. Corallian & L. Kimmeridgian of France.
24.	*Brachyphyllum* sp. cf. (?)*mammillare* Brongniart	P	P	—	P	—	—	A	—	? Tabbowa of Ceylon.
25.	*Pagiophyllum* sp. cf. *P. divaricatum* (Bunbury) Seward**	P	—	—	—	—	—	—	—	Oolitic of Yorkshire.
26.	*Desmiophyllum indicum* Sahni (=*Podozamites lanceolatus*)	P	P	P	—	—	P	P	—	Tabbowa of Ceylon.

*Gopal, Jacob & Jacob (1957) place these shales on the Kota horizon as also was done by Krishnan in the first four editions of his "Geology of India & Burma", but in the 5th edition of his book he does not appear to be definite on this point; also see Pascoe (1959).

P — Presence of the same species.

A — Presence of an allied species.

**Species known from elsewhere, but now found to occur in Saurashtra.



TEXT-FIG. 1 — 1. *Matonidium goepperti* (Ettings.) Schenk; specimen No. SN 44/70, showing fusion of pinnae. × 2.

Matonidium indicum of Sahni is a synonym of *M. goepperti* (Ettings.).

Varma & Rawat (1970) have reported this species from a spot not far to the West of the quarries from which our specimens are collected. They also mention that Venkatraman of O.N.G.C. has found the same species from Umias of Kutch.

Matonidium goepperti is known from lower Oolite of Yorkshire, Kimmeridgian of Sutherland, and Wealden of Germany, Belgium, England and Mesozoic of U.S.S.R.

This species has already been described by Roy (1967) from the Umias of Saurashtra, but we are giving here photographs, since our material is better preserved.

The large number of specimens of this species in our collection is suggestive of its great population during Umia times, at least in Saurashtra.

Occurrence — Shale horizon at Songarh.

Genus — *Phlebopteris Brongniart*

(?) *Phlebopteris* sp.

Pl. 2, Fig. 14

Material — Three specimens.

Figured specimen — SN 118/70.

Dimensions — As measurable on the specimens:

1. Width of the pinna rachis ... 0·23 cm
2. Width of the midrib of a pinnule ... 0·1 cm
3. Length of the longest pinnule ... 4·9 cm
4. Width of the pinnule at the base (maximum) ... 0·6 cm

Description — The three incomplete specimens in our collection show one incomplete pinna each. The longest pinna suggests twenty-one pinnules on each side (Specimen No. SN 34/70). The pinnules arise practically at right angles to the rachis and are attached by their whole bases. They have revolute margins and a prominent midrib. No indication of venation or sori is available.

Remarks — The pinnae in our collection very closely resemble those of the specimens from Rajmahal Hills of Bihar (Rao, 1950, p. 379, Figs. 3-4; Bose & Sah, 1967, p. 22, Pl. 5, Figs. 31-32 & Pl. 6, Fig. 40; Surange, 1964, p. 113, Fig. 72). The striations and grooves mentioned by Rao as characteristic of his material are, however, not observable in our specimens and may be due to poor preservation of our material. But the relative dimensions, the shape and the revolute margin of the pinnules are the points by which our material appears to be nearest to that described by Rao (1950) under the name *Laccopteris* (*Phlebopteris*) sp.

The possibility of this material being *Matonidium* was taken into consideration

by us; but the relative dimensions and other morphological features of the pinnules of our specimens do not appear to take them comparably near to the associated *Matonidium goepperti* or to other species of that genus which we have come across.

Considering that our specimens are sterile we report them here provisionally as (?) *Phlebopteris* sp. noting that it otherwise resembles the Rajmahal species most.

Occurrence — Shale horizon at Songarh.

Insertae-Sedis

Genus — *Cladophlebis Brongniart*

Cladophlebis sp.
Pl. 1, Fig. 8

Material — One specimen.
Plesiotype — SN 11/71.
Remarks — This form is represented in our collection by a single frond not very well preserved. The slender rachis and the small pinnules with their relative dimensions and shape take it nearest to *Cladophlebis srivastavae* Gupta from the Rajmahal Hills (Gupta, 1954, p. 21, Pl. 2, Figs. 7-8; Text-figs. 1-2; Surange, 1964, p. 89, Figs. 54A-B; Bose & Sah, 1967, p. 23, Pl. 6, Figs. 38-39). However, in the absence of any indication of the nature of venation we report it as an indeterminate species. Better preserved material would help us to prove the occurrence of *Cladophlebis srivastavae* Gupta outside the Rajmahal Hills area.
Occurrence — Shale horizon at Songarh.

