



ABSTRACT

MICROFLORAL ZONATION AND CORRELATION OF SOME LOWER TERTIARY ROCKS IN SOUTHWEST WASHINGTON AND SOME CONCLUSIONS REGARDING THE PALEOECOLOGY OF THE FLORA

by Dennis M. Sparks

The study area is located in southwest Washington and northwest Oregon, west of the Cascade Mountains and south of the Olympic Mountains. It is part of a large Tertiary geosyncline which extended from the Klamath Mountains to Vancouver Island. The strata included in this study comprise a composite section 9,000 feet thick, ranging in age from late Middle Eocene to Late Eocene or Early Oligocene. The McIntosh and Skookumchuck Formations represent marine and non-marine phases of the same sedimentary cycle and are in part contemporaneous. The Keasey Formation comprises the uppermost portion of the composite section, representing at least part of the rock removed by late Eocene uplift and erosion of the Skookumchuck Formation in part of the study area.

The two principal objectives have been to establish a relative chronologic framework for the units described and to elucidate the nature and distribution of the early Tertiary flora based on the dispersed plant microfossils.

Five palynologic zones are recognized, based on the stratigraphic range of 53 plant microfossils. Quantitative

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for ensuring transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It highlights the need for a systematic approach to data collection and the importance of using reliable sources of information.

3. The third part of the document focuses on the analysis and interpretation of the collected data. It discusses the various statistical and analytical tools used to identify trends, patterns, and relationships within the data set.

4. The fourth part of the document addresses the challenges and limitations of data analysis. It notes that while data analysis provides valuable insights, it is not without its own set of challenges, such as data quality and the potential for bias.

5. The fifth part of the document discusses the importance of communication and reporting in the data analysis process. It emphasizes that the results of the analysis must be clearly and effectively communicated to the relevant stakeholders.

6. The sixth part of the document provides a summary of the key findings and conclusions drawn from the analysis. It highlights the overall impact of the data and the implications for future research and practice.

7. The seventh part of the document discusses the future directions of data analysis research. It identifies emerging trends and areas for further exploration, such as the use of artificial intelligence and machine learning in data analysis.

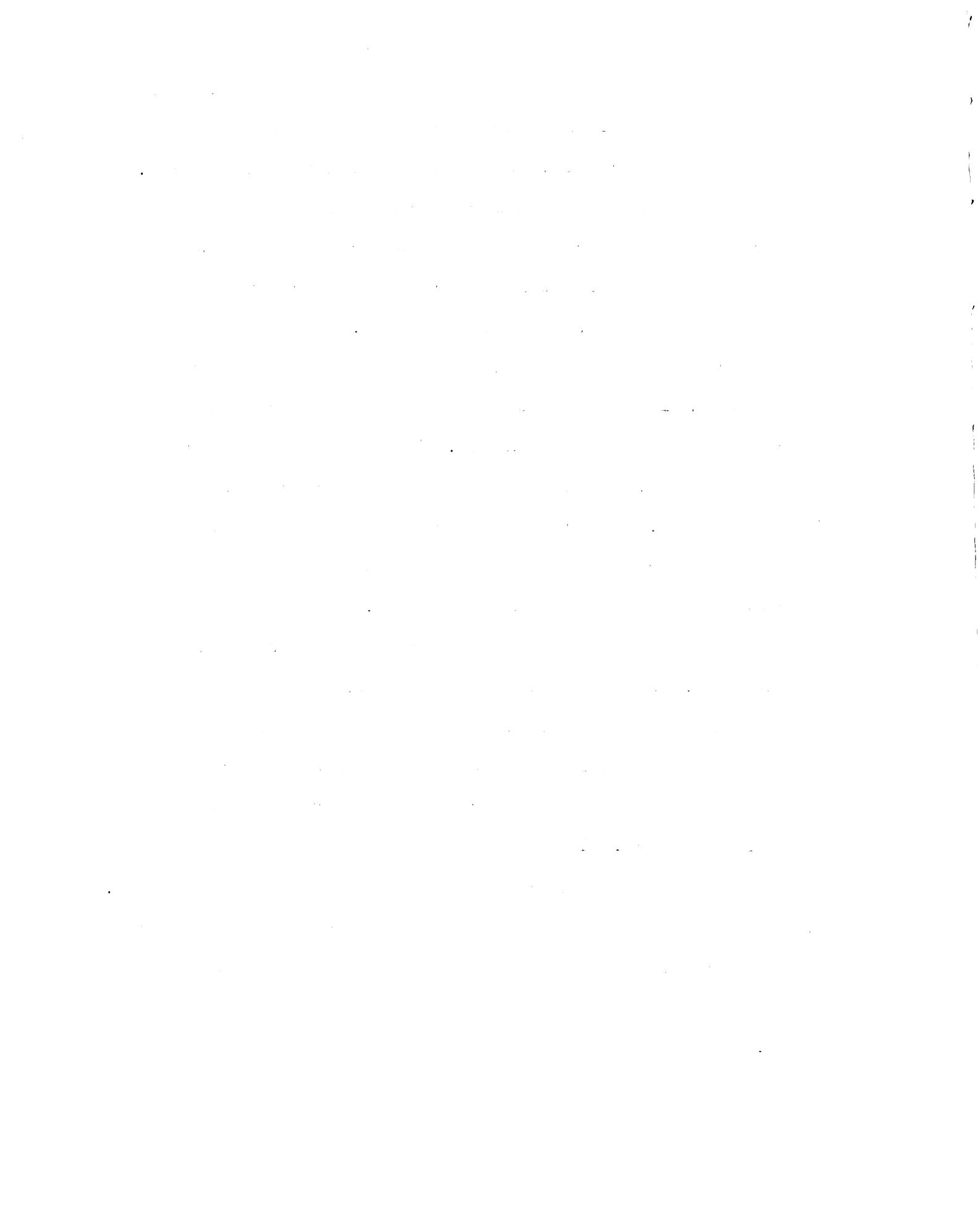
8. The eighth part of the document provides a final conclusion and a call to action. It encourages researchers and practitioners to continue to explore the possibilities of data analysis and to work together to advance the field.

Dennis M. Sparks

data provide additional stratigraphic subdivision of the zones, based on relative abundance of ten selected forms. Independence of these ten forms from control by environmental factors is shown by the relative relationships within the sum of the ten compared with microplankton-fungi ratios, rock facies, and total numbers.

Correlation of the zones in an east-west cross section shows the McIntosh Formation on-lapping the Crescent Formation in the Willapa Hills. The Skookumchuck Formation is shown to have been deposited during a regressive phase of sedimentation. A north-south cross section indicates considerable relief on the unconformity below the Lincoln Formation in the Skookumchuck section.

One hundred twelve plant microfossils have been identified. Included in the list of taxa with which some of the dispersed pollen and spores may have affinities, are some with centers of distribution in the subtropics, a large number of temperate forms, and several cool temperate or boreal genera. The climate was warm and humid in the lowland, where swamp forests and wet forests were developed. The upland was more temperate, and supported a mixed, more mesic forest. Coniferous trees were the major constituent of a montane element which occupied higher regions to the east.



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OF SOME LOWER TERTIARY ROCKS IN SOUTHWEST
WASHINGTON AND SOME CONCLUSIONS CONCERNING
THE PALEOECOLOGY OF THE FLORA

By

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Pan American Petroleum Corporation, through their Research Center, introduced me to the problem, and generously supported the field work. The Geological Society of America and the Society of the Sigma Xi provided funds for laboratory equipment and supplies, photographic supplies and a portion of the field work.

From September 1963 to March 1965 I was under the tenure of a National Defense Education Act Fellowship at Michigan State University, and I am deeply appreciative of the opportunity to have been part of that federal program.

Finally, I wish to acknowledge the stoic patience and spartan fortitude of my wife Shirley, whose encouragement and material assistance has helped bring this academic

effort to a successful end.

It is my sincere hope that this dissertation is worthy of those persons who have helped in its completion.

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The first part of the document discusses the importance of maintaining accurate records of all transactions. This includes not only sales and purchases but also the various expenses incurred in the course of business. It is essential to ensure that every receipt is properly filed and that the books are balanced regularly.

In addition, the document emphasizes the need for transparency and honesty in all financial dealings. It is important to disclose any potential conflicts of interest and to provide clear and concise information to all stakeholders. This helps to build trust and ensures that the business is operated in a fair and ethical manner.

Furthermore, the document outlines the various methods used to collect and analyze financial data. This includes the use of spreadsheets, accounting software, and other tools to track income, expenses, and profit margins. Regular analysis of this data allows the business owner to identify trends, make informed decisions, and adjust the business plan as needed.

Finally, the document provides a detailed overview of the financial statements that should be prepared and reviewed. These include the balance sheet, income statement, and cash flow statement. Each of these statements provides a different perspective on the financial health of the business and is essential for a comprehensive understanding of its performance.

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INTRODUCTION

The Tertiary rocks of western Oregon and Washington represent a vast and little known sedimentary province. In an area of approximately 60,000 square miles, lying west of the Cascade Mountains and extending from the Olympic Mountains on the north to the Klamath Mountains on the south, about 20,000 feet of sedimentary rocks are preserved. These rocks range in age from Middle Eocene to Pliocene. The sequence of sediments rests conformably upon, and is intimately related to, a series of basic volcanic rocks of Early to Middle Eocene age, with a thickness in excess of 10,000 feet. The inferred paleogeography in Eocene time is shown in Figure 1.

To describe the area as a basin is a misleading oversimplification. The western limits have not been established, and rocks extend onto the continental shelf, and even beyond to the continental rise. To most geologists the area represents a geosyncline, but within the broad context of that concept it is a special case, requiring, like most geosynclines, a complete and unique definition. That kind of definition and understanding has not as yet been realized, nor is it the purpose of this paper to attempt it. Rather, this project focuses on a very small part of the geographic and stratigraphic extent of this Tertiary geosyncline, in an attempt to establish a chronologic framework for the lower Tertiary sedimentary rocks of southwest Washington and part of northwest Oregon.

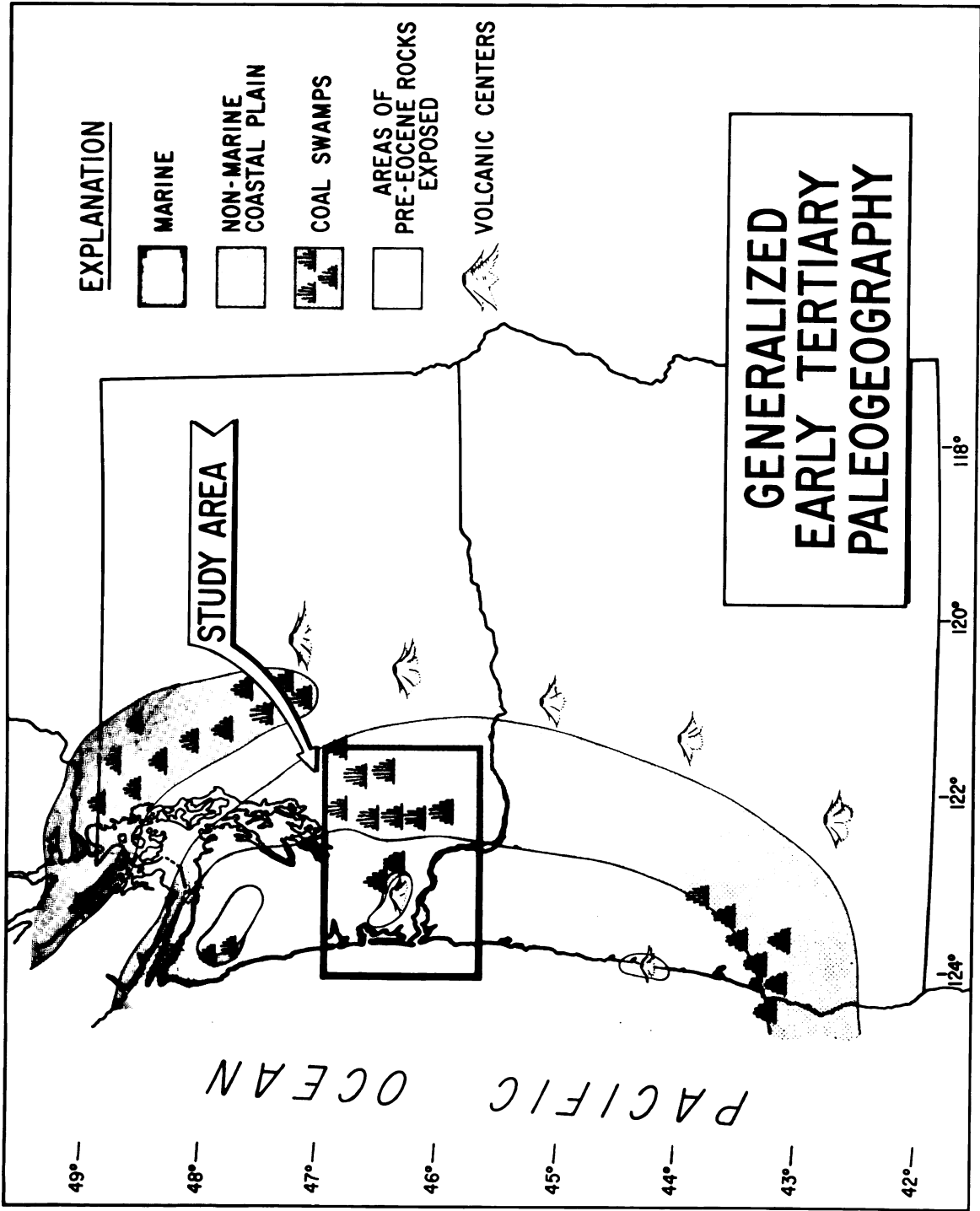


FIGURE 1

To this end, the dispersed spores and pollen of plants growing on the land adjacent to the area of accumulating sediments are utilized in a biostratigraphic fashion. Several characteristics of plant microfossils uniquely qualify these entities for biostratigraphic application; (1) they are nearly ubiquitous in their occurrence in most types of sedimentary environments; (2) they are remarkably resistant to most degradational processes in sedimentation and diagenesis; (3) they possess characteristic morphological features which allow differentiation and recognition; and (4) they reflect time related changes in their qualitative and quantitative distribution in the stratigraphic column caused by evolutionary and/or environmental conditions.

In the process of analyzing dispersed plant microfossils in a stratigraphic section, two kinds of results may be obtained. First the data show qualitative and quantitative characteristics which provide time-stratigraphic information. Second, these same data comprise a fossil record of the plants which grew in the area, from which compositional, distributional, and ecological information may be obtained. These two kinds of information are closely and genetically related, although conclusions about one may be made without reference to the other, sometimes, however, with less than satisfactory results. This study approaches both aspects in the hope that a working hypothesis regarding the ecological conditions of

the early Tertiary vegetation will facilitate the construction of a time-stratigraphic framework, as well as being of significant interest in itself.

There are three principle objectives sought in the study: first, the zonation and correlation of outcrop sections of Middle Eocene and Upper Eocene rocks in western Washington and northwest Oregon; second, interpretation of the composition and general distribution of a portion of the early Tertiary flora, and possible environmental implications; and third, an adequate systematic treatment of the microfossils to allow wider application of the information by other workers.

The amount of published information available pertinent to this study is not extensive. Much of the geologic work done before 1950 in western Washington and Oregon was of a reconnaissance nature, and the paleontologic investigations were largely concerned with faunal assemblages described from isolated localities. During the period from 1950 to the present, The United States Geological Survey has been conducting a series of studies in conjunction with the Washington State Department of Conservation that has led to the publication of descriptive maps and reports prepared on a considerably more detailed scale. Frequent and repeated reference to these publications is made in this report. The literature of Tertiary palynology is not extensive. Several hundred published reports are available, some of which concern lower Tertiary rocks. Studies dealing with

the Tertiary section of western North America number only about 15. A much larger number of publications is available dealing with more conventional paleobotanical aspects (leaves, wood, etc.) of the Tertiary section of the west coast, and these were consulted often, although they generally are not cited directly in the text. Current interest in petroleum exploration in the offshore area adjacent to the states of Washington and Oregon has led to a rapid increase in the amount of work carried out in the region, both stratigraphically and palynologically. The extent of this effort and the results of it, both economically and geologically, is, at present, competitive information and is not available. Perhaps much of this information will eventually be published and our understanding of the events of the Tertiary Period in western North America will be greatly enhanced.

Methods

Several different methods were used in the collection and synthesis of the data contained in this report. These can be conveniently classed as: (1) field methods; (2) laboratory methods; and (3) analytical methods.

The field methods used were determined by the objectives of the study. The purpose was to establish an abstract chronologic framework for the rock column. The sections that were selected for detailed study had, for the most part, been previously described in detail. The samples were collected along paced traverses, with brunton compass

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readings of attitude to establish vertical distance between samples. The total thickness of sections determined in this manner agrees well with those measured more accurately and described in the published reports. Where detailed geologic maps were available, the samples localities were placed directly thereon; otherwise localities were plotted on United States Geological Survey 15' topographic quadrangle maps.

Laboratory preparation procedures were the same as those used in many palynological laboratories. The inorganic rock matrix was removed by treatment with 10% hydrochloric acid, followed by 70% hydrofluoric acid. The organic fraction, which was large in almost every sample, was then treated with Schulze's solution (one part aqueous potassium chlorate to three parts concentrated nitric acid) for five to thirty minutes, depending on the amount of organic detritus. This usually resulted in the oxidation of most of the organic residue, but left the pollen and spores, along with cuticular fragments, various lignified plant cells, and often an assemblage of fungal and algal cells, including dinoflagellate cysts. The oxidized organic detritus was dissolved in a 5% potassium hydroxide solution. The sample was then washed free of that solution, and a stain was added (usually safranin). A glassware detergent, Alcojet, was used to advantage on many samples to hold very fine debris in suspension before staining, and thus further concentrate the pollen and spores, etc. Permanent

slides were prepared in Clearcol with Harleco Synthetic Resin used to cement the coverslip.

The analytical methods consisted of making a qualitative collection of the dispersed spores and pollen by morphological class, the establishment of stratigraphic range for these classes, and a quantitative evaluation of certain morphologic types. The classification is based upon a scheme proposed by Tschudy (1957) in which the morphological types are designated by descriptive formulae. This permits the handling of large numbers of different kinds of pollen and spores when their proper nomenclature may not be established in the early phases of an investigation. Figure 2 shows the classification used and the formula designation for each class. Abbreviations of certain distinctive types are occasionally used as well, such as A1-1 (Alnus-like).

The entire area of the mount under the coverslip was scanned systematically and both the qualitative and quantitative data were collected simultaneously. An effort was made to control the quality of the preparations and to obtain approximately the same number of pollen on each slide. By extrapolation the total number of grains per slide generally ranges from about 1000 to as high as 8500, but the average is between 2000 and 3000. The quantitative data consists of two kinds of relative abundance counts. The objective of the first was to determine the most abundant types in the sample, some of which

| MORPH. CLASS | | | ORNAMENTATION | | |
|---------------|-----------------|---------|---------------|------|---------|
| TYPE | CODE | DIAGRAM | TYPE | CODE | DIAGRAM |
| trilaesurate | T ₁ | | psilate | sm | |
| monolaesurate | M ₁ | | foveolate | fov | |
| vesiculate | V | | fossulate | fos | |
| inapertuate | I | | vermiculate | v | |
| monosulcate | S ₁ | | scabrate | sc | |
| monocolpate | C ₁ | | granulate | g | |
| tricolpate | C ₃ | | verrucate | ver | |
| polycolpate | C _∞ | | gemmate | gm | |
| syncolpate | Syn | | clavate | cl | |
| tricolporate | CP ₃ | | echinate | sp | |
| polycolporate | CP _∞ | | rugulate | rug | |
| diporate | P ₂ | | striate | st | |
| triporate | P ₃ | | reticulate | r | |
| polyporate | P _∞ | | cicatricose | cic | |

FIGURE 2

reflect the local environmental or ecological conditions, and the second count was designed to provide stratigraphically significant data, independent of local conditions. The first count was a 200 grain fixed sum count of every pollen or spore encountered in traversing the slide until that sum was reached. Hopefully, these data make possible an interpretation of the distribution of plants growing in the vicinity of the depositional site, especially as they may be related to environments reflected in the lithologic record, such as with the coals and lignitic siltstones. The second kind of count was a fixed area count of ten specific types of pollen, the sum being the total number of the ten types present on the slide. If the assumptions which are made regarding these ten types are valid then the data collected by this method will yield results that are significant to the time-stratigraphy of the area. These quantitative methods are discussed in more detail in a following section.

All microscopic work was carried out with Leitz Ortholux microscope. A 35mm Leica camera mounted on the microscope provided the photographs. Kodak Panatomic-X and Adox KB-14 films were used, and the prints were enlarged to standard magnifications of 500x, 1000x, or 1250x.

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PART I: GEOLOGY

Introduction

In undertaking to establish a relative chronology for the rocks within an area, it is imperative that the geologic setting of the area is clearly understood by the investigator. This is no less true in attempting to portray the distribution and development of a flora from the fossil record. The understanding of the geologic setting is not necessarily intended to imply a knowledge of the "true" geologic relationships; but rather an awareness of the extent of objective data available and the limitations of those data, familiarity with the various hypotheses advanced for the historical development of the area, and some first-hand observations of the structural and stratigraphic relationships of the rocks in the field. The following paragraphs summarize the geologic setting of the area under consideration in this study. This will be followed in the second section by the analysis of the time-stratigraphic distribution of the plant microfossils within this geologic setting.

Physiography

The present day topography in western Washington and northwest Oregon is directly related to the structure and composition of the local bedrock. The structural highs are the prominent topographic elevations, and the

1. The first step in the process of identifying a problem is to recognize that a problem exists. This is often done by comparing current performance with a desired state or goal.

2. Once a problem is identified, the next step is to define the problem more precisely. This involves identifying the causes of the problem and the scope of the problem.

3. The third step is to generate potential solutions. This is often done by brainstorming or using a structured problem-solving process.

4. The fourth step is to evaluate the potential solutions. This involves comparing the solutions against the criteria that were used to define the problem.

5. The fifth step is to select a solution. This is often done by choosing the solution that is most likely to be successful and that is most consistent with the organization's values and goals.

6. The sixth step is to implement the solution. This involves putting the solution into action and monitoring its progress.

7. The seventh step is to evaluate the results of the solution. This involves comparing the actual results with the expected results and identifying any areas for improvement.

8. The eighth step is to communicate the results of the solution. This involves sharing the results with the relevant stakeholders and providing feedback.

9. The ninth step is to document the solution. This involves recording the steps that were taken to solve the problem and the results that were achieved.

10. The tenth step is to review the solution. This involves reflecting on the process and identifying any lessons learned.

11. The eleventh step is to share the solution. This involves sharing the solution with other people who may be facing a similar problem.

12. The twelfth step is to evaluate the overall impact of the solution. This involves assessing the long-term effects of the solution on the organization and its stakeholders.

13. The thirteenth step is to celebrate the success of the solution. This involves recognizing the efforts of the people who were involved in solving the problem.

14. The fourteenth step is to learn from the experience. This involves reflecting on the process and identifying any areas for improvement.

15. The fifteenth step is to apply the lessons learned to other problems. This involves using the knowledge gained from solving this problem to solve other problems.

16. The sixteenth step is to continue to monitor the solution. This involves checking in on the solution periodically to ensure that it is still working and that it is still meeting the organization's needs.

17. The seventeenth step is to update the solution. This involves making any necessary adjustments to the solution to keep it current and effective.

18. The eighteenth step is to evaluate the overall impact of the solution. This involves assessing the long-term effects of the solution on the organization and its stakeholders.

19. The nineteenth step is to celebrate the success of the solution. This involves recognizing the efforts of the people who were involved in solving the problem.

20. The twentieth step is to learn from the experience. This involves reflecting on the process and identifying any lessons learned.

crystalline volcanic rocks exposed in the high areas hold up sharp ridges and steep-sided canyons. The maximum relief in the area is in the Willapa Hills which have an elevation of about 3000 feet and the peaks stand some 1500-2000 feet above the valleys. The structurally low areas between the prominent northwest-southeast trending anticlinal ridges are in part occupied by the major streams of the area, and present a low rolling topography developed on the partly truncated folds of the lower Tertiary sediments. The rate of chemical degradation of the largely basic bedrock is high. Soils are frequently thick, and the area is densely covered with vegetation. For these reasons, the surface expression of many faults and minor folds cannot be seen. Geomorphically, the entire area is in a stage of early maturity, with the exception of areas where Miocene basalts lie unconformably upon older deposits, producing a youthfully dissected appearance. Most of the interstream divides are sharp, and about 70 per cent of the region is in slope. Two of the major streams of the area, the Cowlitz River and the Chehalis River, are mature in their lower courses, but are more youthful in their headwater regions. The Columbia River is youthful throughout its course, especially where it is incised across the structure of the Coast and Cascade Ranges. The Cowlitz River has a wide flood plain, and shows a number of terrace levels above the present river plain. The Chehalis River also shows several terraces along its lower course.

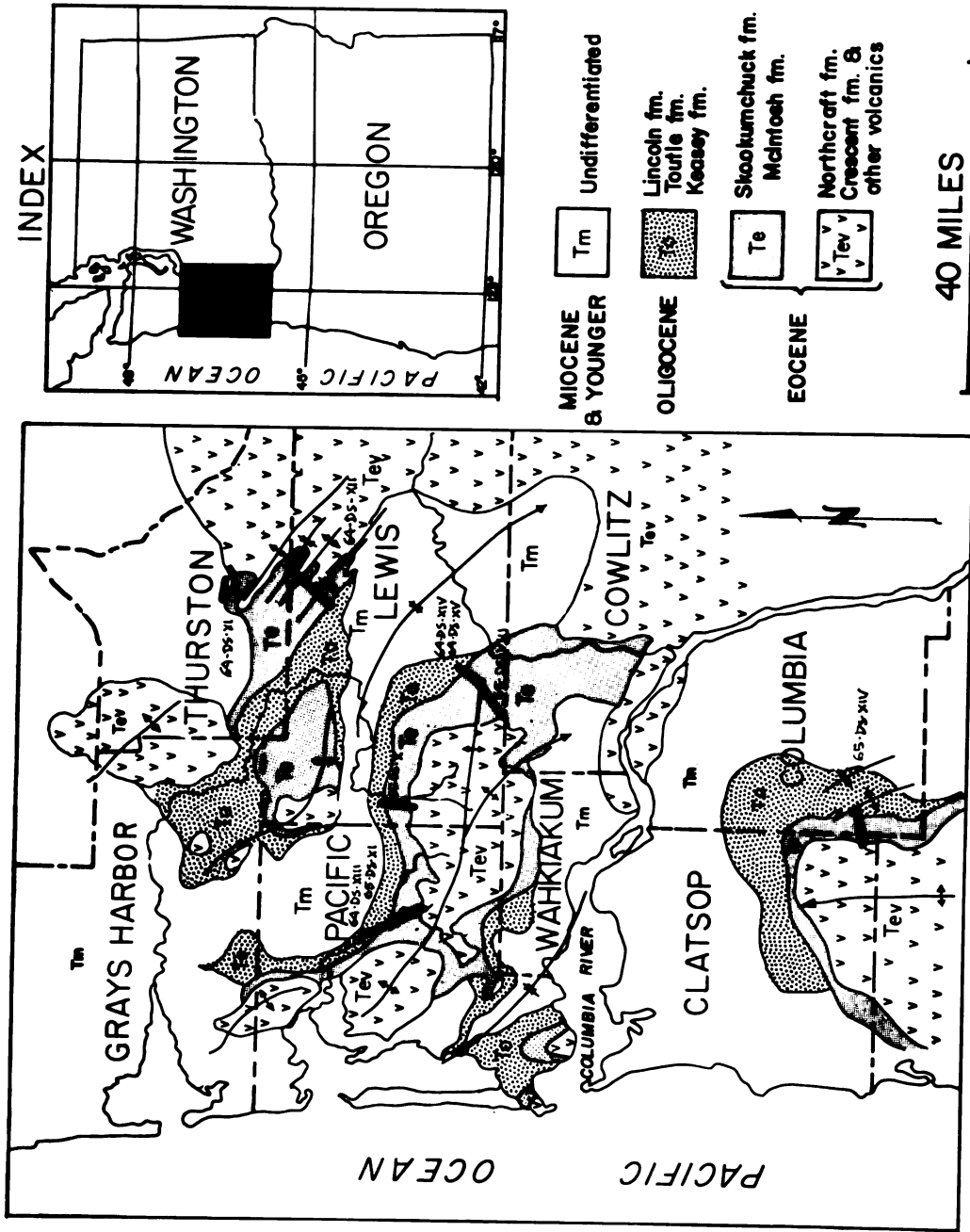
These probably reflect changes in base level (sea level for these streams) during Pleistocene time, and may also indicate the continued process of orogenic uplift in Pleistocene and Recent time.

Structural Framework

General Features

The major structural features in the study area are northwest-southeast trending uplifted areas exposing cores of early Tertiary volcanics. Between these major high areas and associated with them, in part, are a series of rather poorly defined anticlines and synclines. Faults occurring in the area are usually high angle, sometimes reverse, and occasionally show a slip-strike component. Bounding the area in a tectonic sense are the Cascade Ranges to the east, the Olympic Mountains to the north, and the east Pacific basin on the west. The major structural axes are shown on Figure 3.

The present day Cascade Ranges are the result of Pliocene and Pleistocene activity, although the tectonic history of that mountain belt involves more than a single orogenic phase. Misch (1952) describes several periods of folding, metamorphism, and intrusion which took place in Paleozoic, Mesozoic, and Cenozoic time. Of particular interest to this study is the history of early Tertiary deformation that produced an area of considerable relief trending northwest-southeast, and located further to the



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FIGURE 3

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east than the present day Cascades. The forces which produced that uplift were probably responsible for the structural trend seen today in the area of this study. The presence of a highland area to the east (see Figure 1), and its subsequent erosional history, certainly played a part in the source and distribution of the lower Tertiary sediments, as well as affecting the distribution of the Eocene flora. Although the dominant source of sediments has been a volcanic terrane, located, in part, within the sedimentary province itself, many of the more arkosic and quartzitic sediments were derived from the igneous and metamorphic terrance of the early Cascade Mountains.

The Willapa Hills are developed upon a northwest-southeast trending anticlinal high which lies near the center of the study area (Figure 3). The axis plunges toward the southeast, and the lower Tertiary sediments exhibit an erosional off-lap relationship, dipping at low angles away from the plunging crest. Crescent Formation volcanics (see stratigraphic units, Figure 4) are exposed in the axial portion, and have been a source of sediments during early Tertiary time.

The Doty Uplift is an anticlinal fold trending northwest-southeast, located about 10 miles to the north of the Willapa Hills anticline. The lower Tertiary sediments bear a similar erosional off-lap relationship to the Doty Uplift as they do in the Willapa Hills, although faulting has brought Oligocene or Miocene rocks in contact

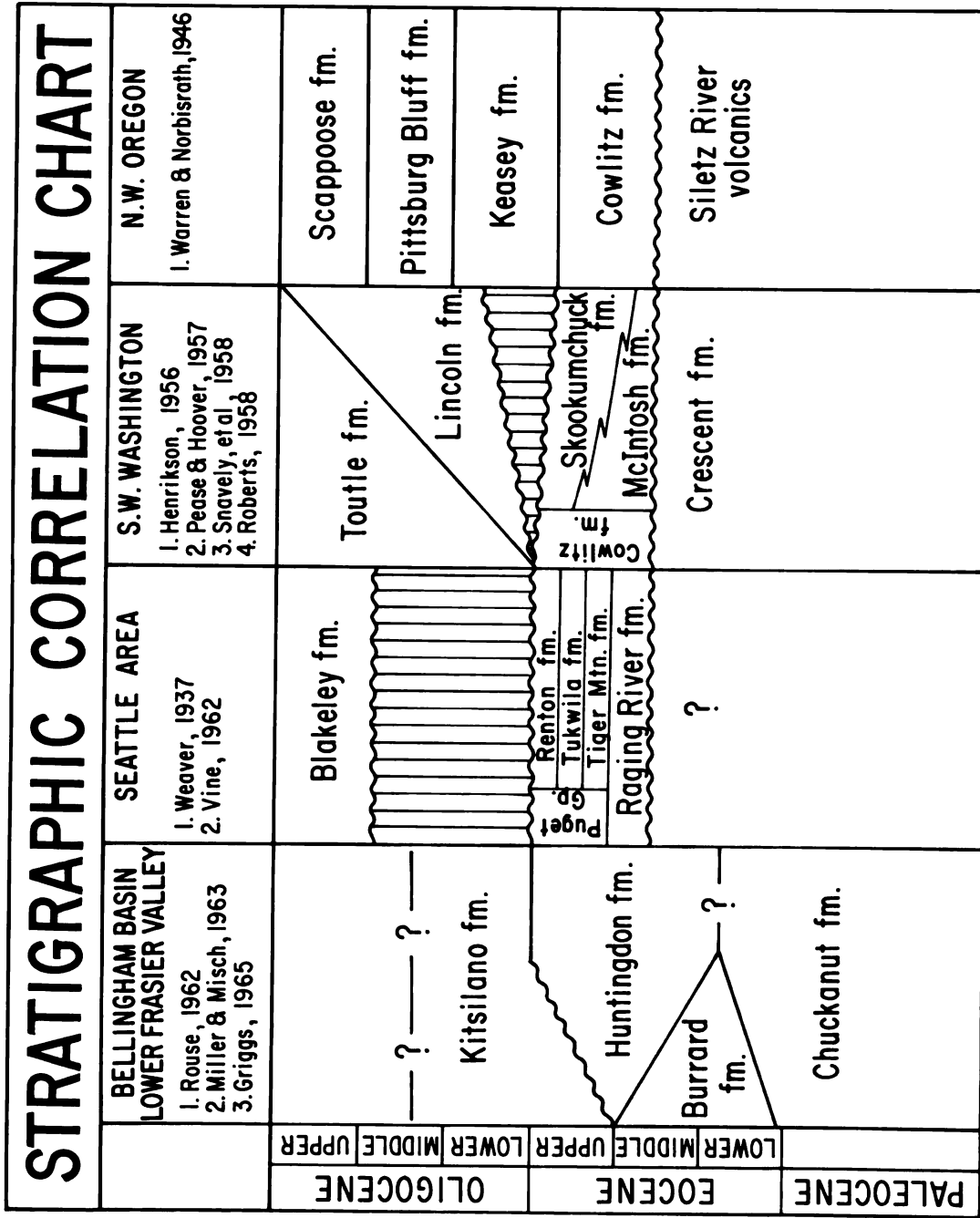


FIGURE 4

with the Crescent volcanics in some places. The Black Hills are located on the Doty Uplift as a topographic high.

