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A palynological investigation of the offshore Cretaceous sequence on the south-west coast of South Africa

Sandersen, Andrea

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GLOSSARY OF DESCRIPTIVE TERMS

The descriptive terms used in this thesis are those which have been widely accepted and used in the same sense by other authors. Many of the definitions have been extracted with little or no modification from the descriptive glossaries of Potonié (1934), Erdman (1952), Harris (1955), Potonié and Kremp (1955), Kremp (1968), Grebe (1971) and Punt *et al*., 1994, and reference is made to the authors of the definitions.

GENERAL TERMINOLOGY

PALYNOLOGY:

- The study of pollen grains and spores and other biological materials that can be studied by means of palynological techniques (Hyde, 1944).

PALAEOPALYNOLOGY:

- The study of fossil palynomorphs. Traverse (1988) defines it as now interpreted broadly by most to include study of a wide range of fossil microscopic, usually organic bodies, in addition to spores and pollen.

PALYNODEBRIS:

- All palynomorph-sized particles in a sediment excluding those that actually are palynomorphs but including wood fragments, cuticles and some animal remains (Manum, 1976).

PALYNOFACIES:

- A term used in palaeopalynology for the assemblage of palynomorph taxa in a portion of sediment, representing local environmental conditions and not typical of the regional palynoflora (Traverse, 1988).
- The assemblage of phytoclasts found in a particular sediment, such as palynomorphs, wood, cuticles etc. (Combaz, 1964).

PALYNOMORPHS:

- A general term for all entities found in palynological preparations (Tschudy, 1961).
- A microscopic, resistant walled organic body found in palynologic maceration residues and include pollen grains, spores, colonial algae, fungal spores, dinoflagellates, acritachs etc. (Traverse, 1988).

POLLEN DIAGRAM:

- Any diagram of pollen abundance showing the fluctuations in time of concentration of various types of pollen types, as revealed from studies of cores and other samples of sediment (Traverse, 1988).

SPOROMORPH:

- A fossil dispersed pollen grain or spore (Traverse, 1988).

TURMA:

- An artificial suprageneric grouping of form-genera of fossil spores and pollen based on morphology (Traverse, 1988).

PALYNOMORPH CATEGORY

FUNGAL SPORE:

- A spore of the usually multicellular, non-vascular, heterotrophic organisms belonging to kingdom Fungi. Such spores include a wide variety of types from simple unicellular to multicellular scelerotia. Those fungal spores preserved in sediments and surviving maceration are chitinous and such fungal spores range primarily from Late Jurassic to present (Traverse, 1988).

MONOLETE:

- A spore with a single laesurae (Erdtman, 1943).

POLLEN:

- The microspores of seed plants (Linnaeus, 1751).
- Fossil pollen consists entirely of the microspore wall or exine (Traverse, 1988).