CONIFERALES

ARAUCARINEAE

Genus *Araucarites* Presl

Araucarites cutchensis Feistmantel
Pl. 1, Fig. 9

1928 — *Araucarites cutchensis* Feistmantel: Sahni, p. 32, Pl. 5, Figs. 65-66 (and synonymy given by him).
1932 — *Araucarites cutchensis* Feistmantel: Deb, p. 103.
1968 — *Araucarites cutchensis* Feistmantel: Baksi, p. 210, Pl. 3, Figs. 16a, 16b.

Material — Twelve specimens.
Plesiotype — TR 38/70.
Remarks — These cone-scales in our collection by the single deltoid seeds, tapering downwards and situated in the scale agree in all respects with *Araucarites cutchensis* Feistmantel from Umias of Cutch, Jabalpurs, Raghavpuram Mudstone and Vemavaram beds.

This species (and sometimes a comparable form) is also reported from Upper Jurassic to Lower Cretaceous of Ceylon, Grahamland, New Zealand, New South Wales, Victoria, Uitenhage series of Cape-Colony, Patagonia and Queensland (Sahni, 1928, p. 32).
Occurrence — Shale horizon at Tarnetar.

Araucarites macropterus Feistmantel
Pl. 1, Fig. 10

1928 — *Araucarites macropterus* Feistmantel: Sahni, p. 33, Pl. 6, Fig. 76 (and synonymy given by him).
1932 — *Araucarites macropterus* Feistmantel: Deb, p. 103.

Material — Twelve specimens.
Plesiotype — SN 39/70.
Remarks — By bigger size of the cone-scale, the deltoid seed shorter, and with a broad membraneous border, we separate the present material from the associated *A. cutchensis* and take it under *A. macropterus* Feistmantel reported from Rajmahal stage of Golapilli, Kota stage of Sripermatur group, Jabalpurs and Umias of Kutch.
Occurrence — Shale horizon at Songarh.

Incertae-Sedis

Genus *Elatocladus* Halle

Elatocladus longifolia sp. nov.
Pl. 1, Figs. 11-12; Pl. 2,Fig. 13, Text-fig. 2

Material — Twelve specimens.
Holotype — TR 12/70.
Dimensions — as measurable on the specimens:

1. Width of the rachis ... 1·00 mm
2. Length of the distichous leaves up to 25·00 mm
3. Width of the distichous leaves up to 1·00 mm
4. Length of the scale-like leaves up to 5·00 mm
5. Width of the scale-like leaves up to 1·00 mm

6. Width of the frond as a whole up to 40·00 mm

Diagnosis — Sterile coniferous shoot with slender axis; two types of leaf, the linear leaves distichous, long, narrow and acicular, and scale-like leaves up to 5 mm. in length.

Description — All the specimens of this species in our collection are sterile and therefore their belonging to a particular family cannot be ascertained definitely in the absence of fructification.

The tender rachis which appears hardly more than 1 mm. across bears both the types of leaf — the distichous linear leaves and the crowded scale-like leaves.

The linear leaves are acicular, long, narrow and thin. They are attached by the whole width of their bases. The leaves are attached at an angle of about 70° or so; however, some specimens show 'sweeping' of leaves and their attachment appears to be at smaller angles, sometimes as small as 30°.

The central scale-like leaves may be as long as 5 mm and are attached at an angle of about 15°.

Both the types of leaf have faintly marked midribs.

Remarks — In comparison with all the known species of *Elatocladus* the present form is distinct in having decidedly longer and more slender leaves.

Elatocladus zamoides (Leckenby) Seward from Oolite of Yorkshire (Seward, 1900, p. 300, Pl. 10, Fig. 5) is strikingly similar to our specimens in having slender axis and a comparable length of the distichous linear leaves which, however, are almost twice in their breadth. Also the Yorkshire species is not reported to have the scale-like leaves.