Farther to the north, southwest of Olympia, another unnamed anticlinal high occurs with Crescent volcanics exposed along the axis. The sedimentary cover, if it ever completely over-lapped the area, has been stripped off by erosion.

The southeastward extension of these structural features terminates where the axes plunge as the result of the late Tertiary diastrophism in the Cascade Mountains. Some of the major structural trends can be traced northwest to the coast line, but their extension onto the continental shelf is as yet unknown. Between these major structurally-high areas, the lower Tertiary rocks are folded in a series of smaller anticlines and synclines almost all of which trend between $N60^{\circ}W$ and $N75^{\circ}W$.

Structural History

Several periods of tectonic activity have affected the area under consideration. The structural events prior to Eocene time are not evident in southwestern Washington, since the base of the Lower and Middle Eocene Crescent volcanics is not exposed. On Vancouver Island, however, and in the Olympic Mountains, the Crescent formation lies unconformably upon Cretaceous and older rocks (Weaver, 1937, 1945). This relationship is not well established, however, and all that is certain is that in Early (?) and Middle Eocene time a great out-pouring of basic volcanics

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial data and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. These methods include direct observation, interviews, and the use of specialized software tools.

3. The third part of the document describes the results of the data collection and analysis. The findings indicate that there are significant areas for improvement in the current processes, particularly in the areas of data accuracy and reporting.

4. The fourth part of the document provides recommendations for addressing the identified issues. These recommendations include implementing more rigorous data entry procedures and investing in more advanced data analysis software.

5. The fifth part of the document discusses the potential benefits of implementing the recommended changes. These benefits include improved data accuracy, more efficient reporting, and better overall financial management.

6. The sixth part of the document concludes the report and provides a summary of the key findings and recommendations. It also includes a list of references and a list of appendices.

7. The seventh part of the document is a list of references, which includes a list of books, articles, and other sources used in the research.

8. The eighth part of the document is a list of appendices, which includes a list of tables, figures, and other supplementary materials.

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10. The tenth part of the document is a list of figures, which includes a list of figures and their corresponding data.

occurred, covering effectively the underlying rocks from southern Vancouver Island to the Klamath Mountains. It was upon this basement, and associated with it in part, that the sedimentary rocks of Middle to Late Eocene age began to accumulate in different areas.

In early Late Eocene time, and perhaps earlier, movements along pre-Tertiary structural trends began to uplift portions of the crust, exposing the underlying volcanics in northwest-southeast oriented highs. These movements probably were continuous from Middle Eocene time, although the first evidence of sediments derived from them occur in early Late Eocene. The effect of these movements was relatively minor, and usually of local extent.

Near the close of Eocene time, more significant diastrophic events took place. Further uplift in the Willapa Hills, Doty Uplift, and other northwest-southeast features occurred, as well as positive movement in the Coast Range and Olympic Mountains. Some minor folding of the Eocene sediments also occurred near the uplifts, allowing erosion to strip away part of the section in some areas. Often the effects of these movements were relatively minor. However, in some sections near the structural highs, the marine sediments of Oligocene age lie with considerable unconformity upon the Eocene rocks.

The major structural events that affected the area occurred in Miocene and Pliocene time. In early Miocene, uplift and erosion of Eocene and Oligocene rocks took place.

Lower and Middle Miocene marine sediments lie unconformably upon the Eocene and Oligocene rocks. Further uplift and extensive vulcanism in later Miocene time caused a retreat of marine waters, and the structural pattern presently seen was established. The Miocene deformation occurred from compressive forces acting to fold the sedimentary rocks into a pattern trending northwest-southeast, parallel with the earlier trends. During Late Pliocene time, major tectonic activity occurred in the Cascade Mountain area. This folding and accompanying intrusion brought the Cascade Mountain ranges to their present day configuration and caused further movement along faults as well as more folding within the Tertiary section of western Washington. Downwarping occurred along the Puget-Willamette Trough, the Grays Harbor embayment, and the lower Columbia River valley allowing non-marine sediments to accumulate.

Tectonic activity has continued in the area through Pleistocene time to the present as shown by movement along several active faults, explosive volcanic activity, and evidence of recent uplift in the Coast Range. The present sedimentary province is displaced westward, where sediments are accumulating on the continental shelf and slope that are very similar to those of the Tertiary section on the adjacent land area. The Pleistocene glaciations have altered the pattern of structural development, certainly, but there is no sound evidence that any of the events initiated in early Tertiary time have yet come to an end.

Stratigraphy

General Statement

The stratigraphic sequence of rocks considered in this study consists of about 10,000 feet of clastic sediments with some associated volcanics, and represents approximately 8-12 million years of time (Kulp, 1961), from Middle Eocene to earliest Oligocene. The stratigraphic section consists of rocks exhibiting facies¹ indicative of a wide range of depositional environments. Sedimentary accumulations in deep, offshore waters, shallow marine and neritic areas, estuary and delta environments, and non-marine coastal swamp environments are represented. The present outcrop pattern is the result of middle and late Tertiary tectonic events, and is shown in Figure 3. The present land surface is densely covered with vegetation, dominated by the coniferous forests which are so characteristic of the

¹The term "facies" is one that has a long history of diverse usage. Unfortunately, the many different uses, and misuses, reduces its value in conveying the concept for which it was originally coined. Teichert (1956) presents an excellent review of the problem and suggests some practical solutions. When the word "facies" is used in this paper, it refers to the collective assemblage of characteristics that the sedimentary rock possesses. It includes composition, grain size, primary structures, sorting qualities, fossil content, organic matrix, and any other observable feature of the rock. From these facies features the depositional environment may be interpreted. For example, a sample of lignitic-siltstone facies is interpreted as having been deposited in a swamp or estuarine environment. The facies are the observable, unequivocal, aspects of the rock; the depositional environment is the analytical interpretation based upon them.

northwest. These forests, along with the general lack of relief in the area make it difficult to locate outcrops. Stream beds, and railroad and highway cuts provide most of the exposures, but these are not abundant. A description of the rock units within the stratigraphic interval studied follows. Figure 4 shows the relationships of the stratigraphic units from published sources.

Crescent Formation

The Crescent Formation is the name given by Arnold (1906) to the thick sequence of volcanic flows and associated tuffaceous sediments exposed on the north side of the Olympic Mountains at Crescent Point. Some controversy regarding the nomenclature of these volcanics has ensued, and in several reports (Weaver, 1945, and Henrikson, 1956), the name Metchosin Formation (Clapp, 1910) has been applied to volcanic rocks occupying a similar stratigraphic position in other areas. That some question regarding these rocks should arise is not surprising. The entire region, from southern Vancouver Island to the Klamath Mountains, is underlain at the base of the Tertiary section by a thick sequence of volcanic rock which appears to be genetically related over the whole region. Weaver (1944, p. 1407) describes the distribution of the Metchosin volcanics as "one vast lava field extending from Vancouver Island southward to the north slope of the Klamath Mountains and eastward to the present site of the western foothills of the Cascade

Mountains." He indicates that the volume of rock involved is probably greater than that of the Miocene basalts of the Columbia Plateau. Recent workers with the United States Geological Survey (Brown, Gower and Snively, 1960, 1961; Gower, 1960; Snively, Brown, Roberts, and Rau, 1958) use the name Crescent Formation for these rocks, and that practice is followed in this study. The thickness of the Crescent Formation is probably quite variable, but in the Willapa Hills it is at least 8000 feet (Henrikson, 1956) and near Lake Crescent, north of the Olympic Mountains, it is in excess of 10,000 feet (Brown, Gower, and Snively, 1960). The flows within the formation often show pillow structure, indicating submarine extrusions, but part of the volcanic activity was probably subaerial as well.

The Crescent Formation is exposed in numerous localities in western Washington and Oregon. In the Central Coast Range of Oregon, the Siletz River volcanics were named by Snively and Baldwin (1948) where they crop out in many places along the crest of that anticlinal high. These volcanics are for the most part equivalent in age and origin to the Crescent Formation. In northwestern Oregon, outcrops of Crescent-like volcanics were called the Tillamook volcanic series by Warren and Norbistrath (1946). In Washington, the Crescent Formation forms the bedrock in most of the structurally high areas where the sedimentary cover has been stripped away. The Willapa Hills, the Doty Uplift, and others structurally high areas shown in

Figure 3, illustrate the outcrop distribution.

The age of the Crescent volcanics has been based largely on stratigraphic position, and on a few foraminiferal and molluscan assemblages. The fossils indicate an Early to Middle Eocene age, at least for parts of the Crescent Formation.

Cowlitz Formation

The Cowlitz Formation was named and described by C. E. Weaver (1912). Later, Weaver (1944) designated the type section as that exposed in the banks of Olequa Creek, from the confluence of that stream with the Cowlitz River north to the contact with the overlying Oligocene strata near Winlock. Henrikson (1956), in a study of the Eocene stratigraphy of the area, emended the type section by including the rocks exposed in the bed of Stillwater Creek from 3 miles west of Ryderwood to the point where they overlap Weaver's original section in Olequa Creek. Thus, at the present time, the Cowlitz Formation includes about 8000 feet of rock divided into four members: (1) the Stillwater Creek member, (2) the PeEl1 volcanics member, (3) the Olequa Creek member, and (4) the Goble volcanics member. The volcanic members are, at best, difficult to recognize as mappable units in the field and are not conspicuously present in the Olequa-Stillwater Creek section. As now defined, the Cowlitz Formation is a very thick and diverse rock unit, and not amenable to mapping except on a very large scale. Snavely et al., (1951)

proposed the names McIntosh, Northcraft and Skookumchuck Formations for the sequence of rocks apparently stratigraphically equivalent to the emended Cowlitz Formation but 15-20 miles to the north of the Stillwater-Olequa Creek section in the Centralia-Chehalis district. In ascending stratigraphic order, the section consists of marine siltstones and sandstones of the McIntosh Formation, volcanic breccias and flows of the Northcraft Formation, and a lignitic siltstone, sandstone and coal sequence in the Skookumchuck Formation. With the possible exception of the volcanic Northcraft Formation, these represent mappable lithologic units of a scale which permit detailed investigation and an understanding of the relationship of depositional environments. The McIntosh Formation corresponds in general to the Stillwater Creek member of Henrikson, although it would also include marine siltstones occurring higher in the Olequa Creek member, the non-marine portion of which corresponds to the Skookumchuck Formation. The relationship of the volcanics in the two areas is not clear, and Henrikson (1956) indicates that the Northcraft volcanics differ petrographically from the PeEll and Goble members of the Cowlitz Formation. There were certainly many centers of volcanic activity in early Tertiary time within the area considered in this study, and lack of continuity over the area of a single, recognizable unit is not surprising. The names McIntosh, Northcraft, and Skookumchuck Formations are used in this study in order

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to consider the marine — non-marine phases of deposition more easily, and to maintain consistency with current work of the United States Geological Survey in the area.

McIntosh Formation

This rock unit was named by Snavely, Rau, Hoover, and Roberts (1951) for good exposures on the south shores of McIntosh Lake and in cuts along State Highway 5H, 3 1/2 miles east of Tenino, Thurston County (Figure 3). A total thickness of about 4000 feet is given for the formation in the type area, with the base not exposed. The rocks consist of dark gray, tuffaceous, massive to fissile, siltstone and sandstone. The beds commonly contain calcareous concretions and lenses. The sandstones are generally poorly sorted, feldspathic or lithic wackes (Williams, Turner and Gilbert, 1954) with basaltic or andesitic fragments the most abundant constituent. They appear to be immature sediments both texturally and compositionally. Fossils of neritic communities are not common in the type area, although foraminiferal assemblages are abundant. East of the type area, the sediments become generally more coarse, and lignitic stringers are present with plant fossils preserved in them. The rocks in the type area generally exhibit facies that indicate deposition at a rapid rate in off-shore, marine waters, without a great deal of high energy sorting action. Further to the west, the lithologies become finer grained and often exhibit fair to good fissility. The formation occurs discontinuously throughout

the study area. In the Black Hills area, Snavely, et al. (1958), have mapped the McIntosh Formation with extensive interbedded basic volcanics in the lower part. Pease and Hoover (1957) recognized two members in the McIntosh Formation in the Doty-Minot Peak area. The lower member in the Chehalis River valley near PeEll consists of sandstone and siltstone, dark in color, poorly sorted, and often showing graded bedding with interbedded basic volcanics. These can be seen to lie directly upon or interbedded with the Crescent Formation and are about 900 feet thick. The upper member consists of dark gray, tuffaceous, somewhat fissile, siltstone with thin interbeds of feldspathic sandstones. The total thickness of the McIntosh Formation in this area is about 2500 feet. Further to the west, in the Willapa River valley near Raymond, less than 1000 feet of McIntosh Formation is present (Rau 1958) and represents the upper member of Pease and Hoover (1957). It rests directly upon Crescent Formation volcanics without the coarse clastic and volcanic transition beds of the lower member which are present near PeEll.

The age of the McIntosh Formation is late Middle to early Late Eocene. This has been established on the basis of many well preserved foraminiferal assemblages (Snavely, et al., 1951 and 1958). Those authors correlate the McIntosh foraminiferal assemblages with the upper Domengene and lower Tejon stages of California. The McIntosh

Formation transgresses time toward the west, where the age of these marine rocks is entirely Late Eocene.

Northcraft Formation

The Northcraft Formation was named by Snively, et al., (1951) from outcrops of andesitic flows and breccias occurring in the vicinity of Northcraft Mountain, Thurston County (Figure 3). In the type area, these volcanic rocks are about 1000 feet thick and conformably overlie the McIntosh Formation. The formation has not been recognized as such west of the Chehalis River, and a source toward the east is indicated by an increase in the thickness of the flows in that direction. Snively, et al., (1958) suggest a correlation of the Northcraft Formation with a lower part of the Goble Series (Wilkenson, Lowry, Baldwin, 1946) in northwestern Oregon, and it seems likely that the Goble member of the Cowlitz Formation (Henrikson, 1956), (Goble member of the Skookumchuck Formation of this paper), represents the same lithologic unit.

The age of the Northcraft volcanics, as determined largely by stratigraphic position, is early Late Eocene. Directly overlying the Northcraft Formation, in part unconformably, and in some cases interbedded with the upper portion, are the non-marine rocks of the Skookumchuck Formation.

Skookumchuck Formation

Snively, Roberts, Hoover and Pease (1951) applied the

name Skookumchuck Formation to a series of non-marine sandstones, lignitic siltstones, and coals, with some intertongues of marine siltstone exposed along the Skookumchuck River near Centralia, Washington. The formation has a thickness of 3500 feet in the type area, and crops out in an irregular belt across Chehalis district, in the lower Toutle River valley, along the Cowlitz River and Olequa Creek, and in the PeEll-Doty area (Figure 3). The rocks exhibit sandy, lignitic and coaly facies which indicate deposition in a generally non-marine environment with rapid changes between very high energy and low energy conditions. In part the rocks probably represent a deltaic environment, as indicated by the proximity of marine tongues associated with cross-bedded, fairly well-sorted channel sands and coal, indicative of swamps. Also present are massive sandstone beds, crossbedded in part, and lenticular in shape, which may represent channel mouth bars, or larger offshore bars.

The sandstones, which predominate in the lower and upper most part of the section, are bluish-gray, poor to fairly well-sorted, feldspathic or lithic wackes, with a fairly high percentage of volcanic rock fragments. They are generally friable, with the grains angular to sub-rounded, and are often carbonaceous and micaceous, which gives the rock a well bedded appearance in some areas. Quartz is not a dominant constituent, although it is present in small percentages (10 - 30%). The siltstones

are generally feldspathic, always carbonaceous, sometimes lignitic and they often contain brackish water molluscan fossils. The color is dark gray to dark brown, depending on the amount of plant detritus present. The lignitic siltstones are often associated with coal seams which range in thickness from one inch to several feet. The coals are often banded, subbituminous in rank, and contain a large amount of recognizable plant remains, including whole logs, leaves, and roots which sometimes are seen in growth position, penetrating the former soil layer beneath the coal.

The non-marine phase of deposition represented by the Skookumchuck Formation is thickest toward the east, and thins rapidly toward the west. In the Chehalis River valley between PeEll and Doty, the Skookumchuck Formation is several hundred feet thick, and contains only small amounts of coal and lignitic siltstone. Massive, bluish-gray to greenish gray sandstone and carbonaceous, micaceous siltstones are the most common lithologic types in that section. Further west, in the Willapa River valley, rocks of the Skookumchuck Formation are absent.

Where the Northcraft Formation does not separate them, the McIntosh and Skookumchuck Formations show an inverse relationship in thickness from east to west. In the eastern part of the study area, deposition in the brackish, non-marine environment of the Skookumchuck Formation began earlier and lasted longer than in the

western part, the reverse is true for the McIntosh Formation. From this it is obvious that the two formations are in part genetically related to the same depositional cycle, but represent different environments.

The age of the Skookumchuck Formation is given as Late Eocene, based on limited foraminiferal and macrofaunal evidence (Snively, et al., 1958). Plant fossils, which at best have been studied only generally, indicate an Eocene, probably Late Eocene, age (Brown, in Snively, et al., 1951). The Skookumchuck Formation has been correlated with Weaver's original Cowlitz Formation at Olequa Creek, and in this paper is recognized at that locality as equivalent to part of the Olequa Creek member of Henrikson (1956).

In most of the study area, the Skookumchuck Formation is overlain by rocks of the Lincoln Formation. The contact is not conformable and there is some evidence that the Skookumchuck Formation underwent a period of lithification, slight uplift, and, in some areas, erosion before deposition of the Lincoln Formation. In several exposed sections, a thick breccia or conglomerate of volcanic rock fragments and some pebbles of Skookumchuck-like lithology marks the base of the Lincoln Formation. In other sections, the overlying rocks are nearly conformable, but marked by a distinct change in facies. Only in a few places where the contact is exposed is it gradational between the Skookumchuck Formation and the Lincoln Formation, although the length of time involved in the observed unconformity is open to question.

Keasey Formation

Schenck (1927) applied the name Keasey Formation to about 500 feet of dark gray, tuffaceous, marine sediments exposed along Rock Creek for two miles east of Keasey, Columbia County, Oregon. This description has since been emended to include beds stratigraphically higher that crop out farther down Rock Creek (Weaver, 1937; Warren and Norbistrath, 1946). The formation consists of three members, the lower of which represents the original type section. The total thickness of the Keasey Formation is about 2000 feet, and it rests with apparent conformity upon rocks that have been mapped as Cowlitz Formation (Skookumchuck of this paper). The underlying sediments consist of bluish-gray sandstones, lignitic siltstones and gray, micaceous siltstones that are very similar lithologically to the Skookumchuck Formation, except that no coal is present. The upper part of the Skookumchuck beds along Rock Creek are mainly massive to slightly bedded sandstones that appear to grade into the dark, glauconitic, tuffaceous siltstone of the lower member of the Keasey Formation.

The Keasey Formation is exposed in numerous localities in northwest Oregon, but an especially good section is exposed along the Wolf Creek Highway near Sunset Tunnel in Washington County, Oregon. The upper two members are both well exposed in road cuts, although the lower member is not definitely present in this section. For this study, the lower member is of particular interest, and when the

term Keasey Formation is used henceforth, the lower member of the Keasey Formation will be implied. The Keasey Formation has been recognized in Washington State (Rau, 1951; Weaver, 1937), but current workers do not use that designation, referring instead to the Lincoln Formation, which occupies in large part a similar stratigraphic position, and is similar lithologically.

The age of the Keasey Formation is given as Early Oligocene in Schenck's original description, based on foraminiferal and molluscan assemblages which are common throughout the section. Moore and Vokes (1953) give a brief but convincing argument for an earliest Oligocene age for the Keasey Formation (rather than Eocene), although Weaver (1944) and Warren and Norbistrath (1946) indicate the possibility of Late Eocene age for the lower member. That the Keasey Formation is correlative in part with the Lincoln Formation is clear, but the exact time relationship is not yet established.

PART II: STRATIGRAPHIC PALYNOLOGY

General Statement

The zonation of the time-rock column represented by the rock units described in the previous section is a primary objective of this study. For this purpose a total of 120 samples were prepared and examined. Well-preserved plant microfossils in large numbers were present in all but eleven of the samples. Two of the eleven were fairly well sorted sandstones from which the microfossils had been winnowed in the sorting process accompanying deposition. Eight barren samples came from one section located east of Seattle in the foothills of the Cascades. The section consists of the Raging River and Tiger Mountain formations, which are probably partly correlative with the McIntosh and Skookumchuck Formations further south. The sediments were complexly interbedded with volcanic rocks, however, and the lack of plant microfossils in the collected samples is attributed to the effect of high temperatures and the subsequent development of locally degrading conditions. Because of the lack of microfossils, the attempt to include that section in the correlation had to be abandoned. Only one other sample was barren, and that also was associated with a volcanic flow in the lower part of the Stillwater Creek section. The samples that were used came from six separate measured sections in western Washington and Oregon. The location of these sections and the subsequent

correlation between them are described in the following paragraphs.

Studied Sections

The location of the sections is shown in Figure 3, and are described in greater detail in Appendix A.

Stillwater-Olequa Creek Section

This section is exposed in the banks of Stillwater and Olequa Creeks, from three miles west of Ryderwood to one mile south of Winlock, Lewis and Cowlitz Counties, Washington. The total section is 8000 feet thick and consists predominantly of marine siltstone and sandstone of the McIntosh Formation, with increasing amounts of interbedded non-marine siltstone, sandstone, and coal of the Skookumchuck Formation near the top. These beds dip 8-10° east to northeast, strike from N45°W to due north, and are off-lapping by erosion relative to the underlying Crescent Formation. This section is located on the northern flank of the south-eastward plunging Willapa Hills anticline. The rocks range in age from late Middle Eocene to Late Eocene and are overlain by the Oligocene Lincoln Formation which appears unconformable on top of the Eocene sediments. This section has been measured in detail by Henrikson (1956); the upper part, only, by Weaver (1934); and the lower part, only, by Rau (1958).

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Willapa River Section

About 1250 feet of gray marine siltstone and sandstone are exposed in the Willapa River stream bed over a distance of three miles, about 10 miles southeast of Raymond, Pacific County, Washington. This represents only the lower portion of the total exposed section which is one of the best Tertiary exposures in the area, ranging from the Upper Eocene McIntosh Formation to the Miocene Astoria Formation. This section is very similar lithologically to the lower part of the Olequa-Stillwater section (McIntosh Formation) but it is greatly shortened. Non-marine rocks of the Skookumchuck Formation are entirely lacking. The rocks dip $10-20^{\circ}$ NE and strike about $N30^{\circ}W$, and the section is part of the north limb of the Willapa Hills anticline. Rau (1951 and 1958) has studied the section in detail and described the foraminifera.

Chehalis River Section

The Chehalis River section is a composite of several discontinuous outcrops in the vicinity of PeEll, Lewis County, Washington. A total thickness of about 4500 feet is represented, consisting mostly of McIntosh Formation. Near the top, however, beds of lignitic siltstone containing coalified wood and massive bluish-gray sandstone are present, which are assigned to the Skookumchuck Formation. The rocks dip generally north at $5-25^{\circ}$, strike nearly east-west, and are located on the north flank of the Willapa Hills anticline. This section was included within the area

studied by Pease and Hoover (1957). The Eocene rocks appear to be conformably overlain by the Lincoln Formation in this section, although there is an abrupt facies change and a coarse clastic basal unit is present.

McIntosh Lake Section

This section is located about 5 miles east of Tenino, Thurston County, Washington, in a road cut along State Highway 5A on the south side of McIntosh Lake. It is part of the composite type section of the McIntosh Formation, and consists of about 300 feet of dark gray, fissile to massive marine siltstone, with interbedded calcareous horizons. The section dips uniformly 12-15° S.E., strikes N40°W, and is located on the northeast flank of the Crawford Mountain anticline which plunges to the southeast. The McIntosh Formation at this locality has been dated as late Middle Eocene, and has been measured in detail by Snively, et al., (1958). The upper and lower contacts are not exposed at this locality, but nearby, the volcanic rocks of the Northcraft Formation lie directly upon the McIntosh Formation.

Rock Creek Section

The Keasey Formation is exposed in the banks of Rock Creek between Keasey and Vernonia, Columbia County, Oregon. This section is discontinuously exposed and consists of nearly 1000 feet of tuffaceous, gray, marine siltstone with some horizons of calcareous concretions. The locality

is on the northeast flank of the Coast Range of Oregon where that structural high plunges toward the north. Several smaller folds complicate the section somewhat, but the deformation is not extensive. The section was originally measured and described by Schenck (1927), and Warren and Norbistrath (1946) discuss it in detail. The age is given as Early Oligocene. The Keasey Formation overlies sandstone and siltstone of the Skookumchuck Formation with an apparently conformable contact. Only the lower member of the Keasey Formation is represented in this section, and the top is not exposed.

The Composite Reference Section

In order to establish a time-stratigraphic reference for the rocks within the area, it is necessary to have a complete rock section which represents all of the time in question. This is the purpose of the composite reference section. An abstract rock column is pieced together from separate outcrops in such a way that any gaps in a given section are filled by rocks from another section. In the area presently being considered, there is no single section which gives a complete record of Middle Eocene through Early Oligocene time, although the 8000 feet of the Olequa-Stillwater section apparently approaches that. It was determined that part of the record was missing in the unconformity at the top of the Skookumchuck Formation in the Olequa-Stillwater section. From field investigations

it was apparent that this same break was present in several sections, and possibly present in others where the contact was concealed. However, in the Rock Creek section, rocks lithologically similar to the Skookumchuck Formation grade without any apparent break into the greenish-gray, glauconitic, tuffaceous siltstones of the lower member of the Keasey Formation. Paleontologic work (Warren and Norbistrath, 1958; Moore and Vokes, 1953), indicates that the Keasey Formation along Rock Creek is older than the type Lincoln Formation, but younger than the Skookumchuck Formation along Olequa Creek. This does not offer conclusive evidence for the placement of the Rock Creek section on the top of the Stillwater-Olequa section in the composite section, but it lends support. A preliminary examination of the plant microfossils showed that the lowermost samples from the Rock Creek section are not only lithologically similar, but also bear a spore - pollen assemblage that is very similar to the Skookumchuck Formation at Olequa-Stillwater section and the Rock Creek section to construct the composite reference section from which the stratigraphic ranges of the plant microfossils could be established. The time represented in this section is from late Middle Eocene to Early Oligocene, although the Eocene-Oligocene boundary is not well established in the area.

Zonation

Qualitative Method

Two fundamental kinds of information are available in the fossil record; one is qualitative, or the kinds of fossils present; the second is quantitative, the number of fossils present, both individuals and species. Both the qualitative and quantitative data may contain significant information, but it is available only if methods can be devised to extract it. The qualitative methods of this paper are entirely empirical. The stratigraphic ranges within the reference section of all of the microfossil classes comprise the data. Of the two possible kinds of stratigraphic distribution, long ranging or limited range, only the second is of stratigraphic value qualitatively. Several factors may contribute singly or through interactions, to limiting of the range of an organism. If the time involved is sufficient, evolutionary processes within a population may lead to the creation of distinct, new forms. Through essentially the same selective processes, established forms may become extinct. Even the most sedentary of biologic organisms may alter their distributional patterns in response to changing environmental conditions, and new forms may occur in a stratigraphic sequence as the result of immigration. Likewise, established forms may emigrate, with a resulting termination of their fossil record in a given area. The full understanding

and appreciation of all of these factors may eventually lead to establishment of continental or even inter-continental recognition of biostratigraphic age determinations, and that is the ultimate objective of biostratigraphy in general. However, in the present study, considering the state of the art in palynology, the simple recognition of the effect of any of these factors is considered significant. The most conspicuous effects recognized are the first occurrence of new forms and the last occurrence of established types. The latter is generally less reliable than the first occurrence, stratigraphically. Reworking of fossils from older into younger rocks is an occurrence often observed by palynologists. If the time interval represented by the total range of a species is small, that species may become a key form for a particular zone or horizon. Factors such as distinctive morphology, consistency or frequency of occurrence, and extent of dispersal, etc. may increase or decrease the value of a species as a key fossil. By utilizing these empirical relationships, a zonation can be achieved. Of 300 or more entities differentiated during the course of this study, which comprise only those types represented by a significant number of individuals, 53 show a restricted stratigraphic distribution. The remainder are either long ranging forms, or they occur in such a sporadic manner that their range is not reliably indicated. Many more palynomorphs were observed in the samples studied, but they generally were



represented by single specimens and thus lack statistical significance. The placement of zone boundaries, based on the qualitative aspect of the microfloral assemblages, is largely subjective. There is no evidence of large scale changes which are reflected in grossly different palynological assemblages. The changes are rather subtle, producing a gradational sequence of characteristic assemblages with many more species in common than unique. The boundaries were selected where the most conspicuous differences were evident at a midpoint between distinctive floral assemblages, or at the transition zone between them.

Qualitative Results

Five zones are established on the basis of the stratigraphic range of 53 palynomorph species. Those ranges are shown in Figure 5. The chart is arranged according to the position of first occurrence of the palynomorphs in the composite reference section. The zones are designated by letters, starting with the lowermost as zone A. The palynomorph types are listed by code designation. These codes are included with the formal names applied in the systematic section. These forms include pollen of gymnospermous and angiospermous plants, fern spores, and a few dinoflagellates in encysted stages and marine organisms of unknown affinity. The ranges shown here are not intended to indicate the absolute range of the species in time, but the sample size considered in establishing these ranges has been large enough that they may be



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utilized with some degree of confidence locally. The 53 species selected represent only a small portion of the total palynomorph content of the rocks studied. Certainly many of the 300 other differentiated forms, as well as others that were not recognized as distinct, do exhibit a distribution in time that is of stratigraphic value. Perhaps further study will allow a more precise and far reaching zonation.

Several characteristic features of each zone are described in the following paragraphs, including the most significant forms of each zone.

Zone A is characterized by the association of P3gm-1, Alga-1, Hyx-8, and C3gm-1. These forms are not restricted to this zone, but they do not appear in the younger zones as a recognizable assemblage. The form CP3st-5 is not found above zone A, and, although it is not a common type, it is a useful key fossil. C3r-9, Til-6, Til-7, P3sm-4, and Syn3g-4, have their first occurrence within zone A. A significant feature of this zone is the lack of many distinctive forms which are present in the younger zones. This negative evidence is not conclusive, but it is useful. Plate 1 illustrates the zone A palynomorphs.

In zone B, sixteen forms occur for the first time. Alga-1 and P3gm-1 disappear in this zone and do not reappear until much later in zone E. The presence of such forms as CP3g-7, P r-3, Syn3r-1, and CP3r-7 in association with P3gm-1 and Alga-1, and the absence of forms from

higher zones, characterize zone B. The most characteristic palynomorphs are shown on plate 3.

The first common occurrence of six distinctive palynomorphs, a key form, and the lack of lower and higher forms, characterize zone C. Several appear first in the uppermost part of zone B, but are most characteristic of zone C. P5rug-1, Syn3g-2, Dino-1, and C3r-1 are especially significant in this zone. Hyx-4 has been found only in zone C, and is common in some samples. All of these forms are illustrated on plate 2.

Zone D is the most distinctive of the five zones. Twelve common and distinctive forms appear for the first time and the ranges of six forms terminate in this zone. Also, CP3sp-1, an uncommon but consistently occurring form, is a key fossil. Of particular interest in the recognition of the zone is the absence of Hyx-8, and the first common representation of *Tsuga* and *Picea* types. The presence of P_{oo}r-1, C3r-19, CP3st-4, CP3g-6, and Prot-5 are also significant in this zone. Plate 4 illustrates the types of zone D.