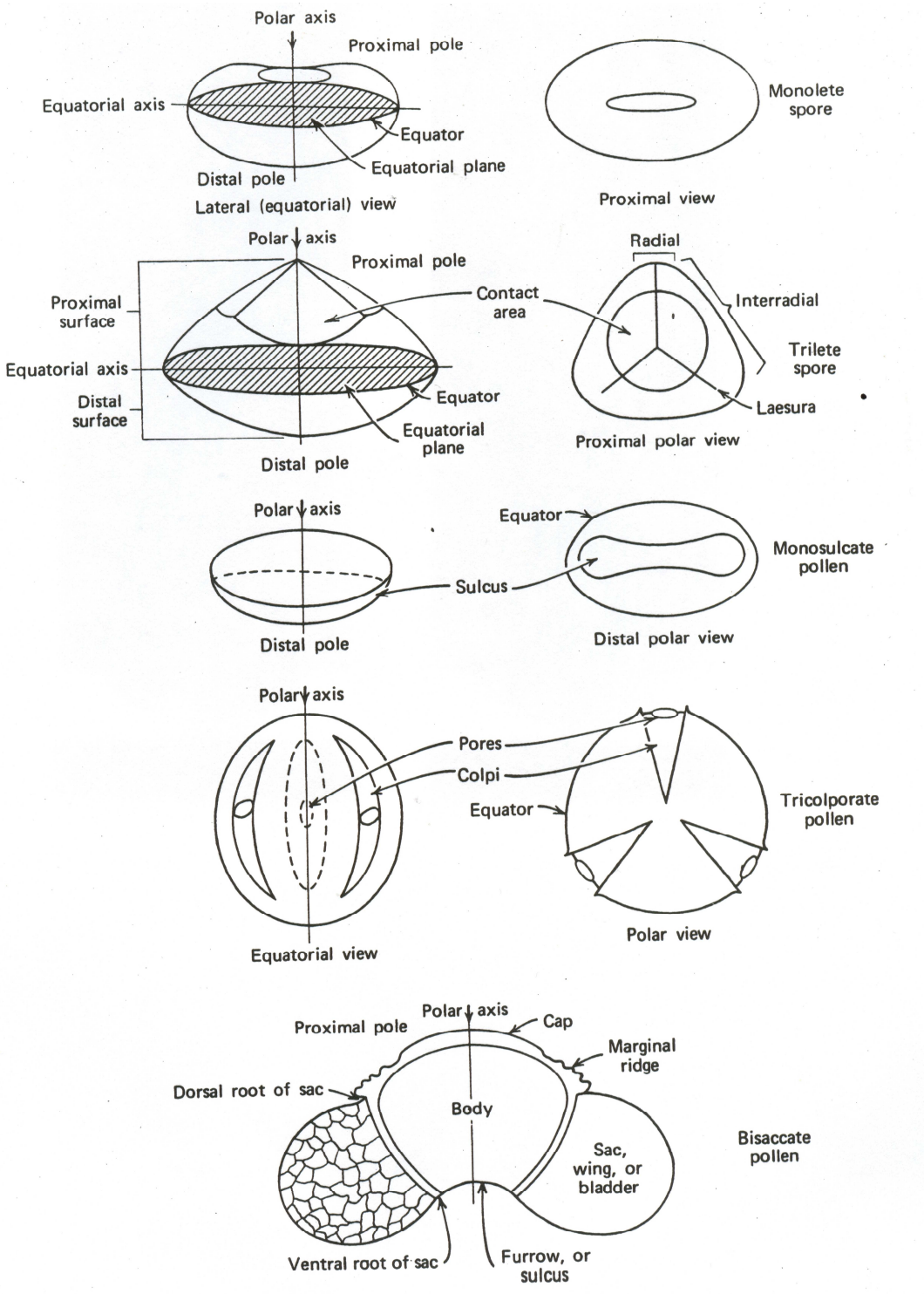
SPORES:

- A general term for the usually microscopic, unicellular, asexual, re- productive units of crytograms (Jackson, 1928).

TRILETE SPORE:

- A spore with a three-armed laesurae, therefore showing a trilete mark (Erdtman, 1943).

POLARITY AND SHAPE



General terms used in describing pollen and spores modified after Tschudy & Scott, 1969.

AMB:

- The outline of a pollen grain or spore seen in polar view (Erdtman, 1952).

APICES:

- The corners of a palynomorph that can range in shape from broadly rounded to angular.

CONTACT REGION:

- The area adjacent to the tetrad mark (Harris, 1955).
- Area on the proximal face of the spore interpreted as having formed in contact with the other members of the tetrad (Potonié, 1956).

DEHISCENCE FISSURE / FURROW / LIST / MARK / RIDGE:

- In contrast to pollen, spores usually show a triradiate mark, the Y-mark which is formed by the dehiscence-lists and –furrows and which aids in germination (Potonie, 1956).

DISTAL POLE:

- The point opposite the proximal pole (Erdtman 1952).

DISTAL FACE:

- That part of the spore which is directed outwards in its tetrad (Erdtman 1952).

EQUATOR:

- The border line between the proximal and distal surfaces of a polar spore (Wodehouse,1935 and Erdtman, 1952).

INTERRADIAL REGION:

- The region that includes the proximal region adjacent to the tetrad mark and the corresponding distal region (Dettmann, 1963).
- Referring to the areas of the proximal face or the equatorial periphery of trilete spores, lying between the radial arms of the laesurae (Couper & Grebe, 1961).

MONOLETE MARK:

- The dehiscence mark in spores separated from the tetragonal-tetrad appears as a kyrtome**,** an abruptly convex exinal area in the proximal and equatorial radial regions; the limits of this area more or less parallel the tetrad mark (Klaus, 1960).
- In compressed spores the kyrtomes usually are reduced to arcuate folds which surround the laesurae (Dettmann, 1963).

POLAR / EQUATORIAL OUTLINE:

- The outline of the spore as seen in equatorial view (Harris, 1955).

POLYAD:

- A dispersal unit comprising more than four pollen grains (Iversen & Troels – Smith, 1950).

PROXIMAL FACE:

- That part of the spore which is directed inwards in its tetrad (Erdtman, 1952).

