

the water, in fish traps or in holes in the ground. There is still no record of anybody seeing one of those lizards moving normally, either by day or night.

During January 1963, Sarawak experienced the worst floods in its history. On one small river near Sibu, in the Rejang delta, a Dayak longhouse, which has become particularly interested in these creatures, collected a dozen specimens adrift or stranded from the unprecedented inundation.

At present, the Sarawak Museum has 15 live specimens. As previously recorded, the only food we have been able to get them to take is raw turtle egg⁴. Here, they thrive on this. But individuals sent, even by safe hand and air, to Chicago, New York and elsewhere have not survived more than a few days under different conditions.

Extreme lethargy continues to be the major behaviour pattern, even in healthy individuals. But on one occasion copulation was recorded at 4 p.m. on February 2, 1963. This was successfully photographed (Fig. 1). The position was maintained for more than an hour.

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¹ Harrison, T., and Halle, N. S., *Nature*, **190**, 1213 (1961).

² McDowell, S. H., and Bogert, Charles, M., *Bull. Amer. Mus. Nat. Hist.*, **105**, (1), 1 (1954).

³ Harrison, T., *Discovery* (July 1961).

⁴ Harrison, B., *Sarawak Mus. J.*, **10**, (17), 286 (1961).

Ephedra-type Pollen Grains in the Dharamsala (Tertiary) Formations, Punjab, India

THE Gnetales are considered to be the most highly evolved order among the gymnosperms. The fossil record of the order is surprisingly poor, and has been reviewed by Wilson¹. Some palynologists have, however, reported the occurrence of fossil pollen grains having close resemblance to gnetalean pollen. While analysing some samples from Dharamsala beds (Lower Miocene to Oligocene) of Kangra District, Punjab, we came across some pollen grains which showed a gnetalean affinity.

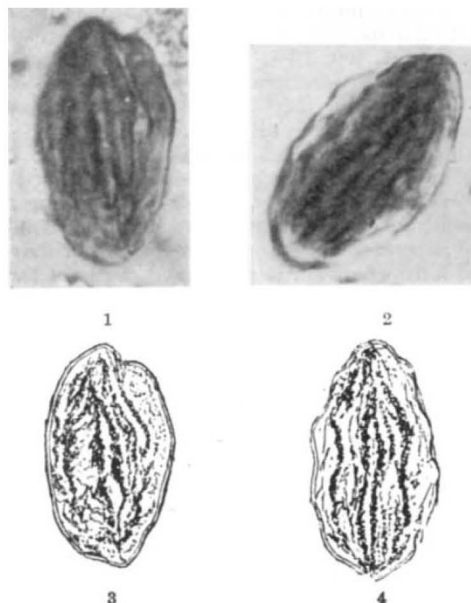
Samples, mostly clays, with occasional siltstone, were macerated in nitric acid and potassium hydroxide followed by separation in a heavy liquid of specific gravity 2.3. The light crop was taken and centrifuged. The sediment collected was mounted in glycerine jelly.

The grains can be described as follows: Ellipsoidal, bilateral, medium, with ridges on the body; $30-36\mu \times 20-22\mu$ in size; exine slightly thick; germinal furrow not distinguishable; number of ridges on the body between 5 and 8, but sometimes more (11); hyaline lines between the ridges very faintly visible; lines appear to be branched; ridges somewhat flattened (Figs. 1 and 2).

The lines between the ridges are hyaline and very difficult to trace and are indistinctly branched. The ridges appear to be flattened and comparable with *E. pedunculata* Engelm. ex. S. Wats. figured by Scott², with the exception that the number of ridges is less. The grains are smaller in size than those recorded so far. They do not show any germinal furrow, and hence appear more related to *Ephedra* than any other genera.

Similar types of grains have been recorded from the other Dharamsala beds in Punjab and from the Oligocene of Assam by one of us (D. B.) in course of routine analysis of samples from there.

Fossil *Ephedra* pollen has been reported by a few workers from different parts of the world¹⁻². Wodehouse³ reported *Ephedra* pollen from the Eocene Oil shales of Green River Formation, having 5-7 high vertical ridges with zigzag hyaline lines in the grooves. He compared the grains with living species of *Ephedra*. From the Pleistocene of Kashmir he also reported the occurrence of *Ephedra*⁴. Bolkhovitin⁵ reported some gnetalean pollen from the Upper to the Lower Cretaceous deposits of Kazakhstan,



Figs. 1-4. *Ephedra*-type pollen from Dharamsala formation (Tertiary), Punjab, India. 1 and 2, Photomicrographs of 2 grains; 3 and 4, camera lucida drawings of the grains. ($\times 1,000$)

but later modified her findings and referred the grains to Schizaeaceae. Kuyt, Muller and Waterbolk⁶ have reported *Ephedra* type of pollen from the Upper Eocene to the Middle Cretaceous of the United States, Iraq, Venezuela and Nigeria. Scott² recorded pollen of *Ephedra* from the Upper Triassic of the United States and suggested that the name *Equisetosporites* Daugherty should be abandoned as it is a conspecific *Ephedra* pollen. The range of these grains can thus be traced almost without a break from the Triassic to the Pleistocene and should have, therefore, a great phylogenetic significance.

Recently, Bharadwaj⁷ has recorded some "non-saccate pollen grains" and referred to "*Gnetaceapollenites* and *Welwitschiapites*", which closely resemble pollen of living *Ephedra* and *Welwitschia*, from coals of Raniganj Stage (Upper Permian) of India, thus corroborating Wilson's¹ evidence extending the fossil history of this group to Permian.

It appears that these grains possibly have a restricted range of occurrence, and had a distribution from Jammu and Kashmir to Assam covering practically the whole Himalayan region from west to east. During Lower Miocene to Oligocene times, the conditions probably favoured growth of such type of vegetation.

Ephedra has a restricted distribution to-day in Kashmir and North-West India.

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³ Wodehouse, R. P., *Torrey Club. Bull.*, **80** (1933).

⁴ Wodehouse, R. P., *Mem. Conn. Acad.*, **9** (1935).

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⁶ Kuyt, O. S., Muller, J., and Waterbolk, H. T., *Geologie en Mijnbouw*, N.S. **17**, No. 3, 49 (1955).

⁷ Bharadwaj, D. C., *The Palaeobotanist*, **9**, Nos. 1 and 2, 68 (1960).

⁸ Wodehouse, R. P., *Pollen Grains* (McGraw-Hill Book Co., New York, 1935).

⁹ Cookson, I. C., *Nature*, **177**, 47 (1956).