Zone E is a very significant time-stratigraphic unit. The ranges of fifteen common forms terminate in this zone, some of which have been important members of the microfloral assemblage throughout the lower part of the section. Six forms appear in abundance for the first time in this zone, including Al-6 and Car-3, both of which are abundant forms in samples from overlying Oligocene rocks that have been

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examined, but not included in this study. It is probable that this zone represents the early part of the transition from Eocene to Oligocene microfloral assemblages, and forms such as P3sm-4 and C3sp-4 may be reliable indexes to the Eocene rocks of the area. The microplankton forms Hyx-9 and Tith-1 are conspicuous in the all marine rocks of this zone. *Tytthodiscus* is a very common element in the Oligocene marine rocks higher in the section as well. Zone E forms are illustrated on plate 5.

Quantitative Method

The quantitative aspects of a fossil floral assemblage (abundance, inverse-positive associations, diversity, etc.) may be of stratigraphic value, especially when the time and area under consideration are fairly limited. The number of individuals of different species (sporophytes) growing within an area is, in a general way, in ecological equilibrium with the environmental forces acting upon them. Changes in the environmental conditions are reflected in the numbers of individuals of different species, as some gain competitive advantage at the expense of others. These changes are also reflected in the microfloral record, since the amount of pollen available for incorporation in sediments as fossils is in large part determined by the abundance of the parent plants in the vegetation. Ideally, the absolute number of individuals of various species of palynomorphs originally deposited in a unit volume of sediment, or per unit area on a depositional surface, is

required for stratigraphic evaluation. The absolute abundance of a single palynomorph is not affected by the abundance of others. If a high or low abundance of a particular type is stratigraphically significant, this maximum or minimum will be present in all comparable sediments deposited at the same time, regardless of the numbers of other individuals present. This cannot be realized practically, however, because of the difficulties of sampling an area of a depositional plane, and the lack of information regarding rates of sedimentation. Therefore, relative numbers of palynomorphs present are utilized. The relative abundance of one kind of pollen or spore is a function of how many individuals of other kinds are present. Several factors may contribute to variations in the relative abundance of individuals of different species in a stratigraphic section. Many of these factors may have nothing at all to do with time-related phenomena, but rather may be the result of local variations in pollen output, accumulation, or preservation. In this case, a form which has a constant absolute abundance in the sediment may show wide variation in its relative abundance, because of the increased or decreased abundances of other palynomorphs. Therefore, it is imperative that relative abundance data be carefully analyzed before stratigraphic conclusions are drawn. The data gathered are simple counts of individuals within a population and percentages are computed on the basis of the total count. Often a fixed

sum is used. The fixed sum should be sufficiently large that the sample means are reliable estimates of the population means. Another possibility is to count a fixed area of a slide instead of a fixed sum. Both of these techniques are used in this study, but for gathering different kinds of information. A fixed sum count of 200 grains was made, including all plant microfossils arranged into 35 classes. This provides information concerning the most abundant forms represented, which in turn may yield conclusions regarding the distribution of the plants and their environments. A fixed area count was made of ten pollen and spore species to provide stratigraphic information.

If the hypothesis that relative abundance data has time-stratigraphic significance is to be utilized, several assumptions must be accepted. The first is that the plant microfossils contained on a slide are a random sample of the pollen-spore assemblage present at a given stratigraphic level. Second, it is assumed that on a single time plane, the distance between any two samples is small relative to the distance from the source of the pollen and spores. This means that at any given time the distribution of the plant microfossils and their relative abundances are constant over the area under consideration or have a definable gradation in their areal distribution. Sorting action or selective degradation in the sedimentary environment creates variations in the pattern of

distribution, but these variables are not random and can usually be compensated for in the final analysis. Third, it is assumed that the ratios among spore and pollen types in a sediment sample reflect specific, although usually unknown, ratios among the sporophytes from which they came. It follows from this that changes in the abundance of pollen and spores reflect changes in the sporophyte population. Fourth, it is assumed that any condition which leads to a change in the abundance of individuals of different species (sporophytes), as that change is reflected in the related abundances of the palynomorphs selected, is operative over a regional extent. This assumption is necessary in order that fluctuations in the abundances of the selected palynomorphs can be interpreted as having correlative stratigraphic value. The conditions which might be effective in this way include climatic shifts, major edaphic alterations, and evolutionary trends.

The validity of these assumptions, and hence the hypothesis, depends on the careful choice of the microfossil types selected for quantitative analysis. It is obvious that the assumptions do not hold if pollen from indigenous swamp plants are included in the count of a coal. Several factors determined the choice of the ten forms counted in this phase of the study: (1) they were long ranging forms; (2) they were common enough that they could be expected to be found in most samples; (3) they were distinctive enough morphologically that no confusion

over identification would occur, even at fairly low magnifications of study; and (4) the source of the pollen or spore was removed from the depositional environment. Some control for the determination of the fourth condition was developed by determining the relationship of various palynomorphs to different lithologic types, and the elimination from consideration of those which show a significant correlation with particular lithologies. Also, in the final counts, a continual comparison was made with several attributes of the samples which clearly have environmental significance, such as relative numbers of microplankton and fungi, and the facies of the rock itself. Consideration was also given to pollen and spore types referable to extent genera whose known ecological requirements preclude the reasonable possibility of their growth in proximity to the depositional environment in which these palynomorphs were found. The ten types are: Osmundacites (1 species); Schizeaceous spores (3 species); Podocarpidites (2 species); Pinuspollenites (1 species); Sabalpollenites (1 species); Momipites (2 species); Ilexpollenites (1 species); Pterocaryapollenites (1 species); Proteacidites (1 species); and Ephedripites (1 species). These forms are illustrated on plates 6 and 7. To provide the data on the ten selected classes, the fixed area was the center 18 x 18 mm square of a 22 x 22 mm coverslip. Each occurrence of the ten types within the square was recorded. The total of all pollen and spores, exclusive of microplankton and fungi,

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was extrapolated from four random traverses, with all forms counted which could be referred at least to a gross morphological class, such as tricolpate pollen or trilete spore, etc. The relative abundance of the ten types was computed as a percentage of the sum of those ten. The abundance of the ten collectively, relative to all pollen and spores, was computed as a percentage of the extrapolated sum of all palynomorphs on the slide. The figures for the microplankton and fungi were obtained by fixed sum counts of 200 grains and are relative to all other palynomorphs on the slide. The data obtained are discussed in the following section.

Quantitative Results

The quantitative data are shown in Figure 6. The diagram is arranged into 16 columns which contain all of the pertinent information. Column 1 is the composite geologic reference section, showing lithology and the distribution of samples. Column 2 is a representation of the depositional environment as determined from the facies present in the section. It is a very general representation and consists of only three divisions: (1) marine environment at a depth greater than that where breaking waves are dominant energy source; (2) marine environment, but including all nearshore or shoal conditions, some of which may be represented by brackish water; and (3) non-marine environment which may include swamps, freshwater estuaries, parts of delta developments, etc. These interpretations are based entirely

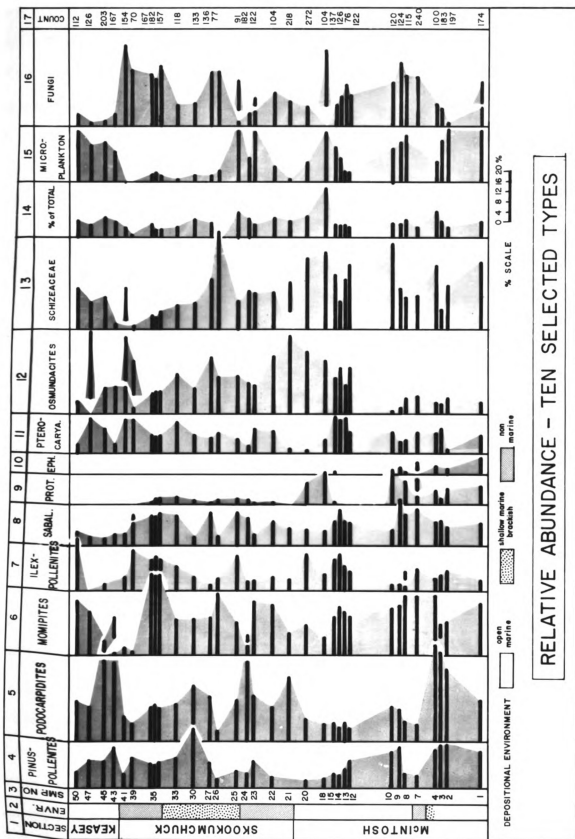
The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This not only helps in tracking expenses but also ensures compliance with tax regulations.

In the second section, the author outlines the process of reconciling bank statements. It is crucial to compare the bank's records with the company's ledger to identify any discrepancies. This process should be performed regularly to prevent errors from accumulating.

The third section covers the topic of budgeting. A well-defined budget allows a company to allocate resources effectively and avoid overspending. It is recommended to review the budget periodically to adjust for any changes in market conditions or internal needs.

Finally, the document concludes with a summary of key financial management practices. It stresses the importance of transparency, accuracy, and regular communication with stakeholders. By following these guidelines, a company can ensure its financial health and long-term success.

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on the facies present, which include poorly sorted gray siltstone facies; sandy, partly well sorted, carbonaceous, fossiliferous siltstone facies; and lignitic siltstone or coaly facies. Columns 3 through 12 show the relative abundance profiles for the ten selected forms. The abundance of the ten types relative to the sum of all spores and pollen is shown as a curve in column 13. Column 14 shows the abundance of microplankton relative to all palynomorphs. The same is shown for fungi in Column 15. Finally, column 16 shows the sum of the ten types counted.

Initial attention to the diagram should be focused on the effect, or lack of effect, of depositional environment on the abundances of the ten types selected. Three features of the diagram are indicative of the depositional environment. If the profile of column 13 is compared with column 2, it can be seen that the percentage total of the ten types is highest when the sample is from an offshore marine sediment. Likewise the numbers of the ten types are relatively small in nearshore or non-marine samples. This indicates that in the nearshore or onshore area an indigenous plant population deposited greater numbers of pollen than the plants represented by the ten types selected here. This lends support to the assumption that these ten types had a source area more distantly removed from the depositional environment, but it is not conclusive. It appears then, that the relative abundance of the ten taken collectively is, in a general way, indicative of

depositional environment. Also, when column 14, the microplankton profile, is compared with column 2, a striking relationship is seen. The microplankton, being totally indigenous in the marine environment, are very reduced in relative numbers in the samples which are close to a vegetated shoreline. A comparison of the microplankton and fungi curves, columns 14 and 15, shows that an inverse relationship generally holds for these two groups. In this case, the fungal remains are considered indigenous to the non-marine environments and the distributional pattern would be expected to be opposite the microplankton. Columns 2, 13, 14, and 15, therefore, provide a reference to the changing depositional environments, and provide a control to which the relative abundances of the ten selected pollen and spores can be compared. When this comparison is made, it is apparent that the depositional environment exerts little obvious control over the abundance of the ten. At the generalized level at which the depositional environments are considered, the numbers of the ten selected forms relative to one another are independent of depositional environment. There are specific exceptions to the generalization, but these do not invalidate the rule, the exceptions and limitations of the generalization are discussed briefly in a later paragraph.

Another significant feature to note is the distance between samples in the section. Although the time involved is not great, the thickness of the section is.

1. The first step in the process of identifying a problem is to recognize that a problem exists. This is often done by comparing current performance with a desired state or goal. For example, a manager might notice that sales are declining or that customer satisfaction is low. Once a problem is identified, the next step is to define it more precisely. This involves determining the scope of the problem, its causes, and its effects. A clear definition of the problem is essential for developing an effective solution.

2. The second step is to gather information about the problem. This can be done through a variety of methods, including interviews, surveys, and data analysis. The goal is to understand the problem from multiple perspectives and to identify the underlying causes. For example, a manager might interview customers to learn about their concerns or analyze sales data to identify trends. Gathering information is a critical step because it provides the foundation for developing a solution.

3. The third step is to generate potential solutions. This involves brainstorming ideas and evaluating them based on their feasibility and effectiveness. A manager might consider different strategies for increasing sales or improving customer service. The goal is to identify a solution that addresses the problem and is practical to implement. Generating potential solutions is a creative process that requires thinking outside the box.

4. The fourth step is to select a solution. This involves comparing the potential solutions and choosing the one that is most likely to be successful. A manager might evaluate the solutions based on their cost, risk, and potential impact. The goal is to select a solution that is both effective and practical. Selecting a solution is a decision-making process that requires careful consideration of all the options.

5. The fifth step is to implement the solution. This involves putting the chosen solution into action and monitoring its progress. A manager might assign tasks to team members, allocate resources, and track performance. The goal is to ensure that the solution is implemented correctly and that it leads to the desired results. Implementing the solution is a process that requires coordination and communication.

6. The sixth and final step is to evaluate the results. This involves comparing the actual results with the desired state and determining whether the problem has been solved. A manager might use the same methods as in the first step to measure performance. The goal is to determine whether the solution was effective and to identify any areas for improvement. Evaluating the results is a process that requires objective assessment and reflection.

Thirty two samples were analyzed from the 9,000 feet of composite section for an average of 280 feet between samples. The samples are not evenly distributed, however, and an attempt to provide some control was made. The three samples shown at the 7200 foot level of the section represent a close interval sampling taken as ten inch channel cuts ten feet apart in a continuous outcrop. The very similar values for these samples indicates that the time involved in the deposition of 30 feet of sediment was probably not sufficient for evolutionary of climatic changes of the magnitude necessary to be recognizable in the fossil record. On that basis, the sample interval over the rest of the section is assumed to be adequate for the conclusions that are reached.

Relative abundance profiles may show three major features: first, maximum and minimum values for given species are shown; second, trends within the profile may be indicated, either decreasing or increasing; and third, profiles of different species may exhibit a significant relationship to each other in particular zones or through certain parts of the section. If these features cannot be related to differences in the depositional environments, then they must result largely from the distributional patterns of the plants which produced the pollen and spores, or from error in obtaining the data. The latter has been minimized as much as possible by careful attention to procedures, and it is therefore assumed that the variations

in the profiles result from the differences in the composition and distribution of plant communities which produced the pollen and spores. In a previous paragraph it has been argued that the relationship among the members of pollen and spores reflect a specific but unknown relationship among the sporophytes which produced them, and that changes in the percentage relationships of the sporophytes will be reflected by changes in the pollen-spore ratios. Also it is assumed that the relationship among the numbers of spores and pollen is generally constant between two sites on a time plane, provided the distance between the two is small relative to the distance to the source of the pollen and spores, and environmental conditions are not controlling factors. This provides the hypothetical basis by which the fluctuations in the profiles shown in Figure 6 take on meaning in a stratigraphical sense. The maxima and minima, the general trends, and the positive and inverse relationships are the result of dynamic changes within the plant communities that produced the spores and pollen. The changes were effective over fairly broad areas in a short time, geologically, and recognition of the changes in the fossil record provides useful stratigraphic information.

When the information contained in the relative abundance diagram is utilized for correlation, several factors should be considered. First, the absolute values obtained for a specific species is not as important as it's relative

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value. That is, a maximum value in a profile is important, but whether the absolute figure is 15% or 50% of the sum is less significant. Likewise, a decreasing trend in the abundance of a species is significant whether the trend is going down from 5% to 1% of the total or from 25% to 15%. Second, the profiles are in no way a continuous log, and analogies drawn between the discrete samples in a section and a continuous profile such as obtained in an electric log are misleading. The lines connecting the bars in the graph are simply the shortest distance between ends. They represent an interpolation of sorts, but the possibility of great quantitative variation in the palynomorphs abundances in the intervals between sampled horizons must be recognized. Third, the quantitative results do not necessarily show any relationship to the qualitative results. The quantitative data may be used to establish an independent part of the zonation, but they are put to use here as correlative points with the qualitative zones.

Correlation of Zones

The extent to which zones established on certain criteria for the reference section may be recognized by those same criteria in other areas is a measure of the stratigraphic usefulness of the zones. In this study, four separate sections were examined and compared with the composite reference section to determine the extent to which these zones could be recognized laterally. These sections have been described previously. In order to

facilitate the comparison of the microfloral assemblages, a qualitative checklist was devised (Figure 7). Some of the palynomorphs selected for the qualitative zonation are shown along the top of the chart, grouped under the zone in which their first occurrence is found. Since many of the species found first in the lower zones have a range which extends into higher zones, the groupings of species are not totally diagnostic assemblages for the zone under which they appear. The zonal groupings shown provide a maximum relative age, i.e. a comparison sample containing species with first occurrences in zones A, B, and C is indicated as being not older than zone C. If species which first appear in zone D or higher are not present in the sample being correlated, a tentative minimum relative age is provided, that is, not younger than zone C. The four sections being correlated with the reference section are shown along the side of the chart. A check mark (X) in the sample column of these other sections indicates the occurrence of the characteristic palynomorph indicated in the zonal groupings.

The quantitative data from the sections to be correlated is shown in Figure 8. Several points should be mentioned regarding these diagrams. First, not all of the profiles show correlative values at the same horizon. This discrepancy may be due either to failure to meet all of the necessary assumptions completely (as discussed previously), or to a difference in the stratigraphic positions of samples for which the interpolation between known values in

| ZONE | A | | | B | | | C | | | D | | | E | | | |
|---------------|------------------|------|--|------------------|------|--|------------------|------|--|------------------|------|--|------------------|------|--|--|
| | SECTION & SAMPLE | CODE | | SECTION & SAMPLE | CODE | | SECTION & SAMPLE | CODE | | SECTION & SAMPLE | CODE | | SECTION & SAMPLE | CODE | | |
| SANDWICH RIV. | 4 | | | | | | | | | | | | | | | |
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| | 1 | | | | | | | | | | | | | | | |
| MATA RIVER | 2 | | | | | | | | | | | | | | | |
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| | 4 | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | |
| OPPELIS RIVER | 5 | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | |
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| PELTON LAKE | 1 | | | | | | | | | | | | | | | |
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OCCURRENCE CHECK - LIST
OF
SELECTED STRATIGRAPHIC TYPES

FIGURE 7

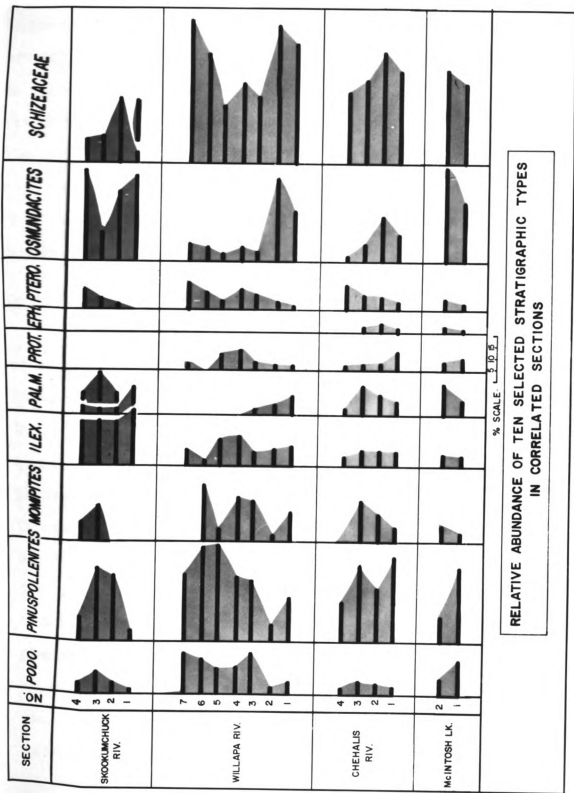


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the reference section is not valid. Both factors probably interact to produce the observed anomalies. The profiles of Ilexpollenites, Palm and to some extent, Momipites, seem to be the least consistent of the ten forms. In a later section it is suggested that these forms may have grown close enough to the swamp environment that they are over-represented there, and thus do not meet the conditions of the assumption that the distance from deposition site to the source is large.

Correlation of the McIntosh Section

The two samples examined from the McIntosh Lake section are from the dark, calcareous, carbonaceous, marine siltstone in the upper part of the McIntosh Formation. Sample 2 is located about 100 feet stratigraphically above Sample 1 and both contain large numbers of palynomorphs. The presence of six types in the two samples that are commonly found in zones A and B (see Figure 7) and the total absence of typical zone C or higher types indicates that the rocks in this section should be correlated with zone B. Quantitatively the two samples are quite similar and are characterized by fairly low Podocarpidites values, significant percentages of Proteacidites, and high values for the two fern groups. Within zone B, these samples seem to match samples 14 and 15 of the reference section most closely.

Correlation of the Skookumchuck Section

The lowermost of the four samples examined from the

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Skookumchuck section is correlated with zone C (Figure 7). The three higher samples all contain types indicative of zone D. The quantitative correlations were made as follows:

Sample 1--The very high Osmundacites value, and the low Podocarpidites value indicates a correlation near Sample 21 of the reference section.

Sample 2--This sample also has a high percentage of Osmundacites, but is declining relative to Sample 1, while Podocarpidites is increasing. This pattern, as well as the relative values of the rest of the spectrum correlates with interpolated values between Samples 22 and 23 of the reference.

Sample 3--This fits into the same pattern as 2.

Sample 4--This sample appears to correlate near Samples 26 and 27. The high Osmundacites and low Podocarpidites fit well into the interpolated pattern near those two reference samples.

Correlation of the Willapa River Section

Palynologic assemblages in the lower part of the Willapa River section correlate with assemblages in the upper part of the composite reference section. Of the seven samples analyzed, the lower four samples contain palynomorphs indicative of zone D while the upper three contain typical zone E palynomorphs (Figure 7). The quantitative correlations follow:

Sample 1--The spectrum of this sample is very similar

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to that of Sample 25 of the reference section, and probably correlates fairly near that position.

Sample 2--This sample has a lower percentage of Podocarpidites and a greatly increased value for Osmundacites. Considering the rest of the spectrum as well, it correlates near Sample 26 of the reference section.

Sample 3--This sample is similar in many respects to reference Sample 30.

Sample 4--The significant percentage of Protiacidites in this sample, and the relative values of Podocarpidites and Osmundacites, indicate a correlation near reference Samples 30 and 33.

Sample 5--This sample is compared well near Samples 33 and 35 of the reference section. The quantity of Proteacedites present is significant, although not conclusive.

Sample 6--The relative values and trends of this sample spectrum correspond quite closely to reference Sample 35.

Sample 7--This sample possesses a characteristic spectrum that cannot be compared directly with any reference sample in zone E, but it is most comparable to Sample 43.

Correlation of the Chehalis River Section

From the data of Figure 7, Samples 1 and 2 are correlative with zone D of the reference section, and Samples 3 and 4 are correlative with zone E. Within these two zones, the relative abundance spectra of the four samples are compared with the reference section as follows:

Sample 1--The low Podocarpidites value, significant

Proteacidites and moderate Osmundacites correlate with the interpolated values between 25 and 26 of the reference section. The forms Ilexpollenites, Pterocaryapollenites and the Schizeaceous fern spores also show similar relative values.

Sample 2--This spectrum is very similar to sample 26 of the reference section, with Podocarpidites, Proteacidites and Osmundacites present in identical percentages.

Sample 3--This sample appears to correlate near Samples 35 and 39 of the reference section. The absolute values are lower, but the whole spectrum shows a fairly good relative fit with 35.

Sample 4--The very low values for Podocarpidites and Osmundacites, and an exceptionally high value for Pterocaryapollenites indicate a correlation with, or near, Sample 39 of the reference section.

Summary of Palynologic Correlations

Figures 9 and 10 are cross sectional diagrams of the study area. The base of the Lincoln Formation is used as a datum, and thicknesses and distances are drawn to scale. Figure 9 is an east-west cross section including the Stillwater-Olequa section, Chehalis River section, and the Willapa River section. Several features of this diagram are significant:

1. The Skookumchuck Formation thins and finally pinches out towards the west.
2. The Skookumchuck-McIntosh contact transgresses the

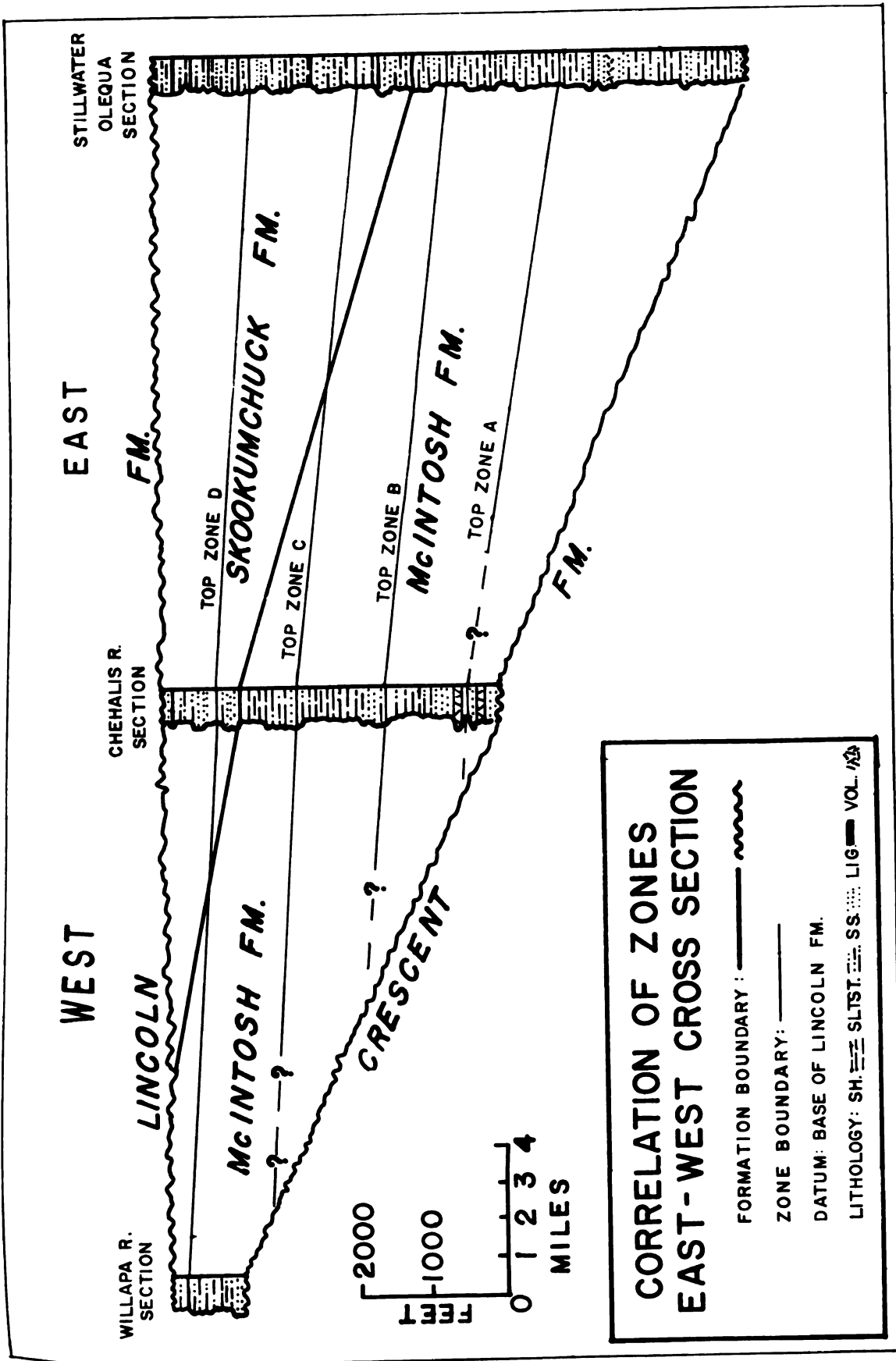


FIGURE 9

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time lines westward.

3. The McIntosh Formation is onlapping the Crescent Formation to the west.

From field observations it is possible to observe the thinning of the mostly non-marine rocks of the Skookumchuck Formation westward. A general regressive trend of the marine deposits toward the west is indicated, with a shoreline stand only a few miles from the present day coastline in Late Eocene time. It is possible that the non-marine rocks of the Skookumchuck Formation extend even farther to the west, but have been removed by erosion, although the unconformity in the Willapa River section does not appear to support that idea. The uplifting forces which caused a westward retreat of marine conditions probably continued so that the Eocene sediments were exposed to erosion at the end of Eocene time, thus producing the unconformity below the marine Lincoln Formation. It is also possible that the effects seen in this cross section are fairly local in extent, reflecting the presence of a volcanic high area in the Willapa Hills. The onlap of the McIntosh shows the presence of such a high area, and it was probably the source for many of the sandstones in the McIntosh Formation composed of volcanic rock fragments. The westward displacement of marine conditions seems to have been more general, however. Field data and published reports (Vine, 1962 and Vine, 1963) farther to the north indicate a similar continental overlap by the Puget Group on middle Eocene marine sediments (Raging River Formation).

Figure 10 shows a north-south section including the McIntosh Lake section, the Skookumchuck section, the Stillwater-Olequa section, and the Rock Creek section.

Two features are particularly noteworthy in this diagram:

1. The Skookumchuck section is considerably shortened by erosion relative to the Olequa-Stillwater section.

2. The Keasey Formation (lower member) represents at least part of the time represented by the unconformity at the top of the Stillwater-Olequa section.

The upper part of the Skookumchuck section collected in this study lies very near the unconformity below the Lincoln Formation, although the actual contact is not exposed. It appears that considerably more of the Skookumchuck section was removed by erosion than of the Stillwater-Olequa section. About 2,000 feet of mostly non-marine sediments are represented by zones D and E in the latter that are not present in the Skookumchuck section. This represents a significant amount of relief along the unconformity, although only local angular discordance can be seen. This may be related to the volcanic activity which produced the Northcraft Formation and the extensive volcanic terrane of late Eocene age to the east.

To the south, the unconformity seems to disappear, and the boundary between the Skookumchuck and Keasey Formations is indicated by a gradual lithologic change only. This provides a rock record for at least a part of the time involved in the unconformity in other sections.

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The Eocene-Oligocene time boundary is not well defined in the region. Most authors agree that the Lincoln Formation is Oligocene, but the lower part may be Upper Eocene on paleontologic evidence (Rau, 1958). The Skookumchuck Formation is well established as Upper Eocene. The Keasey Formation (lower member) is probably Upper Eocene, although it has been called Lower Oligocene (Moore and Vokes, 1953). No evidence of a definable time boundary was found in the palynological record. Many of the species of pollen and spores found have been reported from both Eocene and Oligocene rocks. The literature in Tertiary palynology is not extensive enough at present to permit an accurate evaluation of absolute age relationships of that order. Many of the forms identified may well be index forms for Eocene rocks, but such an assignment at this time would be premature. The best alternative is to depend upon age assignments based on other fossil assemblages. Tschudy (1964) presents a good review of these stratigraphic principles.

The value of palynological analysis is clearly demonstrated in the correlation of marine and non-marine rocks within the cross-sections shown. With study of additional sections, it should be possible to accurately portray the paleogeographic and environmental setting, including the extensive areas of non-marine deposits which extend over the eastern part of the study area and into the Cascade Mountains. Only by the establishment of a relative

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chronologic framework can the distribution of facies, and their lateral changes, be fully appreciated.

PART III: FLORAL AND ENVIRONMENTAL SECTION

Introduction

To obtain a better understanding of the composition, distribution, and development of the fossil flora of the earth is a legitimate goal of the palynologist. A contribution to the composition and distribution of the lower Tertiary flora is one of the objectives of this study. Data of this type contribute mainly to the purely botanical aspects of the plants of the Tertiary Period, but they also have stratigraphical significance. If the goal of regional biostratigraphic correlation is to be realized, full appreciation of the past phytogeographical relationships is necessary, especially when dealing with relatively small time-stratigraphic units. A great deal yet needs to be done before any synthesis of data on the Tertiary flora, its composition and distribution, can be accomplished, but progress is being made. Papers by Tschudy (1964) and Schopf (1964) are especially valuable in providing guidelines along which to proceed.

Composition of the Flora

Methods

The data for this portion of the study was obtained at the same time as the stratigraphic data, and is in part the same. The qualitative classification of the pollen and spores present in the samples, and their subsequent naming,

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provides the floral data. The procedures followed in nomenclature are discussed in the next section, but several related aspects are pertinent now. It is assumed that pollen or spore morphology is genetically linked with the sporophyte. That is to say, a taxonomic group of plants (sporophytes) can often be recognized by the morphological characters exhibited by their dispersed spores or pollen. The identity often extends only to family level, frequently to generic level, but only seldom to species. It is also assumed that it is perfectly reasonable to recognize the presence of an extant plant taxon in the fossil record on the basis of dispersed spores or pollen, even though the dispersed spores or pollen may possess a different taxonomic name. Further, it is assumed that fossil plants referable to extant taxa possessed ecological requirements that were, in general, similar to those of the modern plant. On the basis of these assumptions, the results shown in the next paragraphs were obtained.

