A TAXONOMIC STUDY OF THE ACACIA POLLEN GRAINS IN KENYA

BY

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B.Sc. First Class (Hons.) (Poona)

'A thesis submitted in fulfilment for the degree of Master of Science in Botany of the University of Nairobi.'

MAY 1987

D E C L A R A T I O N

This thesis is my original work and has not been presented in any other University.

CHARLES ACHIENG' AKETCH

This thesis has been submitted for examination with my approval as University Supervisor.

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A B S T R A C T

The genus Acacia which is the largest in the subfamily Mimosoideae and second largest within the family Leguminosae, is one of the most widespread and important, having 38 indigenous species in Kenya.

Its species are dominant and form an important component of the vegetation over extensive tracts of the Republic. All geographical divisions of Kenya as recognised by Flora of Tropical East Africa have several species of Acacia some of which are of economic importance.

An attempt is hereby made to study the species using their pollen grains and the results have been compared with the classifications based on the nature of the stipules and the types of the inflorescences.

The nature of the apertures, the pollen grain number and the exine stratification have been the major tools used to separate the Acacia species into two natural groups. The two groups have corresponded considerably well with sections Gummiferae and Vulgares of Bentham's classification (1842). Colporate and colummelate grains show a high degree of correlation with the spinescent species while the simple porate and granulate grains have correlated with the non-spinescent species.

Acacia albida Del. has been found to be anomolous on the basis of pollen characters and has deviated from the Section Gummiferae under which it was classified by Bentham (1842). Its pollen grains show a remarkable difference from the grains under Sections Gummiferae and Vulgares. A compromise has to be reached on where to classify this species. The results suggest that a taxonomic category should be created to accommodate it.

With the exception of Acacia albida a conclusion has been reached that a correlation exists between pollen characters and the classification outlined by Bentham (1842) on the African Acacia species

ACKNOWLEDGEMENTS

In completion of this project, I am deeply indebted to my Supervisor, Prof. J.O. Kokwaro for his advice, patience, receptiveness and critical discussions of the results during the time of the study. I am also grateful to him on behalf of the Department of Botany for providing research facilities in the form of the Palynological Laboratory which was his new initiative in the Department.

I am also grateful to Prof. Ph. Guinet of the Laboratoire de Palynologie E.P.H.E., Montpellier (France) for sending much needed information about the project and reprints; to Prof. E. Beck of the University of Bayreuth (West Germany), for accepting my specimens to undergo SEM investigations in his laboratory despite his heavy research schedule; Dr. N.C. Otieno of the Department of Botany University of Nairobi, for critically checking and advising me on methods of Photomicroscopy; to Prof. D. Oduor-Okelo of the Department of Veterinary Anatomy University of Nairobi, for his encouragement and advice.

I am very thankful to DAAD (Deutscher Akademischer Austrauschdienst) for providing the scholarship for my M.Sc. Programme that enabled me to accomplish this project.

I would also like to thank Mr. P. Lisamula of ICIPE for helping and giving advice on the types of films; Mr. H. Khayo of the Department of Botany, University of Nairobi for tirelessly helping out in the Darkroom. Finally, I am thankful to Mrs. Grace Ogalloh for typing the manuscript.

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1. INTRODUCTION

Pollen grain analysis or palynology is the morphological study of the pollen grains leading to the collection of the exine morphological characters and evaluation of these characters for identification purposes. The pollen grains are microscopic avaraging between 10 µ and 150 µ .

In angiosperms and gymnosperms the walls of the pollen grain have the important function of protecting the male gametophyte in its journey between the anther and the stigma. Pollen grain walls are therefore very resistant to water loss and are often elaborately sculptured. It might be that a resistant wall is needed to avoid desiccation during its aerial journey. This explanation does not account for elaborate and distinctive sculpturing nor for the enormous range of sculpturing types found in the pollen grains and so useful to pollen analysists.

It is therefore the nature of the exine of the pollen grains and not the internal structure and other inclusions that a palynologist is interested in. The type of data thus collected from the exine morphological studies are the nature and number of apertures, the various types of sculpturing, the stratification of the exine layers and at times the ultra-fine structure of these layers. Shape and size can also be considered but these characters may vary according to the habit on which the plant species are growing.

The collection and evaluation of this data on pollen grains has proved extremely useful to Ecologists, Palaeoecologists, Medical Scientists, Criminologists, Agriculturists, Archeologists, Taxonomists etc. For whatever disciplines the pollen grains are analysed, the knowledge of plant pollen producers is an essential commodity to a palynologist so that identification is evaluated to a species, genus or family level.

The following disciplines have in the past made use of pollen analysis:

1.1 Tracing of plant groups and species

In order for one to understand the distribution of any species in space, one must study its distribution in the past. This is because species distribution changes in response to environmental factors e.g. climatic factors, ecological factors, activities of man etc. The history of a species will inform us whether its range is expanding or contracting. Such information can often lead us to an understanding of what critical factors underlie the limitation of the range of such species.

1.2 Tracing the history of plant communities and hence habitats

Paleo-ecologists trace the history of plant communities and plant habitats by analysing pollen grains cored up from fossils. Sediments cored up from depths of up to 30 m are chemically processed and finally analysed for their pollen grain contents. A pollen assemblage is thus built up from which a general picture of the major habitats e.g. deciduous woodland, open shrubland or grassland are obtained. The history of plant communities in these habitats can be determined. The age of any sediment obtained from a core is determined by aid of radiocarbon dating.

1.3 The reconstruction of climatic history

From pollen grain analysis it is possible to re-construct a climatic history of a region. By analysing the pollen grains from a fossil sample and carbon-dating the fossil material, the knowledge of flora and its age can be achieved. Knowing the kind of flora that was thriving in that particular habitat we can easily determine the type of climate under which the flora thrived, hence the climatic history. Intensive palynological work in certain areas has occasionally resulted in the production of a detailed account of the gradual, destruction of forest and development of Agriculture within that region by man. Perhaps one of the greatest uses of pollen analysis today is for the prehistoric period when it provides information on the environment at a period during which no documented periods exist.

1.4 Aeropalynology

Aeropalynology is the term applied to the study of pollen grains and spore in the atmosphere. According to Hyde (1969) it was Charles Blackley of Manchester who made the first observations on pollen grains in the atmosphere in 1873. Since that time many scinetists especially microbiologists, agriculturalists, research workers in allergy and palaeoecologists have been concerned with this work.

The transmission of disease, especially fungal diseases of man and his domesticated animals and plants, by means of spores dispersed within the atmosphere has provided ample incentive for agriculturalists and microbiologists who wish to study and record aerospora.

In addition, the fact that many pollen grains are causal agents of hay-fever has intensified the monitoring of pollen and spores in the air, leading to the development of a branch of science dealing with the behavior of these small particles in gaseous suspensions.

In palaeopalynological studies it has become evident that these aerial pollen surveys would be of considerable relevance to the interpretation of fossil data.

1.5 Melissopalynology

The analysis of pollen grains in honey provides information regarding the flora sources which bees are using. This information is often of importance when assessing the quality of the honey (Lieux, 1972). It is also possible to ascertain the season of honey production as this correlates with the flowering period of the species represented by their pollen.

1.6 Criminology

The fact that pollen grains are recognizeable and can aid in the reconstruction of vegetational history has led to their use in forensic science. The analylsis of soil or mud samples can sometimes provide sufficient information for the determination of their source.

1.7 Pollen morphology and taxonomy

The main characters of taxonomic value in pollen grain are: exine structure, number, position and complexity of the apertures, and the form of sculpturing of the exine. Variation is also shown in size and general shape, but this is of less diagnostic value.

The basic types of pollen grains occuring in the angiosperms are monoaperturate and triaperturate. The monoaperturate grains are provided with a single furrow or pore whereas triaperturate grains are provided with three furrows or three pores. Monoaperturate grains are characteristic of gymnosperms and monocotyledons, however, this characteristic is also localised in some dicotyledonous families, especially the woody members of the Ranales and members of other families, e.g. Piperaceae, Chloranthaceae. Triaperturate grains have three meridionally placed furrows. They are characteristic of most of the dicotyledons where they are the basic type from which other types have been derived.

Lines of specialisation starting from both the monocolpate and tricolpate appears to have culminated in the acolpate and pancolpate grains. Thus a great diversity is found in the dicotyledons, including the colporate type, and the increase in the number of pore and furrows and reduction or loss of pores.

The exines of various pollen grains are elaborately sculptured as found in insect and bird-distributed pollen, while in derived anemophilous groups it has become smooth and thin. Other adaptations of the exine such as spines in the Compositae, are also known.

The taxonomic importance of pollen morphology may be at specific, generic, or higher levels. In many cases the type of pollen of a taxon is characteristic and constant and may be exclusive to that group. The taxon is termed as stenopalynous. In other cases, and even within otherwise natural groups the types of pollen grains may vary in size, aperture, stratification of the exine etc. In such taxa that are termed as eurypalynous, the pollen is of great value in subdividing into lower taxa or subfamilies.

Pollen morphology has proved of value in the classification of the family Saxifragaceae which tends to be a dumping ground for several rare plants. Berenice arguta was formerly placed in the family Saxifragaceae but its pollen grain morphology showed that it belongs to the family Campanulaceae. Acacia redacta J.H. Ross is a species that was recently described from South Africa, but its pollen analysis has shown that it is Calliandra redacta (J.H. Ross) Thulin & Hunde (Nord. J. Bot. 1981).

1.7.1 Ultrafine structure of pollen grain walls

With the improvement of techniques it has been possible to demonstratefine details of structure of the walls and their stratification. Electronmicroscopy has shown up new details in the surface of pollen grains. Van Campo (1959) cited by Davis and Heywood (1963) in the studies of the pollen of the Conifers, has discussed the importance of the endexine in systematic and phylogeny. She points out the importance of studying the ektexine and endexine separately, there is for example the tendency for the aperture in the endexine to remain constant while the ektexine proves to be variable, as in members of the Umbelliferae.

In summary, palynological evidence may be used to place taxa of uncertain affinities, to suggest rearrangements, withdrawals and separations, as well as corroborating other lines of evidence. It is confidently expected that pollen morphology will play an increasing role in both comparative phenetic taxonomy and in evolutionary interpretations.

1.8 SUBJECT REVIEW

1.8.1 General morphological account of the pollen exines

Zetsche (1932) cited by Moore and Webb (1978) has reported that the pollen grain wall is made up of two layers; the outer exine and the inner intine. The exine is made up of very unusual substance called Sporopollenin. The intine is made up of cellulose and is very similar in construction to an ordinary plant cell wall. In fossil pollen grain it is only the sporopollenin containing exine that remain and contains the whole range of characters required for pollen identification.

Sporopollenin is unusually tough material but it can be affected by very strong oxidants such as concentrated sulphuric acid mixed with hydrogen peroxide or on treatment with 40% chromic acid or ozone to be completely broken down. The only two bases that affects it are fused potassium hydroxide and 2-aminoethanol. Brooks and Shaw (1968) suggested that sporopollenin was a complex polymer of carotenoids and carotenoid esters with oxygen.

Although sporopollenin is so widespread it is only in angiosperms and gymnosperms that it is built into complex wall structure so much evident in the pollen grains of embryophyta. The exine of pollen grains is divided into an outer sculptured sexine and an inner unsculptured nexine (Erdtman, 1966). The sexine commonly takes the form of a set of radically directed rods supporting a roof. This roof may be complete, partially dissolved or completely absent. The roof is called tectum, a rod supporting complete or a partial roof is called columella and a rod which is not supporting anything is called baculum (Reitsma, 1970).

The exine is characterized by being aperturate, sculptured or smooth. An aperture is any thin or missing part of the exine which is independent of the pattern of the exine. There are two types of apertures named pori or pores and colpi or furrows. Pori are usually isodiametric holes but can be slightly elongated with rounded ends. Colpi are distinguished from pori by being long and boat shaped with pointed ends. Grains with pori are called porate and those with colpi are described as being colpate whereas grains with both porus and colpus combined are called colporate. The intine under the aperture is usually thicker than elsewhere under the grain. An aperture is usually thought to be an emergence of pollen tube at the time of germination on a compatiable stigma. One aperture is enough for the germination of a pollen tube as such the large number of apertures evident in many angiosperms have additional functions. A large store of leached proteins are present in the thicker regions of the intine under the apertures which has a recognition reaction between pollen grain and stigma (Heslop-Harrison, 1971b). The additional apertures are thus exit sites for these proteins. Wodehouse (1935) was the first to suggest that apertures were regulatory devices controlling the movement of water into and out of the grain.

An aperture which is a feature of the sexine is called an ectoaperture (ectocolpus, ectoporus) and an aperture that is a feature of the nexine is called endoaperture (endocolpus, endoporus).

Pollen grains can be classified into groups depending on the number, position and characters of their apertures. Depending on the number, the classification is indicated by attaching the prefixes mono, di-, tri-, penta- and hexa-, before the terms colpate, porate and colporate. More than six apertures is indicated by the use of the prefix poly-.

On the positioning of the apertures, the arrangement is equidistantly around the equator of the grain. This situation is indicated by the prefix zono-. If the apertures are scattered all over the surface of the grain the prefix panto- is used.

On the basis of character, two or more colpi may fuse usually at the poles of the grains but occasionally elsewhere. The term syn colpate is then applied. The fusion gives the grain an appearance of a set of spirals surrounding the whole grain. Members of the Compositae have a tricolpate aperture system that is obsecured by large gaps separated by spiny ridges. They are called fenestrate grains.

In certain families the pollen grains are present as aggregates e.g. tetrads in the Ericaceae or Typhaceae and polyads in the sub-family Mimosoideae or Orchidaceae.

The sculpturing and structure of the exine provides characters of great diagnostic value. The sexine has been described as being composed of small radially directed rods which sit on the nexine and are called columellae if they support tectum, a plate or a small knob; and bacula if they are cylindrical in shape and do not support something.

A grain with free rods, i.e. bacula, clavae, echinae, etc. is called intectate whereas it is tectate when the rods support a roof. Semitectate condition exists when there is only a partial tectum supported, for example, in the members of Cruciferae.

Shapes also help in the identification of pollen grains. However, shape is unreliable factor in identification due to the type of mounting material used, the method of extraction chosen. This can lead to the grains of the same species having different shapes. Although pollen grains are three-dimensional objects, this fact is difficult to observe with a light microscope where only one plane is in focus at any one time. Thus pollen grains are described by the shape of their outline in polar and equatorial views. For the polyads, the planes observed under the light microscope are the diameters and equatorial axes.

1.8.2 Historical account of the genus Acacia Mill.

Acacia (GK akis - point or barbs.) is a coinage from Greek in reference to the thorns; that is ancient Greek name for an Egyptian tree.

Historians are in general agreement that the 'Shittah' trees of Biblical times were Acacia species and accordingly, supplied the 'shittah wood' used to build the ark of the Convenant and the alter and table of the Tabernacle. It is most probable that Acacia seyal Del. and Acacia tortilis Hayne. were the source since these timber trees are believed to have been the principal, or the only sizeable one in the Arabia desert during that period and are today common in the Sinai peninsula(Allen and Allen, 1981).

'Seyal' in Arabic means 'torrent', thus as a specific name it alludes to the abundance of the species in ravines through which water rushed during rainy seasons. Acacia arabica Willd. may also have been a source of wood.

The single genus Acacia is the only representative of the tribe Acacieae of the sub family Mimosoideae. The Mimosoideae was first established when Linnaeus placed all the mimosoid legumes, including the tribe Acacieae in a single genus Mimosa in 1805. Willdenow subdivided the genus Mimosa into five genera namely Inga, Mimosa, Schrankia, Desmanthus and Acacia. A few years later Poiret reduced the five genera established by Willdenow to subgenera on Mimosa, whereas Desfontaines united the genera with Acacia. in 1825, De Candolle re-established Willdenow's five genera and introduced five new ones. Up to this point the criteria used to circumscribe genera were inconsistent and often confusing (Elias, 1981).

In 1842 George Bentham, working on new collections on neotropical plant specimen from English and European herbaria, critically examined previously established generic lines resulting on his work; 'Notes on the Mimosaceae'.

In 1875, other work 'Revision of the suborder Mimoseae' appeared in which he basically used staminal characters to refer to 'three great groups' of mimosoid legumes: the Eumimoseae with definite stamens; the Acaciaeae with indefinite and free stamens, or very shortly or irregularly united at the base; the Ingeae having indefinite stamens united into a tube surrounding the gynoecium. He also established six series within the tribe Acacieae based on vegetative habit as follows:

1. Phyllodineae: leaves simple phyllodia, rarely reduced to scales. 200 species, Pacific and Australia.

2. Botryocephalae: leaves bipinnate. Stipules small or none. Inflorescence axillary or at the ends of fascicled branches. 10 species, all Australia.

3. Pulchellae: Unarmed shrubsor rarely armed; leaves bipinnate, stipules small or none. Peduncles axillary, solitary or fasciculate, simple, globose and more rarely in cylindrical spikes. Many species, all Australia.

4. Gummiferae: shrub or trees, stipules all or a few thorny, leaves bipinnate, peduncles axillary, subfasciculate, or at the ends of subracemose branches; inflorescence globose or in cylindrical spikes. 50 species, African, American a few from Asia and Australia.

5. Vulgares: Trees or shrubs, armed with thorns, stipules not spiny. Petiole often glandular, leaves bipinnate; inflorescence globose or spicate; Peduncles axillary or terminal. 60 species. American, African and Asian.

6. Filicinae: Small trees or shrubs, unarmed. Leaves bipinnate, petiole not glandular. Peduncles axillary, inflorescence globose or oblong, flowers moreless pedicellate. 10 species, American.

1.8.3 CLASSIFICATION OF THE AFRICAN ACACIA SPP. AFTER BENTHAM

The African Acacia spp. fall into two of Bentham's sections namely the Gummiferae and the Vulgares. The Gummiferae accommodates all the species with spinescent stipules while the vulgares all those species with non-spinescent stipules.

Richard, (1847) Harvey, (1862) Engler, (1888) Taubert (1891) and Glover(1915) cited by Ross (1979) all followed Bentham's system in their classification of the African Acacia spp.

The following additional evidence obtained from allied disciplines support the argument that the two groups obtained by using the nature of the stipules may be natural :

(a) Nearly all of the species with spinescent stipules have capitate inflorescences. Acacia albida is anomolous in this position as this species has spinescent stipules and spicate inflorescence.

(b) Coetzee (1955) Van Zinderen Bakker and Coetzee (1959) working on pollen morphology of 28 South African Acacia spp. had their findings supported by Guinet (1969) that there is a definate correlation between the nature of the stipules and the pollen morphology in the African Acacia species.

(c) Considering the chromosome number recorded by Darlington and Wylie (1955) it is found out that among the African Acacia spp., the ones with spinescent stipules have

2n = 52 and the ones with non-spinescent stipules have 2n = 26. Among the spinescent spp. the following are anomolous : Acacia albida, A. elatior, A. macrothyrsa, A. paolii 2n = 26. In A. nilotica 2n = 44, 52, 104; in A. sieberana and A. tortilis 2n = 104. Among the non-spinescent spp. A. ataxacantha 2n = 26 52, 104, and A. laeta 2n = 39, 52 are anomolous.

(d) Vassal and Lescanne (1976) have shown that chromosome of the Acacia species with non-spinescent stipules have different nucleaolor diameter and different chromatine to those of the species with spinescent stipules.

(e) Nearly all species with non-spinescent stipules have seeds with small central horse-shoe shaped areoles, while the seeds of nearly all species with spinescent stipules have large subcircular-lenticular areoles conforming in outline to the shape of the seed (Brenan 1959).

(f) A study of the seedling morphology of some of the African Acacia species by Vassal (1969) revealed that differences between the seedlings of those spp. with spinescent stipules and those with non-spinescent stipules. These results supported the division of the species on the nature of the stipules rather than on the type of inflorescences.

On this basis, Guinet and Vassal (1978) re-evaluated Bentham's sub-divisions (1842) and proposed to divide the genus into three groups taking into account new characters of pollen, seed and seedlings in the following order :

Group 1 : Subgenus Aculeiform Vassal

(= series Vulgares Benth. and Filicinae Benth.)

Group II : Subgenus Heterophyllum Vassal

(= series Phyllodineae, Botryocephalae and Pulchellae all of Benth.)

Group III : Subgenus Acacia Vassal

(= series Gummiferae Benth.)

The subgenus Aculeiferum (Guinet & Vassal, 1978) comprises of all species with scattered prickles or rarely, ones which are unarmed. The subgenus Heterophyllum (Guinet & Vassal, 1978) associated all those species with plurinerved and univerved phyllodes. The subgenus Acacia (Guinet & Vassal, 1978) consists of those species with spinescent stipules.

(g) Robbertse (1975) on the study of the leaf morphology of the South African species, revealed a distinct anatomical differences between the petioles of the species with spinescent stipules and those with non-spinescent stipules. Acacia polyacantha is anomqlous in this respect as its petiolar anatomy corresponds to those species with spinescent stipules. Acacia albida differed in having a petiolar anatomy unlike that of any other species.

(h) All of the species with non-spinescent stipules have pedicellate ovaries and a cup-shaped disc around the base of the ovary while in the spinescent species the ovary is sessile or subsessile and the disc is absent.

Acacia albida is anomolous in that the filaments are basically connate and forms a short thick tube on the inner basal part to form a disc-like structure similar to that found in the species with non-spinescent stipules.

(i) Morphological study of the pods of South African species by Robbertse (1975) showed that in the species with non-spinescent stipules the 'fibre-stratum' of the pod pericarp consists of longitudinal and latitudinal fibres whereas in spinescent species the 'fibre stratum' is longitudinal or absent. The morphology of Acacia albida corresponds with that of the non-spinescent species.

(j) Robbertse (1973) reported that external morphological studies of the seeds, revealed that the seeds of the species with spinescent stipules can be clearly distinguished from those of the species with non-spinescent stipules. A. albida and A. brevispica are anomolous in that the cotyledons of their seeds contain starch grains.

(k) From phytochemistry, Evans and Bell, (1975) reported that the species with spinescent stipules have N-acetyldjenkolic acid and non-spinescent species contain S-carboxyethyl cystein and a derivative of pipe-colic acid. A. albida does not have the above mentioned amino acids.

Oliver (1871) has based his primary divisions of the African Acacia spp. on the nature of the inflorescences. Two broad groups have been recognised, namely, those with capitate inflorescences and those with spicate inflorescences. Gilbert and Boutique (1952) cited by Ross (1979) and Elamin (1973) have preferred Oliver's classification of the African Acacia species.

The following characters support the contention that the two groups obtained by using the inflorescence for dividing the species may be natural.

(a) Almost all of the African species with spicate inflorescences have non-spinescent stipules and are armed with recurved prickles while nearly all of the species with capitate inflorescences have spinescent stipules.

(b) Coetzee (1955) and Van Zinderen Bakker (1959) reported that pollen-morphological studies revealed that species with capitate inflorescences had pollen grains with furrows. Three anomalies were found in A. detinens, A. pennata, and A. schweinfurthii which have capitate inflorescences but pollen grains without furrows.

(c) In spicate flowered inflorescences, the areole is small and horse-shoe shaped occupying the central area of the seed while in the capitate inflorescence species the areole is large and conforms in outline to that of the seed. A. albida is anomolous as it has a large subcircular lenticular areole as in the capitate inflorescence species.

Pedley (1986) has calculated the index of diversity of the Acacia species and proposed a classification which mainly aimes at splitting the genus into three genera namely Acacia, Senegalia and Racosperma. Morphological,anatomical,chemotaxonomical, palynological and susceptibility to rusts are the variables which have been used in the splitting of Acacia sensu lato. According to this proposal the genus Acacia includes all those species classified under the series Gummiferae by Bentham (1842). The genus Senegalia consists of all the species classified under the series Vulgares and Filicinae of Bentham (1842) whereas the genus Racosperma is composed of the series Phyllodineae. Botrycephalae and Pulchellae all of Bentham (1842).

1.8.4 Economic value of the genus Acacia

Acacias have many economic importance. About 50% are cultivated as ornamentals. Many form small, spiny, slow-growing scrub that serves to prevent wind and rain erosion. Acacia glaucescens Willd. is favoured for sea-shore planting because it tolerates salty soils and sprays and control sand dunes.

Some species are among the most ornamentally attractive in the leguminous family because of their fluffy balls of fragrant yellow flowers and their lacy feathery foliage. Acacia dealbata Link, is a typical example. Acacia albida Del. and Acacia tortilis (Forsk.) Hayne excel in stark, majestic beauty in their native habitats. Acacia flowers are often fragrant among the honey to violet-scented blossoms used in the manufucture of commercial perfumes is that of Acacia farnesiana (L.) Willd. whose flower oil provide the foundation essences of Cassie Ancienne and Cassie Romaine.

The foliage of many Acacias is grazed and is economically important as cattle food. Pods and leaves of some members contain compounds that are poisonous e.g. hydrocyanic acid and alkaloids toxic to livestock (Allen and Allen, 1981).

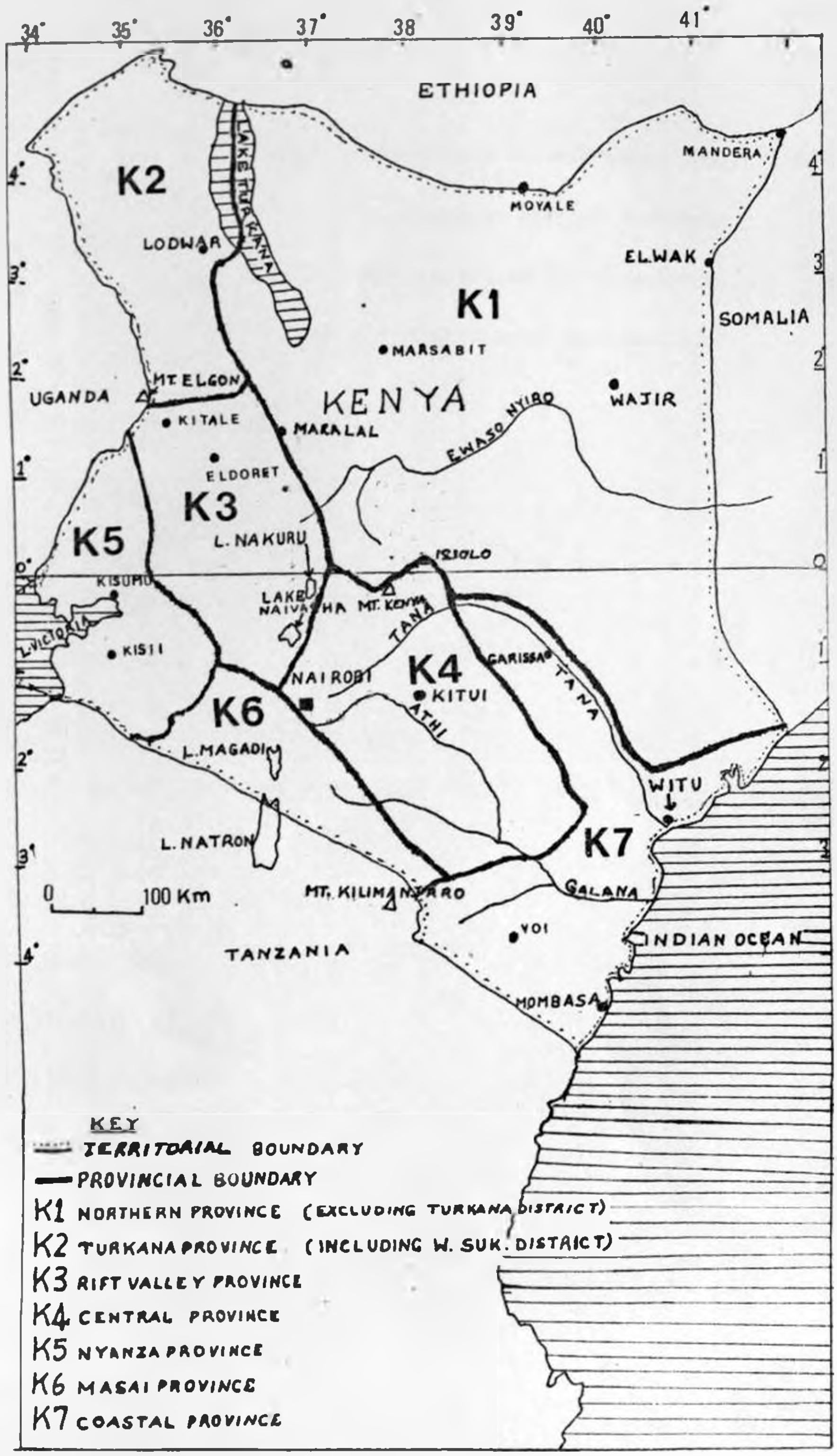
Some of the Acacia species are used in Agroforestry. Acacia albida Del. is a good example that can be used in inter-cropping with sorghum and millet. The tree is also nitrogen-fixing and are left growing on cattle pasture to provide both shade and foliage for browsing animals like goats camels, elephants etc.

Habitation of the swollen, stipular thorns of various xerophytic Acacias by Ant Colonies is one of the best-known examples of Symbiosis between plants and insects. Acacia drepanolobiam Harms ex Sjostedt, A. polyacantha Willd., Acacia senegal (L.) Willd., A. Seyal Del., A. zanzibarica (S. Moore) Taub, all possess galls or swollen thorn bases. The ant species of the genus pseudomyrmax inhabit these galls. The ant feed on enlarged foliar nectaries and modified leaf-let tips. In exchange the ant species which are very ferocious, protect the host Acacia against phytophagous insects and other predators.

Acacia wood is coarse grained, has a high density, is highly durable and responds satisfactorily to finishing treatments, but it is worked with difficulty. The wood serves for small objects such as smoking pipes implement handles and furniture. The wood is also valuable for fuel especially in the arid regions. Wood of large trees is used for paneling, boats and musical instruments. The wood is also used for making rough farm work material as fencing and animal pens. The major timber producers in Kenya are Acacia lahai stued. and Hochst ex Benth, A. polyacantha Willd. A. tortilis Hayne, A. xanthophloea Benth. and A. glaucescens Willd.

Acacia spp. are the source of gum arabic an article of international commerce since the first century A.D., the 'Arabic' had its origin with references to the Port of Aden, Arabia, the major trading outlet of early times. Acacia arabica was considered for many years as the prime source of this completely water-soluble, mucileginous gum, but more recently emphasis has shifted to about 24 other members of the genus that yield commercial grades (Allen and Allen, 1981). Currently, A. senegal (L) Willd., a tree, with a life-span of 25 - 30 years, is the principal source. Acacia seyal also produces this item but to a lesser degree.

The Acacia pollen grains is used by bees in honey making. In a controlled honey making industry, the kept bees are only allowed to fetch the pollen grains from the Acacia species. Thus, the final product of the honey has pollen grains from a single genus, and this is now an up-coming industry in Kenya.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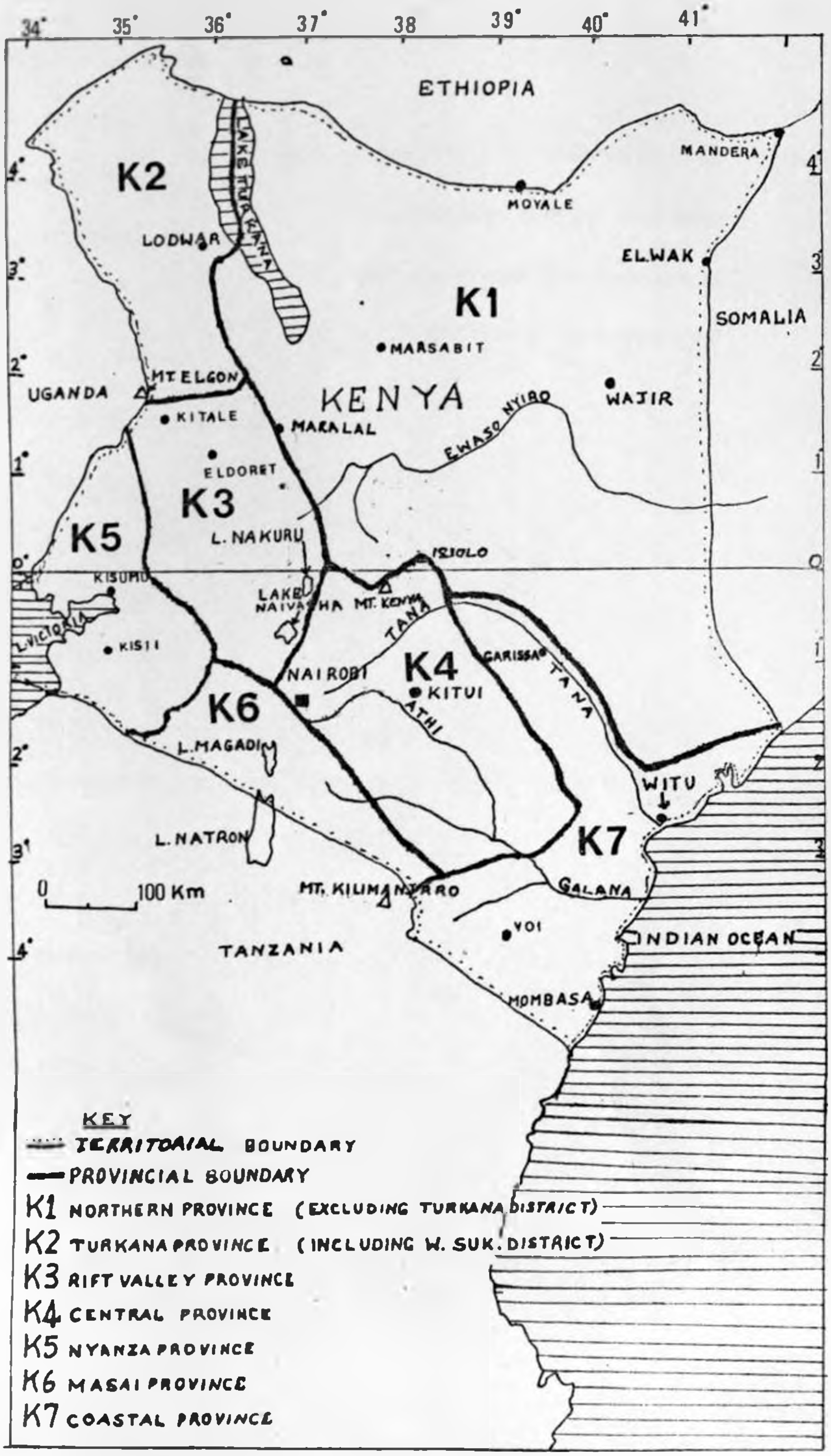
100 Km
MT. KILIMANJARO
GALANA
VOI
INDIAN OCEAN
TANZANIA
MOMBASA
KEY
TERRITORIAL BOUNDARY
PROVINCIAL BOUNDARY
K1 NORTHERN PROVINCE (EXCLUDING TURKANA DISTRICT)
K2 TURKANA PROVINCE (INCLUDING W. SUK. DISTRICT)
K3 RIFT VALLEY PROVINCE
K4 CENTRAL PROVINCE
K5 NYANZA PROVINCE
K6 MASAI PROVINCE
K7 COASTAL PROVINCE

Fig. 1

1.8.5 Fig. 1. Map of Kenya showing taxonomic Provinces as recognised by Flora of Tropical East Africa.



34° 35° 36° 37° 38 39° 40° 41°
ETHIOPIA
MANDERA
MOYALE
K2
LAKE TURKANA
LODWAR
ELWAK
K1
SOMALIA
MARSABIT
MT ELGON
UGANDA
KENYA
WAJIR
EWASO NYIRO
KITALE
MARALAL
ELDORET
K3
K5
L. NAKURU
ISIOLO
KISUMU
LAKE NAIVASHA
MT. KENYA
TANA
L. VICTORIA
KISII
K4
GARISSA
NAIROBI
KITUI
K6
ATHI
L. MAGADI
WITU
K7
L. NATRON
0 100 Km
MT. KILIMANJARO
GALANA
VOI
TANZANIA
INDIAN OCEAN
MOMBASA
KEY
TERRITORIAL BOUNDARY
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K5 NYANZA PROVINCE
K6 MASAI PROVINCE
K7 COASTAL PROVINCE

Fig. 1

1.8.6 Distribution of indigenous Acacia species in the taxonomic Provinces of Kenya as recognised by Flora of Tropical East Africa.

K 1

1. Acacia horrida
2. A. bussei
3. A. mellifera
4 A. xanthophloea
5. A. goetzi
6. A. senegal
7. A. circummarginata
8. A. thomasii
9. A. brevispica
10. A. zanzibarica
11. A. seyal
12. A. hockii
13. A. nilotica
14. A. elatior
15. A. etbaica
16. A. reficiens
17. A. tortilis
18. A. gerrardii
19. A. drepanolobium
20. A. paolii
21. A. stuhlmannii

K 2

1. Acacia albida
2. A. horrida
3. A. mellifera
4. A. polyacantha
5. A. senegal
6. A. circummarginata

7. A. brevispica
8. A. macrothrysa
9. A. nilotica
10. A. elatior
11. A. etbaica
12. A. reficiens
13. A. gerrardii
14. drepanolobium
15. A. paolii

K 3

1. Acacia albida
2. A. lahai
3. A. mellifera
4. A. persiciflora
5. A. xanthophloea
6. A. senegal
7. A. circummarginata
8. A. brevispica
9. A. seyal
10. A. hockii
11. A. nilotica
12. A. elatior
13. A. etbaica
14. A. gerrardii
15. A. drepanolobium
16. A. sieberiana
17. A. nubica
18. A. macrothyrsa
19. A. abyssinica

K 4

1. Acacia lahai
1. A. bussei
3. A. horrida
4. A. mellifera
5. A. polyacantha
6. A. xanthophloea
7. A. goetzei
8. A. senegal
9. A. circummarginata
10. A. thomasii
11. A. mearnsill
12. A. brevispica
13. A. seyal
14. A. hockii
15. A. kirkii
16. A. nilotica
17. A. abyssinica
19. A. etbaica
20. A. reficiens
21. A. tortilis
22. A. clavigera
23. A. gerrardii
24. A. stuhlmannii

K 5

1. Acacia lahai
2. A. persiciflora
3. A. polyacantha
4. A. senegal
5. A. mearnsii

K 5 cont.

6. A. brevispica

7. A. monticola

8. A. cacrothyrsa

9. A. seyal

10. A. hockii

11. A. abyssinica

12. A. garrardii

13. A. drepanolobium

14. A. sieberiana

15. A. nubica

K 6

1. Acacia albida

2. A. lahai

3. A. ataxacantha

4. A. laeta

5. A. mellifera

6. A. polyacantha

7. A. xanthophloea

8. A. senegal

9. A. brevispica

10. A. thomasii

11. A. mearnsii

12. A. seyal

13. A. hockii

14. A. ancistroclada

15. A. kirkii

16. A. nilotica

17. A. elatior

K 6 cont.

18. A. etbaica
19. A. tortilis
20. A. clavigera
21. A. gerrardii
22. A. drepanolobium
23. A. sieberiana
24. A. paolii
25. A. stuhlmannii

K 7

1. Acacia albida
2. A. bussei
3. A. horrida
4. A. ataxacantha
5. A. laeta
6. A. mellifera
7. A. polyacantha
8. A. xanthophloea
9. A. senegal
10. A. brevispica
11. A. thomasii
12. A. adenocalyx
13. A. pentagona
14. A. zanzibarica
15. A. ancistroclada
16. A. nilotica
17. A. elatior
18. A. etbaica
19. A. reficiens

20. A. clavigera

21. A. sieberiana

22. A. paolii

23. A. stuhlmannii

1.8.7 KEY TO NATIVE AND NATURALIZED SPECIES

A. FLOWERS IN SPIKES OR SPECIFORM RACEMES

1a. Stipules spinescent, straight, rarely somewhat curved, often conspicuously enlarged and inflated below and ashed or whitish :

2a. Leaf-rhachis with a conspicuous gland between every pair of pinnae; stipules not enlarged and inflated below, calyx 1-1.7 (-2.5) mm. long; corolla-lobes 5, 1.5-2.5 mm. long; anthers 0.2-0.4 mm. wide, eglandular even in bud; stamen-filaments connate and tubular for about 1 mm. at base ; branchlets pale to whitish; pods indehiscent, falcate or coiled, orange . 1. A. albida

2b. Leaf-rhachis without conspicuous glands stipules often enlarged and inflated below; calyx 0.7-1 mm. long; corolla-lobes 4, sometimes 5, 0.5 mm. long; Anthers 0.1 mm. wide, at least in bud with a caducous apical gland; stamen-filaments free to base; branchlets dull grey, brown or purplish; pods dehiscent, commonly straight or nearly so :

3a. Stipular spines neither inflated nor fusiform; inflorescence-axis (of A. lahai) pubescent and with many reddish sessile or sub-sessile glands; pinnae up to 14 pairs per leaf; leaflets up to 35 pairs per pinnae at comparatively high altitudes (1150-2400 m) . . 2. A. lahai

3b. Stipular spines (or some of them at least characteristically inflated or fusiform ("Ant-galls"); inflorescence-axis with a few or no glands; pinnae up to 8 pairs per leaf; leaflets upto 18 pairs per pinnae; at comparatively low altitudes (180–970 .):

4a. Inflated stipular spines constricted at base; tree 3–10 m. high usually with a well-defined trunk; corolla 3–5 times as long as the 0.7–0.8 m long calyx;pods straight, puberulous, 0.8–1.5 cm. wide. . . 3. A. bussei

4b. Inflated stipular spines not or only slightly constricted at base; bushes 1.3–3.6 m. high (very rarely taller), branching from base; pods falcate or subreniform :

Pods glabrous or nearly so, rarely slightly puberulous, 1.5–2.5 cm. wide, venose; young branchlets glabrous; leaflets sub-glabrous or inconspicuously ciliate; corolla 2–2.5 times as long as the 0.8–1 mm. long calyx . . 4 A. horrida

1b. Stipules not spinescent; prickles (usually present) borne below the stipules, short up to 7(-12) mm. long, usually ± hooked; deflexed or curved, never inflated below, usually brown, blackish or dull grey :

5a. Prickles absent :

6a. Calyx short, 1-1.4 mm. long; red or purplish as is the corolla . 5. A. persiciflora

6b. Calyx 1.7-2.7 mm. long, not red or purplish . . 6. A. polyacantha

5b. Prickles present :

7a. The prickles irregularly scattered along internodes . . 7. A. ataxacantha

7b. The prickles either solitary or in pairs or threes; grouped at or just below the nodes; erect trees or shrubs; ovary glabrous (at least at first), much longer than its supporting stipe :

8a. Flowers distinctly but shortly pedicellate (pedicels 0.5 mm. or more) :

9a. Calyx 1.25-2 mm. long; pedicels mostly less than 0.5 mm. long; rarely as much as 0.75 or even 1 mm.; leaflets mostly in 3-4 pairs (occasionally only 2 pairs on reduced pinnae 8. A. laeta

9b. Calyx 0.6-1 mm. long, pedicels mostly 0.75-1.5 mm. long; rarely as short as 0.5 mm.; leaflets in 1-2, very rarely 3 pairs . 9. A. mellifera

8b. Flowers sessile or subsessile
(pedicels 0-3 mm.):

10a. Prickles in pairs near the nodes :

11a. Pinnae of all leaves 2-3 pairs;
leaflets (2-)3-4 pairs
obovate-elliptic or oblong; pod
(where known) pale brown . 8. A. laeta

11b. Pinnae of all or most leaves four or
more pairs : only occasional reduced
leaves with as few as three :

12a. Calyx short, 1-1.4 mm. long, red or
purplish . . 5. A. persiciflora

12b. Calyx 1.5-4.5 mm. long, normally not
purplish or red :

13a. Gland on petiole large, 2-4 mm. by
1.75-3 mm.; corolla 1½ times in length
of the pubescent calyx; pods 1.2-2.0
cm. wide . . 6. A. polyacantha

13b. Gland on petiole small, 0.8-1.5 mm. in
diameter; corolla equally or only
slightly exceeding the glabrous or
slightly hairy calyx; pods 2-2.6 cm.
wide . . 10. A. goetzei

10b. Prickles in threes near nodes,
the central one hooked downwards,
the laterals ± curved upwards,
or else the prickles solitary,
the laterals being absent :

14a. Corolla about 2.75–4 mm. long;
stamen-filaments (where known)
4.5–7 mm. long; calyx 2–2.75 mm.
long; pinnae 3–7 pairs :

15a. Rhachides of pinnae 0.5-1.5(-2.4);
very rarely to 4) cm long; bark
grey, scaly, rough; branchlets
dull grey to grey-brown or
purplish-grey . . 11. A. senegal

15b. Rhachides of pinnae 2-6.5 cm long;
bark yellow, flaking; branchlets
purplish-brown to purplish-
black . 12. A. circummarginata

14b. Corolla 6.5–7 mm. long; stamen-
filaments 13–15 mm. long; calyx
3.5–4.5 mm. long; pinnae 1–2
(-3) pairs . . 13. A. thomasii

B. FLOWERS IN ROUND HEADS

Two alternative keys are given, one (I) based mainly on floral and vegetative characters, for use with flowering specimens, the other (II) using mainly characters taken from the pods and vegetative parts, for use with fruiting specimens. For the sake of convenience the keys are split into parts, but these parts do not necessarily correspond with natural groupings.

I KEY BASED MAINLY ON FLORAL AND VEGETATIVE CHARACTERS

16a. Plant unarmed; leaflets narrow, 0.5–0.75 mm. wide; flowers pale yellow, in paniculate heads; anthers eglandular . . . 14. A. mearnsii

16b. Plant armed with spines or prickles; anthers (at least some) glandular at apex when young : Prickles scattered along the internodes of the stem, not grouped at or near nodes :
Prickles or spines in pairs at or near nodes : Heads of flowers in panicles; leaves large; flowers bright or orange-yellow . 15. A. macrothyrsa

Ia. Prickles scattered along the internodes of the stem

17a. Petiole 0.5–1.5 cm. long :

18a. Midrib of leaflets excentric at base; calyx
eglandular . . 16. A. brevispica

18b. Midrib of leaflets almost central at base:
calyx glandular outside . 17. A. adenocalyx

17b. Petiole 1.5–6 cm. or more long :

19a. Leaflets 0.3–0.8 mm. wide . . 18. A. monticola

19b. Leaflets 0.8–2 mm. wide :

20a. Young branchlets with numerous red-purple
glands . . . 18. A. monticola

20b. Young branchlets usually eglandular, glabrous
to sparsely puberulous; usually in lowland
forest . . . 19. A. pentagona

Ib. Spines paired; "Ant-galls" present

21a. "Ant -galls" composed of pairs of stipules,
each stipules fusiform-inflated, but not
fused with the other one of the pair, and
free almost or quite so . . 20. A. elatior

21b. "Ant-galls" composed of pairs of stipules
fused below into an inflated, rounded or
bilobed structure :

22a. Flowers bright yellow; "Anti-galls" bilobed :

23a. Calyx 0.8-1.5 mm. long; leaflets usually more than 2 and up to 10 mm. wide, usually with lateral nerves raised especially beneath . . 21. A. zanzibarica

23b. Calyx 2-2.5 mm. long; leaflets at most 3 mm. and usually not more than 1.5 mm. wide, with lateral nerves invisible beneath 22. A. seyal

22b. Flowers white or cream; "Ant-galls rounded . . 23. A. drepanolobium

Ic. Spines paired; no "Ant-galls", pinnae at least 15 pairs on well-developed mature leaves

24a. Leaflets all exceedingly narrow, about 0.25 mm. wide (at most to 0.5 mm.); buds, calyx and corolla red; pinnae 0.4-1.5 cm. long; flat-crowned tree, usually large, 6-20 m. high . . 24 A. abyssinica

24b. Leaflets 0.5 mm. or more wide :

25a. Involucel basal or in lower half of peduncle . . 25 A.sieberiana

25b. Involucel basal or in lower half of peduncle . . 26 A. stuhlmannii

Id. Spines paired; no "Ant-galls"; pinnae 1-14 pairs; flowers bright or golden yellow

26a. Spines all straight or almost so :

27a. Stems powdery, even the branchlets, whose epidermis conspicuously flakes off to expose a yellow, reddish or greyish powdery under-surface; calyx 1-2.5 mm. long; young branchlets almost glabrous :

28a. Peduncles (usually at least) on ± elongate lateral or terminal shoots of the current season, whose leaves are persistent or undeveloped; bark red to yellow or white; involucel firmer and more opaque than that of A. xanthophloea; calyx 2-2.5 mm. long . . 22. A. seyal

28b. Peduncles (usually at least) on abbreviated lateral shoots whose axes do not elongate and are represented by clustered scales; the capitula thus appear to be in lateral fascicles on older often yellow-barked twigs whose leaves have fallen; bark yellow or greenish-yellow; involucel thinner and more transparent-looking towards margins than that of A. seyal; Calyx 1-1.5 mm. long; peduncles more slender than those of A. seyal at comparable age . . 27. A. xanthophloea

27b. Stems not powdery; epidermis of branchlets not conspicuously flaking or peeling; calyx 1–2 mm. long; young branchlets glabrous to subtomentose :

29a. Spines all suberect to spreading, mostly short, up to 2 (rarely to 4) cm. long; branchlet with ± numerous reddish sessile glands, ± densely puberulous in our area; pods dehiscent, 0.3–0.8 cm. wide . 28. A. hockii

29b. Spines, some at least, characteristically deflexed (at least in East African specimens), often 3–4 cm. long or more; branchlets varying from glabrous to (most commonly) densely pubescent or tomentose, with glands inconspicuous or absent; pods indehiscent, 1.3–2.2 cm. wide . . . 29. A. nilotica

26b. Spines mostly strongly hooked downwards, a few only longer and straight; twigs grey to grey-brown, their epidermis not peeling or flaking; bark of main stem peeling off in large pieces; branches to within a few feet of ground . 30. A. ancistroclada

Ie. Spines paired; no "Ant-galls"; pinnae 1–14 pairs flowers cream, white, pink or greenish

30a. Spines all or many short (to about 7 mm.), hooked or curved often with long straight ones of leaves (except in A. etbaica and A. gerrardii) normally short, to about 2 cm. long; peduncles 0.4-2.5 cm. long (sometimes longer in A. gerrardii) :

31a. Habit shrubby, obconical, branching from base; young branchlets puberulous to pulverulent; spines all short, hooked; pinnae 1-3 pairs per leaf . . . 31. A. reficiens

31b. Habit normally tree-like with a well-marked trunk; young branchlets usually pubescent or glabrous, sometimes puberulous; spines various, very often long and short mixed:

32a. Leaf-rachis up to about 2.5 cm long:

33a. Pods straight; young branchlets glabrous or nearly so, or puberulous; ultimate branches (at least in subsp. platycarpa) ascending or erect . . . 32. A. etbaica

33b. Pods contorted or spirally twisted; young branchlets usually ± densely pubescent, very rarely (in our area) glabrous or subglabrous; ultimate branches horizontal or spreading . . . . 33. A. tortilis

32b. Leaf-rhachis 2.5-3 cm. or more long :

34a. Branchlets ± densely pubescent . 34. A. gerrardii

34b. Branchlets glabrous or puberulous :

35a. Pinnae (in our area) short, up to about 2.2 cm. long . . 32. A. etbaica

35b. Pinnae 2.5-3 cm. or more . . 34. A. gerrardii

30b. Spines all straight or nearly so, varying in length; rhachis of leaves usually 3 cm. or more, long; peduncles variable in length, but often more than 2.5 cm. long :

36a. Peduncles (at least below the involucel) with ± numerous, very small, reddish, sessile, apparently sticky glands (use lens of x 10 or more); other hairs often sparse : similar glands on young branchlets and often elsewhere; involucel mostly at or below middle of peduncle, usually 2-3.5 mm. long, conspicuous :

37a. Young branchlets shortly and thinly pubescent, or glabrous :

38a. Bark of twigs grey-brown to plum-coloured, not yellow, of trunk grey to brown or greenish; pinnae of leaves of flowering shoots 6-14 pairs, but some leaves almost always with 8-9 or more pairs ; peduncles rather densely (rarely sparsely) pubescent and glandular throughout . 35. A. kirkii

38b. Bark of twigs soon becoming pale yellow, of trunk lemon-coloured or greenish-yellow, pinnae of leaves of flowering shoots 3-6 (-8) pairs (only on juvenile shoots as many as 10 pairs); peduncles sparingly pubescent to subglabrous (very rarely rather densely pubescent), glandular below and sometimes also above the involucel . . 27. A. xanthophloea

37b. Young branchlets ± densely and coarsely pubescent, often showing a rusty-red colour . . 34. A. gerrardii

36b. Peduncles eglandular or with very small inconspicuous glands; involucel variable in position, mostly 1-2 mm. long :

39a. Involucel at apex of or above middle of peduncle . . 25. A. sieberana

39b. Involucel at base of or below middle of peduncle (sometimes in A. nubica at about the middle):

40a. Corolla-lobes glabrous or almost so outside : Twigs normally becoming coated with yellowish or greenish powdery bark; young branchlets with spreading, often slightly yellowish hairs 0.75-1.5 (-2) mm. long best-developed leaves usually each with more than 10 pairs of pinnae :

41a. Young branchlets pubescent or hairy :

42a. Twigs grey-brown, not rusty-red; large tree to 18-25 m. high; branchlets finely pubescent with hairs less than 0.5 mm. long . . . 20. A. elatior

42b. Twigs usually showing rusty-red where the epidermis has fallen away; shrub or small tree 3-15 m. high branchlets often coarsely hairy with hairs more than 0.5 mm. long . . 35. A. kirkii

41b. Young branchlets glabrous (in our area) :

43a. Spines straight :

44a. Leaflets mostly less than 1.25 mm. wide; pods straight . . 20. A. elatior

44b. Leaflets mostly more than 1.25 mm. wide; pods falcate . . 36. A. clavigera

43b. Spines mostly hooked or recurved . 35. A. kirkii

40b. Corolla-lobes conspicuously hairy outside, sometimes very densely so :

45a. Young branchlets villous with rather long spreading hairs, some of which are up to 1.5–3 mm. long :

46a. Bracteoles and calyx glabrous or almost so . . 37. _A. paolii_

46b. Bracteoles conspicuously ciliate or pubescent; calyx ± pubescent outside . . 26. _A. stuhlmannii_

45b. Young branchlets with shorter hairs up to 0.5(–0.75) mm. long, or sometimes glabrous :

47a. Large tree up to 18–25 m. high; spines on flowering shoots usually small, to about 7 mm. long; peduncles 2–5 cm. long . 20. _A. elatior_

47b. Shrubs 1–5 m. high, obconical or flat-topped; spines or flowering shoots often 1–6.5 cm. long; peduncles 0.4–1.5 cm. long . 38. _A.nubica_

1.8.8 Morphological description of the Acacia species in Kenya.

1. Acacia albida Del.

Tree 6-30 m. high with rough, dark brown or greenish-grey bark and spreading branches. Young branchlets ashen to whitish. Stipules spinescent, up to 1.3(-2.3) cm. long, straight, never enlarged and inflated; no prickles below the stipules. Leaves : rhachis with a single conspicuous gland at junction of each of the (2-)3-10 pairs of pinnae; no gland on petiole; leaflets 6-23 pairs, (2.5-)3.5-6(-12) mm. long, 0.7-2.25(-4) mm. wide, rounded to subacute and mucronate at apex. Flowers cream, sessile or to 0.5(-2.0) mm pedicellate, in inflorescences 3.5-14 cm. long on peduncles 1.3-3.5 cm long. Calyx 1-1.7(-2.5) mm. long. Corolla 3-3.5(-4.5) mm. long, with 5 lobes 1.5-2.5 mm. long. Stamen-filaments 4-5 mm. long, tubular for about 1 mm. at base; anthers 0.2-0.4 mm. across, eglandular even in bud. Pods bright orange, thick,indehiscent, glabrous or very rarely puberulous, falcate or curled into a circular coil, 6-25 cm. long, (1.8-) 2-3.5(-5) cm. wide.