Elatocladus elegans (Corda) coming from the Lower Cretaceous of Bohemia, Greenland, Moravia, Westphalia, Upper Cretaceous beds in Bulgaria and Cretaceous of North America (Seward, 1919, p. 435, Fig. 804A) is the nearest approach to our species, but has its leaves shorter and broader.

Occurrence — Shale horizon at Tarnetar.

Genus *Brachyphyllum* Brongniart

Brachyphyllum expansum (Sternburg)

Pl. 2, Fig. 15

1928 — *Brachyphyllum expansum* (Sternburg): Sahni, p. 20, Pl. 3, Fig. 38 (and synonymy given by him).

1957 — *Brachyphyllum expansum* Schimper: Gopal, Jacob & Jacob, p. 488, Pl. 8, Fig. 12.

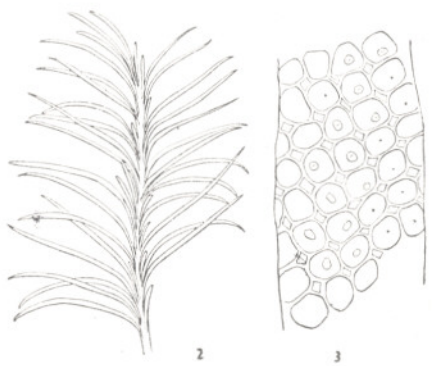
Material — Fourteen specimens.

Plesiotype — SN 4/70.

Remarks — Our specimens agree in all respects with the descriptions and figures given by Sahni (1928) in having appressed, scale-like, broad, polygonal to rounded leaves with rounded apex and alternately arranged secondary branches arising at an angle of 45° to 60°.

This species is known to occur in Rajmahal, Kota, Jabalpur and Umia stages and their equivalent in the East-coast Gondwans, and many Jurassic formations in many regions in Europe (Sahni, 1928, p. 21).

Occurrence — Shale horizon at Than and Songarh.



TEXT-FIGS. 2-3 — 2. *Elatocladus longifolia* sp. nov. Specimen No. TR 12/70×1. 3. *Brachyphyllum regularis* sp. nov. Specimen No. SN 3/70/B×1.

Brachyphyllum regularis sp. nov.

Pl. 2, Figs. 16-17; Text-fig. 3

Material — One specimen.

Holotype — SN 3/70/B.

Dimensions — Measurable on the specimen:

1. Width of the stem ... 1·7 cm
2. Diameter of the leaf ... 0·1 to 0·4 cm

Diagnosis — Stem broad, leaves subhexagonal; the arrangement of leaves is such that a squarish interspace is left amongst every four adjacent leaves.

Description — This form is represented in our collection by a single broad stem.

The scale-like leaves are arranged spirally on the stem. They are subhexagonal in shape, apparently looking circular, and arranged in such a manner that amongst any four adjacent leaves a squarish interspace is produced. Exactly at the centre of some leaves, there is a pit and in others a flat tubercle, almost circular to subhexagonal like the leaves. These tubercles bear a fine slit along their length.

Remarks — In comparison with all known species of *Brachyphyllum* from India (Sahni, 1928) present species stands distinct by its width, sparse distribution of leaves and a flat tubercle at their centres and squarish interspace.

Brachyphyllum ncopos de Saporta and *B. gracilis* de Saporta (Saporta, 1876, pp. 356-372, Pl. 150, Figs. 168-172) from the Upper Corallian and Lower Kimmeridgian of France, have their primary stems somewhat resembling the present form by having polygonal leaves tending to be circular and separated by interspaces. However, our species differs from these French species by having a very regular pattern of arrangement of the leaves with every four of them having an interspace at the centre of the pattern.

Occurrence — Shale horizon at Songarh.

Genus *Pagiophyllum* Heer

Pagiophyllum sp. cf. *P. divaricatum* (Bunbury)

Pl. 2, Fig. 18

Material — Three specimens.

Plesiotype — SN 40/71.

Remarks — The slender main shoots in our collection with alternate branches, elongate leaves with pointed apices and a tendency for the phyllotaxis to become opposite from the original alternate arrangement as the branch grows, show that our specimens agree very closely with *Pagiophyllum* sp. cf. *P. divaricatum* (Bunbury) from Umias of Kutch described by Sahni (1928, p. 23, Pl. 2, Figs. 30-31), and Feistmantel (1876, p. 59, Pl. 10, Fig. 1).

