1. RECONSTRUCTION AND AFFILIATION OF MIDDLE TRIASSIC SEEDS FROM INDIA

SHYAM C. SRIVASTAVA

Birbal Sahni Institute of Palaeobotany, Lucknow-226007, India

"Post Award-Commemorative-Lecture"

Cell Biological and Evolutionary Micropaleontological Laboratory of the Department of Botany of the J. A. University, H-6701, P. O. Box 993, Szeged, Hungary

Mister President Commission for Palaeobotany, Hungarian Academy of Science, Head, C.B.E.M. Laboratory, the Fellow Palynologists and learned friends.

Today (21st August, 1997) I have just arrived a long way from India to have this Commemorative "Honour" to be bestowed upon me for the furtherance of Palaeobotany, a multidisciplinary science possessing a synergistic approach. It is not only my presence but the presence of all in itself will mark a moment in spirit of science and the link which SAHNIS established shall be strengthened and strengthened.

On this "Commemorative Day", I congratulate humbly to all of you and more especially; to Professor KEDVES "a jewel" in Palynology for awakening the palaeobotanical platform in Hungary where great palaeobotanist Professor Paul GREGUSS was born.

My lecture embraces the work of nearly three decades of Indian seeds (±2 Hundred Million Years Old) which has marked an advance both from botanical and geological point of view.

After being processed and analysed the bulk of information has yielded much new data resulting which the full significance is brought out.

Abstract

Variety of seed plants occurred in Triassic flora of Nidpur. Epidermal structures together with other morphological features exhibited great amount of diversification among these seeds. Distinction between these seeds is based largely on features of epidermis and particularly on integument characters. Such a restored seed provide meaningful data which increasingly clear the structural identity.

Key words: Seeds, Triassic, India, *Gymnosperm.*

Introduction

Among the variety of macrobotanical elements, detached seeds have been quite conspicuous in Middle Triassic Nidpur shale of Madhya Pradesh, India (SRIVASTAVA and MANIK, 1993). Generally seeds of bigger size have been found in compressed form on the rock surface but when the waste pieces of carbonaceous shale were macerated in bulk, seeds could be isolated in enormous number. The systematic analysis of nearly one thousand seed specimens yielded several genera and species. By pooling information from such seed specimens it could be possible to have a fairly full and accurate picture of reconstruction of taxonomically established seed genera as evidenced by piece of cutinized seed membranes. Their preservation of epidermal details gave an impetus to reconstruct these organs which belonged to different plant groups of *gymnosperm*. The first such reconstruction was attempted by SRIVASTAVA and MANIK (1990) of the taxon *Rostrumaspermum venkatachalae* based upon the epidermal features of various seed membranes. Here ten seed taxa have been reconstructed revealing their differentiation of various integument layers, nucellar and megaspore membranes. The distinct pollen chambers followed by their reduced size or absolute absence has also been clearly demonstrated associated with restoration of exposed or unexposed micropylar opening. These reconstructions (Plate 1.1., figs. 1–10) are fanciful and their size and spatial relationship of various membranes portrayed is largely based on their illustrations. Thus incorporating the entire characters the relationship of these seeds have also been traced out.

Material

Triassic beds are located near Nidpur village in a small fault bounded outcrop in carbonaceous sandy shale of dark to light-grey colours in Gopad river section, western part of Singrauly coalfield, Sidhi District, Madhya Pradesh (Central India). Being in faulted zone "Nidpur beds" could not be eroded and more or less horizontally placed locked up between the two faults on western most extreme. Fossiliferous beds are capped by lilac coloured shale, clays and pinkish coarse grained sandstone (similar to Parsora Formation) and are faulted contact to the north and south with upper Permian strata. The distinctive flora or *Dicroidium* comprising seeds, fruiting bodies and palynofossils have been recovered trapped between the two faults. Beyond fault Permian sediments are exposed.

Carbonaceous remains were extracted in bulk maceration of rock samples in Hydrofluoric acid and seeds were isolated to study immersed in glycerine and subsequent treatment of acid and alkali, observations were noted and finally seeds were mounted in Canada Balsam.