RADIAL REGIONS:

- The region comprising the proximal region in the immediate vicinity of the tetrad mark and the corresponding distal region (Dettmann, 1963).

SPHEROIDAL:

- The shape of a pollen grain or spore in which the polar axis and the equatorial diameter are approximately equal (Erdtman, 1943).

TETRAD:

- A group of four united pollen grains or spores, either as a dispersal unit or as a developmental stage eg. *Acaciapollenites* (Punt *et al.,* 1994).

TETRAD MARK:

- The mark on that part of the distal surface which was in contact with the other spores of the tetrad. In trilete and monolete spores the tetrad mark corresponds in position to the laesuae (Dettmann, 1963).

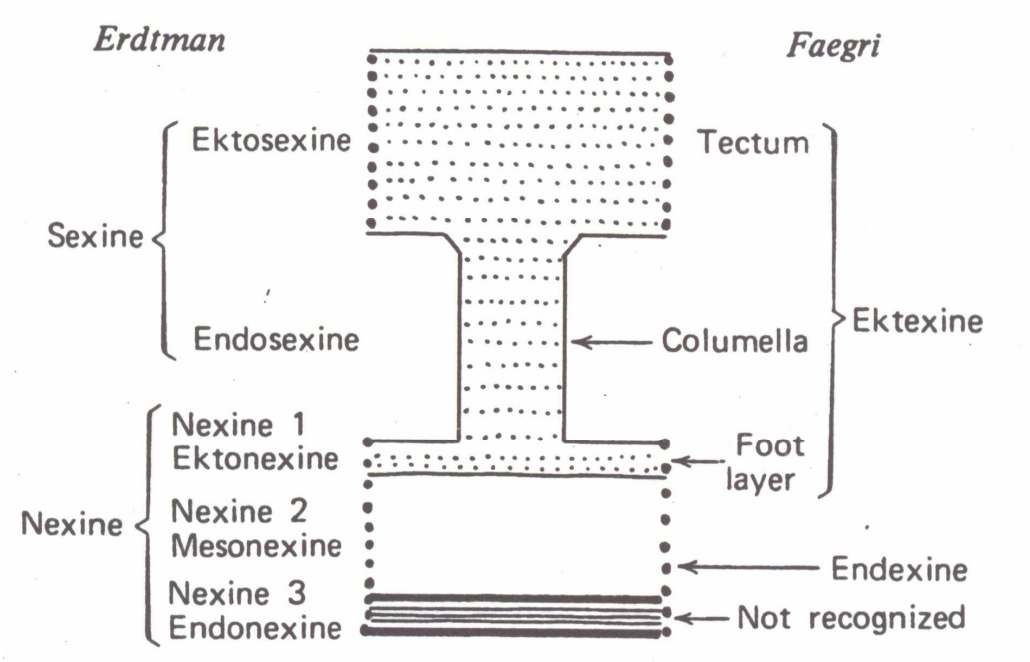
TRILETE MARK:

- The triradiate mark of a trilete spore (Punt *et al*., 1994).

Y-MARK:

- The Y-mark is a tri-radiate, linear, colpus-like solution of one or more exosporlamellae that does not encompass the complete exospore (Thompson & Pflug, 1953).
- The dehiscence mark in spores forming a tetrahedral tetrad appears as a trilete mark or a Y-mark (Potonié & Kremp, 1955).

THE PALYNOMORPH WALL STRATIFICATION



ECTEXINE:

- The outer part of the exine, which stains positively with basic fuchsin in optical microscopy and has higher electron density in conventional prepared TEM sections (Faegri, 1956).
- Ectexine includes the foot layer if present (Punt *et al*., 1994).

ENDEXINE:

- The inner part of the exine which remains relatively unstained with basic fuchsin in optical microscopy and has a lower electron density in conventionally prepared TEM sections (Faegri, 1956).
- The endexine does not include the nexine which is considered part of the ectexine (Punt *et al*., 1994)

EXINE:

- The main outer resistant layer of the sporoderm (Erdtman, 1952).
- The outer layer of the wall of a palynomorph, which is highly resistant to strong acids and bases and is composed primarily of sporopollenin and is situated immediately outside the intine. It is divided into two layers, the ektexine and the endexine (Traverse, 1988).

INTEXINE:

- A synonym of endexine (Traverse, 1988).

INTINE:

- The thin, inner layer of the two major layers forming the wall of spores and pollen, composed of cellulose and pectates and situated inside the exine, surrounding the living cytoplasm and is not normally present in fossil sporomorphs (Traverse, 1988).

