DISACCATE POLLEN FROM PERMIAN OF PAKISTAN

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Abstract

Nine disaccate pollen species belonging to five genera viz, *Alisporites* (Nilson and Daugherty) Jansonius 1971, *Pinuspollenites* Raatz 1937, *Falcisporites* (Leschik) Klaus 1963, *Pityosporites* (Seward) Jansonius 1960 and *Limitisporites* Leschik 11956 from the Permian strata of the Salt Range, Pakistan are morphosystematically described. The *Pityosporites reticulatus* and *Pinuspollenities majus* are reported as new species.

Introduction

Permian system of the Salt Range, Pakistan, has been the main centre of attraction for palynological studies for the past few decades. The most significant contribution in this respect is of Balme (1970) who described a rich and diversified palynological assemblage mainly from Chhidru and Amb Formations of the Salt Range, Pakistan. No work has been published on Dandot and Warchha Formations respectively. The present paper deals with the palynological analysis of the rock samples from the three major Formations of the Permian sequences of Pakistan, viz, Amb, Warchha and Dandot.

Amb Formation constitutes the basal portion of the Zaluch Group of the Permian System of the Kohat Potwar Province of Pakistan. The Formation consists of sandstone, limestone and shale. The sandstone is brownish grey medium grained calcareous and medium to thick bedded. These sandstone beds occupy the lower portion of the Formation. Samples were obtained from twenty meters thick outcrop of the Formation at Jharnawala Nala long 71° 55, lat 32° 30' near Warchha Mandi, Central Salt Range Pakistan.

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Dandot and Warchha Formations constitute the middle portion of the Permian of the Kohat Potwar Province. Dandot Formation is well developed in the eastern Salt Range and thins out westwards. Samples of the Dandot Formation were obtained from the fifteen meters thick outcrop at Jharnawala Nala (long. 71° 40' lat 32° 43' Fig.2) near Warchha Mandi, Central Salt Range, Pakistan. The lithology of the assemblage mainly consists of light grey to olive green yellowish sandstone with subordinate dark grey and greenish splintary shales. Samples of the Warchha Formation were collected from near the Burekhel village (long. 71° 56' lat 32° 28', Fig.1) in the Western Salt Range. The Formation consisted of medium to coarse grained sandstone (long. 71° 55' lat. 32° 30',) The present work include the morphotaxonomic description of several disaccate miospores recovered from the above mentioned strata.

Material and Methods

Standard techniques used for palynomorph extraction were those as suggested by Balme (1970) and Smith and Butterworth (1967). Samples were crushed on tin foil to 5 mm size pieces and thorughly washed in distilled water. Twenty grams of each oven dried sample was further treated with 50% Hydrochloric acid, 40% Hydrofluoric acid and Schultz Solution for twenty four hours respectively with at least six decantations between each shift. It was followed by 5% Potassium hydroxide solution treatment to remove humic acids. Completely neutrilised unstained macerated material was used for preparing slides in glycerine jelly. Relative occurrence of each palynomorphy species is described as follows:–

Dominant: more than 25%, Abundant: more than 15% but less than 25% Common: more than 10% but less than 15%, Frequent: more than 5% but less than 10%, Rare: more than 1% but less than 5%, very rare: less than 1%.

Systematic Description

Anteturma POLLENITES Potonie 1931.

Turma SACCITES Erdtman 1947.

Subturma DISACCITES Cookson 1947.

Infraturma DISACCIATRILETI (Leschik) Potonie 1958.

Genus *Alisporites* (Nilson and Daugherty) Jansonius 1971.

Type Species: *Alisporites opii* Daughterty 1941.

