appeared and the solution was stirred for an additional 5 hr. The precipitate was filtered and recrystallised from acetone-petroleum ether.

C,H,N were determined by microanalysis [Pd(ac.ac) (bpy)] hfac % Found: C, 42·32; H, 2·82; N, 4·94; % Calcd. C, 43·23; N, 2·82; N, 4·92. Molecular weight was determined in acetone solution by cryosocopic method. Found: 551, Calcd. 558·2. Infrared spectra were recorded in nujol mulls on JASCO I.R. E(4000–600 cm^{-1}) and Hitachi EPI-L (700–200 cm^{-1}) spectrometers. A JEOL-MHZ-100 spectrometer was used to obtain ^{1}HNMR spectra in CD_3COCD_3 containing tetramethyl silane as an internal reference.

From the analysis, the complex has the composition [Pd(ac.ac) (bpy)] hfac. Comparison of the infrared spectra of this compound with that of the starting materials made the assignments easier. γ (C = O) + γ (C = C) of the O-bonded ac.ac chelate appeared ≈ 1500–1600 cm^{-1}, γ (C=O) due to ionic hfac was observed around 1670 cm^{-1} and though there are several bands due to coordinated bipyridine, the characteristic band due to pyridine ring vibration was found at 1615 cm^{-1} in the present complex. Observation of γ(Pd–O) and γ(Pd–N) at 475 and 335 cm^{-1} respectively further substantiated the formulation of the complex.

In the ^{1}H NMR spectra, methine proton of ac.ac resonates at 5·66 and that of hfac at 5·88 ppm, methyl protons of ac.ac resonate at 2·14 and 2·24 ppm and bipyridine ring protons at 8·2, 8·8 and 9·0 ppm. The intensity ratios are 1:3:4 respectively for methine, methyl and bipyridine protons. Hence the NMR spectral data corroborate the infrared evidence for the nature of the complex. Probably the carbon bonded ac.ac. replaces the hfac chelate to form an intermediate complex (B). The Pd–C bond is then attacked by hfac anion in an attempt to abstract the proton at the γ–carbon atom as a result of which the Pd–C bond breaks and compound C′ is produced.

27 April 1981

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SOME MESOZOIC PLANT BEDS FROM THE HIGHER HIMALAYA OF BHUTAN

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THE higher Himalaya of Bhutan forms a WNW-ESE trending synclinorium, flanked to its south and east by the older crystalline rocks, while to the north and southwest lie respectively the Tethyan sedimentaries of the Tsang Po valley and Phari basin of Tibet.

The rocks of the Lingshi Group, which range in age from Jurassic to Cretaceous, unconformably overlie the Shodug Formation of Permian age. The stratigraphic sequence of the Lingshi Group is given in table 1.

The Mo Chu Formation forming the lower part of Linghshi Group comprises a 55 m carbonaceous slate with minor quartz arenite in the upper part. A newly discovered Mesozoic flora from the Upper part of the Mo Chu Formation at a locality about 4 kilometres to the north of Yale La along the course of the Mo Chu river is reported here.

The assemblage comprises species of *Cladophlebis*, *Sphenopteris*, *Pachypteris* sp. cf *P. indica*, *Ptilophyllum* sp. cf *P. acutifolium*, Elatocladus sp., *Pagiphyllum* sp. and *Coniferocaulon* sp. cf C. *rajmahalense*. Besides these, there are other fragmentary plant remains which are yet to be identified.

The assemblage is dominated by *Elatocladus*,

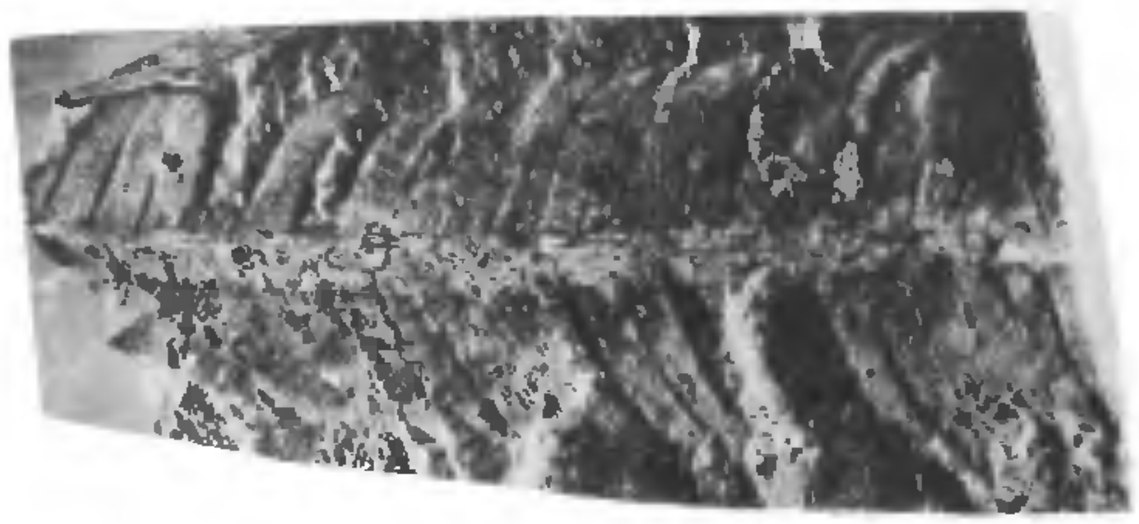

Figure 1. *Ptilophyllum* sp. cf. *P. acutifolium* × 1.6.