Flora List

Table 1 is a generic plant list for the study area. It is based on assumed affinities of the pollen and spores found in this study, and on the published identifications of isolated leaf floras from the Puget Group (late Middle and Late Eocene), the McIntosh Formation, and the Skookumchuck Formation. The megafloral data comes from Wolfe, et al., (1962); Wolfe (in Vine, 1962); Warren, Norbistrath, and Grivetti (1945); and Brown (in Roberts,

• **Explain the importance of the following factors in the development of a country:**
1. **Geography:** Location, climate, natural resources, and terrain. 2. **History:** Colonialism, independence, and historical events. 3. **Economy:** Trade, industry, and agriculture. 4. **Politics:** Government structure and stability. 5. **Society:** Culture, religion, and demographics.

• **Discuss the impact of globalization on the world economy:** Globalization has led to increased trade, economic growth, and the spread of technology. It has also led to the integration of markets and the emergence of global corporations.

• **Explain the role of the World Trade Organization (WTO) in the global economy:** The WTO is an international organization that regulates trade between nations. It aims to reduce trade barriers and promote free trade.

• **Discuss the impact of the World Bank on the global economy:** The World Bank is an international financial institution that provides loans and grants to developing countries. It aims to reduce poverty and promote economic growth.

• **Explain the role of the International Monetary Fund (IMF) in the global economy:** The IMF is an international organization that monitors the global financial system. It provides technical assistance and financial support to member countries.

• **Discuss the impact of the Asian Financial Crisis on the global economy:** The Asian Financial Crisis, which began in 1997, led to a sharp decline in economic growth in Asia. It also led to a global recession and a loss of confidence in the global financial system.

• **Explain the role of the G20 in the global economy:** The G20 is a group of 20 major economies that meet regularly to discuss global economic issues. It aims to promote international economic cooperation and stability.

• **Discuss the impact of the 2008 Global Financial Crisis on the global economy:** The 2008 Global Financial Crisis led to a sharp decline in economic growth worldwide. It also led to a loss of confidence in the global financial system and a period of economic recovery.

• **Explain the role of the World Economic Forum (WEF) in the global economy:** The WEF is an international organization that promotes economic growth and development. It provides a platform for global leaders to discuss economic issues and share best practices.

• **Discuss the impact of the COVID-19 pandemic on the global economy:** The COVID-19 pandemic led to a global economic recession and a loss of confidence in the global financial system. It also led to a period of economic recovery and a focus on public health and safety.

Table 1: Floral List. Includes Sporophytes Inferred From Fossil Spores or Pollen, and Plants Identified From Leaves, Wood, etc. (From Published Sources).

| | POLLEN-SPORES LEAVES, STEM, ETC. | | POLLEN-SPORES LEAVES, STEM, ETC. | | POLLEN-SPORES LEAVES, STEM, ETC. |
|----------------|-------------------------------------|------------------|-------------------------------------|---------------|-------------------------------------|
| Equisetum | x | Cryptocarya | x | Bombax | x |
| Sphagnum | x | Ocotea | x | Proteacidites | x |
| Lycopodium | x | Laurophyllum | x | Maclintockia | x |
| Selaginella | x | Machilus | x | Cupania | x x |
| Isotes | x | Lindera | x | Liquidambar | x |
| Anemia | x x | Litsea | x | Salix | x |
| Lygodium | x | Aralia | x x | Fuchsia | x |
| Gleichenia | x | Ilex | x | Epilobium | x |
| Cyathea | x | Euphorbiophyllum | x | Bursera | x |
| Hemitelia | x | Prunus | x | Sabal | x x |
| Allantodiopsis | x | Rhododendron | ? x | Viburnum | ? x |
| Lastrea | x | Rhus | x x | Stephania | x |
| Dicksonia | x | Cyrilla | x | Hyperbaena | x |
| Polypodium | x x | Alangium | x | Pachysandra | x |
| Asplenium | x | Nyssa | x ? | | |
| Phyllites | x | Cornus | x ? | | |
| Osmunda | x x | Ulmus | x | | |
| Taxodium | x x | Celtis | x ? | | |
| Metasequoia | x x | Rhamnus | x x | | |
| Glyptostrobus | x x | Ceanothus | x | | |
| Podocarpus | x | Gordonia | x x | | |
| Pinus | x | Symplocos | x | | |
| Abies | x | Tilia | x | | |
| Picea | x | Trium felta | x | | |
| Tsuga | x | Ficus | x | | |
| Ephedra | x | Betula | x | | |
| Nymphoides | x | Alnus | x x | | |
| Quercus | x x | Carpinus | x | | |
| Castanea | x x | Corylus | x | | |
| Castaneopsis | ? x | Juglans | x x | | |
| Platanus | x x | Carya | x x | | |
| Cercidophyllum | x | Engelhardtia | x x | | |
| Davilla | x | Pterocarya | x | | |
| Tetracera | x | Platycarya | x | | |
| Cinnomonum | x | "Momipites" | x | | |
| Persia | x | Myrica | x | | |

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1958). The occurrence as pollen-spores, as leaves, or both, is indicated by checks adjacent to the name.

It is by no means a complete list. 100 plant taxa (sporophytes) were tentatively identified from dispersed spores and pollen and appear in the table, but a total of more than 300 entities were differentiated in the course of the study. These 300 must certainly represent but a fraction of the total flora extant within the study area in late Eocene time. The area today supports about 1500 species of higher plants, and cannot be considered as having a "rich" flora. In modern sediments of the area, the pollen and spores of only about 50 of these 1500 can be found with the regularity that 200 or more are found in the late Eocene rocks.

Environmental Indicators in Flora

Tropical - Subtropical Plants

Several of the classes of pollen encountered in the study are inferred to represent extant genera or families whose modern distribution sheds light on the operational environment of the early Tertiary plants of the study area. The most significant of these are several plants which indicate a tropical to subtropical element present in the flora. These include the following:

1. Alangium - This genus is restricted to tropical and subtropical parts of the Old World. It occurs consistently in the samples studied above its first

occurrence in the section although never in abundance.

2. Sapotaceae - Species of this family occur today widely in the tropics and subtropics, extending to southern Florida in this country. The pollen of this family is fairly common in many samples, but is found most frequently in the lignitic siltstone facies.

3. Symplocos - This is a tropical genus of Asia and America. It extends today into southern Mexico where it occupies moist habitats as a tree or shrub. The pollen is uncommon in most of the samples studied, but occurs consistently in the lignitic rocks.

4. Araliaceae - The 65 extant genera of this family are primarily tropical. The Indo-Malaysian region and tropical America are the principal centers of distribution. Some genera are solely or almost entirely climbers; others are trees or shrubs, often restricted to wet habitats. The pollen is never abundant, but occurs commonly throughout the section.

5. Burseraceae - The genera of this family are indigeneous mainly to tropical America. They are large trees or shrubs which often occupy drier habitats. Species of Bursera are found in the Sonoran Desert. The family as a whole, however, is not xerophyteic, and the pollen which is fairly common in many samples is not that of Bursera Odorata.

6. Bombax - This genus is most abundant in the American tropics and is indigenous to either damp or dry

habitats. The pollen is not generally common, but does show some abundance in samples of the carbonaceous, micaceous siltstone facies.

7. Palmae - The palms are pan-tropical, subtropical in distribution. They occur in numerous habitats, today, but the high frequency of palm pollen in some samples of coaly facies suggests the presence of a swamp palm in the study area in early Tertiary time. Sabal is a genus of wet habitats of the Carolina and Florida coasts and may be similar to the one represented by pollen in the samples.

Warm Temperate Plants

Several other genera which are less tropical in distribution, but mostly limited to warm temperate areas are also present;

1. Taxodium - This genus is widely distributed as a swamp tree in the southern United States, and it extends to southern Illinois and Indiana. The Taxodium swamps of the Gulf Coast are well known. The pollen of this genus is common in most samples, but is most abundant in the lignitic and coaly facies.

2. Nyssa - The range of this genus includes the eastern United States and China. It is a warm temperate tree or shrub which occupies wet habitats and is often associated with Taxodium. The pollen of Nyssa is present in almost all samples, but its greatest abundance is in the lignitic siltstones.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for the transparency and accountability of the organization. This section also outlines the various methods and tools used to collect and analyze data, ensuring that the information is reliable and up-to-date.

2. The second part of the document focuses on the implementation of internal controls and risk management strategies. It details how these measures are designed to prevent fraud, minimize errors, and protect the organization's assets. The text also addresses the role of management in overseeing these processes and ensuring that they are effectively integrated into the organization's operations.

3. The third part of the document discusses the importance of communication and collaboration among all levels of the organization. It highlights the need for clear lines of communication and the sharing of information to facilitate decision-making and problem-solving. This section also touches upon the importance of training and development to ensure that all employees have the necessary skills and knowledge to perform their roles effectively.

4. The fourth part of the document addresses the organization's commitment to ethical conduct and social responsibility. It outlines the various policies and procedures in place to ensure that all activities are carried out in a fair, honest, and ethical manner. This section also discusses the organization's efforts to contribute to the community and the environment, demonstrating its commitment to being a responsible corporate citizen.

5. The fifth and final part of the document provides a summary of the key findings and recommendations. It reiterates the importance of the measures discussed throughout the document and offers suggestions for further improvement. The text concludes by expressing the organization's confidence in its ability to continue to grow and succeed while maintaining the highest standards of integrity and accountability.

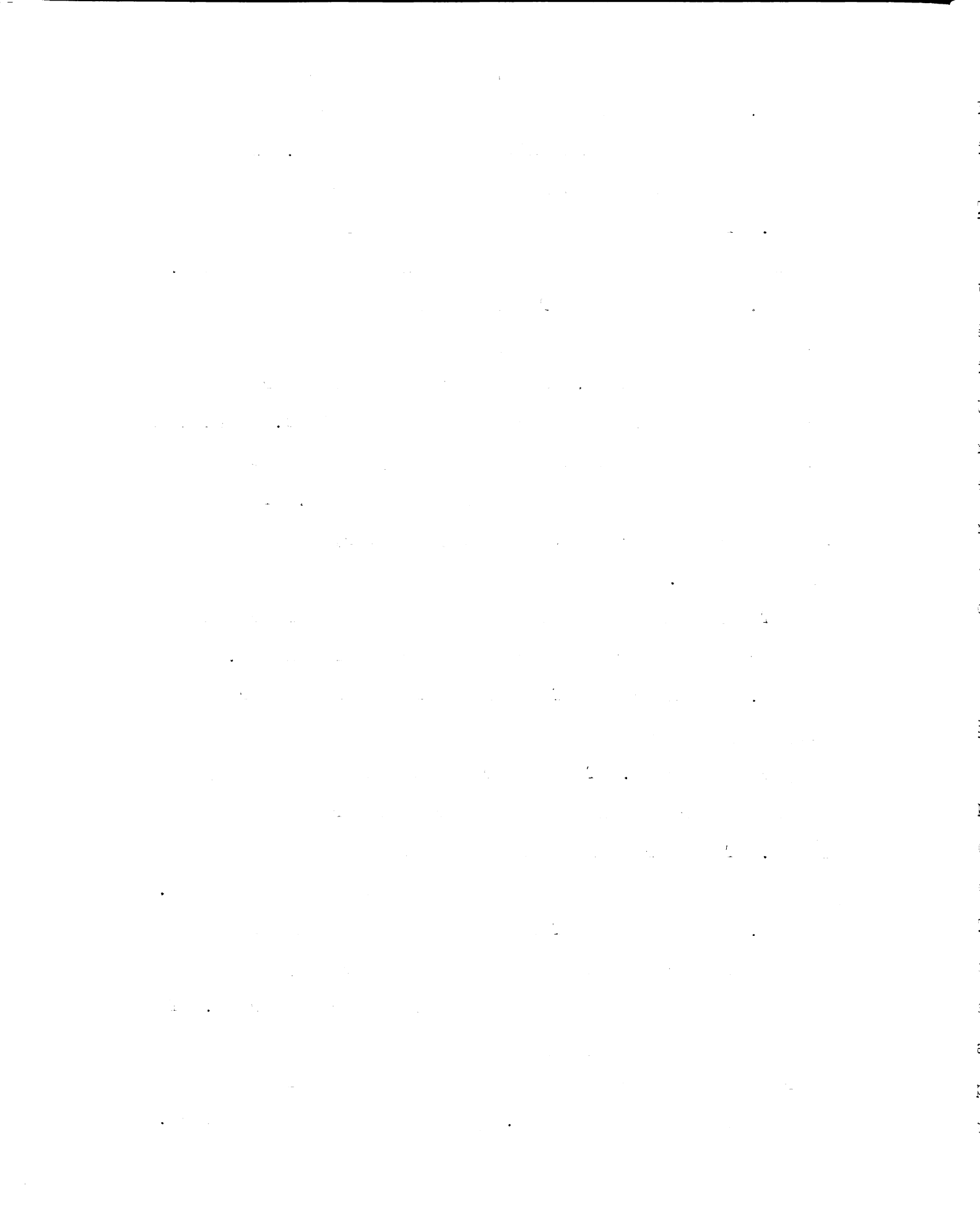
3. Liquidambar - This is a warm temperate to temperate genus common in eastern United States and Asia. It is frequently found in wet forest habitats throughout its range. The pollen is fairly common in certain samples, and is often associated with Symplocos and Sapotaceae pollen.

4. Engelhardtia - The range of this genus is mostly in southeast Asia and Malaya, but two species occur in Mexico and Costa Rica. It is a warm temperate or subtropical plant of upland or mountainous habitat. Pollen of this genus is common in nearly all samples, but it was lumped with Momipites in the fixed sum counts. The Momipites-Engelhardtia values are, however, largely composed of the latter.

Two fern families that are thought to be represented by spores in the samples are also worthy of mention.

1. Osmundaceae - The genera of this family are mostly tropical, although three species of Osmunda extend into temperate America. They occur mostly in wet habitats, and in the temperate zone, as damp forest floor and stream side ferns. The spores of Osmunda are very common in the samples studied, and are abundant in some carbonaceous siltstones.

2. Schizeaceae - This is an almost wholly tropical family of terrestrial ferns, with only three species present, and these rarely, in temperate North America. The genera Anemia and Lygodium seem to be the most commonly represented members of this family, and both of these genera grow in fairly dry habitats. Lygodium is a climbing fern.



The spores are common throughout the section, but are reduced in relative numbers in the lignitic and coaly facies.

Temperate Plants

The remaining plant groups represented by pollen, and those that provide the greatest abundance of pollen, are generally temperate in distribution. Most of these, including the Betulaceae, Fagaceae, Juglandaceae, and Ulmaceae, do, however, also have sub-tropical or tropical representatives of considerable importance. Species of both temperate and sub-tropical distribution are probably represented in the microflora. Most of the Coniferales (Abies, Picea, Isuga, Pinus, and Podocarpus) are indicative of a truly temperate element.

Environmental Distribution of the Flora

Relative Abundance Diagram

Figure 11 shows the relative abundance of 43 palynomorph classes which are, for the most part, generic designations. The percentages were obtained by a fixed sum count of 200 grains, exclusive of microplankton and fungi. The right hand column shows the sample distribution from the composite section, and the general lithology for each sample. Although the data consist of relative numbers and are subject to several basic limitations, discussed previously, a careful analysis of the profiles reveals something of the nature of the plant associations which were

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is crucial for ensuring transparency and accountability in the organization's operations.

2. The second part outlines the various methods and tools used to collect and analyze data. This includes the use of surveys, interviews, and focus groups to gather insights from stakeholders and customers.

3. The third part details the process of identifying key performance indicators (KPIs) and how they are used to measure the organization's progress towards its strategic goals. It also discusses the importance of regular monitoring and reporting on these metrics.

4. The fourth part addresses the challenges and risks associated with data collection and analysis. It highlights the need for robust data security measures and the importance of ensuring the integrity and reliability of the data used in the analysis.

5. The fifth part provides a summary of the findings and conclusions drawn from the research. It identifies the key areas for improvement and offers recommendations for how the organization can better manage its data and improve its overall performance.

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extant at the time of deposition of the sampled sediment. Comparison of particular reconstructed plant associations with the rock facies yields some information about the possible ecologic distribution of the flora. These associations and their distribution are discussed in the following paragraphs.

Ecological Elements Within the Flora

The term "ecological element" is used in this paper to refer to broad groupings of plants growing in the same general habitat. These elements, and their inferred relationship to an ecological gradient (swamp, wet, mesic, dry), are highly speculative and are not intended to represent an ecological analysis in the modern context of that science. Successional development and small scale trends within the ecosystem are beyond the level of this study.

Four separate elements are postulated from the floral data: (1) the swamp element; (2) the wet forest element; (3) the mesic forest element; and (4) the montane forest element. These groupings are based upon significant quantitative relationships within the relative abundance profiles of Figure 11. Several similar ecologic evaluations of palynologic data from Tertiary rocks have provided ideas and guidelines for the identification of the important plant associations (Neuy-Stolz, 1958; Teichmuller, 1958; and Traverse, 1955). An analysis of the modern associations

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of plants indicative of specific habitats, can also be useful for interpretation of the fossil record. The floral and vegetational data from modern habitats must be viewed with caution, however, since relatively few studies of microfloral assemblages from specific habitats have been carried out. Many studies of Pleistocene bogs and lakes have been published, and these point out some of the difficulties in reconstructing vegetation from quantitative pollen data (Davis, 1962, 1963).

The swamp element is the only element which is likely to be autochthonous, i.e. growing in, or indigenous, to the depositional environment in which it is found. The other elements are represented in mixed assemblages as part of the allochthonous sedimentary accumulation. With increasing distance from the depositional environment the influence of local plant communities decreases, and the microfossil assemblage becomes a more "average" sample of the entire flora, rather than reflecting a dominance of certain locally important plants. Therefore, attention is centered on those samples of carbonaceous, micaceous, lignitic and coaly facies which are indicative of nearshore or non-marine environments. A good general summary of these principals is presented by Chibrikova (1963).

Swamp Element

Pollen and spores of an indigenous swamp flora are probably widely distributed in the depositional environments

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represented in the studied section. The best record of this flora is found, however, in the lignitic and coaly facies. Other floral elements are present in these facies as well, but the dominance of the pollen spectra by certain taxa probably reflects the influence of important members of the swamp flora. A number of different swamp environments are considered together in this analysis, ranging from open water to densely vegetated conditions. The most diagnostic feature from the depositional standpoint, however, is the high concentration of plant detritus relative to the inorganic sediments. It is within that framework that the swamp flora is interpreted. The pollen classes thought to represent Taxodium, Nyssa, Quercus, various triporate grains, probably representing Betula and Myrica in part, and palm show positive abundance relationships at several levels in the reference section (samples 7, 21, and 24). The pairing of peaks in the Taxodium profile with the Nyssa highs, even though Nyssa pollen is not an abundant form, probably indicates the presence of a swamp in which those two genera were important plants. The high quantities of Quercus pollen associated with Taxodium and Nyssa especially in Sample 39, shows that at least one species of that genus was an important constituent. The profile for Quercus shows that it was an important pollen producer at almost all levels in the section, but several species are represented in the counts. Those species probably were distributed in several different habitats, thus accounting

for their consistent representation. The high abundance of inferred Betula-Myrica pollen is almost certainly the result of local importance of those trees in proximity to the depositional site. At sample level 7, a high Betula-Myrica value is correlated with an anomalously high percentage of palm pollen. This particular sample is from a 10 inch coal seam located in the lower part of the section. Characteristics of the underlying siltstones indicate that they were deposited in offshore marine conditions. The coal, however, appears to be closely associated with a rather thin basalt flow which thickens abruptly slightly off the line of section. It is postulated that this volcanic unit represents part of a volcanic source area which may have been an island. The coal is separated by about 4,000 feet of marine strata from the next higher non-marine rocks of the Skookumchuck Formation. The depositional environment was certainly non-marine (microplankton) totally absent, and a swamp is a likely interpretation, but Taxodium and Nyssa were not part of the swamp flora. Instead, palm, Betula-Myrica, and other triporate pollen producing plants, and, to some extent, Quercus, were the important plant groups. Neuy-Stolz (1958) describes a similar association from the lower Tertiary brown coals of the Rhine Valley and suggest a possible analogy in some swamps of the east coast of Florida. Fern spores do not play an important role in the swamp microfloral assemblages. Polypodium spores are often

common in association with Taxodium, Nyssa, and Quercus assemblages, but their maximum values do not occur in the coaly-lignitic facies.

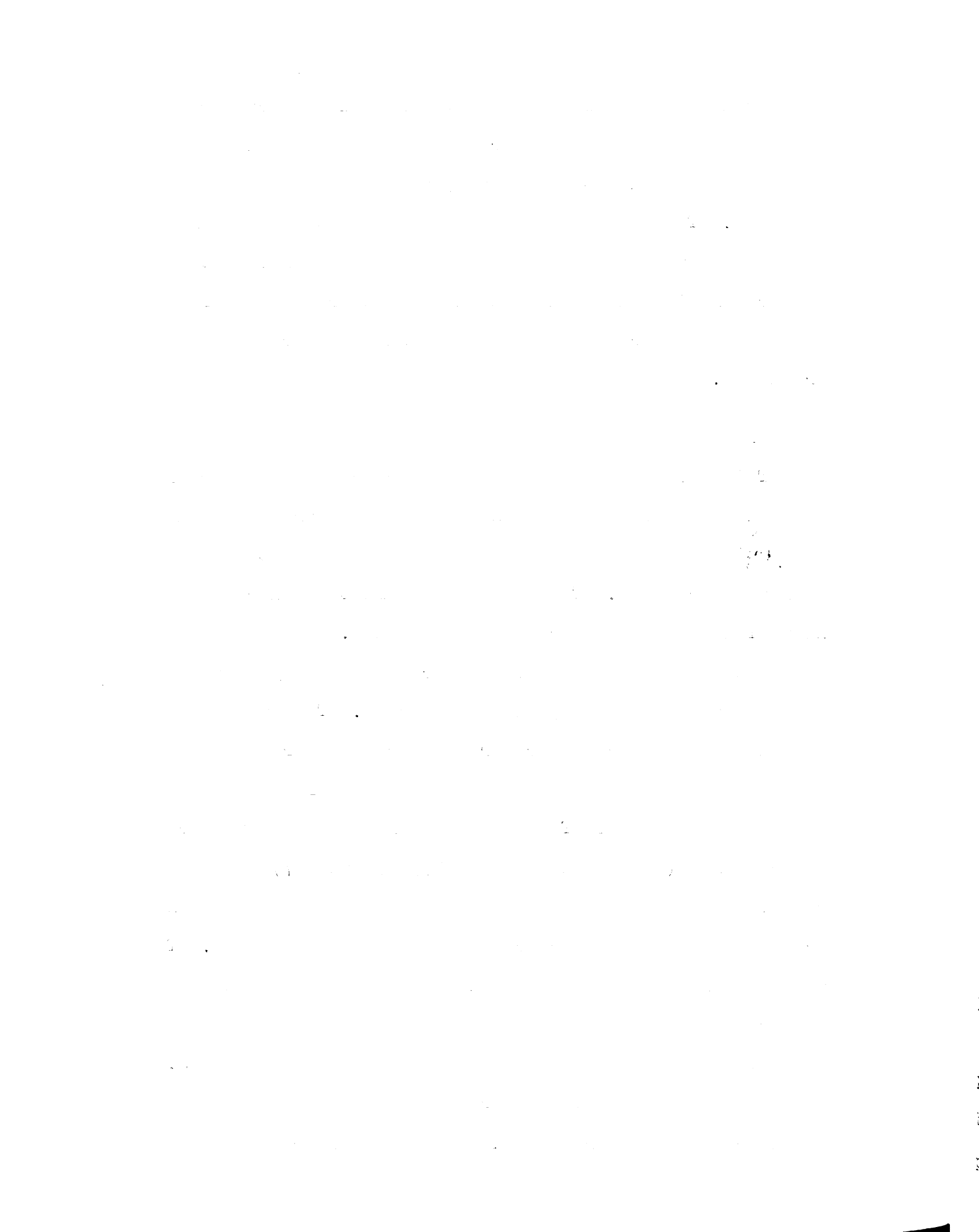
Wet Forest Element

The habitat of this floral assemblage is probably not often recorded in the sedimentary record, although it must be very closely related to the swamp habitat. The characteristic plants in this group are Sequoia, Liquidambar, Carya, Rhus, and Osmunda. Also consistently associated with these are members of the families Araliaceae and Sapotaceae. These pollen of these inferred associations are best seen in samples of carbonaceous, micaceous, siltstone facies, as well as being present to some degree in the lignitic coaly facies. Samples 22, 32, and 41 show these relationships. This element is comparable with the "Sequoia Wald" of the German brown coals, (Neuy-Stolz, 1958) although none of the samples studied in this report are thought to be from within the forest itself, as those of the brown coals are supposed to be. This probably results in an admixture of larger numbers of pollen and spores from other parts of the flora, and a less well defined "Sequoia forest" assemblage. Spores of the family Polypodiaceae are often abundant in samples containing a wet forest element, and probably were associated with these plants in life, but were not restricted to that habitat. Sample 24 shows an assemblage

which contains significant amounts of pollen characteristic of both the swamp and wet forest elements, as well as an abundance of Pollenites constans, a pollen of unknown affinity. The facies of Sample 24 is lignitic siltstone, with leaves and stems common, but contains significant numbers of microplankton as well, and it probably represents a depositional area with both swamp and wet forest in close proximity.

Mesic Forest Element

This very broad grouping is comprised of a number of generally temperate plants whose identities are based on pollen types which frequently occur together in the abundance profiles. The most characteristic genera are Ilex, Tilia, Ulmus, Quercus, and Castanea. Also often associated in the counts are members of the Polypodiaceae, Schizeaceae, Sapotaceae, and Bombacaceae. The habitats occupied by this group were probably removed from the depositional sites and the unique identity of this element is not well defined. Those samples of supposed nearshore, environments (especially Samples 23, 25, and 47) which received considerable quantities of allochthonous sediments, probably give the best representation of this element. The association would appear to contain several typically temperate deciduous genera, although the species may well not have been restricted as summer green deciduous trees. A temperate element of the sort described here has been demonstrated in other lower Tertiary microfloral studies



(Sharp, 1951; Gray, 1960; Jones, 1962; Engelhardt, 1964). Common forms of the element are also discussed by Neuy-Stolz (1948) from the Rhine Valley, although that author does not recognize the association as such within the brown coal environment. Pollen of the genera Pinus and Podocarpus are frequently associated with the mesic forest element, and it is possible that these trees occurred within the general habitat area occupied by this element.

Montane Element

This element is postulated to account for the frequent association of the coniferous genera Pinus, Abies, Tsuga and Picea. Pollen of pine and spruce are often ubiquitous in sedimentary environments, but their most significant percentages are in samples which represent offshore marine depositional sites. This element is the most remote from the depositional environment, and consequently very little can be said regarding the nature of the plant association.

One further association must be mentioned. Pollen thought to represent Platanus and Salix are significant contributors to the microflora at several horizons, and are generally abundant throughout the section. These plants probably occupied streamsides and lowland habitats in considerable abundance. Their proximity to the streams probably accounts for the consistent representation in all but the closed swamp environments. Other plants, particularly the ferns, may also have been similarly

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3. The third part of the document focuses on the role of technology in data management and analysis. It discusses how modern software solutions can streamline data collection, storage, and reporting, thereby improving efficiency and accuracy.

4. The fourth part of the document addresses the challenges associated with data management, such as data quality, security, and privacy. It provides strategies to mitigate these risks and ensure that data is used responsibly and ethically.

5. The fifth part of the document concludes by summarizing the key findings and recommendations. It stresses the importance of ongoing monitoring and evaluation to ensure that data management practices remain effective and aligned with the organization's goals.

6. The sixth part of the document provides a detailed overview of the data collection process, including the identification of data sources, the design of data collection instruments, and the implementation of data collection procedures.

7. The seventh part of the document discusses the various methods used for data analysis, such as descriptive statistics, inferential statistics, and qualitative analysis. It explains how these methods are used to interpret the data and draw meaningful conclusions.

8. The eighth part of the document focuses on the presentation of data, including the use of tables, charts, and graphs. It provides guidelines for creating clear and concise reports that effectively communicate the results of the data analysis.

9. The ninth part of the document discusses the importance of data security and privacy. It outlines the measures that should be taken to protect sensitive data from unauthorized access and ensure compliance with relevant regulations.

10. The tenth part of the document provides a final summary and concludes the report. It reiterates the key findings and emphasizes the need for continued attention to data management practices to ensure the organization's long-term success.

11. The eleventh part of the document includes a list of references and sources used in the report. It provides a comprehensive list of the literature and data sources that informed the analysis and conclusions.

12. The twelfth part of the document provides a detailed appendix of the data collected during the study. This section contains all the raw data and any additional information that was used in the analysis.

13. The thirteenth part of the document includes a list of figures and tables that are referenced throughout the report. This section provides a clear and organized way to locate the specific data points and visualizations used in the analysis.

distributed, and their fairly high abundance may be a reflection of the ease with which their spores and pollen were incorporated in the sedimentary load of the streams.

Areal Distribution of the Floral Elements

Figure 12 is an idealized diagram of the study area, showing the postulated floral distribution. The slope represents an ecological gradient in which many environmental factors were operative, but along which water relationships and/or altitudinal effects were dominant factors.

The swamp element probably occupied rather extensive areas of a coastal plain. It represents an area of low relief, near sea-level, and subject to periodic inundation by marine waters as the result of isostatic or eustatic fluctuations. A swamp habitat existed also within the postulated delta complex, occupying interdistributary areas and abandoned channels. This environment is probably represented by some of the lignitic and coaly facies, where channel cuts filled with sand, often containing large logs, are associated with the coals and lignitic horizons.

The wet forest element probably occupied areas adjacent to the swamps. These areas might have included floodplains, large levees in the delta complexes, and more stable areas within the swamps. The pollen of the supposed plants of this element is not abundant, and it may have had a rather restricted distribution in the area.

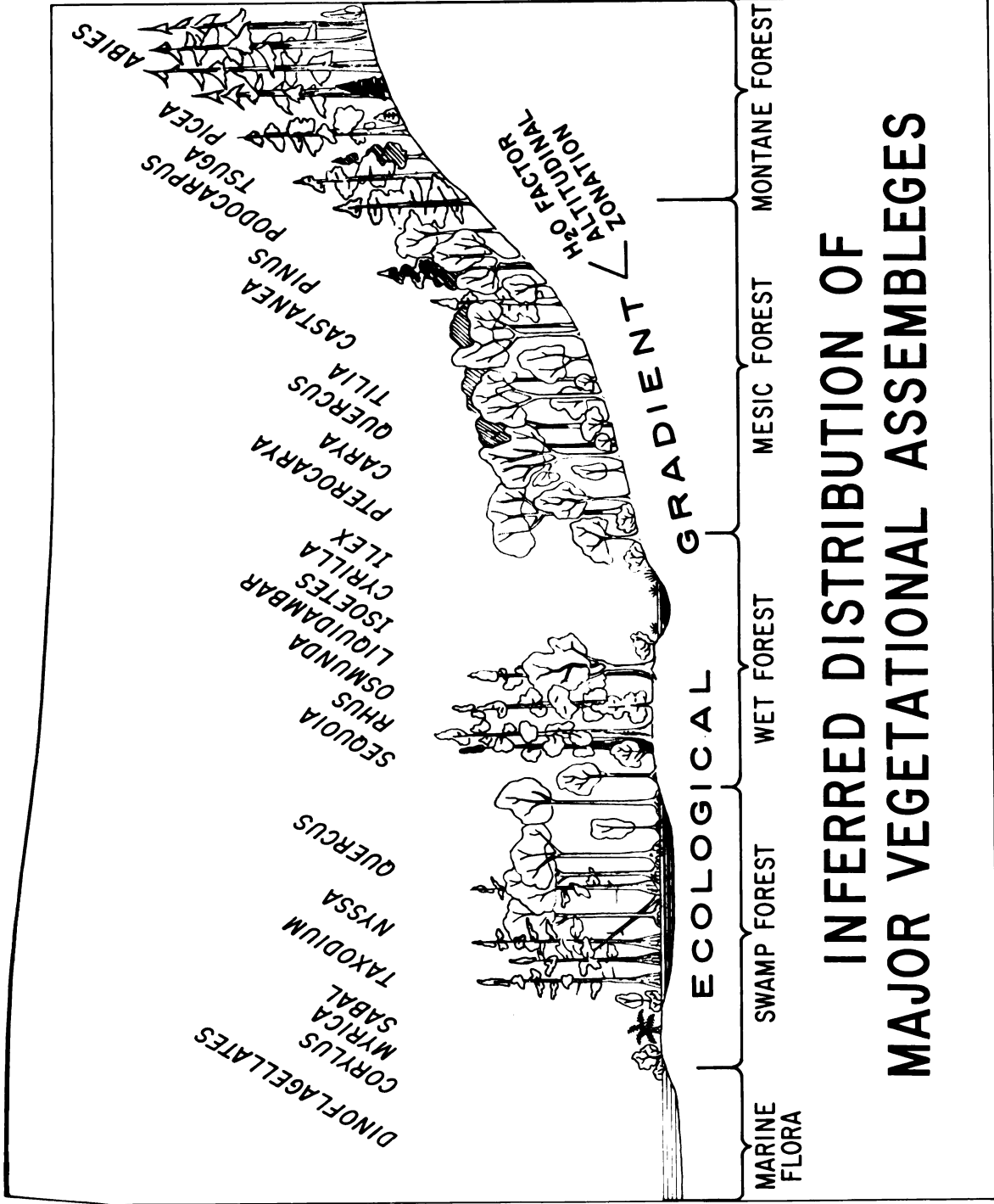


FIGURE 12

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Interfingering with these elements was the mesic forest assemblage. It is postulated that this element occupied extensive areas of upland, grading into both the wet forest and the montane habitats. During certain periods of time in the geologic history of the area, this mesic assemblage was probably widespread as either the range of the swamp or montane flora was restricted by tectonic activity.