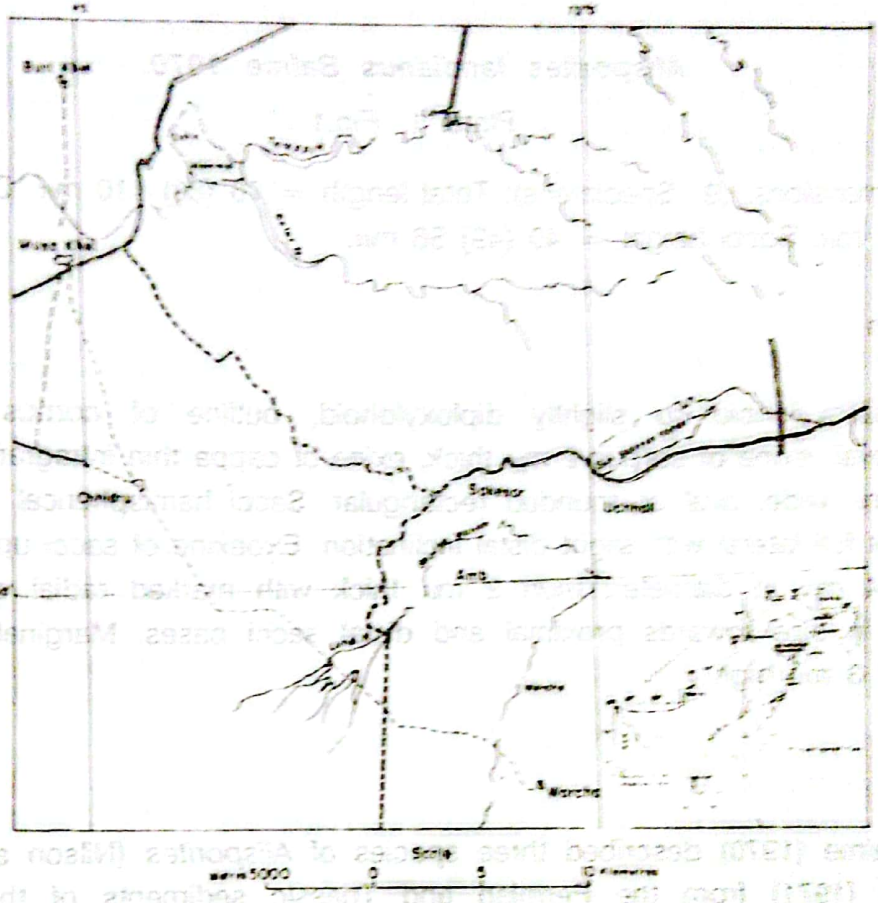

Fig.1 Location Map

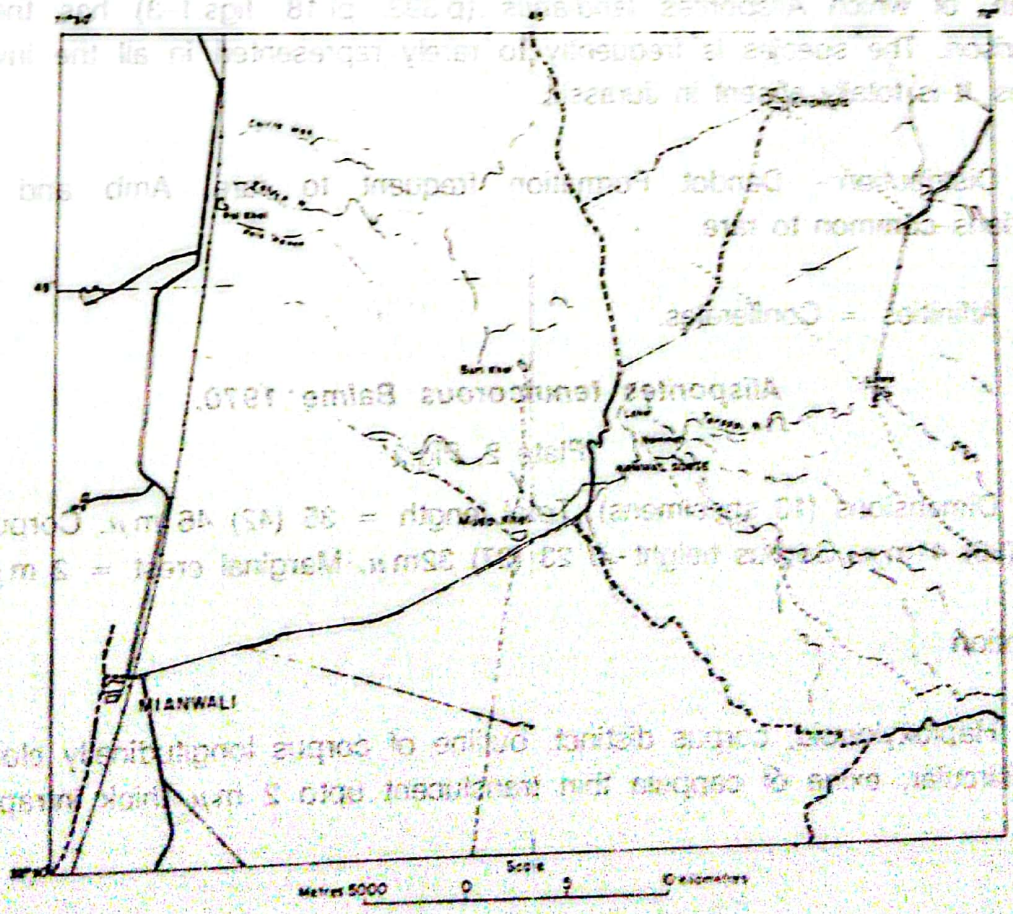

Fig.2 Location Map

Alisporites landianus Balme 1970.

Plate 1, Fig.1

Dimensions: (9 Specimens): Total length = 70 (88) 110 mμ. Corpus breadth = (50) 53 mμ. Sacci height = 40 (49) 56 mμ.

Description

Haploxylonoid to slightly diploxylonoid, outline of corpus longitudinally elongate oval, exine of corpus 2 mμ thick, exine of cappa thin infragranulate, cappule upto 20 mμ wide, oval or rounded rectangular. Sacci hamispherical or crescentric, attachment full lateral with slight distal inclination. Exoexine of sacci upto 2 mμ thick, brochi 2–4 mμ in diameter, muri 2 mμ thick with marked radial elongation and reduction in size towards proximal and distal sacci bases. Marginal ridge weakly developed 3 mμ high.

Remarks

Balme (1970) described three species of *Alisporites* (Nilson and Daugharty) Jansonuis (1971) from the Permian and Triassic sediments of the Salt Range, Pakistan, of which *Alisporites landianus* (p.393, pl.18, figs.1–3) has the closest comparison. The species is frequently to rarely represented in all the investigated samples. It is totally absent in Jurassic.

Distribution:– Dandot Formation frequent to rare, Amb and Warchha Formations–common to rare.

Affinities = Coniferales.

Alisporites tenuicorous Balme 1970.

Plate 2, Fig.2

Dimensions (10 specimens): Total length = 35 (42) 46 mμ. Corpus breadth = 32 (36) 41mμ. Corpus height = 23 (27) 32mμ. Marginal crest = 2 mμ.