Results

Reconstruction: *Pteridospermous*-seed

In the reconstructions of seed taxa *Sahnispermum indicum* SRIVASTAVA and MANIK (1993), *Delevoryaspermum nidpurensis* SRIVASTAVA and MANIK 1993, *Nidispermum glabrosum* MANIK 1988, *Cupolaspermum marhwasianum* SRIVASTAVA and MANIK

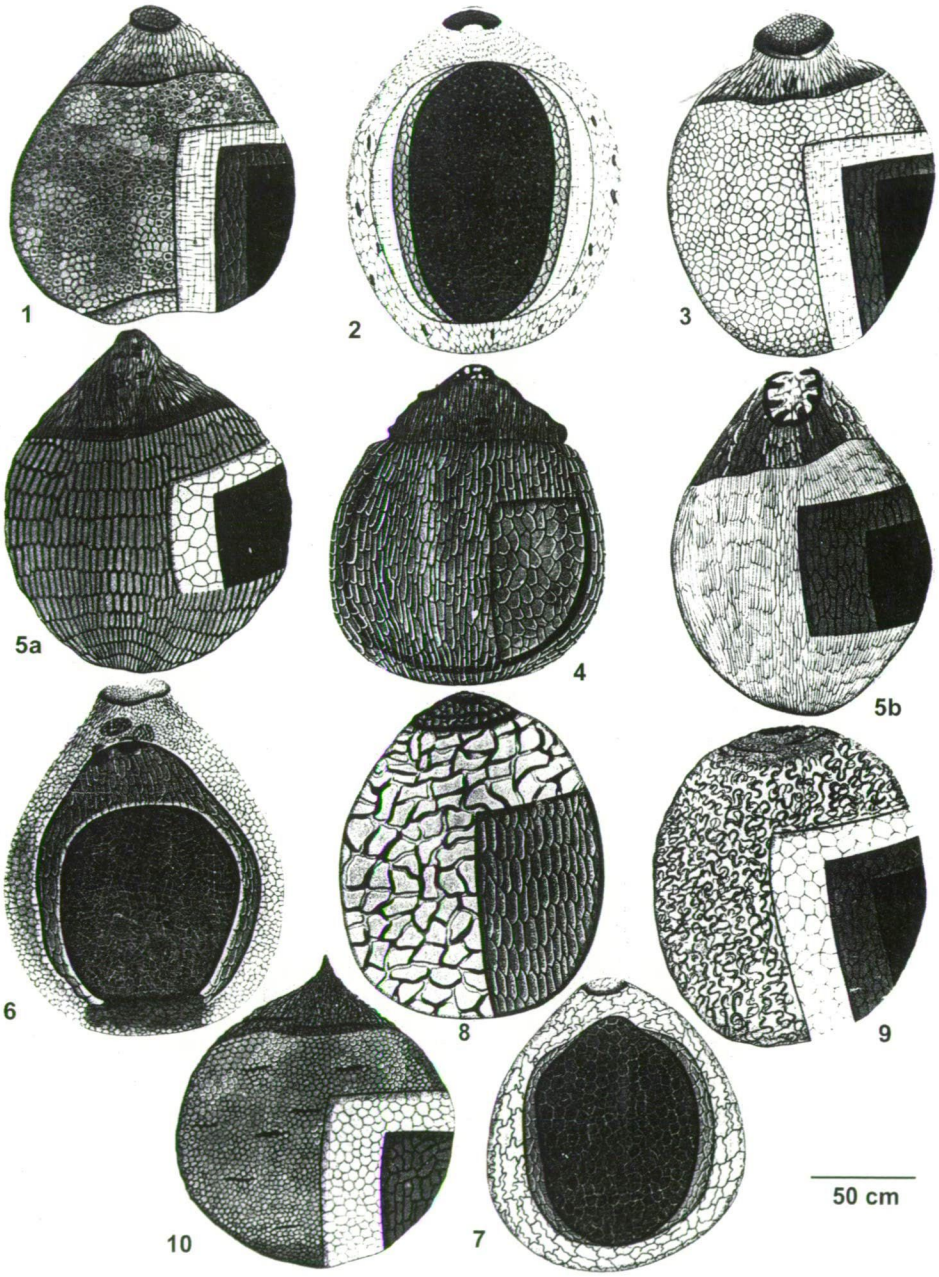

Plate 1.1.

1993 and *Pyriformispermum elongatum* MANIK 1988, differentiation has been based mainly on the features of their cellular characters of integument, distinct pollen chamber and nature of micropylar opening. In *S. indicum* (Plate 1.1., fig. 1) the micropylar opening is asymmetrical and saucer-shaped whereas in *D. nidpurensis* (Plate 1.1., fig. 2) it is somewhat like a bulge appearing to be of bowl-shaped having cutinized rim. But in *N. glabrosum* (Plate 1.1., fig. 3) the micropylar opening looks like lobed structure forming a sort of summit as if for pollen reception. *C. marhwasianum* (Plate 1.1., fig. 4) possessed elliptical-shaped micropylar opening between the two flap-like structures bearing perforated rim all around, a characteristic feature in its own. In *P. elongatum* (Plate 1.1., figs. 5A,B) micropylar opening is depressed and sunken but in some seeds, micropylar hole is inlaid by finger-like projections which might have probably served as a pollen catching device. All these aforesaid seed genera invariably have their pollen chamber well differentiated made up of narrow elongated cells converging towards micropylar end. However, nature of integument is quite variable. The outer integument is generally free from nucellar membrane up to chalazal end. At times the attachment at the base is quite distinct bringing these seeds closer to *pteridosperms*. Further the cells are arranged end to end appearing to be in linear fashion and megaspore membrane is quite conspicuous in suggested reconstructions cut open to depict the various seed membranes.