As pointed out by Sahni the Indian specimens differ from the original of *Pagiophyllum divaricatum* Bunbury, occurring in Oolite of Yorkshire coast by its leaves and branches spreading less and the leaves being neither with longitudinal striations nor suggestive of vertically expanded spines.

Occurrence — Shale horizon at Songarh.

DISCUSSION

Though on grounds of lithological similarity and regional contiguousness Fedden (1884, p. 78) had equated this formation with the Oolitic Umia of Kutch, to Feistmantel (1880) fossil flora from them was nearer to that from the Jabalpurs, one species, *Ptilophyllum acutifolium* Morris, being found even in the Rajmahals (Pascoe 1959, p. 992). Probably for this reason though they have not stated it clearly, Oldham (1893, p. 189) and Fox (1931, p. 132) chose to refer to these strata as 'Kathiawar Beds' instead of using Fedden's term 'Umias of Kathiawar'.

Later work by Rao & Vimal (1950), Roy (1965, 1967), Kasat (1969) and Varma & Rawat (1970) has added to the list several species showing the closeness of this Saurashtra Flora to that from the Umias of Kutch, the Jabalpurs, the Kotas and the Rajmahals.

Among the fossil plants described in the present paper *Brachyphyllum regularis* and *Elatocladus longifolia* being new species do not by themselves help in determining the age of these beds, but it may be mentioned that *Elatocladus longifolia* has a near ally in *E. elegans* (Corda) from Lower Cretaceous of Greenland, Bohemia, Moravia, Westphalia and Upper Cretaceous of Bulgaria and North America.

Besides these two new species our present work has revealed the presence of four species viz. *Equisetum rajmahalensis* (Old. & Morr.), *Gleichenia nordenskiöldi* Heer, *Araucarites macropterus* Feist. and *Pagiophyllum* cf. *P. divaricatum* Bunb. which have been already recorded from the Upper Gondwanas of other parts of India but were not till now known to occur in these beds in Kathiawar. They add to the variety of the flora preserved in these beds, and also to the floral commonness between the Umias, the Jabalpurs, the Kotas and the Rajmahals. But none of them being of a determinative nature for age considerations, they do not add to the evidence bearing on the age of these beds. For that to go entirely by floral evidence we have still to depend on the presence in these beds of *Matonidium goepperti* (Ettings.) Schenk (= *M. indicum* Sahni), *Onychiopsis psilotoides* (Stokes & Webb) Ward and *Weichselia reticulata*

(Stokes & Webb) Ward which indicate a Wealden age and which is supported by the microflora described by Varma & Rawat (1964) and Venkatachala & Rawat (1970).

In the absence of any attempts at studying these floras with a view to finding out the possible zonal succession of the floral elements within each of these groups, and also because these strata occur in rather widely separated regions, it may not be possible at the present stage of our knowledge about them, to know the extent of overlap in the vertical direction between the Umia and the Jabalpur floras and that between the Jabalpur and the Kota-Rajmahal floras. Nevertheless, the extent of floral commonness that is even now evident would suggest that taking these groups (viz. Umia, Jabalpur, Kota and Rajmahal) in a successional manner as chrono-stratigraphic stages may not be altogether as correct as we have been hitherto accustomed to do.

Apart from the common elements that appear to bring the Kota-Rajmahal, the Jabalpur, and the Umia floras near to each other, Spath's (1933, pp. 826-829) study of the marine fauna associated with the Kota-Rajmahal floras as preserved in the East Coast Upper Gondwanas, and of the ammonoids of the Ukra hill associated with the Umia Plant beds in Kutch also provide circumstances pointing to the nearness of the Kota-Rajmahal and the Umia floras of these two regions.

On structural grounds Rajnath places his Ukra stage with Aptian ammonoids (Waagen, 1875, pp. 245-246; Spath, 1933, pp. 826-829) below the Umia plant beds (Rajnath's Bhuj stage) and assigns to the latter Middle Cretaceous age (Rajnath 1932, p. 167, 193; 1942, p. 101; 1952, p. 384).