Description

Haploxylonoid, corpus distinct, outline of corpus longitudinally elongate oval to subcircular, exine of cappula thin translucent upto 2 mμ thick intrapunctate to

granulate, sulcus indistinct, Sacci hemispherical or semielliptical to crescentric, attachment full lateral, exoexine of sacci intravermiculate to intrapunctate, ornamentational elements upto 2 mμ in diameter.

Remarks

Except slight variations in the size range it is closely compareable with *Alisporites tenuicorpus* Balme (1970, p.394, pl.15, figs.3-4). It is differentiated from the genus *Viterisporites* due to the large size range and broader cappula.

Distribution: Dandot Formation frequent to rare, Amb and Warchha Formations frequent to very rare.

Affinities: Coniferales.

Genus Pinuspollenites Raatz 1937.

Type Species *Pinuspollenites labdacus* Potonie .

Plate 2, Fig.3

Pinuspollenites theoracatus Balme 1970.

Dimensions: (8 specimens) Total length = 50 (55) 62 mμ. Corpus breadth = 31 (36) 40 mμ. Corpus Height = 28 (31) 38 mμ.

Description

Haploxylonoid, corpus distinct, exine of cappa intrapunctate to infravermiculate, upto 2 mμ thick, exine of cappula laevigate, cappula upto 10 mμ wide almost parallel sided. Sacci hemispherical, margins of sacci wavy, attachment full lateroventral, exoexine of sacci 2 mμ thick, intrareticulate on distal side, reticulum distinct, meshes rounded, lumina 4 – 8 mμ in diameter, muri 2 mμ.