The distribution of the montane element was probably along the flanks of the early Tertiary counterpart of the Cascade Ranges. The relief in that region is not known, but the degree of orogenic activity described by Misch (1952) probably created mountains of considerable magnitude.

Summary of Environmental Conditions

The composition of the early Tertiary flora within the area, based on the pollen-spore assemblages, indicates a significant subtropical or tropical representation in the flora, as well as major contributions by temperate plants. The frequent occurrence of the subtropical-tropical pollen types in the coaly and lignitic facies, indicates that the plants which produced the pollen were primarily indigenous in the low-lying coastal area. The interfingering of the marine and non-marine rocks in the upper part of the reference section is evidence of a near-shore position and the low relief of the area. To the east, the early Tertiary Cascade Ranges provided a more temperate habitat in an

upland or even mountainous area. It is probably most accurate to describe the climate as sub-tropical, with the mountainous areas showing altitudinal zonation comparable to latitudinal belts assigned to the cool temperate or boreal realm (Dansereau, 1957, pp. 101-106). The mountainous regions of Central America might provide an analgous climatic situation. Sharp (1951), Engelhardt (1964) and Gray (1960) have compared the floral assemblages of some Gulf Coast Eocene rocks with that of the eastern slope of the Sierra Madre of Mexico. Many temperate genera are present in the upland areas, coniferous trees are growing in the mountains, and a tropical element occupies the swampy coastline.

Several lines of evidence indicate a wet climate. The presence of extensive swamps indicate a high water table and ample supplies of surface water. The inferred presence of delta complexes, and the massive quantities of allochthonous sediments, some quite coarse, indicate an extensive drainage development. The rivers were probably large and their discharge high in order to accommodate heavy sedimentary loads, perhaps due to high rainfall in the hinterland areas. The early Tertiary Cascades may well have operated as a moisture barrier much as the modern day Cascades do. The pattern of onshore flow of moist air may have been very different from today, but with marine conditions prevailing to the west, and a mountainous region to the east, a very wet belt could be developed.

The marine fauna of the McIntosh and Skookumchuck Formations has been characterized as being sub-tropical (Van Winkle, 1918; Effinger, 1938). Also, Brown (in Roberts, 1958) and Wolfe (1961) indicate a tropical to sub-tropical environment for plant megafossils collected from rocks of the Puget Group to the north and equivalent in age to the Skookumchuck Formation in part. These plants have been listed previously.

The evidence thus suggests that a warm, humid, sub-tropical climate prevailed in southwestern Washington in early Tertiary time. No evidence for a change in that general climate is indicated during Eocene or earliest Oligocene time. Many minor fluctuations must have occurred, but no trend toward the modern wet, cool temperate climate of the area today was seen. The plants of a temperate climate were present in the higher elevations, and with a gradually cooling climate, the distributional range of that element would expand, causing a conspicuous alteration in the pollen abundance relationships. At some higher horizon in the Tertiary section, these changes in the pollen abundance as well as qualitative changes, should be apparent.



PART IV: SUMMARY AND CONCLUSIONS

This study was undertaken to establish a relative chronologic framework for the lower Tertiary sedimentary rocks of western Washington, and to evaluate the composition, distribution, and environmental conditions of the early Tertiary flora. Six outcrop sections were chosen for study, providing a north-south and an east-west cross section of the area. The cross sections intersect at the location of the most complete rock sequence in the area, the Stillwater-Olequa Creeks section. Four of the sections represented type sections of the lithologic units under consideration, and the remaining two had been previously measured in detail.

From the field relationships, and from published data, a composite reference section was established. The Stillwater-Olequa section contains 8,000 feet of Middle and Upper Eocene strata, but an unknown amount of the section is missing at the top as evidenced by the unconformable contact with the overlying Oligocene strata. The lower member of the Keasey Formation provided a rock record for at least part of this gap.

From an analysis of 50 samples in the reference section, 53 stratigraphically limited palynomorphs were found. The vertical distribution of these provides a five part zonation of the reference section. By comparing the palynological assemblages in the other sections with the reference, a biostratigraphic correlation was achieved.



The Skookumchuck section contained 36 palynomorphs in common with the reference section. The Chehalis River section contained 40 of the 53 stratigraphically significant forms. 39 correlative types occurred in the Willapa River section, and 9 in the McIntosh Lake section.

In addition, ten long ranging palynomorphs were recognized in the reference section whose uniform distribution in all facies indicated that quantitative relationships among them might be of stratigraphic value. Relative abundance profiles for these ten forms were established in the reference section. Individual sample spectra were then compared from the other sections, and correlations made. This provides a further refinement of the correlation within the qualitative zones. Seven of the ten forms showed a distributional pattern that was almost entirely independent of depositional environment. The depositional environment is indicated by the rock facies, the ratio of microplankton to fungal remains, and the ratio of the sum of ten selected forms to all other spores and pollen. The time correlations are shown to cross facies boundaries. In the east-west cross section non-marine rocks in the Stillwater-Olequa section are correlated with marine rocks in the Willapa River section. Coal of the Skookumchuck section correlates with lignitic siltstones in the Stillwater-Olequa section, shown in the north-south cross section.

In all, 112 palynomorph species are identified belonging

1. The political economy of development is a field that has grown rapidly in importance and scope in recent years. It seeks to understand the relationship between political institutions and economic development, and to identify the factors that influence the success or failure of development efforts. This field is particularly concerned with the role of the state in development, and the impact of political institutions on economic growth and social development.

2. One of the central questions in the political economy of development is the role of the state. The state is often seen as a key actor in development, and its actions can have a profound impact on the economic and social development of a country. The state can provide public goods, such as infrastructure and education, and it can regulate the economy and enforce property rights. However, the state can also be a source of corruption and inefficiency, and it can hinder development through its actions.

3. Another central question in the political economy of development is the impact of political institutions on economic development. Political institutions, such as the constitution, the judiciary, and the legislature, can have a significant impact on the economic development of a country. For example, a strong judiciary can help to enforce property rights and contract law, which is essential for economic growth. A strong legislature can help to ensure that the government is accountable to the people, and it can help to pass laws that promote economic development.

4. The political economy of development is a complex and multifaceted field, and it is an area of active research and debate. There are many different theories and approaches to the study of the political economy of development, and there is still much to be learned about the relationship between political institutions and economic development.

to 60 genera in 46 families. These are selected forms and represent only about one third of the total number differentiated in the course of the study. Fourteen of the identified genera or families are today subtropical or tropical in distribution. Twenty taxa are mostly temperate, but with subtropical representatives, and seven are wholly temperate or boreal. A list of 58 taxa based on leaf fossils was made from published data relating to the same general stratigraphic and geographic locality as this study. Almost all of the taxa represented by leaves are tropical-subtropical plants. Twenty three taxa as interpreted by the presence of dispersed spores and pollen presumed to have affinities with those taxa, are present which also are represented by leaves or wood.

The identified forms were grouped into 41 classes and the relative abundances computed by a fixed sum population count of 200 grains. From the abundance profiles of these groups, significant quantitative associations are apparent. By relating the associations with the depositional environment of the samples and to the geologic setting of the area, the distributional patterns of the plant associations was interpreted. Four major forest types were recognized, based on the observed quantitative relationships, the sample facies, and analogous modern plant communities. The four assemblages are swamp forest; wet forest; mesic forest; and montane forest.

From the results of the study summarized in the foregoing

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters. This section also touches upon the need for regular audits and reviews to ensure that all data is up-to-date and correct.

2. The second part of the document focuses on the role of technology in modern business operations. It highlights how digital tools and software can streamline processes, reduce errors, and improve overall efficiency. The text suggests that organizations should invest in reliable technology solutions that can scale with their growth and provide robust security features to protect sensitive information.

3. The third part of the document addresses the importance of clear communication and collaboration within an organization. It stresses that effective teamwork and open communication channels are crucial for achieving common goals and resolving issues promptly. The text encourages the use of various communication tools and platforms to facilitate interaction and ensure that everyone is on the same page.

4. The fourth part of the document discusses the significance of continuous learning and professional development. It notes that in a rapidly changing business environment, employees must stay updated with the latest industry trends and skills. The text recommends providing training opportunities, workshops, and courses to help employees grow and contribute more effectively to the organization.

5. The fifth part of the document covers the importance of risk management and contingency planning. It explains that organizations should identify potential risks and develop strategies to mitigate them, ensuring business continuity in the face of unforeseen circumstances. The text also discusses the need for regular risk assessments and updates to contingency plans as the business evolves.

6. The sixth part of the document focuses on the importance of customer satisfaction and loyalty. It states that providing excellent customer service and meeting customer needs are key to long-term success. The text suggests implementing feedback loops and personalized service strategies to enhance the customer experience and build a strong, loyal customer base.

7. The seventh part of the document discusses the importance of financial management and budgeting. It emphasizes that organizations should maintain a clear understanding of their financial health and create realistic budgets to guide their operations. The text also touches upon the importance of monitoring expenses and optimizing resource allocation to maximize profitability.

8. The eighth part of the document covers the importance of legal compliance and ethical practices. It notes that organizations must adhere to all relevant laws and regulations to avoid legal penalties and maintain their reputation. The text also emphasizes the importance of ethical behavior and integrity in all business dealings, as these are fundamental to building trust and a positive corporate culture.

9. The ninth part of the document discusses the importance of innovation and creativity. It states that organizations should foster a culture of innovation where employees are encouraged to think outside the box and propose new ideas. The text suggests implementing processes and incentives that support creative thinking and the development of innovative solutions to business challenges.

10. The tenth part of the document covers the importance of sustainability and social responsibility. It notes that organizations have a responsibility to their stakeholders to operate in an environmentally and socially responsible manner. The text suggests implementing sustainable practices and social responsibility initiatives that can benefit the community and the environment while also supporting the organization's long-term success.

paragraphs, the following conclusions seem justified:

1. The plant microfossils contained in the lower Tertiary rocks of the study area possess qualitative and quantitative characteristics which permit a biostratigraphic zonation to be established.
2. The zonation is laterally correlative in southwest Washington and northwest Oregon, and can probably be extended beyond that region.
3. Depositional environment does not affect the identification of the biostratigraphic zones. This fact suggests the possibility of detailed paleogeographic studies which include the extensive non-marine deposits lying to the east, adjacent to, and within the Cascade Mountains.
4. The McIntosh Formation shows an on-lapping relationship with the Crescent Formation in the east-west cross-section. This indicates that the Willapa Hills structural high was present during late Eocene time, and was probably a source for some of the sediments of the lower part of the McIntosh Formation to the north and east.
5. The Skookumchuck Formation represents a regressive phase of deposition in Late Eocene time. The disappearance of marine conditions was general in the area, and was culminated by uplift and erosion of the underlying sediments. The uplift may have been fairly localized near the volcanic highs, and deposition

seems to have been continuous in some areas (Rock Creek section).

6. Considerable relief exists along the unconformity at the base of the Lincoln Formation. If the correlative time lines within the studied section were extended and used as a datum, a clearer picture of the pre-Lincoln surface could be obtained.
7. The flora occupying the land areas adjacent to the depositional sites was very diverse. The swamps supported forests comparable to the *Taxodium Nyssa* swamps of southwestern United States, or the open everglades-type vegetation. Wet habitats adjacent to the swamps were occupied by a forest of Sequoia, Quercus, Ilex, Araliaceous plants and others. The drier upland held a forest perhaps in part comparable to that of the southern Appalachian Mountains, with Tilia, Liquidambar, Pinus, Podocarpus, Quercus, Juglans and many others. The mountainous regions postulated to the east supported a coniferous flora in part, with Abies, Picea, and Tsuga present.
8. Many plants are represented by leaf or wood fossils which are not represented by pollen or spores, and the reverse is also true. Likewise, a large part of the flora is probably not preserved at all, especially those plants growing outside of the depositional environments.
9. The climate was tropical to subtropical in the lowland,

more temperate in the areas of higher elevation.

Water stress was probably not a factor in the environment, with ground and surface water, as well as atmospheric moisture abundant.

10. No significant shift in the climatic conditions is apparent during the time represented in the composite reference section. The beginning of such a shift may be reflected in the uppermost part of the section, however, where the range of the alpine forest element shows signs of expanding as indicated by increased abundance of the pollen of those plants.
11. Further investigation into the Tertiary microfloral record of the area would prove fruitful. The quality and quantity of the plant microfossils, and their demonstrated usefulness in stratigraphy and paleoecology, indicate a high probability of success for such studies.

PART V: SYSTEMATIC SECTION

The purpose of this section is to provide taxonomic names and references for the pollen and spores utilized in the preceding sections of this paper. A rigorous taxonomic treatment is not attempted, and no new names are proposed, although some are altered. The application of published names and their references should provide a means for wider application of the data contained in this paper by other workers, even though there may be disagreement over the validity of the name applied.

Nomenclature

A few comments regarding the names used in this paper are worthy of mention, although the knotty problem of Tertiary palynological nomenclature has been discussed at length by Potonie (1958 and 1960), Traverse (1955, 1956, and 1961), Krutzsch (1959) and many others. First, it is necessary to be aware that of the 300,000 plus described plant species in the world today, practically none possess a morphological description of their pollen or spores as part of the original diagnosis, and the pollen or spores of relatively few taxa have been studied subsequently. This situation is being remedied by the work of Wodehouse, Erdman, Selling, Ikuse, Cookson and Lecompte, to mention only a few workers in modern pollen morphology, but the pace is not rapid. Many hundreds of species of described plants are totally unknown as regards their pollen

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters. This section also touches upon the legal implications of failing to maintain such records, which can lead to severe consequences for individuals and organizations alike.

2. The second part of the document delves into the specific requirements for record-keeping, including the types of documents that must be retained and the duration for which they should be kept. It provides a detailed overview of the various categories of records, such as financial statements, contracts, and correspondence, and outlines the best practices for organizing and storing these documents to ensure they are easily accessible and secure.

3. The third part of the document addresses the challenges associated with record-keeping, particularly in the context of digital information. It discusses the risks of data loss, corruption, and unauthorized access, and offers strategies to mitigate these risks. This includes the use of secure storage solutions, regular backups, and access controls to protect sensitive information.

4. The fourth part of the document focuses on the role of record-keeping in legal proceedings. It explains how well-maintained records can serve as crucial evidence in court cases, helping to establish facts and support legal arguments. It also discusses the importance of preserving records in their original form or as certified copies to ensure their admissibility in court.

5. The fifth part of the document provides a summary of the key points discussed and offers final thoughts on the importance of record-keeping. It encourages individuals and organizations to take a proactive approach to record-keeping, recognizing it as a fundamental aspect of good governance and risk management. The document concludes by emphasizing that maintaining accurate records is not just a legal obligation, but a best practice that can benefit an organization in many ways.

morphology, not to mention the number of plants not yet described even as sporophytes. This naturally places a limitation on the degree of confidence with which one may assign fossil pollen to extant taxa. This is not to say that many plant taxa may not have pollen morphological characters which allow them to be identified on that basis alone, but it does mean that the uniqueness of the pollen morphology in many taxa is not established. It follows then, that the assignment of a new species, defined solely on pollen morphology, to an extant genus, may lead to an enlargement of the genus which is unwarranted. It is not reasonable that a new species of modern plant would be adequately described taxonomically by a complete elucidation of its pollen. As Potonie (1958, p. 38) points out, if a genus is defined by a type species, based on a sporophyte holotype, it is not reasonable to add a new species to that genus which is based on a spore or pollen holotype. The name is a means of referring to a specific category, and the description and classification of that category could well carry whatever information the data reasonably allows as to botanical affinity. In this study, the floral and environmental descriptions have utilized the names of extant plant taxa, but those names have applied to the inferred sporophytes. The sporophytes are an analytical interpretation based on the empirical presence of pollen and spores which are classified by their similarity to their similarity to known forms. This is in no way affected

by the valid taxonomic names applied to the specific pollen or spores.

In this study, the validity of the names utilized in publications is not generally challenged, and only slight changes have been made to maintain consistency. The names are based largely on Potonie's work (1960), but other references are utilized as well. Published illustrations and descriptions were used, and no type specimens were examined. The catalog of Fossil Spores and Pollen published by Pennsylvania State University has been helpful in this effort, although original references were available for most species. The descriptions are arranged in a broad morphological form classification following the Turma and Subturma of Potonie. The abundance notations in the descriptions have the following approximate values;

| | |
|---------------|----------------|
| very abundant | > 25 per 1000 |
| abundant | 10-25 per 1000 |
| common | 5-10 per 1000 |
| uncommon | 3- 5 per 1000 |
| rare | < 2 per 1000 |

Location and Collection Information

Each specimen described carries a reference to a slide and position on the slide. The coordinates are from the stage of a Leitz Ortholux microscope. The latitude coordinate is given, followed by the longitude. Conversion to other stages can be accomplished by reference to one of three index slides marked with an "X". The coordinates of

the index are marked on the slide, and a conversion factor for all readings can be obtained by taking the difference between the corresponding readings on the index slide and those of the new stage. The difference is then added to the coordinates given for a specimen (one may add a negative number in some cases). If the scale direction is opposite on the second microscope an additional negative sign is involved, in which case additions may change to subtractions. Close attention to the signs avoids confusion (Traverse, 1955).

Each slide is complete with a collection and a maceration number. The collection number refers to the section and sample position in the field, the maceration number refers to the laboratory preparation schedule. All rock samples processed in the Michigan State University Palynological Laboratory are prefixed by the letters Pb (Paleobotanical), followed by a number. By reference to the master file, the collection site, age, lithology and preparation procedure for each sample can be obtained. Vials containing the sample residues, and slides of illustrated specimens are on file at Michigan State University.

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3. Results

4. Discussion

5. Conclusion

6. References

7. Appendix

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FERN SPORES

Genus POLYPODIISPORITES Pot., 1934

Polyodiisporites cf. favus Pot., 1934

(Plate 8, Figures 2 and 3)

The comparison with *P. favus* is close, however, the illustrated form generally possesses slightly larger verrucae. The botanical affinity is probably with the family Polypodiaceae, and this species comprises a large part of the percentages shown under that heading in Figure 11.

Occurrence: Common throughout section, one of the most abundant spores represented.

Location: Pb 3801 5 ; 38.0 x 119.3 (Fig. 2)

Pb 3802 7 ; 38.2 x 120.4 (Fig. 3)

Code: Mlver-4

Polyodiisporites sp. 1

(Plate 1, Figure 1; Plate 8, Figure 1)

The affinity of this species with Polypodiaceae is not certain. The exine is very thick, in some cases, appearing to result from a fusing of distally expanded clavate projections in a tectate fashion.

Occurrence: Generally rare, but most frequent occurrence in Zone A.

Location: Pb 3809 6 ; 45.9 x 124.2 (Pl. 1, Fig. 1)

Pb 3805 5 ; 45.0 x 124.9 (Pl. 8, Fig. 1)

Code: Mlver-7

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

In the second section, the author outlines the various methods used to collect and analyze the data. This includes both primary and secondary data collection techniques. The primary data was gathered through direct observation and interviews, while secondary data was obtained from existing reports and databases.

The third section details the statistical analysis performed on the collected data. It describes the use of descriptive statistics to summarize the data and inferential statistics to test hypotheses. The results indicate a significant correlation between the variables being studied.

Finally, the document concludes with a series of recommendations based on the findings. It suggests that further research should be conducted to explore the underlying causes of the observed trends. Additionally, it provides practical advice for stakeholders based on the study's conclusions.

TRILETE SPORES

Genus LAEVIGATISPORITES Pot., 1931

Laevigatisporites cf. pseudomaximus Pf., in Thom. and Pf., 1953

(Plate 8, Figure 7)

This species bears a close resemblance to Cyathidites australis Couper, 1960, although it is less angular in outline. The botanical affinity may be with the genus Cyathia. The comparison with L. pseudomaximus is very close.

Location: Pb 3883 6 ; 47.8 x 122.8

Code: Tlsm-11

Genus OSMUNDACITES

Osmundacites wellmanii Couper, 1953

(Plate 6, Figure 1; Plate 8, Figure 11)

This species is one of the more common spores in the samples studied. It almost certainly represents the genus Osmunda, and it comprises the total percentages of that type shown in Figure 11. Baculatisporites gemmiculavatus Pot., 1934 is a very similar species.

Occurrence: Common to abundant, ranges throughout the section.

Location: Pb 5622 1 ; 59.0 x 119.0 (Pl. 6, Fig. 1)

Pb 3832 5 ; 35.5 x 118.2 (Pl. 8, Fig. 11)

Code: Tlgm-1

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial statements and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. These methods include direct observation, interviews, and the use of statistical techniques. Each method has its own strengths and limitations, and it is important to choose the most appropriate one for the specific research objectives.

3. The third part of the document describes the process of data analysis. This involves identifying patterns and trends in the data, testing hypotheses, and drawing conclusions based on the results. It is important to be transparent about the methods used and to provide a clear explanation of the findings.

4. The final part of the document discusses the implications of the research findings. This includes a discussion of the limitations of the study and suggestions for future research. It is important to be honest about the limitations and to provide a clear and concise summary of the key findings.

Genus CICATRICOSISPORITES

Cicatricosisporites cicatricosoides Krutzsch, 1959

(Plate 8, Figures 5 and 6)

The botanical affinity of this species is thought to be with the family Schizeaceae, possibly the genus Anemia. It comprises a small percentage of the Schizeaceae profile in Figure 11.

Occurrence: Rare, though it occurs consistently throughout the section.

Location: Pb 3811 1 ; 39.0 x 121.9

Code: T1c1c-1

Cicatricosisporites cf. hallei Delcourt and Spurmont, 1955

(Plate 6, Figure 6)

This species probably also has affinities with the Schizeaceae. It comprises most of the percentage of that group in Figure 11. The comparison with C. hallei is very close, differing only slightly in the size of the ridges on the distal side of the spore.

Occurrence: Generally fairly common, and very consistent throughout the section and in various facies.

Location: Pb 5621 4 ; 43.0 x 115.0

Code: T1c1c-3

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Genus TRILITES (Erdman; Cookson) Couper, 1953

Trilites asolidus Krutzsch, 1959

(Plate 6, Figures 2 and 3)

The botanical affinity of this species is probably the family Schizeaceae, and it resembles quite closely spores of the genus Lygodium.

Occurrence: Generally common and very consistent throughout the section in various facies.

Location: Pb 3874; 30.6 x 121.6

Code: Tlfos-1

Trilites cf. paravallatus Krutzsch, 1959

(Plate 8, Figure 4)

The comparison with T. paravallatus is tentative. The botanical affinity is unknown, but it is similar to some Schizeaceae, and it was included in the counts of Figure 11 under that heading.

Occurrence: Rare in the samples studied.

Location: Pb 5617-3; 42.0 x 116.5

Code: Tlfov-1

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. It begins with the first settlers who came to the continent in search of a better life. They found a land of opportunity, but also a land of conflict. The struggle for independence was a long and hard one, but in the end, the people of the United States won their freedom and established a new nation. The years that followed were a time of great achievement and progress. The United States became a world power, and its influence was felt in every corner of the globe. The story of the United States is a story of hope and dreams, of a people who have never given up on their vision of a better future.

The United States has a rich and diverse history. It is a land of many cultures and traditions, and it has been shaped by the people who have lived and worked here. The story of the United States is a story of resilience and strength, of a people who have overcome many challenges and emerged as a nation of freedom and opportunity. The history of the United States is a story that continues to inspire and guide us today. It is a story of a people who have never given up on their dream of a better life, and who are always striving for progress and improvement.

Genus POLYPODIACEOISPORITES Pot., 1951

Polypodiaceoisporites sp.

(Plate 8, Figures 8 and 9)

The botanical affinity of this species is not known. It compares well with the diagnosis of the genus Polypodiaceoisporites, but shows no close relationship with any described species of the genus.

Occurrence: Rare, occurs sporadically throughout section.

Location: Pb 3843 2 ; 35.5 x 120.7

Code: Tlfos-3

Genus FOVEOTRILETES (van der Hammen) Pot., 1956

Foveotriletes crassifovearis Krutzsch, 1959

(Plate 8, Figure 10)

The botanical affinity of this species is unknown. It may prove to be an excellent marker within the lower Tertiary.

Occurrence: Rare, although it occurs consistently in the upper part of the section.

Location: Pb 3838 6 ; 54.0 x 111.2

Code: Tlfov-2

The following table shows the results of the experiment. The first column is the number of trials, the second column is the number of correct responses, and the third column is the percentage of correct responses. The data shows that the percentage of correct responses increases as the number of trials increases, indicating that the subject is learning the task.

| Number of Trials | Number of Correct Responses | Percentage of Correct Responses |
|------------------|-----------------------------|---------------------------------|
| 10 | 4 | 40% |
| 20 | 8 | 40% |
| 30 | 12 | 40% |
| 40 | 16 | 40% |
| 50 | 20 | 40% |
| 60 | 24 | 40% |
| 70 | 28 | 40% |
| 80 | 32 | 40% |
| 90 | 36 | 40% |
| 100 | 40 | 40% |

The results of the experiment show that the subject is able to learn the task and maintain a constant level of performance. This suggests that the task is relatively simple and that the subject has sufficient cognitive resources to learn it.

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| Number of Trials | Number of Correct Responses | Percentage of Correct Responses |
|------------------|-----------------------------|---------------------------------|
| 10 | 5 | 50% |
| 20 | 10 | 50% |
| 30 | 15 | 50% |
| 40 | 20 | 50% |
| 50 | 25 | 50% |
| 60 | 30 | 50% |
| 70 | 35 | 50% |
| 80 | 40 | 50% |
| 90 | 45 | 50% |
| 100 | 50 | 50% |

The results of the experiment show that the subject is able to learn the task and maintain a constant level of performance. This suggests that the task is relatively simple and that the subject has sufficient cognitive resources to learn it.

The following table shows the results of the experiment. The first column is the number of trials, the second column is the number of correct responses, and the third column is the percentage of correct responses. The data shows that the percentage of correct responses increases as the number of trials increases, indicating that the subject is learning the task.

| Number of Trials | Number of Correct Responses | Percentage of Correct Responses |
|------------------|-----------------------------|---------------------------------|
| 10 | 6 | 60% |
| 20 | 12 | 60% |
| 30 | 18 | 60% |
| 40 | 24 | 60% |
| 50 | 30 | 60% |
| 60 | 36 | 60% |
| 70 | 42 | 60% |
| 80 | 48 | 60% |
| 90 | 54 | 60% |
| 100 | 60 | 60% |

The results of the experiment show that the subject is able to learn the task and maintain a constant level of performance. This suggests that the task is relatively simple and that the subject has sufficient cognitive resources to learn it.

Genus CONCAVISPORITES
(Thom. and Pf.) Delcourt and Spurmont, 1955

Concavisporites minimodiversus Nagy, 1963

(Plate 8, Figures 12 and 13)

The botanical affinity is unknown. It is included in the percentages of the "other spores" class of Figure 11.

Occurrence: Generally rare, most frequent in upper zones.

Location: Pb 3804 6 ; 43.2 x 110.3

Code: Tlsm-16

Concavisporites minimus Krutzsch, 1952

(Plate 4, Figure 1)

Gleicheniidites apilobatus Brenner is a very similar form. The affinity of this type may be with the family Gleicheniaceae, although it is not certain.

Occurrence: Rare, but it occurs consistently in Zones D and E.

Location: Pb 3883 4 ; 52.2 x 121.4

Code: Tlsm-10

Genus BACULATISPORIS Thom. and Pf., 1953

Baculatisporis cf. baculatus Krutzsch, 1959

(Plate 5, Figure 1)

The botanical affinity of this grain is not known, but it may represent the family Osmundaceae. The comparison with B. baculatus is only tentative.

Occurrence: Rare to fairly common, especially in Zone E.

Location: Pb 3839 1 ; 45.7 x 127.3

Code: Tlg-1

GYMNOSPERMOUS POLLEN

SACCATE POLLEN

Genus ABIETINEAEPOLLENITES Pot., 1951Abietineaepollenites microalatus (Pot.) Pot., 1951

(Plate 6, Figure 5)

This is the Pinus hapoxylon-type of Thiergart. It appears in the percentages of Pinus, Figure 11, and was utilized as a stratigraphic form in the abundance counts of Figure 6.

Occurrence: Fairly common throughout the section.

Location: Pb 5618 4 ; 38.2 x 114.1

Code: V2-4

Genus ABIESPOLLENITES Thiergart, 1937Abiespollenites cf. absolutus Thiergart, in Raatz, 1937

(Plate 9, Figures 1, 2 and 3)

The affinity of this species with Abies is not certain, but it resembles pollen of that genus closely. The comparison with A. absolutus is close, and examination of the type would probably allow reference of the illustrated form to that species.

Occurrence: Rare to common, generally throughout the section.

Location: Pb 3804 6 ; 40.5 x 110.0 (Fig. 1)

Pb 5617 3 ; 49.0 x 125.0 (Fig. 2)

Pb 5618 4 ; 38.2 x 115.7 (Fig. 3)

Code: V2-1

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Genus PICEAPOLLENITES Pot., 1931

Piceapollenites sp.

(Plate 4, Figure 2)

This type is very similar to modern Picea pollen. It probably represents more than a single species, but all specimens fall under the generic diagnosis and are distinguished from Abiespollenites by the relatively thin proximal cap, the fine texture of the body ornamentation, and the characteristic attachment of the bladders.

Occurrence: Generally common, especially in and above Zone D.

Location: Pb 3883 4 ; 40.2 x 115.0

Code: V2-5

Genus PODOCARPIDITES (Cookson) Couper, 1953

Podocarpidites sp.

(Plate 6, Figure 4; Plate 9, Figure 4)

The affinity with modern Podocarpus is almost certain for this pollen, although again several species may be represented. This form represents most of the counts shown in the abundance graph of Figure 6 under Podocarpidites.

Occurrence: Rare to common, throughout the section.

Location: Pb 3838 5 ; 52.5 x 123.2 (Pl. 6, Fig. 4)

Pb 3871 1 ; 35.1 x 120.0 (Pl. 9, Fig. 4)

Code: V2-3

QUESTION 1

Consider the following reaction scheme for the synthesis of a substituted benzene derivative:

c1ccc(cc1)C(=O)O + c1ccc(cc1)C(=O)O >> c1ccc(cc1)C(=O)OC(=O)c2ccc(cc2)C(=O)O

Identify the reagents and conditions required for the successful completion of this reaction.

Provide a detailed mechanism for the reaction, showing all intermediate structures and the flow of electron pairs.

Discuss the regioselectivity of the reaction, explaining why the product is formed in the observed position.

Propose a synthetic route to the starting materials from simple aromatic hydrocarbons and common reagents.

Calculate the theoretical yield of the product if 10.0 g of the limiting reagent is used in the reaction.

Describe the purification and characterization techniques you would use to confirm the identity and purity of the product.

Discuss the safety and environmental considerations associated with the reagents and conditions used in this reaction.

Provide a retrosynthetic analysis of the product, showing the disconnection of the molecule into its starting materials.

Explain the role of the solvent in the reaction and how it might influence the rate and yield.

Discuss the potential side reactions that could occur under the proposed conditions and how they can be minimized.

Provide a summary of the key findings and conclusions from your analysis of this reaction scheme.

NON-SACCATE POLLEN

Genus TAXODIACEAEPOLLENITES Kremp, 1949

Taxodiaceapollenites hiatus (Pot.) Kremp, 1949

(Plate 9, Figures 6 and 10)

The affinity of this species is thought to be Taxodium, although other genera (Sequoia, Metasequoia, Cryptomeria) also have similar pollen. This species comprises most of the percentages shown for Taxodium in Figure 11, although some Sequoia, etc. may also be included.

Occurrence: Generally common throughout section.

Location: Pb 5616 1 ; 57.9 x 122.5 (Fig. 6)

Pb 3892 3 ; 32.3 x 111.6 (Fig. 10)

Code: Isc-1

Genus TSUGAEPOLLENITES Pot. and Ven, 1934

Tsugaepollenites viridifluminipites (Wodehouse)
Thom. and Pf., 1953

(Plate 4, Figure 3; Plate 9, Figure 5)

This species bears a close resemblance to pollen of Tsuga heterophylla, although other species of the genus have similar pollen. Only one species was recognized in the samples studied, and this comprises the total count shown in Figure 11.