Distribution : K2, 3, 6, 7

Altitude : 600-1830 m.

2. Acacia lahai (Steud. & Hochst. ex) Benth.

Flat-crowned tree 3-15 m. high with rough, brown or grey-brown bark. Young branchlets brown to blackish-purple, pubescent. Stipules spinescent, up to 7 cm. long, straight (very rarely somewhat curved), subulate but not enlarged or fusiform, grey to grey-brown; no prickles below the stipules.

Leaves : rhachis without conspicuous single glands (only clusters of tiny red bodies) between the (3-) 6-15 pairs of pinnae; often a conspicuous gland on the petiole; leaflets 10-28 pairs, 1.5-4.5 mm. long, 0.3-0.75(-1.0) mm. wide, glabrous or ciliolate on the margins especially near the rounded to subacute apex, lateral nerves invisible. Flowers cream or white, sessile, in spikes 2.5-7 cm on peduncles 0.7-2.2 cm. long; axis ± pubescent and with many reddish, sessile or subsessile glands. Calyx 0.5-1.25 mm. long. Corolla 2-3 mm long, glabrous, with 4-5 lobes 0.5 mmm long. Stamen-filaments 4.5-5 mm. long, free; anthers 0.1 mm. across, with a caducous gland. Pods brown, dehiscent, glabrous, or puberulous on the stipe, elliptic-oblong or oblong, straight or ± falcate,mostly 4-7 cm. long, 1.5-3 cm wide.

Distribution : K3 - 6
Altitude: 1828-2438 m.

3. Acacia bussei (Harms ex) Sjostedt, Schwed.

Tree 3-10 m. high, usually flat-crowned with a well-defined trunk, sometimes branching from base; bark black or brown, roughish. Young branchlets grey-brown to purplish, glabrous or pubescent. Stipules spinescent, up to 9 cm. long, some normally with their lower part enlarged and ovoid or fusiform but much constricted at base, whitish or ashen; no prickles below the stipules. Leaves: rhachis eglandular between the 2-8 pairs of pinnae; usually a conspicuous gland on the petiole; leaflets (-7) 10-18 pairs, 1.5-5 mm. long, 0.5-1.5 mm. wide, ciliate or ± pubescent, apex obtuse or rounded, lateral nerves invisible.

Flowers cream, sessile, in spikes 1.8-5 cm. long on peduncles usually 0.5-1.2 cm. long; axis pubescent, rarely subglabrous, with few or no glands.

Calyx 0.7-0.8 mm. long. Corolla 2.5–3.5 mm. long; glabrous, with 4 lobes 0.5 mm. long. Stamen-filaments about 6 mm. long, free; anthers 0.1 mm across, with a caducous gland. Pods brown, dehiscent, puberulous, narrowly oblong, straight, 2–6.5 cm. long, 0.8–1.5 cm. wide.

Distribution : K1, 4, 7

Altitude : 610 m.

4. Acacia horrida (L.) Willd.

Shrub 1.3–3.6 m. high, normally flat-crowned, obconical and branching from base, very rarely taller (to 10 m.) but still with fastigiate branching from base. Young branchlets grey-brown to brown or blackish-purple, glabrous. Stipules spinescent, up to 9.5 cm. long, some normally with their lower part enlarged and ovoid or fusiform, not or only slightly constricted at base; no prickles below the stipules. Leaves : rhachis eglandular between the 2–6 pairs of pinnae; often a conspicuous gland on the petiole; leaflets 5–11 pairs, 2–6 mm. long, 0.75–1.8 mm. wide, subglabrous or inconspicuously ciliate, rounded to subacute or acute at apex, lateral nerves invisible. Flowers cream, sessile, in spikes 1–4.5 cm. long on peduncles 0.5–1 cm long. Calyx 0.3–1 mm long. Corolla 2–2.5 mm. long, glabrous, with 4 lobes 0.5–0.7 mm. long. Stamen-filaments about 5 mm. long; anthers 0.1–0.15 mm. across, with a caducous gland. Pods brown, dehiscent, glabrous or slightly puberulous especially near base and along sutures, oblong, subreniform or ± shortly falcate, (2.5–)3–6 cm. long, (1.2–) 1.5–2.5 cm. wide.

Distribution : K1, 2, 4, 7

Altitude : 180–910 m.

7. Acacia ataxacantha DC.

Scandent shrub up to 15 m. high or (but apparently not in our area) a non-climbing shrub or small tree 3-6 m. high. Young branchlets pubescent. Stipules not spinescent, obliquely ovate. Prickles scattered along the internodes, hooked or deflexed, up to 6 mm. long. Leaves : rhachis 5-12 cm. long, prickly or unarmed; usually a gland on the petiole and between the uppermost 1-3(-5) pairs of pinnae; pinnae 6-17(-25) pairs; leaflets 14-50 pairs, 2-5(-7) mm. long, 0.5-1(-1.2) mm. wide, ± ciliate otherwise glabrous or (but not in our area) appressed-hairy on surface beneath, apex obtuse to subacute, lateral nerves usually invisible or faintly apparent. Flowers cream to white, 0.25-0.4 mm. pedicellate or appearing sessile, in speciform racemes 4-8 cm. long on peduncles 1-2.5 cm. long; axis ± densely puberulous or pubescent. Calyx 1-1.7(2.5) mm. long; glabrous or (but not in our area) slightly pubescent. Corolla 2.5-3 mm. long, with 5 lobes 0.5-0.8 mm. long. Stamen-filaments 4.5-6 mm. long, free; anthers 0.15 mm across, with caducous gland. Ovary pubescent, on a stipe longer than itself. Pods purple-brown, dehiscent, puberulous or almost glabrous, linear-oblong, straight, very acuminate at both ends, 5-14 cm. long, 1-1.9 cm wide.

Distribution: K 6, 7

Altitude : 915 m.

8. Acacia laeta (R. Br. ex) Benth.

Shrub or small tree up to 6 m. high. Young branchlets glabrous, grey-brown or rarely purplish. Stipules not spinescent. Prickles in pairs just below each node, purplish-black, hooked, 3-5.5 mm. long, their base about 3-5 mm. long. Leaves: petiole usually glandular;rhachis glabrous to ± pubescent, frequently with a gland between the top pair of pinnae; pinnae 2-3 pairs; leaflets (2-) 3-5 pairs 4-15 (-20) mm. long, 2-7(-10)mm. wide, obliquely obovate-elliptic or -oblong, glabrous or ± puberulous, venose, rounded to mucronate or subacute at apex. Flowers white, subsessile or up to 0.5(-0.75, very rarely 1) mm. pedicellate, in spiciform racemes 3.5-5 cm. long on peduncles 0.5-2 cm. long; axis glabrous or ± pubescent. Calyx 1.25-2 mm. long, glabrous. Corolla 2.75-4 mm. long, 5-lobed. Stamen-filaments 5-7 mm. long, free; anthers 0.1 mm. across, with a caducous gland. Ovary glabrous at first, very shortly stipitate. Pods pale brown dehiscent, glabrous or slightly puberulous towards base, oblong, straight, venose, rounded to acuminate at apex, 3.5-8 cm. long, 1.7-2.8 (-4) cm wide.

Distribution : K6, 7

Altitude : below 1219 m.

9. Acacia mellifera (Vahl) Benth.

Shrub or small tree 1-6 (-9) m. high. Young branchlets pubescent or glabrous, grey-brown to purplish-black. Stipules not spinescent. Prickles in pairs just below each node, deep brown to blackish, hooked, 2.5-5(-6) mm. long. Leaves: petiole usually glandular; rhachis glabrous to pubescent, frequently with a gland between the top 1-2 pairs of pinnae;

pinnae 2-3, very rarely 4 pairs; leaflets 1-2 (very rarely 3) pairs, 3.5-22 mm. long, 2.5-16 mm. wide, obliquely obovate to obovate-elliptic or -oblong, glabrous to pubescent, venose, rounded to emarginate or subacute and often apiculate at apex. Flowers cream to white, on pedicels (0.5-)0.75-1.5 mm. long in subglobose to ± elongate racemes; axis 0.15-3.5 cm. long, glabrous or sometimes pubescent; peduncle 0.4-1.3 cm long. Calyx 0.6-1 mm. long, glabrous. Corolla 2.5-3.5 mm long, 5-lobed. Stamen-filaments 4-6 mm. long, free; anthers 0.15-0.25 mm. across, with a caducous gland. Ovary glabrous; stipe very short. Pods pale brown to straw-coloured, dehiscent, glabrous, oblong, straight, venose, rounded to shortly and abruptly acuminate at apex, (2.5-) 3.5-8(-9) cm long, 1.5-2.5 (-2.8) cm wide.

Distribution : K1 - 4, 6, 7

Altitude : 300 - 1680 m.

5. Acacia persiciflora Pax

Tree 4.5-9 (-15) m. high, sometimes flat-crowned; bark brownish-yellow, scaling off in verticle strips. Young branchlets pubescent to puberulous. Stipules not spinescent. Prickles few (often absent from branchlets), in pairs just below nodes, small, recurved, up to about 3 mm. long. Leaves: petiole usually glandular (gland 0.3-0.5 mm. in diameter); rhachis pubescent, glandular between the top 1-5 pairs of pinnae; pinnae 4-8 pairs; leaflets 11-17 pairs, 3-5.5(-10) mm wide, oblong-linear, ciliate on margins or glabrous or nearly so, lateral nerves almost invisible beneath, apex obtuse to subacute.

Flowers sessile or subsessile, precocious, in spikes 1.5–3 cm long on peduncles 0.3–1.3 cm long. Calyx cupular, 1–1.4 mm. long, red or purplish, glabrous. Corolla 2.5–3.5 mm. long, red or purplish, 5-lobed, glabrous. Stamen-filaments 6–8 mm. long, white; anthers 0.1–0.15 mm. across, glandular at apex. Ovary glabrous, shortly stipitate. Pods brown, dehiscent, straight or slightly curved, venose, with minute dark glands, otherwise sparsely puberulous to subglabrous, 6–15 cm. long, (1.4–) 1.6–2.5 cm. wide.

Distribution : K3, 5

Altitude : 1220 - 2130 m.

6. <u>Acacia</u> <u>polyacantha</u> Willd.

Tree up to 21 m. high; trunk with fissured bark and knobby persistent prickles. Young branchlets pubescent or puberulous, rarely subglabrous, grey to brown. Stipules not spinescent.
Prickles in pairs just below each node, straw-coloured to brown or blackish, 4–12 mm. long. Leaves: petiole glandular (gland usually 2–4 x 1.75–3 mm.); rhachis pubescent or puberulous, rarely subglabrous, glandular between the top 3–17 pairs of pinnae; pinnae (6–) 13–40 (-60) pairs; leaflets (15–) 26–64 pairs, 2–5 (-6) mm. long, 0.4–0.75(-1.25) mm. wide, linear to linear-triangular pubescent usually only on margins, only the midrib (except sometimes some very small basal nerves) visible, subacute to narrowly obtuse at apex. Flowers cream or white, sessile or nearly so, in spikes (3.5–)6–12.5 cm. long, produced with the new leaves;

axis densely pubescent or tomentellous; peduncle (0.5-) 1.2-2 cm. long. Calyx1.7-2.25 mm. long, pubescent or puberulous, rarely puberulous on lobes only or subglabrous. Corolla 2-3 mm. long, 5-lobed, usually 1⅓ times or more as long as calyx. Stamen-filaments 4.5-6 mm. long; anthers 0.1 mm. across, with a caducous gland. Ovary glabrous; stipe very short. Pods brown, dehiscent, glabrous or nearly so rarely ± pubescent oblong, straight, venose, usually acuminate at apex, 7-18 cm. long, 1-2.1 cm. wide.

Distribution : K2, 4-7

Altitude : 0 - 1830 m.

27. Acacia xanthophloea Benth.

Tree 10-25 m. high; bark on trunk lemon-coloured to greenish-yellow. Young branchlets brown to plum-coloured, almost glabrous and with some sessile reddish glands; twigs showing conspicuous pale yellow powdery bark. Stipules spinescent, straight or almost so, varying in length, up to 7(-8.5) cm long; "ant-galls" and other prickles absent. Leaves : rhachis (2.5-)3-7 cm. long, glabrous to sparingly pubescent; pinnae 3-6(-8) pairs (on juvenile shoots sometimes to 10 pairs) per leaf; leaflets rather numerous, 2.5-6.5 mm. long, 0.75-1.75 mm. wide; lateral nerves invisible beneath. Flowers varying from white or purplish to yellow or golden. Peduncles sparingly (rarely rather densely) pubescent to subglabrous, and glandular below and sometimes also above the involucel, usually (at least) on abbreviated lateral shoots whose axes do not elongate and are represented by clustered scales, the peduncles thus appearing to be in lateral fascicles on the older often yellow-barked twigs whose leaves have fallen; involucel conspicuous, 3-3.5 mm. long, near base of to about half-way up peduncle.

Calyx 1-1.5 mm. long. Pods indehiscent, linear-oblong, straight or slightly curved, ± moniliform with segments mostly longer than wide, often breaking up, pale brown or brown, reticulate-venose, eglandular or sparingly glandular, (-3) 4-13.5 cm. long, 0.7-1.4 cm. wide.

Distribution : K1, 3, 4, 6, 7

Altitude : 600 - 1980 m.

10. Acacia goetzei Harms

Tree 4-20 m. high, with rounded crown and rough, grey or brown bark. Young branchlets glabrous to pubescent. Stipules not spinescent. Prickles in pairs just below nodes, pale then dark brown or grey, hooked downwards, up to 7 mm. long. Leaves: petiole with or rarely without a small gland; rhachis glabrous to pubescent, usually glandular between the top 1-3 (-5) pairs of pinnae (and sometimes the basal pair as well); pinnae 3-10 pairs; leaflets (2-) 5-20 (-23) pairs, (-2) 3-17(-20) mm. long, (0.7-75-) 1-7(-12.5) mm. wide, rounded to mucronate or subacute at apex, glabrous to pubescent , Venation somewhat prominent beneath. Flowers sessile or nearly so, white or slightly yellowish in spikes (2-)3-12 cm. long on 0.4-4.5 cm. long peduncles, produced with the leaves; axis glabrous to pubescent. Calyx glabrous, 1.5-2.75 mm. long. Corolla 2-3.75 mm. long, glabrous, 5-lobed, exceeding the calyx. Stamen-filaments 4.5-6 mm. long, free; anthers 0.2-0.25 mm. across, with a caducous gland. Ovary glabrous, very shortly stipitate. Pods dehiscent glabrous or nearly so, oblong or irregularly constricted, straight or nearly so, venose, red- to purplish-brown, acuminate or apiculate at apex, (5-)8-17 cm. long,(1.8-)2-3 cm wide.

Distribution : K1, 4

Altitude : 460 - 1220 m.

11. Acacia senegal (L.) Willd.

Shrub or tree up to 12 m. high; bark grey, scaly, rough. Young branchlets densely to spasely pubescent, soon glabrescent. Stipules not spinescent. Prickles just below nodes, either in threes, up to 7 mm. long, the central one hooked downwards, the lateral ± curved upwards, or else solitary, the lateral being absent. Leaves : petiole glandular or not (gland about 0.5–0.75 mm. in diameter); rhachis ± pubescent, glandular between the top 1–5 pairs of pinnae, prickly or not; pinnae (2–)3–6 pairs, 0.5–1.5 (–2–2.4, very rarely to 4) cm long; leaflets 8–18 pairs, 1–4(–7) mm. long, 0.5–1.75 mm. wide; linear to elliptic- oblong, ciliate on margins only or hairy on surface, or wholly subglabrous, lateral nerves not visible or sometimes somewhat prominent beneath, apex obtuse to subacute. Flowers white or cream, fragrant, sessile, in spikes 2–10 cm long on peduncles 0.7–2 cm long, normally produced with the leaves; axis pubescent to glabrous. Calyx 2–2.75 (–3.5) mm. long, glabrous to somewhat pubescent. Corolla 2.75–4.0 exceeding the calyx, 5-lobed, glabrous outside. Stamen-filaments 4.5–7 mm. long, free; anthers 0.2–0.25 mm. across, with a caducous gland. Ovary glabrous, very shortly stipitate. Pods usually grey-brown, sometimes pale or dark brown, dehiscent, densely to sparsely appressed-pubescent to -puberulous, oblong, straight, venose, rounded to acuminate at apex, (3–)4–14 cm. long, (1.3–) 2–3.3 cm. wide.

Distribution : K1 – 7

Altitude : 120 – 1680 m.

12. Acacia circummarginata Chiov.

Closely related and similar in most of its characters to A. senegal, differing mainly as follows:

Tree 5-9 m. high; crown flat (T.T.C.L.) or rounded, bark yellow, flaking. Young branchlets subglabrous to puberulous, rather smooth except for lenticels, purplish-brown to purplish-black Leaves with 3-7 pairs of pinnae, their rhachis 2-6.5 cm. long; leaf-lets 8-25 pairs, 3-9 mm. long, 1.2-2(-3) mm. wide, usually with few to many minute appressed hairs beneath. Axis of flowering spikes glabrous, rarely slightly hairy. Pods usually brown, dehiscent, sparingly to sometimes densely puberulous, oblong to elliptic usually subacute, sometimes rounded at apex, 7-18.5 cm. long, 1.7-2.8 cm. wide.

Distribution : K1 - 4

Altitude : 730 - 1180 m.

13. Acacia thomasii Harms

Straggling shrub or small tree up to 5 m. high, with elongate whippy upper twigs. Young branchlets densely pubescent. Stipules not spinescent. Prickles just below each node, usually blackish, up to 7.5 mm. long, in threes or occasionally solitary, the central one hooked downwards, the laterals curved upwards or sometimes nearly straight. Leaves: petiole glandular, 2-11 mm. long including the pubescent eglandular rhachis; pinnae 1-2(-3) pairs; leaflets 7-15 pairs, 3-9 mm. long, 1.5-3 mm. wide, obliquely oblong or elliptic-oblong, glabrous to somewhat pubescent, rounded to acute or mucro-nulate at apex, lateral nerves (other than minute basal ones) Not visible beneath.

Flowers cream or lemon, sessile or nearly so, in spikes 4–9 cm. long on peduncles about 0.5–1.2 cm. long. Calyx 3.5–4.5 mm. long, glabrous. Corolla 6.5 mm. long, 5-lobed, glabrous outside. Stamen-filaments 13–15 mm. long, free; anthers 0.2 mm. across, with a very caducous apical gland. Ovary glabrous; stipe very short. Pods yellow-brown or brown when ripe, dehiscent, puberulous, oblong, straight or near so, venose, coriaceous, subacute to acuminate at apex, 5–10 cm. long, 1–2.3 cm. wide.

Distribution : K1, 4, 6, 7

Altitude : 620 m.

14. Acacia mearnsii De Wild

Tree 2–15 m. high unarmed; crown conical or rounded; all parts (except flowers) ± densely pubescent or puberulous. Leaves: petiole 1.5–2.5 cm. long, with a gland above; rhachis usually 4–12 cm.long, with numerous raised glands all along its upper side; pinnae (8–) 12–21 pairs; leaflets usually in 16–70 pairs, linear-oblong, 1.5–4 mm. long, 0.5–0.75 mm. wide. Flowers pale yellow, fragrant, in heads 5–8 mm. in diameter on peduncles 2–6 mm. long, panicled. Pods ± grey puberulous, jointed, almost moniliform, dehiscing, usually about 3–10 cm. long and 0.5–0.8 cm. wide, with 3–12 joints.

Distribution : K4, 5, 6

Altitude : 1615 – 1800 m.

16. Acacia brevispica Harms

Shrub or small tree 1–7 m. high, often semi-scandent and forming coppice. Young branchlets densely pubescent or puberulous and with many minute reddish glands. Prickles scattered, recurved or spreading arising from longitudinal bands along the stem which are usually paler than the invervening lenticellate bands.

Leaves : petiole 0.4–1.3(-1.5) cm. long; pinnae 6–18 pairs mostly 1–4 cm. long, straight or slightly curved; leaflets numerous, linear or linear-oblong, midrib nearer one margin at base. Flowers white or yellowish-white in heads 10–15 mm. in diameter, racemosely arranged, or aggregated into a rather irregular terminal panicle up to about 15(-30) cm long. Stipules at base of peduncles small, 0.75–1(-2) mm. wide, inconspicuous, soon caducous, not subcordate at base. Calyx eglandular, outside, puberulous or glabrous. Pods subcoriaceous, oblong, 6–15 cm. long, (1.2-)1.5–3.3 cm. wide, glabrous or puberulous with many minute reddish glands.

Distribution : K1 - 7

Altitude : 0 - 2280 m.

17. Acacia adenocalyx Brenan & Exell

Compact shrub or small tree 1-4.5 m. high, sometimes low and spreading, or even scadent. Young branchlets puberulous and with very many minute brown glands. Prickles scattered, deflexed, arising from longitudinal bands along the wholly blackish-brown stems. Leaves : petiole 0.5–1.2 cm. long; pinnae 10–19 pairs, 0.6–3, 5 cm long; leaflets very numerous and neat, linear-oblong, 0.3–0.75 mm. wide; midrib subcentral at base. Flowers white, in heads about 8–10 mm. in diameter, often irregularly paniculate. Stipules at base of peduncles small, 0.3–0.5 mm. wide, incónspicuous, soon caducous, not subcordate at base. Calyx-lobes with many minute brown glands outside. Pods subcoriaceous or stiffly long, 1.6–3.6 cm. wide, puberulous or glabrous and with very many minute brown glands.

Distribution : K7

Altitude : 45 - 450 m.

18. Acacia monticola Brenan & Exell

Scandent shrub to 30 m. high. Young branchlets ± densely pubescent with fulvous hairs and many red-purple glands mixed, dark brown, later going blackish. Prickles deflexed, scattered, arising from longitudinal bands usually darker than the intervening ones. Leaves: petiole 1.5–3.5 cm. long; pinnae 7–19 pairs, 3–4.5 (-5.5) cm long; leaflets linear-oblong, 0.5–1.25 mm. wide, glabrous or margins sparsely and inconspicuously cilialate midrib nearer one margin at base. FLowers cream or white, in heads 10–15 mm. in diameter usually in pyramidal panicles. Stipules at base of peduncles small, 1-1.5 mm wide, inconspicuous, soon caducous, not subcordate at base. Calyx puberulous and eglandular outside. Corolla puberulous outside. Pods subcoriaceous, oblong, dark brown dehiscent, 8–18 cm. long and 3–4.5 cm wide, with margins 1-1.5 mm. wide and not very thickened.

Distribution : 5

Altitude : 1676 m.

19. Acacia pentagona (Schumach. & Thonn.) Hook.

An often tall liane. Young branches sparsely puberulous to glabrous and eglandular, very rarely with inconspicuous sessile glands, red-brown to deep purplish. Prickles deflexed, scattered, arising from longitudinal bands usually darker than the intervening one. Leaves: petiole (1.5-) 2–6 cm. long; pinnae 8–15 pairs, 2.5–9 cm long; leaflets linear or linear-oblong, 0.7–1.8(-2) mm wide, glabrous or nearly so, midrib nearer one margin at base. FLowers white, in heads 8–10 (-12) mm. in diameter usually in ample panicles. Stipules at base of peduncles small, 0.75–1.5 mm. wide, inconspicuous, soon caducous, not subcordate at base.

Calyx eglandular outside. Corolla glabrous or rarely sparingly puberulous outside. Pods thick, hard, oblong, dark brown, 7.5–16 cm. long, 1.8–3.5 cm wide, indehiscent and with markedly thickened margins 2–4 mm. wide.

Distribution : K 7

Altitude : 400 - 1450 m.

15. Acacia macrothyrsa Harms

Small or medium tree 2–12 m. high; bark rough, fissured, grey (or brown). Stipules spinescent, stout, brown, glossy, compressed, up to 1.6(-2.8) cm. long. Leaves large 10–20 cm wide; rhachis (with petiole) 10–37 cm. long; pinnae mostly 9–16(-27) pairs; leaflets 12–40 pairs(4-)6–11(-20) mm. long, 1-3.5 (-6) mm. wide, rather stiff and glossy above, glabrous. Flowers orange or yellow, strongly and sweetly scented, in heads 8–13 mm. in diameter, in a panicle up to about 45 cm long and 30 cm wide, whose branches (and usually also main axis) are leafless. Pods coriaceous, glossy, glabrous, oblong, straight, blackish, blackish-purple or brown, 8–20 cm long and 1.5–2.5 cm. wide.

Distribution : K2 -3, 5

Altitude : 600 - 1830 m.

21. Acacia zanzibarica (S. Moore) Taub.

Tree 3–9 m. high; bark yellow-green to yellow or whitish, turning cinnamon-coloured and powdery with age. Young branchlets glabrous or nearly so, mostly brown or grey-brown, older ones with minutely flaking or powdery, yellowish to brown bark. Stipules spinescent, mostly straight, grey, 1.2–7.5 cm. long, some fused at base into ± deeply bilobed blackish "ant-galls", each rounded or fusiform lobe to about 2-2.5 cm. in diameter; other prickles absent.

Leaves glabrous or nearly so; petiole 4–7(–15) mm. long, often glandular at middle or top; rhachis 0–1.5(–6.5) cm. long; pinnae 1–4 (–6) pairs, mostly 1–2 cm. long; leaflets 3–10 pairs, oblong to ± obovate, mucronate or acute at apex, 2–13(–20) mm. long, (0.5–) 2–6(–10) mm. wide; venation usually raised, especially beneath. Flowers bright yellow, in rhachis, sweetly scented; involucel at or shortly above the base of the glabrous or sub-glabrous peduncles. Calyx 0.8–1.5 mm. long, puberulous or glabrous. Corolla 2.25–4 mm. long, glabrous. Pods linear, falcate to almost straight, subcoriaceous, glabrous, closely venose, 5.5–12 cm. long, 4–7 mm. wide, blackish-brown.

Distribution : K1, 7
Altitude : 0 – 850 m.

22. Acacia seyal Del.

Tree 3–9(–12) m. high; bark on trunk powdery, white to greenish-yellow or orange-red. Young branchlets almost glabrous; and with numerous reddish sessile glands, epidermis of twigs becoming reddish and conspicuously flaking off to expose a greyish or ± reddish powdery bark. Stipules spinescent upto 8 cm. long; "Ant-galls" or not; other prickles absent. Leaves often with a rather large gland on the petiole and between the top 1–2 pairs of pinnae; pinnae (2–) 3–7(–8) pairs; leaflets (7–)11–20 pairs 3–8(–9) mm. long; 0.75–1.5 (–3) mm. wide, in our area sparingly ciliolate to glabrous; lateral nerves invisible beneath. Flowers bright yellow, in axillary pedunclate heads 10–13 mm. in diameter; involucel in lower half of peduncle, 2–4 mm. long; apex of brateoles rounded to elliptic, sometimes pointed. Calyx 2–2.5 mm. long, inconspicuously puberulous above. Corolla 3.5–4 mm. long, glabrous outside. Pods dehiscent, linear, ± falcate ± constricted between the seeds, finely longitudinally veined, glabrous except for some sessile glands, (5–)7–20(–22) cm. long, 0.5–0.9 cm. wide.

Distribution : K1, 3–6

Altitude : 600 – 1830 m.

28. Acacia hockii De Wild.

Shrub or tree (1-) 2-6 (-12) m. high; bark not powdery, red-brown to greenish or rarely pale yellow, peeling off in papery layers when not burned. Young branchlets ± densely puberulous, rarely glabrous with numerous reddish sessile glands, usually elongate and slender with reddish or brownish bark which does not peel to expose a powdery layer as in A. seyal Stipules spinescent, mostly short, straight, suberect or spreading, to 2(rarely to 4) cm. long, subulate or flattened on upper side; "ant-galls" and other prickles absent. Leaves often with a gland on the petiole and between the top 1(-3) pairs of pinnae; pinnae (1-)2-11 pairs; leaflets 9-29 pairs, 2-6.5 mm. long, 0.5-1(-1.25)mm. wide, usually densely ciliolate, lateral nerves invisible beneath. Flowers bright yellow, in axillary pedunculate heads 5-12 mm. in diameter; involucel ⅓-⅔-way up peduncle, 1.5-3 mm. long. Apex of bracteoles rounded to rhombic, sometimes pointed. Calyx (1-)1.5-2 mm. long, glabrous except above. Corolla 2.5-3.5 mm. long, glabrous outside. Pods as in A. seyal except for being often ± puberulous, (4-)5-14 cm. long, 0.3-0.6 (-8)cm. wide.

Distribution : K1, 3-6

Altitude : 0 - 2300 m.

30. Acacia ancistroclada Brenan

Shrub or small tree up to 7.5 m. high; trunk usually branching a short distance above ground; bark peeling off in large papery pieces, reddish or greenish-yellow. Young branchlets glabrous except for minute sessile reddish glands which soon disappear, purplish at first, soon grey to red-brown; bark of twigs not flaking off.

Stipules spinescent. mostly short, 2.5–8 mm. long and downwardly hooked, but some (especially on older twigs) elongate, 2–5.8 cm. long and nearly straight; "ant-galls" and other prickles absent. Leaves : pinnae 1–2 pairs, a small gland between the top (or only pair; rhachis 0–8 mm. long; leaflets 3–9 pairs, mostly 2–5 mm. long, 0.75–1.5 mm. wide, glabrous or margins very sparsely and inconspicuously ciliolate; lateral nerves invisible beneath. Flowers bright yellow, in axillary pedunculate heads; involucel

about ⅓–⅔-way up the peduncle. Calyx (except for puberulous lobes) and corolla glabrous outside. Pods dehiscent, linear, falcate, slightly constricted between the seeds, finely longitudinally or somewhat obliquely veined, glabrous, 6–15 cm. long, 0.5–0.6 cm wide.

Distribution : K6 – 7

Altitude : 820 – 1310 m.

35. Acacia kirkii Oliv.

Tree 2.5–15 m. high, flat-crowned; bark green, peeling or scaling. Young branchlets pubescent to sometimes subglabrous, with numerous reddish sessile glands; twigs grey, brown or plum-coloured, not showing yellow bark. Stipules spinescent, straight or almost so, varying in length, up to 8 cm. long; "ant-galls" and other prickles absent. Leaves : rhachis 3–8 cm. long, normally rather densely pubescent above; pinnae 6–14 pairs (some leaves always with 8–9 pairs or more); leaflets numerous, small, narrowly oblong or oblong-linear, 2–5 mm. long, 0.5–1(-1.25) mm. wide. Flowers with red corolla and white stamen-filaments, in axillary heads whose involucels are conspicuous, 2–3 mm. long and near base of or 1/5–½-way up the peduncle; peduncles rather densely pubescent and with sessile glands throughout, rarely sparingly pubescent.

Pods indehiscent, narrowly oblong, straight (or only bent in a plane at right-angles to the flattened plane of the pod), 3.5–9 cm long, 0.8–2.1 cm. wide, often ± moniliform with the segments mostly as wide or wider than long.

Distribution : K4, 6

Altitude : 1520 m.

29. Acacia nilotica (L.) Del.

An exceedingly variable species. Tree (1.2–)2.5–14 m. high; bark on trunk rough, fissured, blackish, grey or brown, neither powdery nor peeling. Young branchlets from almost glabrous to subtomentose; glands inconspicuous or absent; bark of twigs not flaking off, grey to brown. Stipules spinescent, up to 8 cm. long straight or almost so, often ± deflexed; "ant-galls" and other prickles absent. Leaves often with 1(–2) petiolar glands and others between all or only the topmost of the 2–11 pairs of pinnae; Leaflets 7–25 pairs, 1.5–7 mm. long, 0.5–1.5 mm. wide, glabrous to pubescent; lateral nerves invisible beneath. Flowers bright yellow, in axillary pedunculate heads 6–15 mm. in diameter; involucel from near base to about halfway up peduncle. Calyx 1–2 mm. long, subglabrous to pubescent. Corolla 2.5–3.5 mm. long, glabrous to pubescent outside. Pods especially variable, indehiscent, straight or curved, glabrous to grey-velvety, turgid, (4–)8–17(–22) cm long, 1.3–2.2 cm. wide.

Distribution : K1 – 4, 6, 7

Altitude : 15 – 1830 m.

24. Acacia abyssinica Benth.

Flat-crowned tree 6–15(-20)m. high; bark rough and fissured, brown to nearly black; epidermis not peeling on the twigs; bark on young trees papery. Indumentum of branchlets variable, pubescent to shortly villous, grey or somewhat yellowish. Stipules spinescent, other prickles absent; spines variable, absent, short or up to 3.5 cm. long, straight, ashen when elongate, never inflated. Leaves : petiole 2–5 mm. long; pinnae of well-developed leaves of mature shoots 15–36 pairs (reduced leaves with fewer pairs usually also present); leaflets up to 4 mm. long and 0.75 mm. wide. Flowers in heads; stamens white; calyx and corolla red. Corolla glabrous or inconspicuously puberulous on lobes outside. Pods subcoriaceous, straight or slightly curved, grey or brown, longitudinally veined, glandular and sometimes puberulous, narrowed at base and sometimes at top, 5–12 cm. long 1.2–2.1(-2.8) cm. wide.
Distribution : K3 – 5

Altitude : 1500 – 2300 m.

20. Acacia elatior Brenan

Large tree up to 18–25 m. high; crown rounded, with pendulous branchlets; bark brown to almost black, deeply longitudinally fissured. Young branchlets glabrous to pubescent, grey-brown. Stipules spinescent, straight or nearly so, some short, to about 7 mm. long, others long, whitish, to about 9 cm. long, sometimes modified to inflated fusiform "ant-galls". Leaves : rhachis 1–6 cm long; pinnae 5–13 pairs, some leaves normally with 8 or more pairs; Leaflets (7-)13–25 pairs per pinnae, 1.25–4 mm. long, 0.5–1.25 mm. wide, glabrous or ciliate.

Flowers greenish-white to white or very pale yellow, in heads on peduncles 2-5 cm. long, whose involucel is about $\frac{1}{3}$-$\frac{1}{2}$ way above base. Pods straight, narrowly oblong, dehiscent, 3-12 cm. long, 1.2-1.8 cm. wide, shortly attenuate at base, acuminate or rounded at apex, brown or purplish-brown, finely and mostly obliquely veined, glabrous or ± pubescent near base.

Distribution : K1 - 4, 6, 7

Altitude : 180 - 1070 m.

32. Acacia etbaica Schweinf.

Normally a tree 2.4-12 m. high with a well-defined trunk and a flat or rounded crown; bark rough, brown to almost black. Young branchlets glabrous to puberulous; older ones glabrous or glabrescent, grey to brown. Stipules spinescent, all short and hooked or straight, up to about 7 mm. long, or with long straight spines up to 6 cm. long intermixed; "Ant-galls", and other prickles absent. Leaves: rhachis variable, 0.4-5 cm. long; pinnae 1-9 pairs, some leaves usually with 4 or more pairs; leaflets 4-35 pairs per pinna, 0.5-4 mm. long, 0.25-1.25 mm. wide, glabrous or ± puberulous. Flowers white or cream, in small axillary heads on peduncles 0.7-2.5 cm. long whose involucel is $\frac{1}{3}$-$\frac{1}{2}$-way up, or sometimes near base. Pods straight, linear-oblong to oblong, dehiscent, 2-12 cm. long, (0.6-)0.7-2.2 cm. wide, attenuate at base, acuminate to rounded at apex, grey to brown or deeply purplish, marked with fine mostly oblique or longitudinal veins and glabrous or ± puberulous especially near base.

Distribution K1 - 4, 6, 7

Altitude : 270 - 1524 m.

31. Acacia reficiens Wawra

Bush 1-5(-6) m. high, obconical, branching from base. Young branchlets shortly puberulous to pulverulent, as are the leaf-rhachis and peduncles; older branchlets glabrescent, grey to brown, often rather slender and almost straight. Stipules spinescent, all short, hooked, 2-6 mm. long, coloured like the twigs; "ant-galls" and other prickles absent. Leaves : rhachis short, 0.3-1.2 cm. long; pinnae 1-3 pairs (at least in our area); leaflets 5-11 pairs per pinna, 2-4.5 mm. long, 0.5-1.25 mm. wide, glabrous or slightly puberulous. Flowers whitish, in small axillary heads; involucel on peduncle basal or in lower third. Pods straight, linear-oblong, dehiscent, 3-6.5 cm. long attenuate at base, acuminate to obtuse at apex, brown or deep purplish, marked with fine mostly longitudinal veins and ± pulverulent to glabrous or nearly so.

Distribution : K1 - 2, 4, 7

Altitude : 80 - 1220 m.

33. Acacia tortilis (Forsk.) Hayne

Tree 4-21 m. high, occasionally a bush 1 m. high; crown flat or spreading; bark grey to black, fissured. Young branchlets glabrous to densely pubescent, going brown to purplish-black. Stipules spinescent, some short ± hooked and up to about 5 mm. long mixed with other long straight whitish ones to about 8(-10) cm. long; "ant-galls" and other prickles absent. Leaves : rhachis short, 2 cm. long or less; pinnae 2-10 pairs, 2-17 mm. long; leaflets 6-19 pairs per pinna, usually very small, 0.5-2.5 (-6) mm. long, ciliate to glabrous. Flowers cream or whitish, in axillary heads 5-10 mm. in diameter on peduncles 0.4-2.4 cm. long. Pods contorted or spirally twisted, longitudinally veined, tomentellous to glabrous.

Distribution : K1, 2, 4, 6, 7

Altitude : 600 - 1500 m.

36. Acacia clavigera E. Mey.

Tree 5–25 m. high; crown flat or spreading; bark on trunk grey to dark brown, fissured or sometimes smooth. Young branchlets usually glabrous, eglandular, becoming grey to grey-brown, sometimes grey-purplish; bark of branchlets lenticellate, otherwise rather smooth, neither flaking off nor fissuring to expose red under-bark. Stipules spinescent, straight or very slightly curved, mostly short, up to 7 mm., sometimes longer, to 6(-9) cm.; "ant-galls" and other prickles absent. Leaves: rhachis (2.5-) 3–7 cm. long; pinnae (2-)3–8(-10) pairs; leaflets 9–27 pairs (with us usually 13 or more pairs), (2-)3.5–6.5 mm. long, 1–3.5 mm. wide, glabrous or ciliolate on margins oblong. Flowers white, very sweetly scented, profuse, in heads on axillary, shortly pubescent to puberulous, eglandular or very inconspicuously glandular peduncles, whose involucel is shortly above base or in lower third of peduncle. Corolla glabrous outside. Pods falcate, dehiscent, glabrous, linear, 10.5–19 cm. long, 0.7–1.7 cm. wide; valves rather thin, grey to deep red-brown, ± longitudinally veined. Otherwise smooth, attenuate at base.

Distribution : K4, 6, 7

Altitude : 1370 m.

34. Acacia gerrardii Benth.

Shrub or more usually a tree 3–15 m. high; crown flat, umbrella-shaped or irregular; bark on trunk grey, blackish-brown or black, rough, fissured. Young branchlets ± densely grey-pubescent, rarely glabrous or nearly so; epidermis usually spilitting or falling away to expose a rusty-red inner layer.

Stipules spinescent, usually straight or nearly so, sometimes recurved rarely hooked, mostly short, to about 1 cm. long, rarely to about 6 cm long and then usually grey: "ant-galls" and other prickles absent. Leaves: rhachis (1.5)2-7 cm. long, ± densely pubescent; pinnae (3-)5-10(-12) pairs; leaflets (8-)12-23(-28) pairs, 3-7.5 mm. long, 1-2 mm. wide, ± ciliate on margins at least near base, otherwise glabrous or nearly so, sometimes hairy on surface. Flowers white or cream, scented, in heads on axillary densely grey-pubescent eglandular or inconspicuously glandular, occasionally strongly glandular peduncles; involucel at or shortly above or sometimes to one-third way up peduncle. Corolla glabrous or only slightly and inconspicuously pubescent outside. Pods falcate, dehiscent, linear or linear-oblong, (4.5-) 7-16(-22) cm. long, mostly 0.6-1.1 sometimes to 1.7 cm wide; valves rather thin ± grey-puberulous to tomentellous, rarely subglabrous or glabrous.

Distribution : K1 - 6

Altitude 450 - 2130 m.

23. Acacia drepanolobium Sjostedt

Bush or small tree 1-5(-7.5) m. high, with short radiating branches from main stem, sometimes spreading at top. Young branchlets shortly pubescent to puberulous, rarely glabrous, grey then going brown; no powdery inner bark on twigs. Old bark black or grey, usually rough, sometimes smoothish. Stipules spinescent, mostly 1.5-4.5(-7.5) cm. long (some shorter ones often also present); straight, grey or whitish some fused at base into ± round "ant-galls" 1-3.5 cm. in diameter, grape-purple going blackish.

Leaves : petiole 2-5 (very rarely to 10) mm. long, glandular at the lowest of the 3-13 pairs of pinnae; rhachis 0.8-4.5(-9) cm. long, glandular between the top 1-6 pairs of pinnae; leaflets 11-22 pairs, glabrous or minutely ciliolate, subacute or acute sometimes obtuse at apex, 1.5-5.5 mm. long, 0.7-1.25 (-1.75) mm. wide. Flowers white or sometimes cream, in heads; involucel at or rarely a short way above base of the glabrous puberulous or shortly pubescent peduncle. Calyx 0.75-1.5(-2.5) mm. long, glabrous or ciliolate. Corolla glabrous outside, sometimes puberulous on lobes, 3-4 mm. long. Pods falcate or annular, thinly coriaceous, finely longitudinally venose, glabrous or ± puberulous, mostly attenuate or even acuminate at ends, 4-7 cm. long, 0.5-1.0 cm. wide.

Distribution : K1 - 6

Altitude: 600 - 2680 m.

25. <u>Acacia</u> <u>sieberiana</u> DC.

Tree 5-18 m. high; bark usually grey and rough on trunk, sometimes light brown, or yellowish and flaking especially on branches. Young branchlets glabrous to tomentose, eglandular, green to grey or yellowish, later grey; outer bark then usually flaking away to expose an olive or yellow inner layer. Stipules spinescent, straight, up to 9(-12.5) cm. or more long, whitish; "ant-galls" and other prickles absent. Leaves : rhachis 2.5-10 cm. long; pinnae mostly 6-23(-35) pairs; leaflets 14-45 (-52) pairs, 2-6.5 mm. long, (0.5-)0.6-1.5 mm. wide, glabrous to ciliate, narrowly oblong, rounded to obtuse at apex; midrib, and sometimes small lateral nerves also, somewhat prominent on both surfaces. Flowers white or very pale yellow, in heads on axillary peduncles 1.5-5 cm. long which are variable in indumentum but eglandular, and whose involucel is normally apical or in upper half of peduncle. Pods straight or sometimes ± falcate, flattened but thick and almost woody in texture when dry, very slow in dehiscing, (8-)9-21 cm. long, (1.5-) 1.7-3.5 cm. wide, ± smooth and glossy, without raised veins, glabrous or somewhat hairy.

Distribution : K3, 5, 6, 7

Altitude : 950 - 1830 m.

38. Acacia nubica Benth.

Shrub 1-5 m. high, with branches from base; bark green below, usually pale grey to whitish or whitish-green above. Young branchlets glabrous to pubescent with short spreading hairs to 0.5(-0.75) mm. long, greenish, going whitish to grey-brown; epidermis not peeling or flaking; lenticels pale, dot-like. Stipules spinescent, straight or almost so (at least in our area) 0.4-1.7(-2.7) cm. long; "ant-galls" and other prickles absent. Leaves : rhachis mostly (1.5-) 2-4(-6) cm. long, rarely shorter, pubescent to subglabrous; pinnae (2-)3-7(-11) pairs; leaflets 5-16 pairs, 2.5-6(-9) mm. long, (0.5-)0.75-2.5 mm. wide ± ciliate to glabrous. Flowers white, cream or greenish (perianth and anthers pink to red), in heads on axillary, pubescent, eglandular peduncles 0.5-1.5 cm. long; involucel below or sometimes about middle of peduncle. Corolla-lobes conspicuously pubescent outside. Pods straight or sometimes slightly curved, coriaceous, dehiscent, 4-13 cm. long, 0.9-2.2 cm, wide, puberulous to densely and shortly pubescent, straw-coloured to pale brown or grey-brown valves with a convex longitudinally veined central part and (in our area) with a narrow flat wing-like margin 1-3.5 mm. wide.

Distribution : K3, 5

Altitude : 1220 - 2130 m.

37. Acacia paolii Chiov.

Usually a shrub up to 1.5–2.4 m. high, branching from the base, obconical and ± flat-crowned, sometimes a small tree to 5 m, bark dark green, smooth, apparently without papery-peeling. Young branchlets and their indumentem as in A. stuhlmannii except that the hairs are less golden when young, usually fewer and more quickly disappearing. Stipular spines as in A. stuhlmannii, up to 5 cm. long. Leaves : rhachis 2.5–7 cm. long, pubescent; pinnae 4–9 pairs; leaflets 8–15 pairs, (2–) 3–7 long, 1–1.75 mm. wide with ± appressed cilia. Flowers in heads on axillary, pubescent, eglandular, peduncles 0.7–2 cm. long; involucel basal or in lower quarter of peduncle. Bracteoles and calyces glabrous or almost so. Corolla-lobes conspicuously hairy or pubescent outside. Stamen-filaments white; anthers red. Pods somewhat falcate, coriaceous, dehiscent, attenuate for about 2–3 cm. at base and apex, (6–) 7–12.5 cm. long, 0.6–1.0 cm. wide, densely clothed with whitish spreading hairs up to 3–4 mm. long, the hairs not matted and finely longitudinally veined surface of the valve easily visible.

Distribution : K1, 2, 6, 7

Altitude : 600 – 1370 m.

26. Acacia stuhlmannii Taub.

1–6(–7.5) m. high, varying from a low spreading bush to a small ± obconical-crowned tree. Young shoots with spreading golden villous hairs up to 1.5–3 mm. long, hairs later going grey; branchlets becoming glabrescent, olive- to grey-brown, marked with pale dot-like lenticels, longitudinally wrinkled, but epidermis neither cracking nor peeling; the old stems in the tree-form, however, may have papery-peeling golden-brown bark over a green layer.

Stipules spinescent, straight, 0.7-4.5(-6.5) cm. long; "ant-galls" and other prickles absent. Leaves : rhachis usually 2-5 cm. long, spreading-hairy;pinnae 4-8(-12) pairs; leaflets 7-25 pairs ciliate 2-5.5 mm. long,(0.8-)1-1.5(-2) mm. wide. Flowers white with reddish-buff or mauve anthers, in heads on axillary, densely hairy or tomentose, eglandular peduncles 0.4-3 cm. long, often produced when the plant is without leaves; involucel basal or in lower half of peduncle; bracteoles conspicuously ciliate or pubc-scent. Calyx ± pubescent outside. Corolla-lobes conspicuously pubescent outside. Pods somewhat curved or sometimes straight, thick, hard and woody, indehiscent, usually much attenuate at base, densely clothed with long spreading hairs, (2-)4-9 (-10.5)cm long, (1.1-)1.2-2.5(-3) cm. wide.

Distribution : K1, 4, 6, 7

Altitude : 0 - 1740 m.

1.8.9 GENERAL MORPHOLOGY OF THE ACACIA POLLEN GRAINS AND THEIR TAXONOMIC SIGNIFICANCE

Van Zinderen Bakker and Coetzee (1959) Guinet (1969) and Robbertse (1974) have done some preliminary work on the pollen grains of the Acacia species. Their studies indicate that the pollen grains is a reliable line of evidence in attempting to detect natural relationship in the genus. All of the species belonging to subgenera, Heterophyllum, Aculeiferum and Acacia, are polyads having 8, 12, 16, 24, 32 or 48 monads. The cells in each polyad are regularly arranged and do not separate easily, functioning as one pollen grain except in fertilization and germination. The central part of the 16—celled polyad consist of 8—cells lying in two layers of 4—cells each, and forming a rectangular block around which are arranged the other 8—peripheral cells. The entire polyad has the shape of biconvex flattened disc, the general outline of which is circular or rounded square. The disymmetric shape of each cell as well as the disymmetric distribution of the exine is as a result of the closeness of their association (Guinet 1981). The most frequent type of association of the cells in the genus Acacia is the acalymmated type (Van Campo & Guinet 1961).

Another unique feature in the pollen grains of the genus is the occurance of balanced heteromorphy in the compound grains of the 16—celled polyads.

Guinet (1969) observed that such a pattern is characterised by two kinds of morphologies symmetrically distributed with respect to the centre of the symmetry of the compound grain whereby one type of character is restricted to the central monads and the other character is localised on the peripheral cells. Heteromorphy constantly occurs in the subgenus Heterophyllum whereby one half of the cell shows a particular set of characters and the remaining half depicts another set of characters.

The ectexine is well developed in the grains of the Acacia species and the occurance of the tectum is a constant character in all the species irrespective of the underlying layer, be it granulate or columellate. Some species of the subgenus Heterophyllum have faintly striate-reticulate exine with the lumina of the supratectal reticulum arranged in parallel rows and an areolate ornamentation while in the subgenera Aculeiferum and Acacia the exine is smooth (Guinet 1969).

Tectum perforations are particularly associated with the subgenus Acacia and present in some species of the subgenus Aculeiferum while completely absent in the subgenus Heterophyllum (Guinet 1981).

The endexine is present in every species of the genus and never exceeds the thickness of the foot layer. The foot-layer is present and very prominent in the subgenus Acacia and absent or reduced in the subgenus Heterophyllum, while completely absent in the subgenus Aculeiferum. The prominent types of exine structure are either granulate, in the subgenera Aculeiferum and Heterophyllum or Columellate in the subgenus Acacia.

The absence of a columellae corresponds to a a granular infractal structure and vice-versa, and the reason for such an association is unknown (Guinet 1981).

The development of the proximal exine is reduced and thinner as compared to the distal exine. Guinet (1981) has pointed out that the reason for such unequal development may be attributed to unequal distribution of sporopollenin material during the development of the grain.