Remarks

It is slightly different from all the species of *Pinuspollenites* Raatz (1937) on the basis of the distinct reticulate pattern of the exoexine of sacci, whereas in other features it perfectly match with the description of *Pinuspollenites theoracatus* Balme (1970, p.400, pl.15, figs.10-14).

Distribution: Dandot Formation rare, Amb and Warchha Formations frequent

Affinites: Coniferales.

***Pinuspollenites majus* n. sp.**

Plate 1, Figs. 2,3.

Holotype:-

Dimensions (29 – specimens). Total length = 70 (74) 78 mμ. Corpus breadth = 39 (41) 43 mμ. Corpus height = 38 (30) 32 mμ. Sacci height = 34 (37) 39 mμ.

Diagnosis

Haploxylonoid, outline of corpus diffuse, circular, overall amb elliptical, exine of corpus intrapunctate to intravermiculate, Sacci sharply defined, semi elliptical in outline, attachment lateral, exoexine of sacci intrareticulate to intrapunctate, marginal crest indistinct.

Description

Haploxylonoid, corpus indistinct, outline of corpus circular, exine of corpus upto 3 mμ thick, intrapunctate to intravermiculate gradually merging into sacci, exine of cappa hyaline, intrapunctate, cappula parallel sided, sulcus indistinct. Sacci semielliptical, attachment complete lateral, slightly distally inclined. Exoexine of sacci intrapunctate to reticulate with more thick ornamental pattern along lateral margins. Brochi 2mμ in diameter, exoexine of sacci 4 mμ thick.

Remarks

It is separated from all the known species of *Pinuspollenites* Raatz (1937) by the diffuse outline of corpus, larger overall size, and sharp sacci in relation to corpus. *Pinuspollenites* sp. A. of Romans (1975 p.315, pl.6, fig.7) is apparently identical but the description which Romans has provided is incomplete and of limited value. *Pinuspollenites* sp. mentioned by Tiwari (1979 pl.2 fig.22) is again difficult to be compared as no description or size range has been provided.

Distribution: Dandot Formation frequent, Amb Formation rare, Warchha Formation very rare.

Affinites: Coniferales.

Etymology: *Majus* referring to the large size of the specimen.

Genus *Falcisporites* (Leschik) Klaus 1963

Type Species: *Falcisporites zapfei* Potonie and Klaus.

Falcisporites stabilis Balme 1970.

Plate 2, Figs. 7,8,9

Dimensions (23–Specimens): Total length = 82 (91) 111 mμ. Corpus breadth = 32 (40) 60 mμ, Corpus height = 31 (41) 57 mμ, Sacci height = 39 (46) 68 mμ.

Description

Diploxylonoid, corpus clearly defined, outline of corpus longitudinally elongate oval, exine of cappa intrareticulate, upto 2mμ thick, meshes elongate, lumine 2–5mμ broad, muri curved rarely straight 2 mμ thick, marginal crest indistinct, exine of cappula intrareticulate to intrapunctate, sulcus oval to fusiform, 5 mμ long, 15 mμ wide. Sacci semielliptical, attachment full lateral slightly distally inclined, exoexine of sacci 3 mμ thick, coarsly intrareticulate; muri curved to rarely fragementimurate, 1–3 mμ thick.

Remarks

The present specimens are compareable to *Falcisporites nuthallensis* (Clerk); Balme 1970 but differ in having more circular corpus and overall large size.

Distrbition: Dandot Formation frequent to rare, Amb Formation rare, Warchha Formation common.

Affinitles: Coniferales.

Falcisporites nuthalensis (Clerk) Balme 1970.

Plate 1, Figs. 5,6

Dimensions: (38 specimens): Total length: 68 (73) 81 mμ. Corpus breadth: 30 (33) 41 mμ. Corpus height: 45 (48) 47 mμ marginal crest: 2 mμ.