NEXINE:

- The inner, non-sculptured part of the exine which lies below the sexine (Erdtman, 1952).

PERINE:

- The outermost extraexinal sporoderm layer in some spores (Erdtman, 1952).

SEXINE:

- The outer, sculptured layer of the exine, which lies above the nexine (Erdtman, 1952).

APERTURES

ANNULATE:

- An area of the ectexine / sexine surrounding a pore that is sharply differentiated from the remainder of the exine, either in ornamentation or thickness (Punt *et al.,* 1994).

APERTURE:

- A specialized region of the sporoderm, that is thinner than the remainder of the sporoderm and generally differs in ornamentation and /or in structure (Erdtman, 1947).

DIPORATE:

- Pollen with two more or less isodiametric germinal apertures

COLPI / COLPUS:

- An elongated aperture with a length/breadth ratio greater than 2 (Erdtman, 1947).

COMMISURE:

- The slit or line of dehiscence in the laesurae (Harris, 1955).

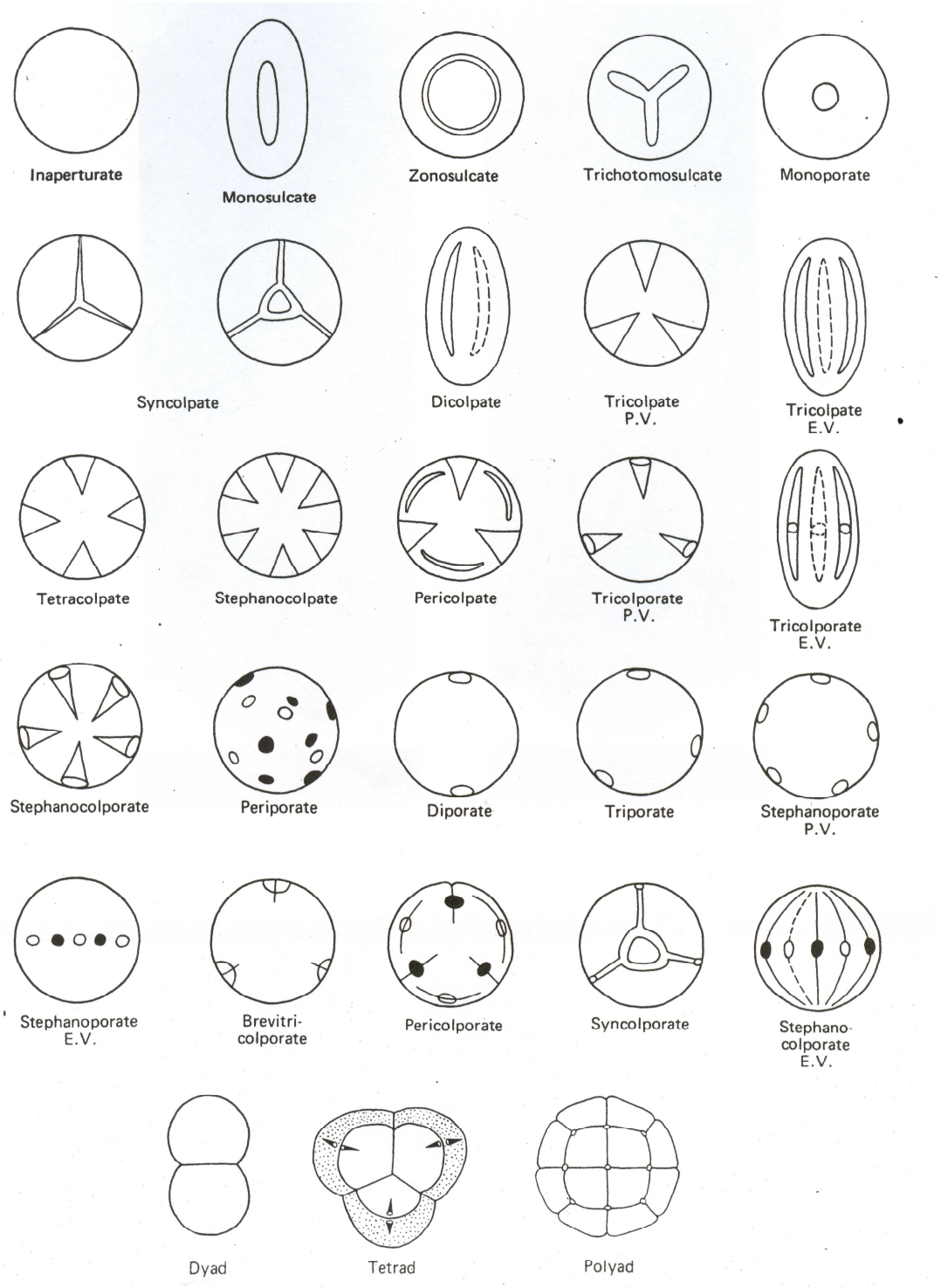
CRYPTOSPORE:

- An alete miospore with well differentiated contact areas but no laesurae (Richardson, Ford & Parker, 1984).