The functional apertures are of two kinds :- the complex and the simple apertures. The complex apertures (Colporate apertures) are associated with the subgenus Acacia while the subgenera Aculeiferum and Heterophyllum are associated with the simple apertures (porate apertures) and complete absence of complex aperture system. Within the species with simple porate type, the occurance of additional pseudo-furrows is displayed by very many species of Acacia subgenus Heterophyllum (Guinet 1969). Another valuable taxonomic character is the occurance of functional proximal pores within the genus Acacia.

Guinet (1981) has reported three pollen types that approximately coincide with the major subdivisions of Bentham. The implication of these pollen data are strengthened by seeds and seedling characters (Guinet & Vassal, (1978). The three types of pollen grains recognised are on the basis of the apertures, and exine structure.

1.9 OBJECTIVE

1.9.1 Taxonomic study of the genus Acacia by use of their pollen grain morphology as a taxonomic tool in Kenya

Taxonomic study of the family Cucurbitaceae was done primarily on the basis of pollen grain analysis. This is therefore, one of the major taxonomic characters used in modern taxonomic studies. The morphological characters of the pollen grains of the *Acacia* species in Kenya shall be studied. The evidence gathered from the morphological studies shall be used to evaluate the similarities of species and to examine if the evidence supports the contentions of the nature of the stipules versus the types of inflorescences as being natural characters in the primary divisions of the *Acacia* species.

CHAPTER TWO

2. MATERIAL AND METHODS

2.1 Materials:

	Photomicroscope,
Pollen material	beakers, ball point,
Centrifuges	sieves, squart bottles
Centrifuge tubes	vortex mixer
5% KOH solution	gloves, mounting needle[s]
Glacial acetic acid	hood, razer blades
Acetic anhydride	paper towels
conc. H_2SO_4	Transferpettor
absolute alcohol	vial bottles, yellow ti[ps]
glycerine liquid	treated pollen samples
paraffin wax	hot plate
conformal mount liquid	empty test tube racks
glycerine jelly	labels, scissors, slide[s]
distilled water	& slide cover slips
mounting card	micro-pipettes
fine tipped forceps	small envelopes (10x6)c[m]

2.2 Pollen specimen collection from the Herbaria

The pollen of the *Acacia* species analysed for taxonomic revision, were collected from the University of Nairobi Herbarium and the East African Herbarium (hereafter referred to as NAI and EA respectively).

(i) Using a fine tipped forceps, a little sample of the pollen grains or flowers was taken from the herbarium sheets on which the required species was mounted and the collected pollen grains or flowers was placed inside the small plastic or paper envelopes of 10 x 6 cm by size.

(ii) The details of the collected specimen were noted down on a piece of paper and placed inside the envelope (10 x 6) cm. The details went as follows:

(a) Species
(b) Authority
(c) Family or subfamily
(d) Collector's name
(e) Collector's or Herbarium number
(f) Herbarium from which the specimen has been collected
(g) Location from which collected
(h) Determiner of the species identified if any
(i) Date and year of collection

When a collector did not include his/her collection number on the specimen, the abbreviation s.n. (=without number) was inserted after the collector's name.

(iii) A little of the anthers containing pollen grain material of the species to be analysed was placed inside the centrifuge tubes ready for the next step.

2.3 Methods:

2.3.1 Reference pollen procedure:

(i) 7 ml of 5% KOH was added to each tube containing material and placed in boiling water bath for 5-10 minutes. The discoloured solution was centrifuged and poured off then washed twice with distilled water.

(ii) The polleniferous material in the tube was then rinsed with glacial acetic acid, centrifuged and decanted. (The hood was always used when working with glacial acetic acid).

(iii) Fresh acetolysis mixture was prepared daily under the hood: 9 parts acetic anhydride was added to 1 part concentrated H_2SO_4.

For 12 tubes:

81 ml acetic anhydride was added to 9 ml H_2SO4.

Acid was added slowly to acetic anhydride whose beaker had been set in a pan of ice. The solution was agitated all the time with a glass stirring rod.

(iv) 7 ml of acetolysis mixture was added to each tube.

(v) The tube rack was placed in boiling water bath for 4 to 5 minutes. Solution turned brown, was centrifuged and poured off.

(iv) The material was washed once with glacial acetic acid and twice with distilled water. The water was decanted.

(vii) 5% KOH was added to the tube and heated in the water bath for 5-10 minutes. It was then centrifuged and poured off.

(viii) The material was then rinsed twice with distilled water.

(ix) A fresh metal sieve was placed on top of a clean and fresh 50 ml. beaker. The material plus distilled water was poured through the wire mesh into the beaker. The tube was rinsed well with the distilled water in the squirt bottle. The material in the wire mesh was given a squirt and the mesh was discarded. The liquid in the beaker was transferred to original tube using the squirt bottle for final rinsing of the beaker. The same process was repeated for all twelve tubes using fresh beakers and fresh metal sieves, always centrifuging and pouring off the supernatant.

(x) 7 ml of water and alcohol 3:1 was added to the tubes centrifuged, and poured off.

(xi) (a) If material was to be used for SEM work; it was rinsed twice with ethanol and poured off all but ½ to 1 ml of liquid and stoppered in tubes. This marked the end of this process.

(b) If material was to be used for reference slides, after pouring off the water and alcohol 3:1, the tubes were stood upside down on filter paper or paper towel for 15-20 minutes.

(xii) 50% glycerine was added shaken well and was let to stand for at least one hour.

(xiii) The glycerine was then centrifuged and poured off. The tubes were stood upside down on filter paper for 2-24 hours to drain and dry (best at 50°C). Usually overnight was sufficient.

Slides were made within a few days to prevent material from drying out too much or from getting air bubbles inside the pollen grains.

Note: Tubes were agitated after the addition of any liquid. 2-3 ml was added, agitated using Vortex mixer, and then filled to 7 ml. Gloves were used when working with acetolysis mixture, glacial acetic acid, or KOH

No. 1 brand of 18 mm. round coverslips were used when making slides.

2.3.2 Making Reference Slides - Erdtman Method:

(i) 6 slides were cleaned with alcohol and then laid on the table. (preferably on Kimwipe).

(ii) A small piece of glycerine jelly was put on another clean slide and cut into pin-head-size pieces with a razor blade.

(iii) The cleaned slides were placed on mounting card in the angle of 'L'.

(iv) The needle was cleaned with alcohol, stuck into one of of the jelly cubes and touched against the prepared pollen so that a suitable amount stuck.

(v) The cube plus pollen was placed on the slide exactly over the cross on the mounting card and the coverslip was placed.

(vi) A small piece of paraffin wax was placed against (touching) the coverslip and gently warmed so that as it melted it was drawn under the coverslip and surrounded the jelly. Air bubbles appearing under the coverslip usually disappeared after the slide was gently re-warmed.

(vii) The slide was laid face downwards on a frame so that the pollen grains came close to the coverslips, and left until the wax hardened.

(viii) Excess wax was scraped off with a razor blade and cleaned with 95% ethanol and Kimwipes.

(ix) Temporary label was attached on the right hand side of the slide.

(x) Steps (iv) through (ix) were repeated until 6 slides were completed or pollen was gone.

(xi) Any remaining pollen was preserved in 2 ml. vials in a solution of 95% ETOH or G.A.A. which was added to the tube by the end of the day to avoid damage to the pollen from drying.

(xii) At the end of each working session stoppered preserves were placed in refrigerator. When entire number of tubes were finished, the liquid preserved was transferred to ½ dram vials and stored in a coldroom. Since glycerin was no longer used in the preserving medium, the preserves were refrigerated at all times.

2.3.3 <u>Mounting and Sealing with conformal coating</u>:

A yellow tip was fixed on the transferpettor then the volume was adjusted as required (20 ml was sufficient). Fresh tips were fixed for each and every different species to avoid contamination or pollen mix-up on the slides.

(ii) Pollen material was drawn out from each tube and placed on the slide.

(iii) Pollen material was covered with a square cover-slip and sealed with a thin coating of conformal.

(iv) The slide was left to dry for 6 minutes and observed under the microscope.

Note: The advantages of conformal coating was that the pollen grains could be rotated inside the slide.

2.4 Microscopy Calibration & Measuring of Pollen Grain

A Leitz Orthoplan Microscope with a mounted MPS 45 Camera was used for the taking and studying of the Micrographs. Phase Contrast Microscopy at the Magnification of ' x 1000' was used in the study of pollen Morphological characters all the time. 'LO' analysis (Erdtman, 1956) was applied to the study of the exine structure using phase contrast lense (x 1000). The same Microscope was calibrated for the purpose of measuring the 'D' and 'E' planes of the polyads. Phase contrast and Bright Field lenses (x 1000), were interchangebly used for this purpose, depending on the suitability of the specimen on the slide.

A portion of the same specimen was vialed and sent to the University of Bayreuth (W. Germany), for the study of the exine sculpturing.

(i) An ocular and stage micro-ameters were placed on the eye-piece and stage of the microscope respectively.

(ii) The microscope was then set to the required magnification.

(iii) The number of units on the ocular micro-ameter that corresponded to the number of units on the stage micro-ameter were counted.

(iv) The stage micro-ameter units were converted into microns (the stage micro-ameter is divided into 100 small units representing 1 mm. = 1000 u.)

(v) By knowing the number of optical units corresponding to the units on the stage micro-ameter, the value of microns that was represented by 1 optical unit of the ocular micro-ameter was calculated. The value thus calculated at the magnification was a constant x.

(vi) At the same magnification, a prepared slide of the pollen granis was placed and the stage micro-ameter removed.

(vii) Suppose we were looking at the polyad of _Acacia persiciflora_ Pax at the same magnification, and we counted 22 units and 15 units on the ocular micro-ameter for the diameter and thickness of the grain respectively, we then multiplied the units by the constant e.g. (22 x X) m and (15 x X) m.

2.5 Basic information and preparation of chemicals

5% KOH - This was made up in large batches and stored in a 1 litre plastic jug under the sink in the pollen prep. lab. The proportions were 189.5 g KOH and 3690.5 ml. dH_2O. This was mixed in a 4 litre beaker using a glass stirring rod. Under heated conditions the KOH served two purposes; it deflocculated the material and softened the fibres.

(ii) Acetolysis mixture, a mixture of acetic anhydride and sulphuric acid - since this mixture was made up fresh when it was needed and was not stored, the directions and proportions for its preparation are located in the procedure. The acetolysis mixture was used to digest cellulose. Also, after acetolysis, exine features become more distinct, making use of stains necessary.

(iii) 95% EtOH - This was used in commercial concentration and stored either under the sink in the pollen prep. lab. or in the cabinet labelled organic reagents in the large laboratory. Because of its low density EtOH was used to cause material in suspension to centrifuge down into a pellet. It was also used for storing the sample.

(iv) Glacial acetic acid - This was stored under the sink in the pollen prep. laboratory and was used in commercial concentration. Glacial acetic acid was used for a rinse before and after acetolysis because water reacts strongly with the acetolysis mixture.

(v) Deacon 90 - This was the detergent used to clean glassware that had come in contact with pollen. It was kept under the sink in the main laboratory. This detergent was used at a 5% strength, in proportions of 5 ml of Decon to 95 ml of distilled water, and was made up in large tubs in which the glassware soaked.

3. CHAPTER 3

RESULTS

Presented in this Chapter are Scanning Electron Micrographs and photomicrographs of the pollen grains of all the indigenous Kenyan *Acacia* species which I have studied. Also expressed here is a dendrogram measuring the degree of the similarities of the *Acacia* species.

The Scanning Electron Microscope (SEM) installed in I C I P E, and the only one in the country, was out of order at the time of study. Consequently, the polleniferous material was sent to the University of Bayreuth (W. Germany) for S E M investigations. S E M Micrographs of 11 *Acacia* species are not represented here due to lack of sufficient time and heavy research schedule at the University of Bayreuth. However, the S E M data absent on these 11 species have been recorded in table 2 from microscopic observations.

A Leitz Orthoplan Microscope with a mounted Camera was used to take and study the remaining presented micrographs. Phase contrast and bright field lenses were used to carry out the research and formed the basis of the study here at the Department of Botany. To facilitate the understanding of the characters researched and expressed on the micrographs, you are referred to figures 2 & 3 which are sketch diagrams with all sets of characters consolidated in a single polyad. This condition cannot possibly be observed under the microscope due to the uneveness in thickness of the polyads. The distribution of pollen characters of the 38 indigenous Kenyan Acacia species are summarised on table 2.

Fig. 4 expresses the degree of the similarities of the studied Acacia species in a 'Single Linkage' dendrogram. The expression of this dendrogram is based on characters (table 1) drawn from pollen grains and was drawn by a B B C Micro—computer using a 'Viewclust' programme.

Explained below are the abbreviations used in this chapter :

SEM	=	Scanning Electron Micrographs
Ph	=	Phase contrast Microscopy ; Mag. x 1000
Br.	=	Bright field; Mag. x 1000
D	=	Diameter of Spherical grain of indistinct polarity
E	=	The length of the equatorial axis of an isopolar grain.

3.1 SKETCH DIAGRAMS

Figures 2 and 3 : Sketch diagrams illustrating all sets of pollen characters, their position, loca--tion and the assemblage of the individual cells as seen from microscopic top view of Gummifera and Vulgares polyads.

Fig. 2 Sketch diagrams of a Gummifera polyad.

Fig. 3. Sketch diagram of Vulgares polyad.

KEY

Q. = Pore clusters in threes

C. = Pore clusters in fours

ap. = Pore clusters in twos

api. = Pore clusters in threes

S. = Supplementary set of pore clusters in fours

Fy. = Y - shaped furrows

Fh. = H - shaped furrows

st. = exine structure

t. = tectum

Co. = Columellae

en. = endexine

nc = granular structure

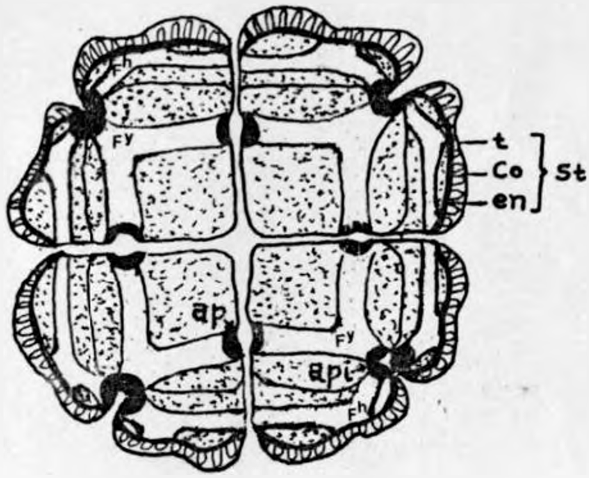


Fig 2

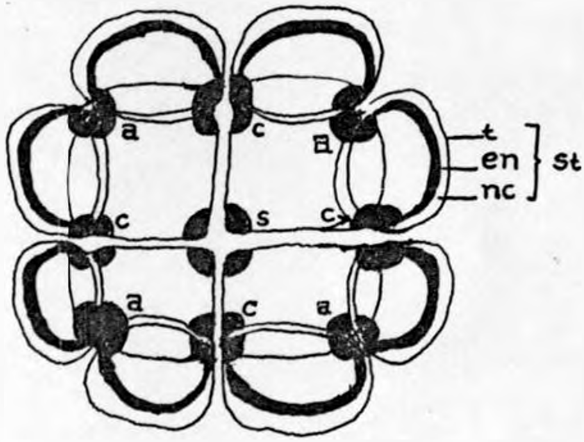


Fig 3

3.2 Micrographs showing pollen morphological characters of different *Acacia* species in Kenya.

Plates 1 – 4 : *Acacia albida.*

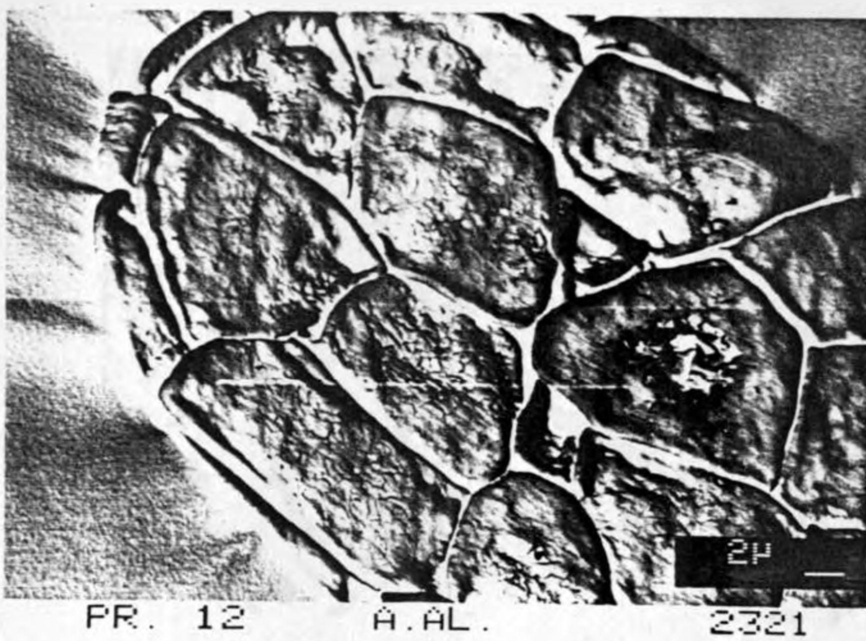
1. SEM (x 20,000) showing exine sculpturing.
   Smooth, flat and unperforated

2. Ph. (x 1000)
   Granular exine structure and
   aperture clusters in twos.

3. Ph. (x 1000) D = 115. 62 μ

4. Ph. (x 1000) E = 63.20 μ

NB. The Micrograph in plates 3 and 4 were taken at Mag. x 400 while the measurements were done at Mag. x 1000.



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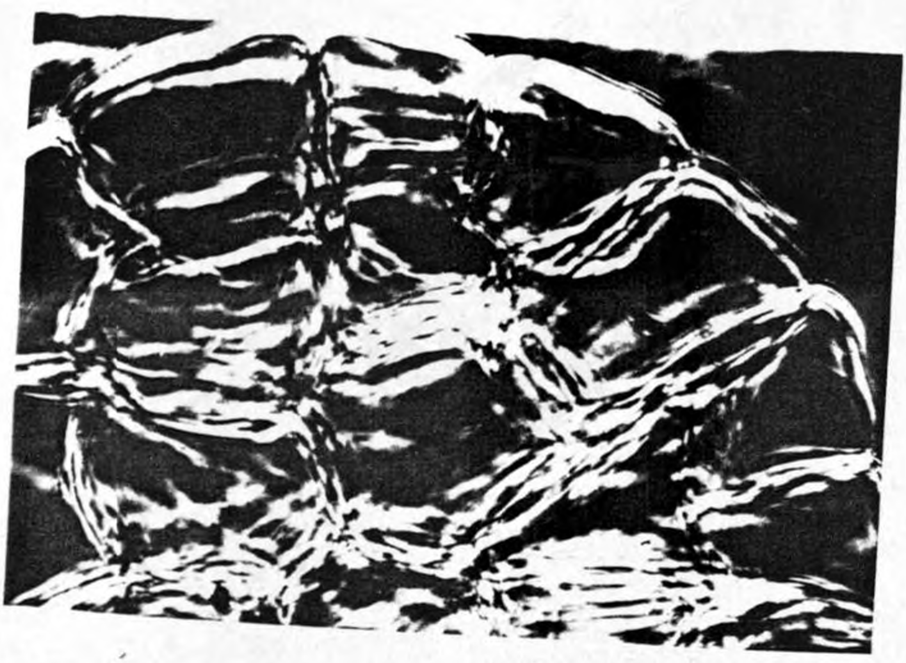

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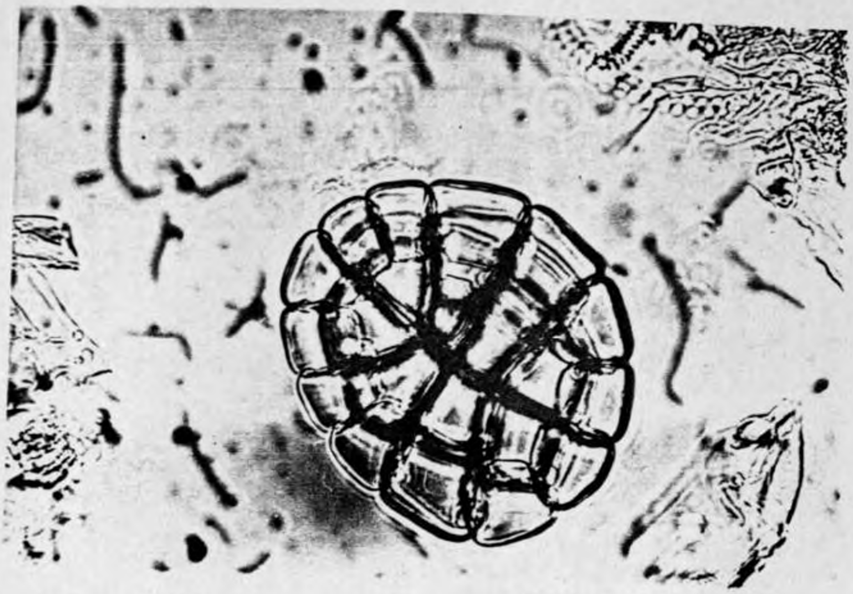


3

4

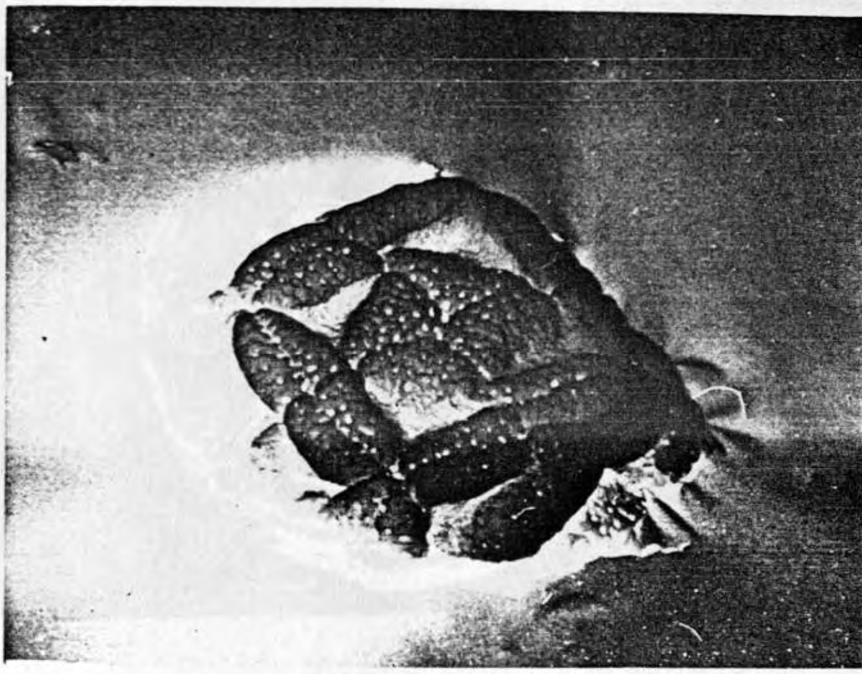
Plates 5 - 8 : Acacia lahai

5. SEM (x 10,000); showing exine sculpturing, flat and perforated.

6. Ph (x 1000) showing furrows on the central monads

7. Ph (x 1000) showing Columellate exine structure all round the periphory of the polyad. and size D = 51.09 μ

8. Size Ph. (x 1000) ; E = 33.20 μ



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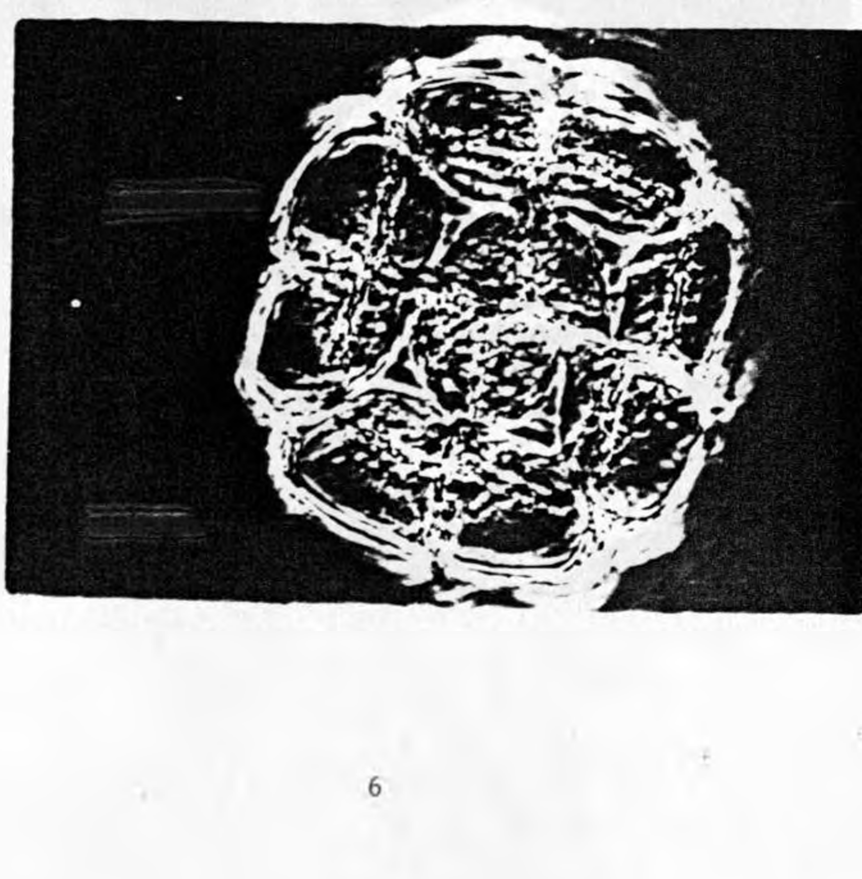

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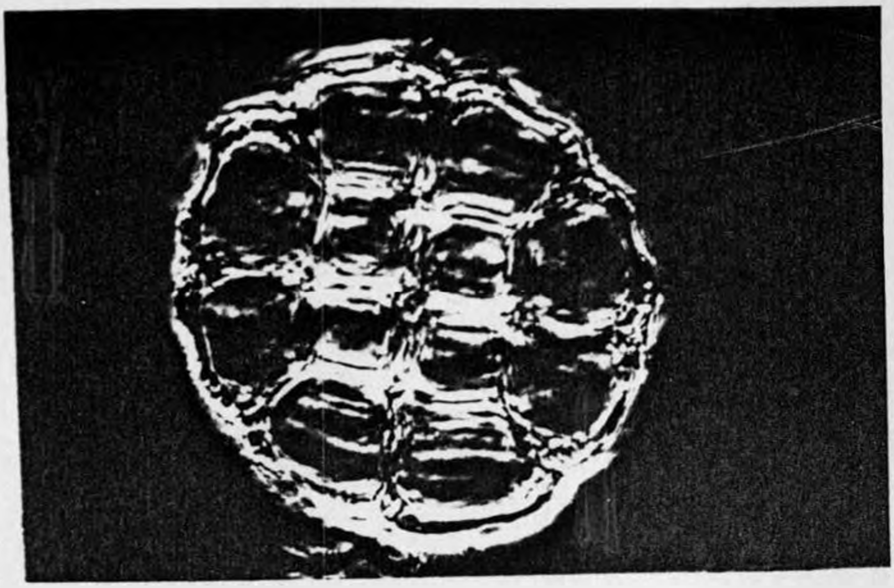

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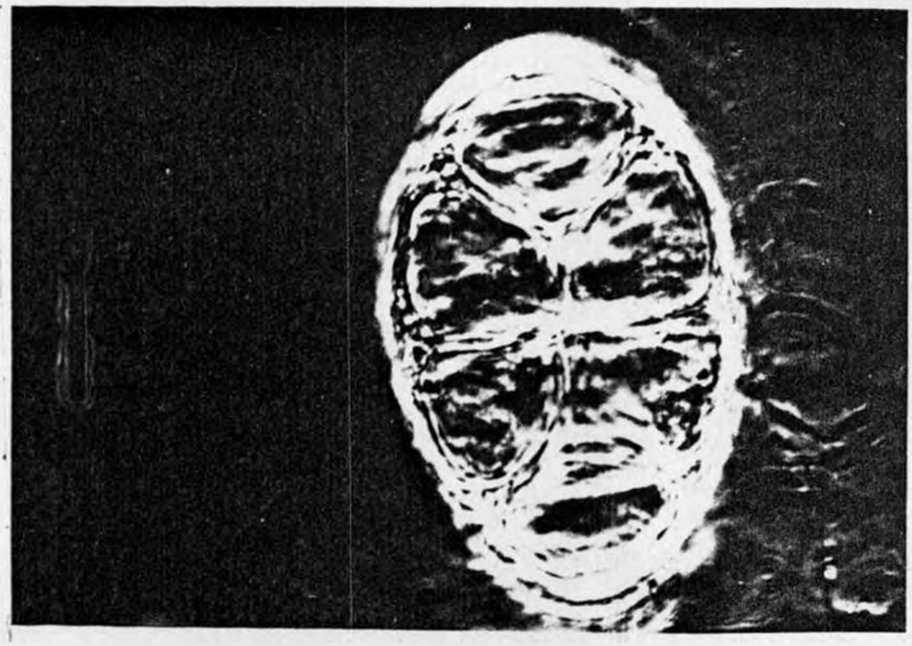

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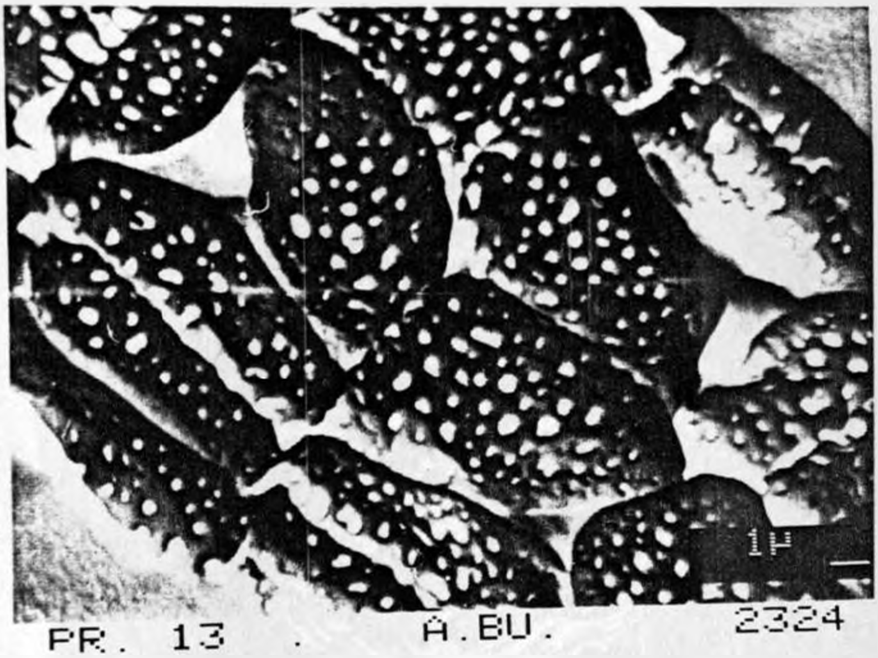
Plates 9 - 12 : Acacia bussei

9. SEM (x 40,000) showing densely perforated exine sculpturing.

10. Ph. (x 1000) showing Y- shaped furrows on central monads and H - shaped furrows on the peripheral monads.

11. Ph. (x 1000) shows columellate exine structure and size D= 68.48 μ.

12. Ph. (x 1000) size E = 35.28 μ.



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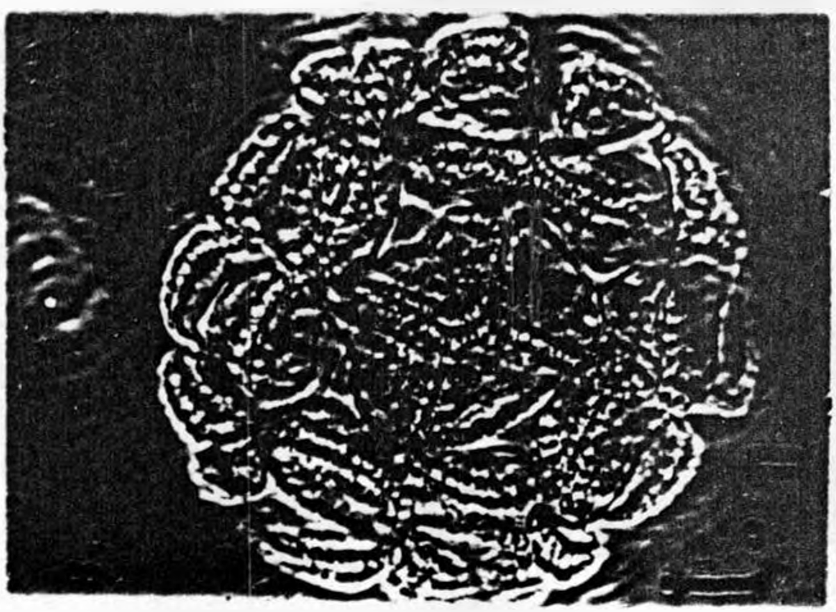

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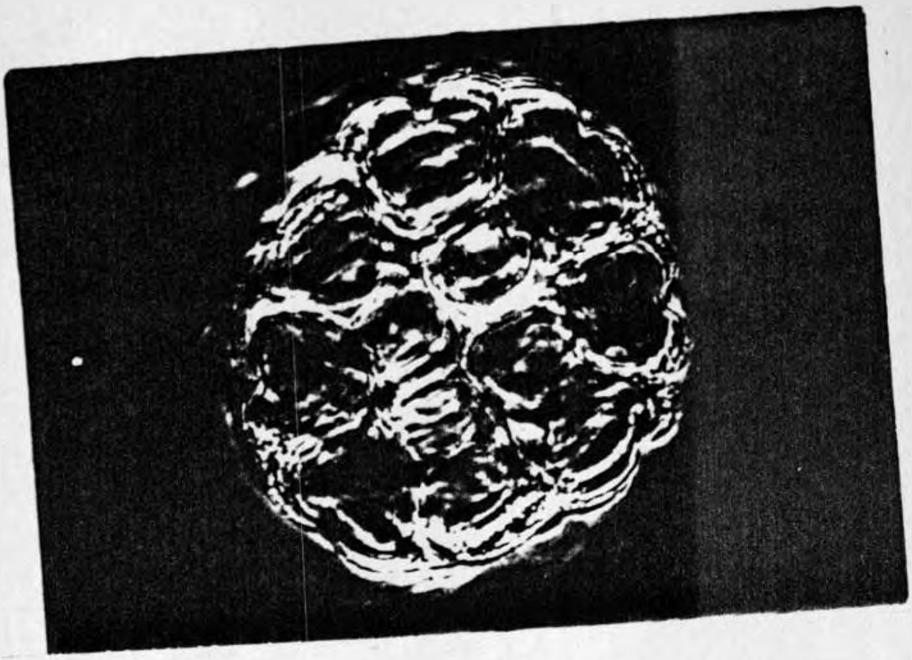

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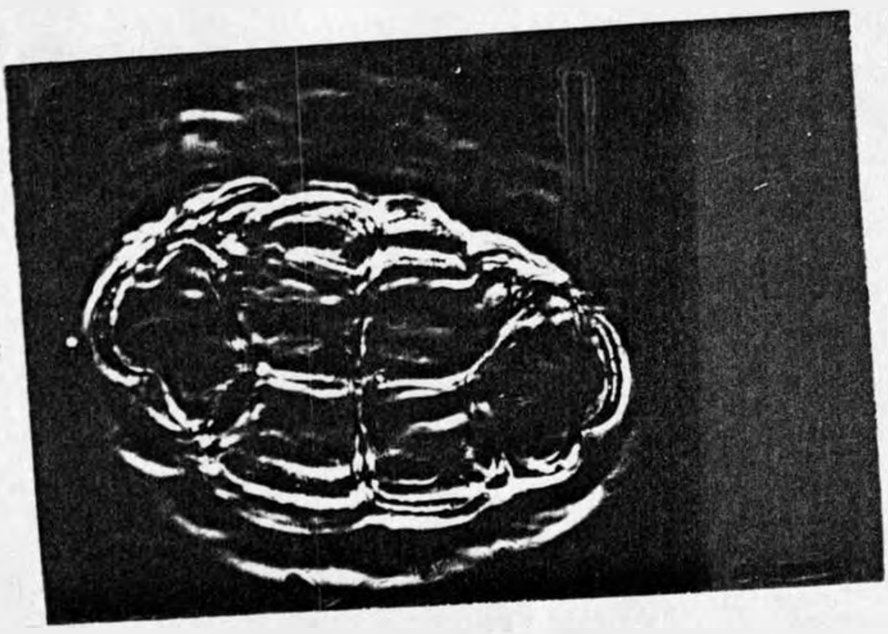

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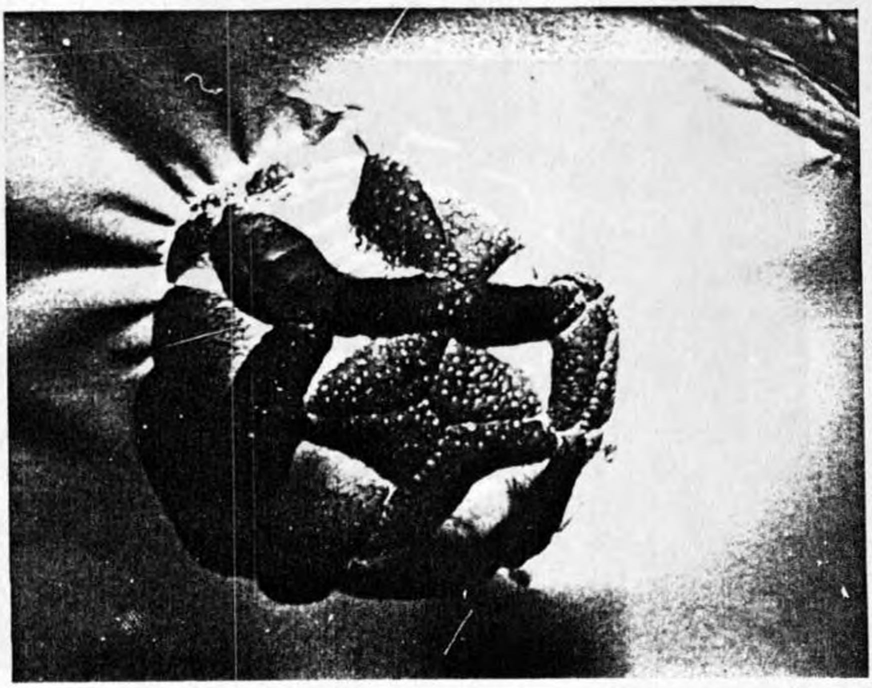
Plates 13 - 16 : <u>Acacia horrida</u>

13. SEM (x 10,000) ; showing perforated exine sculpturing.

14. Ph. (x 1000) shows Y -shaped furrows on the central cells.

15. Ph. (x 1000) shows columellate exine structure and size D = 50.46 μ

16. Ph. (x 1000) shows size E = 41.50 μ



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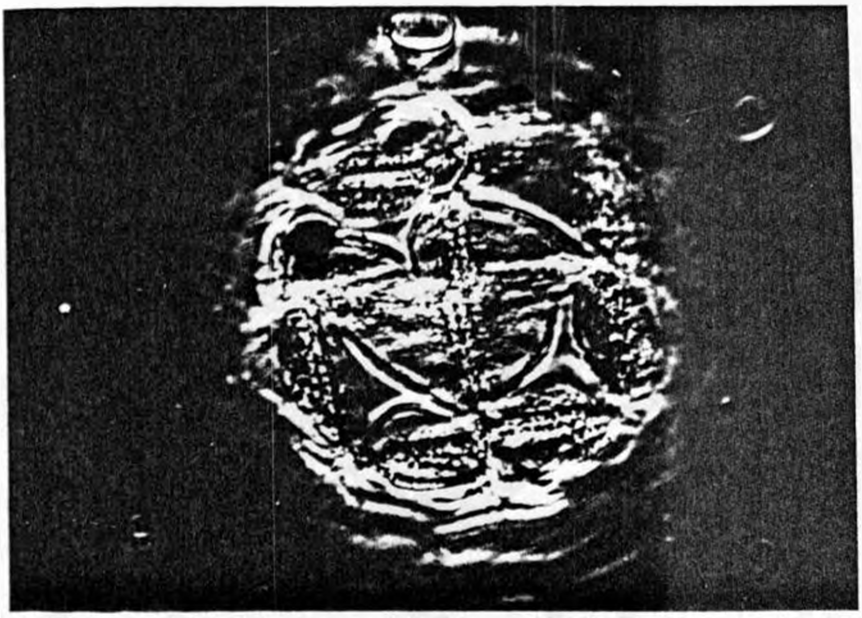

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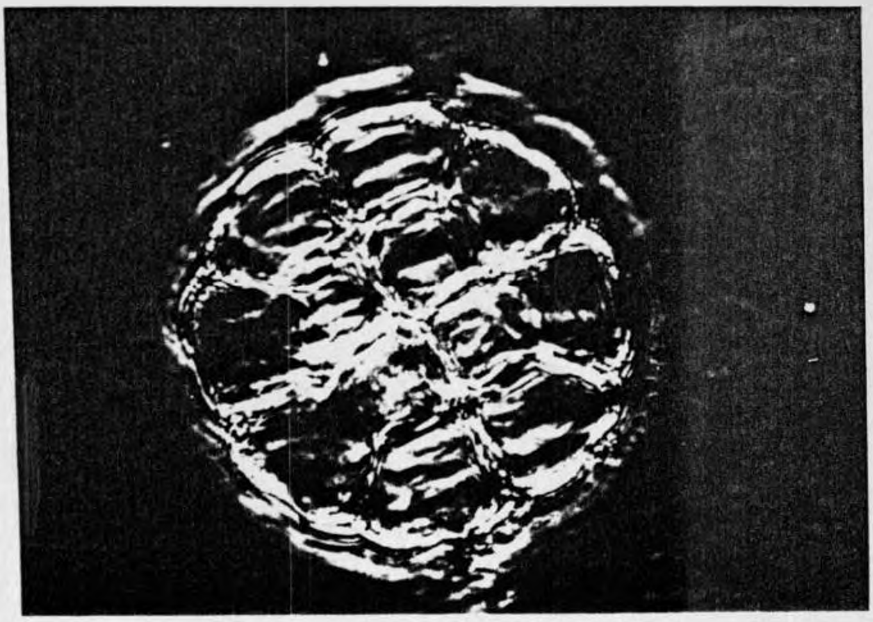

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Plates 17 - 20 <u>Acacia persiciflora</u>

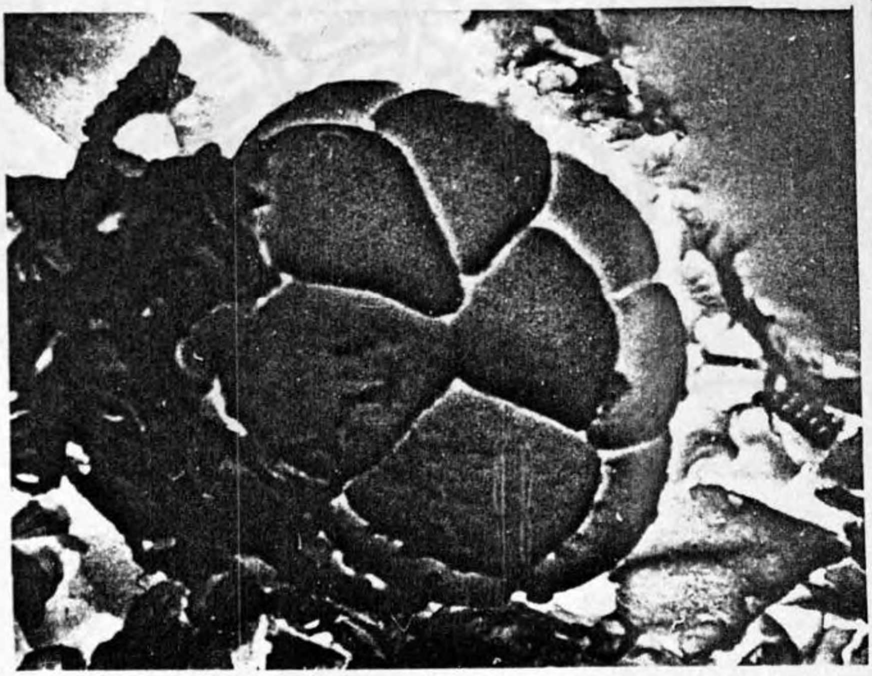
17. SEM (x 10,000); showing smooth, flat exine surface.

18. Ph. (x 1000); showing pore clusters

19. Ph. (x 1000); shows granulate exine structure and pore clusters.

Size D = 66.40 μ

20. Ph. (x 1000) ; size E = 41.50 μ



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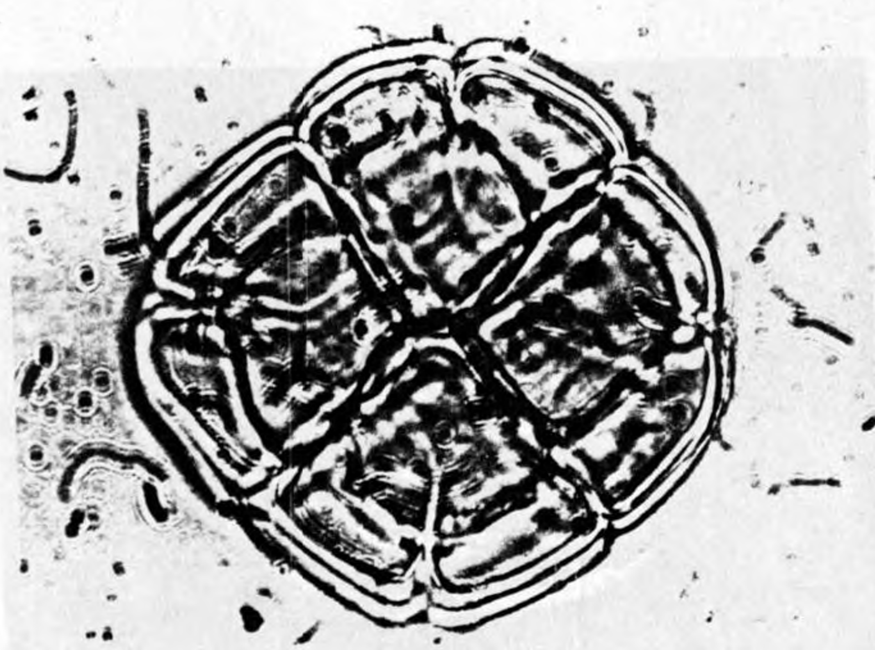

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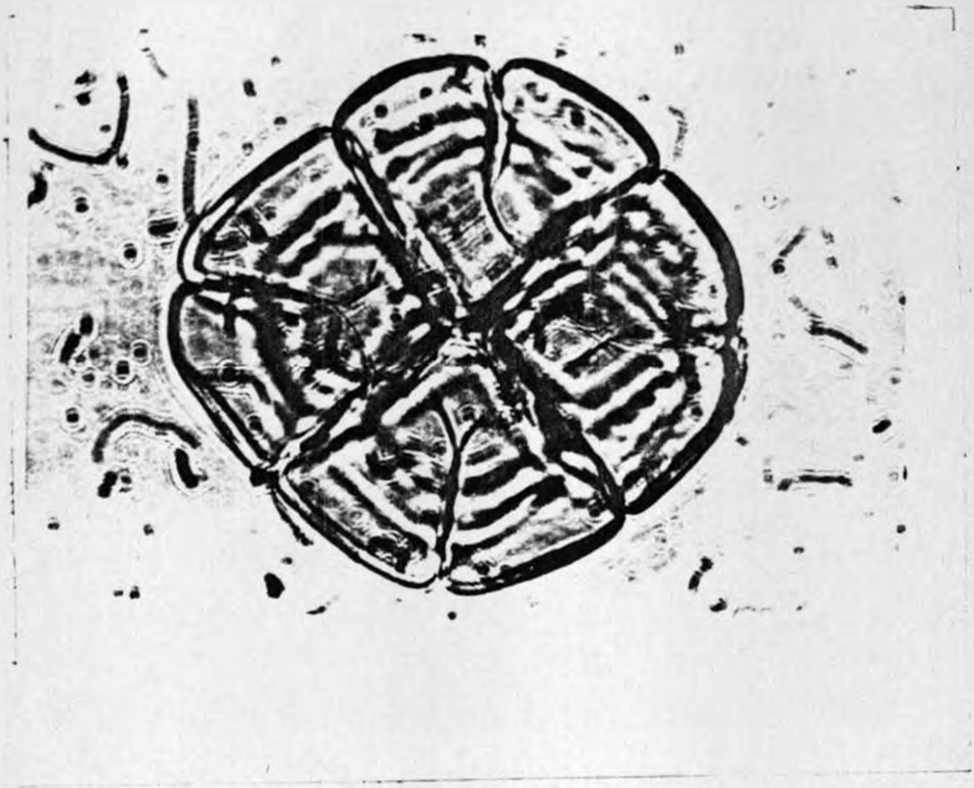

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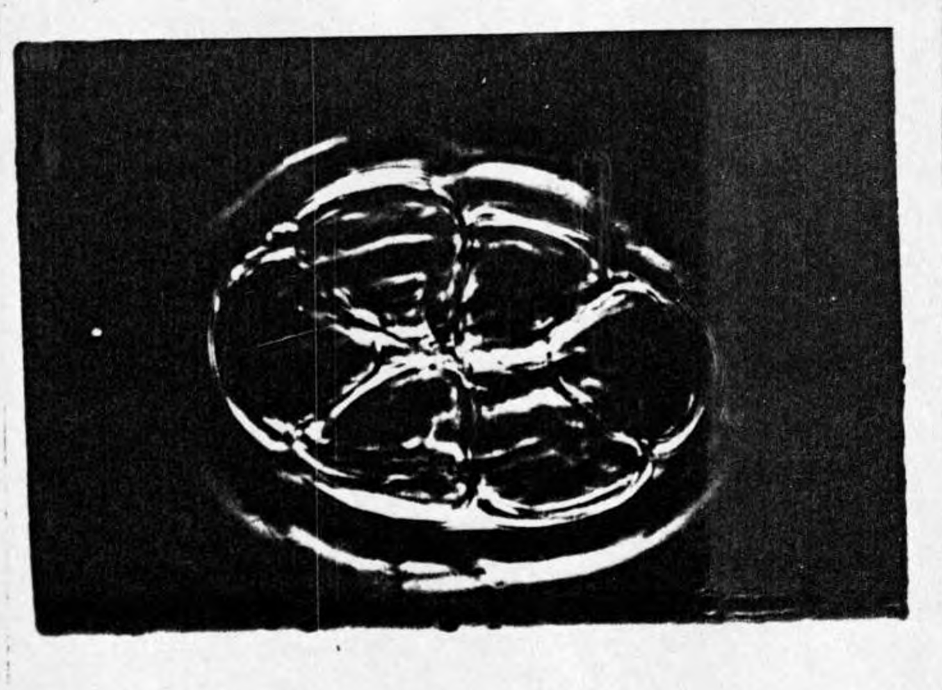

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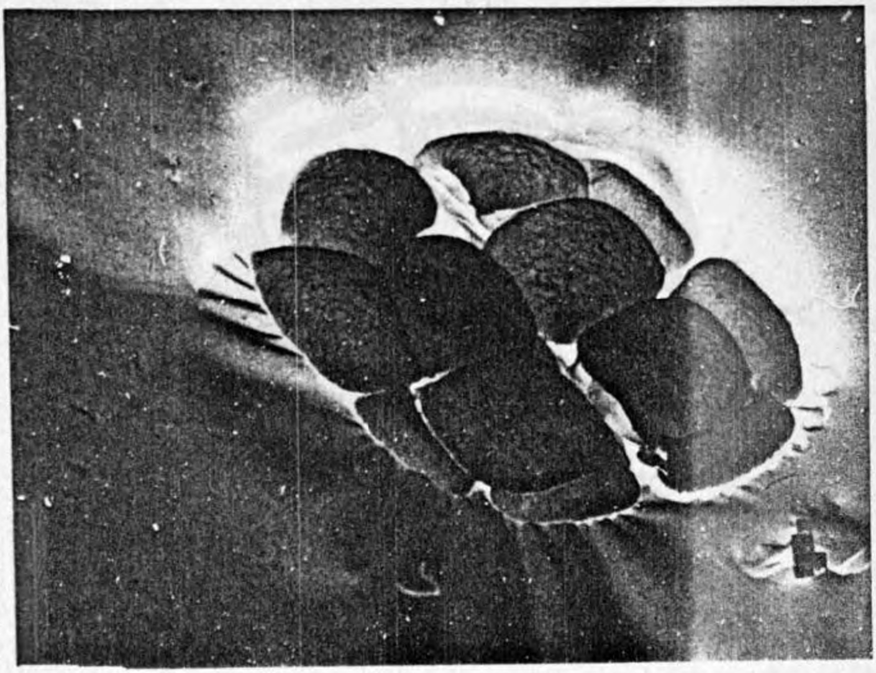
Plates 21 – 24 : Acacia polycantha