If this interpretation of Rajnath is accepted the Umias of Saurashtra (i.e. Kathiawar Beds) also would have to be elevated to that horizon. Here it must be borne in mind that these plant bearing shales are succeeded by a thickness of about 100 metres of barren (?) sandstones which are part and parcel of the Umias of Saurashtra (i.e. Kathiawar Beds); and they are succeeded with a slight unconformity by the Wadhwan Formation which is equated with the Bagh Beds of Cenomanian-Turonian age, with part of the Nimar Sandstone probably extending down into the Albian (Chiplonkar & Borkar 1971, p. 433 and Chiplonkar & Badve, 1971, in Press).

An another implication of Middle Cretaceous age for the Umias of Kutch and Saurashtra time range of the genus *Matonidium* occurring in these rocks has to be extended into the Middle Cretaceous; and further the Himmatnagar Sandstone in which *Matonidium goepperti* (= *M. indicum* Sahni, 1936) occurs also may have to be raised to that horizon.

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EXPLANATION OF PLATES

PLATE 1

1. *Equisetum rajmahalensis* (Oldham & Morris) Feistmantel: Specimen No. TR 27/71, Plesiotype; showing vegetative stem. × 1.

2. Same; Specimen No. TR 33/71; showing vegetative stem with a nodal diaphragm. × 1.

3. Same; Specimen No. TR 30/71; a detached nodal diaphragm. × 3.

4. *Gleichenia nordenskiöldi* Heer; Specimen No. SN 76/70; Plesiotype; × 1.

5. Same; some pinnules enlarged to show sori. × 5.

6. Same; a portion of the frond on specimen No. SN 102/70, counter-part of the plesiotype; enlarged to show venation. × 3.

7. Same; Specimen No. SN 137/70, showing arrangement of pinnules. × 1.

8. *Cladophlebis* sp., Specimen No. SN 11/71; showing a pinna. × 1.

9. *Araucarites cutchensis* Feistmantel. Specimen No. TR 38/70, Plesiotype. × 1.

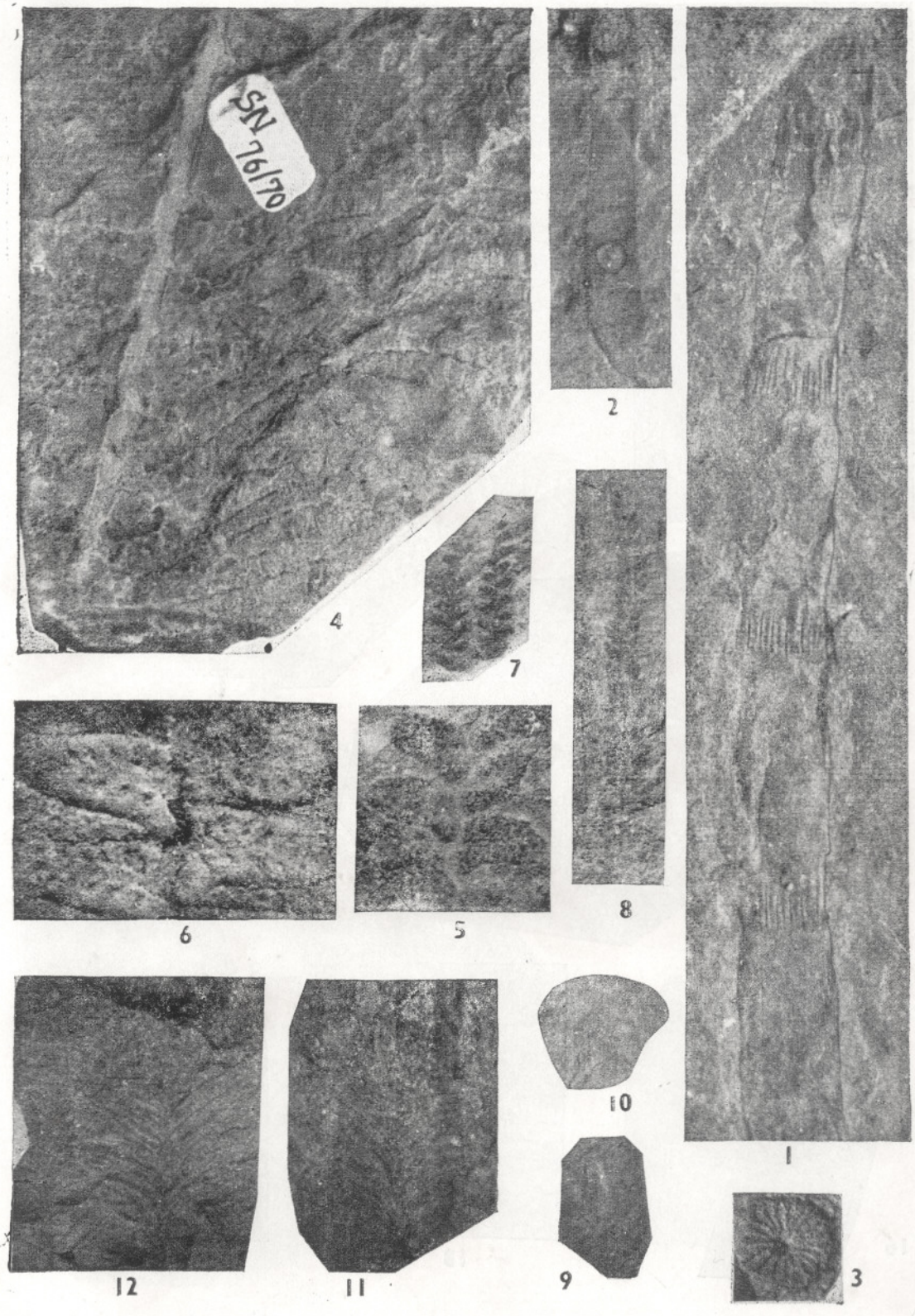
10. *Araucarites macropterus* Feistmantel, Specimen No. SN 39/70; Plesiotype. × 1.