FURROW:

- A common word for colpus (Punt *et al.*, 1994).

POLLEN TYPES



Principle types of pollen grains and their apertures modified after Tschudy & Scott, 1969.

GERMINAL MECHANISMS:

- See crytospore, pore, trilete mark etc.

LAESURA:

- The proximal aperture of trilete and monolete spores. Trilete spores possess three laesurae which radiate from the proximal pole and monolete spores possess one laesurae which has its centre at the proximal pole (Erdtman, 1952).

HILUM:

- The usually irregular distal or proximal aperture of certain spores. The hilum forms as the result of a natural breakdown of the sclerine in an area showing structural or sculptural modifications about the distal pole (Erdtman, 1952).

MONOPORATE:

- Pollen grains provided with a single pore (Traverse, 1988).

MONOSULCATE:

- Having a single germinal furrow or colpus or sulcus (Traverse, 1988).

ORA:

- Synonym for endospore, an inner aperture of a complex structure (Traverse, 1988).

PERIPORATE:

- Pores are arranged other than on the equator i.e. scattered over the pollen grain surface (Traverse, 1988).

PORE:

- A general term applied in palynology to a circular or elliptic aperture with a length/breadth ratio less than 2 (Jackson, 1928 and Wodehouse, 1935).

PSEUDEOPORE:

- An especially thin area in the leptoma of certain coniferous pollen (Traverse, 1988).

STEPHANOCOLPORATE:

- Pollen grains having more than three colpi, meridionally arranged and provided with pores (Traverse, 1988).

STEPHANOPORATE:

- Pollen grains having more than three equatorial, equally spaced pores disposed on the equator (Traverse, 1988).

SULCUS:

- An elongated latitudinal ectoaperture sited at the distal or proximal pole of a pollen grain (Erdtman, 1947).
- An elongate aperture in the exine of pollen grains (Traverse, 1988).

SYNCOLPATE:

- Pollen grains in which the colpi join normally near the pole (Traverse, 1988).

TRICOLPATE / TRICOLPRATE / TRIPORATE:

- Three ectocolpi, three compound apertures or three pores (Iversen & Troels – Smith, 1950).

TRICHOTOMOSULCATE:

- A three-armed sulcus or triradiate germinal furrow (Erdtman, 1952).
- Of monosulcate pollen grains in which the sulcus is more or less triangular often simulating a trilete laesurae (Traverse, 1988).
- The germinal furrow is drawn out into a three-pronged shape sometimes resembling a trilete laesurae.

TRICOLPATE:

- Pollen grains having three meridionally arranged colpi which are not provided with pores, transeverse furrows or other such modifications (Traverse, 1988).

TRICOLPORATE:

- Pollen grains having three colpi which are provided with pores or other usually equatorial modifications (Traverse, 1988).

TRIPORATE:

- Three equatorial more or less isodiametric germinal apertures.

VESTIGIAL MARKINGS:

- A rudimentary pore or trilete mark with a possible germinal function.

THICKENINGS AND EXTENSIONS OF THE SPORE WALL

AZONATE:

- Spores without a zone or similar extension (Traverse, 1988).

BLADDER / SACCUS:

- An expanded sac formed by a local separation within the exine of a pollen grain and at least partly filled with an aveoloate infrastructure (Erdtman, 1952).

CAVATE:

- A single saccus or intercommunicating vesiculae is formed equatorially.

CINGULUM:

- A thick or thin outer structure of a spore that projects at the equator, but does not extend over the distal or proximal face (Potonié & Kremp, 1955).
- A more or less regular thickening of the equatorial to sub-equatorial region which is usually wedge shaped in cross-section (Grebe, 1971).

APICAL RIDGE:

- Krutzsch (1954) suggested that apical ridges were possibly lines of detachment or dissolution of the exine.
- However, Pocock (1970) suggested that the nexine and sexine were loosely adhering and readily split apart, this would give rise to vacuoles and spaces developing between these layers, particularly at the corners.

BIFURCATE:

- A splitting at the end of one or more of the laesurae / tetrad scars.