21. SEM (x 4000) shows smooth, flat exine surface.

22. Ph. (x 1000), pore clusters and granulate exine structure.

23. Ph. (x 1000) , pore clusters and size D = 53.95 μ

24. Ph. (x 1000) size E = 37.35 μ



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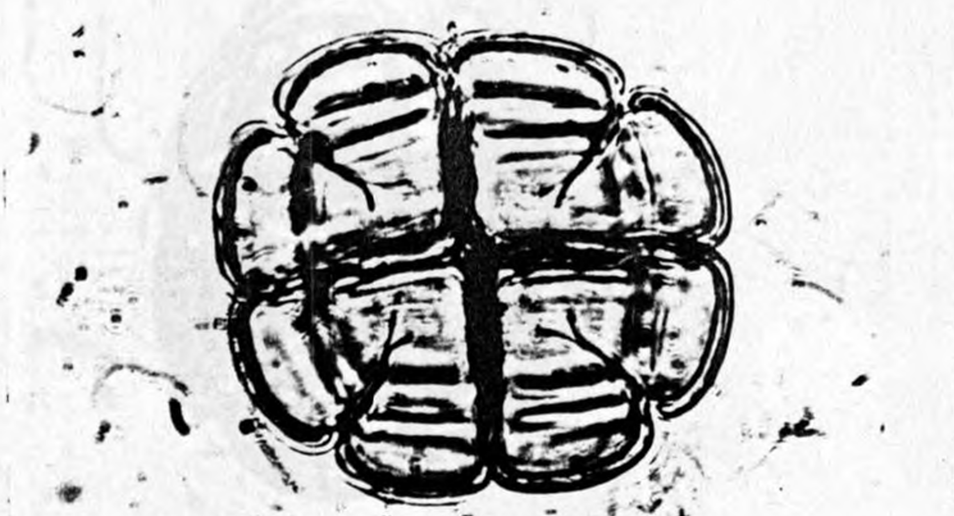

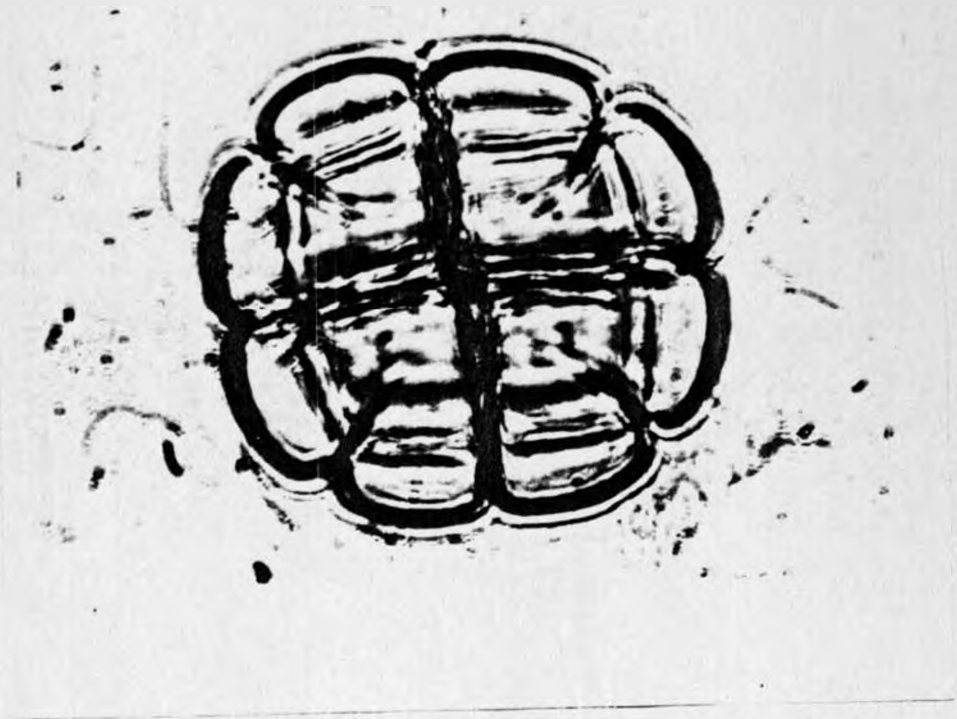

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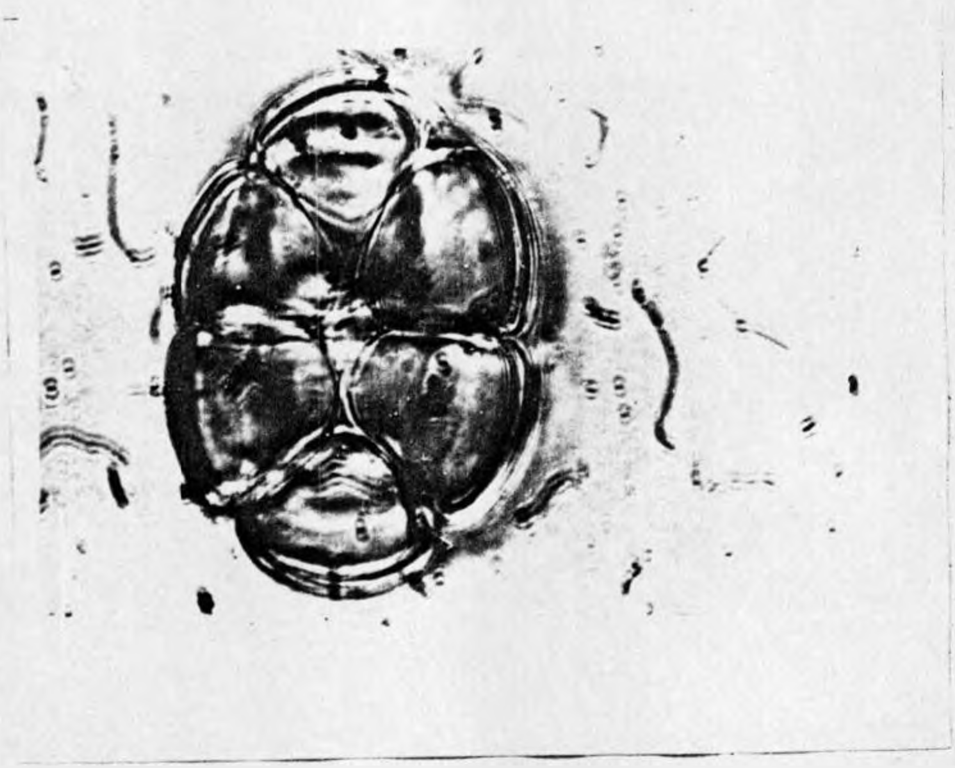


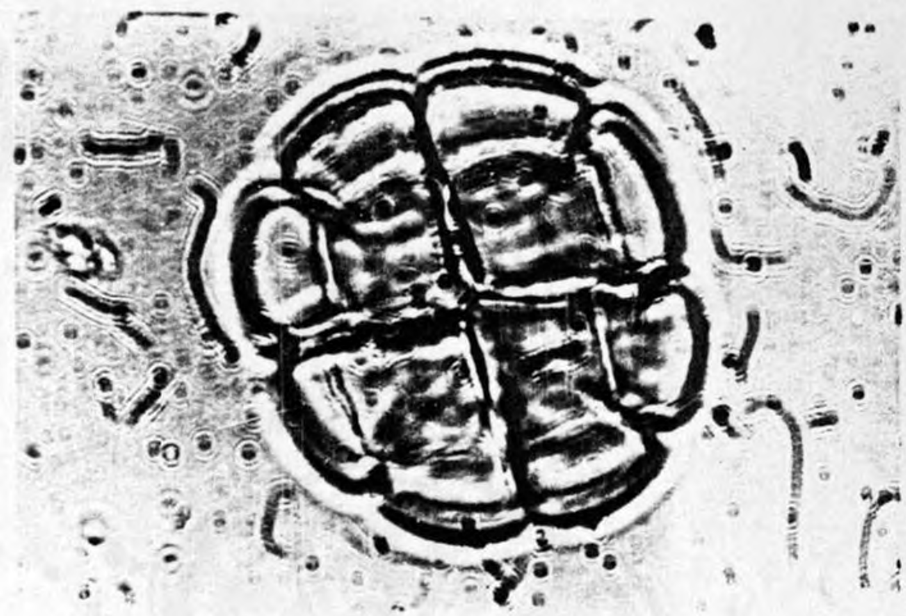
24

Plates 25 - 27 : Acacia ataxacantha.

25. Ph. (x 1000) pore clusters

26. Ph. (x 1000) granular exine structure and size D = 45.70 µ.

27. Ph. (x 1000) size E = 35.28 µ.



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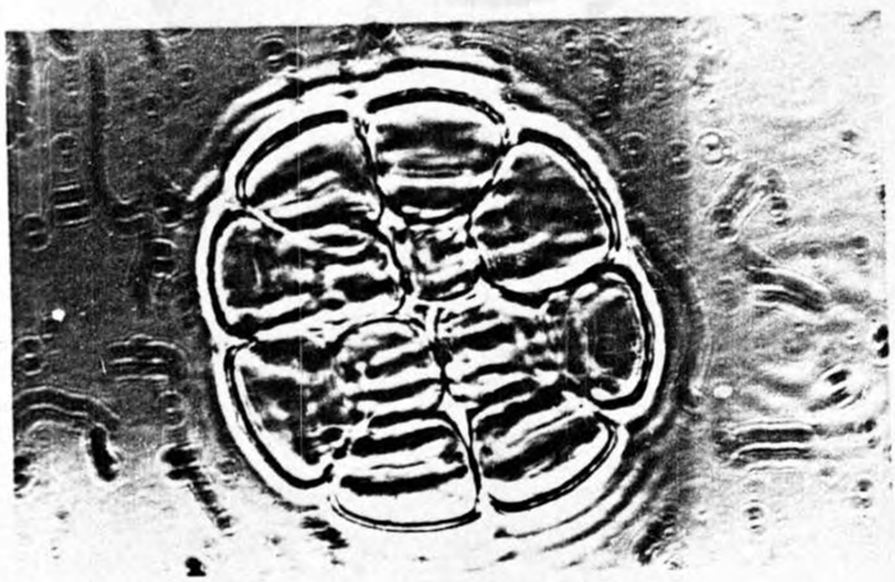

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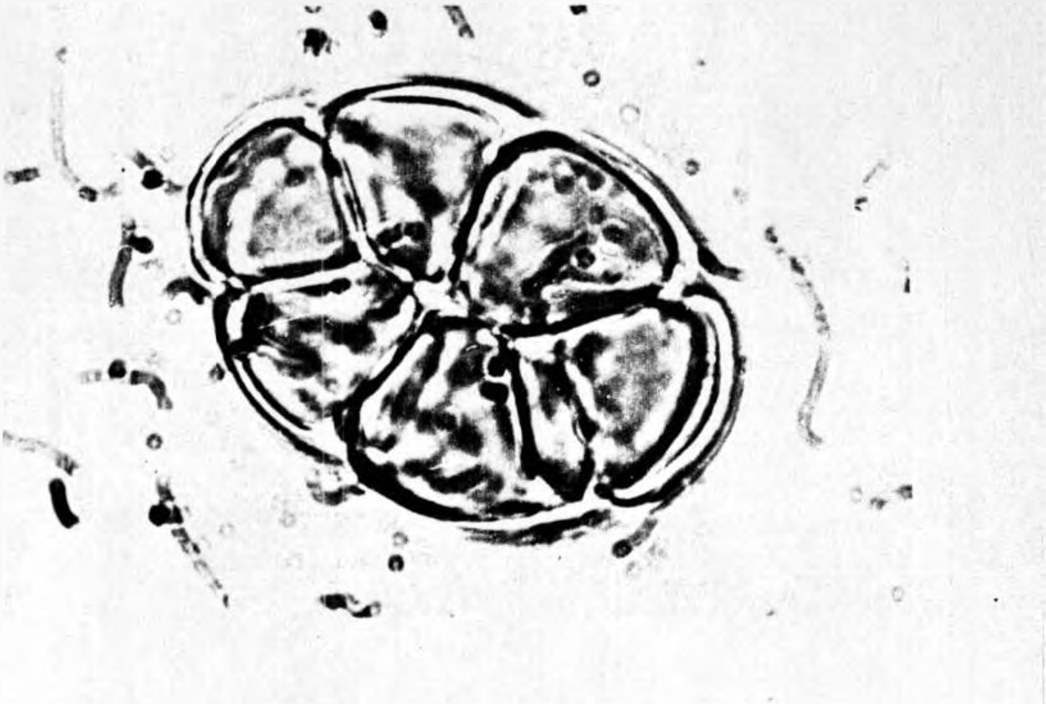

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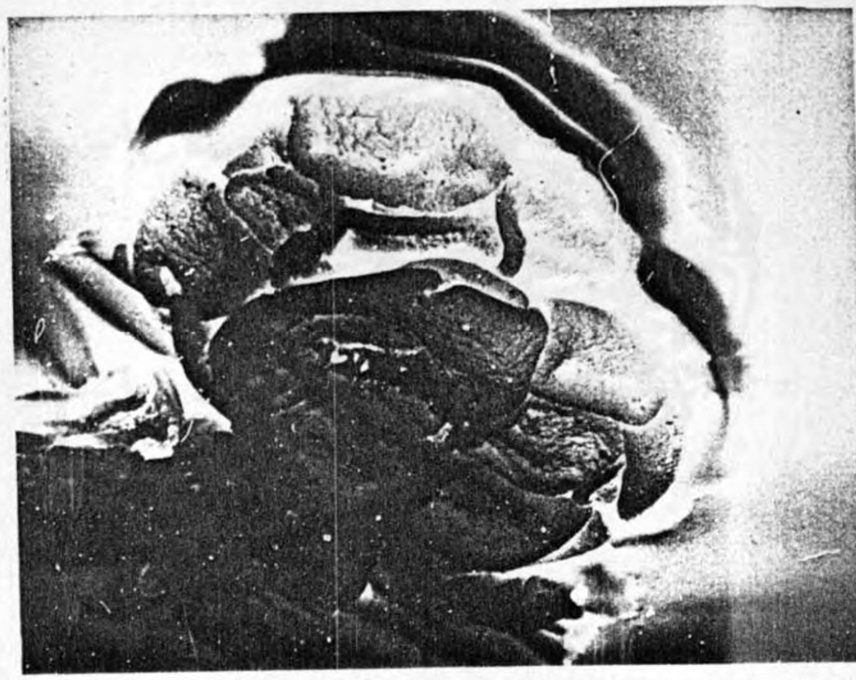
Plates 28 – 31 : Acacia laeta

28. SEM (x 10,000); flat, smooth exine surface

29. Ph. (x 1000); pore clusters and granulate exine structure.

30. Ph. (x 1000) ; pore clusters and size D = 48.00 μ

31. Ph. (x 1000) size E = 41.50 μ



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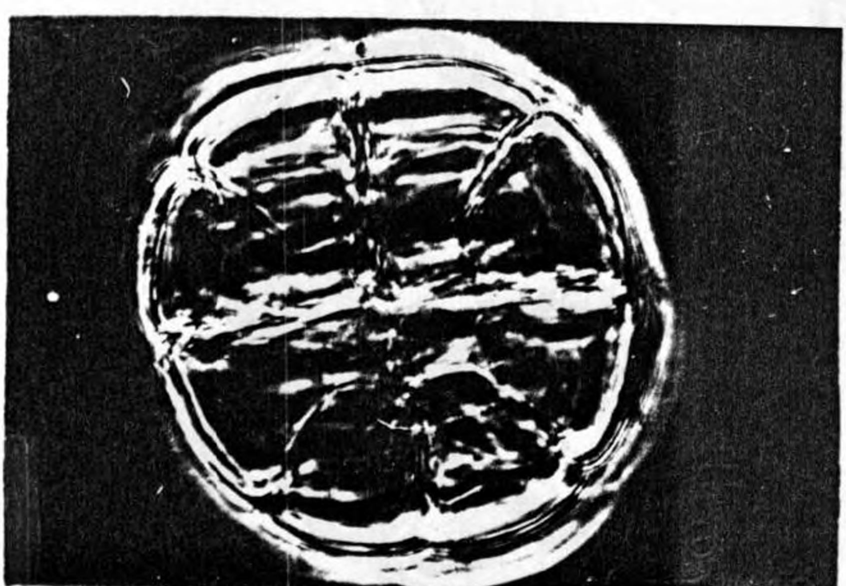

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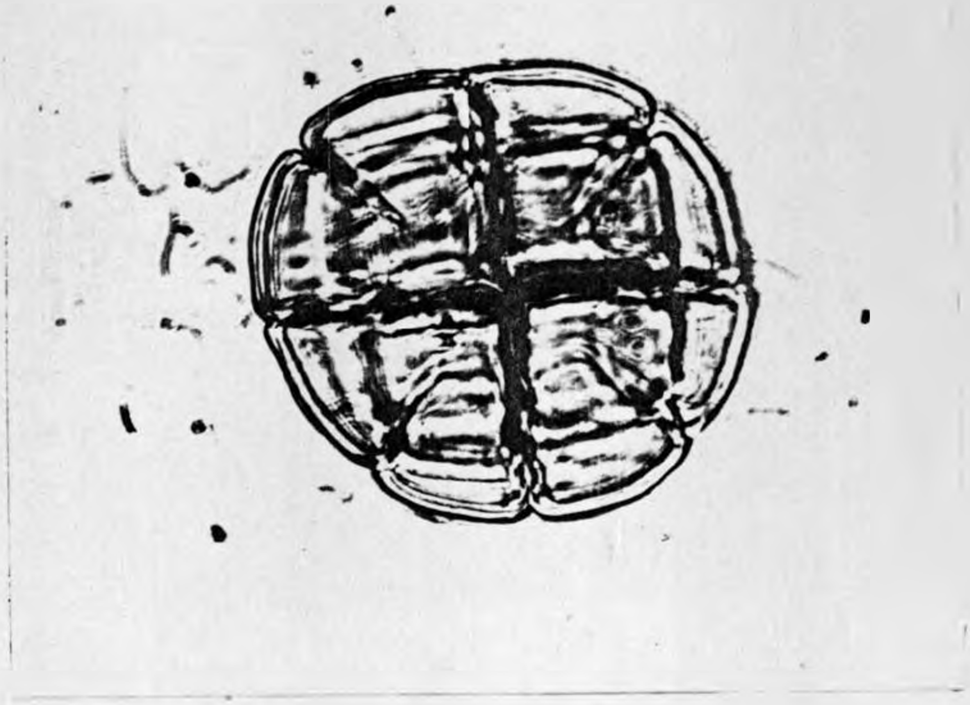

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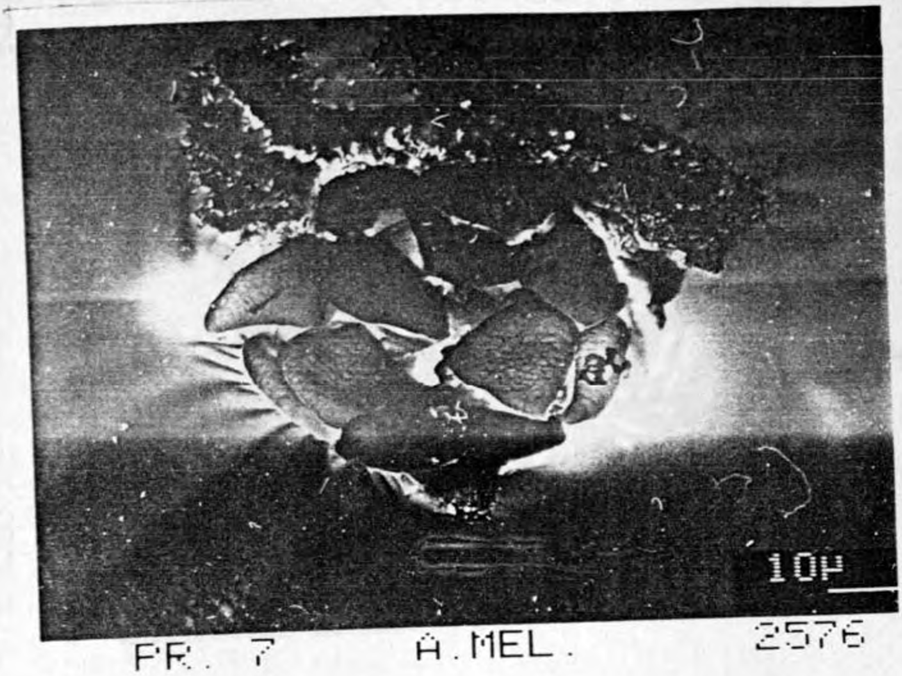
Plates 32 – 35 : Acacia mellifera

32. SEM (x 4000) ; Surface ornamentation ; flat and smooth.

33. Ph. (x 1000); Pore clusters and size D = 53.95 μ, granulate exine structure.

34. Ph. (x 1000) ; Pore clusters

35. Ph. (x 1000); size E = 41.50 μ.



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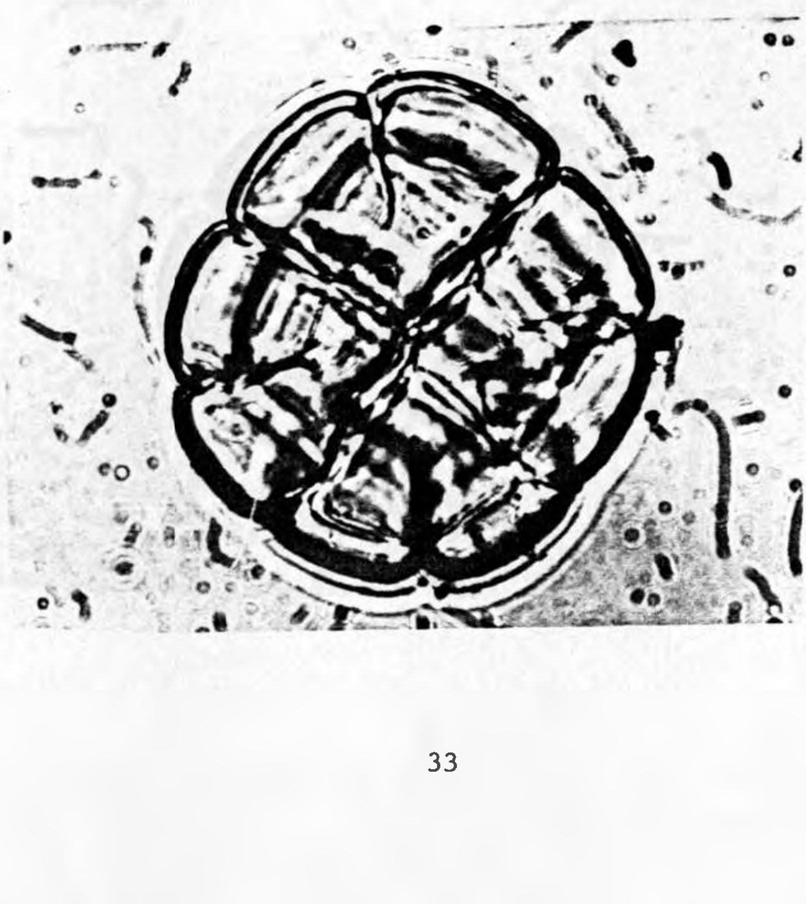

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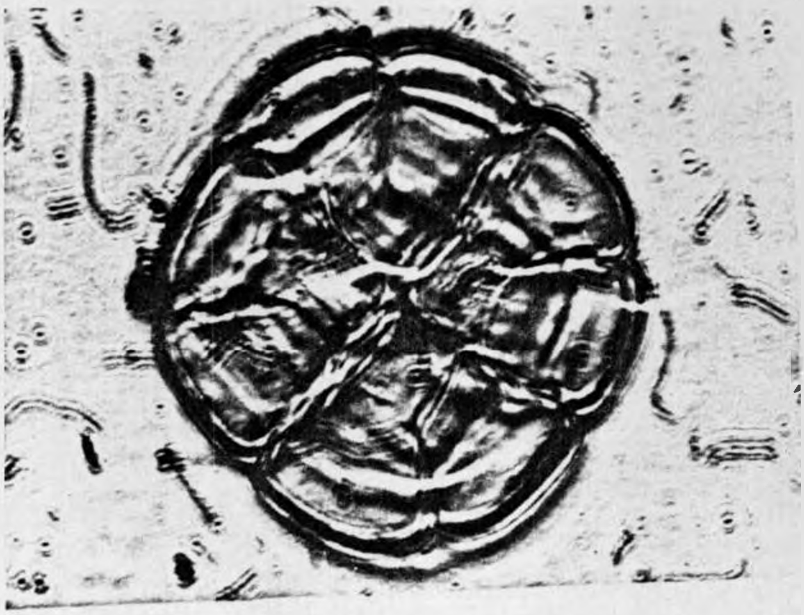

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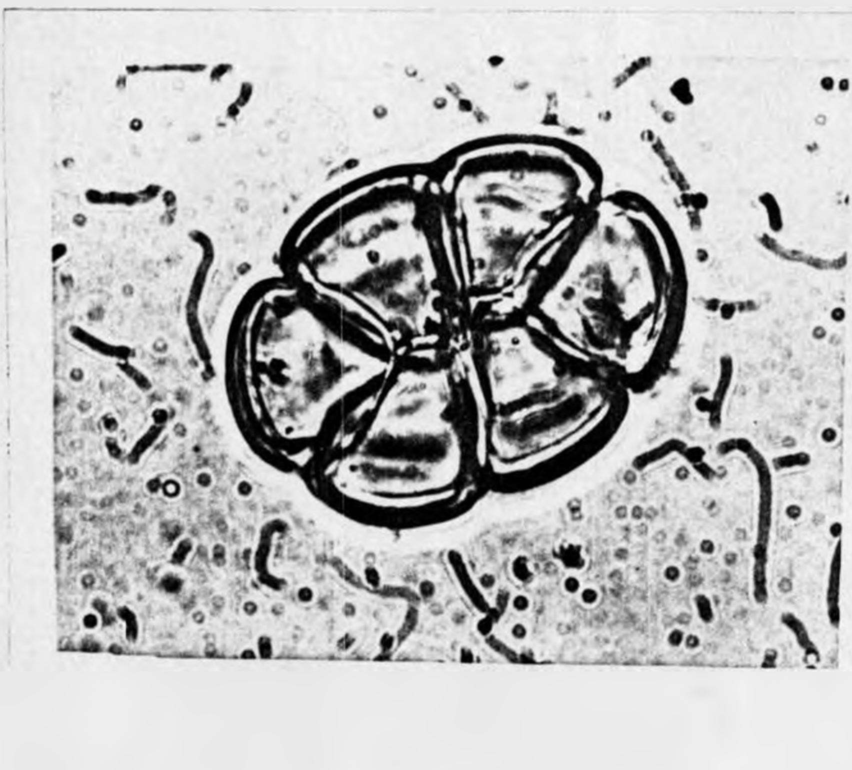

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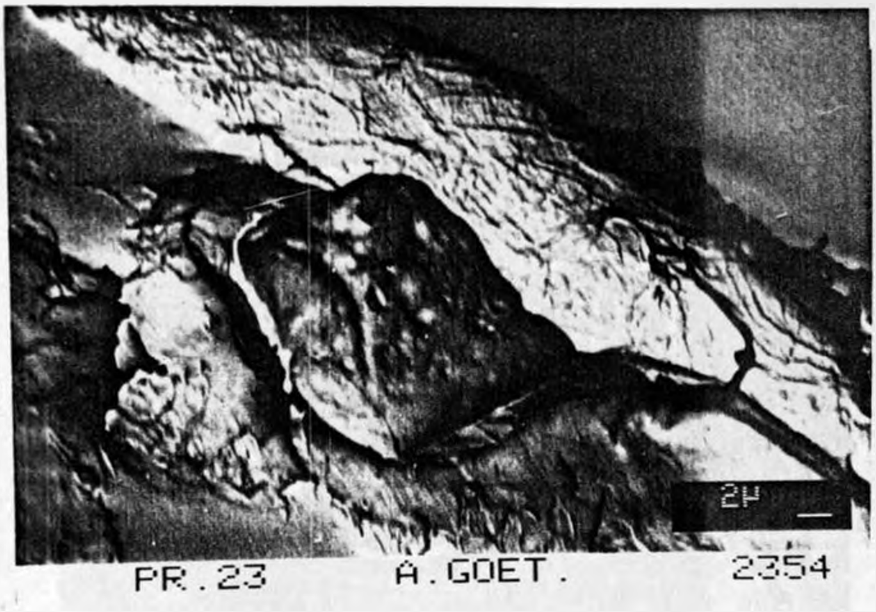
Plates 36 - 39 : Acacia goetzei.

36. SEM (x 20,000) ; smooth flat exine surface, as shown in the centre of the micrograph.

37. Ph. (x 1000) ; Pore clusters and size D = 68.40 μ

38. Ph. (x 1000); Pore clusters, granular exine structure

39. Ph. (x 1000) ; size E = 37.60 μ.



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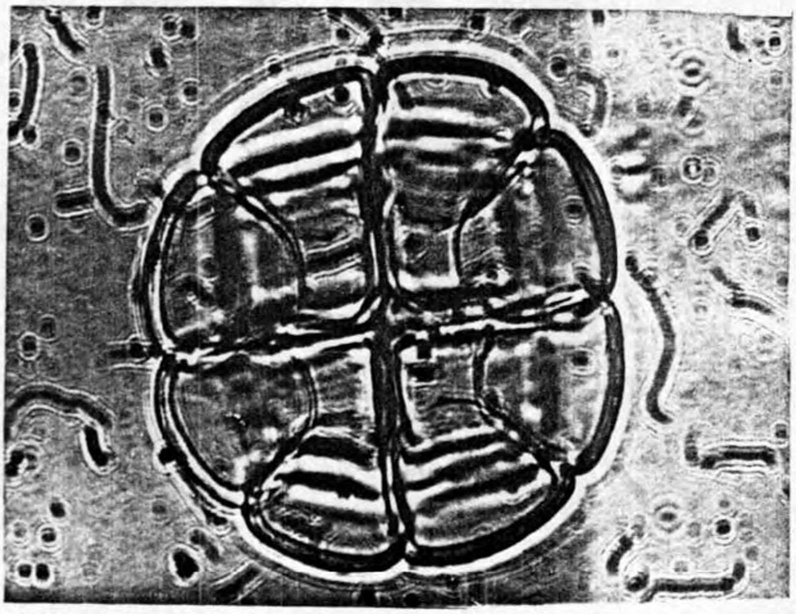

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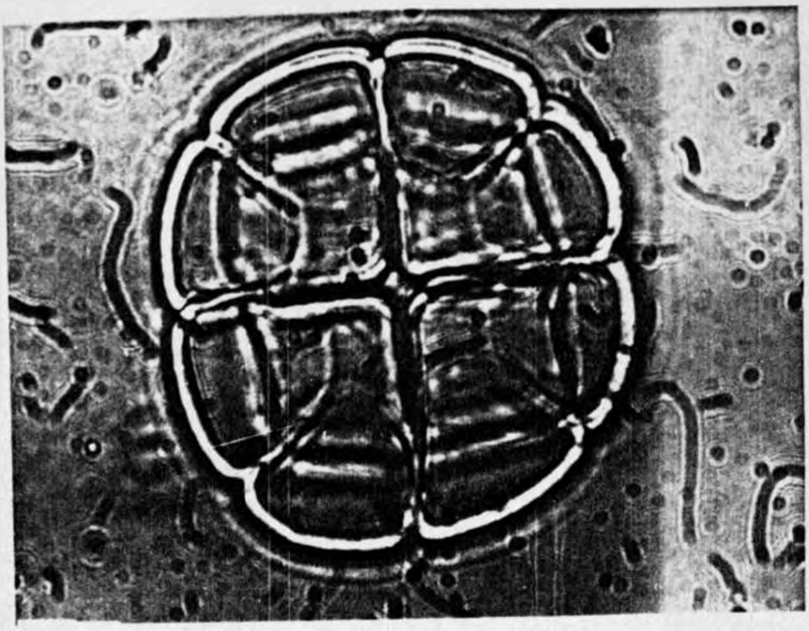

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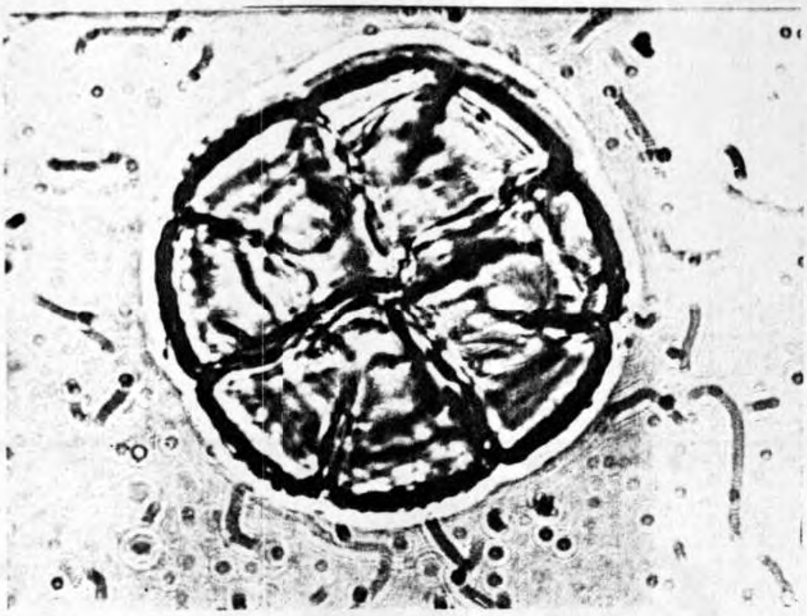
Plates 40 – 42 : *Acacia senegal.*

40. Ph. (x 1000); pore clusters and size D = 62.25 μ.

41. Ph. (x 1000); Pore clusters and granular structure.

42. Ph. (x 1000); size E = 41.50 μ.



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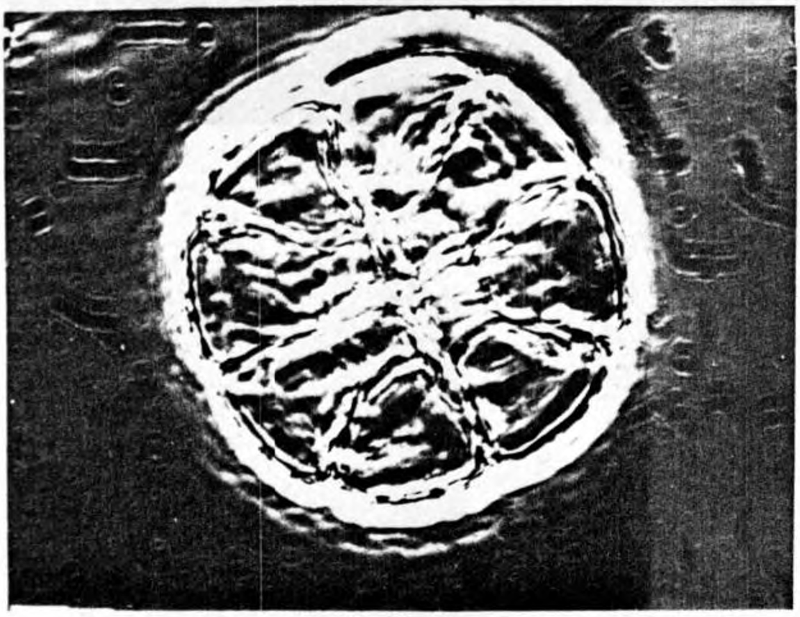

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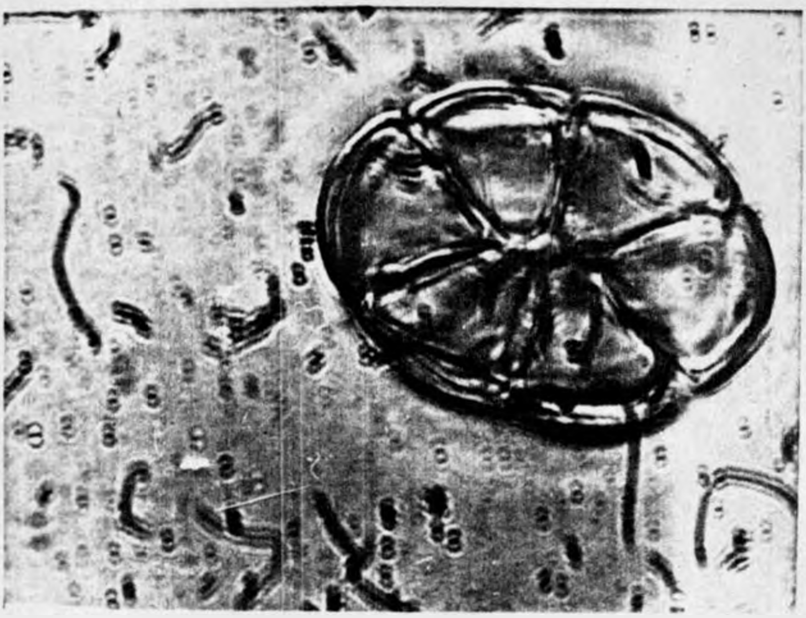


42

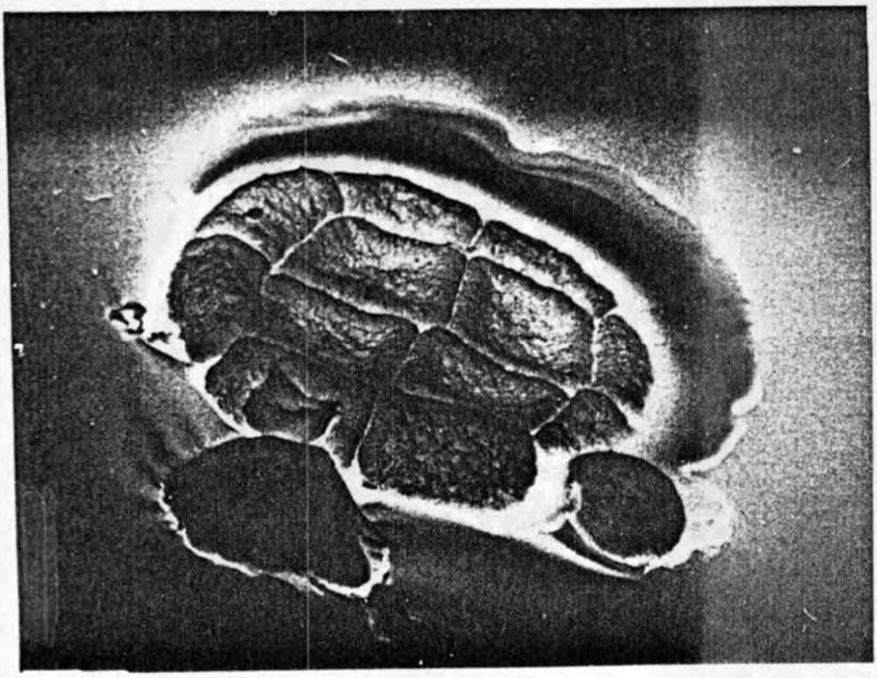
Plates 43 – 46 <u>*Acacia circummarginata.*</u>

43. SEM (x 10,000); flat unperforated surface of the exine.

44. Ph. (x 1000); Pore clusters and size D = 58.10 μ

45. Ph. (x 1000); Pore clusters and granular exine structure

46. Br. (x 1000); size E = 41.09 μ.



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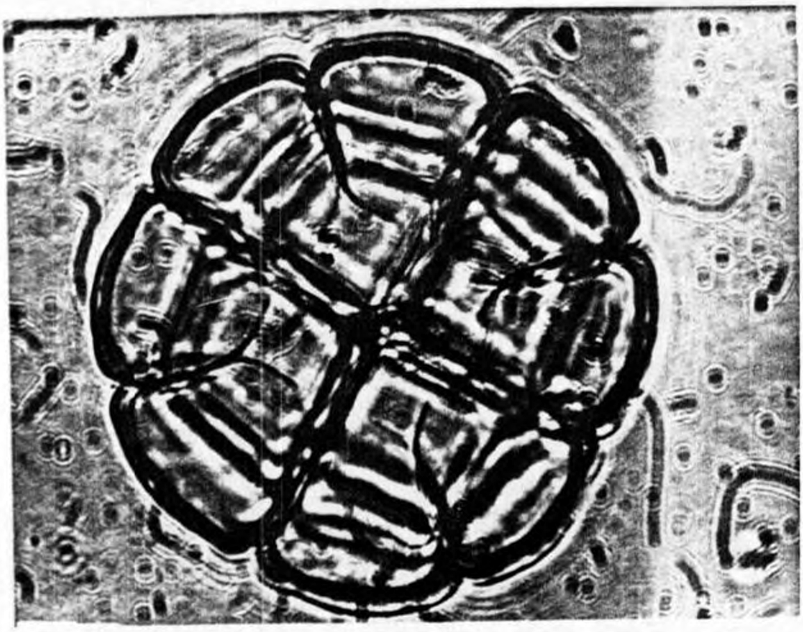

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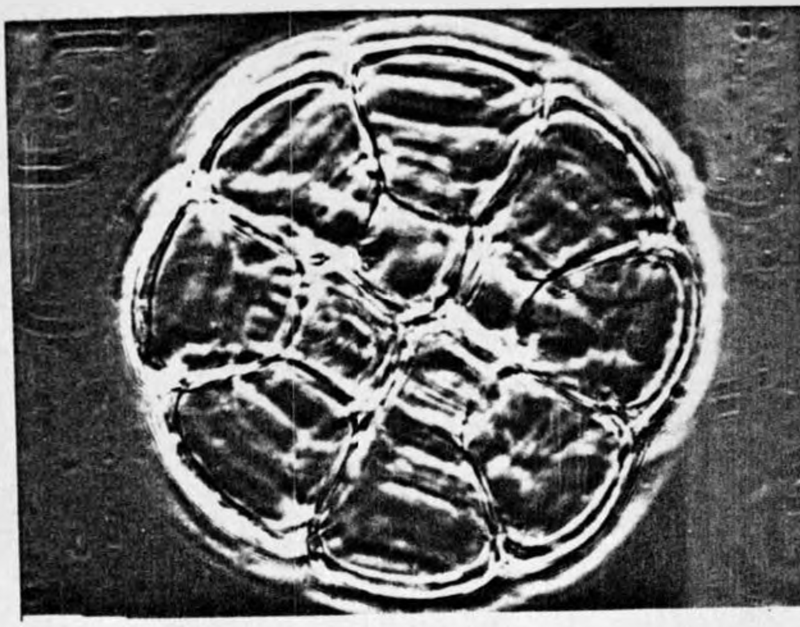

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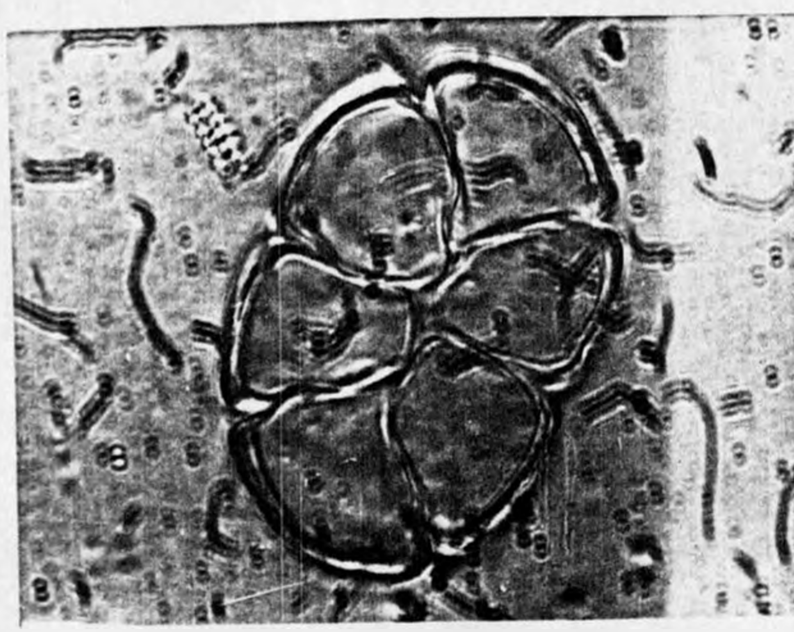


46

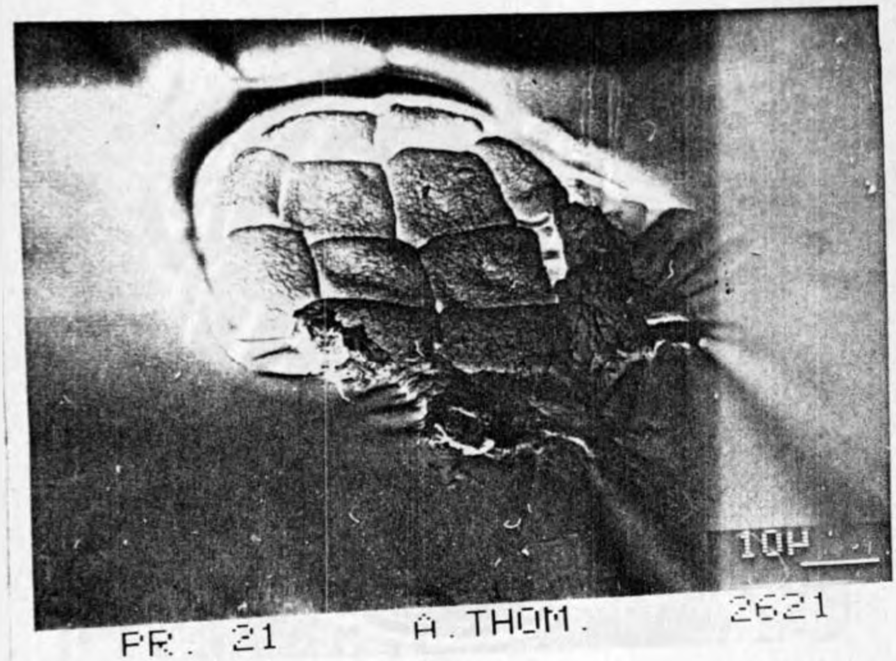
Plates 47 - 50 : Acacia thomasii

47. SEM (x 4000); flat unperforated exine surface.

48. Ph. (x 1000); pore clusters

49. Ph. (x 1000) granular exine structure and size D = 75.12 μ.

50. Br. (x 1000); size E = 47.52 μ



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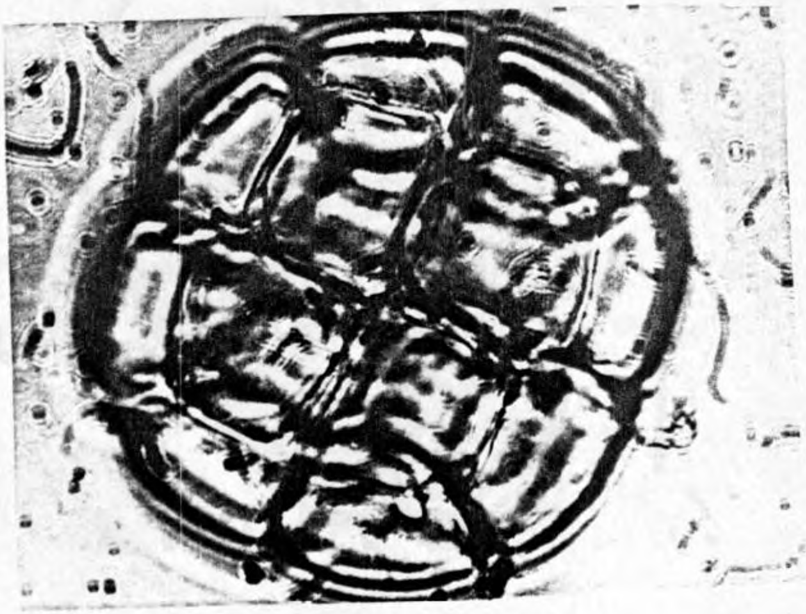

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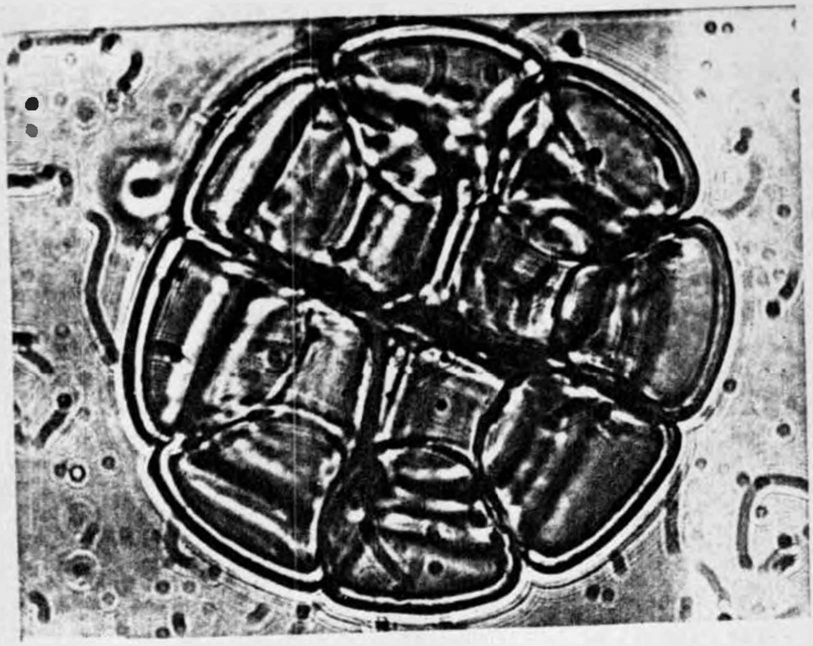

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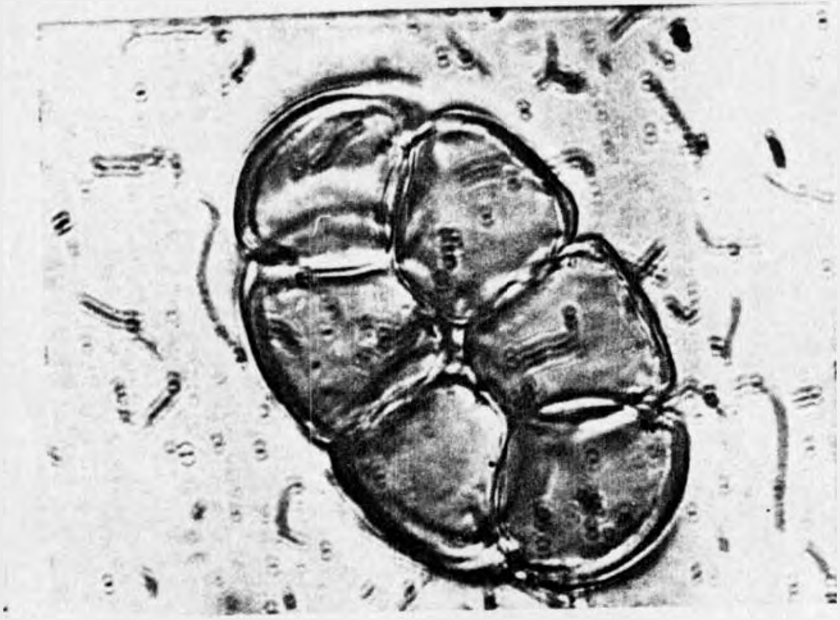


50

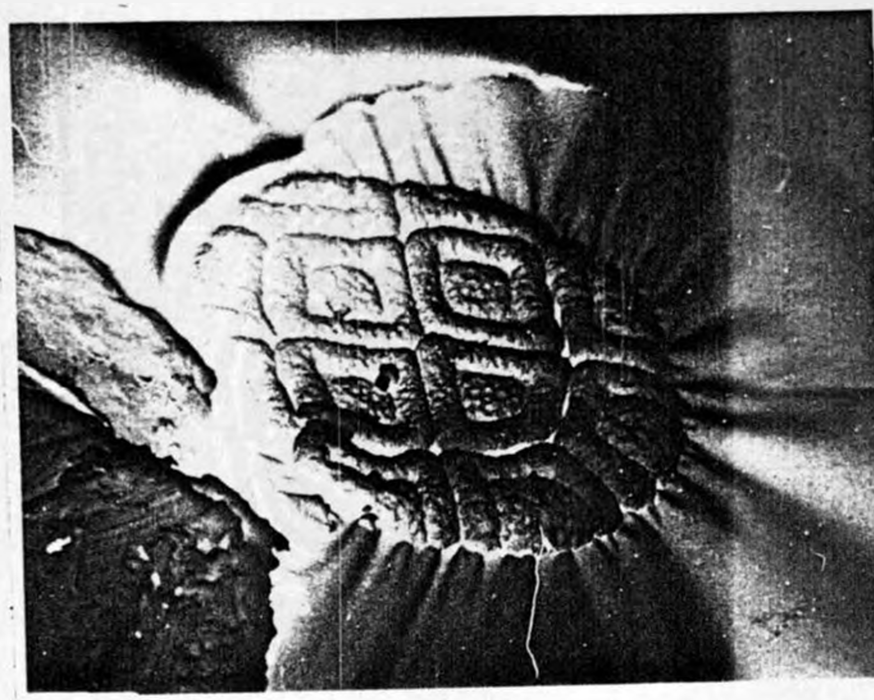
Plates 51 – 54 : Acacia mearnsii.