11. *Elatocladus longifolia* sp. nov., Specimen No. TR 11/70; Paratype. × 1.

12. Same, Specimen No. TR 16/70, Paratype. × 1.

PLATE 2

13. *Elatocladus longifolia* sp. nov. Specimen No. TR 12/70; Holotype. × 1.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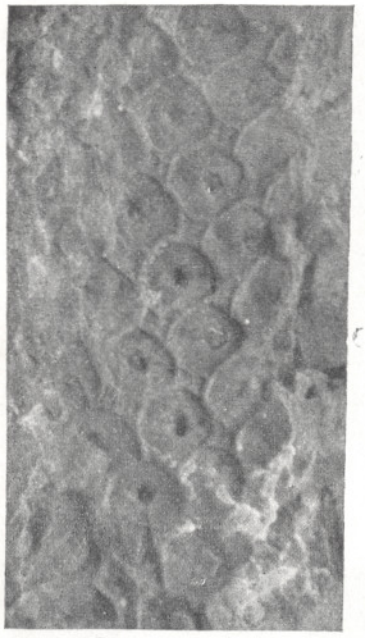

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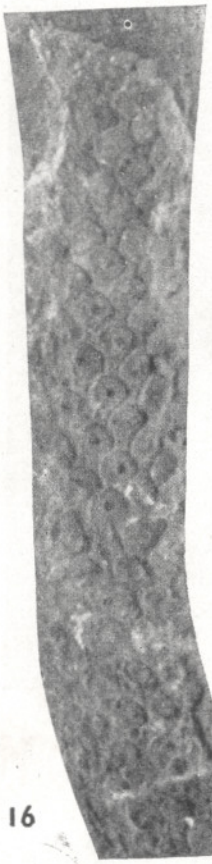

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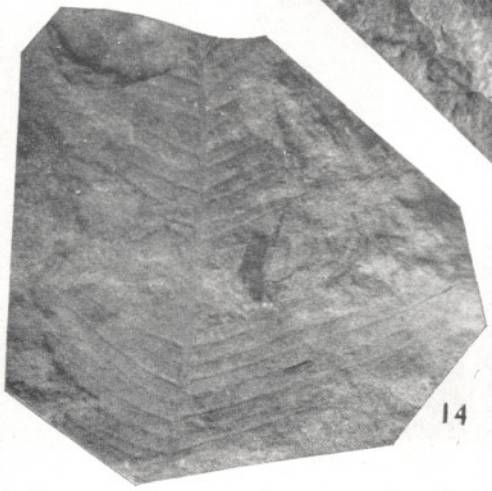