Occurrence: Rare, but occurs consistently in and above zone D.

Location: Pb 3896 2 ; 45.9 x 126.1 (Pl. 4, Fig. 3)

Pb 3892 1 ; 39.0 x 118.0 (Pl. 9, Fig. 5)

Code: V1-1

Genus SEQUOIAPOLLENITES Thiergart, 1937

Sequoiapollenites sp.

(Plate 9, Figure 9)

The affinity of this pollen with Sequoia is not certain. Metasequoia has very similar pollen and is represented in fossil floras of the study area by leaves and cones. Specimens of this genus may have been referred to Taxodiaceapollenites if the distinctive recurved papilla was not apparent.

Occurrence: Rare, occurs throughout the section, but is most abundant in some lignitic siltstone facies.

Location: Pb 3872 3 ; 37.5 x 110.4

Code: Isc-2

ANGIOSPERMOUS POLLEN

MONOSULCATE POLLEN

Genus SABALPOLLENITES Thiergart, 1938

Sabalpollenites cf. convexus Thiergart, 1938

(Plate 9, Figure 8)

This species represents the palm family, and possibly the genus Sabal. The comparison with S. convexus is tentative, the illustrated form being somewhat larger, and with a finer reticulum.

Occurrence: Rare to common, throughout section, but with highest frequencies occurring in some coals.

Location: Pb 3873 1 ; 45.3 x 122.8

Code: Slr-1

Genus LILLIACIDITES Couper, 1953

Liliacidites intermedius Couper, 1953

(Plate 6, Figure 10)

This species is similar to Sabalpollenites cf. convexus, but is generally larger and is more coarsely reticulate. The affinity is thought to be with the family Palmae, and may also represent the genus Sabal. This species comprises most of the percentage under Palm in Figure 11, and it is included as one of the ten types in the fixed area counts shown on Figure 6.

Occurrence: Rare to common, throughout section, especially common in some coals.

Location: Pb 3872 3 ; 49.0 x 122.0

Code: Slr-2

COLPATE AND COLPORATE POLLEN

Genus CUPULIFEROIPOLLENITES Pot., 1951

Cupuliferoipollenites cf. pusillus Pot., 1951

(Plate 10, Figure 7)

Affinity with the family Fagaceae is suggested, particularly the genus Castanea. The pore structure is generally well developed and serves to distinguish this type from the similar forms referred to the genus Castaneoidites.

Occurrence: Rare to common, but it occurs most frequently in nearshore sediments.

Location: Pb 3828 5 ; 39.6 x 113.8

Code: CP3sc-1

Genus QUEROIDITES Pot., Thom., and Thierg., 1950

Quercoidites henrici (Pot.) Pot., Thom., and Thier., 1950

(Plate 3, Figure 2; Plate 9, Figures 7 and 11)

This species is the most abundant single species represented in the samples. Its botanical affinity is almost certainly Quercus and it accounts for a large part of the percentages under that class in Figure 11. More than one species of Quercus may be represented by this pollen type, but at least one of the possible species grew as a swamp tree. Large numbers of Quercus-like pollen have been noted in several other early Tertiary microfloral assemblages (Traverse, 1955; Nuey-Stolz, 1958).

Occurrence: Common to very abundant, especially in some lignite and coal samples.

Location: Pb 3837 6 ; 38.8 x 125.7 (Pl. 3, Fig. 2)

Pb 3892 1 ; 30.0 x 111.5 (Pl. 9, Fig. 11)

Pb 3897 4 ; 36.6 x 118.9 (Pl. 9, Fig. 7)

Code: C3sc-1

Querocoidites sp. 2

(Plate 4, Figure 12)

This species is included in the Quercus percentages of Figure 11, although its contribution is small. The botanical affinity with Quercus is not definite, but the general morphology is suggestive of that genus. In general, the pores are weakly developed, and it may be sometimes confused with Q. henrici.

Occurrence: Generally rare, but very consistent in Zone D.

Location: Pb 3806 2 ; 32.8 x 110.8

Code: CP3v-1

Genus PLATANOIDITES Pot., Thom., and Thierg., 1950

Platanoidites sp.

(Plate 9, Figures 17 and 18)

The botanical affinity of this species is not certain, but it probably is with the genus Platanus, at least in part. Leaves of Platanus are commonly found in equivalent age rocks in the study area.

Occurrence: Common to abundant in many samples, especially in marine sediments, both near and offshore. The very small size of these grains probably accounts in large part for their wide and abundant dispersal.

Location: Pb 3875 4 ; 42.8 x 121.3 (Fig. 17)

Pb 3896 2 ; 42.0 x 108.0 (Fig. 18)

Code: C3r-12

Genus ARALIACEOIPOLLENITES Pot., 1951

Araliaceoipollenites cf. edmundi (Pot.) Pot., 1951

(Plate 10, Figure 10)

The comparison with A. edmundi is very close, although A. euphorii is also similar. This species, together with Tricolporopollenites satzveyensis, comprise the Araliaceae percentages in Figure 11. The species is common in the lower Tertiary of central Europe. Leaves assigned to the genus Aralia have been recorded from the Eocene rocks of the study area, although pollen with affinities to the family have not been commonly recorded in North America. Stanley (1960) illustrates a form similar to this species, and refers to it as Tricolporopollenites problematicus.

Occurrence: Rare to fairly common, consistently occurring in nearshore carbonaceous siltstones.

Location: Pb 5621 4 ; 52.0 x 114.0

Code: CP3fov-1

Genus CASTANEOIDITES Pot., Thom., and Thierg., 1950
Castaneoidites cf. exactus Pot., Thom., and Thierg, 1950
 (Plate 9, Figure 12)

The comparison with C. exactus is very close, and only a slightly larger size keeps it from being referred directly to that species. The botanical affinity of this type appears to be with the family Fagaceae, and possibly the genus Castanea. The species Castanea minutapollenites Rouse, is a very similar pollen, perhaps identical.

Occurrence: Common to abundant in almost all samples studied, but especially abundant in some samples containing high frequencies of Quercus-like pollen.

Location: Pb 3829 5 ; 34.2 x 111.0

Code: C3sm-1

Genus ILEXPOLLENITES Thiergart, 1937
Ilexpollenites iliacus (Pot.) Thierg., 1937
 (Plate 1, Figure 6; Plate 9, Figure 14)

This species has commonly been recorded from Tertiary deposits in North America and Europe. The botanical affinity appears to be with the genus Ilex, and I. iliacus contributes a large part of the percentages under Ilex in Figure 11.

Occurrence: Common to abundant in nearly all samples studied.

Location: Pb 6320 1 ; 41.3 x 118.0 (Pl. 1, Fig. 6)

Pb 5617 3 ; 50.0 x 118.0 (Pl. 9, Fig. 14)

Code: C3cl-1

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in the context of public administration and financial management. The text notes that such records should be accessible to the public and should be maintained in a secure and organized manner.

2. The second part of the document addresses the need for regular audits and reviews. It states that periodic audits are necessary to ensure that all funds are being used as intended and that there are no instances of mismanagement or fraud. The document suggests that these audits should be conducted by independent bodies to ensure objectivity and fairness.

3. The third part of the document focuses on the importance of communication and public participation. It argues that government officials and agencies should engage with the public through various channels, such as public hearings, town hall meetings, and online platforms. This engagement is crucial for understanding the needs and concerns of the community and for making more informed decisions.

4. The fourth part of the document discusses the role of technology in improving government operations. It highlights how digital tools and platforms can streamline processes, reduce costs, and increase efficiency. The document encourages the adoption of e-governance systems to make services more accessible and user-friendly for citizens.

5. The fifth part of the document concludes by reiterating the importance of integrity and ethical conduct in public service. It calls for a strong commitment to the public good and for the avoidance of conflicts of interest. The document suggests that regular training and education on ethics should be provided to all public officials to ensure they are equipped to handle the challenges of their roles.

Ilexpollenites inaequaliclaviata (Traverse) Pot., 1960

(Plate 6, Figures 8 and 9)

This species is less common than I. iliacus, although it is a major pollen type represented in the section. The botanical affinity is probably with the genus Ilex.

Occurrence: Rare to common, occurs throughout the study section.

Location: Pb 3877 4 ; 29.8 x 114.0

Pb 3883 4 ; 40.7 x 115.7

Code: C3c1-2

Ilexpollenites cf. marginatus (Pot.) Raatz, 1947

(Plate 3, Figure 1)

The figured specimen is a partially broken example of the species which is significantly larger than the other two species of this genus. It is strongly colpate, with no tendency toward pore development as is seen in other species of Ilexpollenites. The colpi are long, and are often seen gaping open. The clavae are generally equal in size, and extend to the colpi margins.

Occurrence: Rare to common, but occurs only in upper part of the section.

Location: Pb 3839 1 ; 37.5 x 128.2

Code: C3c1-3

Ilexpollenites sp.

(Plate 3, Figures 12 and 13)

Some illustrations of I. iliacus show a pore structure similar to this grain, but not generally elongated equatorially. The illustrated species is distinctly colporate, although the heavy ornamentation of clavate projections may obscure the aperture structure in many specimens. The affinity with the genus Ilex is not certain, although some individuals are included in the counts under that heading.

Occurrence: Rare to common, occurs very consistently in and above Zone B.

Location: Pb 3875 4 ; 38.3 x 120.3

Code: CP3gm-1

Genus TRICOLPITES (Cookson) Couper, 1953

Tricolpites cf. striatus Couper, 1954

(Plate 4, Figure 4)

The specimen illustrated shows a fairly close comparison with T. striatus. The gross morphology of the grain suggests a possible affinity with the family Aceraceae, although this is not certain. This species is a useful stratigraphic type even though it is not abundant enough to be included in the relative abundance counts.

Occurrence: Rare, but it occurs consistently in small numbers in and above Zone D.

Location: Pb 3805 5 ; 40.3 x 119.7

Code: C3st-1

Tricolpites sp. 1

(Plate 10, Figures 1 and 2)

This species is usually seen in the polar view, with the colpi long and simple, without longitudinal costae. Covering the colpus is an endexinous membrane, generally with a granular texture. The botanical affinity is unknown.

Occurrence: Common in most samples above Zone C, although rare in lignitic and coaly facies.

Location: Pb 3883 4 ; 38.2 x 114.0

Pb 3895 4 ; 32.2 x 111.9

Code: C3r-15

Tricolpites sp. 2

(Plate 2, Figures 4 and 5)

The botanical affinity of this species is not known. It is useful as a stratigraphic form, and is easily recognized by its conspicuously spinate exine.

Occurrence: Rare, although it occurs consistently in Zones B, C, and D.

Location: Pb 3872 3 ; 37.0 x 117.4

Pb 3874 4 ; 34.9 x 128.0

Code: C3sp-3

Tricolpites sp. 3

(Plate 9, Figure 19)

Several species of the genus Protoquercus Bolkhovitina are quite similar to the illustrated form, although the comparative material was not sufficient to allow placing this form with that genus. The botanical affinity is not known, but pollen of some species of modern Platanus is similar. It was included in the Platanus-Salix percentage counts of Figure 11, although it represents only a small portion of that group.

Occurrence: Rare to common, the species ranges throughout section, but its highest frequency occurs in the lignitic siltstone facies.

Location: Pb 3805 5 ; 51.3 x 125.9

Code: C3r-17

Tricolpites sp. 4

(Plate 4, Figures 5 and 6)

The botanical affinity of this species is unknown. Its large size (ca. 35-40) and heavy, reticulate exine make it very conspicuous. Some individuals show a tendency toward a porate condition, and Engelhardt (1964) figures a similar form, referring to it as Tricolporopollenites sp. 4.

Occurrence: Pb 3883 4 ; 40.2 x 124.9 (Fig. 5)

Pb 5616 1 ; 58.7 x 114.8 (Fig. 6)

Code: C3r-19

Genus TRICOLPOPOLLENITES Thom. and Pf., 1953

Tricolpopollenites cf. retiformis Pf. and Thom., 1953

(Plate 9, Figures 15 and 16)

This species is included in the counts of Platanus-Salix in Figure 11. The affinity with Salix is not certain, but the morphology suggests that relationship. The comparison of the illustrated form with T. retiformis is close, although the illustrated form has a slightly heavier reticulum.

Occurrence: Rare to common, especially in some marine siltstones in the middle part of the section (Zones C and D).

Location: Pb 3838 4 ; 40.0 x 114.9

Code: C3r-3

Genus RHOIPITES WODE., 1933

Rhoipites cf. bradleyensis Wode., 1933

(Plate 10, Figure 9)

The comparison with R. bradleyensis is close, although the original illustration is slightly vague. The botanical affinity is thought to be with the genus Rhus, family Anacardiaceae. The morphology of Rhus typhina pollen is similar.

Occurrence: Rare, occurs sporadically throughout section.

Location: Pb 5621 4 ; 48.9 x 115.0

Code: CP3st-4

Rhoipites pseudocingulum (Pot.) Pot., 1960

(Plate 10, Figures 14 and 16)

This species probably represents the family Anacardiaceae, and possibly the genus Rhus, although that is not certain. Potonie mentions Rhus as the likely affinity in the original description of the species. The species is frequently illustrated in studies of Tertiary microfloral assemblages.

Occurrence: Common in most samples, but the highest frequencies occur in nearshore marine or brackish water environments.

Location: Pb 3802 7 ; 44.5 x 120.8

Pb 3809 6 ; 41.1 x 126.4

Code: CP3sc-2

Rhoipites cf. pseudocingulum forma navicula (Pot.) Pot, 1960

(Plate 10, Figures 12 and 13)

The comparison with R. pseudocingulum forma navicula is tentative. Engelhardt (1964) illustrates a nearly identical form and refers to it as Tricolporopollenites sp. 1. He compares it with Acer mullensis Simpson from the Eocene of Great Britain. The botanical affinity is uncertain, but it is included in the counts of Figure 11 as Rhus, and probably represents the family Anacardiaceae, if not Rhus.

Occurrence: Rare to common, generally throughout the section, although it occurs most frequently in nearshore or brackish environments.

Location: Pb 3872 3 ; 47.8 x 110.1

Pb 3873 1 ; 47.2 x 119.8

Code: Cp3st-2

Rhoipites dolium (Pot.) Pot., 1960

(Plate 4, Figure 8)

Nuey-Stolz (1958) relates this species to the family Theaceae (as Tricolporopollenites dolium Thom. and Pf.). Potonie (1960) indicates that R. dolium is quite similar to R. bradleyi, and probably represents the genus Rhus. The figured specimen compares closely with Potonie's original illustrations, but the affinity with Rhus is not definite. It was not included in the counts of Figure 11 under Rhus.

Occurrence: Rare to common in samples in and above Zone D.

Location: Pb 3809 6 ; 51.8 x 112.2

Code: CP3g-6

Genus CYRILLACEAPOLLENITES (Murr. and Pf.) Pot., 1960

Cyrillaceaepollenites cf. megaexactus (Pot.) Pot., 1960

(Plate 11, Figure 11)

The comparison with C. megaexactus appears to be quite close, although the specimen found in this study are frequently slightly larger (25-30). Pollen of Cyrilla has been reported from other lower Tertiary localities, where sometimes it is abundant (Brandon Lignite, Traverse, 1955).

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Occurrence: Generally rare in samples studied, except in some lignitic siltstones where it was common.

Location: Pb 6320 2 ; 44.0 x 117.7

Code: CP3sc-12

Genus FAGUSPOLLENITES Raatz, 1937

Faguspollenites cf. versus Raatz, 1937

(Plate 11, Figure 7)

The comparison with F. versus is tentative. It compares quite closely with modern Fagus pollen, and it comprises most of the percentage count under that heading in Figure 11.

Occurrence: Rare, although it occurs consistently throughout the section and is common in some nearshore siltstones.

Location: Pb 3805 6 ; 47.0 x 116.8

Code: CP3sc-7

Faguspollenites sp.

(Plate 11, Figure 3)

This species compares quite closely with some modern Fagus pollen (Fagus sylvatica). It is present in many samples, but in small numbers. It makes up a small portion of the Fagus percentage of Figure 11.

Occurrence: Rare, generally throughout the section.

Location: Pb 3838 6 ; 55.5 x 115.2

Code: CP3g-5

Genus TRICOLPOROPOLLENITES Thom. and Pf., 1953

Tricolporopollenites cf. helmstedtensis Pf. in Thom.
and Pf., 1953

(Plate 3, Figure 9)

The comparison with T. helmstedtensis is quite close, although the figured species often has a slightly coarser reticulum in which the lumina are very angular. The botanical affinity is not established. Pflug (1953) indicates that this species is a common lower Tertiary element in Europe.

Occurrence: Rare to common, in and above Zone B, most frequent in Zone C and higher. Occurs consistently in nearly all sample types.

Location: Pb 3806 2 ; 93.5 x 40.5

Code: CP3r-7

Tricolporopollenites satzveyensis Pf., in Thom. and Pf., 1953

(Plate 10, Figure 11)

T. satzveyensis is regarded by Krutzsch (1957) as a key lower Tertiary form in central Europe. It is similar to Araliaceopollenites edmundi, and may represent the family Araliaceae, although it is not certain. It was counted under the Araliaceae heading in Figure 11, although its contribution is small.

Occurrence: Rare to fairly common, occurs consistently in samples from nearshore and brackish environments.

Location: Pb 5619 1 ; 57.8 x 114.0

Code: CP3fov-2

Tricolporopollenites cf. macrodurensis Pf. and Thom., 1953

(Plate 3, Figure 7)

The comparison with T. macrodurensis is quite close, although not certain. The botanical affinity is unknown. Thompson and Pflug (1953) suggest a possible relationship with genus Parthenocissus.

Occurrence: Pb 3802 7 ; 34.7 x 119.5

Code: CP3r-11

Tricolporopollenites sp. 1

(Plate 3, Figure 5)

The affinity of this species is unknown. Its small size and distinct reticulate exine may cause it to be confused with Platanus-like pollen if the grain is seen in polar view. In equatorial view, however, the small, round pore is conspicuous.

Occurrence: Rare, although it occurs consistently in and above Zone B, in all facies.

Location: Pb 3877 4 ; 32.1 x 121.4

Code: CP3r-2

Tricolporopollenites sp. 2

(Plate 3, Figure 6)

The botanical affinity of this type is unknown. The coarse reticulum composed of broad lumina and thin, high muri make this a distinctive form.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. Key components of a successful business plan include:

- A clear statement of the company's mission and vision.
- A detailed market analysis of the industry and target audience.
- A comprehensive financial plan, including projected income statements and cash flow.

3. It is essential to regularly review and update the business plan as market conditions change.

4. The following table provides a summary of the key financial metrics:

| Metric | Q1 2023 | Q2 2023 | Q3 2023 |
|----------|-----------|-----------|-----------|
| Revenue | \$120,000 | \$135,000 | \$150,000 |
| Expenses | \$80,000 | \$90,000 | \$100,000 |
| Profit | \$40,000 | \$45,000 | \$50,000 |

5. The data indicates a steady increase in revenue and profit over the three-quarter period.

6. Recommendations for future growth include:

- Expanding into new geographic markets.
- Investing in research and development to create innovative products.
- Strengthening relationships with key suppliers and distributors.

7. The company should also consider implementing a robust cybersecurity strategy.

8. The following table shows the projected financial performance for the next year:

| Quarter | Revenue | Expenses | Profit |
|---------|-----------|-----------|----------|
| Q1 2024 | \$140,000 | \$95,000 | \$45,000 |
| Q2 2024 | \$155,000 | \$105,000 | \$50,000 |
| Q3 2024 | \$170,000 | \$115,000 | \$55,000 |

9. The projections are based on current market trends and internal capabilities.

10. The company should continue to monitor market conditions and adjust its strategy accordingly.

11. The following table shows the company's performance relative to industry benchmarks:

| Metric | Company | Industry Average |
|-----------------------|---------|------------------|
| Revenue Growth | 15% | 12% |
| Profit Margin | 35% | 30% |
| Customer Satisfaction | 4.5/5 | 4.2/5 |

12. The company's performance is consistently above the industry average.

13. The following table shows the company's financial performance over the last five years:

| Year | Revenue | Profit |
|------|-----------|----------|
| 2018 | \$100,000 | \$30,000 |
| 2019 | \$110,000 | \$35,000 |
| 2020 | \$120,000 | \$40,000 |
| 2021 | \$130,000 | \$45,000 |
| 2022 | \$140,000 | \$50,000 |

Occurrence: Rare to common, especially in nearshore siltstones in the upper part of section.

Location: Pb 3805 6 ; 44.3 x 120.8

Code: CP3r-12

Tricolporopollenites sp. 3

(Plate 1, Figure 14)

The affinity of this species is not known. Its occurrence is fairly consistent in the lowermost part of the section, but its range is not definitely established. The very characteristic striate exine makes it readily identifiable, even though it is quite small (18-20 μ).

Occurrence: Rare, a possible key form for Zone A.

Location: Pb 3828 6 ; 37.5 x 119.4

Code: CP3st-5

Genus ALANGIACEOIPOLLENITES (Traverse, 1955) n. comb.

Type species: Alangiaceoipollenites (as Alangium)

barghoornianum (Traverse, 1955, page 65, Figure 12, photo 102; ca. 92) n. comb.

Alangiaceoipollenites barghoornianum (Traverse) n. comb.

(Plate 11, Figure 9)

The affinity of this species with the genus Alangium is almost certain. Specimens of Alangium chinense pollen in the reference collection at Michigan State University are very similar. It is the first known record of this genus in North America outside of the Oligocene Brandon Lignite, studied in detail by Traverse (1955). The family Alangaceae

The first part of the document discusses the importance of maintaining accurate records of all transactions. This includes not only sales and purchases but also any other financial activities that may occur. It is essential to ensure that all entries are properly documented and supported by appropriate evidence.

In addition, the document emphasizes the need for regular reconciliation of accounts. This process involves comparing the company's internal records with the bank statements to identify any discrepancies. By doing so, the company can ensure that its financial statements are accurate and reliable.

Another key aspect of financial management is the timely payment of bills and invoices. Failure to do so can result in late fees, penalties, and damage to the company's credit rating. Therefore, it is crucial to establish a system for tracking and paying all obligations on time.

Finally, the document highlights the importance of budgeting and financial forecasting. By creating a budget, the company can set financial goals and monitor its performance against those goals. Financial forecasting allows the company to anticipate future cash flows and make informed decisions about investments and financing.

In conclusion, effective financial management is essential for the success of any business. By following the principles outlined in this document, the company can ensure that its financial records are accurate, its accounts are reconciled, its bills are paid on time, and its financial goals are achieved.

is today distributed in the tropics and subtropics of the old world.

Occurrence: Rare, although it occurs consistently in and above Zone D, in all facies.

Location: Pb 3805 5 ; 48.2 x 117.3

Code: CP3st-4

Alangiaceoipollenites sp. 1

(Plate 4, Figure 7)

This species is very similar to A. barghoornianum, and additional study may show that the two are really only one species. The illustrated specimen shows, however, the finer striate pattern of the exine and the more angular outline. The botanical affinity of this species is probably Alangium.

Occurrence: Rare, although fairly consistent in Zone D and above.

Location: Pb 3880 3 ; 43.7 x 124.5

Code: CP3st-5

Alangiaceoipollenites sp. 2

(Plate 3, Figure 11)

This species is very similar to Pollenites ortholaesus Pot., and it is clearly distinct from A. barghoornianum and A. sp. 1, having less well developed annular structure around the pores, thinner exine, and distinctly foveolate sculpture. The affinity is assumed to be with the family Alangiaceae, although it bears a strong resemblance to pollen

of the closely related family, Nyssaceae.

Occurrence: Rare to common, especially in and above Zone B.

Location: Pb 5621 4 ; 40.0 x 126.9

Code: C3g-6

Genus NYSSAPOLLENITES Thiery., 1937

Nyssapollenites accessorius (Pot.) Pot., 1950

(Plate 3, Figure 10; Plate 11, Figure 4)

The botanical affinity appears to be Nyssa. This species comprises the major part of the Nyssa percentages of Figure 11. It frequently occurs in association with Taxodium-like pollen, and is assumed to indicate the presence of Taxodium-Nyssa swamp conditions during the time of deposition of some lignitic siltstones and coals.

Occurrence: Rare to common, occurs consistently in and above Zone B.

Location: Pb 3802 7 ; 39.6 x 114.1 (Pl. 3, Fig. 10)

Pb 3809 6 ; 52.6 x 115.1 (Pl. 11, Fig. 4)

Code: CP3g-7

Nyssapollenites cf. thompsoniana (Traverse) Pot., 1960

(Plate 11, Figure 5)

This comparison is only tentative. This species is very similar to pollen of modern Nyssa, and its botanical affinity is probably with that genus. It is included in counts of that species in Figure 11, although its contribution is small.

Occurrence: Rare, generally throughout the section.

Location: Pb 3841 2 ; 36.9 x 113.9

Code: CP3g-8

Nyssapollenites sp. 1

(Plate 11, Figure 8)

This species is tentatively referred to the genus Nyssapollenites. It resembles pollen of some members of the family Theaceae (Gordonia), but an affinity with that family is not certain.

Occurrence: Rare, generally throughout the section studied.

Location: Pb 5615 1 ; 51.0 x 111.5

Code: CP3r-13

Nyssapollenites sp. 2

(Plate 11, Figures 1 and 2)

This species is included in the percentages of the Nyssa group in Figure 11, although the affinity with that genus is not certain.

Occurrence: Rare, occurs only occasionally in lignitic siltstones in upper part of section.

Location: Pb 5615 1 ; 50.0 x 115.0

Code: CP3g-9

Genus GOTHANIPOLLIS Krutzsch, 1959

Gothanipollis sp.

This species bears some resemblance to specimens of G. gothani Krutzsch, although it appears to be distinct from that species. It appears to be a key form for lower Tertiary rocks in North America and Europe. The botanical affinity is unknown.

Occurrence: Rare, although it occurs conspicuously in most samples above Zone A.

Location: Pb 3832 2 ; 46.2 x 113.3

Code: Syn3g-4

Genus CUPANIEIDITES Cookson and Pike, 1954

Cupanieidites cf. orthoteichus Cookson and Pike, 1954

(Plate 3, Figure 4)

The figured species compares quite closely to C. orthoteichus, although is somewhat larger (ca. 30) and the exine is usually granular. The natural affinity may be with the family Sapindaceae, although that is not certain in this species.

Occurrence: Rare, although it is consistently present in Zones C and D.

Location: Pb 3837 6 ; 44.8 x 127.2

Code: Syn3g-1

Cupanieidites sp. 1
(Plate 3, Figure 8)

No comparative illustrations or descriptions for this species have been found. It appears to be an extremely useful stratigraphic form in the samples studied. The botanical affinity is as yet unknown, but it may well represent the family Sapindaceae, a nearly pan-tropical family.

Occurrence: Rare, but very consistent in Zones C and D.

Location: Pb 3883 6 ; 44.1 x 124.2

Code: Syn3r-1

Genus SYNCOLPORITES van der Hammen, 1954

Syncolporites sp. 1

This species is very distinctive and easily recognizable. The botanical affinity is unknown, and no similar forms have been illustrated from other Tertiary localities as far as is known. The species is characterized by the presence of a compound colpus, united at both poles (syncolpate) and enclosing an island at the poles. This island extends to the equatorial area, where it is interrupted by the pore structure. The grains are nearly always seen in polar view, and the pore is only rarely observed.

Occurrence: Rare, occurs very consistently, however, in and above Zone C.

Location: Pb 3803 5 ; 48.0 x 121.1

Code: Syn3g-2

Syncolporites sp. 2

(Plate 2, Figure 2)

This species appears to be closely related to Syncolporites sp. 1, differing only in that the colpi do not actually extend over both poles. The botanical affinity is not known.

Occurrence: Rare, appears to be a key form for Zone C.

Location: Pb 3839 5 ; 45.2 x 112.4

Code: Syn3g-2a

Genus SYMPLOCOIPOLLENITES Pot., 1951

Symplocoipollenites vestibulum (Pot.) Pot., 1951

(Plate 3, Figure 14; Plate 11, Figure 6)

This species has been frequently recorded Tertiary deposits of Europe and North America. The botanical affinity is thought to be with the genus Symplocos, a tropical to subtropical genus of wide distribution.

Occurrence: Rare to common, occurs consistently in samples from Zone C and above.

Location: Pb 3840 6 ; 54.0 x 117.6 (Pl. 3, Fig. 14)

Pb 3836 5 ; 41.6 x 113.0 (Pl. 11, Fig. 6)

Code: C3rug-1

Symplocoipollenites sp. 1

(Plate 4, Figure 10)

This species is vaguely similar to Symplocos Jacksonia Traverse, described from the Oligocene Brandon Lignite. Its botanical affinity is very likely with the family Symplocaceae, although its generic reference to Symplocos is not certain.

Occurrence: Rare, although it occurs consistently in Zone D.

Location: Pb 5617 3 ; 49.7 x 126.8

Code: Prot-5

Symplocoipollenites sp. 2

(Plate 2, Figures 8, 9 and 10)

The assignment of this species to Symplocoipollenites is tentative. Krutzsch (1957) illustrates a similar type which he calls the "gesperlte vestibuloide formen," and indicates that the probable affinity is with the Symplocaceae.

Occurrence: Rare, although it occurs consistently in samples in Zone B and above.

Location: Pb 5621 4 ; 37.0 x 117.9 (Fig. 8)

Pb 3876 4 ; 48.4 x 110.9 (Figs. 9 & 10)

Code: CP3sp-4

The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for ensuring transparency and accountability in financial operations. This section also outlines the various methods and tools used to collect and analyze data, highlighting the need for consistency and precision in data collection.

The second part of the document focuses on the analysis of the collected data. It describes the various statistical techniques and models used to interpret the data, including regression analysis, time series analysis, and hypothesis testing. This section also discusses the challenges associated with data analysis, such as missing data, outliers, and the need for appropriate statistical tests.

The third part of the document discusses the application of the analyzed data to various business and financial decisions. It highlights the importance of using data-driven insights to inform strategic planning, risk management, and performance evaluation. This section also discusses the role of data in identifying trends, opportunities, and potential risks in the market.

The fourth part of the document discusses the future of data analysis and the role of emerging technologies. It highlights the importance of staying up-to-date with the latest developments in data science, machine learning, and artificial intelligence. This section also discusses the potential benefits and challenges of these technologies in the context of business and financial operations.

In conclusion, the document emphasizes the importance of data analysis in making informed decisions and achieving business success. It highlights the need for accurate data collection, rigorous analysis, and the application of data-driven insights to various business and financial decisions. The document also discusses the future of data analysis and the role of emerging technologies in this field.

Genus SAPOTACEOIDAEPOLLENITES Pot., Thom., and Thier., 1950

Sapotaceoideaepollenites cf. sapatoides
(Tom. and Pf.) Pot., 1960

(Plate 11, Figures 11, 12 and 13)

The comparison with S. sapatoides is quite close, although in some examples (Figures 11 and 12) the pores appear more silt-like. This species is almost certainly related to the family Sapotaceae, but the generic affinity is not known. The Sapotaceae is a nearly pan-tropical family today with a distribution reaching highest latitudes in North America.

Occurrence: Rare, occurs consistently throughout the section.

Location: Pb 6320 2 ; 44.0 x 117.7

Pb 3805 5 ; 56.1 x 126.4

Pb 3873 1 ; 50.5 x 120.5

Code: CP4sc-1

Genus BETULACEOIPOLLENITES Pot., 1951

Betulaceoipollenites bituitus (Pot.) Pot., 1951

(Plate 12, Figures 3 and 4)

The morphology is very similar to that of the genus Betula, and this species was included in counts of that group in Figure 11. The family Betulaceae is, however, a difficult one to divide on the basis of pollen morphology alone, and the genus Betula is only a suggested affinity here.



Occurrence: Common to abundant, especially abundant in some lignitic siltstone samples.

Location: Pb 3875 4 ; 47.8 x 121.0

Pb 3809 6 ; 48.4 x 110.6

Code: P3sm-2

Genus TRIVESTIBULOPOLLENITES (Pf.) Thom. and Pf., 1953

Trivestibulopollenites cf. salebrosus Pf., 1953

(Plate 10, Figure 6)

The comparison with T. salebrosus is only tentative. The figured species is very similar to some members of the family Burseraceae, and in Figure 11 this type is shown as a percentage under that heading. The family Burseraceae is mainly subtropical in distribution.

Occurrence: Rare, although it occurs with great consistency throughout the section, reaching its highest abundances in marine sediments.

Location: Pb 3840 6 ; 39.0 x 121.0

Code: P3st-1

Genus INTRATRIPOROPOLLENITES Thom. and Pf., 1953

Intratriporopollenites rizophorus (Pot.)

(Plate 1, Figures 7 and 8)

The figured specimens match very closely illustrations of this species from Eocene brown coals in Germany. Krutzsch (1957) indicates that it is a typical lower Tertiary form. Pflug, in his recombination of the species, indicates that it may be related to the family Malvaceae.

Occurrence: Rare, occurs consistently only in the lower part of the section.