51. SEM (X 10,000); flat, perforated exine ornamentation

52. Ph. (x 1000); Pore clusters.

53. Ph. (x 1000) ; granular exine structure and size D = 49.80 μ

54. Br. (x 1000); size E = 29.58 μ



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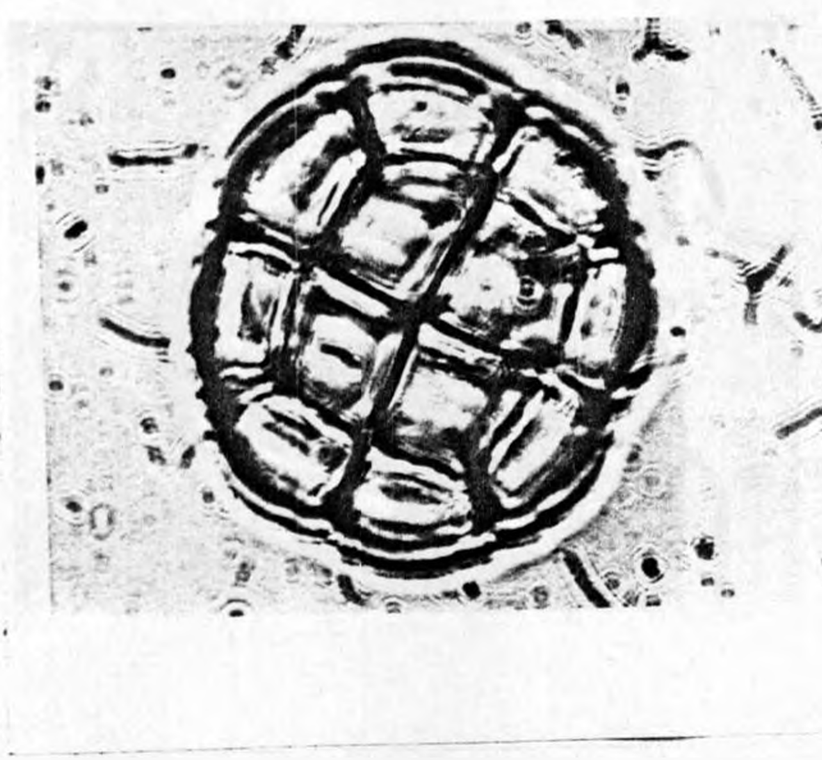

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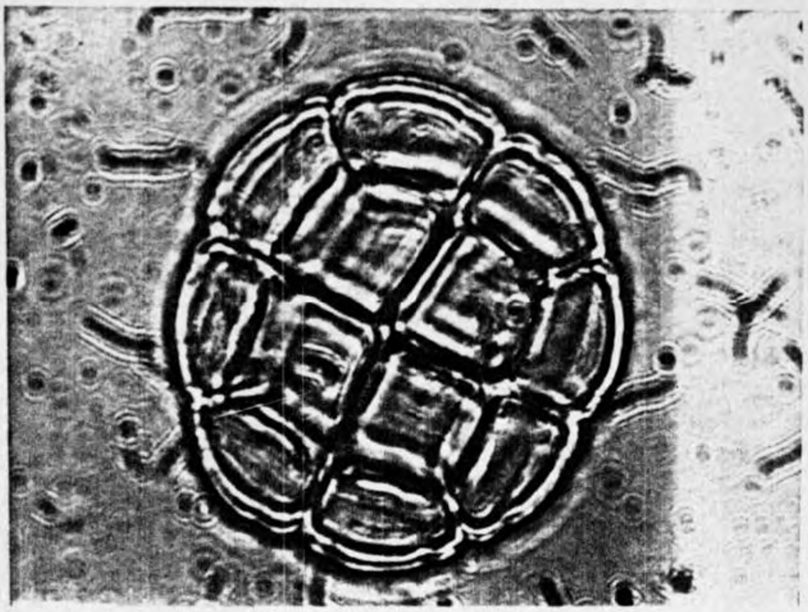

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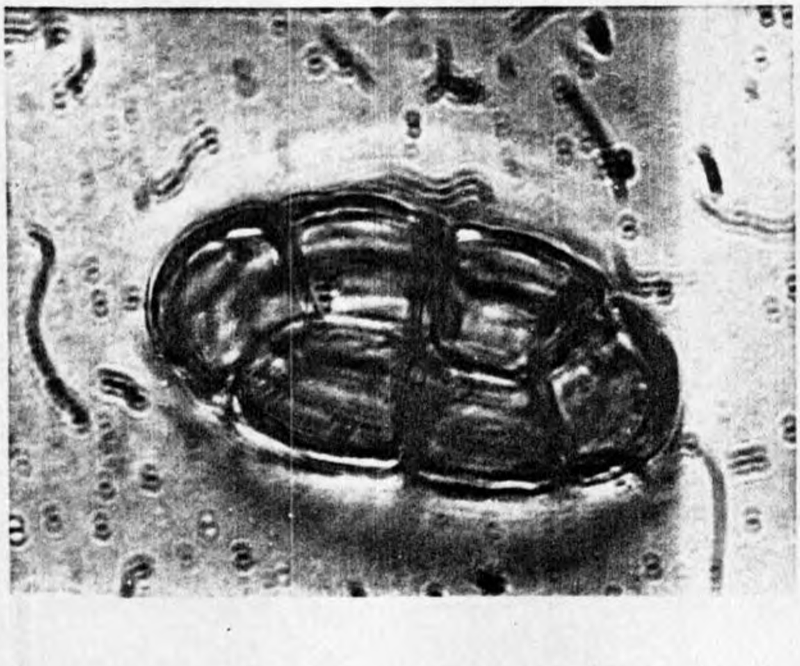


54

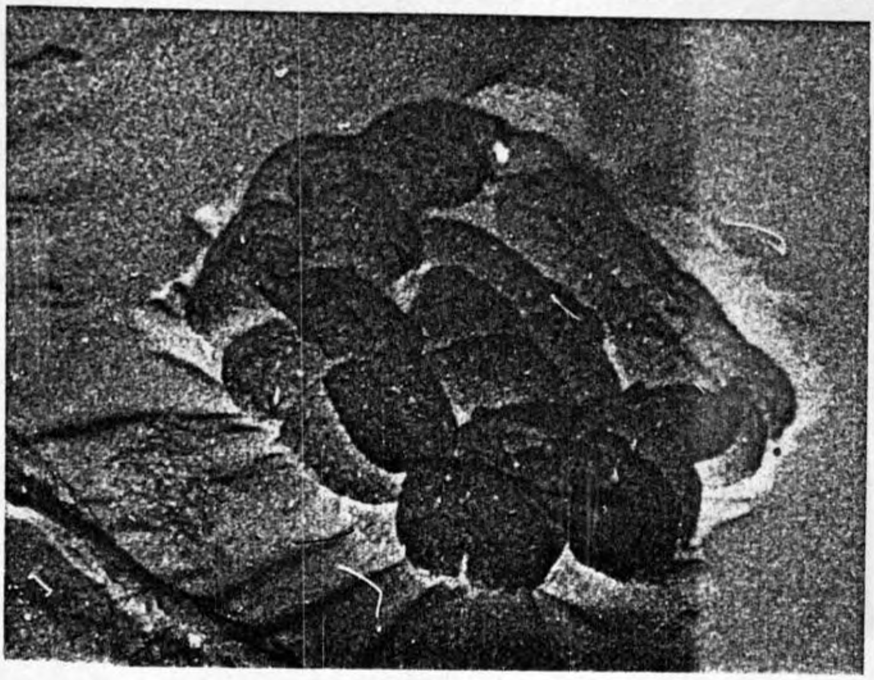
Plates 55 - 58: *Acacia macrothyrsa*

55. SEM (x 20,000); flat, perforated exine surface

56. Ph. (x 1000); Y-shaped furrows on the central monads and H-shaped furrows on the peripheral monads.

57. Ph. (x 1000); Exine structure (Columellate) and size D = 60.79 μ.

58. Ph. (x 1000); size E = 41.98 μ



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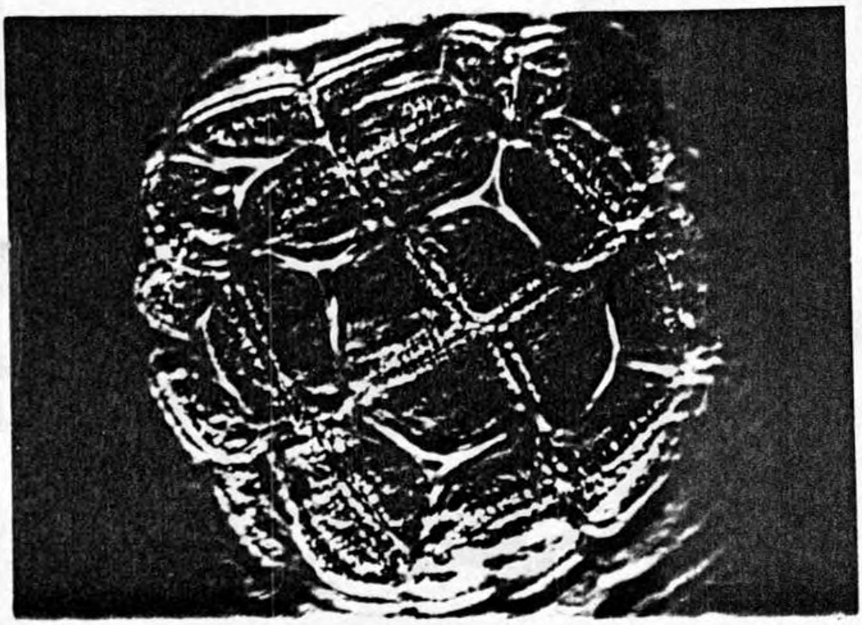

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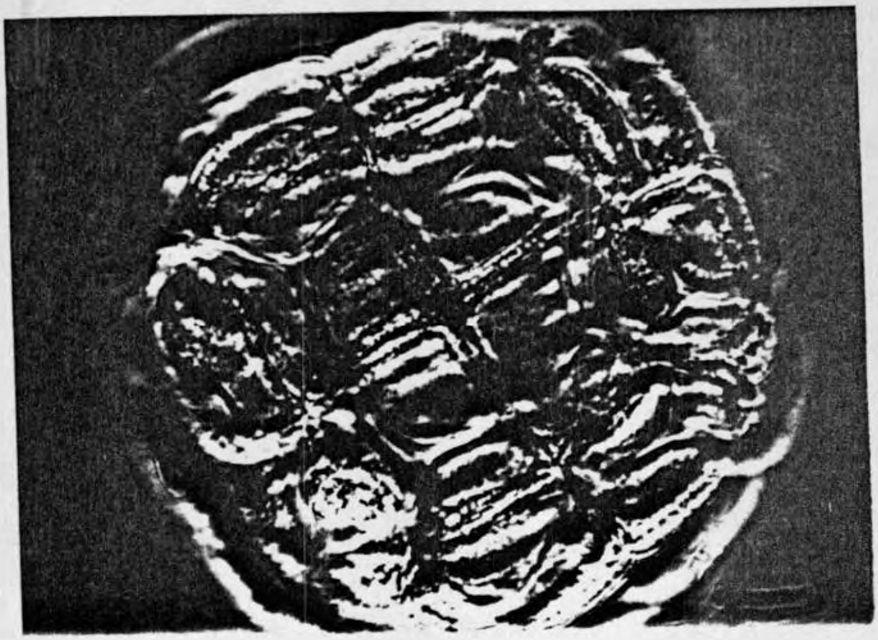


57

58

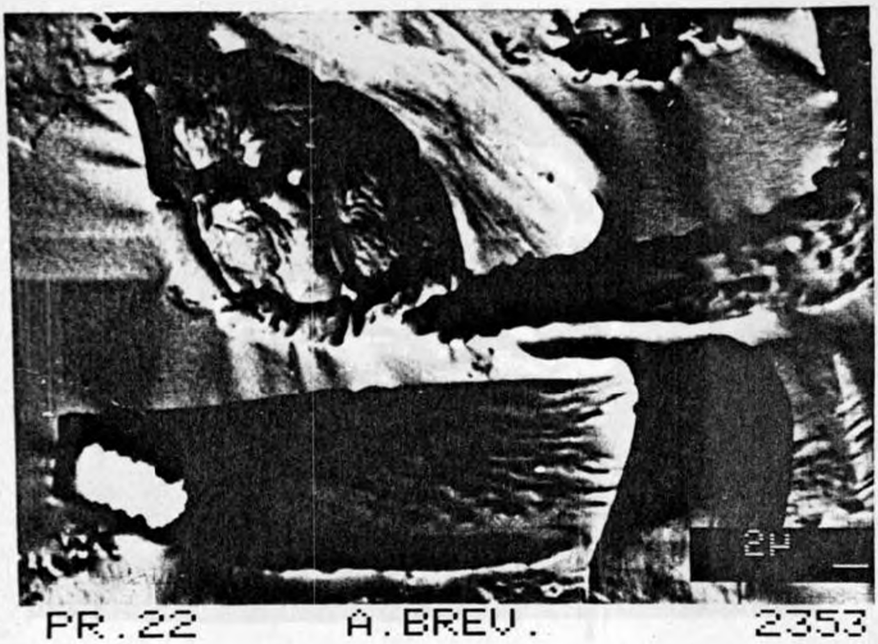
Plates 59 - 62 : Acacia brevispica

59. SEM (x 20,000); flat smooth surface as shown on the upper left part of the micrograph.

60. Ph. (x 1000); pore clusters.

61. Ph. (x 1000); granular exine structure and size D = 41.58 μ

62. Br. (x 1000) size E = 33.20 μ



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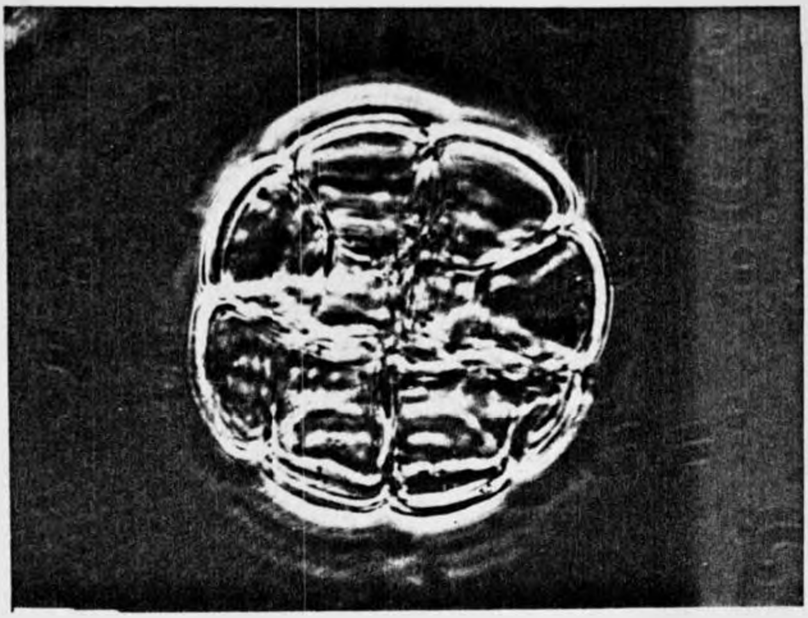
60



61

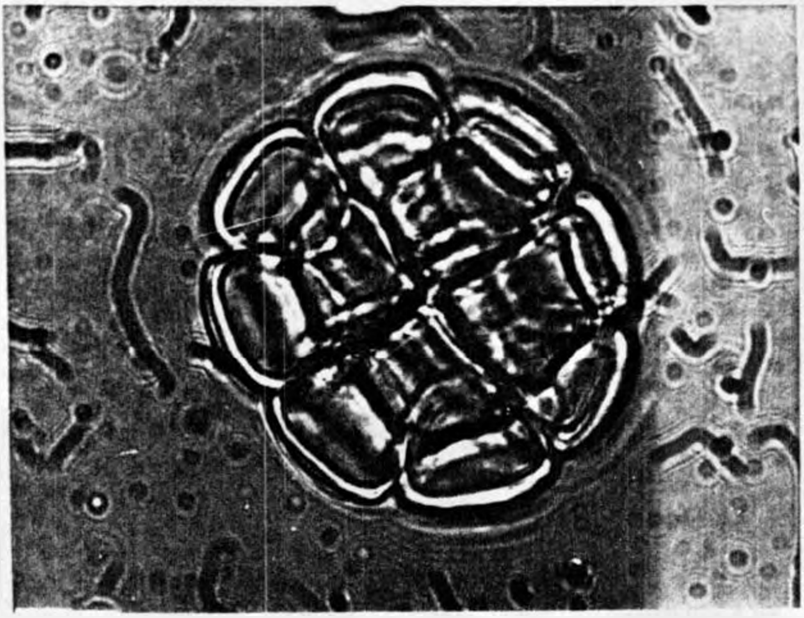
62

Plates 63 - 65 : <u>*Acacia adenocalyx*</u>

63. Ph. (x 1000) pore clusters

64. Ph. (x 1000) granular exine structure and size D = 49.80 μ

65. Br. (x 1000) size E = 29.55 μ.



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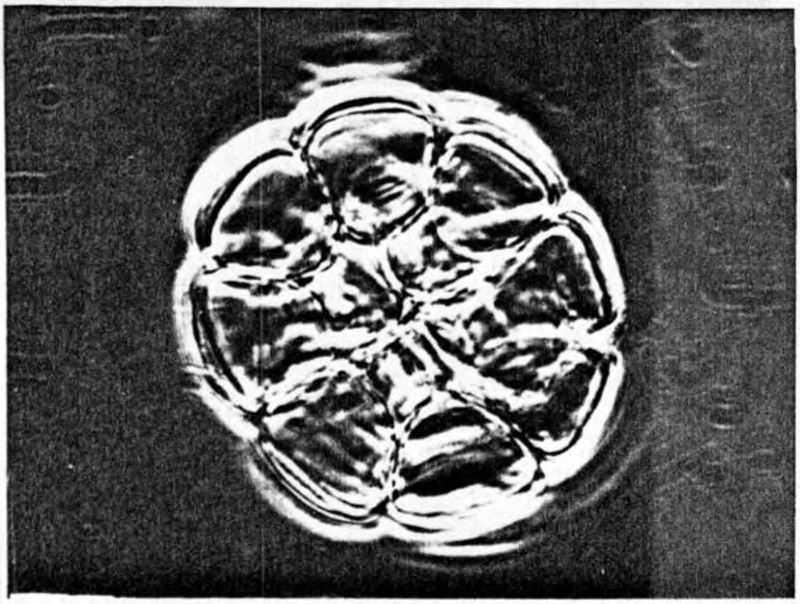

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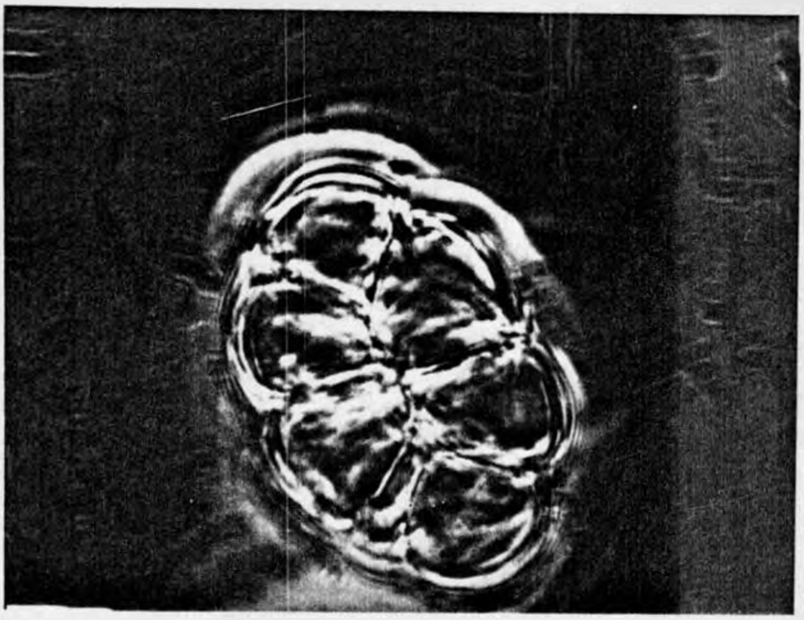


65

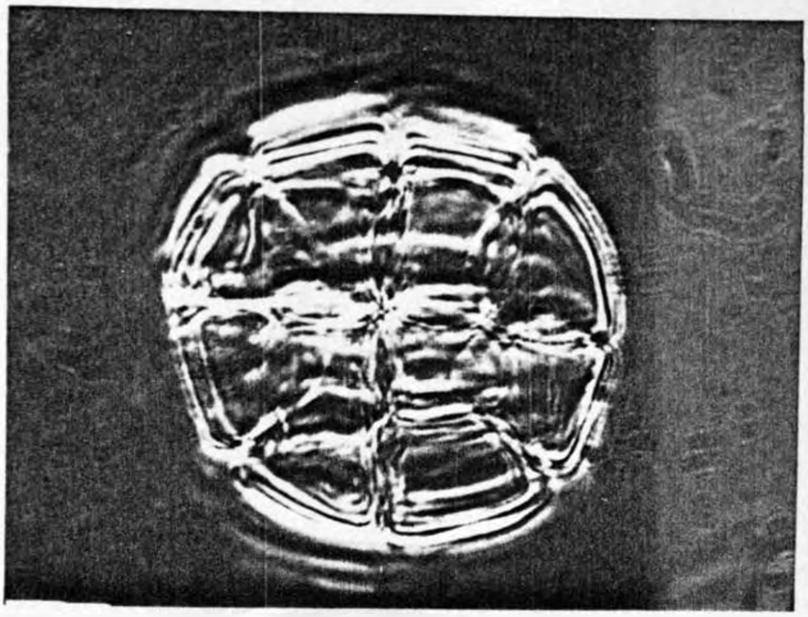
Plates 66 – 68 : Acacia monticola

66. Ph. (x 1000); granular exine structure

and size D = 46.90 μ

67. Br. (x 1000); size E = 33.20 μ.

68. Ph. (x 1000); pore clusters but disorted.



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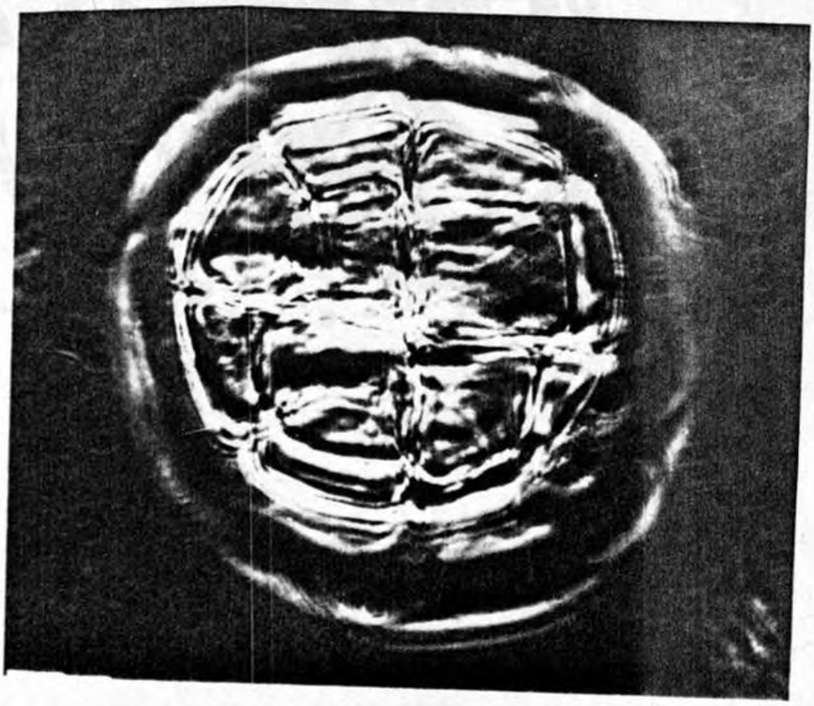

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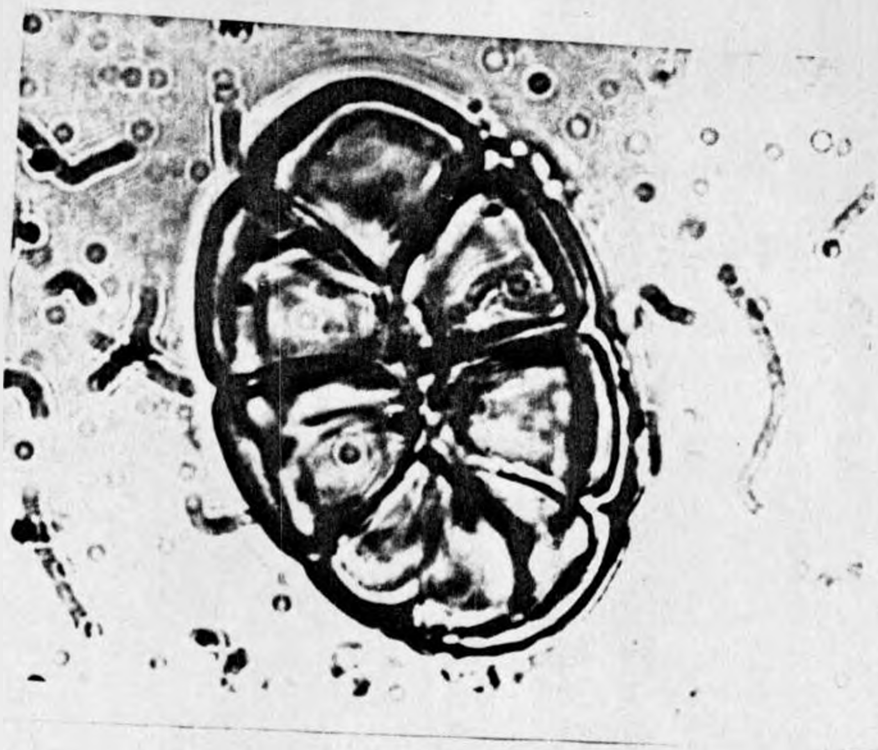


68

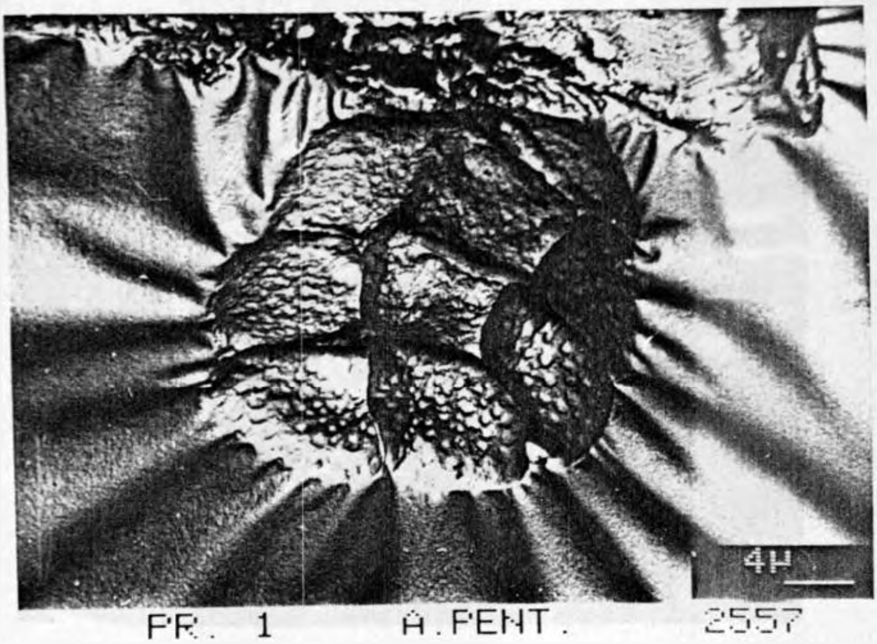
Plates 69 – 72 : Acacia pentagona

69. SEM (x 10,000); flat, perforated surface exine.

70. Ph. (x 1000); pore clusters

71. Ph. (x 1000); granular exine structure pore clusters and size D = 53.90. μ

72. Br. (x 1000); size E = 41.50 μ.



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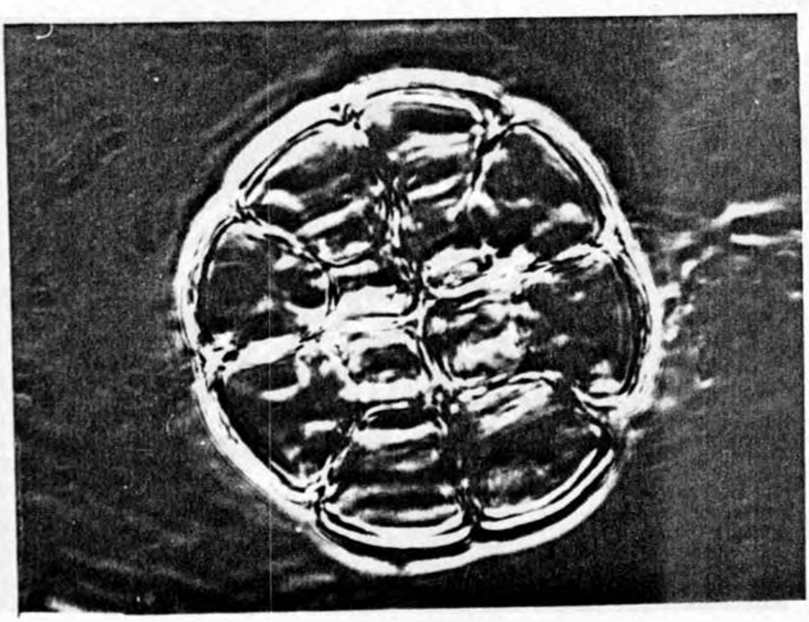

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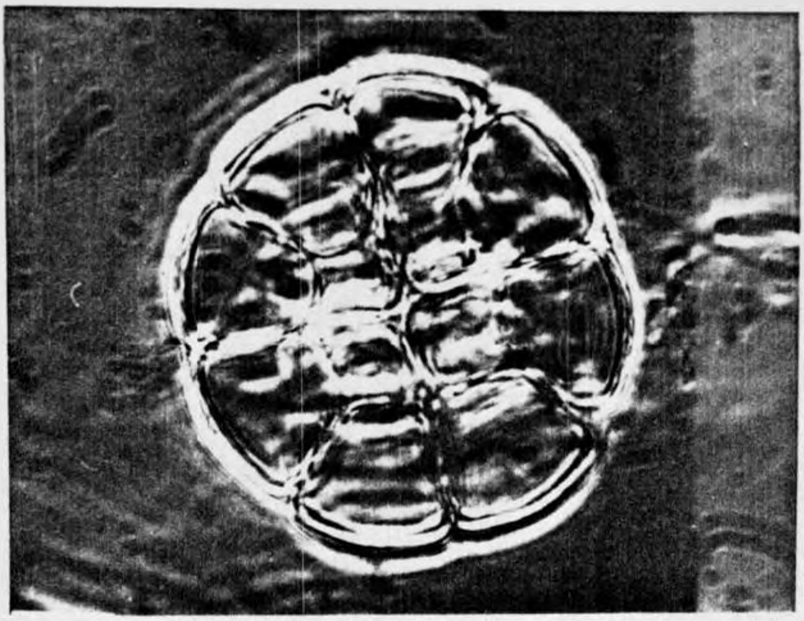

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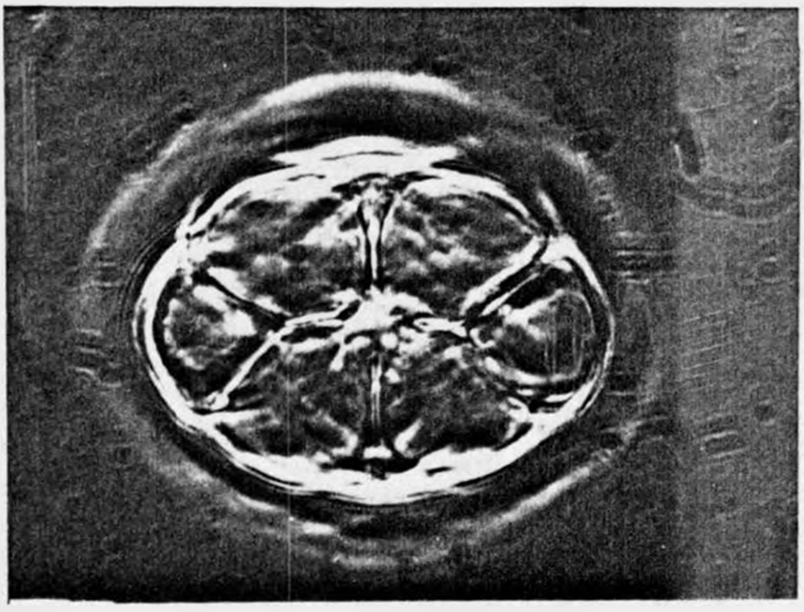


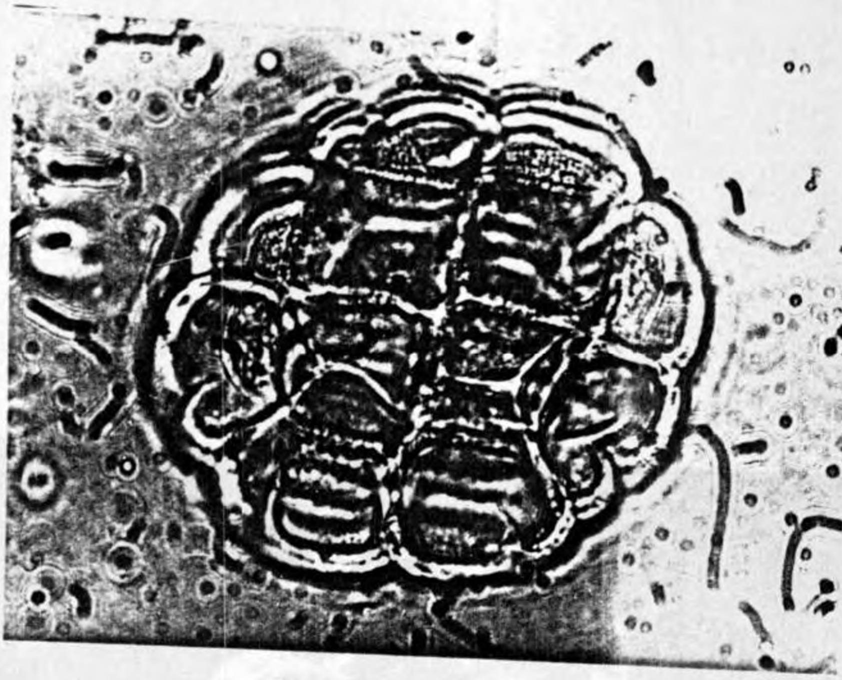
72

Plates 73 – 75 : Acacia elatior.

73. Ph. (x 1000); Y and H – shaped furrows on central and peripheral monads respectively.

74. Ph. (x 1000); columellate exine structure and size D = 67.23 μ

75. Ph. (x 1000) ; size E = 33.65 μ



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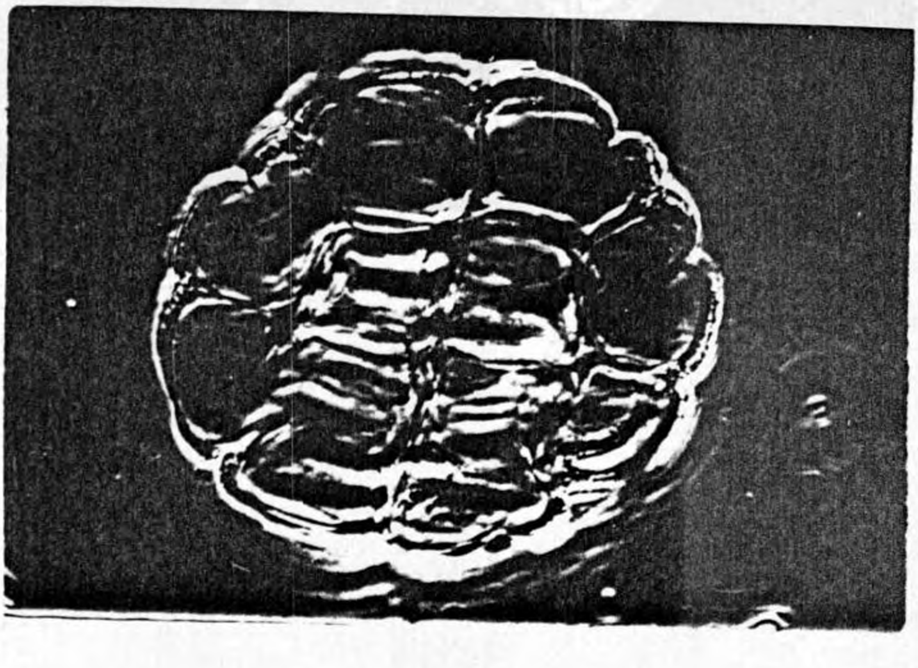

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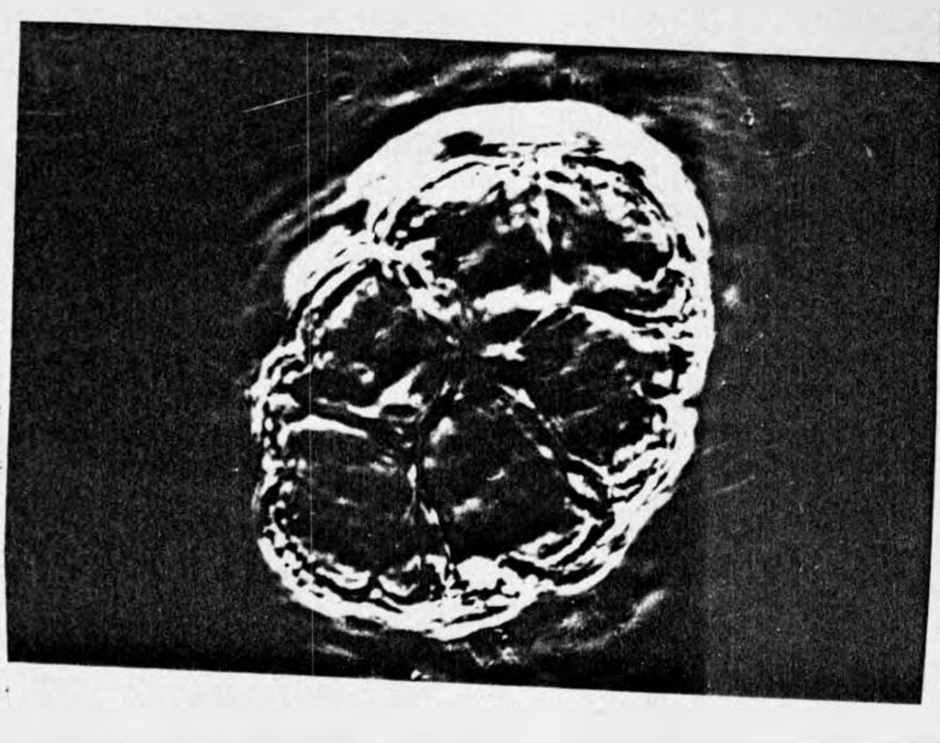


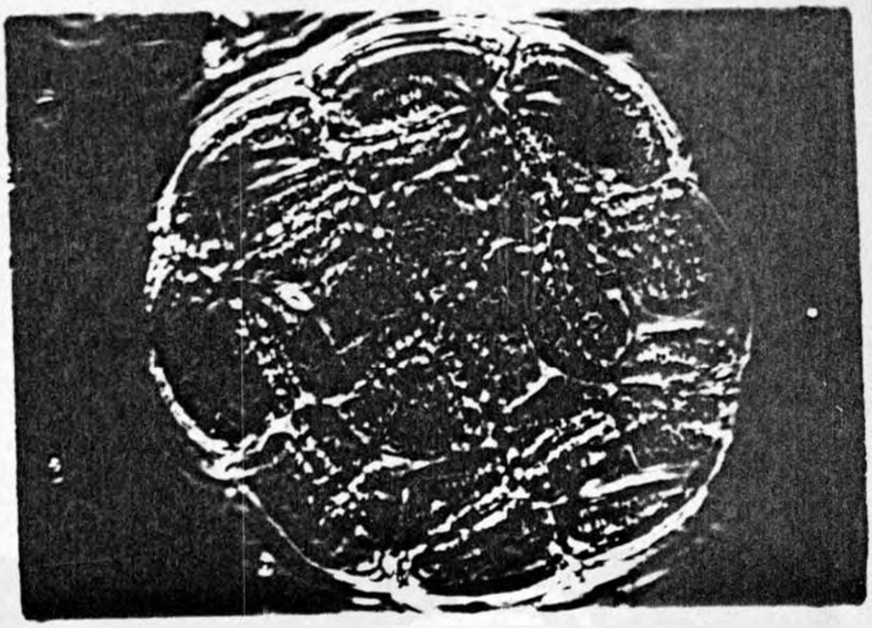
75

Plates 76 – 78 : <u>Acacia zanzibarica</u>

76. Ph. (x 1000); Y and H. shaped furrows on central and peripheral monads respectively

77. Ph. (x 1000); Exine structure and size D = 64.32 μ

78. Ph. (x 1000); size E = 41.50 μ



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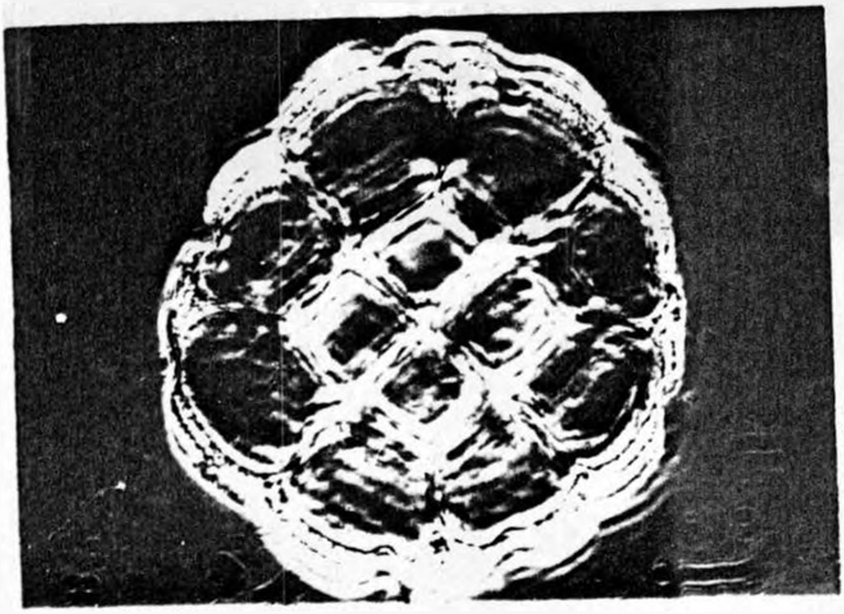

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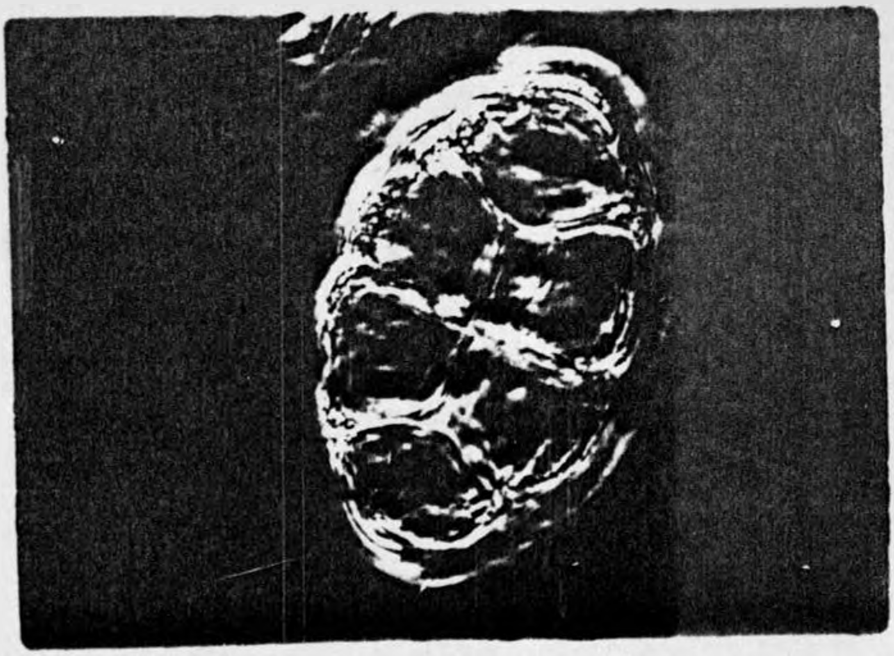


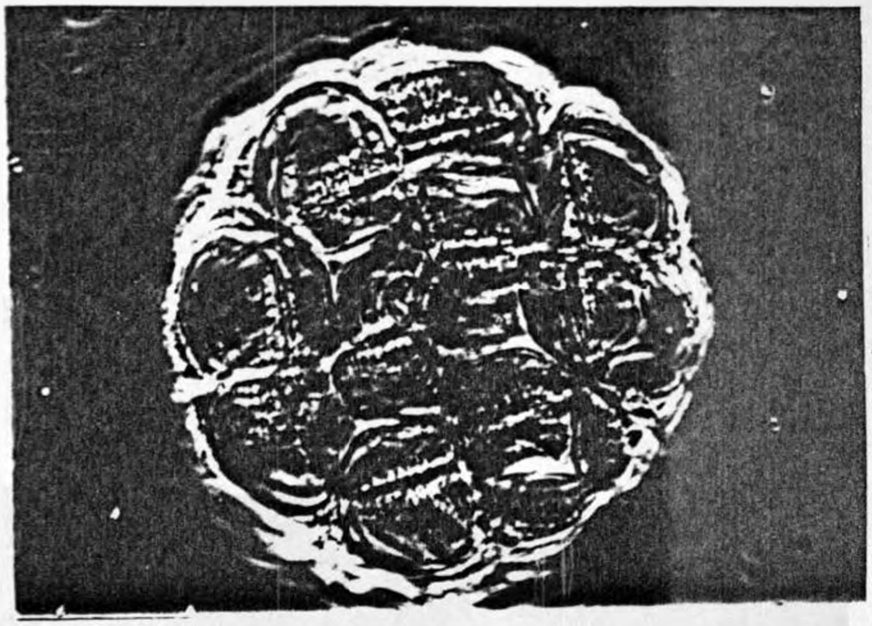
78

Plates 79 – 81 ; Acacia seyal

79. Ph. (x 1000); Y and H. shaped colporate apertures on central and peripheral monads

80. Ph. (x 1000); columellate exine structure and size D = 54.37 µ

81. Ph. (x 1000); size E = 33.20 µ



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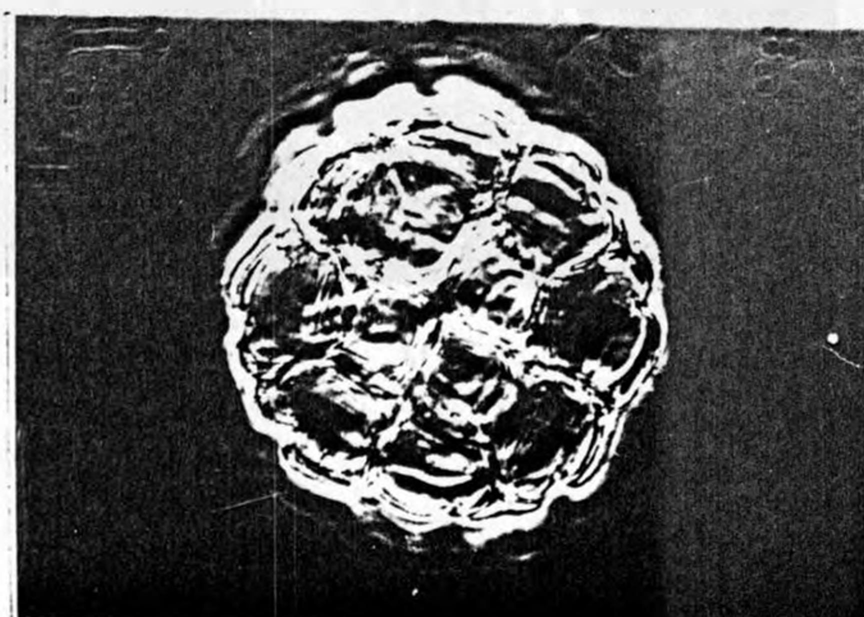

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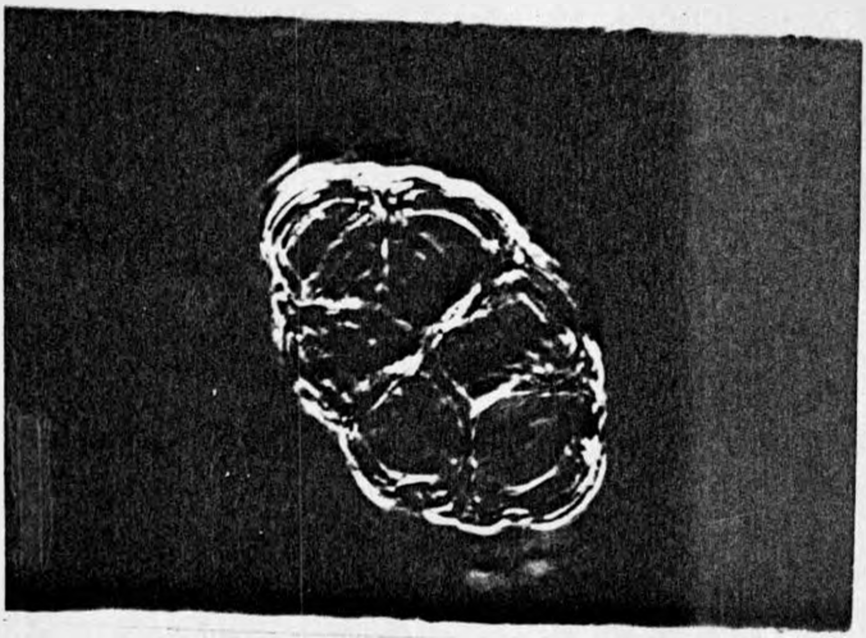


81

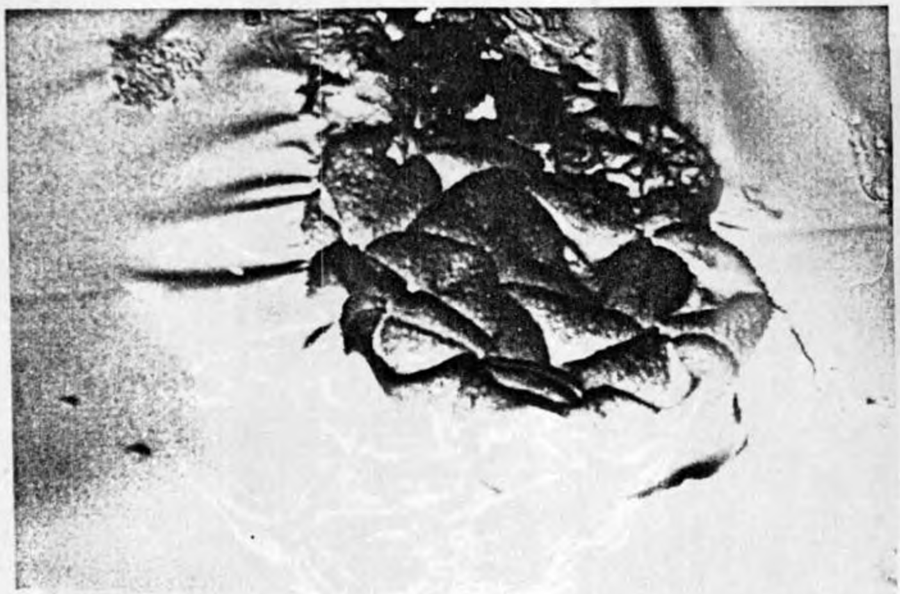
Plates 82 - 85 : <u>*Acacia drepanolobium.*</u>