Description

Haploxylonid, overall amb elliptical to elongate oval, corpus indistinct, outline of corpus longitudinally elongate oval, exine of cappa intragranulate to intrareticulate 2 mμ thick, meshes diffuse, exine of cappula intrapunctate, Marginal crest raised sinuous 2 mμ high, sulcus diffuse cappula 10 mμ wide. Saccihemispherical or semi elliptical, attachment complete lateral, slightly distally inclined, exoxine of sacci intrareticulate to punctate, lumina 2 - 8 mμ broad, muri 2 mμ thick.

Remarks

Balme (1970) described and amended *Falcisporites nuthallensis* Clerk (1965) which is closely compareable to the present playnomorph.

Distribution: Dandot Formation frequent, Amb Formation rare, Warchha Formation common.

Affinites: Coniferales.

Genus Pityosporites (Soward) Jansonius (1960)

Type Species: *Pityosporites antarcticus.*

***Pityosporites communis* Tschudy and Kosanke 1966.**

Plate 1, Fig.4

Dimensions (8 specimens): Total length = 79 (81) 85 mμ corpus breadth = 43 (46) 50 mμ. corpus height = 33 (36) 41 mμ marginal crest = 2 mμ

Description

Haploxylonoid to slightly diploxylonoid, corpus clearly defined, transversely elongate to rounded rectangular, exine of cappa 2 mμ thick, exine of cappula thin translucent, intrapunctate, sulcus well defined. Secci hemispherical slightly displaced towards central side. Exoexine of sacci intrareticulate 3 mμ thick, brochi 2–4 mμ in diameter, margins of sacci smooth to slightly undulating, marginal ridge 2 mμ high.

Remarks

It is separated from all the known species of the genus *Pityosporites* (Manum ex Seward) Jansonius (1960) in having significantly larger size of massive sacci. The closest comparison can however he made with *Pityosporites communis* Tschudy and Kosanke (1966, p.66, pl.2, figs.32,33) from the Permian of Texas USA, which is similar in gross morphology but is significantly smaller in size. Only eight well preserved specimens were observed which are too limited for the erection of a new species.

Distribution: Dandot Formation–very rare, Amb and Warchha Formations–very rare.

Affinities: Filicinean.

Pityosporites recticulatus n. sp.

Plate 2, Fig.1

Holotype Pl. Fig.

Dimensions (46 specimens): Total length = 140 (145) 151 mμ. Corpus breadth = 88 (94) 104 mμ. Corpus height = 57 (61) 64 mμ, marginal crest = 3 mμ.

Diagnosis

Haploxylonoid, overall amb rounded quadrilateral, well defined, amb of corpus transversly oval to elliptical, marginal crest well developed 3 mμ high, cappula distinct, sacci hemispherical, attachment full lateral.

Exoexine of sacci coarsly intrareticulate.

Description

Haploxylonoid, amb rounded quadrilateral, corpus distinct, corpus eliptical in outline, exine of cappa intratreticulate to intragranulate showing plications, exine of cappula same as cappa, marginal crest distinct, sinuous raised 3 mμ high. Sacci hemispherical slightly compressed at the point of attachment around corpus, attachment full lateral. Exoexine of sacci coarsly intrareticulate, reticulum distinct, meshes distinct, lumina 6 – 10 mμ in diameter, muri 2 mμ thick, meshes less broad at saccale area, becoming fused along margins of sacci forming distinct 4 mμ thick continuous limboid margins.

Remarks

Pityosporites communis Tschudy and Kosanke (1966), described by Tschudy and Kosanke (1966 p.66 pl.32) is similar in gross morphology but lacks intrareticulate ornamentional pattern of sacci with raised muri which are the characteristic features of the *Pityosporites reticulatus*. *Pityosporites westphalensis* Williams (1955, Smith and Butterworth, 1967, pl.24, figs.39-40) is not comparable due to the converging pattern of sacci. *Pityosporites granulatus* (Grebe) Tschudy and Kosanke 1966 and *Pityosporites devolens* Leschik, are all significantly smaller in size and lack intrareticulate exoexine of sacci.

Distribution : Amb Formation frequent.

Affinites : Coniferales.

Etmology : Reticulatus refering to intra-reticulate exoexine of sacci.