In *Sahnispermum, Delevoryaspermum, Nidispermum, Cupolaspermum* and *Pyriformispermum*, the outer and inner integuments are frequently free from nucellus up to base, revealing thereby relationship with *Pteridospermales*. Presence of fairly well developed large massive dome-shaped pollen chamber as in *Cupolaspermum* is also indicative of its an alignment with *Pteridospermales*. In *Pyriformispermum* the cutinized finger-like appendages in the inner lining of micropylar hole reflect towards the primitive feature of *pteridosperms* and further provide a supportive evidence for these seeds to be attributed to *Pteridospermales*.

Among these seeds, the reconstructions of the taxa *S. indicum* and *D. nidpurensis* have shown their alliances with that of their parent plant on the grounds of complimentary evidences, for instance the outer integument of *S. indicum* is stomatiferous possessing papillae overhanging stomatal pits. In this characteristic feature, its affiliation is considered to family *Peltaspermaceae*. Also the position of pendant sporangia around the periphery of flattened sporophyll in *Bosea indica* SRIVASTAVA 1975 is built upon similar plan as is marked in case of peltate seeds of *Peltaspermum* HARRIS 1932. It could be inferred on the basis of this particular evidence that there exist an alliance between the leaf *Lepidopteris indica* BOSE and SRIVASTAVA 1972, the microsporangiate

Plate 1.1.

1–10. Triassic seeds from Nidpur.

1. *Sahnispermum indicum* SRIVASTAVA and MANIK, BSIP Nos. 10635, 10637.
2. *Delevoryaspermum nidpurensis* SRIVASTAVA and MANIK, BSIP Nos. 10640, 10641.
3. *Nidispermum glabrosum* MANIK, BSIP Holotype No. 9279.
4. *Cupolaspermum marhwasianum* SRIVASTAVA and MANIK, BSIP No. 10642.

5A,B. *Pyriformispermum elongatum* MANIK, BSIP Holotype No. 9731.

6. *Urceolaspermum gopadensis* SRIVASTAVA and MANIK, BSIP Nos. 10646, 10647.
7. *Tayloriaspermum sinuosum* SRIVASTAVA and MANIK, BSIP Holotye Nos. 10644, 10645.
8. *Konaspermum sidhiensis* SRIVASTAVA and MANIK, BSIP Nos. 19648, 10649, 10651.
9. *Pantiaspermum cristatum* MANIK, BSIP Holotype Nos. 9732, 9733.
10. *Rotundaspermum mucronatum* MANIK, BSIP Holotype No. 9730.

organ *B. indica* and the seed *S. indicum* belonging to the family *Peltaspermaceae*. The seed *S. indicum* is supposedly *peltaspermaceous* because of its close identity in structural features with that of *Lepidopteris* leaf and pollen organ *Bosea*.

Likewise there is a close agreement in between the epidermal features of outer integument of *Delevoryaspermum nidpurensis* and leaf epidermis of *Dicroidium nidpurensis* BOSE and SRIVASTAVA 1971. In their cellular organization smooth nature of surface wall, number of subsidiaries and construction of stomatal apparatus both of leaf and seed integuments apparently are identical. The seed *D. nidpurensus* match so closely with the pollen-organ *Pteruchus nidpurensis* SRIVASTAVA 1974 that it becomes as pointer for the two members to be from a related lineage. Therefore there is greater chance that the two were borne upon possible parent seed plant *Dicroidium nidpurensis*.

Reconstruction: *Cycadean*-seed

Reconstruction in figs. 6 and 7 (Plate 1.1.) are quite distinctive because of having reduced pollen chamber and tenuous outer integument adherent to nucellus getting nucellar apex completely free in micropylar region. The genera *Urceolaspermum gopadensis* SRIVASTAVA and MANIK 1993 and *Tayloriaspermum sinuosum* SRIVASTAVA and MANIK 1993 are the examples revealing such a feature. Besides, in these seeds, micropylar opening is not much projected as we see in *U. gopadensis* where micropyle is subspherical bearing zagged edge while in *T. sinuosum* micropylar opening is unevenly thickened encircled by heavily cutinized rim.