Location: Pb 3830 6 ; 47.0 x 110.5 (Fig. 7)

Pb 3867 5 ; 43.0 x 125.9 (Fig. 8)

Code: C3sp-4

Genus SUBTRIPOROPOLLENITES Pf. and Thom., 1953

Subtriporopollenites cf. constans Pf., 1953,
in Thom. and Pf., 1953

(Plate 10, Figure 5)

The botanical affinity of this species is unknown. Pflug (1953) suggests a possible relationship with the Myricaceae, but many of the several hundred species of this large family have not studied as regards their pollen morphology, and the suggested affinity must be considered very tentative. The comparison with S. constans is very close, and Krutzsch (1957) indicates that it is a common type in the Tertiary of Europe. It is shown on Figure 11 as Pollenites constans.

Occurrence: Generally common, but becoming rare near top of section. The highest frequencies of this species occur in some lignitic siltstones of apparent estuary or lagoon environment.

Location: Pb 5622 - 1 ; 49.0 x 120.0

Code: C3g-1

Genus TRIATRIOPOLLENITES (Pf.) Thom. and Pf., 1953

Triatriopollenites rurensis Thom. and Pf., 1953

(Plate 12, Figure 2)

This species matches Myricipites dubius Wode. quite closely, and an affinity with the family Myricaceae is probable. The percentages of this species are shown in Figure 11 combined with pollen of other Myricaceous and Betuloid types, including also Corylus-like pollen.

Occurrence: Common, especially in association with Betula-like pollen in some coals and lignitic siltstones. The species occurs throughout the section.

Location: Pb 3883 4 ; 34.8 x 111.8

Code: P3sm-4

Genus MOMIPITES Wode., 1933

Momipites coryloides Wode., 1933

(Plate 6, Figure 7; Plate 12, Figure 9)

The percentages of Momipites shown in Figure 6 are combined values including pollen of Engelhardtia-type. The affinity of the species figured is not known for certain, but the morphology is similar to the pollen of Momisia of the family Ulmaceae. Figure 9, on plate 12, shows a slight tendency toward thickening of an annular area around the pores that is not present in pollen of Momisia, however.

Occurrence: Rare to common, throughout entire section, but the highest frequency occurs in carbonaceous siltstones of a nearshore marine environment.

Location: Pb 3877 4 ; 29.8 x 114.0 (Pl. 6, Fig. 7)

Pb 3832 5 ; 46.2 x 125.0 (Pl. 12, Fig. 9)

Code: P3sm-8

Genus ENGELHARDTIOIDITES Pot., Thom., and Thier., 1950

Engelhardtoidites microcoryphaeus (Pot.) Pot., 1950

(Plate 12, Figure 5)

This species is nearly identical to pollen of the genus Platycarya of the family Juglandaceae. It is commonly figured and referred to by that name in many reports dealing with Tertiary palynology.

Occurrence: Generally rare, but distributed consistently throughout the entire section.

Location: Pb 3895 4 ; 38.1 x 115.2

Code: P3sm-6

Engelhardtoidites (as Pollenites) quietus
(Pot., 1933, p. 556, Figure 13;

Pot., 1934, p. 83, Plate 4, Figures 18 and 21) n. comb.

(Plate 12, Figure 10)

This species is here placed in the genus Engelhardtoidites in order to have a clear distinction between the small triatriate pollen grains with the characteristic grooves of the Platycarya type, and the entirely smooth grains of the Engelhardtia type. The species names microcoryphaeus and quietus were applied by Potonie (1931) to species of the large form genus Pollenites, and his original illustrations show the distinctive features mentioned. E. quietus is very similar

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2. The second part of the document outlines the various methods and tools used to collect and analyze data. It highlights the need for consistent and reliable data collection processes to support effective decision-making.

3. The third part of the document focuses on the role of technology in data management and analysis. It discusses how modern software solutions can streamline data collection, storage, and reporting, thereby improving efficiency and accuracy.

4. The fourth part of the document addresses the challenges associated with data security and privacy. It stresses the importance of implementing robust security measures to protect sensitive information from unauthorized access and breaches.

5. The fifth part of the document explores the integration of data with other organizational systems. It discusses how data can be shared and analyzed across different departments to provide a comprehensive view of the organization's performance.

6. The sixth part of the document discusses the importance of data quality and the steps taken to ensure it. It notes that high-quality data is crucial for generating accurate insights and making informed strategic decisions.

7. The seventh part of the document concludes by summarizing the key findings and recommendations. It reiterates the need for a data-driven approach to organizational management and the importance of ongoing monitoring and improvement.

8. The eighth part of the document provides a detailed overview of the data collection process, including the identification of data sources, the selection of appropriate collection methods, and the implementation of data management protocols.

9. The ninth part of the document discusses the various data analysis techniques used to extract meaningful insights from the collected data. It covers both descriptive and inferential statistics, as well as advanced analytical methods.

10. The tenth part of the document focuses on the visualization of data, explaining how charts, graphs, and dashboards can be used to present complex information in a clear and accessible manner for stakeholders.

11. The eleventh part of the document addresses the ethical considerations surrounding data collection and analysis. It emphasizes the need for transparency, informed consent, and the protection of individual privacy rights.

12. The twelfth part of the document discusses the future of data management and analysis, highlighting emerging trends such as artificial intelligence, big data, and cloud computing, and their potential impact on organizational operations.

13. The thirteenth part of the document provides a final summary and concludes the report. It expresses the hope that the information provided will be valuable in supporting the organization's data-driven goals and objectives.

to pollen of Engelhardtia, and both E. quietus and E. microcoryphaeus probably are representatives of the family Juglandaceae, if not the genera Platycarya and Engelhardtia.

Occurrence: Generally rare, but very consistent throughout the section.

Location: Pb 3836 1 ; 91.1 x 33.0

Code: P3sm-9

Genus MYRICACEOIPOLLENITES Pot., 1951

Myricaceoipollenites cf. megagranifer (Pot.) Pot., 1951

(Plate 12, Figure 1)

The comparison with M. megagranifer is quite close, although the pores of the figured species appear to be slightly larger, and with a somewhat heavier annular thickening. The species probably has affinities with the family Myricaceae, and the morphology suggests a possible relationship with the genus Myrica. This species is combined with other Myricaceous and Betuloid types in the counts of Figure 11, and its contribution is relatively large.

Occurrence: Common to abundant, especially in lignitic and coaly facies throughout the section.

Location: Pb 6320 2 ; 49.8 x 113.0

Code: P3sm-2a



Genus TILIAPOLLENITES (Pot.) Pot. and Ven., 1934

Tiliapollenites instructus (Pot.) Pot. and Ven., 1934

(Plate 10, Figure 4)

The botanical affinity of this species is almost certainly with the genus Tilia, and it is frequently recorded from Tertiary deposits. This species is combined with other Tilia-like pollen types in the counts of Figure 11, but T. instructus comprises the bulk of the percentages shown.

Occurrence: Rare to fairly common, the species occurs consistently throughout the section.

Location: Pb 3837 1 ; 44.5 x 121.2

Code: Til-2

Tiliapollenites indubitabilis (Pot.) Pot. and Ven., 1934

(Plate 1, Figure 2)

This is a smaller species of Tilia-like pollen, and the affinity with the genus Tilia is not certain, although it certainly is related to the family Tiliaceae. Its contribution to the Tilia percentages on Figure 11 is relatively small.

Occurrence: Rare to fairly common, with the highest frequencies occurring in Zone A.

Location: Pb 3875 4 ; 39.0 x 121.0

Code: Til-7

Tiliapollenites (as Tilia) crassipites
(Wodehouse, 1933, page 510, Figure 48) n. comb.

(Plate 1, Figure 3)

This species, described by Wodehouse from the Green River formation, is probably related to the family Tiliaceae, but its affinity with the genus Tilia is not certain. Its coarse, even reticulum, and its relatively open apertures distinguish it from the other species of Tiliapollenites illustrated in this study.

Occurrence: Generally rare, restricted to lower half of section (Zones A and B).

Location: Pb 3875 - 1 ; 36.4 x 126.0

Code: Til-6

Genus PISTILLIPOLLENITES Rouse, 1962

Pistillipollenites mcgregorii Rouse, 1962

(Plate 1, Figure 4; Plate 5, Figures 2 and 3)

The botanical affinity of this species is not known for certain, although Rouse suggests a possible affinity with the genus Rusbyanthus, a genus of the family Gentianaceae. The size of the body and the club-shaped ornamental elements is quite variable, as is the number and distribution of the elements over the surface of the grain. The apertures appear to be short colpi with a raised margin surrounding them, the margin sometimes being covered with the pistillate projections.

Occurrence: Rare to common, the species is present in the lower and uppermost part of the section, but is absent



in the middle portion (Zones C and D).

Location: Pb 3831 6 ; 39.5 x 123.9

Pb 3867 5 ; 43.0 x 125.9

Pb 3811 1 ; 51.0 x 117.7

Code: P3gm-1

Genus BOMBACACIPITES Anderson, 1960

Bombacacipites cf. nacimientoensis Anderson, 1960

(Plate 10, Figure 8)

The comparison with this species is tentative. The botanical affinity of the illustrated form is thought to be with the family Bombacaceae, although the relationship is not certain. Other bombacaceous-like pollen is included in the percentages of the Bombax group in Figure 11, but this species is the dominant type.

Occurrence: Rare to fairly common, it occurs throughout the section, but its highest frequencies appear in carbonaceous siltstones in the upper part.

Location: Pb 3826 3 ; 46.8 x 111.1

Code: Bom-1

Genus BOMBACACIDITES Couper, 1960

Bombacacidites cf. bombaxoides Couper, 1960

(Plate 5, Figure 5)

The genera Bombacacides and Bombacacipites, both published in 1960, are probably not both valid, although no change is made here. This species is very similar to modern Bombax pollen, and affinity with the family

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters.

2. The second part outlines the specific procedures for handling sensitive information and data. It stresses the need for strict confidentiality and the implementation of robust security measures to protect against unauthorized access and data breaches.

3. The third section addresses the requirements for reporting and documentation. It details the frequency and format of reports, ensuring that all relevant information is captured and presented in a clear and concise manner.

4. The fourth part focuses on the role of internal controls and audits. It explains how these mechanisms are designed to identify and prevent errors, fraud, and other irregularities, thereby safeguarding the organization's assets and integrity.

5. The fifth section discusses the importance of communication and collaboration. It encourages open dialogue between all stakeholders and the establishment of clear lines of responsibility and authority.

6. The sixth part covers the legal and regulatory aspects of the organization's operations. It highlights the need to stay up-to-date with applicable laws and regulations and to ensure full compliance at all times.

7. The seventh section addresses the issue of risk management. It describes the process of identifying, assessing, and mitigating various risks that could potentially impact the organization's success.

8. The eighth part discusses the importance of continuous improvement and innovation. It encourages the organization to regularly evaluate its processes and seek out new and better ways of doing things.

9. The ninth section covers the topic of human resources and talent management. It emphasizes the need to attract, develop, and retain top talent to drive the organization's growth and performance.

10. The final part of the document provides a summary of the key points and reiterates the organization's commitment to excellence and ethical conduct.

Bombacaceae if not Bombax is fairly certain. The family is tropical to subtropical in distribution today.

Occurrence: Rare, but it occurs conspicuously in Zone E.

Location: Pb 5621 4 ; 52.5 x 120.6

Code: Bom-4

Genus PROTEACIDITES Cookson, 1950

Proteacidites cf. marginus Rouse, 1962

(Plate 10, Figure 7)

The comparison with P. marginus is close, although, as Rouse points out, considerable variation exists and this species may be gradational with P. terrazus. The botanical affinity is probably the family Proteaceae.

Occurrence: Rare to common, especially in the lower part of the section.

Location: Pb 3828 5 ; 39.6 x 113.8

Code: Prot-1

Proteacidites terrazus Rouse, 1962

(Plate 6, Figure 12)

This species together with P. cf. marginus, comprise the total percentage of Proteacidites shown on Figure 6. Illustrations of similar types are common in studies of lower Tertiary sections, and it appears that this species is an excellent marker for Eocene rocks.

Occurrence: Rare to common, generally throughout the section, but with decreasing frequency in Zones D and E.

Location: Pb 3843 2 ; 43.3 x 112.0

Code: Prot-2

Genus CARYAPOLLENITES Raatz 1937

Caryapollenites simplex (Pot.) Raatz, 1937

(Plate 12, Figure 8)

The botanical affinity of this species is probably the family Juglandaceae, and possibly the genus Carya, although C. simplex is considerably smaller than pollen of most modern species of Carya. This species comprises the total shown under Carya in Figure 11.

Occurrence: Common to abundant, occurs throughout the section; its highest frequencies occur in carbonaceous siltstones apparently deposited in brackish lagoons or bays.

Location: Pb 3829 5 ; 41.6 x 113.8

Code: Car-1

Caryapollenites spackmanius (Traverse) Pot., 1960

(Plate 5, Figure 4)

This species is about twice as large as C. simplex. It appears that the larger C. spackmanius type may be the product of an evolutionary trend to larger pollen from the smaller C. simplex type. C. spackmanius occurs only in a few samples in the uppermost part of the section, and though C. simplex is still present in those samples, its abundance is considerably reduced. This species compares closely with modern Carya pollen, and an affinity with that genus is probable.

Occurrence: Rare, the species occurs only in Zone E.

Location: Pb 3897 4 ; 50.3 x 121.0

Code: Car-2

Genus ALNIPOLLENITES Pot., 1931

Alnipollenites versus (Pot.) Pot., 1934

(Plate 12, Figure 6; Plate 4, Figure 9)

The botanical affinity of this species is almost certainly with the genus Alnus, family Betulaceae. It is a commonly identified form in Tertiary deposits. This species comprises most of the percentages shown under Alnus in Figure 11.

Occurrence: Common in most samples throughout the section, although its relative abundance decreases generally in most coal samples. A six pored form of this species (Plate 4, Figure 9) occurs only in Zones D and E.

Location: Pb 3838 4 ; 43.4 x 120.8 (Pl. 12, Fig. 6)

Pb 3897 4 ; 46.5 x 116.5 (Pl. 4, Fig. 9)

Code: Al-1

Alnipollenites sp.

(Plate 12, Figure 7)

This species may be referable to the species A. versus, although the pores appear to be consistently oriented slightly off the equator, and the pore annulus is generally less well developed. Only four pored forms of this type were observed, while four and five pored A. versus were present in nearly equal numbers. The affinity with the

genus Alnus is less certain for this species, although it was included in counts under that heading in Figure 11.

Occurrence: Rare, the species ranges throughout the section.

Location: Pb 3883 4 ; 47.5 x 128.0

Code: A1-2

Genus ULMIPOLLENITES Wolfe, 1934

Ulmipollenites undulosus Wolfe, 1934

(Plate 2, Figure 11; Plate 12, Figure 11)

Anderson (1960) used the name Ulmoidipites for grains very similar to the types illustrated here. The botanical affinity appears to be with the family Ulmaceae, although the generic affinity is not certain. Four and five pored forms of this species are present, and both types are included in counts of Ulmus in Figure 11.

Occurrence: Generally common throughout the section, although the five pored form occurs only in samples from Zone B and above.

Location: Pb 5615 1 ; 52.2 x 113.8 (Pl. 2, Fig. 11)

Pb 3883 4 ; 36.2 x 125.1 (Pl. 12, Fig. 11)

Code: P_orug-1

Ulmipollenites sp.

(Plate 1, Figure 13)

This is a smaller, three pored pollen which is in other respects similar to U. undulosus. Anderson (1960) illustrates a similar type referring to it as Ulmoidipites

krempi. It appears that an evolutionary sequence from three pored to polyporate aperture condition is present in this group of pollen, which are probably related to the family Ulmaceae.

Occurrence: Rare to common, this species does not range above Zone D.

Location: Pb 3831 6 ; 47.5 x 117.2

Code: P3rug-1

Genus PTEROCARYAPOLLENITES Thiery., 1937

Pterocaryapollenites stellatus (Pot.) Raatz, 1937

(Plate 6, Figure 10; Plate 12, Figure 15)

The botanical affinity of this species appears to be with Pterocarya. The percentages of Pterocarya shown in Figure 11, and of Pterocaryapollenites in Figure 6, are comprised entirely of this species. The sporadic occurrence of extremely high abundances of this species in particular swamp or brackish environments reduces its stratigraphic value, although it provides some indication of the ecological setting of the parent plant.

Occurrence: Rare to abundant, the species occurs throughout the section with the highest abundances occurring in some coals and lignitic siltstones in the upper part of the section.

Location: Pb 3872 3 ; 49.0 x 122.0 (Pl. 6, Fig. 10)

Pb 3801 5 ; 35.0 x 125.3 (Pl. 12, Fig. 15)

Code: P_{pop}-1

Genus LIQUIDAMBARPOLLENITES Raatz, 1937

Liquidambarpollenites stigmosus (Pot.) Raatz, 1937

(Plate 4, Figure 11)

The botanical affinity of this species appears to be with the genus Liquidambar of the family Hemamelidaceae. It is a frequently identified form from Tertiary deposits. This species comprises about half of the counts shown under Liquidambar in Figure 11.

Occurrence: Rare to common, this species occurs in Zones D and E and the highest frequencies appear in some lignitic siltstone samples.

Location: Pb 3802 2 ; 50.3 x 120.2

Code: P_{oo}r-1

Liquidambarpollenites cf. mangelsdorfiana

(Traverse) Pot., 1960

(Plate 3, Figure 15; Plate 12, Figures 12 and 13)

The illustrated species compares quite closely with L. mangelsdorfiana from the Oligocene Brandon Lignite. The pores are slightly more elongate and the exine somewhat thicker in the illustrated species than in the original illustration of L. mangelsdorfiana. It is included in the percentages of Liquidambar in Figure 11.

Occurrence: Generally rare, but it is consistently present in and above Zone B.

Location: Pb 3827 5 ; 38.0 x 125.1 (Pl. 3, Fig. 15)

Pb 3872 3 ; 48.2 x 123.3 (Pl. 12, Figs.12,13)

Code: P_{oo}r-3

The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for ensuring transparency and accountability in financial operations. This section also outlines the various methods and tools used to collect and analyze data, highlighting the need for consistency and precision in data collection.

The second part of the document focuses on the analysis of the collected data. It describes the various statistical techniques and models used to interpret the data, including regression analysis, time series analysis, and hypothesis testing. This section also discusses the challenges associated with data analysis, such as missing data, outliers, and the need for appropriate statistical tests.

The third part of the document discusses the application of the analysis results. It describes how the findings are used to inform decision-making and to identify areas for improvement. This section also discusses the importance of communicating the results of the analysis to the relevant stakeholders and the need for ongoing monitoring and evaluation.

The fourth part of the document discusses the future of data analysis and the role of technology in this field. It describes the various emerging technologies, such as artificial intelligence, machine learning, and big data, and how they are being used to improve data analysis. This section also discusses the challenges associated with these technologies and the need for ongoing research and development.

The fifth part of the document discusses the ethical implications of data analysis. It describes the various ethical issues, such as privacy, security, and bias, and how they can be addressed. This section also discusses the need for ongoing education and training in data ethics and the role of regulatory bodies in ensuring ethical standards are met.

The sixth part of the document discusses the role of data analysis in various industries and sectors. It describes how data analysis is being used in healthcare, finance, marketing, and other industries to improve performance and make better decisions. This section also discusses the challenges associated with data analysis in these industries and the need for ongoing research and development.

The seventh part of the document discusses the role of data analysis in public policy and government. It describes how data analysis is being used to inform policy-making and to evaluate the impact of various programs and policies. This section also discusses the challenges associated with data analysis in government and the need for ongoing research and development.

The eighth part of the document discusses the role of data analysis in education. It describes how data analysis is being used to improve student performance and to identify areas for improvement in schools and universities. This section also discusses the challenges associated with data analysis in education and the need for ongoing research and development.

The ninth part of the document discusses the role of data analysis in sports. It describes how data analysis is being used to improve athletic performance and to identify areas for improvement in various sports. This section also discusses the challenges associated with data analysis in sports and the need for ongoing research and development.

The tenth part of the document discusses the role of data analysis in the environment. It describes how data analysis is being used to monitor and manage natural resources and to address environmental issues. This section also discusses the challenges associated with data analysis in the environment and the need for ongoing research and development.

The eleventh part of the document discusses the role of data analysis in social science. It describes how data analysis is being used to understand human behavior and to identify areas for improvement in social and economic systems. This section also discusses the challenges associated with data analysis in social science and the need for ongoing research and development.

The twelfth part of the document discusses the role of data analysis in the arts and humanities. It describes how data analysis is being used to analyze and interpret cultural and historical data. This section also discusses the challenges associated with data analysis in the arts and humanities and the need for ongoing research and development.

The thirteenth part of the document discusses the role of data analysis in the legal system. It describes how data analysis is being used to analyze and interpret legal data and to identify areas for improvement in the legal system. This section also discusses the challenges associated with data analysis in the legal system and the need for ongoing research and development.

The fourteenth part of the document discusses the role of data analysis in the media and communication industry. It describes how data analysis is being used to analyze and interpret media and communication data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the media and communication industry and the need for ongoing research and development.

The fifteenth part of the document discusses the role of data analysis in the entertainment industry. It describes how data analysis is being used to analyze and interpret entertainment data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the entertainment industry and the need for ongoing research and development.

The sixteenth part of the document discusses the role of data analysis in the technology industry. It describes how data analysis is being used to analyze and interpret technology data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the technology industry and the need for ongoing research and development.

The seventeenth part of the document discusses the role of data analysis in the healthcare industry. It describes how data analysis is being used to analyze and interpret healthcare data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the healthcare industry and the need for ongoing research and development.

The eighteenth part of the document discusses the role of data analysis in the financial industry. It describes how data analysis is being used to analyze and interpret financial data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the financial industry and the need for ongoing research and development.

The nineteenth part of the document discusses the role of data analysis in the marketing industry. It describes how data analysis is being used to analyze and interpret marketing data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the marketing industry and the need for ongoing research and development.

The twentieth part of the document discusses the role of data analysis in the retail industry. It describes how data analysis is being used to analyze and interpret retail data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the retail industry and the need for ongoing research and development.

The twenty-first part of the document discusses the role of data analysis in the manufacturing industry. It describes how data analysis is being used to analyze and interpret manufacturing data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the manufacturing industry and the need for ongoing research and development.

The twenty-second part of the document discusses the role of data analysis in the transportation industry. It describes how data analysis is being used to analyze and interpret transportation data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the transportation industry and the need for ongoing research and development.

The twenty-third part of the document discusses the role of data analysis in the energy industry. It describes how data analysis is being used to analyze and interpret energy data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the energy industry and the need for ongoing research and development.

The twenty-fourth part of the document discusses the role of data analysis in the agriculture industry. It describes how data analysis is being used to analyze and interpret agriculture data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the agriculture industry and the need for ongoing research and development.

The twenty-fifth part of the document discusses the role of data analysis in the construction industry. It describes how data analysis is being used to analyze and interpret construction data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the construction industry and the need for ongoing research and development.

The twenty-sixth part of the document discusses the role of data analysis in the telecommunications industry. It describes how data analysis is being used to analyze and interpret telecommunications data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the telecommunications industry and the need for ongoing research and development.

The twenty-seventh part of the document discusses the role of data analysis in the aerospace industry. It describes how data analysis is being used to analyze and interpret aerospace data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the aerospace industry and the need for ongoing research and development.

The twenty-eighth part of the document discusses the role of data analysis in the defense industry. It describes how data analysis is being used to analyze and interpret defense data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the defense industry and the need for ongoing research and development.

The twenty-ninth part of the document discusses the role of data analysis in the intelligence industry. It describes how data analysis is being used to analyze and interpret intelligence data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the intelligence industry and the need for ongoing research and development.

The thirtieth part of the document discusses the role of data analysis in the space industry. It describes how data analysis is being used to analyze and interpret space data and to identify areas for improvement in the industry. This section also discusses the challenges associated with data analysis in the space industry and the need for ongoing research and development.

Genus MULTIPOROPOLLENITES Pf., in Thom. and Pf., 1953

Multiporopollenites ludlowensis Stanley, 1960

(Plate 12, Figures 17 and 18)

This identification is based on a thesis description, and it is therefore not a valid name. The species almost certainly represents the genus Pachysandra of the family Buxaceae. This pollen species has been identified from a number of Tertiary localities in North America.

Occurrence: Rare, although it occurs with some consistency throughout the section.

Location: Pb 3873 1 ; 45.5 x 121.9

Code: Pac-1

Genus JUGLANSPOLLENITES Raatz, 1937

Juglanspollenites versus Raatz, 1937

(Plate 12, Figure 16)

The botanical affinity of this species appears to be with the genus Juglans. The pollen possesses the characteristic feature of pores arranged equatorially with one to three pores in one hemisphere, off the equator.

Occurrence: Rare, the species occurs very consistently in nearshore marine sediments, especially in the upper part of the section.

Location: Pb 3806 2 ; 34.3 x 111.7

Code: P sm-3

Genus POLLENITES H. Pot., 1893

Pollenites oculus-noctis Thierg., 1940

(Plate 1, Figure 10; Plate 11, Figures 14 and 15)

Couper (1960) has illustrated very similar forms and referred them to the genus Epilobium. The two pored form illustrated in this paper (Plate 11, Figure 15) is identified as Fuchsia by Couper (1960). Traverse (1955) illustrates a nearly identical form and refers it to the modern genus Jussaea. The botanical affinity of P. oculus-noctis is almost certainly with the family Onagraceae.

Occurrence: Rare, although it occurs consistently throughout the section with the highest frequencies appearing in the lower half of the section.

Location: Pb 3831 6 ; 51.3 x 113.7 (Pl. 1, Fig. 10)

Pb 5622 1 ; 61.0 x 122.8 (Pl. 11, Fig. 14)

57.8 x 111.3 (Pl. 11, Fig. 15)

Code: P3sm-4

Pollenites cf. ventosus Pot., 1931

(Plate 3, Figure 3)

The comparison of the illustrated specimen with Potonies original drawing is only suggestive of an identity. The form present in the samples studied is tricolpate with a suggestion of pore development at the equator. It is nearly always seen in polar view, with the colpi narrow and slit-like. It is a frequently occurring Eocene form in the German brown coals.

Occurrence: Common to rare, the species occurs throughout the section.

Location: Pb 3809 6 ; 45.9 x 110.9

Code: C3g-4

Pollenites genuinus Pot., 1934

(Plate 2, Figure 1)

The illustrated species usually shows a slight constriction or pore-like development within the colpi at the equator, much as Potonie describes as a genuculus in P. genuinus. It is common in some Eocene sediments of Europe. The botanical affinity is not known.

Occurrence: Rare to common, in and above Zone C.

Location: Pb 3895 2 ; 48.2 x 110.0

Code: C3r-18

Pollenites anulus (Pot.) Pot. and Ven., 1934

(Plate 12, Figure 14)

This species possibly represents the genus Celtis, although that is not certain. The number of pores is variable from three to six, but most commonly there are five. This is a frequently identified lower Tertiary species.

Occurrence: Generally rare, however it is very consistent in the upper part of the section.

Location: Pb 3806 2 ; 44.5 x 116.3

Code: P_∞sm-5

Genus SPORITES H. Pot., 1893

Sporites cf. vegetus Pot., 1934

(Plate 1, Figure 5)

Despite the misleading name, this species is a tricolpate pollen, as pointed out by Krutzsch (1957). The botanical affinity is unknown. The comparison of the illustrated form with S. vegetus is close.

Occurrence: Rare to fairly common, especially in the lower part of the section.

Location: Pb 3839 1 ; 45.7 x 127.3

Code: C3r-9

FUNGI

FAMILY MICROTHYRIACEAE

(Plate 7, Figures 4, 8 and 9)

A great variety of fungi are present in nearly all of the samples examined. The illustrated specimens represent only an example of the most abundant types. The family Microthyriaceae is today a tropical-subtropical group of ectoparasites commonly found on ferns, broadleaf trees and cenifers.

Occurrence: Common to abundant, especially abundant in some lignitic siltstones and coals. The fungi as a whole show an inverse relationship in abundance with the microplankton.

Location: Pb 5607 1 ; 38.2 x 119.0

Pb 3805 5 ; 41.0 x 114.7

Pb 3805 5 ; 52.4 x 124.9

Section 1

1. The first part of the document is a list of items.

Section 2

2. The second part of the document is a list of items. The items are listed in a table with columns for 'Item Name' and 'Quantity'.

Section 3

3. The third part of the document is a list of items. The items are listed in a table with columns for 'Item Name' and 'Quantity'.

Section 4

- Item 1
- Item 2
- Item 3

ALGAE

Genus CYCLONEPHELIUM (Deflandre and Cookson)
Cookson and Eisenack, 1962

Cyclonephelium sp.

(Plate 7, Figure 1)

The genus Cyclonephelium is a commonly identified Mesozoic to lower Tertiary form. It is a significant contributor to the percentages of microplankton in Figure 6.

Occurrence: Rare to common in samples of marine origin, especially those away from the swampy shoreline.

Location: Pb 3836 5 ; 41.0 x 110.3

Code: Hyx-2

Genus WETZELIELLA Eisenack, 1938

Wetzeliella glabra Cookson, 1956

(Plate 7, Figures 2 and 7)

This species has been described from the Eocene in Australia, and it is likely that it will prove to be an excellent stratigraphic marker for lower Tertiary rocks.

Occurrence: Rare, apparently in open marine environments.

Location: Pb 5616 2 ; 38.5 x 127.1 (Fig. 2)

Pb 5617 3 ; 36.4 x 115.3 (Fig. 7)

Code: Dino-5

The first part of the document discusses the importance of maintaining accurate records of all transactions. This includes not only sales and purchases but also the various expenses incurred in the course of business. It is essential to ensure that every receipt is properly filed and that the books are balanced regularly.

In addition, the document emphasizes the need for transparency and honesty in all financial dealings. It is important to disclose any potential conflicts of interest and to provide clear and concise information to all stakeholders. This helps to build trust and ensures that the business is operated in a fair and ethical manner.

The second part of the document provides a detailed overview of the company's financial performance over the past year. This includes a breakdown of revenue, expenses, and net income. It also includes a comparison of the current year's performance to the previous year, highlighting areas of growth and areas that need improvement.

The document concludes with a series of recommendations for the future. These include the need to continue to invest in research and development, to expand into new markets, and to maintain a strong focus on customer service. It also recommends that the company should continue to prioritize financial stability and transparency in all its operations.

Wetzeliella sp.

(Plate 7, Figure 5)

Occurrence: Rare to common, especially in samples from upper part of the section.

Location: Pb 5618 4 ; 50.8 x 118.1

Code: Dino-6

Genus DEFLANDREA Eisenack, 1938

Deflandrea cf. spinulosa

(Plate 7, Figure 6)

This species is commonly seen in lower Tertiary sediments. It exhibits a considerable range of morphological features, but the illustrated specimen is by far the most common type seen in the samples studied.

Occurrence: Common to abundant, occurring in large numbers in some apparently nearshore or even brackish environments.

Location: Pb 5616 2 ; 32.3 x 123.6

Code: Dino-2

Deflandrea sp.

(Plate 2, Figure 12)

Occurrence: Rare to common, mostly in middle part of section (Zone C).

Location: Pb 3838 1 ; 35.5 x 115.3

Code: Dino-1

Genus CYMATIOSPHAERA (wetzell) Deflandre, 1954

Cymatiosphaera sp.

(Plate 1, Figure 9)

This genus is comprised of species most of which are Paleozoic to Mesozoic in age. The figured specimen appears to be referable to the genus, however, although no specific comparisons were found.

Occurrence: Generally rare, it occurs most frequently in the lower part of the section, especially in Zone A.

Location: Pb 5603 1 ; 46.3 x 114.9

Code: Hyx-8

Genus CANNOSPHAEROPSIS Wetzell, 1932

Cannosphaeropsis sp.

(Plate 2, Figure 13)

This genus is composed mostly of Mesozoic species, and has not been recognized from North America.

Occurrence: Rare to common, it is restricted to Zone C and appears to be an excellent marker for that zone in marine rocks.

Location: Pb 3874 4 ; 46.2 x 122.0

Code: Hyx-4

Genus TYTTHODISCUS Norem, 1955

Tytthodiscus sp.

(Plate 5, Figure 8)

Occurrence: Rare to common, it occurs with highest frequency in the upper part of the section, especially Zone E.

Location: Pb 3896 2 ; 52.5 x 115.2

Code: Tyth-1

INCERTAE CEDIS

(Plate 1, Figure 12; Plate 5, Figure 7)

This specimen may be an encystment or budding state of a brown edge alga (Phaeophyta) (Prescott, G. W. personal communication). It bears some resemblance to the genus Halogoras Cookson, 1956 which is also assumed to be an algal cyst by that author.

Occurrence: Rare to common, it occurs in the lowermost and uppermost part of the section and is totally absent in between.

Location: Pb 3828 5 ; 39.5 x 127.5 (Pl. 1, Fig. 12)

Pb 3830 6 ; 42.7 x 124.2 (Pl. 5, Fig. 7)

Code: Alga-1

1. Theorem 10.1 (The Mean Value Theorem)

Let f be a function defined on $[a, b]$.