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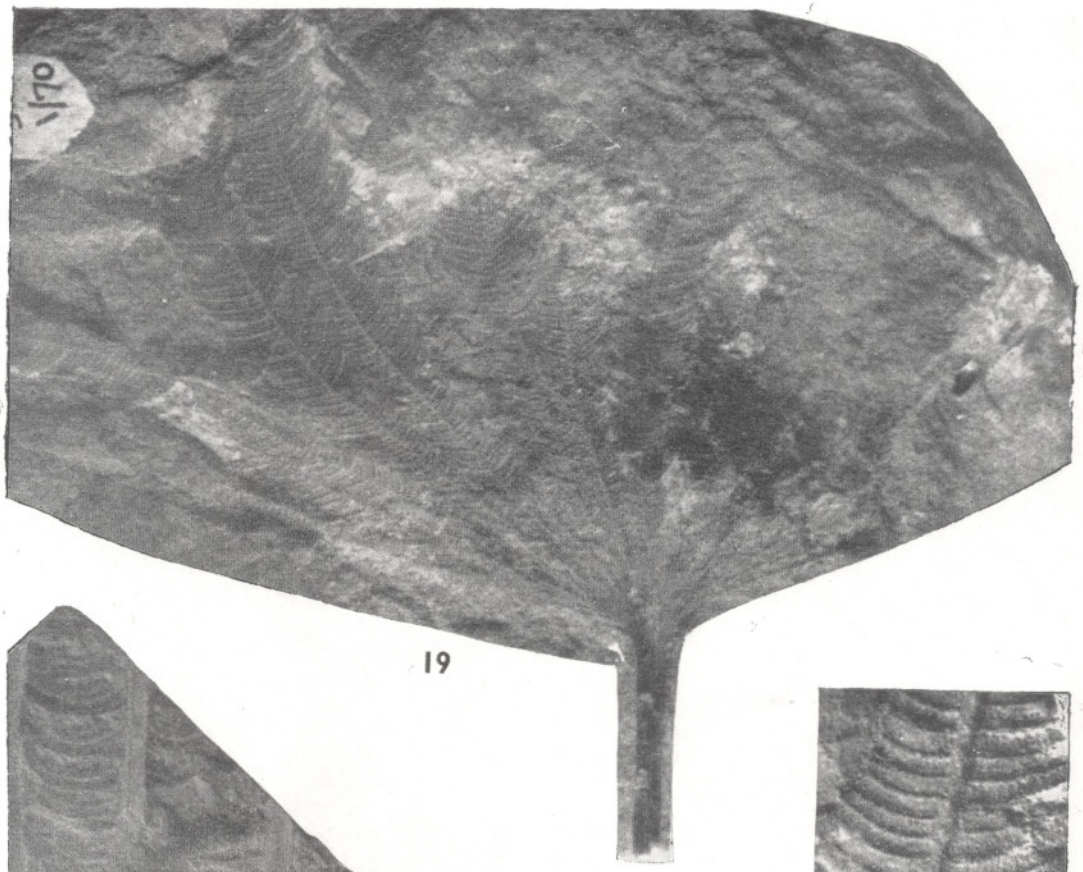

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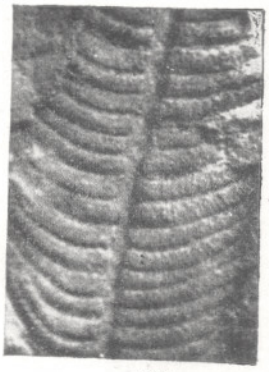

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14. ? *Phlebopteris* sp., Specimen No. SN 118/70. × 1.
15. *Brachyphyllum expansum* (Sternburg), Specimen No. SN 4/70; Plesiotype. × 0·75.
16. *Brachyphyllum regularis* sp. nov., Specimen No. SN 3/70/B; Holotype. × 1.
17. Same, a portion enlarged. × 2.
18. *Pagiophyllum* cf. *P. divaricatum*, Specimen No. SN 40/71. × 1.

PLATE 3

19. *Matonidium goepperti* (Ettings) Schenk, Specimen No. SN 1/70; Plesiotype. × 0·75.
20. Same, a portion of specimen No. SN 2/71 enlarged to show sori. × 2.
21. Same, a portion of Specimen No. SN 53/70 enlarged to show furcate venation. × 2.
22. Same, Specimen No. SN 44/70. × 2.