Thus in its overall qualitative aspects, such as having reduced pollen chamber, laterally attached outer integument with nucellus, tenuous outer integument, free nucellar apex from outer integument, thick nucellar membrane (in free part thinner) and well developed highly cutinized megaspore membrane weigh heavily in favour of *cycadean* affinity to this seed taxon. Similarly *T. sinuosum* characterized by outer integument continuing up to micropylar rim and nucellus for a short distance remaining free, depicts its *cycadean* affiliation. In these seeds, extremely reduced pollen chamber delimited from deeply depressed nucellar apex, is an other distinguishing feature for their relationship with *cycads* possessing sinuous anticlinal walls of integument. *T. sinuosum* fully agrees with the leaf of extant *cycads* and shows resemblance with the leaf *Taeniopteris glandulata* SRIVASTAVA 1971, described from same beds of Nidpur.

Reconstruction: *Coniferous*-seed

While evaluating the morphological features, in idealized reconstructions of *Konaspermum sidhiensis* SRIVASTAVA and MANIK 1993, *Pantiaspermum cristatum* MANIK 1988, and *Rotundaspermum mucronatum* MANIK 1988 (Plate 1.1., figs. 8–10), no defined pollen chamber could be marked. The micropylar opening are not very distinctive. In *K. sidhiensis* micropylar hole is blunt and sunken surrounded by thinly cutinized concentric rings but in *P. cristatum* micropylar hole is elliptical, all around ridged or cristate due to excessive proliferation of papillae concealing the opening. Moreover, *R. mucronatum* where micropylar opening is mucronate having small circular hole and short micropylar canal, presents a primitive feature so as for the reception of pollen. However, all these taxa seemingly belong to *Coniferales* largely upon the evidence of nucellar membrane being free over most of the seed bearing outer investment easily detachable and in having pollen chamber not well defined. Additionally in *R. mucro-*

natum its apical micropylar opening associated with short micropylar canal is also indicative of its relationship with *conifers*.

Affiliation

The significant common characters seem to characterize the taxon for its affiliation to the respective plant group. Epidermal features presenting logical grounds have made it possible to determine with good deal of certainty the precise position of a seed taxon in relation to its parent plant. Further the co-existence of seeds with other vegetative fertile plant organs in intimate association revealing identical epidermal details presented convincing evidence for the very close morphological relationship between the compression specimens of other plant organs belonging to the same plant group and has been of utmost importance in tracing the course of their lineage.

Consequently, the seed restorations substantiated by clarity of noteable characters point strongly the representation of various plant groups of *gymnosperm* in the floral assemblage of Nidpur.

Acknowledgements

Thanks are due to Dr. S. R. MANIK and SHRI. P. K. BAJPAI for their all assistance in reconstruction of seeds under the supervision of the author.

References

BOSE, M. N. and SRIVASTAVA, SHYAM C. (1971): The genus *Dicroidium* from the Triassic of Nidpur, Madhya Pradesh, India. – Palaeobotanist *19*, 41–45.

BOSE, M. N. and SRIVASTAVA, SHYAM C. (1971): *Lepidopteris indica* sp. nov. from the Lower Triassic of Nidpur, Madhya Pradesh, India. – J. Palaeont. Soc. India *15*, 64–68.

HARRIS, T. M. (1932): The fossil flora of Scoresby Sound East Greenland. Part 2: Description of seed plants incertae sedis together with a discussion of certain *cycadophyte* cuticles. – Meddlelser om Gronland *85*, 1–112.

MANIK, S. R. (1988): Some new genera of Triassic seeds. – Palaeobotanist *36*, 197–200.

SRIVASTAVA, SHYAM C. (1971): Some *gymnospermic* remains from the Triassic of Nidpur, Sidhi district, Madhya Pradesh. – Palaeobotanist *18*, 280–296.

SRIVASTAVA, SHYAM C. (1974): *Pteridospermic* remains from the Triassic of Nidpur, Sidhi district, Madhya Pradesh, India. – Geophytology *4*, 54–59.

SRIVASTAVA, SHYAM C. (1975): A new microsporangiatae fructification from the Triassic of Nidpur, India. – Palaeobotanist *22*, 19–22.

SRIVASTAVA, SHYAM C. and MANIK, S. R. (1990): *Rostrumaspermum venkatachalae* gen. et sp. nov., an archegoniate seed from Triassic of Nidpur, India. – Palaeobotanist *38*, 98–104.

SRIVASTAVA, SHYAM C. and MANIK, S. R. (1993): Taxonomic diversity of Triassic seeds from India. – Proc. Eight Gondwana Symposium, Hobart (Tasmania) Australia, 265–275.