Slide No : P35Y/S2/C3.

Infraturma DISACCIMONOLETI Klaus 1963.

Genus *Limitisporites* Leschik 1956.

Type species : *Limitisporites rectus* Leschik 1956.

Limitisporites plicatus Bose and Kar 1966.

Plate 2, Figs.4,5,6

Dimensions (10 specimens): Total length = 108 (112) 118 mμ. corpus breadth = 81 (86) 89 mμ. corpus and sacci height is identical.

Description

Haploxylonoid, Corpus ill defined, amb of corpus circular, exine of cappa laevigate 1 mμ thick intragranulate with an open transverse monolete mark in the centre, exine of cappa intrapunctate to intragranulate, cappula bordered by fusiform exinal folds with diverging extermities. Sacci hemispherical, attachment complete lateral with slight distal inclination. Exoexine of sacci intrapunctate more dark and liboid at margins.

Remarks

Limitisporites sp. cf. *L. plicatus* Bose and Kar (1966, Bharadwaj, Kar and Navale, 1967; p.82, pl.5, fig.60) is almost identical in gross morohology with the

Plate 1

Fig. 1. *Alisporites landianus* Balme 1970, Sample No.A2188, Maceration A16, Slide P35Y/53/C4, Film 29/061182/07, X1000.

Fig. 2,3. *Pinuspollenites majus* n.sp, Sample No.W2613, Maceration A36, Slides, P35Y/S4/C1, P35Y/S3/C3, Films 29/061182/14, 29/061182/17, 28/051182/11, Holotype = Fig.3, X1000.

Fig. 4. *Pityosporites communis* Tschudy and Kosanke 1966. Sample No.D2491, Maceration D102, Slide, P35Y/S2/C4, Film 28/051182/02, X1000.

Fig. 5,6. *Falcisporites nuthallensis* (Clark) Balme 1970, Sample No.D2491, Maceration D102, Slide P35Y/S3/C3, K6/S2/C2, Films 28/O51128/18, 42/07183/1, X1000.