82. SEM (x 10,000); exine surface flat and perforated

83. Ph. (x 1000); Y - shaped furrows on the central monads.

84. Ph. (x 1000); columellate exine structure and D = 76.81 μ

85. Br. (x 1000); E = 55.61 μ



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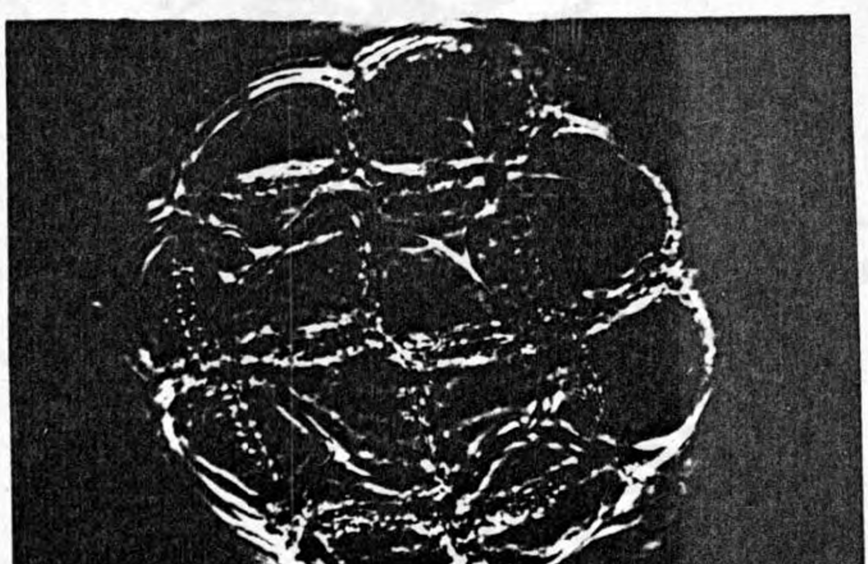

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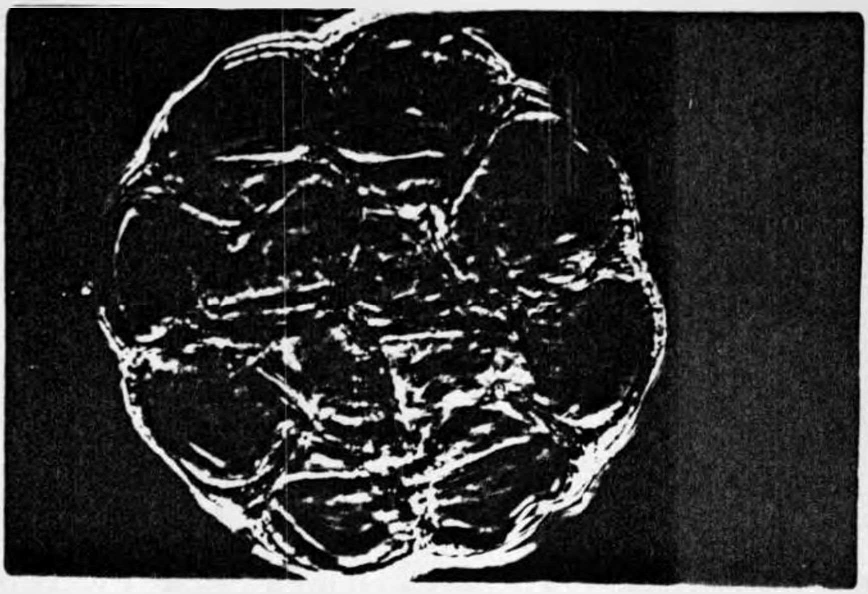


84

85

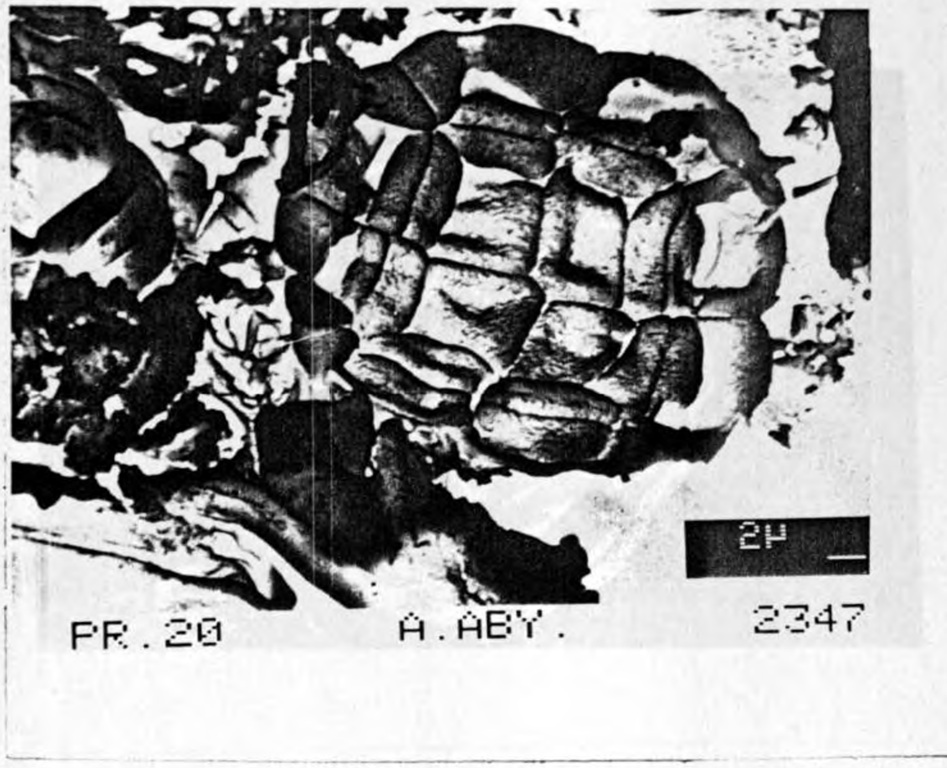
Plates 86 - 89 : Acacia abyssinica

86. SEM (20,000); flat, smooth exine surface.

87. Ph. (x 1000); Y- shaped colporate apertures on the central monads.

88. Ph. (x 1000); columellate exine structure, and size D = 67.23 µ

89. Br. (x 1000); size E = 41.50 µ



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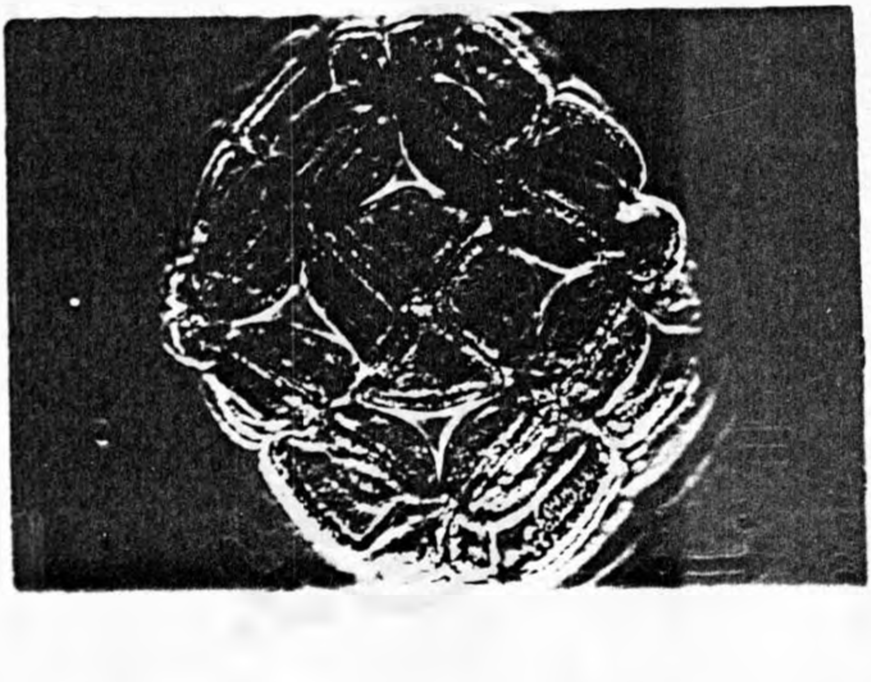

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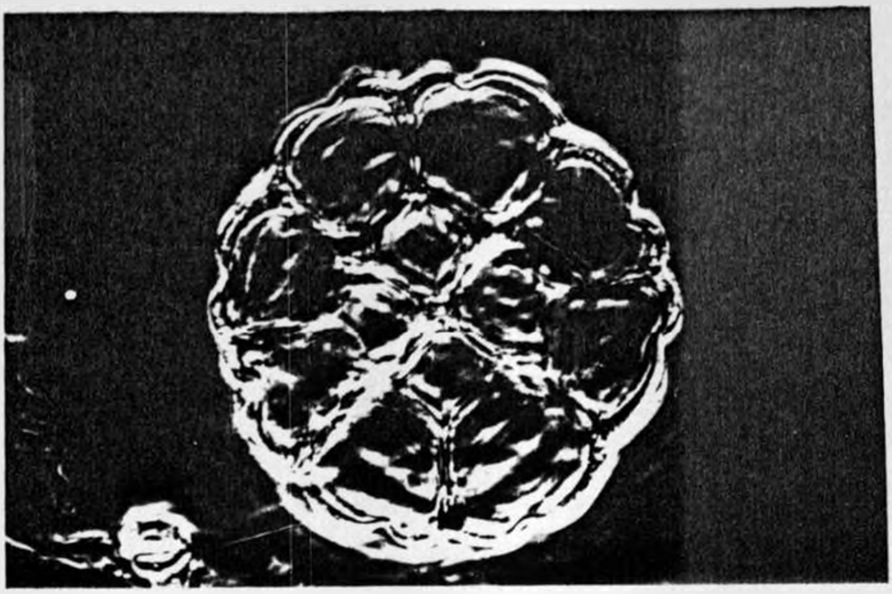


88

89

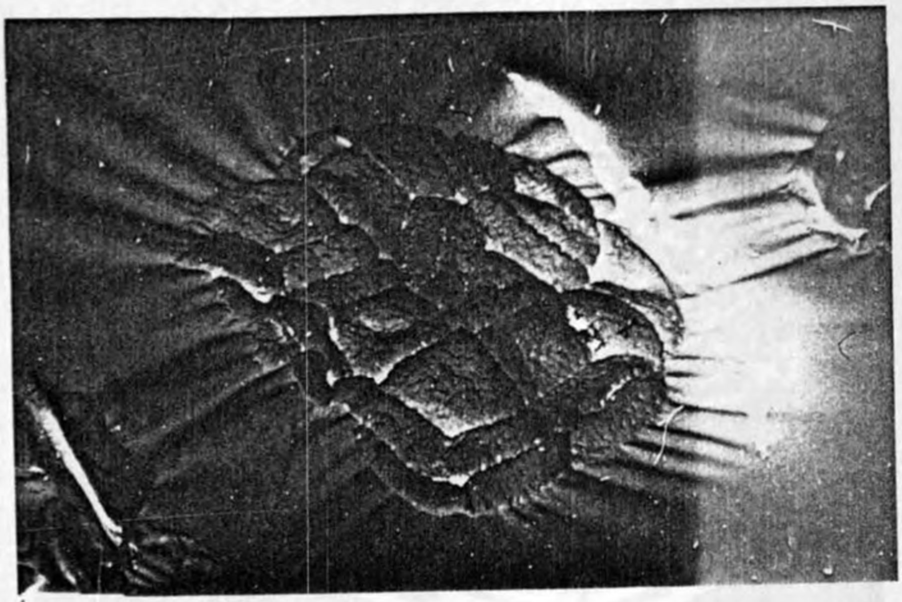
Plates 90 - 93 : *Acacia sieberiana.*

90. SEM (x 10,000); Exine surface flat and perforated.

91. Ph. (x 1000) Y. shaped furrows on the central monads.

92. Ph. (x 1000) Exine structure and size D = 62.83 μ

93. Br. (x 1000) Size E = 41.50 μ



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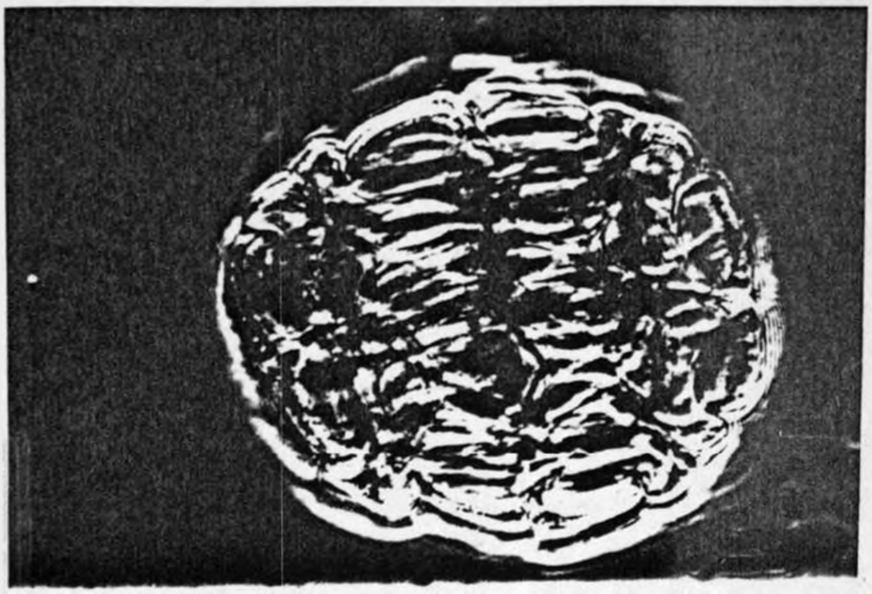

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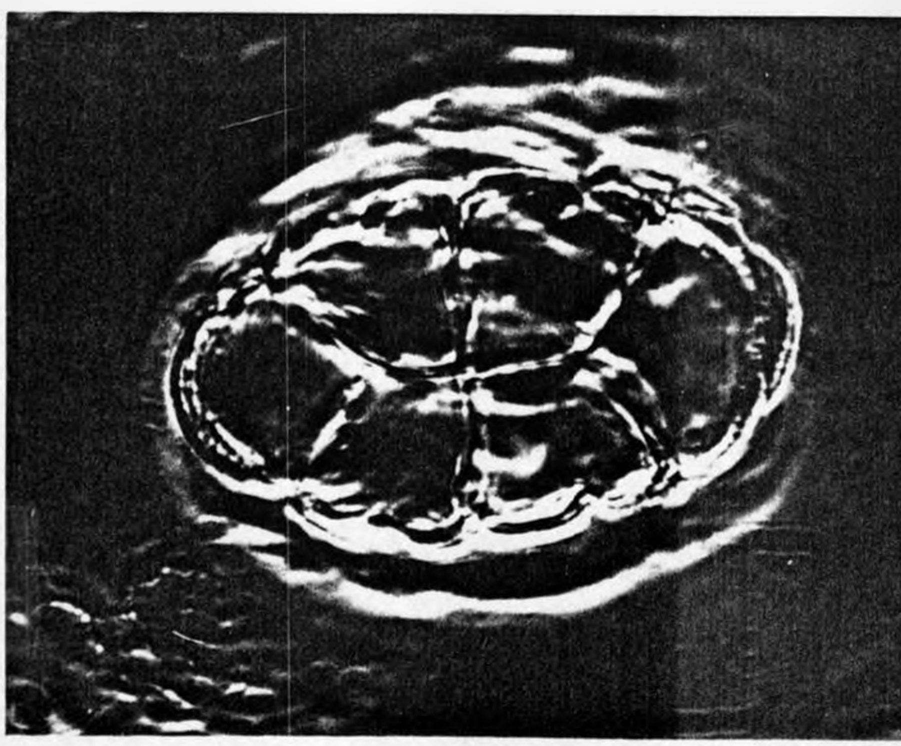


93

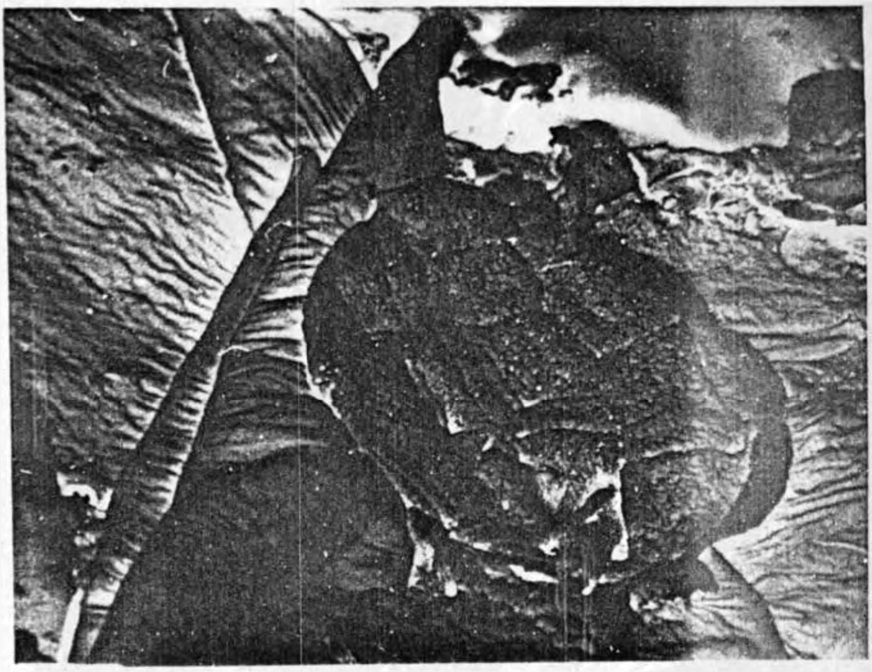
Plates 94 – 97 : Acacia stuhlmanii

94. SEM (x 10,000); Exine surface flat and perforated.

95. Ph. (x 1000); Y. shaped colporate apertures on the central monads

96. Ph. (x 1000); exine, columellate structure and size
D = 66.82 μ

97. Ph. (x 1000) size E = 41.5 μ



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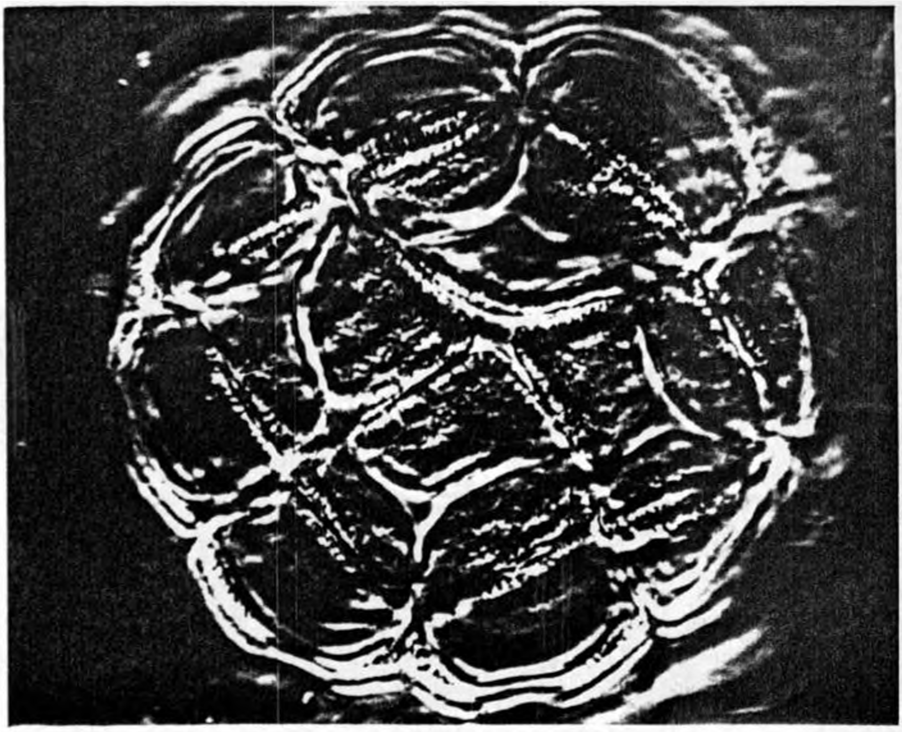

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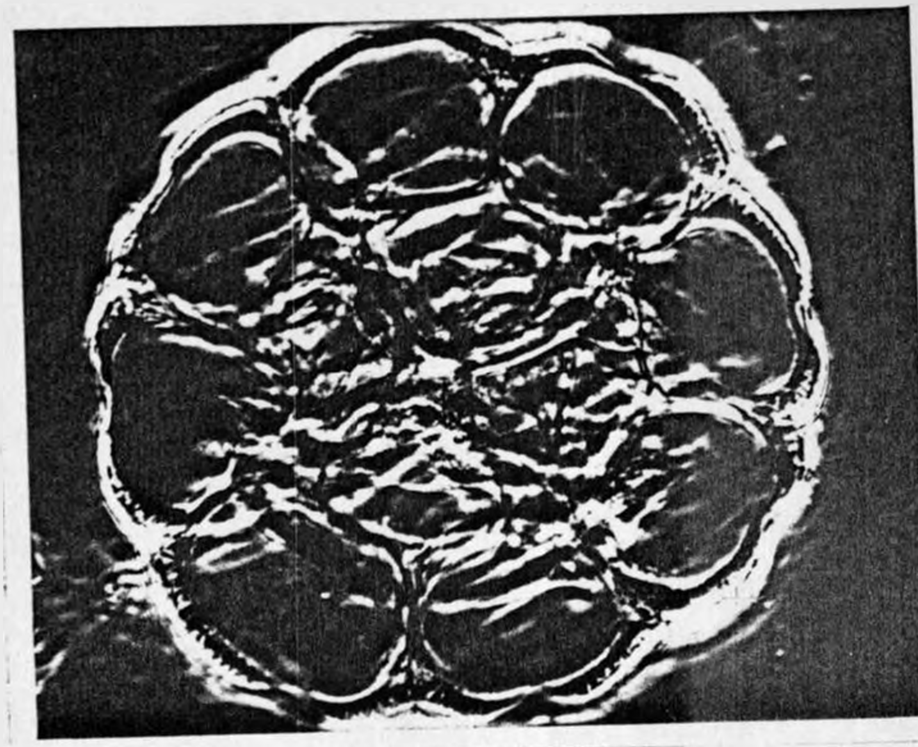

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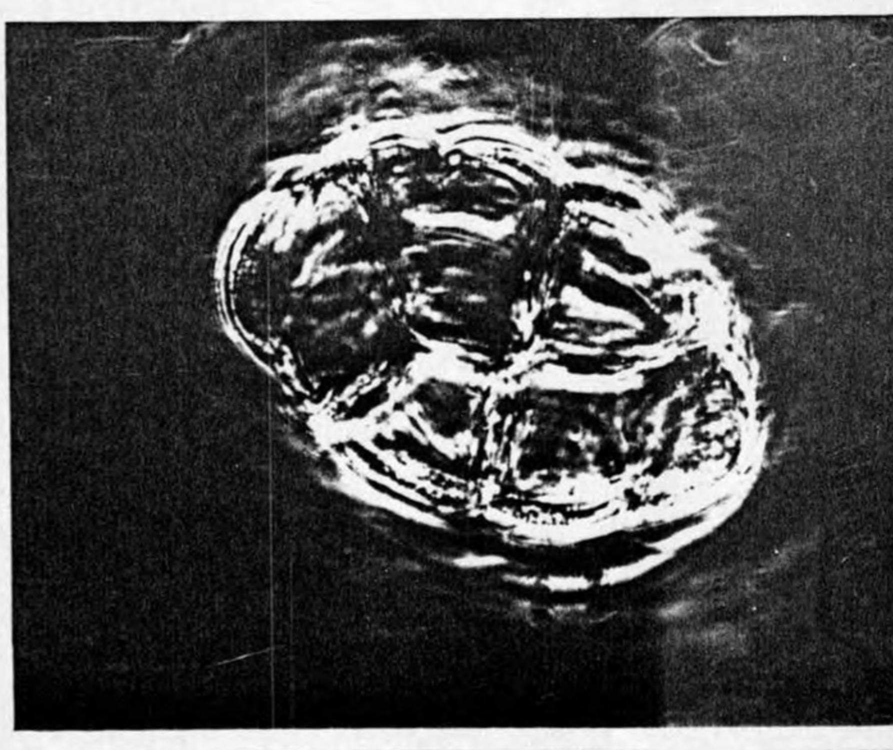


97

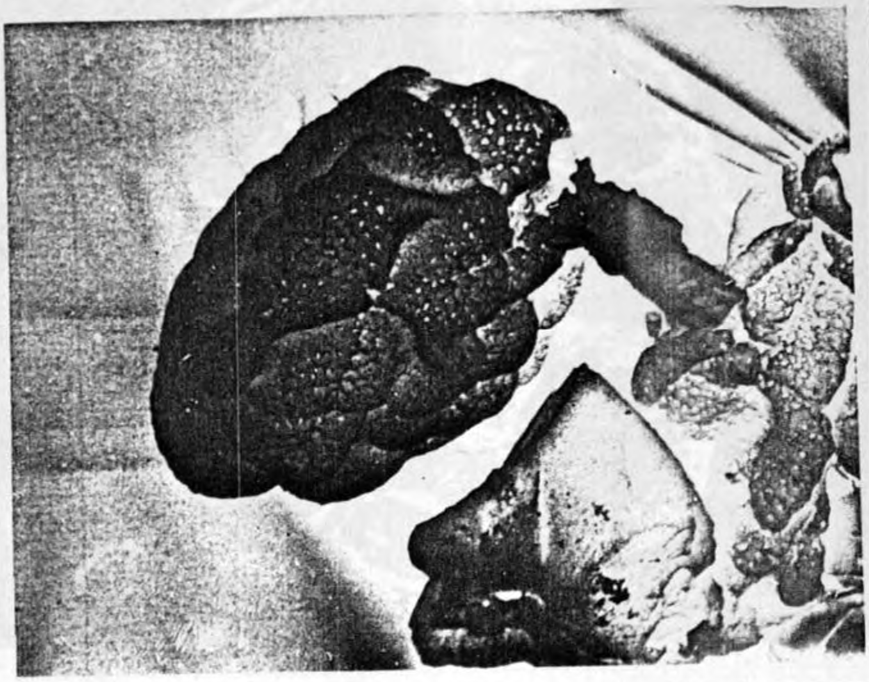
Plates 98 – 101 : Acacia Xanthophloea

98. SEM (x 10,000); Exine surface, flat and perforated.

99. Ph. (x 1000) Y– shaped colporate apertures on central monads

100. Ph. (x 1000) columellate exine structure and size D = 70.55 μ

101. Ph. (x 1000) size E = 41.5 μ



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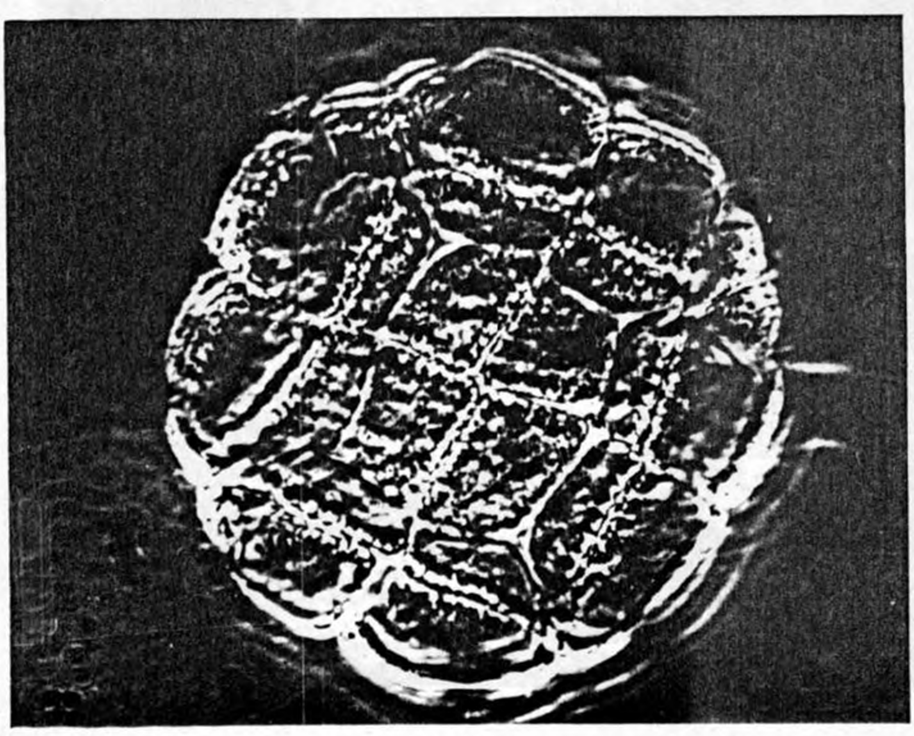

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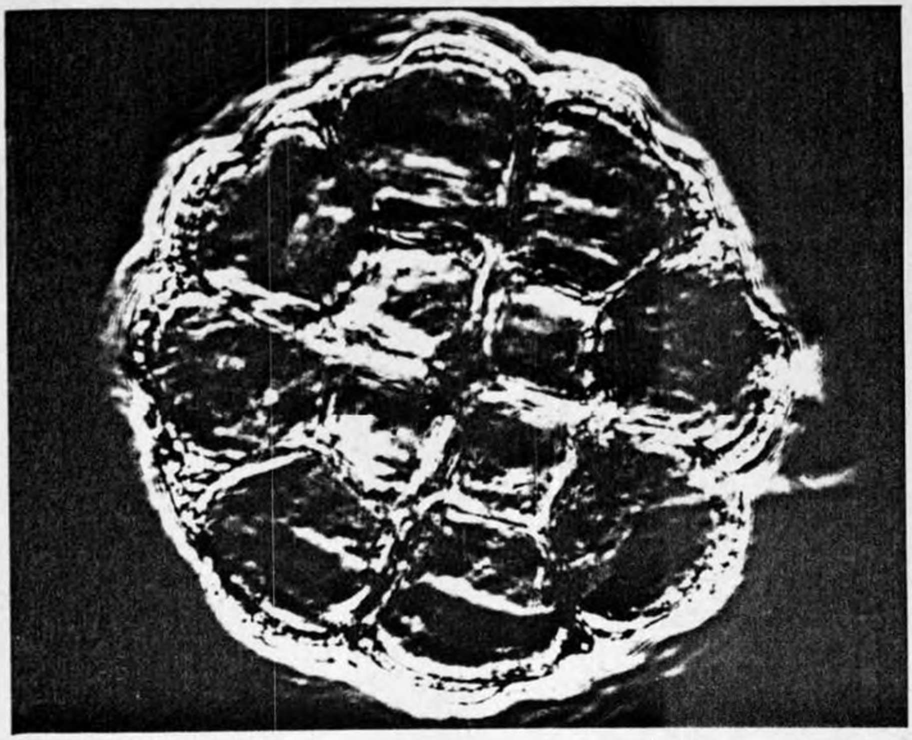

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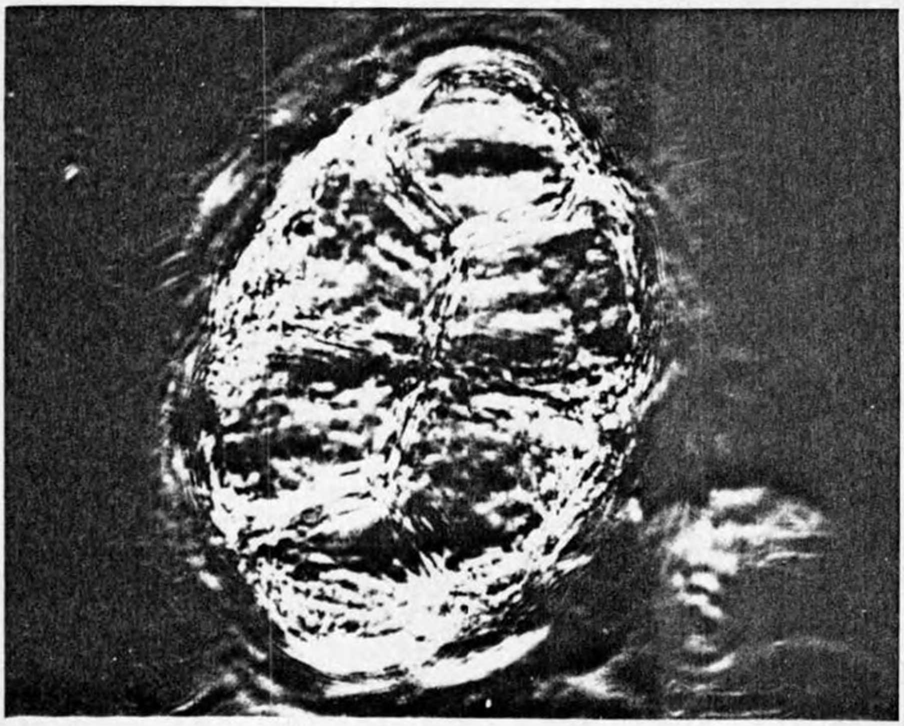


101

Plates 102 – 105 : Acacia hockii.

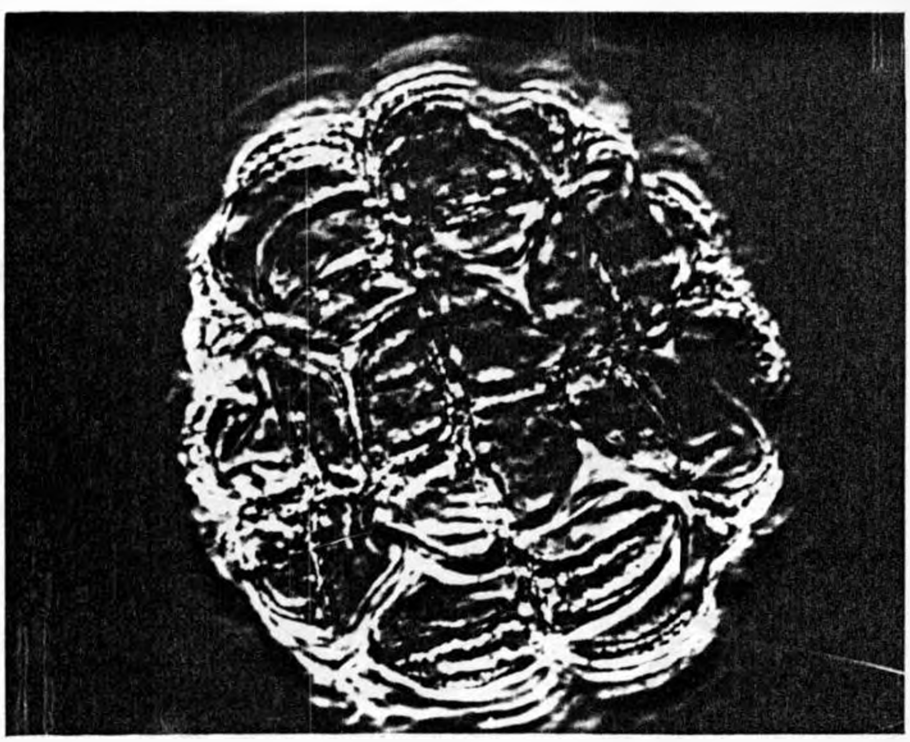
102. SEM (x 4000); exine surface flat and perforated

103 Ph. (x 1000) Y – shaped furrows on the central monads and H – shaped furrows on the peripheral monads.

104. Ph. (x 1000) columellate exine structure and size D = 64.12 μ

105. Ph. (x 1000) size E = 45.65 μ

102



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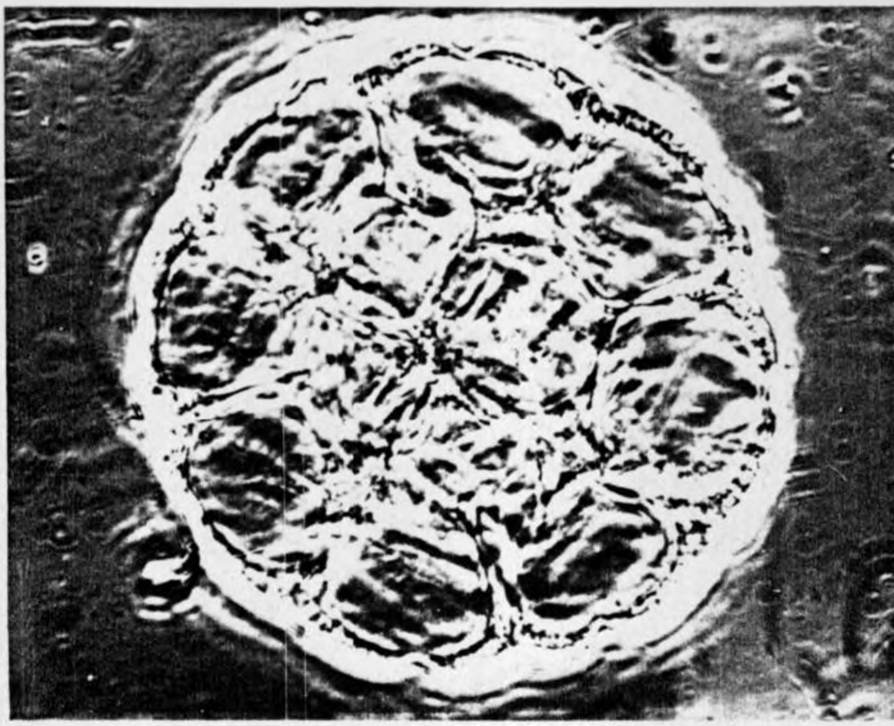


104

105

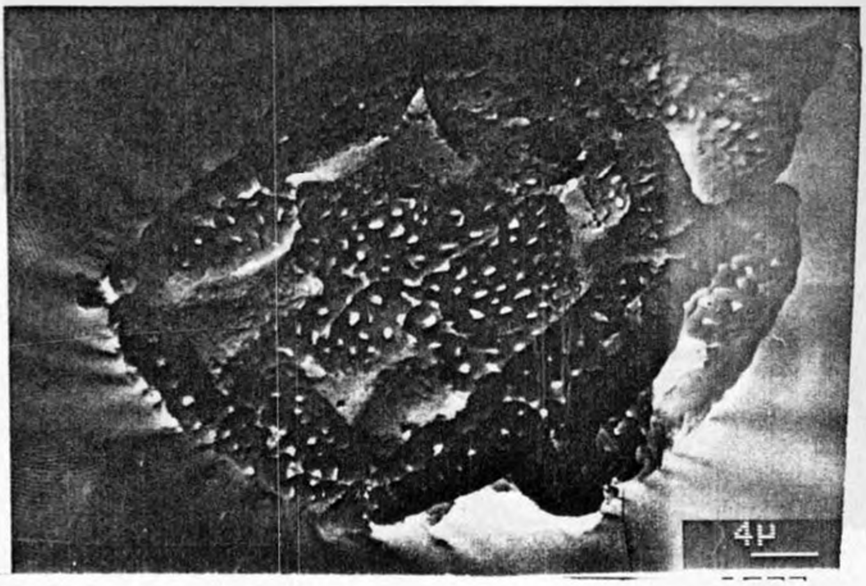
Plates 106 - 109 : *Acacia nilotica*

106. SEM (x 10,000); exine surface flat and perforated

107. Ph. (x 1000); Y. shaped colporate apertures on the central monads.

108. Ph. (x 1000); columellate exine structure and size D = 51.05 μ

109. Ph. (x 1000) size E = 37.35 μ



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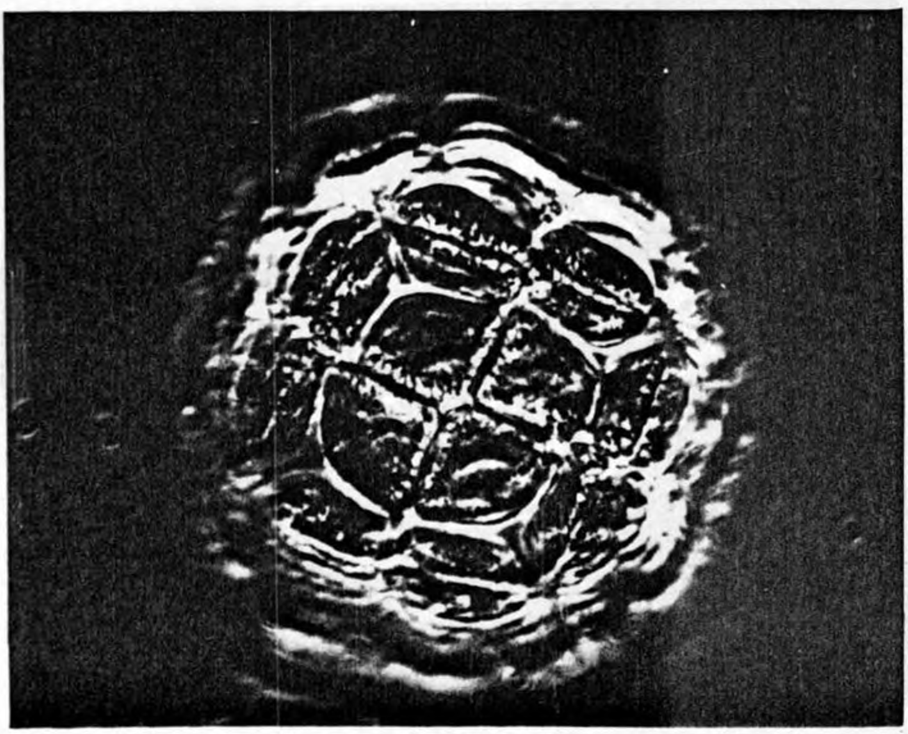

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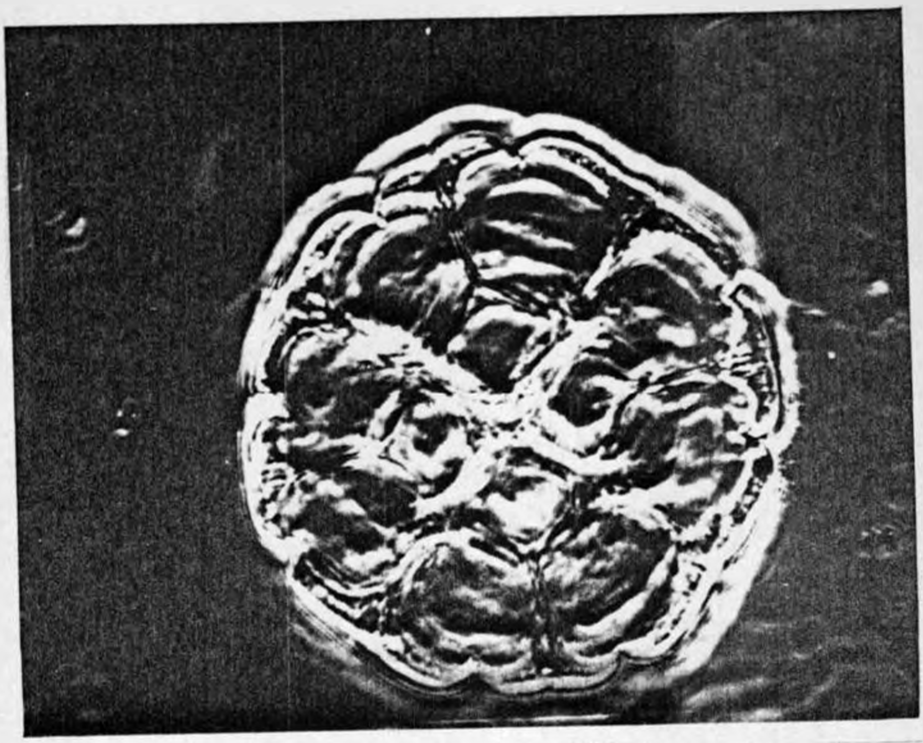

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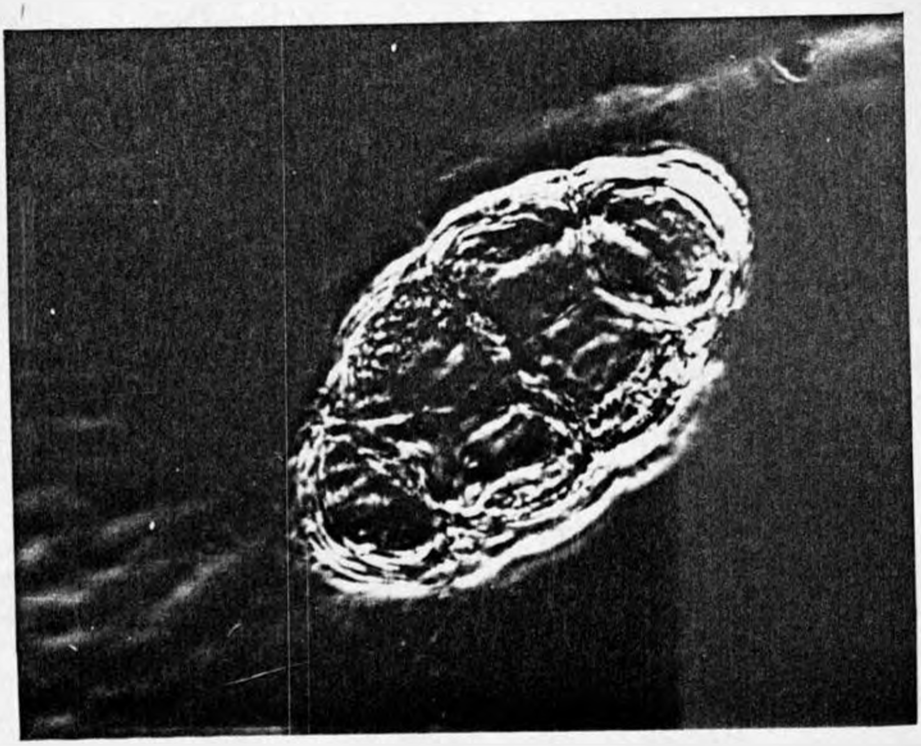


109

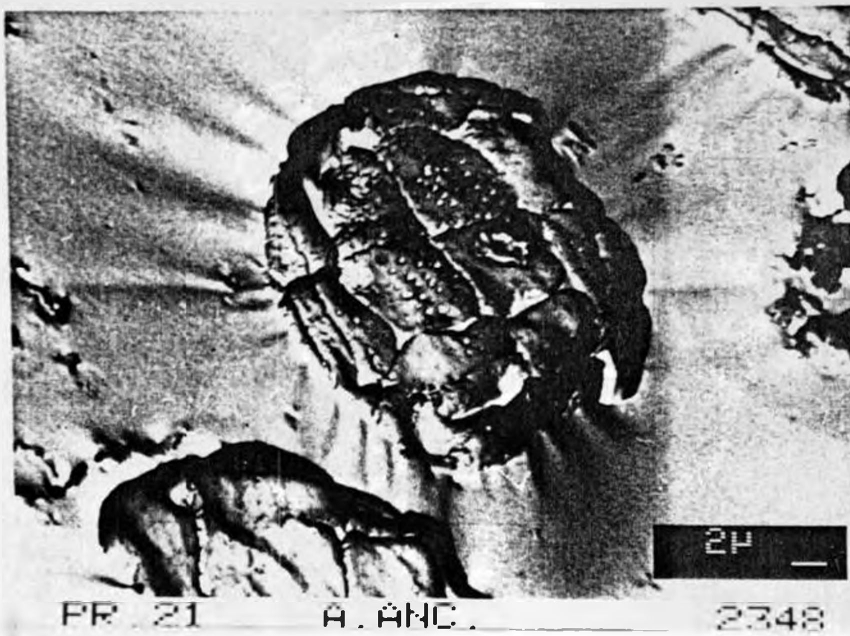
Plates 110 - 113 : <u>Acacia</u> <u>ancistroclada</u>

110. SEM (x 20,000); flat, perforated exine surface.

111. Ph. (x 1000); Y- shaped colporate apertures on the central surface and H - shaped colporate apertures on peripheral cells.