BISACCATE:

- Pollen grains with two sacci, usually occurs in conifers but also found in other gymnosperms (Traverse, 1988).

CRASSITUDES:

- Synonym for a thickening (Grebe, 1971).

INTERRADIAL CRASSITUDES:

- A thickening of the exine in the equator region but restricted to the interradial position (Grebe, 1971).

KYRTOMES / TORI:

- A more or less arcuate fold or band in the interradial area outside the laesurae of trilete spores (Potonié & Kremp, 1955).
- A more or less arcuate fold or band in the interradial area outside the laesurae of a trilete spore (Traverse, 1988).

LIPS:

- A thickened rim that surrounds the tetrad scar in some specimens (Traverse, 1988).

MARGO:

- An area of exine around an ectocolpus that is differentiated from the rest of the sexine, either in structure or by difference in thickness (Iversen & Troels-Smith, 1950).

MEDIOBACULATE LAYER:

- The spore has structured layers located on either side of one of the tetrad scar branch-lines. This mediobaculate layer as it is known is positioned in the lower interradial equatorial regions of the spore wall.

MONOSACCATE:

- A pollen grain with a single saccus (Potonié & Kremp, 1954).

PERINE:

- An additional wall layer external to the exine in certain spores and pollen. It is composed of a thin and loosely attached sporopollenin and is therefore not usually encountered in dispersed fossil sporomorphs (Traverse, 1988).

SACCUS / SACCI / BLADDER:

- An expanded sac formed by a local separation within the exine of a pollen grain and at least partly filled with an aveoloate infrastructure (Erdtman, 1952).
- A wing-like extension or vesicle of the exine in gymnosperms, especially in coniferous pollen. The saccus is an expanded, bladdery projection of the ektexine extending beyond the main body of a pollen grain and typically displaying more or less complex internal structure (Traverse, 1988).

SEUDOSACCUS:

- An ektexinous saccus-like outer part of a fossil spore or pollen grain, resembling the true saccus of some pollen grains but not showing internal structure characteristic of sacci. Some researchers limit the use of the term pseudosaccus to spores only (Traverse, 1988).

TORI / TORUS / KYRTOMES:

- An arcuate invagination or protrubance of the exine more or less paralleling the laesurae of a spore in the interradial area (Thompson & Pflug, 1953).

WING:

- Synonym for saccus.

ZONA:

- A synonym of cingulum (Potonié & Kremp, 1954).
- A more or less equatorial extension of a spore or pollen grain having varying equatorial width and being as thick or thinner than the spore wall. It is much thinner than a cingulum (Traverse, 1988).

TERMS USED TO DESCRIBE SCULPTURE

ANASTOMOSE:

- Muri radiate out in numerous directions.

BACULAE / BACULATE:

- Projections in which the height is greater than the basal diameter (Grebe, 1971).

CANICULATE:

- Synonym of fossulate (Potonié, 1934).