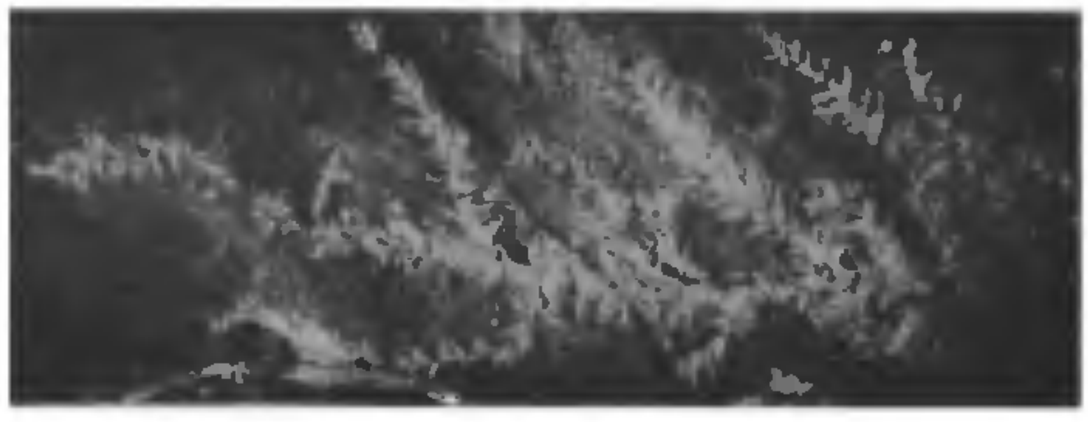

Figure 2. *Pagiophyllum* sp. × 1·1

TABLE I

Stratigraphic sequence of the Lingshi basin

Lithology	Age/ Group/ Formation/ Fauna/ Flora	Approx. Thickness (m)
Dark carbonaceous slates and minor quartzite.	(1) Upper Jurassic to Cretaceous Group: Lingshi, Formation: Chebesa *Astarte* sp., *Trigonia costata, Ancella spitensis Nuculana* sp. *Neocomites* sp. *Kalinella sp. Odontodiscus* sp. *Callipity choreras* sp. Occasional *Ptilophyllum* sp. in shale streaks.	1000
(a) Dark carbonaceous and micaceous slate, minor quartzite.	*Cladophlebis* sp. *Sphenopteris* sp. *Pachypteris* sp. cf *P. Indica Ptilophyllum* sp. cf. *P. acutifolium Elatocladus* sp. *Pagiophyllum* sp. and *Coniferocaulon* sp. cf. *C. rajmahalaense*	55
(b) Dark grey and grey quartzite, white sandstone and occasional bleached shale.	(2) Middle to Upper Jurassic Group: Lingshi, Formation: Mo Chu, Fragmentary plant remains and ammonites in shale streaks.	250
UNCONFORMITY Complex sequence of slate grit slate, quartzite, pebbly quartzite and boulder beds showing abrupt facies variation	(3) Permian,: Group: Black Mountain Formation: Shodug *Spirifer nitensis, spirifer Iydekkeri, Productus cora, Marginifera himalayense Ambikella sahni, Derbia* sp. *Camarophoria* sp. *Terebratula* sp. and fenestrate bryozoans.	800–1000
(a) Limestone, marbly limestone, minor phyllite and shale.	(4) Carboniferous to Permian. Group: Black Mountain, Formation: Barishong *Spirifer* sp. *Products* sp. *Syringothyris* sp. *Favosites* sp. *Fenestella* sp. *Polypora* sp. and *Dogaddenella* sp. found towards top	1500–1750
(b) White quartzite and Calc quartzite with interbands of tourmaline granite:		
Phyllite and quartzitic phyllite with lenticular limestone.	(5) Devonian to Silurian Formation: Chekha	
Intrusive tourmaline muscovite granite		1500 (variable)
Migmatites, gneisses, high grade schists and metasediments. Intruded profusely by tourmaline muscovite granite.	(6) Lower Palaeozoic to Pre-Cambrian Thimphu Gneissic Complex.	

followed by *Ptilophyllum* and *Pachypteris*. The older beds in the Rajmahal Hills *viz.*, Bindaban, Mandro and Onthea, etc. also have an assemblage with frequent occurrence of *Ptilophyllum* and *Elatocladus* type of leaves. But here along with these, one finds quite a few species of *Pterophyllum*. The latter genus is entirely absent in the Lingshi basin. The younger beds of Rajmahal Hills occurring at Nepania have a dominance of leaves belonging to confiferales associated with Pentoxylean remains. So the Lingshi assemblage is entirely different from the younger beds of the Rajmahal Hills.

The Lingshi assemblage resembles more the assemblages met at Jatamau and Sehora in the Satpura basin and some of fossiliferous beds of Kakadbhit and Kurbi in Kutch. From the present record, it seems, the Lingshi assemblage resembles more the Upper Jurassic beds within the Upper Gondwana sequence of India.

7 *September* 1981