112. Ph (x 1000) columellate exine structure and size D = 64.12 μ

113. Ph. (x 1000) size E = 41.50 μ.



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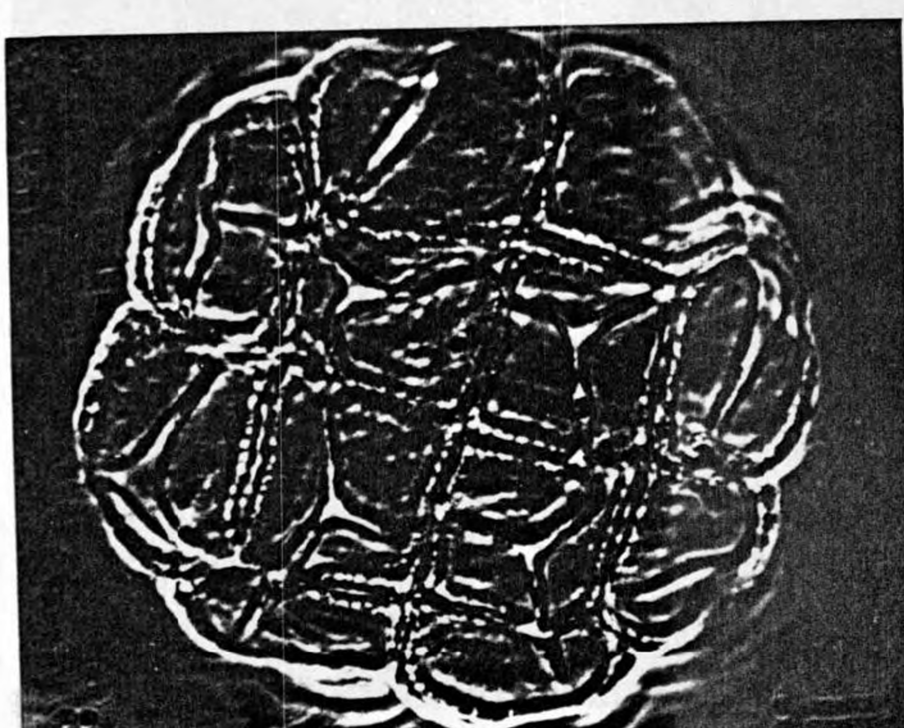

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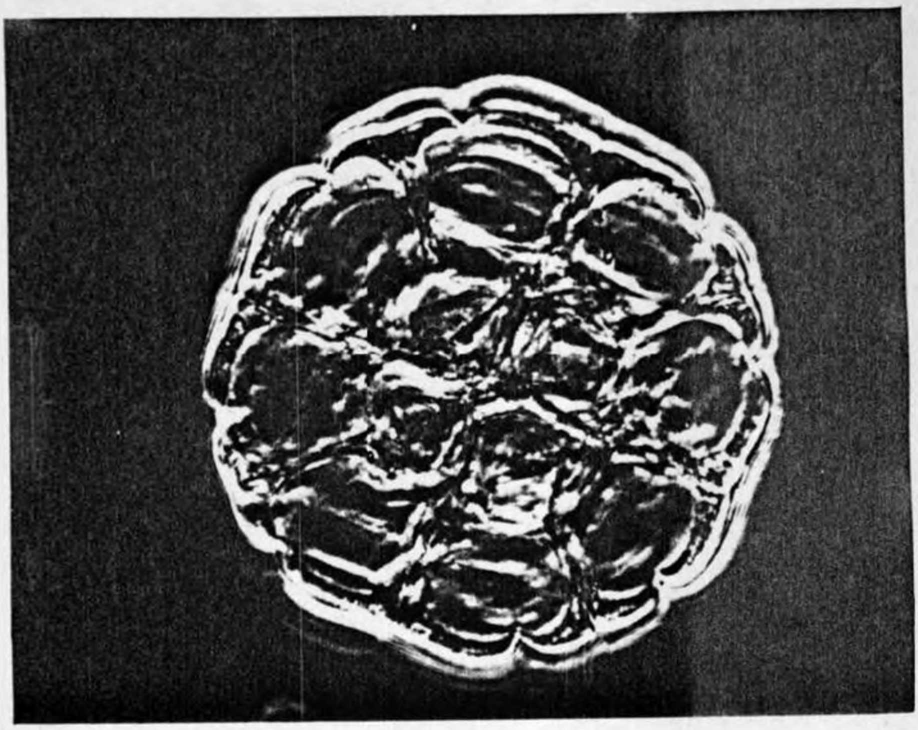

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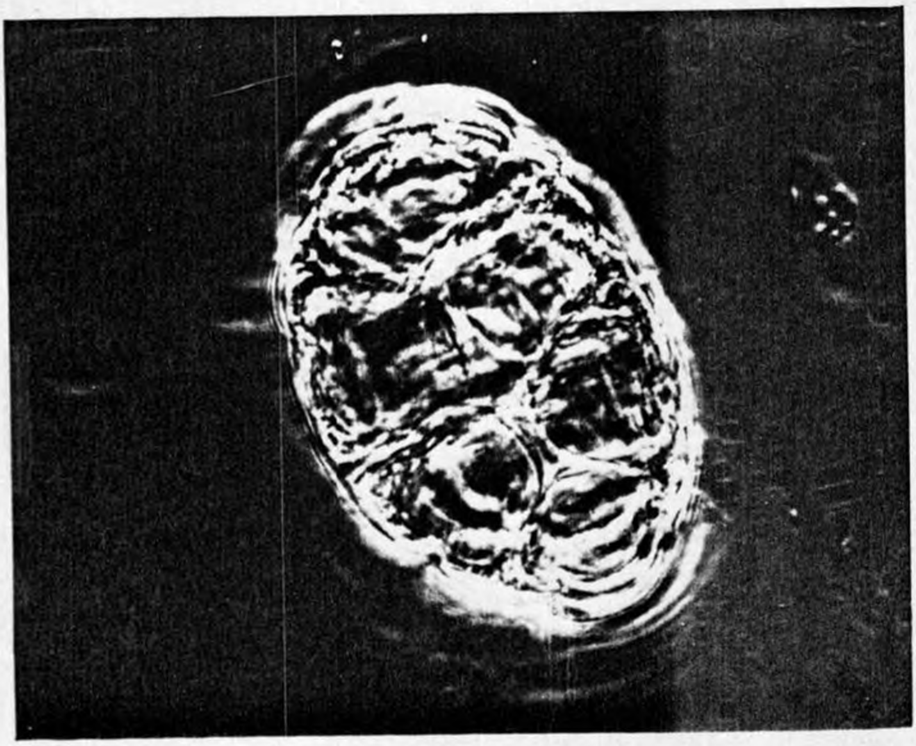


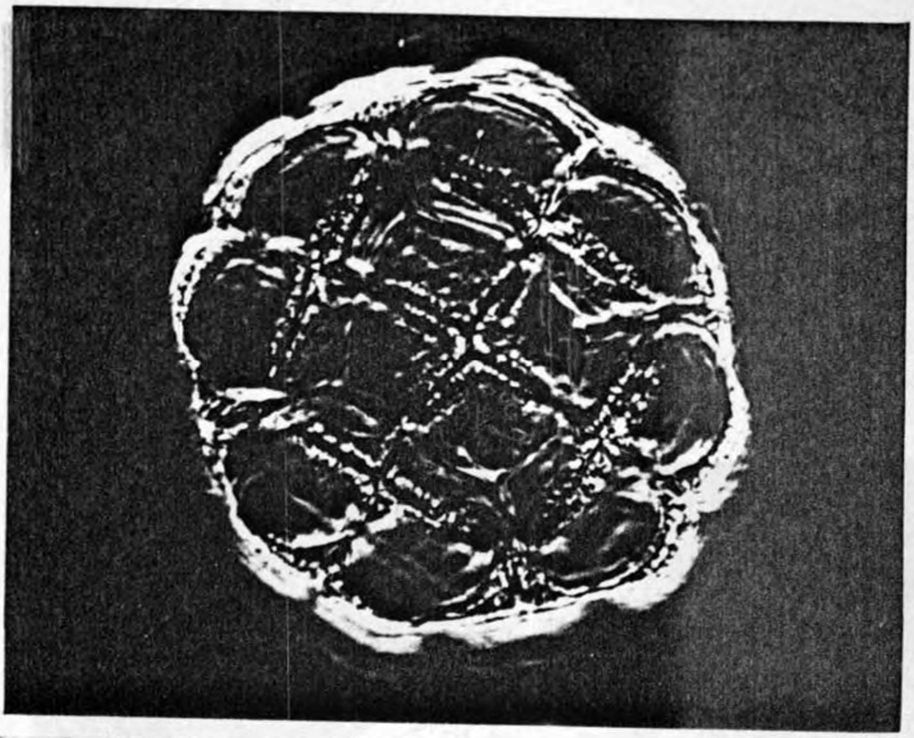
113

Plates 114 – 116 : Acacia reficiens

114. Ph. (x 1000); Y – shaped colporate apertures on the central monads.

115. Ph. (x 1000) columellate exine structure and size D = 67.65 μ

116. Ph. (x 1000) size E = 41.90. μ



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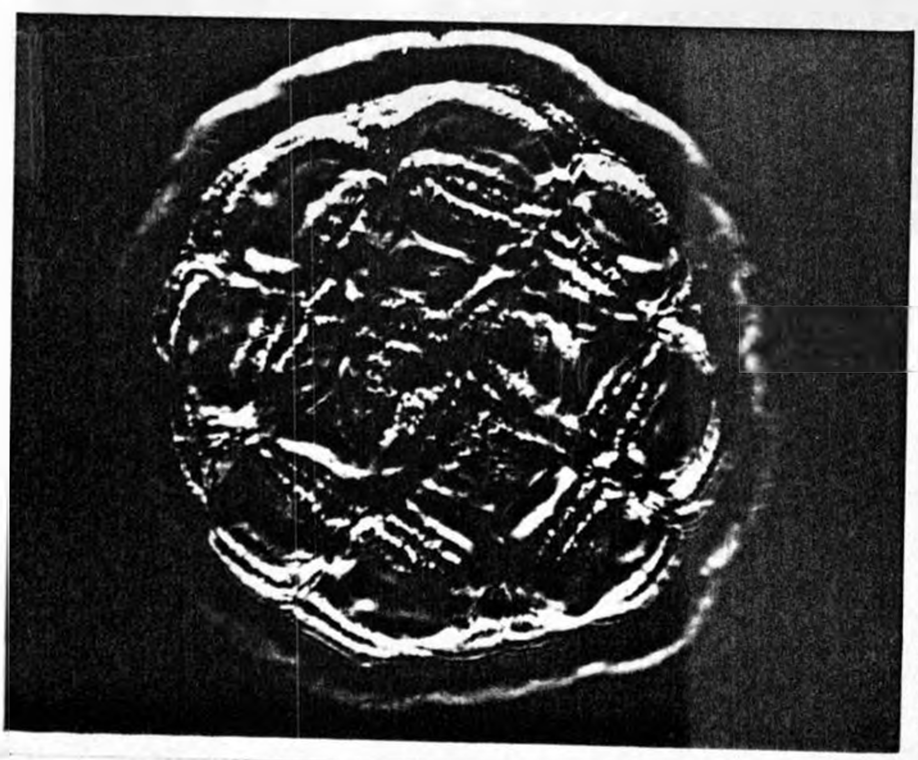

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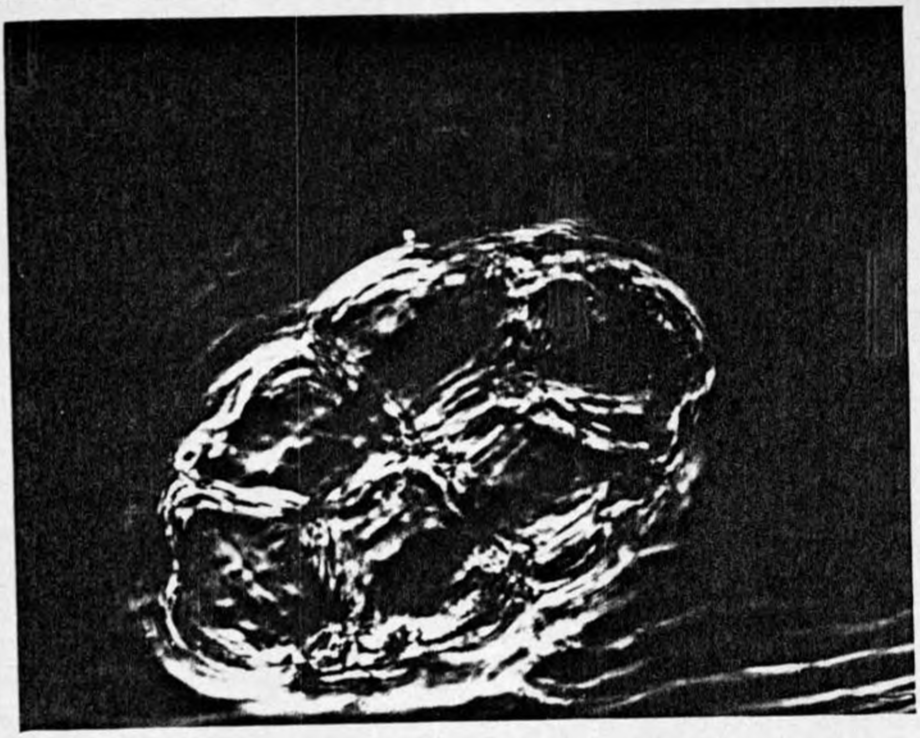


116

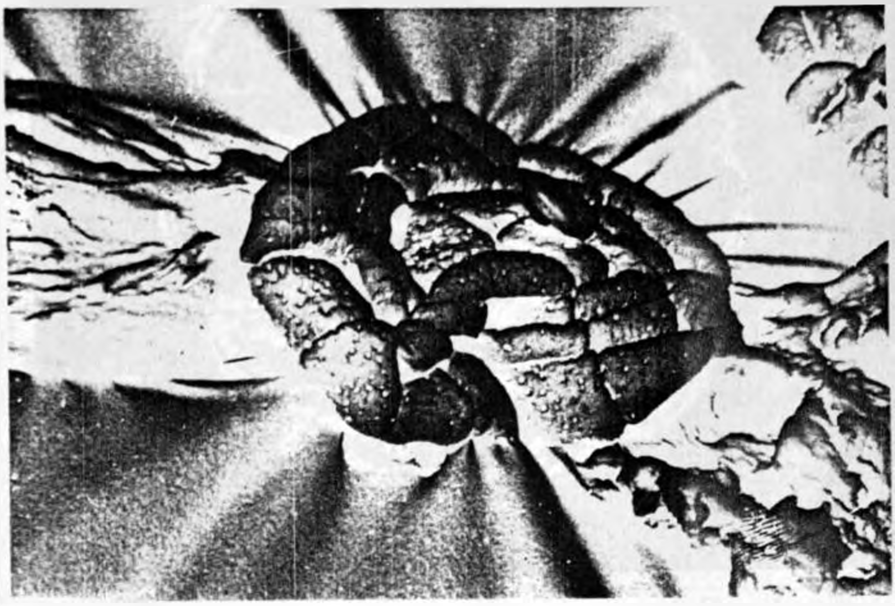
Plates 117 - 120 : Acacia etbaica

117. SEM (x 4000) exine surface flat and and perforated.

118. Ph. (x 1000) Y- shaped furrows on the central monads.

119. Ph. (x 1000) columellate exine structure and size D = 75.12 μ

120. Ph. (x 1000) size E = 45.65 μ



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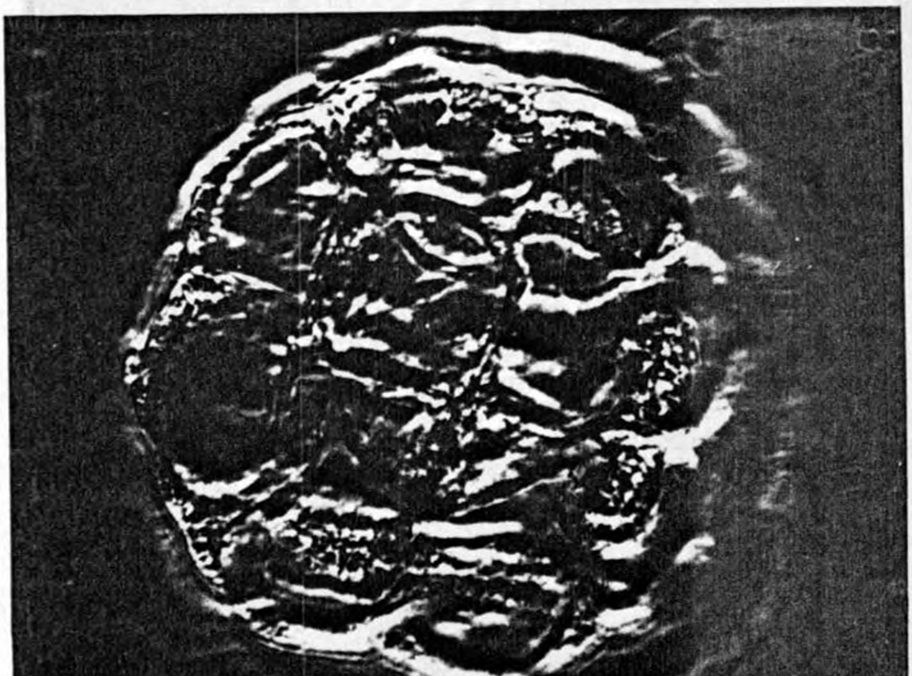

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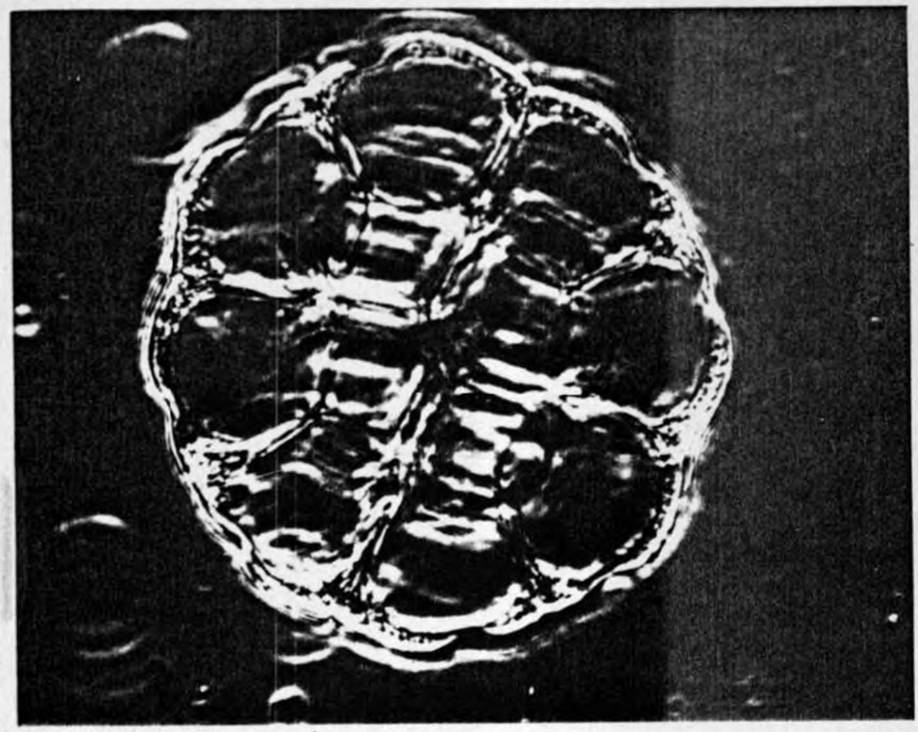

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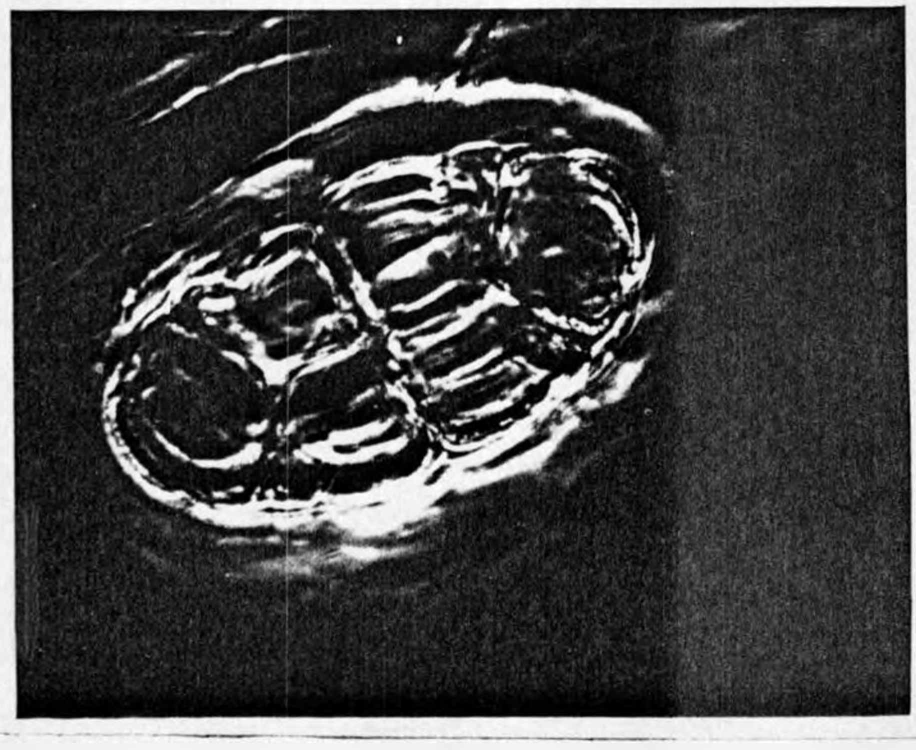


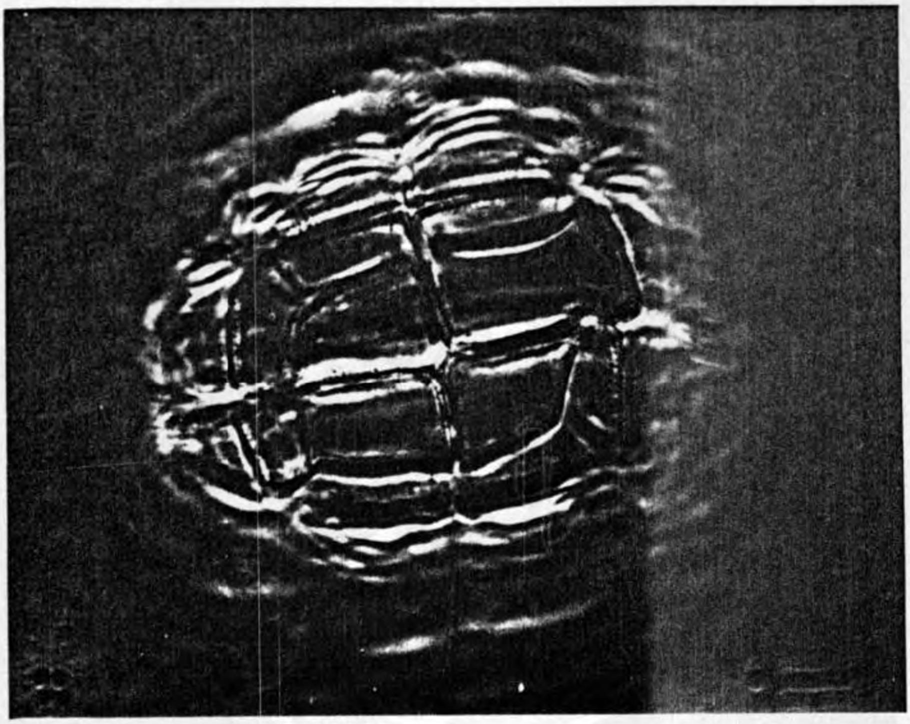
120

Plates 121 - 123 : Acacia tortilis

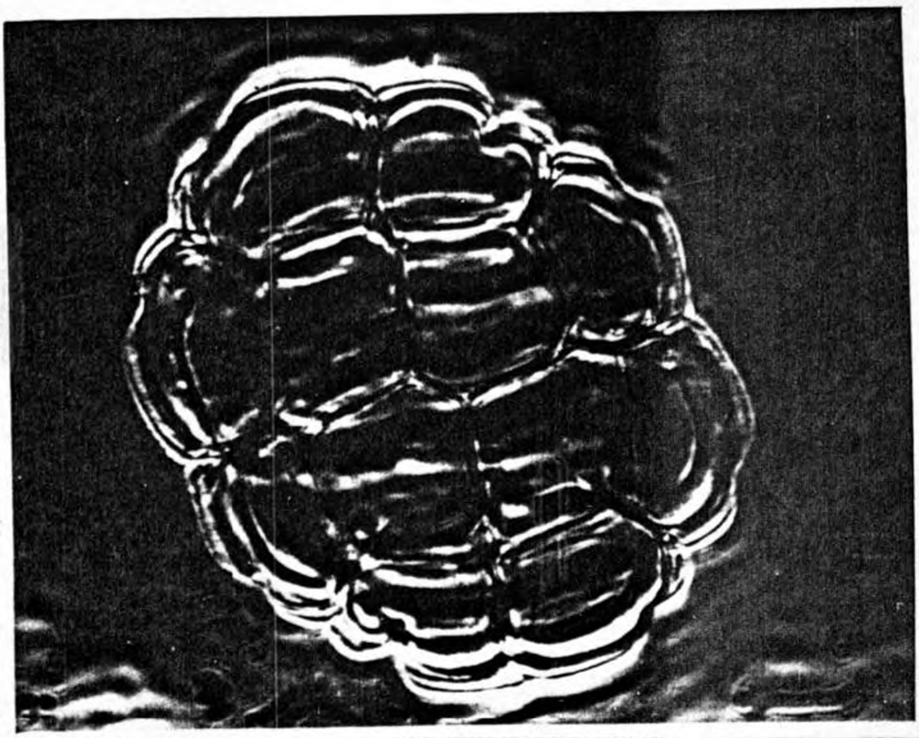
121. Ph. (x 1000); Y- shaped furrows on central monads.

122. Ph. (x 1000); size E = 37.35 μ and columellate exine structure.

123. Ph. (x 1000); size D = 62.25 μ and columellate exine structure.



121



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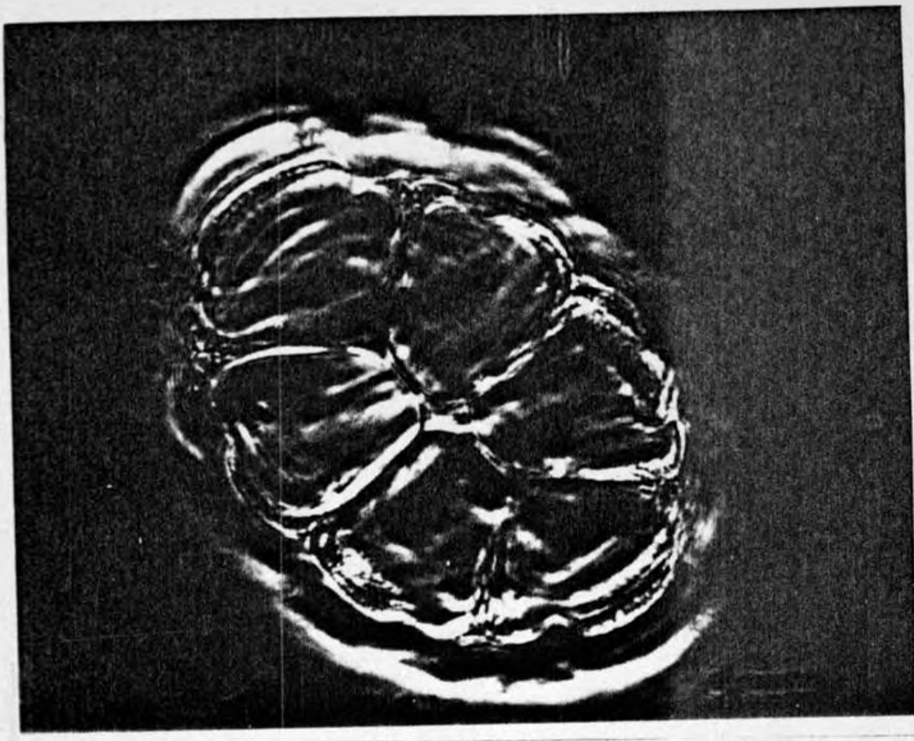


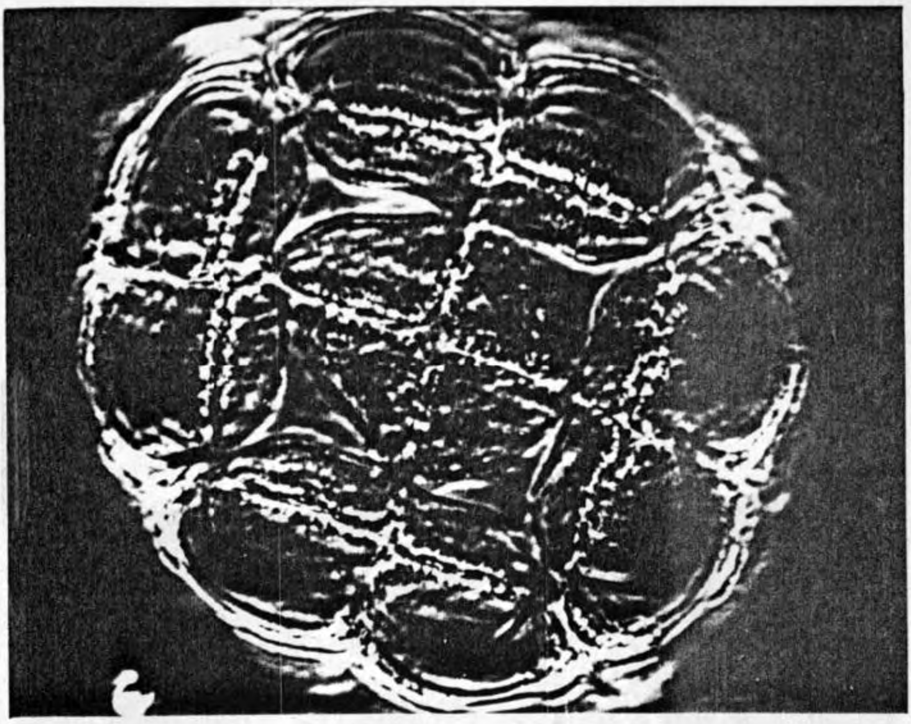
123

Plates 124 – 126 : Acacia gerrardii

124. Ph. (x 1000); Y shaped furrows on the central monads.

125. Ph. (x 1000); columellate exine structure and size D = 78.80 μ

126. Ph. (x 1000); size E = 54.40 μ



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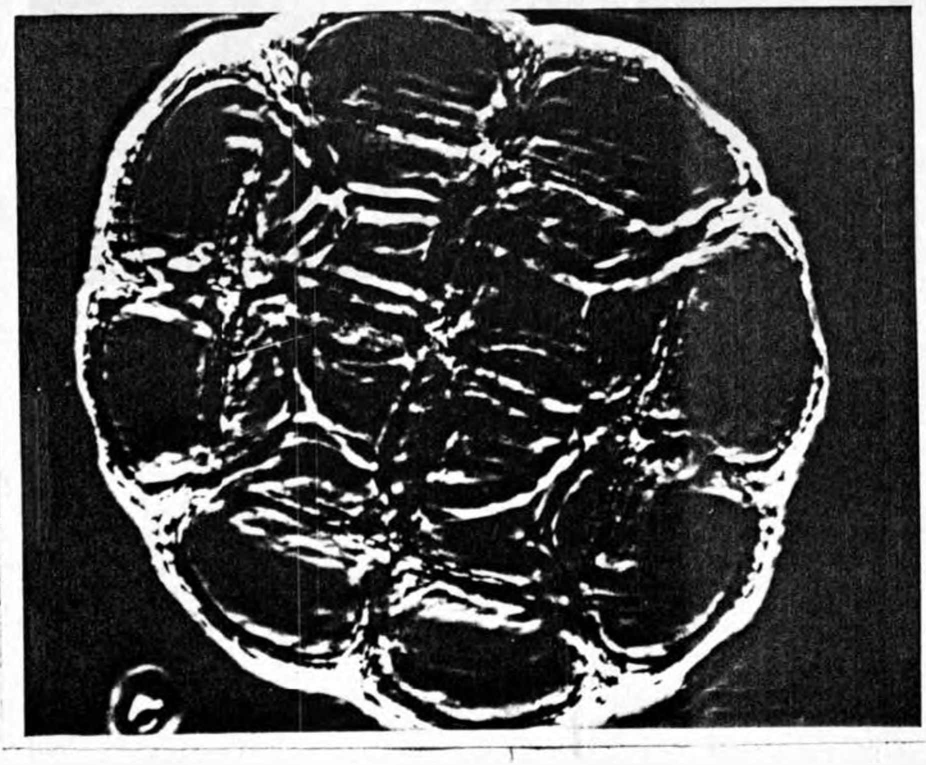

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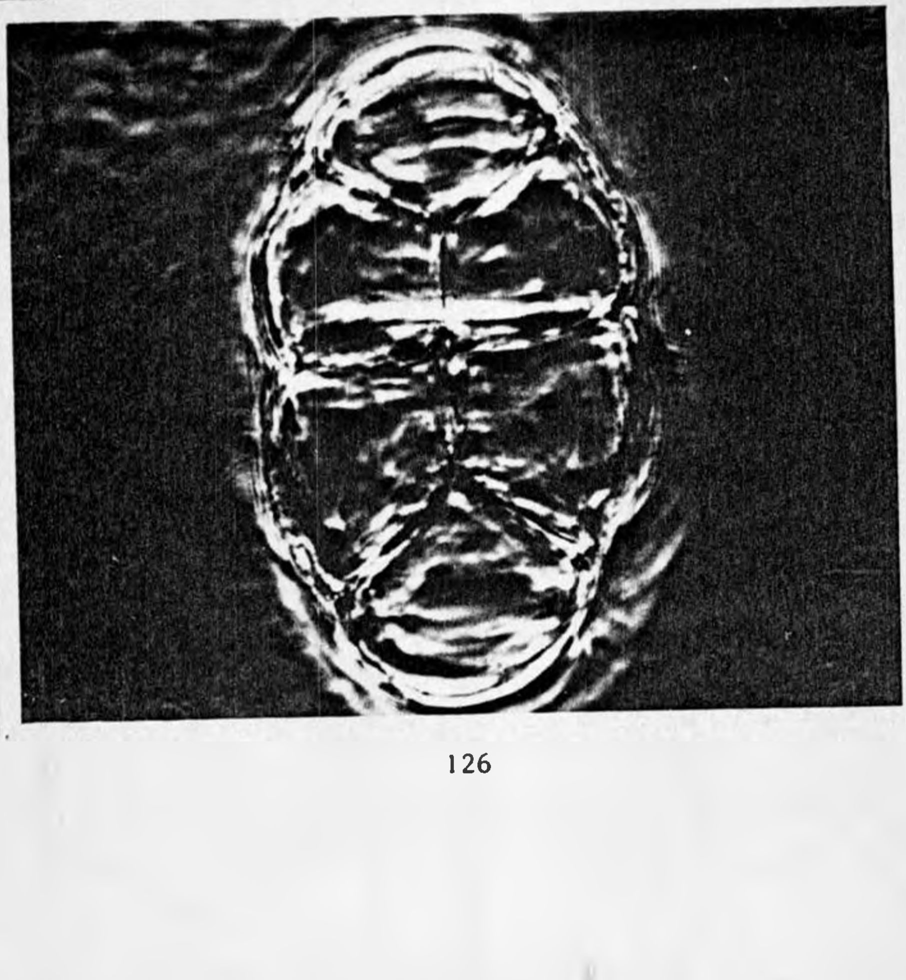


126

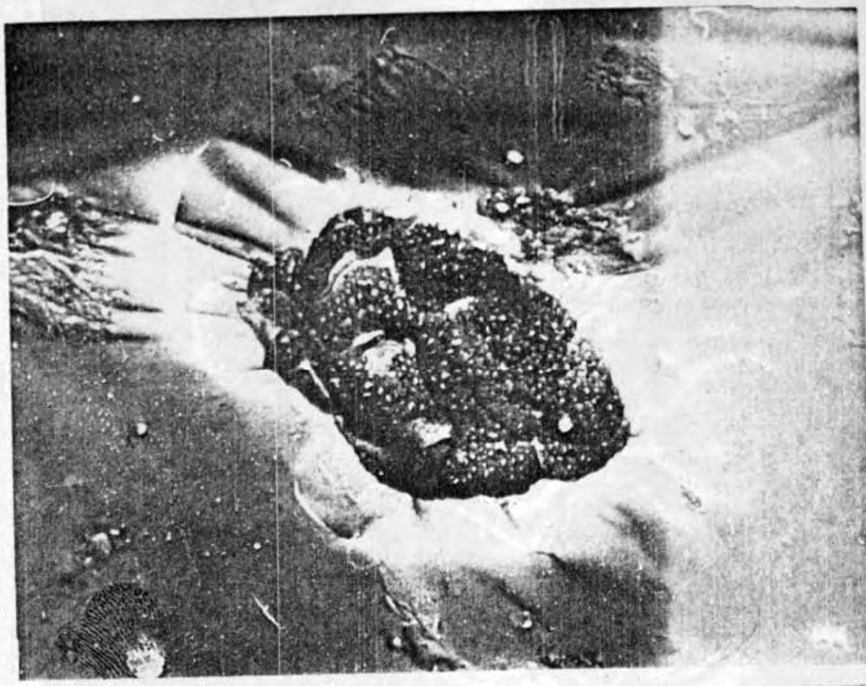
Plates 127 - 130 : Acacia kirkii

127. SEM (x 4000); flat and perforated exine surface.

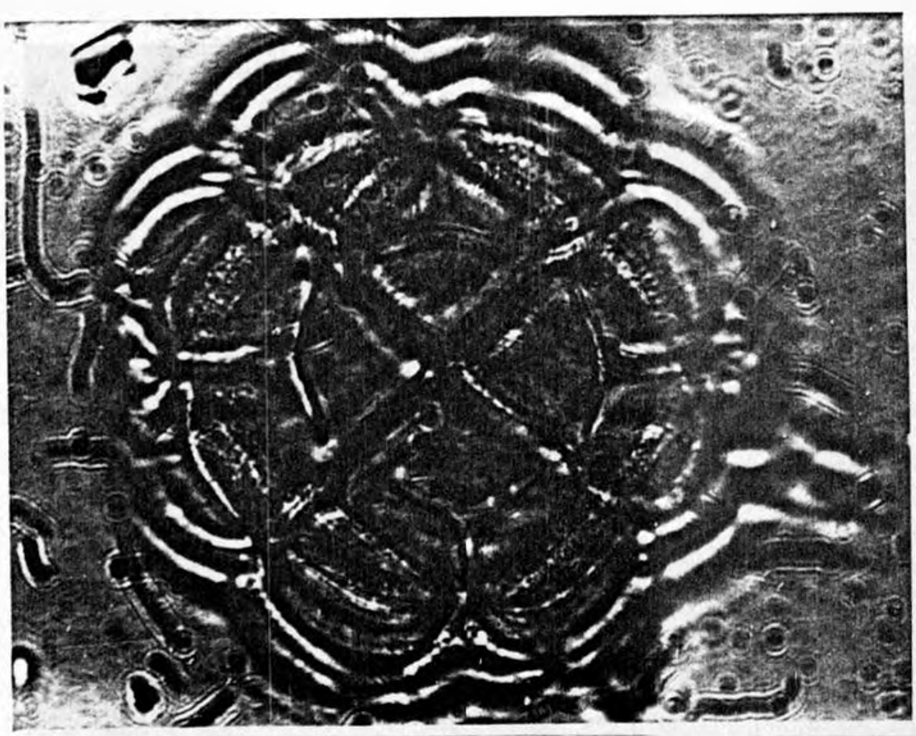
128. Ph. (x 1000) Y- shaped furrows on the central monads.

129. Ph. (x 1000); columellate exine structure and size D = 62.25 μ

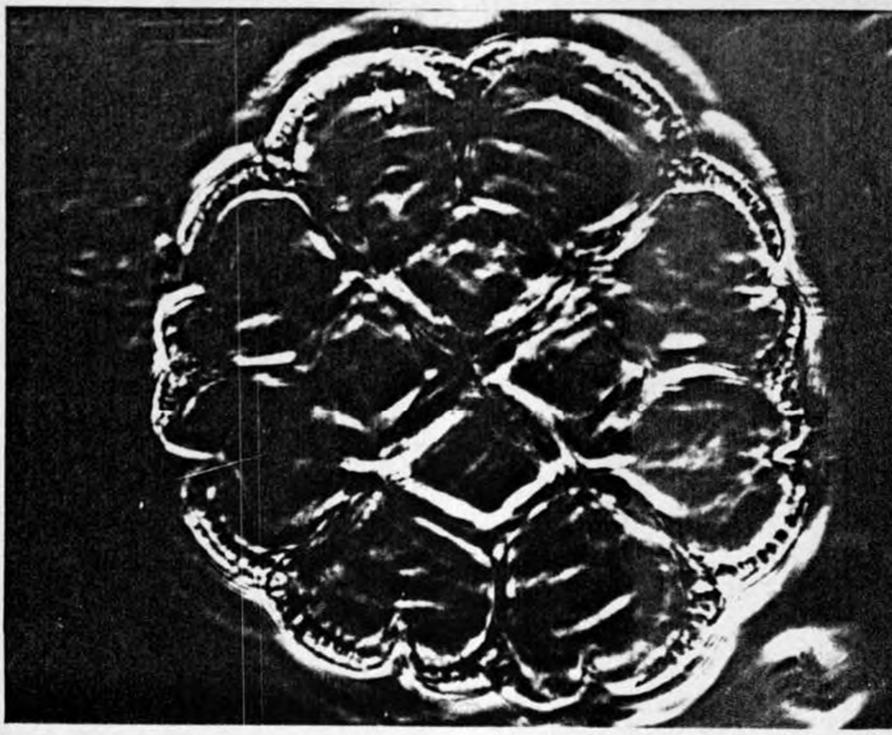
130. Ph. (x 1000); size E = 41.09 μ



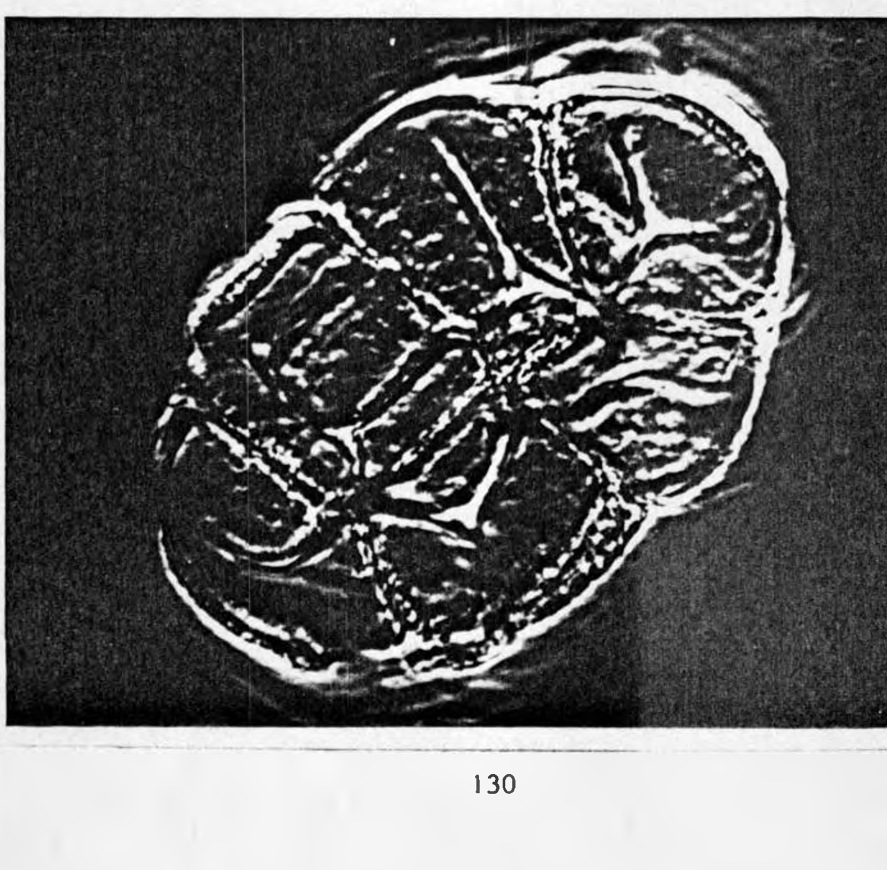
127



128



129



130

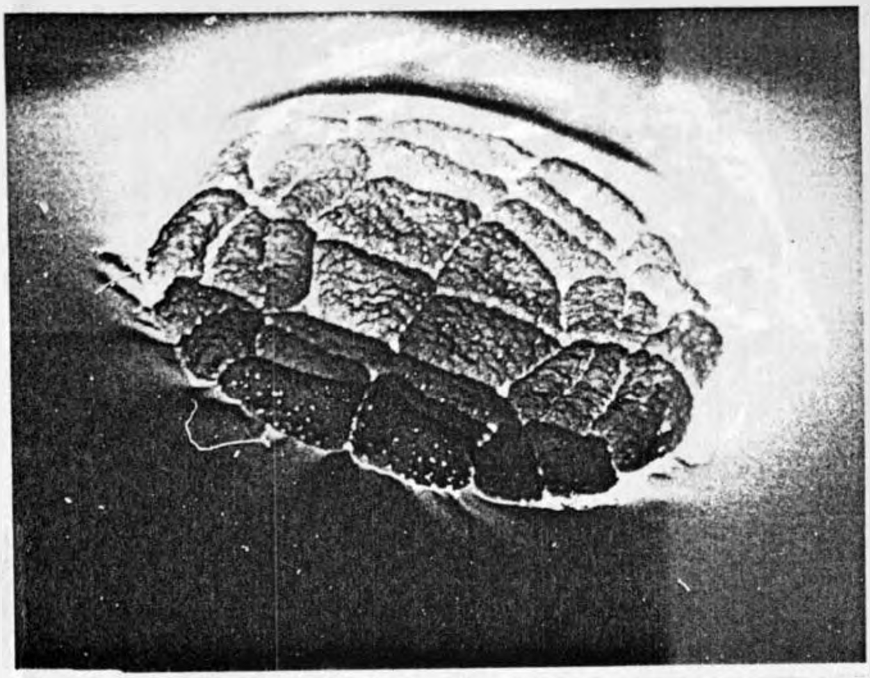
Plates 131 – 134 : Acacia clavigera

131. Ph. (x 1000) Y- shaped furrows on exine surface.

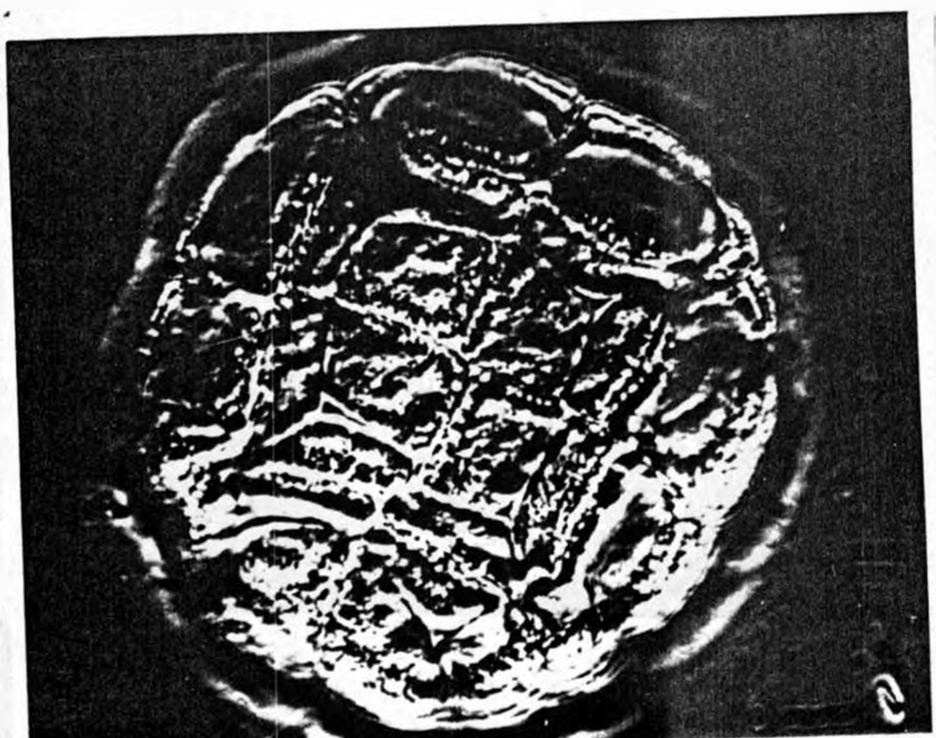
132. Ph. (x 1000) Y- shaped furrows on the central monads.

133. Ph. (x 1000) columellate exine structure and size D = 67.23 μ

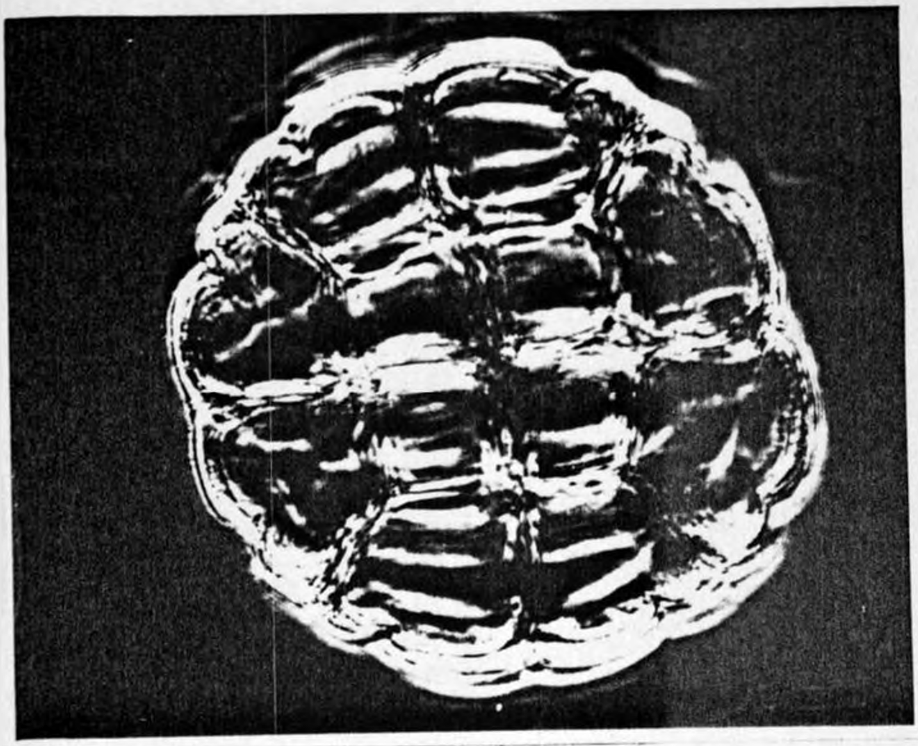
134. Ph. (x 1000); size E = 49.80 μ



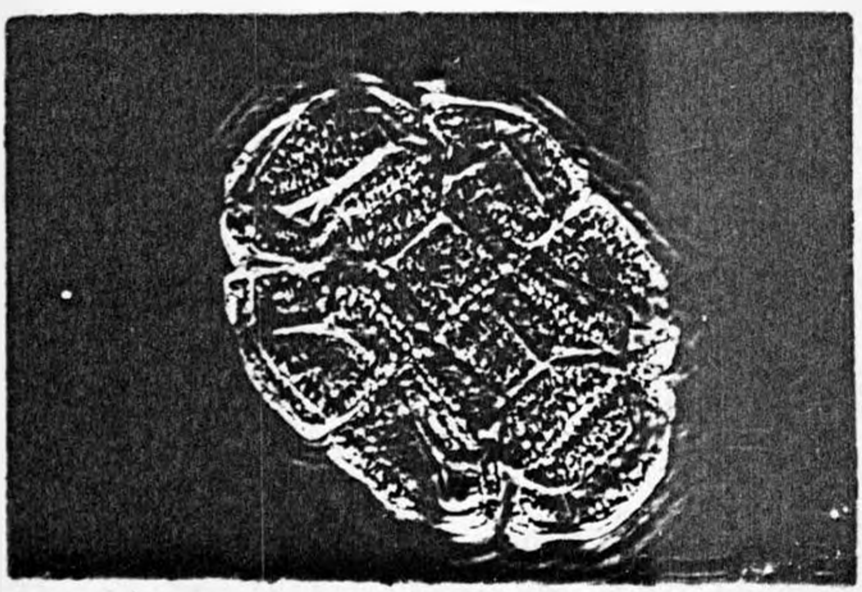
131



132



133



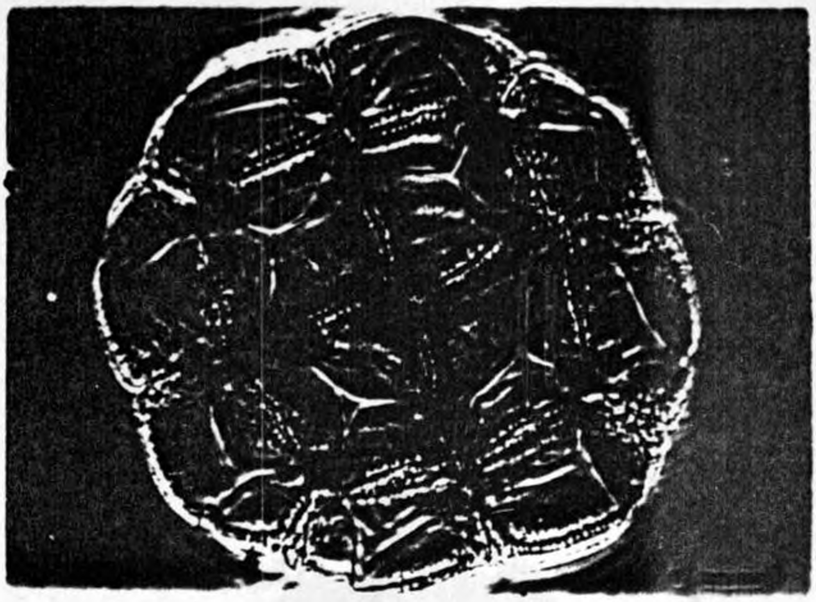
134

Plates 135 – 137 : Acacia paolii

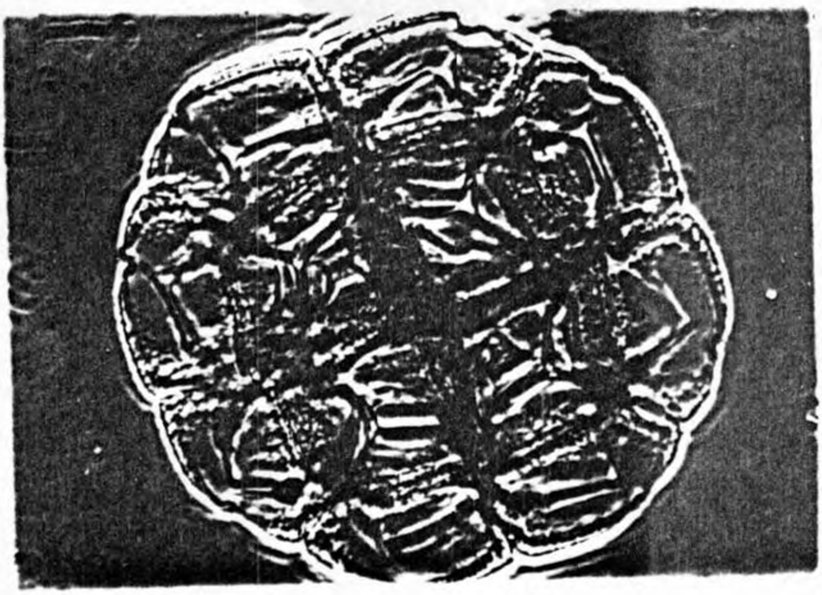
135. Ph. (x 1000); Y and H – shaped colporate apertures on the central and peripheral monads.

136. Ph. (x 1000); columellate exine structure and size D = 68.48 μ

137. Br. (x 1000); size E = 39.43 μ



135



136

137

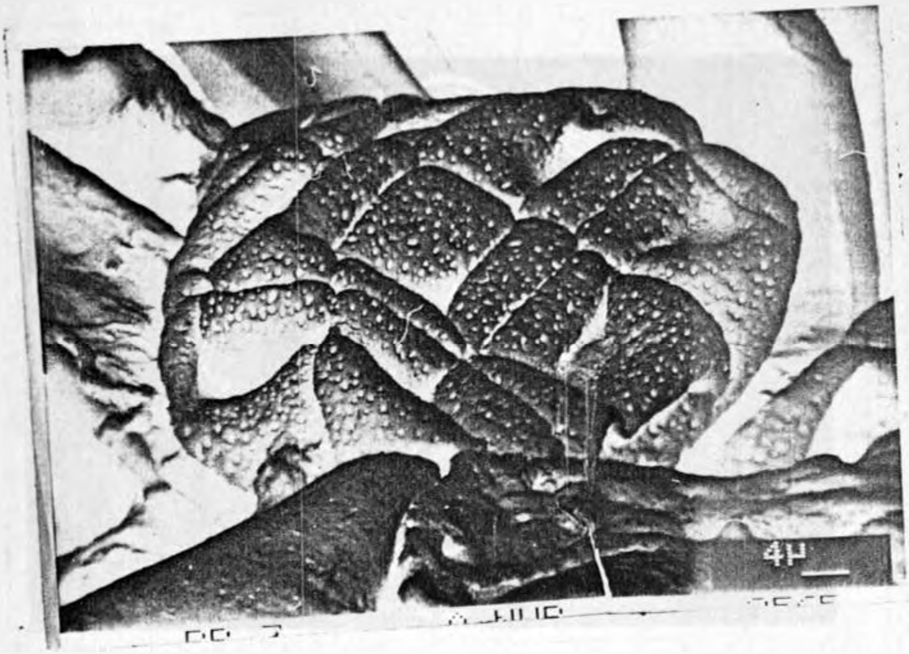
Plates 138 - 141 : Acacia nubica

138. SEM (x 10,000); flat, perforated exine surface.

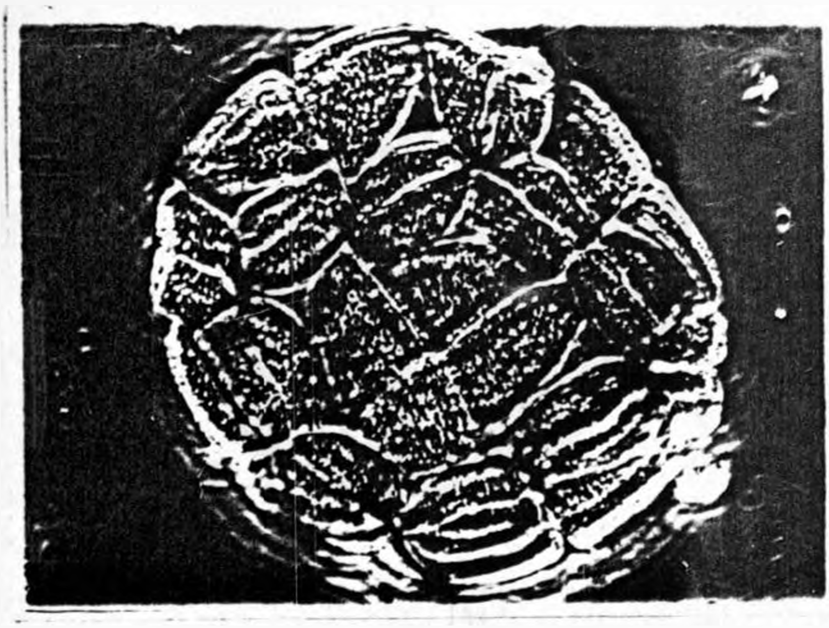
139. Ph. (x 1000) Y-shaped furrows on the central monads.