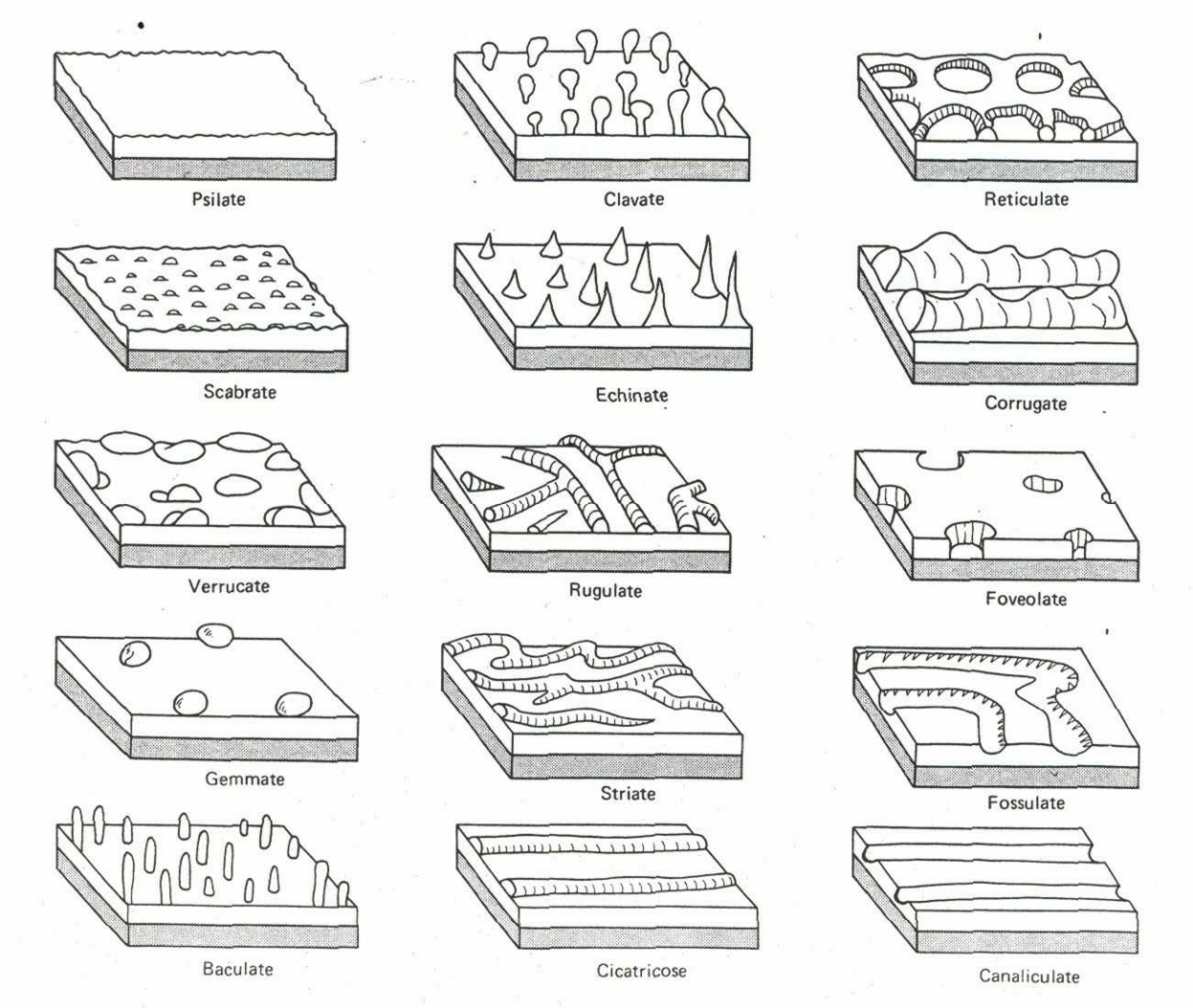
CHAGRINATE:

- Fish scale effect.
- A smooth and translucent sculpture of pollen and spores (Traverse, 1988).

CICATRICOSE:

- Marked with scars (Potonié, 1934).
- Consisting of more or less parallel ridges in the manner of a fingerprint (Traverse, 1988).

SURFACE TEXTURES



A few examples of sculpturing modified after Tschudy & Scott, 1969.

CLAVAE / CLAVATE:

- A club-shaped element of the ectexine / sexine that is higher than 1 μm , less than this in diameter and thicker at the apex than the base (Dettmann, 1963).
- Projections in which the terminations are constricted (Harris, 1965).

COLUMELLAE:

- A rod-like element of the ectexine / sexine supporting a tectum (Iversen & Troels – Smith, 1950).

CONATE / CONUS:

- As seen from the side, the cones or coni are pointed, blunt or rounded cone-shaped. Their height does not exceed twice the diameter of their base, the latter can be extended (Potonié and Kremp, 1955).

CRISTATE:

- A frequent type of arrangement of combs that are built up from pila, rodlets etc., which are sometimes laterally connected and can join to form networks (Potonié, 1934).

CROTON PATTERN:

- A characteristic type of ornamentation comprising rings of five or six raised sexine elements arranged around a circular area, usually formed by pila (Erdtman, 1952).

ECHINAE / ECHINATE:

- Ornamentation consisting of spines longer than 1 μm (Wodehouse, 1928).
- Elevations in which the height is at least twice the basal diameter (Erdtman, 1952).

FOSSULATE:

- A feature of ornamentation consisting of an elongated, irregular grooves in the surface (Faegri & Iversen, 1950).

FOVEOLAE / FOVEOLATE:

- Rounded depressions 1 – 2 μm in diameter and are too widely spaced to form a reticulum (Grebe, 1971).
- Small (up to 2 μm) depressions which are more or less rounded in surface view (Erdtman, 1952).

FOVEO-RETICULATE:

- With pits large enough and close enough together to form a reticulum (Harris, 1955 and Kremp, 1965).

GEMMATE:

- A sexine element that is constricted at it's base, higher than 1 μm and approximately the same width as its height (Iversen & Troels- Smith, 1950).
- Sculpture of pollen and spores consisting of more or less spherical projections (Traverse, 1988).