(1) If f is continuous on $[a, b]$,

(2) and if f is differentiable on (a, b) , then there exists a point c in (a, b) such that

$$f'(c) = \frac{f(b) - f(a)}{b - a}.$$

(3) In other words,

$$f'(c) = \frac{f(b) - f(a)}{b - a} \iff f(b) - f(a) = f'(c)(b - a).$$

(4) This is the Mean Value Theorem.

Proof. See Lecture 10.

Example 1. Let $f(x) = x^2$. Then $f'(x) = 2x$. Let $a = 1$ and $b = 4$. Then

$$f(b) - f(a) = f(4) - f(1) = 16 - 1 = 15, \quad b - a = 4 - 1 = 3.$$

Therefore, by the Mean Value Theorem, there exists a point c in $(1, 4)$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a} = \frac{15}{3} = 5.$$

Since $f'(x) = 2x$, we have $2c = 5$, so $c = 2.5$. This is the point c in $(1, 4)$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a} = \frac{15}{3} = 5.$$

Example 2. Let $f(x) = \sin(x)$. Then $f'(x) = \cos(x)$. Let $a = 0$ and $b = \pi$. Then

$$f(b) - f(a) = f(\pi) - f(0) = 0 - 0 = 0, \quad b - a = \pi - 0 = \pi.$$

Therefore,

$$f'(c) = \frac{f(b) - f(a)}{b - a} = \frac{0}{\pi} = 0.$$

Since $f'(x) = \cos(x)$, we have $\cos(c) = 0$, so $c = \frac{\pi}{2}$. This is the point c in $(0, \pi)$ such that

$$f'(c) = \frac{f(b) - f(a)}{b - a} = \frac{0}{\pi} = 0.$$

INCERTAE CEDIS

(Plate 5, Figures 6 and 9)

This specimen appears to be a marine microplankton species, probably a member of the Dinoflagellatae. It appears in abundance in Zone E, and may be an excellent marine marker for latest Eocene and/or earliest Oligocene.

Location: Pb 3896 2 ; 54.0 x 109.0 (Fig. 6)

Pb 3896 2 ; 36.3 x 115.0 (Fig. 9)

Code: Hyx-9

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The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This not only helps in tracking expenses but also ensures compliance with tax regulations.

In the second section, the author outlines the process of reconciling bank statements with the company's ledger. This involves comparing the bank's record of deposits and withdrawals against the internal accounting records to identify any discrepancies.

The third section covers the preparation of financial statements, including the balance sheet, income statement, and cash flow statement. It provides a step-by-step guide on how to calculate each component and ensure that the numbers balance.

The fourth section discusses the role of the accounting department in providing financial insights to management. It highlights how regular reporting can help identify trends, control costs, and make informed decisions about the company's future.

Finally, the document concludes with a summary of key points and a reminder that accurate financial reporting is essential for the long-term success of any business.

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APPENDIX A

The location of the sections collected and studied are presented in this section. The position and lithologic description for each sample is also provided. The lithologic descriptions are based on field examination only, and are not intended as accurate petrographic analyses. The sample numbers correspond to those mentioned in the text and shown in the illustrations.

Skookumchuck River Section 64-DS-XII Sec. 33, T15N, R2W

| Sample Number | Position in Section | Lithology |
|---------------|-------------------------|--|
| 4 | 590 ft. | dark gray, soft, fissile, carbonaceous shale, some molluscan fossils |
| 3 | 500 ft. | 12" coal seam, with underclay where roots are in place |
| 2 | 360 ft. | lignitic siltstone and thin coal, many leaf fossils |
| 1 | base of exposed section | thick coal and parting clay sequence, some logs and stumps appear to be in growth position |

Willapa River Section 64-DS-XIII and 65-DS-XI Secs. 3, 11, 14, 24, 25, 36, T13N, R8W, Pacific County, Wash.

| Sample Number | Position in Section | Lithology |
|---------------|---------------------|---|
| 7 | 900 ft. | hard, dark gray, fissile, micaceous siltstone |
| 6 | 800 ft. | same lithology as above |
| 5 | 700 ft. | dark gray, massive, poorly sorted, micaceous siltstone, possibly graded |
| 4 | 600 ft. | gray, concretionary shale, with associated coarse agglomerate zone |
| 3 | 200 ft. | dark gray, carbonaceous, concretionary, sandy siltstone |
| 2 | 150 ft. | dark gray, poorly sorted, coarse sandstone |
| 1 | 50 ft. | dark gray, fissile siltstone, with associated coarse volcanic sandstone |

Rock Creek Section 65-DS-XIV
T4N, R5W; T5N, R5W; T5N, R4W, Columbia County, Oregon

| Sample Number | Position in Section | Lithology |
|---------------|---------------------|---|
| 50 | 850 ft. | soft, tuffaceous, dark gray, well bedded, silty shale |
| 49 | 750 ft. | soft, massive, concretionary siltstone |
| 48 | 700 ft. | same lithology as above, with calcareous horizons |
| 47 | 600 ft. | dark gray, tuffaceous, sandy, siltstone, with CaCO ₃ stringers |
| 46 | 450 ft. | gray, well bedded, slightly fissile, silty sandstone |
| 45 | 350 ft. | hard, dark gray, fissile, well bedded siltstone and shale |
| 44 | 250 ft. | same lithology as above |
| 43 | 125 ft. | dark gray, fissile, carbonaceous siltstone |
| 42 | 50 ft. | gray, very carbonaceous, micaceous siltstone with plant fossils and associated bluish sandstone |

Chehalis River Section 65-DS-X
Sec. 12, 13, T12N, R5W, Lewis County, Washington

| Sample Number | Position in Section | Lithology |
|---------------|---------------------|--|
| 6 | 4000 ft. | lignitic, micaceous, siltstone with associated channel sandstone |
| 5 | 3900 ft. | brownish-gray, well bedded, carbonaceous shale |
| 4 | 3700 ft. | dark gray, poorly sorted, concretionary siltstone |
| 3 | 3000 ft. | hard, dark gray, fissile, concretionary shale |
| 2 | 2500 ft. | dark gray, micaceous siltstone with carbonaceous stringers possibly graded bedding |
| 1 | 1000 ft. | hard, dark gray, fissile, silty shale with associated volcanic sandstones |

The following table shows the results of the experiment. The first column shows the number of trials, the second column shows the number of correct responses, and the third column shows the percentage of correct responses. The fourth column shows the number of trials that were not completed.

| Number of trials | Number of correct responses | Percentage of correct responses | Number of trials not completed |
|------------------|-----------------------------|---------------------------------|--------------------------------|
| 10 | 8 | 80% | 2 |
| 20 | 15 | 75% | 5 |
| 30 | 22 | 73% | 8 |
| 40 | 28 | 70% | 12 |
| 50 | 35 | 70% | 15 |
| 60 | 42 | 70% | 18 |
| 70 | 48 | 69% | 22 |
| 80 | 55 | 69% | 25 |
| 90 | 62 | 69% | 28 |
| 100 | 70 | 70% | 30 |

The results show that the percentage of correct responses remains relatively stable around 70% across the range of trials. The number of trials not completed increases as the total number of trials increases, suggesting that the task becomes more difficult as the number of trials increases.

McIntosh Lake Section 64-DS-XI
 Sec. 14, T16N, R1W, Thurston County, Washington

| Sample Number | Position in Section | Lithology |
|---------------|-------------------------|--|
| 2 | 100 ft. | hard, dark gray, thin bedded, fissile, concretionary shale and siltstone |
| 1 | base of exposed section | same lithology as above |

Stillwater-Olequa Creek Section
 64-DS-XIV, 64-DS-XV and 65-DS-VIII
 Secs. 4, 5, 6, T10N, R3W; Secs. 25, 26, 34 T11N, R3W,
 Lewis and Cowlitz Counties, Washington

| Sample Number | Position in Section | Lithology |
|---------------|---------------------|--|
| 41 | 7925 ft. | lignitic, micaceous siltstone with much plant debris |
| 40 | 7900 ft. | coarse channel sandstone with coalified logs and thin clay stringers |
| 39 | 7840 ft. | interbedded coals and bluish shales, roots seen in place |
| 38 | 7800 ft. | channel sandstone cutting through lignitic siltstone and coal |
| 37 | 7600 ft. | bluish, micaceous, carbonaceous sandstone with coaly horizons |
| 35 7 | 7250 ft. | gray, thinnly bedded, shale and siltstone, very carbonaceous |
| 6 | 7240 ft. | same lithology |
| 5 | 7230 ft. | same lithology |
| 4 | 7220 ft. | same lithology |
| 3 | 7215 ft. | same lithology |
| 2 | 7210 ft. | same lithology |
| 1 | 7200 ft. | same lithology |
| 34 | 7000 ft. | gray, tuffaceous, concretionary siltstone with some sandy layers |
| 33 | 6825 ft. | thinnly interbedded sandstone and siltstone, associated channel sandstone |
| 32 | 6600 ft. | interbedded carbonaceous shales, sandstone and siltstone |
| 31 | 6500 ft. | lignitic siltstone, interbedded with massive to crossbedded sandstone lenses |
| 30 | 6450 ft. | gray, fairly well sorted, fissile siltstone with foraminifera |
| 29 | 6400 ft. | same lithology, but containing molluscan fossils |

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| Sample Number | Position in Section | Lithology |
|---------------|---------------------|---|
| 28 | 6250 ft. | same lithology |
| 27 | 6150 ft. | gray siltstone, with molluscan fossils and associated fairly well sorted sandstones |
| 26 | 6000 ft. | same lithology |
| 25 | 5600 ft. | fossiliferous, poor to well sorted gray siltstone |
| 24 | 5400 ft. | lignitic siltstone interbedded with gray siltstone and fossiliferous |
| 23 | 5300 ft. | bluish massive sandstone with carbonaceous stringers |
| 22 | 4900 ft. | gray, carbonaceous, micaceous, poorly sorted siltstone |
| 21 | 4600 ft. | same lithology |
| 20 | 4250 ft. | soft, bluish-gray, micaceous, fairly massive siltstone |
| 19 | 4100 ft. | gray, micaceous, fine sandstone and siltstone |
| 18 | 3950 ft. | dark gray, massive, poorly sorted siltstone |
| 17 | 3900 ft. | hard, bluish, fissile shale with some concretions |
| 16 | 3750 ft. | dark gray siltstone and bluish sandstone, some concretions |
| 15 | 3650 ft. | dark gray, poorly sorted, well bedded siltstone with woody fragments |
| 14 | 3600 ft. | same lithology as above |
| 13 | 3500 ft. | dark gray, bedded siltstone and sandstone with carbonaceous fragments |
| 12 | 3400 ft. | thinly bedded, concretionary, micaceous siltstone |
| 10 | 2600 ft. | gray, micaceous, carbonaceous, poorly sorted siltstone |
| 9 | 2400 ft. | same as above |
| 8 | 2300 ft. | dark gray, and well bedded, carbonaceous, fissile siltstone |
| 7 | 2100 ft. | 10 inch coal seam, with associated massive sandstone |
| 5 | 1750 ft. | blue-gray, poorly sorted sandy siltstone |
| 4 | 1700 ft. | concretionary, dark gray, sandy siltstone |
| 3 | 1600 ft. | thinly interbedded fine sandstone and siltstone, possibly graded |
| 2 | 1500 ft. | hard, dark gray, poorly sorted, massive siltstone |
| 1 | 800 ft. | hard, dark gray, poorly sorted siltstone |

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry, no matter how small, should be recorded to ensure the integrity of the financial statements. This includes recording all sales, purchases, and expenses in a timely and accurate manner.

The second part of the document provides a detailed breakdown of the company's revenue. It lists the various products and services sold, along with the corresponding revenue generated from each. This information is crucial for understanding the company's primary sources of income and for identifying areas of growth.

The third part of the document details the company's operating expenses. It categorizes these expenses into fixed and variable costs, providing a clear picture of the company's cost structure. This analysis is essential for determining the company's profitability and for identifying opportunities to reduce costs.

The fourth part of the document presents the company's net income and profit margins. It shows the company's ability to generate profit from its operations and provides a comparison to industry benchmarks. This information is key for investors and management alike in assessing the company's financial performance.

The fifth part of the document discusses the company's financial position and liquidity. It provides a snapshot of the company's assets and liabilities, as well as its ability to meet its short-term obligations. This analysis is critical for understanding the company's overall financial health and its ability to sustain its operations.

The sixth part of the document outlines the company's future financial projections. It provides a forecast of the company's revenue, expenses, and profit for the next several years. This information is essential for strategic planning and for attracting investment.

The seventh part of the document concludes with a summary of the company's financial performance and a statement of management's confidence in the company's future prospects. It reiterates the company's commitment to transparency and accuracy in its financial reporting.

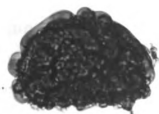
PLATES

PLATE 1

Figure

- 1 Polypodiisporites sp. 1 x500
- 2 Tiliapollenites indubitabilis
- 3 Tiliapollenites crassipites
- 4 Pistillipollenites mcgregorii
- 5 Sporites cf. vegetus
- 6 Ilexpollenites iliacus
- 7 Intratriporopollenites rizophorus
- 8 Intratriporopollenites rizophorus
- 9 Cymatiosphaera x500
- 10 Pollenites oculus-noctis x500
- 11 Gothanipollis sp.
- 12 Incertae cedis, algal cyst?
- 13 Ulmipollenites sp.
- 14 Tricolporopollenites sp. 3

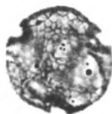
All illustrations x1000 unless otherwise indicated.



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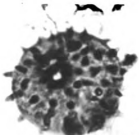
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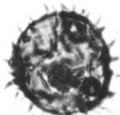
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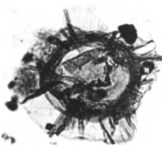
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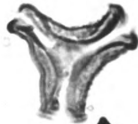
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PLATE I

PLATE 2

Figure

- 1 *Pollenites genuinus*
- 2 *Syncolporites* sp. 2
- 3 *Syncolporites* sp. 1
- 4 *Tricolpites* sp. 2
- 5 *Tricolpites* sp. 2
- 6 *Rhoipites* sp.
- 7 *Rhoipites* sp.
- 8 *Symplocoipollenites* sp. 2
- 9 *Symplocoipollenites*
- 10 *Symplocoipollenites*
- 11 *Ulmidollenites undulosus*
- 12 *Deflandrea* sp. x500
- 13 *Cannosphaeropsis* sp. x500

All illustrations x1000 unless otherwise indicated.

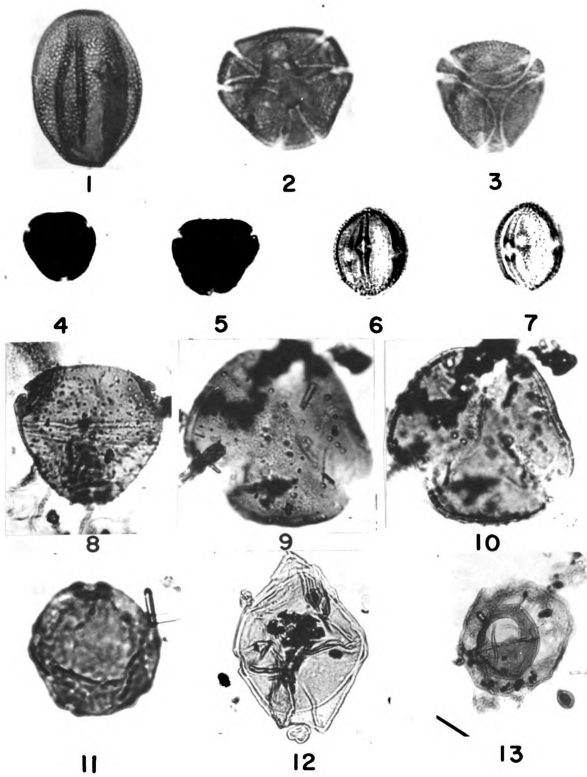


PLATE 2

PLATE 3

Figure

- 1 *Ilexpollenites* cf. *marginatus*
- 2 *Quercoidites* *henrici*
- 3 *Pollenites* cf. *ventosus*
- 4 *Cupanieidites* cf. *orthoteichus*
- 5 *Tricolporopollenites* sp. 1
- 6 *Tricolporopollenites* sp. 2
- 7 *Tricolporopollenites* cf. *macrodurensis*
- 8 *Cupanieidites* sp. 1
- 9 *Tricolporopollenites* cf. *helmstedtensis*
- 10 *Nyssapollenites* *accessorius*
- 11 *Alangaceoipollenites* sp. 2 x500
- 12 *Ilexpollenites* sp.
- 13 *Ilexpollenites* sp.
- 14 *Symplocoipollenites* *vestibulum*
- 15 *Liquidambarpollenites* cf. *mangelsdorfiana*

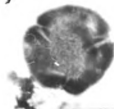
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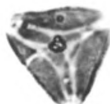
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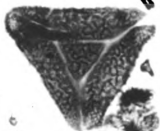
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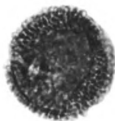
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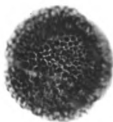
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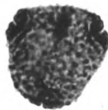
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PLATE 3

PLATE 4

Figure

- 1 *Concavisporites minimus*
- 2 *Piceapollenites* sp.
- 3 *Tsugaepollenites viridifluminipites* x500
- 4 *Tricolpites* cf. *striatus*
- 5 *Tricolpites* sp. 4
- 6 *Tricolpites* sp. 4
- 7 *Alangaceoipollenites* sp. 1 x500
- 8 *Rhoipites dolium*
- 9 *Alnipollenitites* *versus*
- 10 *Symplocoipollenites* sp. 1
- 11 *Liquidambarpollenites* *stigmatosus*
- 12 *Quercoidites* sp. 2

All illustrations x1000 unless otherwise indicated.

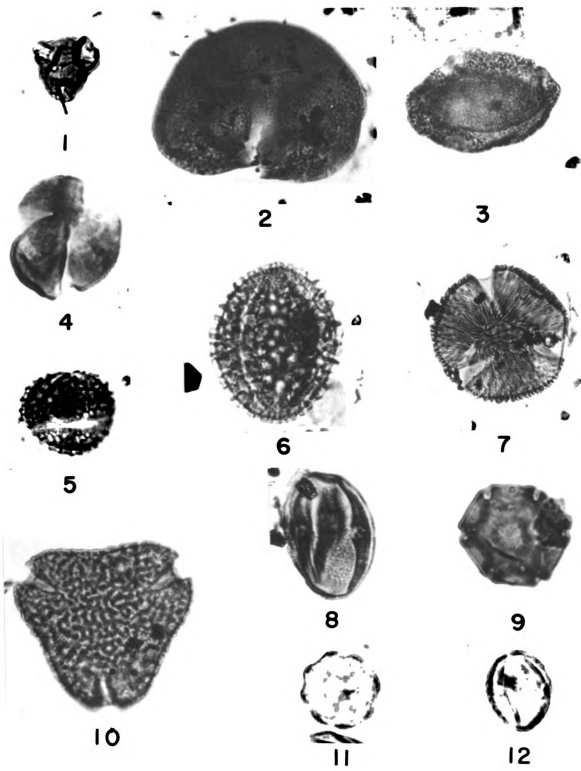


PLATE 4

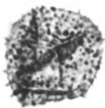
PLATE 5

Figure

- 1 *Baculatisporis* cf. *baculatus*
- 2 *Pistillipollenites* *megregorii*
- 3 *Pistillipollenites* *megregorii*
- 4 *Caryapollenites* *spackmanianus*
- 5 *Bombacacidites* cf. *bombaxoides*
- 6 microplankton, affinity uncertain x500
- 7 *Incertae cedis*, algal cyst?
- 8 *Tytthodiscus* sp. x500
- 9 microplankton, affinity uncertain x500

All illustrations x1000 unless otherwise indicated.

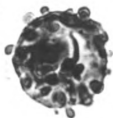




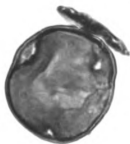
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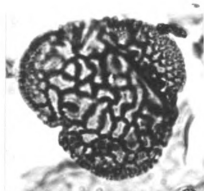
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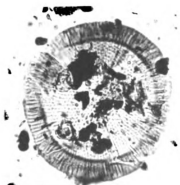
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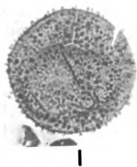
PLATE 5

PLATE 6

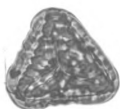
Figure

- 1 *Osmundacites wellmanii* x500
- 2 *Trilites asolidus* x500
- 3 *Trilites asolidus* x500
- 4 *Podocarpidites* x500
- 5 *Abietineaepollenites microalatus* x500
- 6 *Cicatricosisporites cf. hallei* x500
- 7 *Momipites coryloides*
- 8 *Ilexpollenites inaequaliclaviata*
- 9 *Ilexpollenites inaequaliclaviata*
- 10 *Pterocaryapollenites stellatus*
- 11 *Liliacidites intermedius*
- 12 *Proteacidites terrazus*
- 13 *Ephedra cf. notensis*

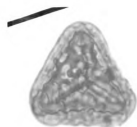
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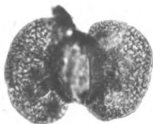
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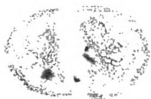
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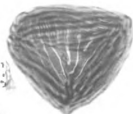
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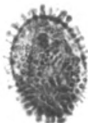
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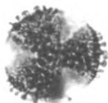
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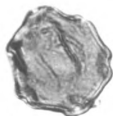
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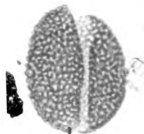
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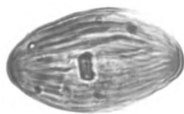
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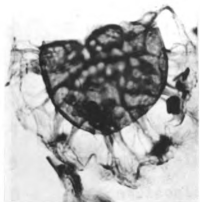
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PLATE 6

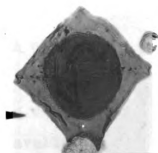
PLATE 7

Figure

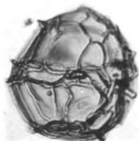
- 1 Cyclonephelium sp. x500
- 2 Wetzellia glabra x250
- 3 Dinoflagellate x500
- 4 Microthyriaceae x1000
- 5 Wetzeliella sp. x500
- 6 Deflandrea cf. spinosa x500
- 7 Wetzeliella cf. glabra x250
- 8 Microthyriaceae x250
- 9 fungus x250
- 10 fungus x1000



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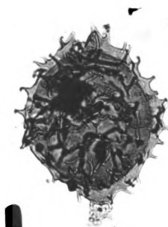
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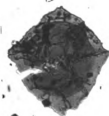
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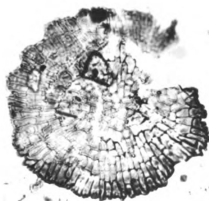
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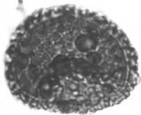
PLATE 7

PLATE 8

Figure

- 1 *Polypodiisporites* sp. 1
- 2 *Polypodiisporites* cf. *favus*
- 3 *Polypodiisporites* cf. *favus*
- 4 *Trilites* cf. *paravallatus*
- 5 *Cicatricosisporites* *cicatricosoides*
- 6 *Cicatricosisporites* *cicatricosoides*
- 7 *Laevigatisporites* cf. *pseudomaximus*
- 8 *Polypodiaceoisporites* sp.
- 9 *Polypodiaceoisporites* sp.
- 10 *Foveotriletes* *crassifovearis*
- 11 *Osmundicites* *wellmanii*
- 12 *Concavisporites* *minimodiversus*
- 13 *Concavisporites* *minimodiversus*

All illustrations x500.



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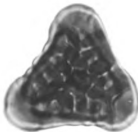
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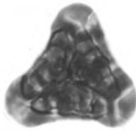
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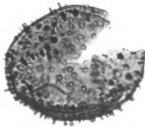
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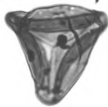
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PLATE 8

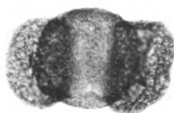
PLATE 9

Figure

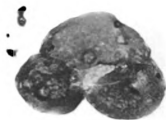
- 1 *Abiespollenites* cf. *absolutus* x500
- 2 *Abiespollenites* cf. *absolutus* x500
- 3 *Abiespollenites* cf. *absolutus* x500
- 4 *Podocarpidites* sp. x500
- 5 *Tsugaepollenites viridifluminipites* x500
- 6 *Taxodiaceapollenites hiatus*
- 7 *Quercoidites henrici*
- 8 *Sabalpollenites* cf. *convexus*
- 9 *Sequoiapollenites* sp.
- 10 *Taxodiaceapollenites hiatus*
- 11 *Quercoidites henrici*
- 12 *Castaneoidites* cf. *exactus*
- 13 *Tricolpites* sp. 3
- 14 *Ilexpollenites iliacus*
- 15 *Tricolpopollenites* cf. *retiformis*
- 16 *Tricolpopollenites* cf. *retiformis*
- 17 *Platanoidites* sp.
- 18 *Platanoidites* sp.
- 19 *Tricolpites* sp. 3

All illustrations x1000 unless otherwise indicated.

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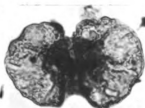
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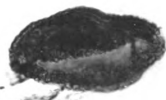
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PLATE 10

Figure

- 1 *Tricolpites* sp. 1
- 2 *Tricolpites* sp. 1
- 3 *Tricolpites* sp.
- 4 *Tiliapollenites instructus*
- 5 *Subtriporopollenites* cf. *constans*
- 6 *Trivestibulopollenites* cf. *salebrosus*
- 7 *Proteacidites* cf. *marginus*
- 8 *Bombacacipites* cf. *nacimientoensis*
- 9 *Rhoipites* cf. *bradleyensis*
- 10 *Araliaceoipollenites* cf. *edmundi*
- 11 *Tricolporopollenites* *satzveyensis*
- 12 *Rhoipites* cf. *pseudocingulum* forma *navicula*
- 13 *Rhoipites* cf. *pseudocingulum* forma *navicula*
- 14 *Rhoipites* *pseudocingulum*
- 16 *Rhoipites* *pseudocingulum*
- 17 *Cupuliferoipollenites* cf. *pusillus*

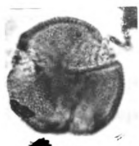
All illustrations x1000

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

In the second section, the author outlines the various methods used to collect and analyze the data. This includes both manual data entry and the use of specialized software tools. The goal is to ensure that the data is both accurate and easy to interpret.

The third part of the document provides a detailed breakdown of the results. It shows that there is a significant correlation between the variables being studied. This finding is supported by statistical analysis and is consistent with previous research in the field.

Finally, the document concludes with a series of recommendations for future research. It suggests that further studies should be conducted to explore the underlying causes of the observed trends. This will help to develop more effective strategies for addressing the issues at hand.



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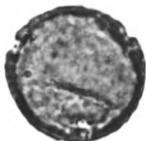
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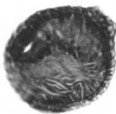
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PLATE 10

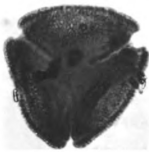
PLATE 11

Figure

- 1 Nyssapollenites sp. 2
- 2 Nyssapollenites sp. 2
- 3 Faguspollenites sp.
- 4 Nyssapollenites accessorius
- 5 Nyssapollenites cf. Thompsoniana
- 6 Symplocoipollenites vestibulum
- 7 Faguspollenites cf. versus
- 8 Nyssapollenites sp. 1
- 9 Alangiaceoipollenites barhoornianum x500
- 10 Cyrillaceaepollenites cf. megaexactus
- 11 Sapotaceoideaepollenites cf. sapatoides
- 12 Sapotaceoideaepollenites cf. sapatoides
- 13 Sapotaceoideaepollenites cf. sapatoides
- 14 Pollenites oculus-noctis x500
- 15 Pollenites oculus-noctis x500

All illustrations x1000 unless otherwise indicated.

- *Chlorophyll a* (Chl a) is the primary photosynthetic pigment in most plants and algae, responsible for capturing light energy.
- *Chlorophyll b* (Chl b) is an accessory pigment that broadens the range of light wavelengths that can be used for photosynthesis.
- *Carotenoids* (including *β-carotene* and *xanthophylls*) are accessory pigments that absorb light energy and transfer it to Chl a.
- *Phycocyanin* (Phyc) is a blue pigment found in cyanobacteria and red algae.
- *Peridinin* (Per) is a carotenoid pigment found in dinoflagellates.
- *Alloxanthin* (Allo) is a carotenoid pigment found in cryptophytes.
- *Chlorophyll d* (Chl d) is a photosynthetic pigment found in cyanobacteria and cryptophytes, capable of absorbing light in the near-infrared region.
- *Phaeophytin* (Phaeo) is a pigment derived from Chl a, often found in brown algae and diatoms.
- *Phaeoerythrin* (Phaeo-ery) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*a** (Phaeo-a) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*b** (Phaeo-b) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*c** (Phaeo-c) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*d** (Phaeo-d) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*e** (Phaeo-e) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*f** (Phaeo-f) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*g** (Phaeo-g) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*h** (Phaeo-h) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*i** (Phaeo-i) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*j** (Phaeo-j) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*k** (Phaeo-k) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*l** (Phaeo-l) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*m** (Phaeo-m) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*n** (Phaeo-n) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*o** (Phaeo-o) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*p** (Phaeo-p) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*q** (Phaeo-q) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*r** (Phaeo-r) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*s** (Phaeo-s) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*t** (Phaeo-t) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*u** (Phaeo-u) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*v** (Phaeo-v) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*w** (Phaeo-w) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*x** (Phaeo-x) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*y** (Phaeo-y) is a pigment found in brown algae and diatoms, related to Phaeo.
- *Phaeo-*z** (Phaeo-z) is a pigment found in brown algae and diatoms, related to Phaeo.



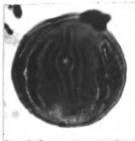
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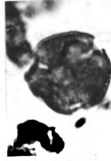
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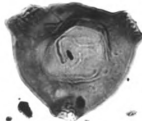
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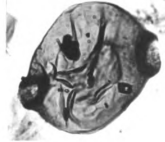
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PLATE II

PLATE 12

Figure

- 1 *Myricaepollenites* cf. *megagranifer*
- 2 *Triatriopollenites* *rurensis*
- 3 *Betulaceopollenites* *bituitus*
- 4 *Betulaceopollenites* *bituitus*
- 5 *Engelhardtoidites* *microcoryphaeus*
- 6 *Alnipollenites* *versus*
- 7 *Alnipollenites* sp.
- 8 *Caryapollenites* *simplex*
- 9 *Momipites* *coryloides*
- 10 *Engelhardtoidites* *quietus*
- 11 *Ulmipollenites* *undulosus*
- 12 *Liquidambarpollenites* cf. *mangelsdorffiana*
- 13 *Liquidambarpollenites* cf. *mangelsdorffiana*
- 14 *Pollenites* *annulus*
- 15 *Pterocaryapollenites* *stellatus*
- 16 *Juglanspollenites* *versus*
- 17 *Multiporopollenites* *ludlowensis*
- 18 *Multiporopollenites* *ludlowensis* x1250

All illustrations x1000 unless otherwise indicated.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that this is essential for ensuring transparency and accountability in the organization's operations.

2. The second part outlines the various methods and tools used to collect and analyze data. This includes both traditional manual methods and modern digital technologies, highlighting the benefits of automation and data integration.

3. The third part focuses on the challenges and risks associated with data management, such as data security, privacy concerns, and the potential for data loss or corruption. It provides strategies to mitigate these risks and ensure the integrity of the data.

4. The fourth part discusses the role of data in decision-making and strategic planning. It explains how data-driven insights can help organizations identify trends, opportunities, and areas for improvement, leading to more informed and effective decisions.

5. The fifth part covers the importance of data governance and compliance with relevant regulations and standards. It outlines the key principles of data governance, including data quality, access control, and retention policies.

6. The sixth part addresses the future of data management, including emerging trends like artificial intelligence, machine learning, and cloud-based data solutions. It discusses how these technologies will shape the way organizations handle their data in the coming years.

7. The final part concludes with a summary of the key points and a call to action, encouraging organizations to embrace data-driven approaches and invest in the necessary infrastructure and talent to succeed in the digital age.

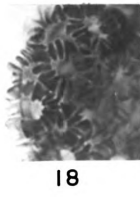
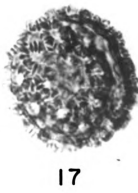
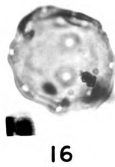
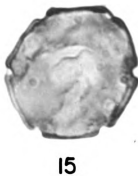
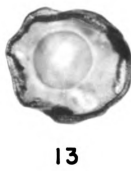
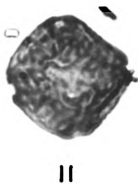
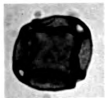
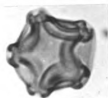
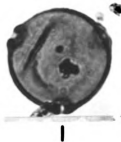


PLATE 12

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