140. Ph. (x 1000); columellate exine structure and size D = 70.60 μ

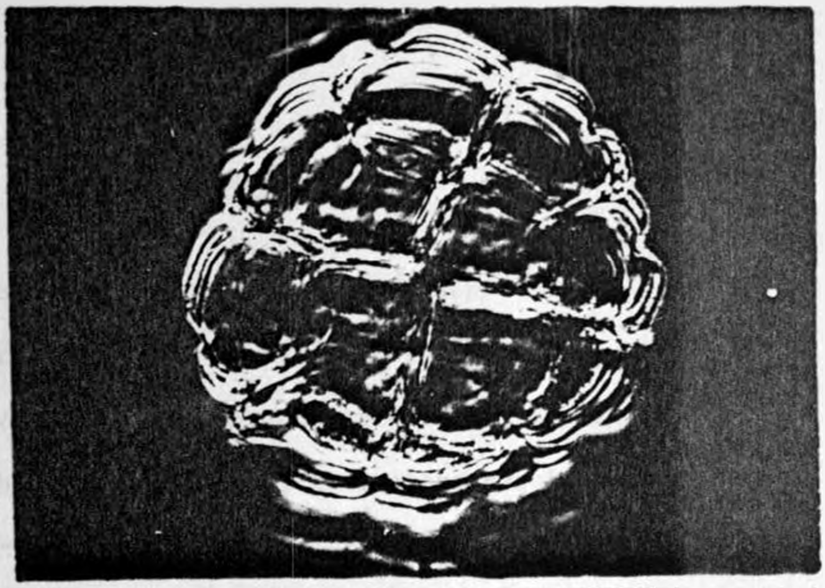
141. Br. (x 1000) size E = 41.50 μ



138



139



140

141

Table 1

3.3 The pollen grain characters considered to measure the degree of similarities of Acacia species in Kenya. The characters were aggregated to achieve the number of characters required for this analysis. Invariant characters were considered not admissible in the analysis.

KEY:

1 = present

0 = absent

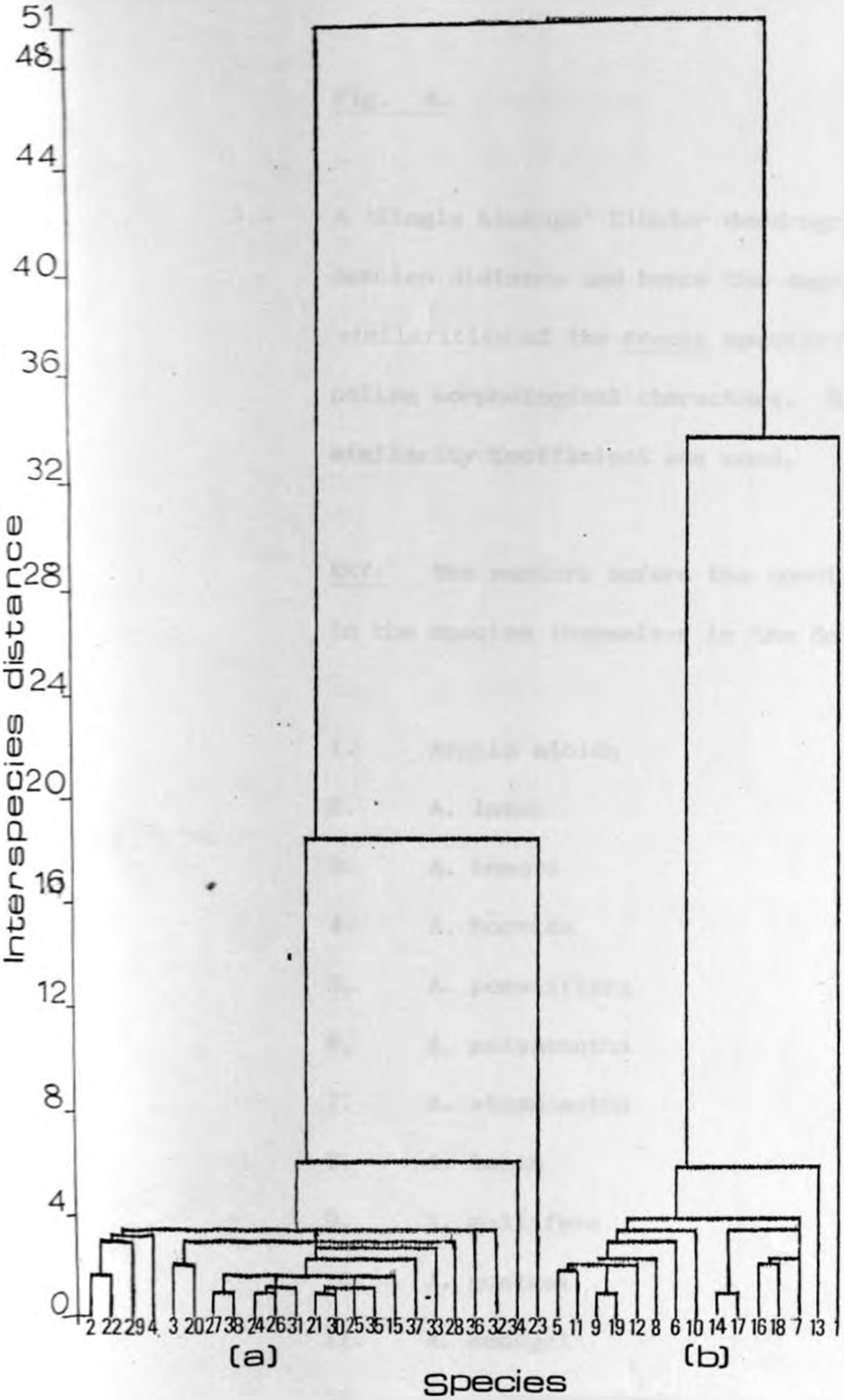
Table 1

characters

Taxa	Polyad Grain No.	Polyad diameter (D)	Polyad thickness (E)	Pore Clusters in 2s	Pore Clusters in 3s	Pore clusters in 4s	Furrows	Exine granular	Exine colum melate	Tectum	Exine smooth	Exine Perforated	Polyad acalymmated
A. albida	32	115.62 μ	63.20 μ	1	1	1	0	1	0	1	1	0	1
A. lahai	16	51.09 μ	33.20 μ	1	1	1	1	0	1	1	1	1	1
A. bussei	16	68.48 μ	35.28 μ	1	1	0	1	0	1	1	1	1	1
A. horrida	16	50.46 μ	41.50 μ	1	1	0	1	0	1	1	1	1	1
A. persiciflora	16	66.40 μ	41.50 μ	0	1	1	0	1	0	1	1	0	1
A. polyacantha	16	53.95 μ	37.35 μ	0	1	1	0	1	0	1	1	0	1
A. ataxacantha	16	45.70 μ	35.28 μ	0	1	1	0	1	0	1	1	0	1
A. laeta	16	48.00 μ	41.50 μ	0	1	1	0	1	0	1	1	1	1
A. mellifera	16	53.95 μ	41.50 μ	0	1	1	0	1	0	1	1	1	1
A. goetzei	16	68.40 μ	37.60 μ	0	1	1	0	1	0	1	1	1	1
A. senegal	16	62.25 μ	41.50 μ	0	1	1	0	1	0	1	1	0	1
A. circummarginata	16	58.10 μ	41.09 μ	0	1	1	0	1	0	1	1	0	1
A. thomasii	16	75.12 μ	47.52 μ	0	1	1	0	1	0	1	1	1	1
A. mearnsii	16	49.80 μ	29.55 μ	0	1	1	0	1	0	1	1	1	1
A. macrothyrsa	16	60.79 μ	41.98 μ	1	1	0	1	0	1	1	1	1	1
A. brevispica	16	41.58 μ	33.20 μ	0	1	1	0	1	0	1	1	1	1
A. adenocalyx	16	49.80 μ	29.55 μ	0	1	1	0	1	0	1	1	1	1

Taxa	Polyad Grain No.	Polyad diameter (D)	Polyad thickness (E)	Pore Clus-ters in 2s	Pore Clus-ters in 3s
A. monticola	16	45.90 μ	33.20 μ	0	1
A. pentagona	16	53.90 μ	41.50 μ	0	1
A. elatior	16	67.23 μ	33.65 μ	1	1
A. zanzibarica	16	54.32 μ	41.50 μ	1	1
A. seyal	16	54.37 μ	33.20 μ	1	1
A. drepanolobium	16	76.81 μ	55.61 μ	1	1
A. abyssinica	16	67.23 μ	41.50 μ	1	1
A. sieberiana	16	62.83 μ	41.50 μ	1	1
A. stuhlmannii	16	66.82 μ	41.50 μ	1	1
A. xanthophloea	16	70.55 μ	41.59 μ	1	1
A. hockii	16	64.12 μ	45.65 μ	1	1
A. ancistroclada	16	64.12 μ	41.50 μ	1	1
A. reficiens	16	67.65 μ	41.90 μ	1	1
A. etbaica	16	75.12 μ	45.65 μ	1	1
A. tortilis	16	62.25 μ	37.35 μ	1	1
A. gerrardii	16	78.80 μ	54.40 μ	1	1
A. kirkii	16	62.25 μ	41.09 μ	1	1
A. clavigera	16	67.23 μ	49.80 μ	1	1
A. paolii	16	68.48 μ	39.43 μ	1	1
A. nubica	16	70.60 μ	41.50 μ	1	1

Pore clusters in 4s	Furrows	Exine granu-lar	Exine colum melate	Tectum	Exine smooth	Exine Perfo-rated	Polyad acaly-mmated
1	0	1	0	1	1	0	1
1	0	1	0	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1



51
48
44
40
36
32
28
24
20
16
12
8
4
0
Interspecies distance
2 22 29 4 3 20 27 38 24 26 31 21 30 25 35 15 37 33 28 36 32 34 23 5 11 9 19 12 8 6 10 14 17 16 18 7 13 1
(a)
(b)
Species

Fig. 4

Fig. 4.

3.4 A 'Single Linkage' Cluster dendrogram showing inter-species distance and hence the degree of the similarities of the Acacia species studied based on pollen morphological characters. Gower's (1971) similarity coefficient was used.

KEY: The numbers before the species correspond to the species themselves in the dendrogram.

1. Acacia albida
2. A. lahai
3. A. bussei
4. A. horrida
5. A. persciflora
6. A. polyacantha
7. A. ataxacantha
8. A. laeta
9. A. mellifera
10. A. goetzei
11. A. senegal
12. A. circummarginata
13. A. thomasii
14. A. mearnsii
15. A. macrothyrsa
16. A. brevispica
17. A. adenocalyx
18. A. monticola

19. A. pentagona
20. A. elatior
21. A. zanzibarica
22. A. seyal
23. A. drepanolobium
24. A. abyssinica
25. A. sieberiana
26. A. stuhlmannii
27. A. xanthophloea
28. A. hockii
29. A. nilotica
30. A. ancistroclada
31. A. reficiens
32. A. etbaica
33. A. tortilis
34. A. gerrardii
35. A. kirkii
36. A. clavigera
37. A. paolii
38. A nubica

RESULT TABLE

TABLE 2:

3.5 **Distribution of Pollen Morphological characters, Pollen types, growth habit of the indigenous Kenyan *Acacia* species as observed under the microscope.**

TABLE 2

RESULTS

SPECIES	SURFACE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
1. Acacia albida	flat, smooth unperforated	pore clusters in twos, threes and fours	tectate and granular	32-celled polyad and acalymmated	115.62	63.20	tree
2. A. lahai	densely perfor-_ted and smooth	Y and H-shaped colporate apert-ures on the distal face of central and peripheral cells respectively	tectate and columnelate	16-celled acalymmated polyad	51.09	33.20	tree
3. A. bussei	densely perfor-_ted and smooth	Y- and H-shaped colporate apert-ures on the distal faces of central and peripheral cells respectively.	tectate columellate	16-celled acalymmated polyad	68.48	35.28	tree
4. A. horrida	densely perfo-rated and smooth	Y- and H-shaped colporate apert-ures on distal faces of the central and peri-pheral cells resp-ectively	tectate and columelate	16-celled acalymmated polyad	68.48	35.28	tree

SPECIES	SURFACE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
5. A. persiciflora	flat, smooth unperforated	Pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad.	66.40	41.50	tree
6. A.polyacantha	flat,smooth unperforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	53.95	37.35	tree
7. A. ataxacantha	flat,smooth unperforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	45.70	35.28	shrub
8. A. laeta	flat,smooth and perforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	48.00	41.50	Shrub or small tree
9. A. mellifera	Smooth and slightly perforated	pore clusters in threes and fours	tectate and granular	16-celled acalymatted polyad	53.95	41.50	shrub or small tree
10. A. goetzei	Smooth and slightly perforated	Pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	68.40	37.60	tree

SPECIES	SURFACE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	
11. Acacia senegal	flat and unperforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	62.25	41.50	shrub or small tree
12. A. circummarginatq	flat, unperforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	58.10	41.09	
13. A. thomasii	flat, slightly perforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	75.12	47.52	shrub or small tree
14. A.mearnsii	flat,and perforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	49.80	29.55	tree
15. A.macrothyrsa	flat and perforated	Y and H-shaped colporate apertures on the central & peripheral cells respectively	tectate and columellate polyad	16-celled acalymmated polyad	60.79	41.98	
16. A. brevispica	flat and slightly perforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	41.58	33.20	shrub or small tree

SPECIES	SURFACE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
17. A.adenocalyx	flat, smooth and slightly perforated.	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	49.80	29.55	shrub o
18. A. monticola	flat and smooth, unperforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	46.90	33.20	shrub o tree
19. A. pentagona	flat and densely perforated	pore clusters in threes and fours	tectate and granular	16-celled acalymmated polyad	53.90	41.50	tall liane
20. A. elatior	flat and perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively.	tectate and granulate	16-celled acalymmated polyad	67.23	33.65	tree

SPECIES	SURFACE ORNAME--NTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
21. A. zanzibarica	flat and perforated	Y and H- shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	64.32	41.50	tree
22. A. seyal	flat and perforated	Y and H- shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	54.37	33.20	tree
23. A. drepanolobium	flat and perforated	Y and H- shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	76.81	55.61	shrub or small tree
24. A. abyssinica	flat and slightly perforated	Y and H- shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	67.23	41.50	tree
25. A. sieberiana	flat and densely perforated	Y and H-shaped colporate apertures on central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	62.83	41.50	tree

SPECIES	SURFACE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
26. A. stuhlmannii	flat and densely perforated	Y and H-shaped colporate apertures on central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	66.82	41.50	tree
27. A. xanthophloea	flat and densely perforated	Y and H-shaped colporate apertures on central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	70.55	41.50	tree
28. A. hockii	flat and densely perforated	Y and H-shaped colporate apertures on central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	64.65	45.65	shrub or tree
29. A. nilotica	flat and densely perforated	Y and H-shaped colporate apertures on central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	51.05	37.35	tree
30. A. ancistroclada	flat and densely peprforated	Y and H-shaped colporate apertures on central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	64.12	41.50	shrub or small tree
31. A. reficiens	flat and peprforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	67.65	41.90	shrub

SPECIES	SURFACE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
32. Acacia etbaica	flat and densely perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	75.12	45.65	tree
33. A. tortilis	flat and very slightly perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	62.25	37.35	tree
34. A. gerrardii	flat and perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	78.80	54.40	tree or small shrub
35. A. kirkii	flat and densely perforated	Y and H- shaped colporate apertures on the central and peripheral cells respectively.	tectate and columellate	16-celled acalymmated polyad	62.25	41.09	tree

SPECIES	STRUCTURE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN μ D	E	HABIT
36. A. clavigera	flat and densely perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	67.23	49.80	tree
37. A. paolii	flat and perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	68.48	39.43	shrub or small tre
38. A. nubica	flat and densely perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively.	tectate and columellate	16-celled acalymmated polyad	70.60	41.50	shrub

SPECIES	STRUCTURE ORNAME-NTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASURE[redacted] IN µ		HABIT
					D	E	
36. A. clavigera	flat and densely perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16–celled acalymmated polyad	67.23	49.80	tree
37. A. paolii	flat and perforated	Y and H-shaped colpo-rate apertures on the central and peripheral cells respectively	tectate and columellate	16–celled acalymmated polyad	68.48	39.43	shrub or small tre
38. A. nubica	flat and densely perforated	Y and H-shaped colpo-rate apertures on the central and peripheral cells respectively.	tectate and columellate	16–celled acalymmated polyad	70.60	41.50	shrub

SPECIES	STRUCTURE ORNAMENTATION	KINDS OF APERTURES	EXINE WALL STRUCTURE	POLLEN TYPE	MEASUREMENTS IN Us D	E	HABIT
36. A. clavigera	flat and densely perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	67.23	49.80	tree
37. A. paolii	flat and perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively	tectate and columellate	16-celled acalymmated polyad	68.48	39.43	shrub or small tre
38. A. nubica	flat and densely perforated	Y and H-shaped colporate apertures on the central and peripheral cells respectively.	tectate and columellate	16-celled acalymmated polyad	70.60	41.50	shrub

CHAPTER 4

4. DISCUSSION & CONCLUSION

4.1 The polyad

The most obvious and outstanding feature observed from the pollen grain studies of the 38 indigenous Acacia species carried out in Kenya, is that at anthesis, the grains represent an assemblage of identical cells or monads compounded into a unit called the polyad. In each polyad the monads are identical both in size and shape. The final arrangement of these cells or monads, in a mature polyad, is induced by the number of associated primary mother cells (Knox & Kenrick, 1983), that are generally regularly patterned. This association that involves identical and definite number of cells is more or less independent of each other and is of the acalymmated type (Van Campo & Guinet, 1961).

The regular pattern is due to the symmetry of the polyad and is directly linked to the polyad grain number. The regular symmetry of a mature polyad is an outcome of a symmetric arrangement of the products from each primary mother cell and a normal development of all the associated monads, that is their shape and size, provided that all the subsequent mitotic divisions of each primary mother cell arises and continues in the same way. Hence the symmetric patterning of the polyads.

Of the 38 Acacia species 37 have a constant 16-cell polyad characteristic, which from a D-view have a central part consisting of 8-cells lying in two layers and forming a rectangular block around which are arranged the other 8-peripheral cells.

This gives the entire polyad a biconvex flattened disc, the general outline of which is circular or rounded square. The 38th species; Acacia albida, departs from the 16-celled characteristic by having a polyad consisting of 32-cells, each of its monads larger than any other monad from the polyads of the first 37 species as a result of which the polyad of this species is generally larger than the remaining species. The size ranges from 41:58 μ (A. brevispica) to 115.62 μ (A. albida) in diameter (D) while in thickness (E) it ranges from 63.20 μ to 33.20 μ in the respective species.

4.2 Exine

In the genus Acacia, the exine consists of the outermost layer called the ektexine, and an innermost layer called the endexine. In the ektexine, the tectum is fully developed in all the Acacia species investigated. The tectum sculpturing type is flat and smooth but variedly perforated. The polyad of Acacia albida is devoid of perforations but nevertherless smooth (table 2).

The predominantly infratectal structure consists of the columellate type on the section Gummiferae and non-columellate type (granulate) on the section Vulgares. This type of exine structure is common in the other angiosperms (Vam Campo and Lugardon, 1973).

The endexine is present in all the species investigated as the final basal layer of the exine and never exceeds the thickness of the ektexine (Guinet, 1981).

It is apparent that the nature of the exine structure is related to the types of apertures. Where the infratectal structure is columellate, the apertures are colporate and when it is non-columellate (granulate), the apertures are porate. The reason for this type of an association is still unknown (Guinet, 1981).

4.3 Apertures

The occurence of functional apertures in the polyads of the 38 investigated indigenous Acacia species is a constant character. There are two types of apertures, the complex and the simple, that depict striking features which are of taxonomic significance. On the basis of these apertures, two groups of the Acacia spp. have been recognised.

The section Gummiferae (Bentham, 1842), proposed to be subgenus Acacia (Guinet & Vassal, 1978) have polyads with complex apertures. A flat view of the distal face of the polyads of this group shows that the central monads have Y-shaped furrows that originate from the base of each to the poles of the same monads (fig. 2). These furrows border out an area that is large enough on each of the monads. The peripheral monads have H-shaped furrows. Pore clusters combining with the furrows to form colporate apertures is of frequent occurence. The clusters of pores are located at the angles where each arm of the Y-shaped furrows terminate or originate. The pore clusters are in threes and twos (Guinet, 1969) among the species belonging to subgenus Acacia and are located at the angles where the monads meet in threes and twos respectively. The clusters of pores by twos are on the distal face of the central monads while clusters by threes are on the peripheral cells. This symmetrical distribution of apertural characters, that is, Y-shaped colporate apertures on the central block of the polyad and H-shaped colporate apertures on the peripheral monads depicts a balanced heteromorphy on the compound grain of the 16-celled polyads, (Guinet, 1969) which characterises the subgenus Acacia.

The polyads of the section Vulgares (Bentham, 1842) and which has been revised and proposed to be subgenus Aculeiferum (Guinet and Vassal, 1978) have functional apertural system consisting of simple porate type. A flat view of the distal face of these polyads show that the pores are in clusters of threes and fours. Additionally, there is an extra supplementary set of pores in clusters of fours in the dead-centre of the polyads of this group. The pore clusters by fours are in the five groups at the angles where the monads meet in fours and are perpendicularly lying on the two symmetrical lines of the polyads (fig. 3). The pore clusters by threes alternate with the clusters by fours along the peripheral angles where the monads meet in threes (fig. 3). There is a complete absence of complex apertures on the subgenus Aculeiferum.

Guinet (1969) reported the presence of functional proximal pores on the proximal face of isolated monads, of the Acacia species (subgenera Acacia, Aculeiferum and Heterophyllum). This further enhances the taxonomic significance of the apertures in reference to their area of distribution on each monad.

The distribution of sporopollenin material is more on the distal face than on the proximal face of the monads. One can therefore, safely deduce that this unequal distribution of the sporopollenin contributes to the differentiation of the colporate apertures on the distal faces, where there is more sporopollenin material, and encourages the development of simple pores on the distal faces of the monads where the sporopollenin is comparatively less deposited.

The proximal faces which have little sporopollenin can only have pores differentiating on these faces. This deduction accords well with Guinet's (1981) hypothesis that a change of the exine structure can easily induce a change on the apertural types. It is also obvious that the subgenus Acacia have more deposition of sporopollenin material on the distal face than the subgenus Aculeiferum.

4.4 Similarities of the Acacia species based on pollen morphological characters.

A summary of the species similarities of the genus Acacia based on pollen taxonomic approach is given in fig 4. A cluster analysis which is a non-statistical data reduction technique for grouping unclassified data into clusters was used to generate a 'Single Linkage' dendrogram (fig. 4). The database contains both binary and quantitative variables (table 1), therefore Gower's (1971) similarity coefficient was used. A 'Viewclust' Computer Programme on a BBC microcomputer was applied.

Gower's similarity coefficient measure is defined as

$$S_{ij} = \sum_{k=1}^{p} S_{ijk} \Big/ \sum_{k=1}^{p} w_{ijk}$$

Where S_{ij} is the similarity between any two taxa (individuals) i and j, S_{ijk} is the shared similarity between taxa i and j for any character k and w_{ijk} is the valid character considered for comparis on. With dichotomous variable, w_{ijk} is set to zero when variable k is known to be absent from both individuals.

For quantitative data $S_{ijk}=1-|x_{ik}-x_{jk}|/R_k$, where x_{ik} is the score of taxa i on variable k, and R_k is the range of variable k.

The characters chosen for comparison (Pg. 205) were drawn from the pollen grains of the Acacia species studied and these characters are basically the representatives of the genus from pollen taxonomic approach point of view. Thus the pollen grain number, the diameter of a spherical grain of indistinct polarity (D) the length of equatorial axis of an isopolar grain (E), the presence of furrows and their number on the central monads, the nature of the exine, the presence of pores and their number (pore clusters in twos, threes and fours) on the polyad were the characters taken into account. The diameter (D) and the length of equatorial axis (E) were measurable characters and vary from the polyad of one species to the other.

Two clear groups denoted by (a) and (b) have separated out naturally in the dendrogram. Group (a) which corresponds to Bentham's (1842) Gummiferae is defined by the 16-celled acalymmated polyad type, columellate exine structure and colporate apertures. These characters are constantly present on the pollen of the species classified under the section Gummiferae. The low branching of Acacia drepanolobium (23) and its nearest neighbour, Acacia gerrardii (34) can be explained to be due to the size measurements of the polyad diameters (D) and thickness (E). It is due to these variable characters that a certain degree of dissimilarities can be seen in the Section Gummiferae. The same explanation can be offered for the degree of dissimilarities occurring in group (b). Group (b) which corresponds to Bentham's Vulgares is defined by the following constant characters: 16-celled acalymmated polyad type, granulate exine structure, simple porate apertures clustered in threes and fours including a supplementary set of pores.

Acacia albida (1) is seen in the dendogram as being anomalous and emphasizes its isolation. Though distanced from the Gummiferae, it shares some pollen characters with the species of Section Vulgares.

On the basis of characters drawn from comparative morphology, this species was classified under section Gummiferae by Bentham(1842) under which, it has characters in common with the other members. Pollen morphological characters of A. albida stand out exempting it from the rest of the species. The grain classification as belonging to Gummiferae or Vulgares which commonly applies to the Acacia species does not all befit it.

Acacia albida departs from the pattern and appears to be anomalous because the monad composition of its polyad consist of 32 cells which makes it larger than the grains of the other species. The polyad has pore clusters in threes and fours minus the supplementary set of pores and the exine shows a smooth, flat unperforated tectum having a granular infratectal structure.
The isolation of A. albida on the basis of pollen characters supports the arguments raised by the findings from Seed morphology (Brenan, 1959) Seed biochemistry (Robbertse, 1973), leaf and pod Morphology (Robbertse, 1975) Phytochemistry (Evans and Bell, 1975) and Chromosomal number and morphology (Vassal and Lescanne, 1976). These lines of evidence manifest the anomalies of Acacia albida in regard to its previous inclusion under the Gummiferae and questions why it should still be treated as so.

It is also clearly evident that the manner in which the Acacia species have separated out in the dendrogram correlates with the nature of the stipules (Bentham, 1842) but not the types of the inflorescences (Oliver, 1871). A comparison between the nature of the stipules and pollen morphological evidence shows that the Acacia species with spinescent stipules, except A. albida, have pollen grains with furrows whereas the species with non-spinescent stipules have pollen grains without furrows.

A similar comparison between pollen morphological evidence and the types of inflorescences shows that while the majority of the Acacia species with capitate inflorescences have pollen grains with furrows, some species (A. brevispica, A. adenocalyx, A. pentagona, A. monticola, A. mernsii) with capitate inflorescences have pollen grains without furrows. On the other hand, majority of the Acacia species with spicate inflorescences have pollen grains without furrows whereas some species (A. lahai, A. bussei, A. horrida) have pollen grains with furrows.

The position of the Acacia species with spinescent stipules and spicate inflorescences and the species with non-spinescent stipules and capitate inflorescences is no longer anomalous when correlated with pollen morphological characters. A correlation between pollen morphological characters and the types of inflorescences produces an anomalous classification in which some Acacia species with capitate inflorescences have pollen grains with and without furrows and some Acacia species with spicate inflorescences have pollen grains without and with furrows.

The pollen morphological evidence overwhelmingly indicates that when a more natural division of the Acacia species is sought, the nature of the stipules must be used for separating the two main divisions of the Acacia species in Kenya. This evidence supports the contention that the stipules is a more natural character than the types of the inflorescences when classifying the African Acacia species. This also accords well with Bentham's (1842) classification of the Acacia species in which he used the stipules to separate out the major divisions of the Acacia species.

4.5 CONCLUSION

The basic character that is common to all the Acacia species investigated is the compound state of their pollen grains. The characters associated with this compound state are the symmetry and shape of the polyads as well as the uneven distribution of the exine material on the faces of the monads. On this basis alone 37 Acacia species in Kenya which falls under section Gummiferae and Vulgares are of 16-celled acalymmated polyad type with an even symmetry and shape. Acacia albida has 32-celled acalymmated polyad type while the symmetry and shape does not change.

There is, however, a set of characters that is independent from the mode of association that distinguish the species into two major groups which correspond to the spinescent and non-spinescent species.

The colummelate exine structure, the Y-shaped colporate apertures and their location on the distal faces of the central monads are distinctive and consistent for the spinescent species. The non-spinescent species are defined by granular exine structure, simple pores clusters in threes and fours including a supplementary set of pores clustered in fours.

The tectum which is present in all the species has a varied sculpturing from smooth, perforated to densely perforated. This character is of little diagnostic value as it occurs in some species and absent in others regardless of their group classification.

The significance of this pollen data to taxonomy is that the pollen morphological characters that have accorded to the spinescent and non-spinescent species correspond to Bentham's (1842) sections Gummiferae and Vulgares respectively.

A comparison between pollen morphological characters with the classification outlined by Bentham (1842) based on the nature of the stipules, shows a high degree of correlation than the classification based on the types of the inflorescences as presented by Oliver (1871) in Flora of Tropical Africa as there is no correlation between pollen characters and the types of the inflorescences.

The deviation shown by Acacia albida on the basis of pollen characters and as evidenced by other workers (Pg.226) make the species anomalous in regard to its classification under section Gummiferae. Comparatively, there are many characters both from pollen analysis and macromorphology which indicate that Acacia albida has no relationship with the section Vulgares.

In view of these facts, there is no line of evidence that supports the treatment of Acacia albida as a member of the section Gummiferae. On the other hand, there is no evidence that suggests that it is not a member of the genus Acacia. The species therefore, must be treated as a member of the genus that neither belongs to the section Gummiferae nor Vulgares. Since the only available evidence contradicts its membership as either belonging to the Gummiferae or Vulgares, the results suggest that a hierarchy be created to accommodate such anomalous species like Acacia albida.

In this study pollen morphological sequence has shown its value and contribution as a tool for taxonomic studies of the African Acacia species. The trend of characters taken from the polyad and characters linked to it, to the nature of apertures and exine structure have shown how naturally they can delimit the taxa into two natural groups (Vulgares and Gummiferae). The significance of this study is that the pollen grain characters has revealed a tendency to agree with Bentham's classification system which is therefore, more appropriate and natural in its choice of stipular character as compared to Oliver's system which tends to be artificial. Owing to the proven consistency of pollen morphological characters, either in fossil form or from old herbarium material, pollen analysis should be incorporated into taxonomy as a line of evidence. This would be a valuable tool particularly in phenetic and phylogenetic studies.

APPENDIX 1.

List of Acacia species collected in Kenya and palynologically Analysed (In alphabetical order)

S. No.	Species	Authority	Sub-Family	Coll.	Herb.No.	Location	Herb. source
1	Acacia abyssinca	Hochst. ex. Benth.	Mimosoideae	Major Lugard	582	Mt. Elogn	E.A.
2	A. adenocalyx	Brenan & Exell	"	Battiscombe	781	Kilifi Distr.	E.A.
3	A. albida	Del.	"	Sormorer	271	Naivasha	E.A.
4	A. ancistroclada	Brenan	"	Thomas D.B.	682	Amboseli	E.A.
5	A. ataxacantha	DC.	"	Ichikawa	151	Mathews Range	E.A.
6	A. brevispica	Harms	"	Riley	74171	Thuchi River	N.A.I.
7	A. bussei	Sjöstedt.	"	Lenthold	98	Irima Waterfalls	E.A
8	A. circummarginata	Chiov.	"	Adamson	40	Mt. Thlat N.Kenya	N.A.I
9	A. clavigera	E. Mey	"	Okerfoot	s.n.	Mt. Nyiru	E.A
10	A. drepanolobium	Sjöstedt	"	Kokwaro	s.n.	Athi plains	N.A.I.
11	A. elatior	Brenan	"	Muchiri	661	Samburu	N.A.I.
12	A. etbaica	Schweinf.	"	Verdcourt	3758	Rhino Hill Kajiado District	E.A.
13	A. gerradii	Benth.	"	Smart	19	Mirte(KI)	E.A.
14	A. goetzei	Harms	"	Gillett	12668	Moyale	N.A.I.
15	A. hockii	De Willd.	"	Chapman	s.n.	Lambwe Valley	E.A

S. NO.	Species	Authority	Sub-family
16	A. horrida	Willd.	Mimosoideae
17	A. kirkii	Oliv.	"
18	A. laeta	Benth.	"
19	A. lahai	Benth.	"
20	A. macrothyrsa	Harms	"
21	A. mearnsii	De Willd.	"
22	A. mellifera	(Vahl)Benth.	"
23	A. nilotica	Del.	"
24	A. monticola	Brenan & Exell	"
25	A. nubica	Benth.	"
26	A. paolii	Chiov.	"
27	A. pentagona	Schum. & Thonn.	"
28	A. persiciflora	Pax	"
29	A. polyacantha	Willd.	"
30	A. reficiens	Wawra	"
31	A. senegal	(L.)Willd.	"
32	A. sieberiana	DC.	"
33	A. seyal	Del.	"

Coll.	HERB. NO.	Location	Herb. source
Adamson	5	Isiolo	E.A.
Napier	5144	Athi river	E.A.
Napper	849	Namanga	E.A.
Ossent	470	Kitale	E.A.
Ivens	733	Nandi Escarpment	E.A.
Breteler	207	Marongo Kisii	E.A.
Simonson	9	River Kerio (K2)	E.A.
Mwangangi	2186	Kithembe Hill	N.A.I.
Lucas	123	Kakamega	E.A.
KES	26	Shombole (K2)	E.A.
Mathew	6746	Eyalel Turkana	E.A.
Greenway	4475	Taveta	E.A.
Nightngale	3	Nakuru	E.A.
Agnew	8857	Tana River	N.A.I.
Heady	1268	Maji ya moto	E.A.
Watkins	30	Suregei	N.A.I.
Graham	2281	K7	E.A.
Mwangangi	2187	Kithambe Hill	N.A.I.

S. No.	Species	Authority
34	A. stuhlmannii	Taub.
35	A. thomasii	Harms
36	A. tortilis	Hayne
37	A. xanthophioea	Benth.
38	A. zanzibarica	Taub.

Sub-Family	Coll.	Herb.No.	Location	Herb.source
"	Strid	2799	Nairobi Falls	N.A.I.
"	Agnew	7329	Tsavo East	N.A.I.
"	Adamson	K/13	Kora Game Reserve K7	E.A.
"	Demmant	95	Nakuru	E.A.
"	Bogdan	s.n.	Mombasa	E.A.

APPENDIX 2: POLYAD 'D' and 'E' PLANE MEASUREMENTS: MAGNIFIED AT X1000

	Species	Measurements (D)	Mean(D)	Measurements (E)	Mean (E)
1	Acacia albida	115.62, 115.00, 116.24	115.62	63.20, 64.50, 61.90	63.20
2	A lahai	51.00, 51.18, 51.09	51.09	33.20, 34.20, 32.20	33.20
3	A. bussei	67.48, 69.50, 68.46	68.48	35.58, 34.62, 35.64	35.28
4	A. horrida	49.41, 51.52, 50.46	50.46	41.50, 41.40, 41.60	41.50
5	A. persiciflora	65.40, 66.69, 67.11	66.40	41.45, 41.40, 41.65	41.50
6	A. polyacantha	53.95, 54.00, 53.90	53.95	37.45, 36.35, 38.25	37.35
7	A. ataxacantha	45.70, 44.90, 46.50	45.70	36.28, 35.00, 34.56	35.28
8	A. laeta	48.35, 48.00, 47.65	48.00	41.55, 40.95, 42.00	41.50
9	A. mellifera	54.05, 53.86, 53.94	53.95	41.35, 41.50, 41.65	41.50
10	A. goetzei	67.72, 68.40, 69.08	68.40	37.00, 38.00, 37.20	37.60

	Species	Measurements (D)	Mean(D)	Measurements (E)	Mean (E)
11	Acacia Senegal	62.35, 62.47, 61.93	62.25	40.90, 41.50, 42.10	41.50
12	A. circummarginata	57.89, 58.20, 58.21	58.10	40.97, 41.11, 41.19	41.09
13	A. thomasii	75.46, 74.58, 75.32	75.12	47.22, 48.01, 47.33	47.52
14	A. mearnsii	49.87, 49.62, 49.91	49.80	30.05, 29.10, 29.50	29.55
15	A. macrothyrsa	60.60, 60.98, 60.79	60.79	41.96, 42.08, 41.90	41.98
16	A. brevispica	41.58, 41.48, 41.68	41.58	33.45, 32.75, 33.4	33.20
17	A. adenocalyx	49.91, 49.77, 49.72	49.80	29.65, 29.51, 29.49	29.55
18	A. monticola	46.80, 47.10, 46.80	46.90	33.23, 33.12, 33.25	33.20
19	A. pentagona	53.90, 54.00, 53.80	53.90	41.55, 41.40, 41.55	41.50
20	A. elatior	67.53, 66.64, 67.62	67.23	33.62, 33.70, 33.63	33.65

	Species	Measurements (D)	Mean(D)	Measurements (E)	Mean (D)
21	Acacia zanzibarica	64.33, 64.35, 64.28	64.32	41.50, 41.40, 41.60	41.50
22	A. Seyal	54.36, 54.50, 54.35	54.37	33.25, 33.10, 33.05	33.20
23	A. drepanolobium	76.83, 76.82, 76.78	76.81	55.64, 55.67, 55.52	55.61
24	A. abyssinica	67.24, 67.32, 67.13	67.23	41.50, 41.49, 41.51	41.50
25	A. sieberiana	62.53, 62.66, 63.30	62.83	41.50, 41.40, 41.60	41.50
26	A. stuhlmannii	66.84, 66.76, 66.86	66.82	41.45, 41.45, 41.60	41.50
27	A. xanthophloea	70.55, 70.57, 70.53	70.55	41.50, 41.50, 41.50	41.50
28	A. hockii	64.14, 64.20, 64.02	64.12	45.69, 44.93 46.33	45.65
29	A. nilotica	51.05, 51.15, 50.95	51.05	37.38, 37.42, 37.25	37.35

	Species	Measurements (D)	Mean(D)	Measurements (E)	Mean (E)
30	Acacia ancistroclada	64.13, 64.21, 64.02	64.12	41.50, 39.99, 43.01	41.50
31	A. reficiens	67.65, 67.66, 67.63	67.65	41.90, 41.89, 41.91	41.90
32	A. etbaica	75.11, 75.22, 75.03	75.12	45.68, 45.63, 45.64	45.65
33	A. tortilis	62.35, 6.00, 62.40	62.25	37.33, 37.40, 37.32	37.35
34	A. gerrardii	78.80, 78.78, 78.82	78.80	54.40, 54.39, 54.41	54.40
35	A. kirkii	62.21, 62.31, 62.23	62.25	41.09, 41.11, 41.07	41.09
36	A. clavigera	67.24, 67.25, 67.20	67.23	49.81, 49.83, 49.77	49.80
37	A. paolii	68.48, 68.46, 68.50	68.48	39.44, 39.44, 39.41	39.43
38	A. nubica	70.61, 70.61, 70.58	70.60	41.51, 40.91, 42.08	41.50

APPENDIX 3 : POLLEN MORPHOLOGICAL CHARACTERS

Taxa	Polyad grain No.			Pore clusters in 2s			Pore clusters in 3s			Pore clusters in 4s			Furrows			Exine granu- lar			Exine colum- melate			Tectum			Exine smooth			Exine perfo- rated			Polyad acalym- mated		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
A. albida	32	32	32	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. lahai	16	16	16	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A. bussei	16	16	16	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A. horrida	16	16	16	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A. persiciflora	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. polyacantha	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. ataxacantha	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. laeta	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. mellifera	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. goetzei	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. senegal	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. circummarginata	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. thomasii	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. mearnsii	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. macrothyrsa	16	16	16	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A. brevispica	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. adenocalyx	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
A. monticola	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1
A. pentagona	16	16	16	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1

Taxa	Polyad grain No.			Pore clusters in 2s			Pore clusters in 3s			Pore clusters in 4s		
	1	2	3	1	2	3	1	2	3	1	2	3
A. elatior	16	16	16	1	1	1	1	1	1	0	0	0
A. zanzibarica	16	16	16	1	1	1	1	1	1	0	0	0
A. seyal	16	16	16	1	1	1	1	1	1	0	0	0
A drepanolobium	16	16	16	1	1	1	1	1	1	0	0	0
A. abyssinica	16	16	16	1	1	1	1	1	1	0	0	0
A. sieberiana	16	16	16	1	1	1	1	1	1	0	0	0
A. stuhlmannii	16	16	16	1	1	1	1	1	1	0	0	0
A. xanthophloea	16	16	16	1	1	1	1	1	1	0	0	0
A. hockii	16	16	16	1	1	1	1	1	1	0	0	0
A. nilotica	16	16	16	1	1	1	1	1	1	0	0	0
A. ancistrocloda	16	16	16	1	1	1	1	1	1	0	0	0
A. reficiens	16	16	16	1	1	1	1	1	1	0	0	0
A. etbaica	16	16	16	1	1	1	1	1	1	0	0	0
A. tortilis	16	16	16	1	1	1	1	1	1	0	0	0
A. gerrardii	16	16	16	1	1	1	1	1	1	0	0	0
A. kirkii	16	16	16	1	1	1	1	1	1	0	0	0
A. clavigera	16	16	16	1	1	1	1	1	1	0	0	0
A paolii	16	16	16	1	1	1	1	1	1	0	0	0
A. nubica	16	16	16	1	1	1	1	1	1	0	0	0

Furrows			Exine granu-lar			Exine colum-melate			Tectum			Exine smooth			Exine Perfo-rated			Polyad acalym-mated		
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

REFERENCES

Allen, O.N. & Allen, E.K., 1981. The Leguminosae. A source book of Characteristics, Uses and nodulation. University of Wisconsin Press.

Bentham, G., 1875. Revision of Suborder Mimoseae. Trans. Linn. Soc. Lond. 30 : 335-664.

Bentham, G., & Hooker., J.D., 1865, Leguminosae, subfamily Mimosoideae. In, Genera Plantarum. 1: 594-595, Reeve and Company, London.

Bentham, G., 1842. Notes on Mimoseae, with a synopsis of species. Hook., Lond. J. Bot. 1 : 318-392.

Bogdan, A.V. & Pratt, D.J., 1961. Common Acacias of Kenya, Government Printer, Nairobi.

Bonnefille, R., 1976. Implications of pollen assemblage from the Koobi Fora Formation, East Rudolf, Kenya. In, Nature, 264 : 403-407.

Bonnefille, R., et Riollet, G., 1980. Pollens des Savanes d'Afrique Orientale. Editions du C N R S, Paris.

Bonnefille, R., 1980. Vegetation history of Savanna in East Africa during the Plio-pleistocene. Proc. Ivint. Palynol. Conf., Lucknow. 3 : 75-89.

Brenan, J. P. M., 1959 Leguminosae subfamily Mimosoideae. In, Flora of Tropical East Africa, ed. C.E. Hubbard & E. Milne-Redhead, Crown Agents, London.

Brooks, J. and Shaw, G., 1968. Identity of Sporopollenin with older kerogen and new evidence for possible biological source of Chemicals in sedimentary rocks. In, Nature, Lond. 220 : 678-679.

Clifford, H.T. & Stephenson, W., 1975. An Introduction to numerical classification. Academic Press, New York.

Coetzee, J.A., 1955. The Morphology of Acacia pollen. S. Afr. J.Sci . 52 : 23-27.

Cronquist, A., 1968. The evolution and classification of flowering plants. Nelson and Sons, London.

Dale, I. R., & Greenway, P.J., 1961. Kenya Trees and Shrubs. Buchanan's Kenya Estates Ltd. & Hatchards, London.

Darlington, C.D., & Wylie, A.P., 1955. Chromosome atlas of flowering plants. George Allen & Unwin., London.

Davis, P.H. & Heywood, V.H., 1963. principles of Angiosperm Taxonomy. Olive & Boyd Ltd., London.

Elamin, H.M., 1973 Sudan Acacia. Forest Research Institute Bull. 1 : 1-64.

Elias, T., 1981. Mimosoideae. In Advances in Legume Systematics ed. R.M. Polhill and P.H. Raven, Royal Botanic Gardens, Kew, pp. 143-151.

Engler, A., 1888. Plantae Marlothianae ein beitrag zur Kenntnis der flora Südafrikas. Bot. Jb. 10 : 1-50.

Erdtman, G., 1966. Pollen Morphology and Plant Taxonomy - Angiosperms, Hafner Publishing Co. New York.

Evans, C.S., & Bell, E.A., 1975. A preliminary Survey of free amino acids in seeds of Acacia species. In, Bull. International Group for study of Mimosoideae 3 : 39

Everitt, B., 1982. Cluster analysis. Heineman Educational, London.

Faegri, K. & Iversen, J., 1964. Testbook of pollen analysis Munksgaard, Copenhagen.

Ferguson, I. K., & Strachan, R., 1982. Pollen Morphology and Taxonomy of the Tribe Indigofereae (Leguminosae : Papilionoideae). Pollen et Spores Vol. XXIV-NO. 2

Gilbert, G. & Boutique, R., 1952. Flore du Congo Belge et du Ruanda-Urundi; 3: 137-233. Bruxelles.

Glover, R., 1915. Extra-tropical South African acaciae. Ann. Bolus Herb. 1 : 143-151.

Gower, J.C., 1971. A general coefficient of similarity and some of its properties. Biometrics, 27 : 857-874.

Guinet, Ph., 1968. Palynologie africaine Viii. Bull. I.F.A.N. Vol. XXX A/3 : 1-33.

Guinet, Ph., 1969. Les Mimosacees. Etude de palynologie fondamentale, correlations, evolution. Trav. Sect. Sc. Techn. Inst. Fr. pondichery 9 : 1-293.

Guinet, Ph. and Vassal, J. 1978. Hypothesis on the differentiation of the major groups in the genus Acacia (Leguminosae). Kew Bull., 32 : 509-527.

Guinet, Ph., 1981. Comparative account of Pollen characters in the Leguminosae. In, Advances in Legume Systematics, ed. R.M. Polhill and P.H. Raven, Royal Botanic Gardens, Kew, PP. 789-799.

Guinet, Ph., 1981. Mimosoideae, the characters of their pollen grains. In, Advances in Legume Systematics, ed. R.M. Polhill and P.H. Raven, Royal Botanic Gardens, Kew PP. 835-857.

Guinet, Ph., 1983. Distribution of the pollen characters in some hybrids and suspected hybrids in the genus Acacia. Bull. Internat. et. Mimosoideae. 11 : 24-27.

Guinet, Ph., 1986. Geographic patterns of the main pollen characters in the genus Acacia (Leguminosae-Mimosoideae), with species reference to the subgenus Phytlodineae. In, Pollen and Spores : Form and Function, Linnean Soc. Symposium Ser. PP. 297-311.

Harvey, W.H., 1862. Leguminosae. In W.H. Harvey & O.W. Sonder, Flora capensis 2 : 1-285. Dublin : Hodges, Smith & Co.

Heslope-Harrison, J., 1971b. Sporopollenin in the biological context. In, sporopollenin, ed. J.B. Brooks, P.R. Grant, M. Muir, P. Van Gijzel and G. Shaw. Academic Press, London, PP. 1-30.

Hyde, H.A. & Adams K.F., 1958. An Atlas of airborne pollen grains Macmillan and Company, London.

Hyde, H.A., 1969. Aeropalynology in Britain - an outline. New phytol. 68 : 579-590.

Knox, R.B., 1979. Pollen and allergy. Edward Arnold Ltd., London.

Knox, R.B. and Kenrick, J., 1983. Polyad function in relation to the breeding system of Acacia. In pollen : Biology and implications for plant Breeding, PP. 411-418. Amsterdam, North Holland Press.

Kokwaro, J.,O., 1976. Medicinal plants of East Africa. East African Literature Bureau.

Lawrence, G.H.M., 1960. Taxonomy of vascular plants. The MacMillan Company, New York.

Lieux, M.H., 1972. A melissopalynological study of 54 Louisiana (USA) honeys. Rev. Palaeobotan. Palynol. 13 : 95-124.

Livingstone, D.A., & Van der Hammen, T., 1978. Palaeogegraphy and Palaeoclimatology. In, Tropical Forest ecosystems : PP. 61-90.

Livingstone, D.A., 1980. Environmental changes in the Nile headwaters. In, The Sahara and the Nile : PP. 339-359.

Moore, P.D. & Webb., J.A., 1978. An illustrated guide to pollen analysis. Hodder and Stoughton, London.

Oliver, D., 1871. Acacia. In, Flora of Tropical Africa 2: 337-354., L. Reeve & Co. London.

Pedley, L., (1986). Derivation and dispersal of Acacia (Leguminosae), with particular reference to Australia, and the recognition of Senegalia and Racosperma. In, Bot. Journ. Linn. Soc. 92 : 219 - 254.

Reitsma, T., 1970. Suggestions towards unification of descriptive terminology of angiosperm pollen grains. Rev. Paleobot. palynol. 10 : 39-60.

Richard, A., 1847. Tentamen florae abyssinicae Vol. 1. Paris.

Robbertse, P.J., 1973. Die genus Acacia in Suid-Afrika - 3 Met speciale verwysing na die morfologie Van die saad). Tydskrif vir Natuurwetenskap 13 : 72-95.

Robbertse, P.J., 1975. The genus Acacia Miller in South Africa - 6 - The morphology of the leaf. Boissiera 249 : 263-270.

Robbertse, P.J., 1975. The genus Acacia in South Africa. IV. The morphology of the mature pod. Bothalia 11 : 481-489.

Ross, J.H., 1979. A conspectus of the Africana Acacia species. I,. Mem. Bot. Surv. S. Afr. 44 : 1-155.

Sokal, R.R. & Sneath, P.H., 1963. Principles of Numerical taxonomy. W.H. Freeman & Co. San Francisco.

Talbot. M.R., _et al,_ 1984. Preliminary Results from sediment cores from Lake Bosumtwi, Ghana. In, palaeocology of Africa and The surrounding Islands 16 : 173-192.

Thulin, M., _et al._ 1981. Calliandra (Leguminosae) in Continental Africa. Nordic J. Bot., 1 : 27-34.

Taubert, P., 1891. _Leguminosae_. In E.G.H. Engler, Die Natuurlichen pflanzenfamilien 3,3 : 70-388. Leipzig.

Van Campo, M. and Guinet., Ph. 1961. Les pollens composes. L'exemple des _Mimosacees_. Pollen et spores 8 : 201-218.

Van Campo, M. and Lugardon., B., 1973. Structure grenue infratectale de l'exctetine des pollens de quelques Gymnospermes et spores 15 : 171-187.

Valsaladevi, G. & Mathew, P.M., 1983. On the operculate aperture in the pollen of _Sanchezia parvibracteata_. In, Current Science, ed. M.R.A. Rao. Current Science Association, Bangalore, India, 52 : 731.

Vassal, J., 1974. Report on Chromosome numbers in the genus _Acacia_. Bull. International Group for Study of Mimosoideae 2 : 21-29.

Vassal, J. & Lescanne, N., 1976. Ctyologie et taxonomie dans le genre _Acacia_. Bull. Soc. Hist. Nat. Toulouse 112 : 101-110.

Wodehouse, P.P., 1935. Pollen Grains. McGraw-Hill, New York

Zetsche, F., 1932. Kork und cuticularsubstanzen. In Handbuch der pflanzen-analyse, ed. G. Klein, Springer-Verlag, Berlin, 3 : 205.

Zinderen Bakker, E.M. van & Coetzee, J.A., 1959. South Africana pollen grains and spores 3 : 115-119. Cape Town. A.A. Balkema