GRANULA / GRANULATE:

- A general word for small rounded elements (Punt *et al.,* 1994).
- Small (up to 1 μm) more or less isodiametric elevations (Erdtman, 1952).

HAMULATE:

- A form of rugulate ornamentation consisting of irregularly arranged, winding or angular rounded muri of varying thickness, which do not form a distinct reticulum, but rather a maze-like pattern (Krutzsch, 1959).

LAEVIGATE / PSILATE:

- A term used for smooth (Punt *et al.,* 1994).
- Smooth with no adornments (Wodehouse, 1928 and Kremp,1965).

LUMINA:

- The pits between the elevations of a reticulate sculptural pattern. Lumina can either be rounded or polygonal in shape (Grebe, 1971).
- The spaces between the muri or rugulae in murornate spores (Potonié, 1934).

MURI:

- A ridge that is part of the ornamentation and separates for example the lumina in a reticulate spore (Erdtman, 1943).
- The elevations bounding the lumina of reticulate and striae of striate sculptural patterns (Grebe, 1971).

PILATE / PILUM:

- A pilum consists of a head and a rod-like pars collaris or baculum (Erdtman, 1948).
- Small rods with with rounded swollen ends or clavae ((Potonié, 1934 and Faegri & Iversen, 1950).

PITTED:

- Marked with small depression (Jackson, 1928).

PUNCTA:

- Used in the case of *Classopollis* for elements of a punctate intrastructure i.e. granules (Kremp, 1965).

PUNCTATE / PUNCTATION:

- A term used for an internal pattern in which the punctation or flecking is noticeable on the exine in vertical view without the presence of ornamentation (Potonié, 1934).

- A rounded or elongated tectal perforation, less than 1 μm in length or diameter (Erdtman, 1952).

RUGULAE / RUGULATE:

- A type of ornamentation consisting of elongated sexine elements more than 1 μm long, arranged in an irregular pattern that is intermediate between striate and reticulate (Iversen & Troels- Smith, 1950).
- Elevations which are elongated and irregular in basal outline and the maximum basal diameter is at least twice the minimum basal diameter, sides are parallel, converging or diverging and crests are flat, rounded or pointed (Harris, 1955).

RETICULATE / RETICULUM:

- The sculptural pattern formed by muri and adjoining lumina (Grebe, 1971).
- The sculptural pattern consisting of a network of ridges (muri) and enclosed areas (lumina) (Erdtman, 1952).

RUGOSE:

- A finely wrinkled appearance (Jackson, 1928).

RUGULAE / RUGULATE:

- Ornamentation pattern consisting of radial projections elongated so that the length is at least twice the breadth (Faegri & Iversen, 1950).
- Elevations with elongated bases at least twice as long as broad with bases curved to irregular in shape in surface view and tops are rounded (Grebe, 1971).

SCABRATE:

- Radial projections or sculptural elements more or less isodiametric and no dimensions of more than 1 μm in size (Faegri & Iversen, 1950).
- Exine is flecked with minute pits less than 1 μm in size giving it a rough appearance (Grebe, 1971).

SETULAE:

- Straight-sided projections in which the terminations are bluntly tapered (Harris, 1955).

SPINATE see ECHINATE:

- A general word applied in palynology to a long and tapering pointed element exceeding 1 μm (Erdtman, 1952).

- Projections in which the height is at least twice the basal diameter and the tops are pointed (Grebe, 1971).

STRIAE / STRIATE:

- Marked with fine longitudinal parallel lines as grooves or ridges (Jackson, 1928).
- A general descriptive term applied in palynology to ornamentation consisting of elongated, parallel elements separated by grooves (Iversen & Troels – Smith, 1950).
- Narrow grooves separated by ridges (Erdtman,1952).
- The elongated depressions that occurs between the muri of a striate sculptural pattern (Grebe, 1971).
- 'Straked' sculpture characterized by multiple, more or less parallel grooves and ribs in the exine (Traverse, 1988).

TUBERCULATE:

- a sculptural patter formed mainly by tubercula whose height is greater than the greatest diameter. They are rounded at the top and may be slightly constricted at the base (Grebe, 1971).

VERMICULATE:

- Adjective describing a pattern formed by worm-shaped elements and used for the intrastructural pattern in the case of *Classopollis* (Reyre, 1970).

VERRUCAE/VERRUCATE:

- Projections whose height is less or equal to its greatest diameter (Grebe, 1971).
- Warty or covered with wart-like knobs or elevations; of spores and pollen having sculpture consisting of wart-like projections (Traverse, 1988).