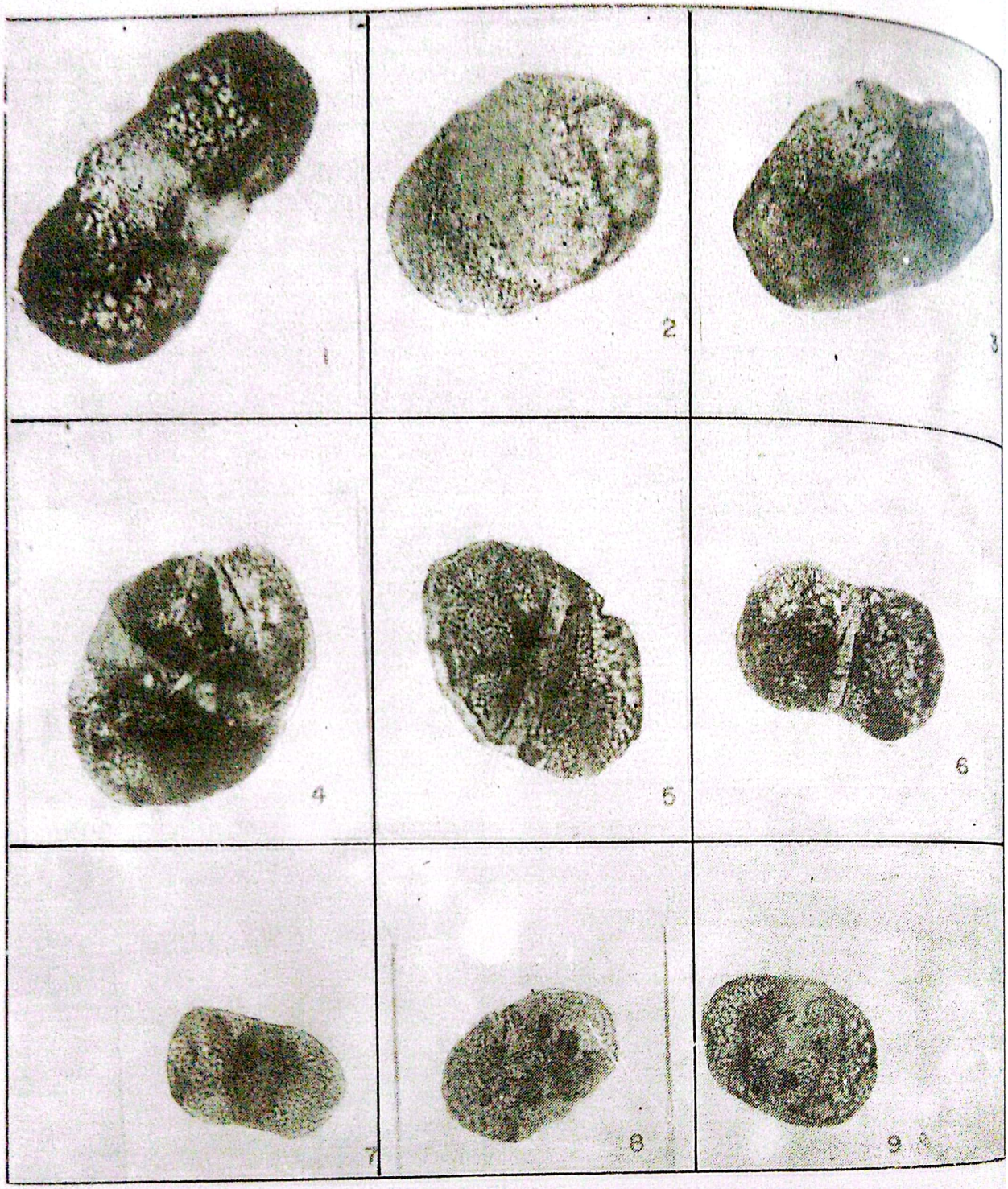

Plate 2

Fig. 1. Pityosporites reticulatus n.sp. Sample No.A466IA, Maceration A1218, Slide P35Y/S2/C3, Film 31/041182/10, X400.

Fig. 2. *Alisporites tenucorpus* Balme 1970, Sample No.A36IA, Maceration, AI2IB, Slide P35Y/S5/C1 Films 34/071182/01, 34/071182/06, X1000.

Fig. 3. *Pinuspollenites theoracatus* Balme 1970, Sample No.W213IA, Maceration W13, Slide P35Y/S7/C1, Film 35/08118/05, X1000.

Fig. 4,5,6. *Limitisporites plicatus* Bose and Kar 1966, Sample No.W22 3IA, Maceration W14, Slide I5/S6/C2. Film 41/06183/03, X400.

Fig. 7,8,9. *Falcisporites stabilis* Balme 1970, Sample No.W233IA, Maceration W14, Slide K6/S3/C2, K6, S10/C2, I5/S7/C2, Films 42/07182/02, 42/07 183/05, 41/06183/06, X400.

exception of being slightly larger in size. It is separated from *Limtisporites lepidus* (Luber and Valts) Hart (1965, p.80, text fig. 191) by its outline and significantly smaller size.

Distribution : Dandot Formation–frequent, Amb Formation–rare, Warchha Formation frequent.

Affinities : Coniferales.

Discussion

Vesiculate palynoflora of the Dandot, Warchha and Amb Formations mainly consisted of haploxylonoid taxa comprising five miospore genera viz., *Alisporites*, *Pinusnollenites*, *Falcisporites*, *Pityosporites* and *Limitisporites*. Most taxa are long ranging, except *Pityosporites*, which was absent in Dandot Formation (Fig.3). Both species of *Pityosporites* were of restricted range, i.e. *P. communis* occurred only in Warchha Formation, where as *P. reticulatus* was confined to Amb Formation (Fig.3). Palynoflora of the Warchha Formation was most rich and diverse as compared to Dandot and Amb Formations. Amb Formation represent the lower part of the Zaluch Group, whereas Dandot and Warchha Formations belong to the Nilawahan Group of the Kohat Potwar province (Upper Indus Basin) of Pakistan (Shah 1977). In terms of the European standard scale the three formations have been assigned to Asselian,

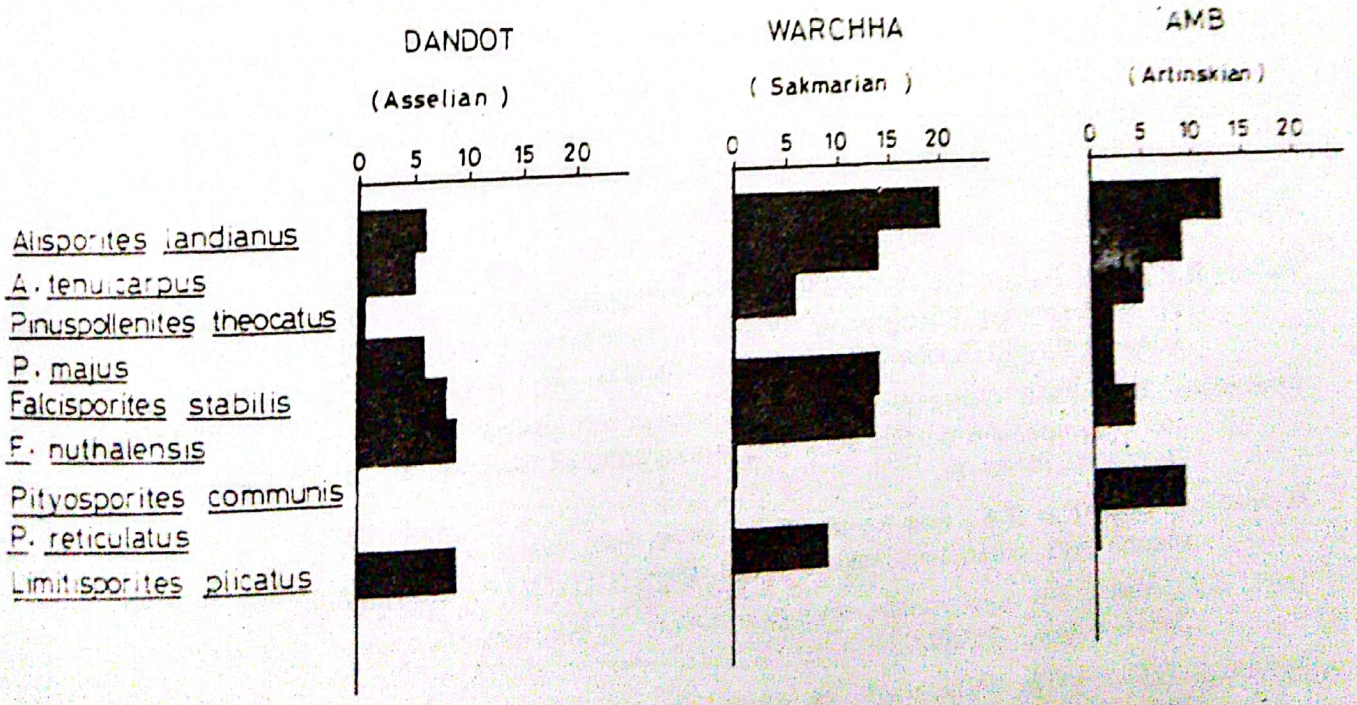

FIG.3 Histogram showing palynomorph taxa in the investigated formations.

Gakmarian and Artinskian respectively (Shah 1980). It is evident (Fig.3) that miospore population was lowest in Amb Formation (Zaluch Group) as compared to Dandot and Warchha Frmations (Nilawahan Group).

Botanical affinities of all the recorded taxa (disaccate non striated pollen grains) are tentatively assignable to coniferales (Bharadwaj 1966). Most pollen grains did not occur in good state of preservation possibly indicating long distance transportaion prior to fossilization.

Conclusion

Permain vesiculate miospores of the Dandot, Warchha and Amb Formations mainly include disaccate haploxylonoid non-striated pollen grains. Most palynomorph species are long ranging i.e., occurring in all the three investigated Formations. Palynomorph frequency is highest in Warchha and lowest in Amb Formation. Palynoflora reflect prevalance of Coniferales during the early Permian period in the hinterland. Poor state of preservation of palynomorph indicate long distance transportation.

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